

VICTORIA

Auditor General
Victoria

Managing Victoria's growing salinity problem

*Ordered to be printed by Authority.
Government Printer for the State of Victoria*

ISSN 1443 4911
ISBN 0 7311 8867 5



AUDITOR GENERAL
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Sir

Under the provisions of section 16 of the *Audit Act* 1994, I transmit my performance audit report on *Managing Victoria's growing salinity problem*.

Yours faithfully

J.W. CAMERON
Auditor-General

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Foreword

The salinisation of Victoria's land and water assets poses a serious threat to our natural resource base. Given its detrimental long-term impact on the environmental, economic and social fabric of this State, I have re-visited this topic which was audited by my Office in 1993. Our report provides an examination of the appropriateness of action taken in response to our earlier recommendations and the procedures in place to implement the State's 2000 *Salinity Management Framework*.

We found that the Victorian Government had invested \$257 million on salinity management since 1990 and had contributed to improved salinity conditions in Victoria's major irrigation districts. However, salinity in non-irrigated (or dryland) areas has worsened over the same period.

The management of salinity is a long-term undertaking and Victoria is now one third of the way into the 30-year Salinity Management Program established in 1988. The most proven dryland salinity management options are to plant trees or perennial pastures over vast catchment areas, depending on regional rainfall. The aim of these treatments is to mimic native vegetation by intercepting rainfall and minimising leakage into the groundwater system, thus lowering watertables over time (e.g. over 50 years).

The audit highlights the difficulties and challenges faced by the Government and rural communities in effectively managing the salinity problem. Foremost is the lack of sufficient research knowledge to determine the precise extent of the dryland salinity problem and the types of management options applicable across the myriad of Victorian landscapes potentially affected. Socio-economic factors were also found to constrain effective implementation because sustainable management solutions will require the adoption of new land uses, the creation of economic markets and changes in socio-economic structures across regional Victoria.

We found that the previous 30-year revegetation targets in the Salinity Management Program covered only one-sixth of the area to be revegetated under the 2000 *Salinity Management Framework*. Moreover, based on past achievements, only a few Catchment Management Authorities are on schedule to meet their 30-year revegetation targets. In our opinion, although Victoria is moving in the right direction to implement management options under the new framework, the scale of the worsening dryland salinity problem may overwhelm future effort. It is, therefore, essential that those social, economic and ecological assets the community wishes to protect for future generations be identified and prioritised.



J.W. CAMERON
Auditor-General

Part 1

Executive summary

INTRODUCTION

1.1 The salinisation of land and the associated degradation of water resources are the cumulative result of over 100 years of traditional land use practices where native vegetation was cleared to create open country for the establishment of broadacre grazing and cropping. *(para. 2.1)*

1.2 Salting of irrigated agricultural land is known as “irrigation salinity”. Some 460 000 hectares, which is 74 per cent of the Victoria’s total irrigated area, is currently at risk of salinity. Types of farming affected by irrigation salinity include dairying, horticulture (e.g. fruit trees and vegetables) and cropping (e.g. barley and cereals). In 1999, the State’s value of agricultural production derived from irrigated farming amounted to a gross value of production of \$1.8 billion per annum. *(para. 2.2)*

1.3 The other main form of salinity, known as “dryland salinity”, affects non-irrigated, rain-fed agricultural land. The area of the State at risk of dryland salinity in 2000 was 665 000 hectares, which represents 5.5 per cent of Victoria’s total dryland agricultural area. Dryland salinity affects farming industries such as grazing (e.g. sheep and cattle) and cropping (e.g. wheat, canola and oats). In 1999, the value of Victoria’s agricultural production derived from dryland farming amounted to a gross value of production of \$4.4 billion per annum. *(paras 2.11 to 2.12)*

1.4 Both forms of salinity arise through rising groundwater levels, which leach salts out of the soil and concentrate them in surface water systems. Groundwater levels are rising over large areas of Victoria. Official predictions are that there will be a ten-fold increase in the area affected by salt by 2050. Official estimates put the direct cost of salinity in Victoria at \$50 million per year. Independent reviews predict that the annual cost of salinity due to lost agricultural production will increase to between \$77 million and \$166 million by 2050. As well, salinity impacts on rural and regional infrastructure and the environment, including plants, animals, rivers, soils, aquifers and wetlands. *(paras 2.10 and 2.62)*

1.5 In view of these projections, it is not surprising that the Department of Natural Resources and Environment views salinity as one of the greatest natural resource management challenges in Victoria. The Department has recently conceded that it is too late to eradicate or control salinity and that it has to be managed to some acceptable level of impact in the future. *(para. 2.62)*

1.6 The Government recently announced additional funding of \$157 million for the Salinity Management Program to be spent over the next 7 years, commencing July 2001. This funding is to be matched dollar-for-dollar by the Commonwealth under its \$1.4 billion National Action Plan for Salinity and Water Quality. The additional funding will more than double the level of public funds annually directed at managing the salinity problem in Victoria. However, other estimates of the level of funding required to address the nationwide salinity problem range from \$37 billion (CSIRO) to \$60 billion over 10 years (Australian Conservation Foundation and the National Farmers' Federation)¹. (*paras 2.52 and 3.9*)

1.7 Recent initiatives include the release of Victoria's 2000 *Salinity Management Framework*, which includes a series of directions and targets to guide future action. Earlier actions included the incorporation of salinity management as a component of an integrated catchment management program, the creation of Catchment Management Authorities to develop and co-ordinate regional catchment strategies and community involvement in the State's Salinity Management Program, established in 1988. (*paras 2.37, 2.55 to 2.41*)

AUDIT OBJECTIVES AND SCOPE

1.8 The objectives of this audit were to determine whether:

- the broad thrust of the recommendations reported in our 1993 performance audit of Salinity had been adequately addressed; and
- the Department of Natural Resources and Environment, Catchment Management Authorities, and the community, are adequately prepared to implement the State's 2000 *Salinity Management Framework*.

1.9 The extent of the salinity problem and trends in salinity levels are quantified in a number of recent reports by government bodies. The audit did not duplicate the quantification work in these reports. The audit included undertaking inquiries with the Department of Natural Resources and Environment, Catchment Management Authorities and various other stakeholder groups.

AUDIT CONCLUSION

1.10 The State's Salinity Management Program has had a much greater impact on managing salinity in the State's irrigation areas than in dryland regions. This is due mostly to a greater knowledge of irrigation salinity, resulting in the implementation of management options in irrigation areas at a much earlier stage than for dryland areas. While dryland salinity has been recognised in Victoria for a number of decades, the enormity of the problem and its fundamental, long-term impact on overall river and stream salinity have only recently been appreciated. (*para. 4.6*)

¹ CSIRO Land and Water Division, Media release Ref. 1999/7 August, 1999. The Australian Conservation Foundation and National Farmers' Federation, Joint Media Release, July 1999.

1.11 There are major challenges and constraints faced by government authorities and the community in managing the salinity problem. These challenges are shared nationally, and relate to:

- Substantial uncertainties in assessing the extent and impact of dryland salinity, the management options and their effectiveness due to imperfect scientific knowledge in the area; (*paras 5.57 to 5.58*)
- The need to maintain impetus and continue to build the knowledge base in salinity management in irrigated areas, given the gains already made; (*para. 5.41*)
- Increasing the adoption of new land management practices by landholders, while acknowledging their limited financial capacity and uncertainty regarding the financial viability of any new practices. Landholders will be expected to invest in salinity management options essentially for future generations, because the investment, particularly in dryland salinity management, has a lengthy payback period. Our observations indicate that commercial incentives and commodity prices are more likely to have a greater influence on changes in land use management practice than incentives that could be funded by government; (*para. 5.109*)
- The difficulty in directly measuring outcomes due to the time lag of 50 years or more between action taken and the realisation of any impact; (*paras 2.66 and 5.10 to 5.11*); and
- The confounding influence of climatic variations on groundwater levels, which complicates the analysis of watertable trends. (*para. 5.61*)

1.12 Bearing in mind the difficulty in dealing with these issues and the uncertain effect that they may have on the success of the Government's long-term Salinity Management Program, we are reasonably assured that Victoria is moving in the right direction in implementing the State's 2000 *Salinity Management Framework*. However, the size of the problem is so enormous that proposed actions may not be sufficient to effectively manage salinity. While some progress has been made in attending to our 1993 recommendations, the audit revealed that some recommendations had not been adequately addressed by the Department of Natural Resources and Environment. Attention directed at the matters raised in this follow-up report will enhance the quality of decision-making by promoting the identification of appropriate options and funding priorities for the next phase of salinity management in Victoria. (*para. 5.149*)

AUDIT FINDINGS

Expenditure on salinity management

1.13 Total Victorian Government expenditure on the Salinity Management Program since 1990-91 has amounted to \$257 million, with average annual expenditure remaining at \$23 million per year, despite the worsening salinity problem. In the same period, the Commonwealth Government's total contribution to Victoria's Program has amounted to \$96 million, which includes significant expenditures of \$35 million over the past 4 years under the Commonwealth Natural Heritage Trust Program. *(para. 4.3)*

1.14 The Department of Natural Resources and Environment estimates that private contributions, mostly in the form of volunteer labour, to the Salinity Management Program are around 4 times public contributions. On this basis, private contributions equivalent to \$1.4 billion, in addition to State and Commonwealth funding amounting to \$353 million, means that a total of \$1.8 billion has been spent on salinity management between 1990 and 2001. *(para. 4.4)*

Extent and impact of watertables in each region

1.15 Watertable depth is now accepted nationally as a measure to assess the salinity risk of a region. Changes in watertable levels in irrigation areas over the last 10 years show a declining trend. This is due to a combination of the State's salinity management initiatives and the prevailing dry climatic conditions across Victoria over the period. The effectiveness of the State's salinity management initiatives in irrigation areas will become more evident in future periods of extended, wet climatic conditions. Under the same dry climatic conditions, however, there has been a long-term trend in rising watertables in most of the State's dryland agricultural regions. *(paras 4.5, 4.6 and 5.61)*

Salinity in rivers and streams

1.16 Since 1990, the salinity levels in Victoria's rivers and streams have not followed a consistent Statewide trend. Decreasing salinity was evident in the Corangamite and Port Phillip catchment regions covering the southern central region of Victoria. Increasing salinity was evident for rivers and streams in the western and north-western regions of the State, within the responsibility of the North Central, Wimmera and Glenelg-Hopkins Catchment Management Authorities. In the eastern half of the State, salinity was predominantly stable. *(para. 4.7)*

1.17 Stream salinity in the Lower Loddon and Avoca Rivers, and for several major rivers in south-western Victoria (e.g. the Barwon and Hopkins Rivers), already exceed benchmarks for water quality set by the Murray-Darling Basin Commission. *(paras 4.9 to 4.10)*

Landcare

1.18 Landcare originated in Victoria in 1986 to become a national voluntary movement involving community groups in the restoration of local land and water resources through government-funded programs. The number of Landcare groups has increased substantially in Victoria over the past decade. In 1998 there were between 25 000 and 30 000 volunteers in approximately 890 Landcare groups. *(paras 4.11 and 5.137)*

1.19 Recent departmental surveys of trends in on-ground works undertaken by Landcare groups show that more effort could have been spent on activities that directly impacted on salinity. Much activity focussed on weed control, pest animal control, tree planting or remnant vegetation protection, which although indirectly related to revegetation for salinity control, may have had only a limited impact on the amount of water entering groundwater systems. The surveys also indicated that there was only limited co-ordinated activity across regional groups and we were informed that Landcare onground activities were not necessarily aligned with priorities set in the regional management plans of Catchment Management Authorities. *(paras 2.72, 4.17, 4.20 and 5.138)*

1.20 Although the Landcare movement in Victoria has facilitated a positive change in the attitude of landowners towards the environment, this increased awareness has not resulted in the widespread adoption of sustainable agricultural systems or practices at the levels believed necessary to alleviate the salinity problem in dryland areas. Surveys conducted by the Department also indicate that the Landcare movement in Victoria has reached its limits in terms of growth and penetration of the farming community. Nevertheless, Landcare remains a central plank of the Government's implementation strategy for the revegetation targets under its 2000 *Salinity Management Framework*. *(paras 4.21 and 5.139)*

1.21 Salinity management activities across Victoria over the past decade, mostly through Landcare, have achieved most of their annual salinity management plan targets for perennial pasture and native revegetation. Based on their past 10-year achievements, only 2 of the 10 Catchment Management Authorities, namely, the North Central and Glenelg-Hopkins Catchment Management Authorities, will reach their 30-year dryland salinity management plan targets for perennial pasture establishment. In relation to native revegetation, only the Goulburn Broken Catchment Management Authority will meet its 30-year target. The remaining Catchment Management Authorities may reach their 30-year revegetation targets, depending on funding levels, community commitment and the success of strategies under the 2000 *Salinity Management Framework*. *(paras 4.13, 4.14 and 5.140)*

1.22 The 30-year revegetation targets set in the dryland salinity management plans of the early to mid-1990s, which cover some 1.1 million hectares, are only a sixth of the estimated catchment area of 6.9 million hectares inferred in the 2000 *Salinity Management Framework* and now understood as needing revegetation. In view of the massive scale of the revegetation required by 2015, and the rate of revegetation for salinity management to date, there is a risk that the proposed regional-scale revegetation targets under the 2000 *Salinity Management Framework* will not be achieved. *(paras 4.16 and 5.141)*

Private forestry plantations

1.23 The Department advised us that commercial forestry plantations established since 1995, covering a total area of 284 575 hectares, have not generally been located in the critical landscape areas of highest recharge. These critical areas are in the lower rainfall regions of the State, where plant-based solutions are effective in limiting the amount of water entering groundwater systems. The Department further advised us, however, that 19 248 hectares in native tree plantings from 1990 to 1998, were planted in high recharge areas. (*paras 4.27 and 5.142*)

1.24 The private forestry industry is rapidly expanding in Victoria and presents an opportunity for the Government to encourage this trend as a strategy under its 2000 *Salinity Management Framework*. Before the Government considers further incentives for private forestry plantations in Victoria, their potential impacts on catchment water yield, socio-economics and the environment need to be balanced with industry development, to achieve desired, long-term dryland salinity management outcomes. (*para. 5.143*)

Status of the Lakes reported in 1993

1.25 New information about the impact of dryland salinity predicts a far greater long-term impact on most of Victoria's wetlands than previously thought. Our 1993 Report examined the development of the salinity management plan for the Kerang Lakes and specific issues relating to salinity management for Lake Corangamite and Lake Tutchewop. (*para. 4.28*)

1.26 The salinity levels of the Kerang Lakes have remained largely unchanged over the past 10 years and the Department is developing environmental management plans for key wetlands in the Kerang Lakes area. Salinity in Lake Corangamite increased over time - almost doubling since monitoring began in 1991. However, the past 4 consecutive dry seasons have resulted in much lower than normal water flow and, accordingly, salinity readings are higher than normal. Lake Corangamite's margins no longer support submergent and emergent aquatic plants, thereby reducing the habitat available to fauna that would normally inhabit, nest and feed in such vegetation. There is evidence that the biological status of Lake Corangamite has changed and that it no longer satisfies the criteria which formed the basis of its selection as a wetland of international importance under the Ramsar convention. (*paras 4.30, 4.35 and 4.38*)

1.27 In 1993² we recommended further research to determine an approach for the rehabilitation of the internationally significant wetlands of Lake Tutchewop following the completion of its use as an evaporation basin. Victoria's agreement in October 1993 to commit to the Murray-Darling Basin *Salinity Drainage Strategy* provided an opportunity for the Government to plan future irrigation development through salinity credits³ generated by the continuation of the Lake Tutchewop salt interception scheme. Thus Lake Tutchewop is to be used as an evaporation basin as part of the Murray-Darling Basin Commission's salt interception scheme, to protect the quality of water entering the River Murray, for at least the next 30 to 50 years. (*paras 5.44 to 5.49*)

Preparedness for the emerging salinity challenge

1.28 This audit highlights the following key areas where further action is required:

- Apart from mapping the wetlands and National Parks threatened by salinity in northern Victoria and in parts of the Corangamite catchment region, the Department has not comprehensively identified public infrastructure or biodiversity assets at risk from salinity and has not prioritised key assets for protection, based on assigning values to those assets, on a Statewide basis. It therefore has a limited information base for decision-making; (*paras 5.51 to 5.53*)
- While action is underway to improve cost-benefit analyses to inform decisions about the direction of salinity management, the incorporation of environmental and socio-economic considerations has not reached the level of sophistication signalled by us in 1993. The Department is of the view that qualitative assessments of social and environmental values are more feasible than assigning economic values to these non-economic considerations. However, the use of economic discount rates to decide on salinity investment options, without factoring in all social costs and environmental benefits, may not result in ecologically sustainable developments; (*para. 5.18*)
- There is scope for expanding mechanisms to encourage structural readjustment in dryland farming communities for the purpose of managing recharge (i.e. limiting the amount of water entering the groundwater system) in high risk salinity areas. For example, incentives could be created to encourage greater aggregation of rural land holdings. The Department together with the Wimmera and North East Catchment Management Authorities is developing a model of land stewardship for the Wimmera and North East catchment regions. This concept could be developed Statewide for landholders of small farms, to further encourage the adoption of sustainable land use practices; (*paras 5.30 and 5.33*)

² *Salinity*, Special Report No 19, Victorian Auditor-General's Office, March 1993. Lake Tutchewop was initially planned as a temporary salt evaporation basin, to be restored to its natural state after 10 years.

³ See Appendix C: "Glossary of Terms and Abbreviations used" for the definition of salinity credits.

- We acknowledge that the Department is currently in the process of revising the Government's 1997 *Private Forestry Strategy* and has been influential in promoting the development of a plantation forestry industry in Victoria. There is further scope, however, for the Department to develop policy instruments, incentives and environmental assessment tools to achieve the scale of revegetation works needed under the 2000 *Salinity Management Framework*. As indicated earlier, based on past revegetation achievements, we do not believe that the revegetation targets under the Framework will be met; (*paras 5.34 to 5.39*)
- Although the Department has researched plant-based solutions for dryland salinity for some time, according to specialist advice this effort has not been as comprehensive as national approaches. There is scope for improving the level of understanding in relation to the applicability, feasibility and impacts of dryland salinity management options at both the local and regional-level; (*paras 5.57 to 5.58*)
- There is room for enhancing accountability mechanisms associated with the State's Salinity Management Program. Objectives and performance indicators covering the productive capacity, environmental quality and the social wellbeing in salt affected areas can be strengthened and reported on in the Department's annual report to Parliament; (*para. 5.76*) and
- While it is acknowledged that there are positive features of the current institutional arrangements, a greater involvement of all major internal and external agency stakeholders and greater access at local and regional levels to technical information, is required in the future implementation of the Program. (*paras 5.90, 5.91 and 5.98*)

1.29 Given that the Department has acknowledged that salinity remains a substantial and growing issue that represents one of the greatest challenges for natural resource management in Victoria, research should be targeted urgently at:

- developing sustainable farming systems⁴ or other land uses that can be widely adopted for their intrinsic commercial value (*para. 5.57*); and
- better understanding the extent and the socio-economic and ecological impacts of the dryland salinity problem. (*para. 5.58*)

1.30 Such research may have a positive long-term impact in reducing the need for large contributions from the public purse into perpetuity. However, managing for a commercial return on agricultural production in marginal areas may not be possible. In this latter scenario, we believe the difficult question for government will be who is going to bear the cost of "living with salt" in those marginal areas where agriculture proves to be uneconomic, but farming is to continue. (*para. 5.146*)

⁴ A sustainable farming system is one that does not degrade the natural resource base over time, that is, it employs farming practices that have minimal impacts on water balance, soil structure and chemistry, nutrient levels, and on plants and animals.

RECOMMENDATIONS

<i>Report reference</i>	<i>Paragraph number</i>	<i>Recommendation</i>
Status of the lakes reported in 1993	4.44	That the Department, Catchment Management Authorities and the Victorian Catchment Management Council give priority to the identification of Victoria's most important, strategic and significant wetlands for inclusion in long-term biodiversity protection programs.
Cost-benefit analyses	5.26	That the Department invest in evaluative tools to measure the socio-economic, environmental and economic impacts of proposed salinity management options. This will provide a basis for sound decision-making in terms of identifying appropriate management options and establishing funding priorities.
Structural re-adjustment and land retirement	5.39	That a thorough investigation be undertaken of the potential impacts of policy instruments and commercial incentives for Victoria's private forestry industry on total catchment water yield, socio-economics of regional areas and the environment.
	5.40	That: <ul style="list-style-type: none"> • greater focus be placed on providing support services for landholders and other members of the rural community adversely impacted by structural re-adjustment associated with managing the salinity problem; and • long-term trends in land use change be monitored to identify opportunities for multiple benefits.
Knowledge base and research capacity	5.67	That: <ul style="list-style-type: none"> • the level of research, planning and implementation support be increased in those areas identified as deriving the greatest benefit; • future actions: <ul style="list-style-type: none"> • be determined according to the value of assets, the benefits of intervention, the cost and how long it will take for the options to result in a benefit; and • include a risk appraisal of the problem and management options; • the Department of Natural Resources and Environment, in partnership with the Victorian Catchment Management Council and Catchment Management Authorities, establish a centrally accessible Statewide salinity register to help identify catchment assets at risk from salinity and to inform decision-making, funding assessments and funding allocation processes; • the aggregated Statewide targets of the 2000 <i>Salinity Management Framework</i> be expanded by identifying and quantifying asset protection targets at a regional, sub-regional and local level; and • the Department research the costs associated with meeting the end of valley targets as agreed under the Murray-Darling Basin Commission's <i>Salinity and Drainage Strategy</i> for Victoria.

RECOMMENDATIONS - *continued*

<i>Report reference</i>	<i>Paragraph number</i>	<i>Recommendation</i>
Accountability mechanisms	5.87	<p>That:</p> <ul style="list-style-type: none"> • The Department develop a baseline of appropriate agricultural sustainability indicators; • The evaluation approach for the second generation of salinity management plans include an appraisal of probable long-term changes and outcomes. The surrogate measure for the short-term could be an assurance that the assumptions are valid and the monitoring system and data collection is in place and it is appropriate and valid for long-term trend analysis; • Reporting be improved by: <ul style="list-style-type: none"> • ensuring that comprehensive information on the progress of the Salinity Management Program and of its overarching 2000 <i>Salinity Management Framework</i> is disclosed in the Department of Natural Resources and Environment's annual report; and • establishing consolidated reporting for salinity actions across the State; • Annual reports of the Catchment Management Authorities provide more relevant and detailed appraisals of the outcomes of their catchment management activities under the 2000 <i>Salinity Management Framework</i>; and • Independent and comprehensive reviews of the Salinity Management Program be undertaken at regular intervals to enable critical evaluation of progress and refocusing of strategies where warranted.
Institutional arrangements	5.99	<p>That institutional arrangements be improved by:</p> <ul style="list-style-type: none"> • strengthening the capacity of Catchment Management Authorities to respond to local salinity management priorities; • structuring collaborative partnering agreements to improve accountability of Catchment Management Authorities and community groups; • greater direct involvement and co-ordination of key internal and external agency stakeholders; • the Department reviewing its provision of Geographic Information System data and maps to internal units and Catchment Management Authorities, and implement alternative purchasing arrangements under the Salinity Management Program, if required; and • enhancing information sharing between agencies, particularly technical information.
Community participation	5.111	<p>That:</p> <ul style="list-style-type: none"> • the Department consider its options in the event that the predicted increases in Landcare participation rates fail to materialise; and • the Department focus on providing information on commercially viable options and appropriate incentives to encourage community involvement in land use change.

RECOMMENDATIONS - continued

Report reference	Paragraph number	Recommendation
Goulburn Broken Dryland Salinity Management Plan	5.116	That the Department work in partnership with the Goulburn Broken Catchment Management Authority to develop well-researched salinity management solutions and sustainable agricultural options.
Cost-sharing arrangements	5.130	That the Department investigate ways to further engage urban communities and local government to enhance the potential for “in-kind” contributions for on-ground works.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Overall comments

The Department of Natural Resources and Environment notes the Victorian Auditor-General’s statement that he is “reasonably assured that Victoria is moving in the right direction in implementing the State’s 2000 Salinity Management Framework” (paragraph 1.12). Most works targets have been achieved, effective management of irrigation salinity has been achieved, and there has been a considerable increase in monitoring data, scientific understanding and modelling capacity. Nevertheless, our improved understanding has shown that some of the early expectations for control of dryland salinity could not be met.

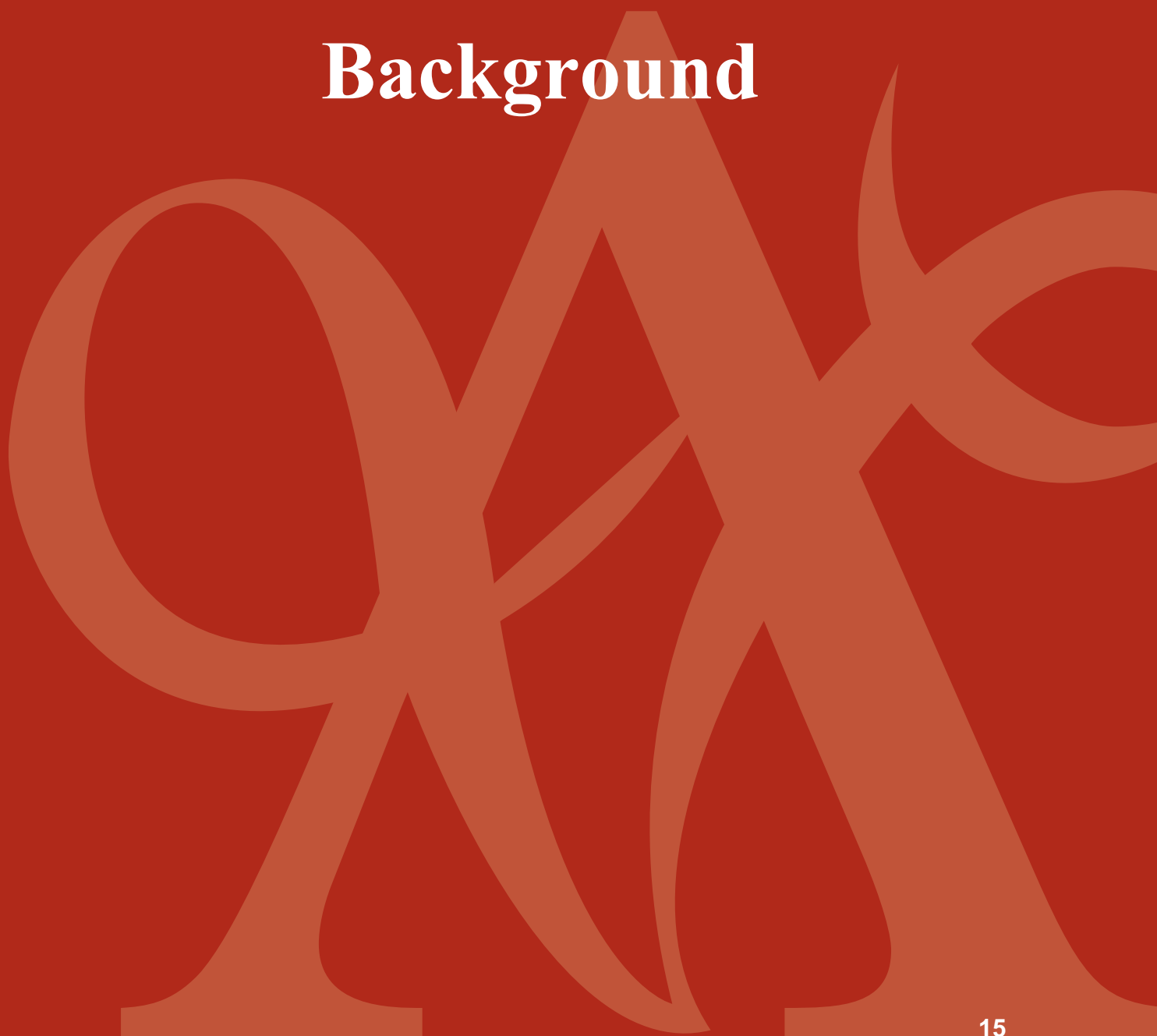
Victoria’s work over the last 15 years has led to improved understanding over time, leading to the evolution of directions, targets and approach of the salinity management program. Victoria has been in similar circumstances as other States; that is, salinity and land degradation are national issues. The audit does not adequately acknowledge that Victoria has been at the forefront, nationally, in its policy development and progress in salinity and land and water management.

The Department has carefully considered the various comments and criticisms made in the audit report, and acknowledges a number of them to varying extents. Responses – rebuttals and explanations – are provided to specific issues raised through the body of the report.

Broadly, it accepts that improvements in indicators, reporting and evaluative tools can and should be made. The Department will work towards addressing the suggested areas for improvement made in the audit.

Part 2

Background



THE EMERGING SALINITY PROBLEM

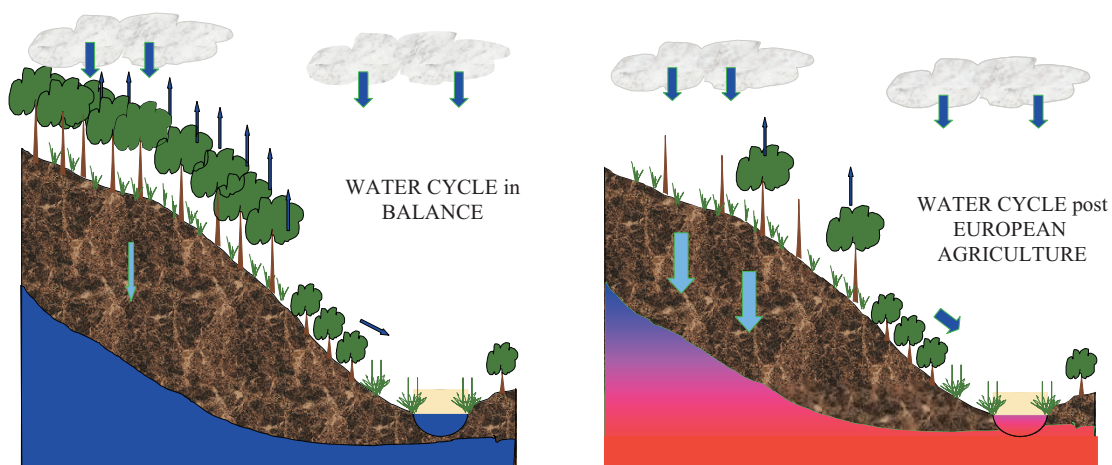
What is the salinity problem?

2.1 The salinity problem is the cumulative result of over 100 years of traditional farming practices where native vegetation was cleared to create open country for the establishment of broadacre grazing and cropping industries. Native vegetation is very efficient in its use of water and allows very little rain to pass by its root zone. However, the shallow-rooted annual pastures introduced through traditional agricultural systems permit much of the rainfall that infiltrates the soil to leak down and add to (or recharge) underlying groundwater systems.

2.2 In some regions, additional water has been imported to supplement the rainfall, so that crops and produce of a higher value can be grown. This practice is commonly known as irrigation. In irrigation areas, the application of water to crops throughout summer increases this hydrological imbalance. Groundwater recharge is increased directly from irrigation as well as indirectly by the wetter incipient conditions at the onset of the higher rainfall/lower evaporation seasons.

2.3 Chart 2A illustrates the fundamental cause of salinity. It should be noted that the hydrological processes that cause salinity are the same in both dryland⁵ and irrigation regions. The red colour in Chart 2A represents a rising watertable, which has been salinised by salts stored in the soil profile.

CHART 2A
THE CAUSES OF SALINITY



Source: Tim Corlett, Catchment and Water Division, Department of Natural Resources and Environment.

⁵ Dryland refers to all non-irrigated agricultural land.

Notes:

- (a) "Groundwater" is water that infiltrates the ground beyond the root zone, permeates porous sands and gravel and flows through any cracks and fissures in rocks. The water eventually saturates the permeable layers of earth and forms an underground water storage, known as an "aquifer".
- (b) "Watertable" is the upper most level of groundwater. Groundwater is dynamic, responding to changes in the climate, such as droughts and floods, which causes the watertable level to fluctuate.
- (c) "Recharge" is the addition of water to the groundwater storage and any losses to the storage are discharge. Increases in recharge in upper catchment areas can raise the watertable in lower catchment areas. Areas that permit the greatest amount of recharge are identified as "critical recharge areas". Recharge is also referred to in scientific literature as "leakage", "leaching" or

2.4 Victoria's forests and woodlands covered 88 per cent of the State prior to settlement. Since settlement about 70 per cent, or 16 million hectares, of native vegetation was cleared, while on private land 95 per cent of the native vegetation has been removed. Currently, there are 12.7 million hectares of agricultural land in Victoria of which 1.2 million hectares is covered in native vegetation. The removal of these vast tracts of native vegetation across the State has led to an overall increase in rainfall recharge of the groundwater system.

2.5 Over time, the uppermost level of the groundwater system, or watertable, has gradually risen towards the land surface and, in the process, dissolved any salt stored in the rock profile or sedimentary layers under the ground. When the watertable is within 2 metres of the land surface, saline groundwater may be transferred by capillary action into the topsoil where it is taken up by plants leaving behind the contained salts, which may build up in the root zone depending upon leaching conditions. Once near the soil surface, the salt may also be concentrated through evaporation. Plants have a root zone salinity threshold beyond which growth and yield suffers. There is also a certain level of root zone salinity above which plants cannot survive and, as plants form the foundation of all biological ecosystems, the impacts of salinity are potentially catastrophic.

2.6 Table 2B shows the Australian Water Resources Council's approximate salinity values for a range of water qualities.

**TABLE 2B
WATER QUALITY CLASSES**

<i>AWRC water class</i>	<i>EC (iS/cm)</i>
Fresh	0 - 800
Marginal	800 - 1 600
Brackish	1 600 – 4 800
Saline	>4 800
Sea water	about 50 000

2.7 Salinity tolerances for plants and animals are shown in Table 2C. The unit of measurement for salinity is electrical conductivity (EC) through water, expressed as microSiemens per centimetre (iS/cm) or a water extract of soil, expressed as milliSiemens per centimetre (mS/cm). In general, irrigation water with salinity of more than approximately 1 700 EC will result in loss of yield for sensitive crops, such as clover and many fruit and vegetable crops. Water with salinity of 800 EC is the accepted maximum level for drinking water supplies in larger towns and cities and a salinity level above 1 500 EC renders water unfit for human consumption.

TABLE 2C
SALT TOLERANCES IN PLANTS AND ANIMALS

	<i>EC (iS/cm)</i>	<i>Suitability</i>
Drinking water (a)	(b) 800	Good quality drinking water based on taste
Aquatic life	1 500	No adverse effects on aquatic life
Crop suitability	<650	For sensitive crops
	650 – 1 300	For moderately sensitive crops
	1 300 – 2 900	For moderately tolerant crops
	2 900 – 5 200	For tolerant crops
	5 200 – 8 100	For very tolerant crops
	>8 100	Generally too saline
Dairy cattle (b)	0 – 3 730	No adverse effects expected
	3 730 – 5 970	Should adapt without loss of production
	5 970 – 10 450	Loss of production, decline in health

(a) Australian Drinking Water Guidelines (2000 Update).

(b) Converted from Total Dissolved Solids (mg/L) to EC.

Source: Draft Australian and New Zealand Guidelines for Fresh and Marine Water Quality, July 1999.

2.8 Recent modelling of the rise in watertables predicts saline water is transported slowly through the landscape by groundwater systems. That is, high watertables in upper catchment areas will seek equilibrium with watertable levels in lower catchment areas causing the lateral movement of groundwater across the landscape. Eventually, over time, the groundwater will reach the middle and lower reaches of catchments salting rivers and wetlands and drinking and irrigation water supplies. The time required for this salting to occur will vary between catchments according to the nature of landscapes and underlying groundwater flow systems. In some local flow systems, the response time might be of the order of decades, in other larger regional flow systems, the response time might be well over hundreds of years. The Murray-Darling Basin Commission's 1999 *Salinity Audit* revealed that the main source of future increases in river salinity will be from dryland farming and grazing areas, rather than irrigation districts.

2.9 The impacts of salinity are both insidious and pervasive with multiple inter-related effects. Salinity can drastically reduce agricultural productivity, biological diversity and social cohesion. Once salinity severely pollutes the land and waterways, its removal may become financially prohibitive, leading to a major environmental problem for all future generations.

2.10 Some of the current and potential impacts of salinity include⁶:

- Nine rural towns in Victoria are at risk of salinity impacts (i.e. Jeparit, Edenhope, Tatong, Swanpool, Eildon, Tallarook, Broadford, Yea and Redesdale are all situated over watertables that are within 2 metres of the land surface) and this is expected to increase to between 28 and 63 towns in 2050;
- Rural and regional infrastructure such as roads, railways, bridges, pipelines, sewage supply systems and buildings are, or will, be damaged through corrosion;
- Nearly 150 kilometres of railway and over 4 000 kilometres of roads in Victoria are salt affected;
- Around 50 per cent of woodland birds may be extinct within decades and the number of threatened plants and animals will double;
- Over 6 000 hectares of native vegetation and over 400 rare plants and animals are affected. Most of Victoria's remnant native vegetation will be lost;
- Around 10 000 kilometres of Victoria's rivers are affected by high salt loads; and
- The annual cost of salinity to agricultural production in Victoria is \$27 million and this is expected to rise to between \$77 million and \$166 million by 2050. (The Victorian Government estimates that the annual loss in agricultural production due to salinity is \$50 million).

What is the extent of salinity?

2.11 The findings of the National Land and Water Resources Audit (2000) indicate that 665 000 hectares of dryland agricultural area in Victoria are currently considered to have a high potential for developing dryland salinity (although not all this area has dryland salinity)⁷. That audit predicted, in a worst case scenario, that this area will quadruple to 3 110 000 hectares by 2050.

2.12 Dryland agriculture is the major land use type in Victoria, constituting 54 per cent of the total area of the State and 95 per cent of the total area of agricultural land. The major agricultural industries in dryland Victoria - comprising broadacre cropping, grazing, mixed farming, rain-fed dairy and horticulture, had a gross value of production of \$4.4 billion in 1999, or approximately 70 per cent of the State's total agricultural production.⁸

2.13 Chart 2D shows the locations and regions of Victoria's Catchment Management Authorities.

⁶ National Land and Water Resources Audit (2000), *Theme 2 – Dryland Salinity; Extent and Impact of dryland salinity in Victoria*, November 2000 and *Australian Dryland Salinity Assessment 2000*, Natural Heritage Trust, Commonwealth of Australia, January 2001.

⁷ According to the National Land and Water Resources Audit (2000), assessments have identified areas where salinity could *potentially* exist and should not be interpreted as areas affected by salt. The assessments are likely to overestimate actual extent of salt-affected land, particularly in hilly landscapes.

⁸ Australian Bureau of Statistics, *Agriculture Australia, 1988-99*, Catalogue No. 7113.0. (In 1999, the total gross value of agricultural production in Victoria, including dryland and irrigated agriculture, was \$6.25 billion.)

**CHART 2D
CATCHMENT MANAGEMENT AUTHORITY REGIONS, VICTORIA**



Source: Department of Natural Resources and Environment.

2.14 Table 2E shows the current area of farmland within each watertable class and the percentage of Catchment Management Authority regions with shallow watertables, that is, watertables that are less than 2 metres below the surface.

**TABLE 2E
LAND ('000 HECTARES) AND WATERTABLE DEPTHS
FOR CATCHMENT MANAGEMENT AUTHORITY REGIONS**

<i>CMA region</i>	<i>Coastal</i>	<i><2m</i>	<i>2-5m</i>	<i>5-10m</i>	<i>>10m</i>	<i>%<2m</i>
Corangamite	(a) 9.9	51.2	333.3	545.0	91.5	5.0
East Gippsland	25.1	1.8	78.6	87.6	166.7	0.5
Glenelg-Hopkins	6.4	144.5	697.8	1051.5	280.7	6.6
Goulburn Broken	-	123.6	320.8	416.4	334.7	10.3
Mallee	-	60.7	167.7	351.0	2062.9	2.3
North Central	-	124.3	437.6	879.4	566.0	6.2
North East	-	40.4	301.6	91.0	216.5	6.2
Port Phillip (b)	20.1	8.5	205.6	399.9	157.8	1.1
West Gippsland	53.2	14.1	192.4	335.7	187.2	1.8
Wimmera	-	96.4	106.3	215.9	1557.2	4.9
Total	114.7	665.5	2 841.7	4 373.4	5 621.2	4.9

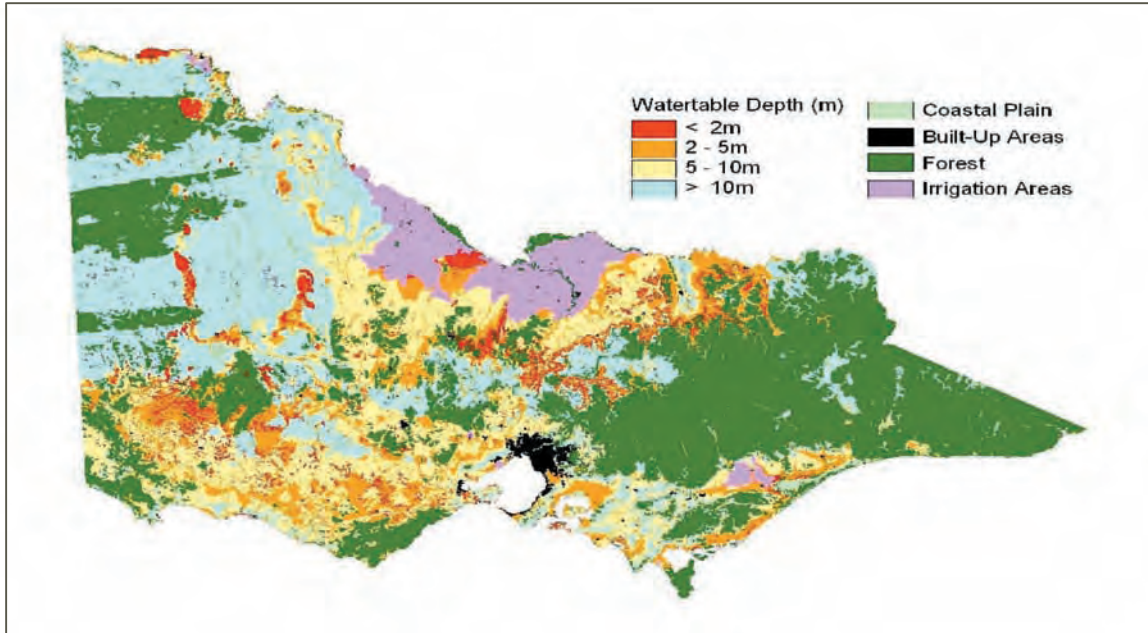
(a) Coastal watertables are shallow watertables that are due to low elevation, rather than to rising watertables.

(b) Catchment and Land Protection Board.

Source: National Land and Water Resources Audit, 2000.

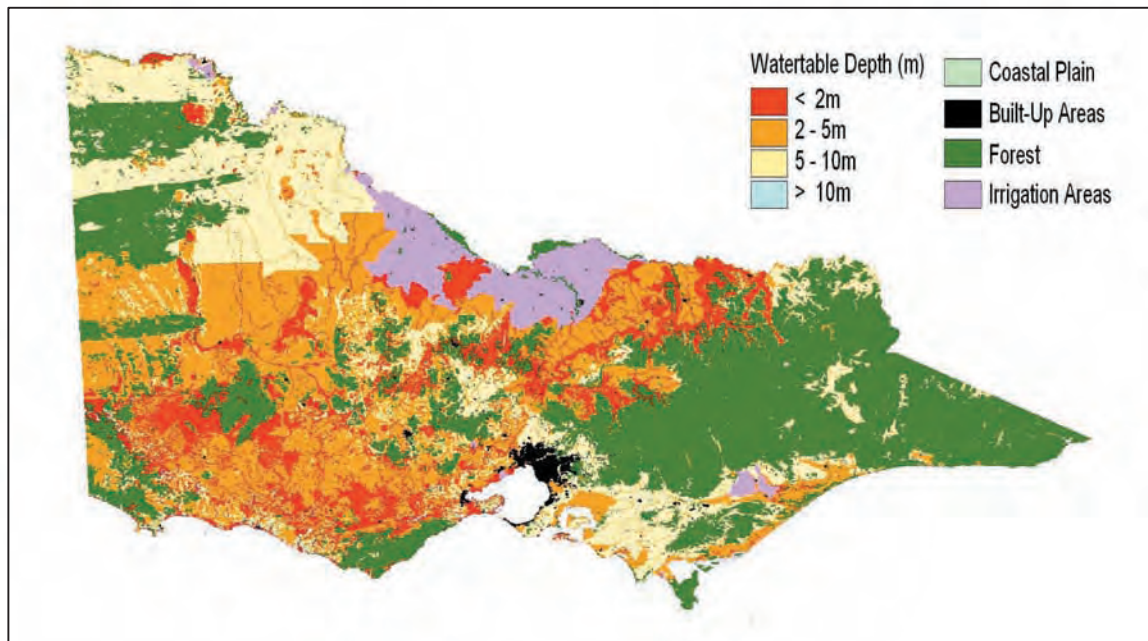
2.15 In terms of agricultural land area the predicted shallow watertables (i.e. less than 2 metres below the land surface), which currently underlie 5 per cent of farmland including towns, roads and wetlands, will grow to nearly 23 per cent of all farmland in Victoria by 2050. A further 47 per cent of Victoria’s agricultural land will then be at moderate risk of dryland salinity. The predicted current extent of shallow watertables is depicted in Chart 2F. In comparison, the scale of the salinity problem in 2050 under a worst case, no intervention scenario is depicted in Chart 2G, which shows a map of the predicted extent of shallow watertables in Victoria by the year 2050. We wish to emphasise a caution that is normally published with shallow watertable data, which is that shallow watertables of less than 2 metres do not necessarily imply salt impacts. Some areas will be immune from shallow watertables due to unique biophysical characteristics in the landscape, including an absence of salt stores in the soil profile, the dynamics of groundwater flows and types of soils.

CHART 2F
ESTIMATED CURRENT DEPTH TO WATERTABLE



Source: National Land and Water Resources Audit, 2000.

CHART 2G
PREDICTED DEPTH TO WATERTABLE IN 2050



Source: National Land and Water Resources Audit, 2000.

MANAGING SALINITY IN VICTORIA

2.16 There are numerous Commonwealth, State, private and local organisations involved in researching, planning and managing Australia’s salinity problem. The following sections describe the activities and roles of the major agencies and details major initiatives, which have been undertaken at State and national level.

Victoria’s institutional framework

2.17 The key objective of land and water management in Victoria is ecologically sustainable development and this is underpinned by an integrated approach to catchment management. Integrated Catchment Management refers to the integration of social, economic and environmental (land, vegetation, water and biodiversity) outcomes.

2.18 Institutional arrangements for salinity management in Victoria have changed over the past 8 years. The 1988 “Salinity Control Strategy *Salt Action: Joint Action*” was implemented through the following 3 State agencies and 3 co-ordinating bodies:

- Department of Agriculture;
- Department of Conservation and Natural Resources;
- Rural Water Corporation;
- Salinity Bureau, Department of Premier and Cabinet;
- Landcare and Salinity Standing Committee; and
- Natural Resources and Environment Cabinet Committee.

2.19 Since the tabling of the Auditor-General’s Salinity report in 1993, there have been several significant changes in the Government’s institutional framework for the implementation of the Salinity Management Program. These include:

- The Rural Water Corporation was abolished in July 1994, 5 regional rural water authorities created and the sale of the Corporation’s technical investigations, monitoring and laboratories to private companies;
- The Catchment and Land Protection Council (now the Victorian Catchment Management Council) and 10 Regional Catchment and Land Protection Boards were created in October 1994, and given responsibility for implementing the then State’s Salinity Control Strategy;
- The Salinity Bureau was transferred in April 1996 from the Department of Premier and Cabinet to the Department of Natural Resources and Environment. The Bureau in effect was absorbed by the Department and ceased to exist as a separate entity;
- The principal agencies responsible for implementing Victoria’s Salinity Control Strategy were amalgamated – the Department of Conservation and Natural Resources with the Rural Water Corporation in 1994, followed by the Departments of Agriculture and Minerals and Energy in 1996 - to form the Department of Natural Resources and Environment;

2.24 The *Catchment and Land Protection Act* 1994 established 10 Catchment and Land Protection regions and 10 Boards to develop and implement Regional Catchment Strategies, which are integrated land and water management plans, for each region. In 1997, the Act was amended to replace 9 of Victoria's Catchment and Land Protection Boards with 9 regional Catchment Management Authorities¹¹. The primary role of the Catchment Management Authorities is to develop and co-ordinate the implementation of regional catchment strategies and to establish and co-ordinate the community-based Implementation Committees.

2.25 Regional catchment strategies are endorsed by the Government and form the overarching strategy for the development, management and conservation of the land and water resources in each region. To plan the implementation of regional catchment strategies, Catchment Management Authorities develop a 3-year rolling regional management plan, which details the investment of funds in natural resource management projects across the region.

2.26 Catchment Management Authorities are funded through the annual regional management planning process. Funds are provided by both the State and Commonwealth Governments to support integrated waterway and floodplain management.

2.27 Recently a Parliamentary Secretary for Environment and Conservation, Mr Geoff Howard, MP was appointed by the Premier. The Parliamentary Secretary does not have a statutory role but functions through references from the Minister, the first of which is to consider the long-term viability of the Landcare movement in Victoria. This task may have direct implications for the management of the salinity problem in Victoria under the 2000 *Salinity Management Framework*.

2.28 Additional comments regarding institutional arrangements are outlined in Part 5 of this report.

The Victorian Salinity Management Program

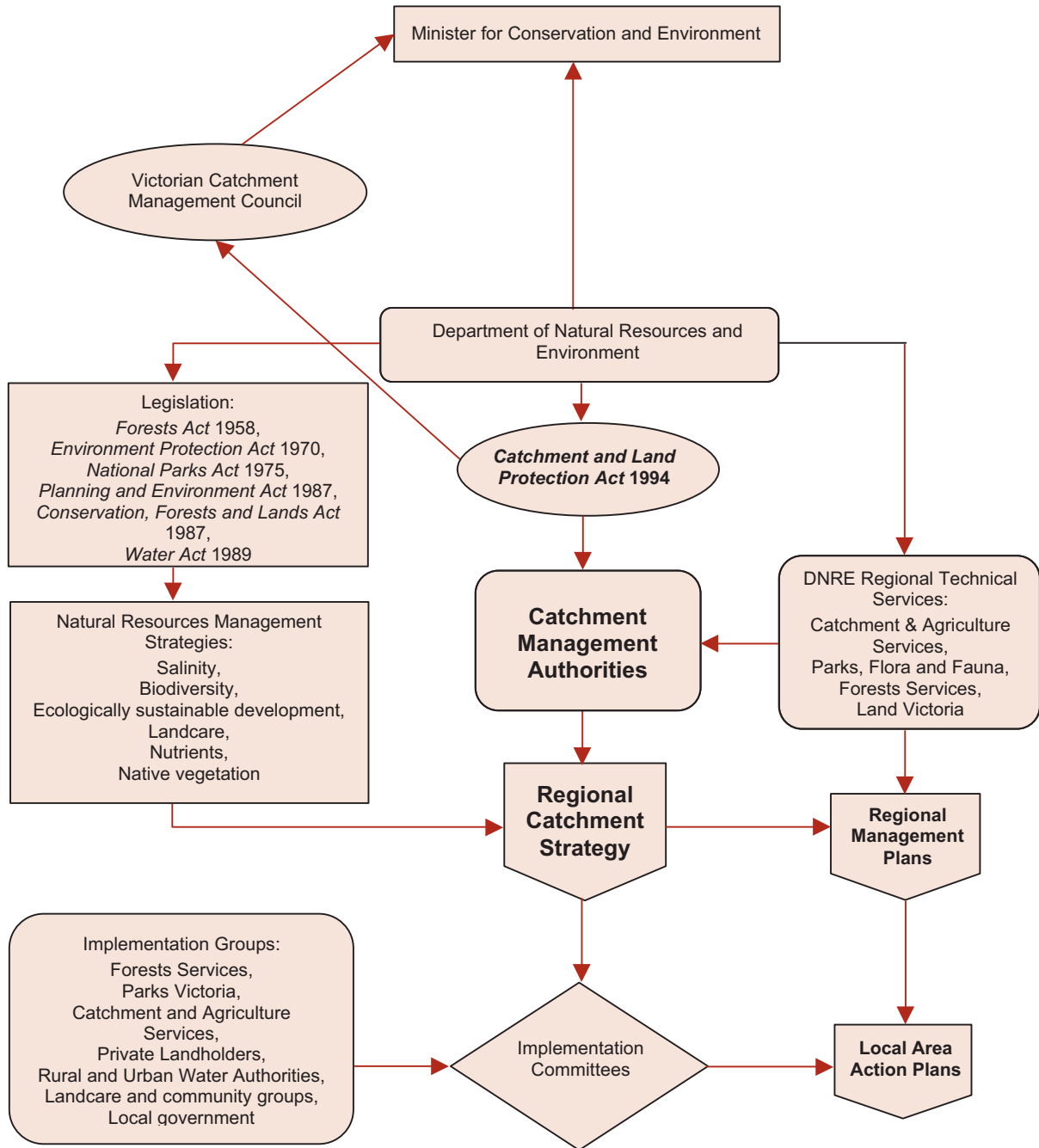
2.29 In May 1988, the State Government released the Victorian Salinity Management Program, *Salt Action: Joint Action* which set out a 30-year program of community-led salinity management plans for salt affected regions. The overall goal of the Salinity Management Program is to manage the salinity of land and water resources throughout Victoria to maintain and, where feasible, improve the social wellbeing of communities and the environmental quality and productive capacity of the regions.

2.30 Since 1988, community groups have developed 21 salinity management plans covering most of Victoria. The plans include:

- an overview of the causes and effects of salinity locally;

¹¹ The status of the Port Phillip Catchment and Land Protection Board is currently under review by the Department of Natural Resources and Environment.

**CHART 2H
VICTORIA'S LEGISLATIVE AND INSTITUTIONAL FRAMEWORK
FOR CATCHMENT MANAGEMENT**



Source: Adapted from the Department of Natural Resources and Environment's submission to the House of Representatives Standing Committee on Environment and Heritage, *Inquiry into Catchment Management*, May 2000.

2.24 The *Catchment and Land Protection Act* 1994 established 10 Catchment and Land Protection regions and 10 Boards to develop and implement Regional Catchment Strategies, which are integrated land and water management plans, for each region. In 1997, the Act was amended to replace 9 of Victoria's Catchment and Land Protection Boards with 9 regional Catchment Management Authorities¹¹. The primary role of the Catchment Management Authorities is to develop and co-ordinate the implementation of regional catchment strategies and to establish and co-ordinate the community-based Implementation Committees.

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The Victorian Salinity Management Program

2.29 In May 1988, the State Government released the Victorian Salinity Management Program, *Salt Action: Joint Action* which set out a 30-year program of community-led salinity management plans for salt affected regions. The overall goal of the Salinity Management Program is to manage the salinity of land and water resources throughout Victoria to maintain and, where feasible, improve the social wellbeing of communities and the environmental quality and productive capacity of the regions.

2.30 Since 1988, community groups have developed 21 salinity management plans covering most of Victoria. The plans include:

- an overview of the causes and effects of salinity locally;

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- an assessment of the economic, social and environmental effects of various alternative salinity control measures, including a “no intervention” option;
- preferred measures and implementation targets;
- cost-sharing arrangements;
- incentives and sanctions to ensure adoption of each plan;
- arrangements governing the discharge of salt to the Murray River;
- descriptions and assessments of wetlands likely to be affected, salinity control measures and the effects of the measures; and
- responsibilities for implementing and reviewing each plan.

2.31 Total State funding for the Salinity Control Strategy from 1990-91 to 2000-01 was \$257 million. The Department estimates that total State, Commonwealth and private expenditure on implementing the salinity management plans under the Strategy over the past 10 years has been \$1.8 billion.

2.32 A review of salinity management plans by the Victorian Catchment Management Council and the Environment Protection Authority¹² found that, even despite funding shortfalls, most community groups and Salinity Implementation Committees had achieved the objectives of their salinity management plans. The Department of Natural Resources and Environment estimates that the implementation of salinity management plans in irrigation regions over the past 10 years and for the next 20 years will save \$2.5 billion in net present value terms. Some of the achievements of the program over the past decade are:

- 71 500 hectares of irrigation land protected by surface drainage;
- 51 000 hectares of irrigation land protected by groundwater pumping;
- 3 000 hectares of wetlands protected;
- 19 248 hectares of native vegetation planted and 4 700 hectares of remnant native vegetation protected by fencing;
- partnership arrangements established with community groups; and
- advances in science and knowledge about managing the salinity problem.

2.33 There have been several significant developments over the past 10 years that have impacted on the achievement of the State’s salinity management objectives. These include:

- Water sector reform;
- The establishment of water markets through Transferable Water Entitlements;
- The introduction of a cap on water diversions from the Murray River and a system of salinity credits¹³ under the Murray-Darling Basin Agreement;

¹² *Know Your Catchments, Victoria, 1997*. Victorian Catchment Management Council and Environment Protection Authority. Department of Natural Resources and Environment, 1997.

¹³ Refer to glossary of terms for the definition of salinity credits.

- Substantially increased funds for addressing natural resources management issues under programs of the Commonwealth’s Natural Heritage Trust;
- The introduction of Integrated Catchment Management to permit the achievement of multiple benefits, while addressing natural resource management issues;
- Since 1994-95, the Department of Natural Resources and Environment head office units act as “purchasers” of services that are delivered by regional units. New budgeting and planning processes have been developed to support this change; and
- The purchase of environmental water flows by the Department and new initiatives to identify water savings across Victoria for the restoration of water flows in the Snowy River.

2.34 We found that the Department and Catchment Management Authorities had undertaken or participated in over 30 reviews related to the State’s salinity management program and salinity management plans since 1993. Appendix A lists the key salinity related reviews undertaken by or involving the Department.

2.35 For example, the Department has indicated that a major review of the State’s Salinity Management Program was undertaken by the consultants Marsden Jacobs in 1994. The Department also completed reviews of dryland salinity management in 1995 in relation to the Goulburn Broken Dryland Salinity Management Plan to gather further information about groundwater processes and the effectiveness of recharge control measures.

2.36 Our assessment of these achievements and outcomes of the Salinity Management Program over the past 10 years are reported in Parts 4 and 5 of this report.

Victoria’s 2000 Salinity Management Framework

2.37 The Government released Victoria’s *Salinity Management Framework: Restoring our Catchments* in August 2000. The 2000 *Salinity Management Framework* details new information concerning a predicted worsening of dryland salinity across many Victorian catchments. The Framework acknowledges one of the major findings of the Murray-Darling Basin Commission’s 1999 *Salinity Audit*¹⁴ that the main source of future increases in river salinity will be from dryland farming and grazing areas rather than irrigation districts. The Framework provides a mechanism for reviewing all of the State’s salinity management plans in light of the new information.

2.38 The Minister for Conservation and Environment directed Catchment Management Authorities to systematically review all salinity management plans to:

- undertake a Statewide stocktake of salinity management plans, including the extent to which they have been continuously improved since their implementation;
- provide criteria from which regions can judge existing and/or amended plans;

¹⁴ Murray-Darling Basin Commission (1999) *Salinity Audit: A 100 year perspective*, Murray-Darling Basin Ministerial Council.

- identify areas requiring improvement; and
- provide licence to amend plans accordingly.

2.39 The Department advises that guidelines are currently under development to assist Catchment Management Authorities to update their dryland plans as part of the Second Generation salinity management plan Initiative. All dryland plans will be reformulated and a revised program established by September 2001.

2.40 The 2000 *Salinity Management Framework* sets the following targets:

- By 2005, there will be representative coverage of monitoring, sufficient to account for the impacts of groundwater rise and river salinity;
- By 2005 critical recharge zones within catchments will be identified with 50 per cent of these critical recharge areas revegetated by 2015;
- By 2005 a quarter of the State's agricultural production will be produced from natural resources that are managed within their capacity. By 2015 this will increase to half of all agricultural production;
- By 2015 there will be a real reduction in the environmental and economic impacts of salinity;
- By 2015 Victoria will have investigated and, where practical, substantially reduced the impact of rising groundwater on the riverine environment and key wetlands; and
- By 2015 Victoria will have participated in the joint Murray-Darling Basin salt interception schemes to earn sufficient salt credits to provide for future drainage, new irrigation development and to protect important environmental values.

2.41 The Framework provides the following 5 strategies for the achievement of the above targets:

- partnerships for integrated catchment management;
- understanding catchment processes and implementing appropriate management actions for particular landscapes;
- building skills and the capacity for change;
- efficient water use and regional growth; and
- salinity management in the Murray-Darling Basin.

National agencies and initiatives

2.42 Table 2I summarises the roles of the main Commonwealth agencies and inter-governmental body involved in salinity management.

TABLE 2I
ROLES OF ORGANISATIONS INVOLVED IN SALINITY

Department of Agriculture, Fisheries and Forestry Australia	Provide services to the agricultural, food, fisheries and forest industries to assist them to become more competitive, profitable and sustainable. Provide research, policy advice, programs and services to address natural resource management challenges.
National Land and Water Resources Audit	A Natural Heritage Trust program to improve decision-making on land and water resource management and to aid with policy development, investment decisions, performance evaluation and direct resource management. Seven audit themes include Agricultural Productivity and Sustainability, Dryland Salinity and Capacity for Change.
Murray-Darling Basin Commission	Provide advice on and develop, co-ordinate and implement measures for the sustainable use of the water, land and other environmental resources in the Murray-Darling Basin. Manage the River Murray and the Menindee Lakes system of the lower Darling River. Co-ordinate government partner contributions to the Murray-Darling Basin Initiative.
Commonwealth Scientific and Industrial Research Organization (CSIRO)	Provide scientific research, development, testing and advice for all industry sectors.
Land and Water Division of the CSIRO	Generate knowledge, strategies and tools to manage land and water in Australia and internationally through research into water, the landscape and the atmosphere

Inter-governmental initiatives

2.43 The **Natural Heritage Trust** was established in 1996 as the Commonwealth Government's major vehicle for funding national natural resource management and land degradation issues. The Natural Heritage Trust was allocated \$1.5 billion in funding over 7 years for a number of programs, including Murray-Darling 2001, Bushcare, the National Landcare Program and the National Land and Water Resources Audit. The Commonwealth recently extended the Natural Heritage Trust program through the allocation of a further \$1 billion over the next 5 years.

2.44 The **National Land and Water Resources Audit** is a 4-year program of the Natural Heritage Trust that commenced in 1997. The purpose of the Audit is to provide a comprehensive national appraisal of Australia's natural resource base. The Commonwealth requested that the Audit concentrates on Australia's rural and remote natural resources, which are managed for a range of productive and conservation uses. The Audit focuses primarily on information needs of Commonwealth and State Governments on issues of land and water resource management and covers, as comprehensively as possible, the environmental and socio-economic aspects of land and water resources for all land tenures.

2.45 The **National Dryland Salinity Program** is a collaborative research and development effort that is investigating the causes of, and solutions to, the national problem of dryland salinity. The first 5-year phase of the Program was completed in 1998 and focused on improving our understanding of the causes of dryland salinity and on establishing a collaborative national focus on the research and development effort.

2.46 A larger, second 5-year phase (1998–2003) of the Program is continuing to identify and research the knowledge gaps in our understanding of the causes and impacts of dryland salinity. The Program is also investigating socio-economic arrangements that encourage or impede appropriate management of salinity, new production options using saline resources and management of saline landscapes.

2.47 The **Murray-Darling Basin Initiative** is a partnership between 6 governments and the community, which was established to give effect to the 1992 Murray-Darling Basin Agreement. The purpose of the Agreement is to promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin.

2.48 The Murray-Darling Basin Initiative is currently placing emphasis on:

- the development and implementation of strategic, large-scale integrated catchment management plans;
- concentrating resources in the areas of greatest need; and
- establishing an integrated catchment management framework that will help governments and communities better address issues such as dryland salinity over the next decade.

2.49 The Murray-Darling Basin Commission's 1988 *Salinity and Drainage Strategy* provides a framework for joint action by the New South Wales, Victorian, South Australian and Commonwealth Governments to effectively manage the problems of water logging and land salinisation in the irrigation districts of the Murray Valley (e.g. the Shepparton and Torrumbarry Irrigation Regions in Victoria), and river salinity in the Lower Murray (e.g. the Mallee in Victoria). The Strategy is based on interception schemes, which divert saline groundwater away from the Murray River, and other non-engineering solutions.

2.50 A review of the *Salinity and Drainage Strategy* in 1999, undertaken by the Murray-Darling Basin Commission, concluded that it had been successful in reducing salinity in the River Murray, as measured at Morgan, South Australia, which is now below 800 EC for more than 90 per cent of the time compared with 60 per cent before the Strategy's implementation.

2.51 The Murray-Darling Basin Ministerial Council is developing a draft Basin Salinity Management Strategy that extends the principles of the *Salinity and Drainage Strategy* across the Basin. The Council agreed that the strategy should:

- include preliminary end of valley targets¹⁵;
- establish improved accountability arrangements for salinity outcomes;

¹⁵ End of valley targets are set under the Murray-Darling Basin Commission 2000-01 *Salinity and Drainage Strategy*. They are salt load targets for streams with monitoring points strategically located to measure the impacts of upstream development and to provide a policy mechanism for trading in salinity credits as a basis for deciding future economic development and sharing costs in specific sub-catchments. Current targets are set based on current levels and trends in water quality.

- include market based approaches to vegetation management for salinity outcomes; and
- enhance research and development into new options to control groundwater recharge or, where this is not feasible, options to help communities live with salinised land and water resources.

2.52 The Commonwealth Government's National Action Plan for Salinity and Water Quality was endorsed by the Council of Australian Governments in November 2000 and commits \$700 million over 7 years to address dryland salinity and deteriorating water quality problems. In May 2001 the Victorian Government announced that it would spend \$157 million over 7 years under the National Action Plan. This includes \$77.5 million to be spent over the next 4 years on salinity management and water quality projects across the Goulburn Broken, North Central, Wimmera, Mallee, Glenelg-Hopkins and Corangamite catchments. The funding is to be equally matched by the Commonwealth. However, other estimates of the level of funding required to address the nationwide salinity problem range from \$37 billion (CSIRO) to \$60 billion over 10 years (Australian Conservation Foundation and the National Farmers' Federation).

2.53 The goal of the National Action Plan is to motivate and enable regional communities to use co-ordinated and targeted action to:

- prevent, stabilise and reverse trends in salinity affecting the sustainability of production, the conservation of biological diversity and the viability of public infrastructure; and
- improve water quality and secure reliable allocations for human uses, industry and the environment.

2.54 The Action Plan will implement:

- Agreed targets and standards for natural resource management in relation to salinity, water quality, water flows and stream and terrestrial biodiversity;
- Integrated catchment and regional management plans developed by the community in all highly affected catchments. The plans will be jointly accredited for strategic content, proposed targets and outcomes, accountability, performance monitoring and reporting;
- Capacity building for communities and landholders to assist them to develop and implement integrated catchment and regional plans, together with the provision of technical and scientific support and engineering innovations;
- An improved governance framework to secure Commonwealth, State and Territory investments and community action in the long-term, including property rights, pricing and regulatory reforms for water and land use;

- Clearly articulated roles for the Commonwealth, State, Territory and Local Governments and the community to replace the current disjointed Commonwealth, State and Territory frameworks for natural resource management. This will include a single Natural Resource Management Council that can sign off on the targets and standards and establish arrangements for monitoring progress; and
- A public communication program to support widespread understanding of all aspects of the Action Plan to promote behavioural change and community support.

Impact of national initiatives on Victoria

2.55 The 7-year National Action Plan for Salinity and Water Quality will more than double the current levels of public funds targeted at salinity and water quality management in Victoria. The National Action Plan funds will augment Commonwealth funds made available under the Natural Heritage Trust (NHT) program, which has been allocated \$1 billion to 2006-07.

2.56 An inter-governmental agreement was finalised in early 2001, bilateral agreements between the Commonwealth and each jurisdiction are expected to be finalised by 1 July 2001 and then partnership agreements will be entered into with each of the 20 targeted regions. Of the 20 highly affected regions identified in the Plan for funding, the following are located in Victoria:

- Goulburn-Broken (covered by the Goulburn Broken Catchment Management Authority);
- Avoca-Loddon-Campaspe (covered by the North Central Catchment Management Authority);
- Glenelg-Corangamite; (covered by the Glenelg-Hopkins Catchment Management Authority and Corangamite Catchment Management Authority); and
- Lower Murray (covered in part by the Mallee Catchment Management Authority and Wimmera Catchment Management Authority).

2.57 The Report of the *Inquiry into Catchment Management* by the House of Representatives Standing Committee on Environment and Heritage stated: “*The Committee is concerned that the National Action Plan may be implemented in a manner similar to that of the NHT. In the Committee’s view, the NHT is not adequately supported by effective partnership agreements that are based upon ‘fair dinkum’ commitments by partners to maintain effort, levels of resourcing and the full implementation of the range of actions required to address the problems facing catchments. Nor do the partnership agreements contain credible and effective enforcement measures for failures to honour the agreements reached.*”¹⁶

¹⁶ The Parliament of the Commonwealth of Australia, *Co-ordinating Catchment Management*, Report of the Inquiry into Catchment Management, House of Representatives Standing Committee on Environment and Heritage, December 2000, Canberra. para. 3.85.

2.58 There are major differences between the funding processes established for grants under the Natural Heritage Trust and how investments are to be managed under the National Action Plan. Funding will be approved under the National Action Plan when the following packaged conditions are met:

- whole or parts of regional integrated catchment management plans are individually accredited by joint Commonwealth and relevant State or Territory assessments;
- there is a regional body or authority with the capacity to develop and deliver the regional integrated catchment management plan;
- the plans provide accountability, performance monitoring and reporting arrangements at catchment and regional-scales, linked to regional targets for salt and nutrient levels, water quality and biodiversity;
- land clearing is prohibited in areas where it would lead to unacceptable land and water degradation; and
- continued funding is contingent on meeting targets and long-term strategies, rather than the approach of funding annual proposals for future works.

2.59 The National Action Plan will impart additional rigour to Victoria's Salinity Management Program, providing an independent review process focusing on continuous development and improvement of regional integrated catchment management plans.

LONG-TERM MANAGEMENT APPROACHES

Balancing a range of objectives

2.60 There is a challenge to balance the benefits of integrated catchment management with maintaining a focus on salinity to ensure that salinity outcomes are delivered for a range of stakeholders. For example, reductions in salinity impacts on economic, environmental and social systems through the adoption of yet to be developed long-term sustainable agricultural systems will need to consider the benefits and costs to the natural resource base, plants and animals (biodiversity), farmers and the agriculture industry, rural communities and future generations.

2.61 The Victorian Government's approach to natural resource management and economic development is underpinned by its adoption of the principles of ecologically sustainable development. Ecologically sustainable development was defined in the 1992 National Strategy For Ecologically Sustainable Development, as follows:

“Ecologically sustainable development is using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. The goal for ecologically sustainable development is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The core objectives are:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and life-support systems.”

Long-term options

2.62 Given that the Department of Natural Resources and Environment predicts there will be a 10-fold increase in the area affected by salt by 2050 and estimates the direct cost of salinity to be \$50 million per year, it is not surprising that the Department views salinity as one of the greatest natural resource management challenges in Victoria. With this background in mind, the Department informed us that Victoria’s focus is on salinity management rather than on salinity control and eradication. Salinity now needs to be recognised as part of the Victorian landscape. Managing salinity requires major changes in vegetation management and land use on a grand scale. The Department aims to inform landholders of the voluntary management options open to them and to assist communities to implement the options and minimise the adverse effects of salinity.

2.63 In the irrigation areas, improvements in water use efficiency and reuse programs to manage the salinity problem have been partly driven by the profitability of management options including labour savings, new irrigation development and transferability of irrigation water. Although the State’s understanding of irrigation salinity and appropriate management actions have been superior compared to efforts undertaken to manage dryland salinity, the following matters are of concern:

- climatic conditions of the past 8 years have been favourable for irrigation salinity and the impacts of an extended, wetter period on irrigation salinity are not known;
- underlying processes, such as the filling of deep-leads in the Goulburn-Broken region and the gradual concentration of salts at the watertable interface, will worsen the on-site and off-site impacts of irrigation salinity;
- some management options such as groundwater recycling may not be sustainable in the longer term, e.g. 20 years; and
- rural structural readjustment may be much more intense and difficult due to the intensity of farming in the State’s irrigation regions.

2.64 It may be more difficult to design incentives to deal with dryland salinity without policy mechanisms governing the control and regulation of water supply. Under these circumstances, longer-term environmental sustainability in dryland agriculture may require shorter-term economic sacrifices. This could involve development of new ecologically sustainable industries at the expense of continuing traditional but unsustainable agricultural systems and land use practices.

2.65 The primary method of managing dryland salinity is through decreasing groundwater discharge via lowering the watertable by replanting native vegetation over widespread areas where groundwater systems are recharged by rainfall. The Government estimates that 60 per cent of many of Victoria’s catchments will need to be revegetated in order to manage salinity. Other related management solutions include voluntarily changing farming systems through a combination of the following land use practices:

- planning crop rotation to avoid fallow periods and using lucerne or perennial pastures¹⁷ as the ley phase in cropping systems;
- the permanent use of deep-rooted perennial pastures that utilise more water, such as lucerne, *Phalaris* and cocksfoot;
- intercropping by sowing crops into established lucerne stands;
- “living with salt” via saline agriculture, which uses perennial vegetation on discharge areas;
- alley farming which mixes trees or other perennials with crops or annual pasture;
- farm forestry;
- revegetation and the protection of remnant native vegetation;
- water use efficiency for cropping systems and the periodic use of perennials in all cropping rotations;
- groundwater pumping and drainage; and
- mechanical methods such as desalination plants.

2.66 Research shows that due to the slow response of groundwater systems, even if all of the above sustainable land use practices were achieved overnight, elevated levels of groundwater discharge would continue over the next 20 years or so and the changed land-use practices, if sustained, would take up to, and in some cases exceed, 100 years to achieve a permanent return to low watertables. This outcome is also heavily dependent on the level of salinity deemed acceptable in any landscape.

2.67 Given the extent of the actions needed and the predicted slow response times, widespread adoption of salinity management actions by farmers is paramount. However, there are constraints to changing traditional agricultural practices, and the rates of adoption of new farming systems over the past decade have been too slow to have had any impact on watertable rises across Victoria’s dryland regions. These constraints include:

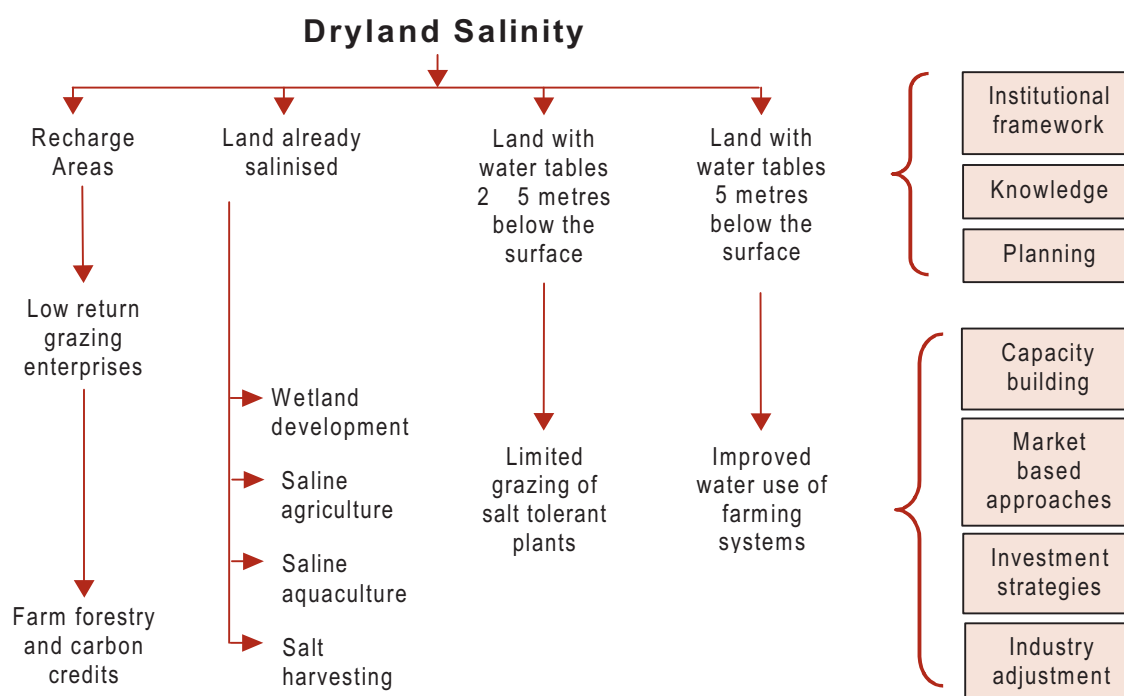
- risk aversion of farmers towards innovations that have not been demonstrated or are perceived uneconomic in the shorter-term, e.g. there are currently no perennial plants that can be produced profitably taking account of the full range of costs;
- the high up-front costs of adoption and the long response times for outcomes under sustainable agriculture systems add to negative perceptions about their viability in real farming situations; and

¹⁷ Deep rooted perennial pastures in low rainfall areas intercept most of the rainfall preventing it from entering the groundwater system.

- resistance to changes that threaten further declines in rural populations and regional services, e.g. blue gum plantations are associated with declining rural populations in south west Victoria and wholesale changes to traditional agricultural systems.

2.68 The alternative living with salt options include using saline agricultural water for farming salt water produce such as snapper, brine shrimps, prawns, molluscs and seaweed. Chart 2J summarises the salinity management options for dryland salinity.

**CHART 2J
SUMMARY OF DRYLAND SALINITY MANAGEMENT OPTIONS**



Source: Standing Committee on Agriculture and Resource Management, *Management of Dryland Salinity: Future Strategic Directions*, Report 78 CSIRO Publishing, March 2000.

2.69 The right hand boxes in the above chart show the strategies recommended to successfully implement each of the options for salinity control and living with salt. These new strategies are now incorporated to varying degrees in both State and Commonwealth salinity and water quality management strategies.

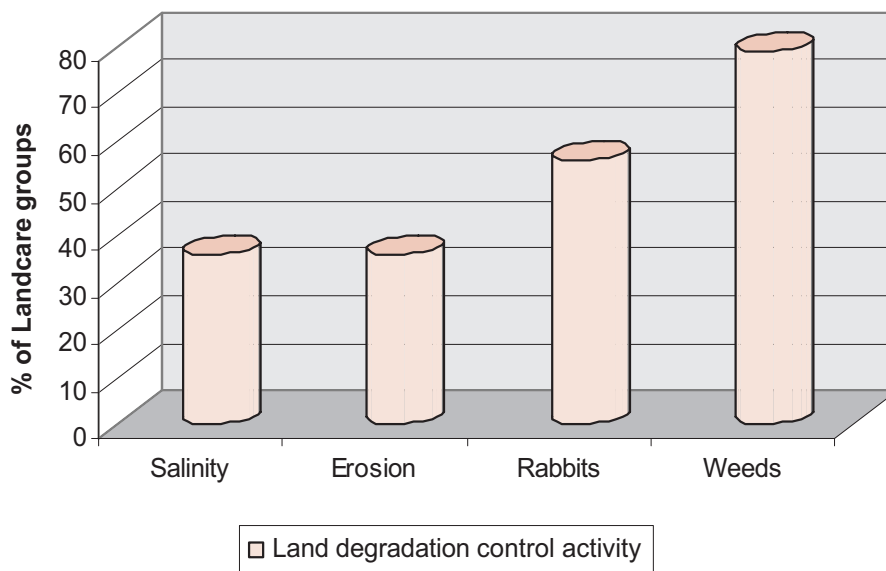
Community involvement

2.70 The Victorian community is well represented in its efforts to combat salinity through several important forums. The *Catchment and Land Protection Act* 1994 provides for community groups to be represented on the Boards of Catchment Management Authorities. Citizens also comprise membership of regional Salinity Implementation Committees and have formed 51 registered Landcare networks across Victoria that provide volunteer services for natural resources management programs.

2.71 Between 34 to 47 per cent of Victoria's farmers participate in a Landcare group (there are around 890 Landcare groups in Victoria), which have been responsible for delivering on-ground works and services for nearly half of the Commonwealth's Natural Heritage Trust programs in Victoria.

2.72 Chart 2K shows that salinity control works were undertaken by 36 per cent of Landcare groups in Victoria in 1998. This is significantly down from 57 per cent in 1995.

CHART 2K
LANDCARE ACTIVITIES TO CONTROL LAND DEGRADATION, 1998
 (per cent of Landcare groups involved)



Source: Allan Curtis, Marike Van Nouhuys "Landcare in Victoria: Beyond on-ground work", The Johnstone Centre for Conservation and Restoration of Landscapes, Report No. 125. Charles Sturt University, March 1999.

2.73 The volunteer organisations of the Landcare movement involve a cross section of the rural population and have been helpful in promoting changes to farming systems through incremental rather than quantum changes. The community and the Landcare movement in Victoria are expected to play a major role under the 2000 *Salinity Management Framework* in terms of ensuring, in partnership with government agencies, that revegetation actions are implemented and targets are met.

Part 3

Conduct of the audit

CONDUCT OF THE AUDIT

Audit objectives

3.1 The objectives of the audit were to determine whether:

- the broad thrust of the recommendations reported in our 1993 Report on salinity had been adequately addressed; and
- the Department of Natural Resources and Environment, Catchment Management Authorities and the community were adequately prepared to implement the State's 2000 *Salinity Management Framework*.

Audit scope

3.2 The severity of the salinity problem and trends in salinity levels have been quantified in a number of recent reports by government bodies.¹⁸ The audit did not duplicate this work.

3.3 We conducted inquiries in the following entities:

- The Victorian Catchment Management Council;
- Department of Natural Resources and Environment, Catchment and Water Division (administers the Catchment and Water Program, which includes the Salinity Management Program). This Division includes the following groups that are directly involved in salinity management:
 - Land Management Group;
 - Water Resource Management Group;
 - Community and Catchment Strategy Group; and
 - Catchment and Agriculture Services.
- Catchment Management Authorities:
 - Corangamite Catchment Management Authority;
 - East Gippsland Catchment Management Authority;
 - Glenelg-Hopkins Catchment Management Authority;
 - Goulburn Broken Catchment Management Authority;
 - Mallee Catchment Management Authority;
 - North Central Catchment Management Authority;
 - North East Catchment Management Authority;

¹⁸ For example, the 1999 Murray-Darling Basin Commission's *Salinity Audit*, and the National Land and Water Resources Audit *Australian Dryland Salinity Assessment 2000* report.

- West Gippsland Catchment Management Authority;
- Wimmera Catchment Management Authority; and
- Port Phillip Catchment and Land Protection Board.

3.4 We also examined initiatives administered by other Divisions within the Department of Natural Resources and Environment that contribute to the objectives of salinity control and salinity outcomes in Victoria. For example, the Divisions of Parks, Flora and Fauna and Agriculture Industries implement programs under government strategies that have an impact on salinity control, such as native revegetation and native vegetation retention programs.

Audit approach

Salinity trends and responses

3.5 The audit has presented information detailing trends in salinity over the past decade and available estimates of the future trends. It has also described the current status of the lakes described in our 1993 report, e.g. the Kerang Lakes, including Lake Tutchewop, and Lake Corangamite. We have also provided information on the level of funding for the Salinity Management Program and the progress towards the achievement of the objectives of the State's 21 salinity management plans.

Follow-up of our 1993 salinity audit

3.6 We have followed up the major themes contained in our 1993 report on salinity using a questionnaire survey. The questionnaire was self-assessed by the audited agencies and, where needed, followed-up with interviews to clarify answers or to develop the information submitted. Some information has also been verified against source documents. The surveys sought information on progress with implementing recommendations relating to:

- improving the cost-benefits analyses in salinity management plans;
- providing clear policy direction on structural readjustment/land retirement;
- researching and developing long-term strategies/lessons from pilot programs;
- incorporating “beneficiaries pay” and “polluters pay” principles into salinity responses;
- implementing cost sharing arrangements;
- developing performance indicators, monitoring and evaluating strategy outcomes;
- establishing a Statewide salinity register;
- undertaking annual reporting;
- involving the community; and
- funding on-ground works.

Assessment of Victoria's preparedness

3.7 To assess the preparedness of the Department of Natural Resources and Environment and Catchment Management Authorities to implement the State's 2000 *Salinity Management Framework*, the following key aspects of the State's Salinity Management Program were examined:

- revegetation targets;
- cost-benefit analyses;
- structural re-adjustment and land retirement;
- knowledge base and research capacity;
- accountability mechanisms;
- institutional arrangements;
- community participation;
- water supply system efficiency; and
- cost-sharing arrangements.

3.8 Interviews in relation to assessing the level of preparedness to implement the State's 2000 *Salinity Management Framework* were conducted at the following Catchment Management Authorities:

- Corangamite Catchment Management Authority;
- Glenelg-Hopkins Catchment Management Authority;
- Goulburn Broken Catchment Management Authority; and
- North Central Catchment Management Authority.

3.9 These Authorities were selected for the following reasons:

- agricultural losses are predicted to be concentrated in the regions of the 4 Catchment Management Authorities if salinity trends follow the worst case scenario or, apart from the Corangamite region, if trends follow the best case scenario¹⁹;
- the regions covered by the 4 Catchment Management Authorities are the most highly salt-affected areas in the State and among 20 national catchments targeted for additional State and Commonwealth funds under the \$1.4 billion National Action Plan for Salinity and Water Quality; and
- the Authorities are evenly distributed north and south of the Great Dividing Range, which gave us an opportunity to compare the impact of the different levels of information and funding on past achievements, due to the involvement of the Murray-Darling Basin Commission in Victoria's northern catchments.

¹⁹ National Land and Water Resources Audit: Theme 2 – Dryland Salinity. *Extent and Impact of Dryland Salinity in Victoria, Final Report*, November 2000.

Methodology for gathering information

3.10 The audit is based on:

- results of interviews;
- responses by the Department and Catchment Management Authorities to questionnaires;
- analysis of trend data supplied by the Department;
- verification of certain key material;
- analysis of other audits, inquiries and reports; and
- information provided by specialists.

3.11 We also sought public submissions by advertisement in a range of newspapers. Unfortunately only 4 submissions were received.

Compliance with auditing standards

3.12 The audit was performed in accordance with Australian Auditing Standards applicable to performance audits and, accordingly, included such tests and other procedures considered necessary in the circumstances.

Resourcing the audit

3.13 Specialist advice was provided to my Office throughout the audit by:

- Mr Clive Lyle, of Clive Lyle and Associates Pty Ltd, who specialises in water resources, catchment and salinity management; and
- Mr Ray Evans, Director, Salient Solutions Australia Pty Ltd, who is an expert in groundwater and salinity management.

3.14 Significant support and assistance was provided to my officers by the Department of Natural Resources and Environment, the Catchment Management Authorities and other experts involved in the water industry. I wish to express my appreciation to these organisations and individuals.

Part 4

Trends in salinity management, 1990-2000

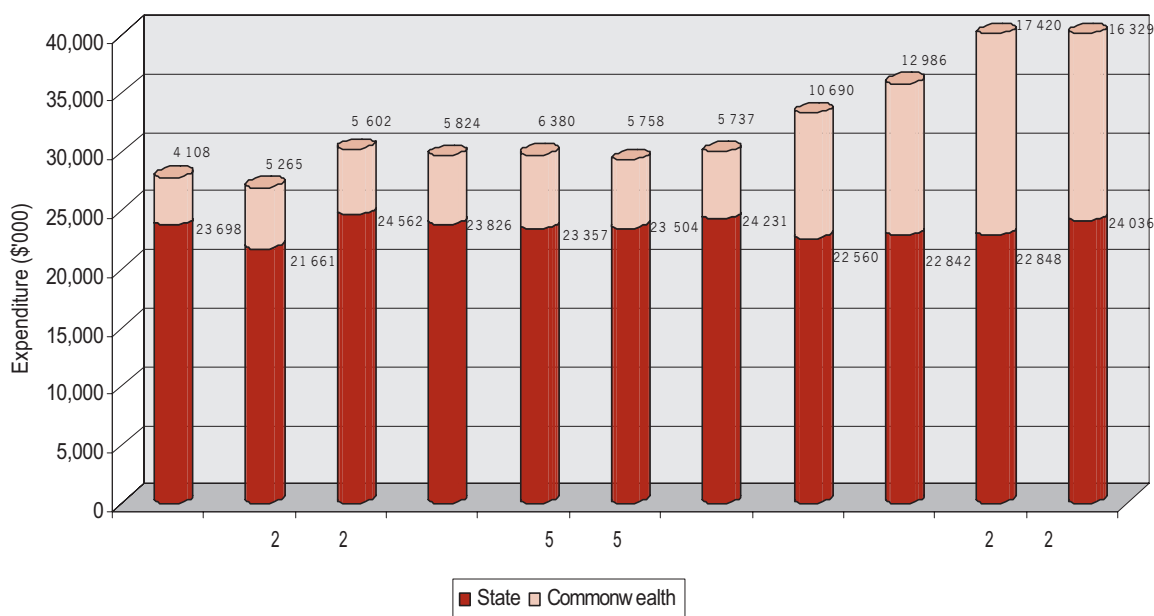
EXPENDITURE AND FUNDING

4.1 Determining the amount spent by the State on salinity management is difficult. Changes in departmental structures and programs and the integration of salinity management within the integrated catchment management program make the task difficult. The Department has, however, provided us with known direct expenditures over the period 1990-91 to 2000-01.

4.2 The figures disclosed in Chart 4A are drawn from all State co-ordinated salinity project codes and include an estimate of the salinity-related proportion of the Murray-Darling Basin Commission's funding. We have examined the way in which these costs have been apportioned and are satisfied with the basis used.

4.3 Chart 4A shows that annual State funding for the Salinity Management Program has remained relatively constant at an average of \$23 million per year over the past decade despite the salinity problem worsening. The Commonwealth's contribution to the program has increased from around \$5.7 million per year prior to 1996-97 to around \$16.3 million in 2000-01, mainly through new funds made available through the Natural Heritage Trust. Over the last 11 years - just over one-third of the way through Victoria's 30-year *Salt Action: Joint Action* salinity strategy - total State expenditure has been \$257 million and total Commonwealth expenditure has amounted to \$96 million.

CHART 4A
EXPENDITURE ON SALINITY, 1990-2000
(\$'000)



(a) 2000-01 figures are estimates.

Source: Department of Natural Resources and Environment.

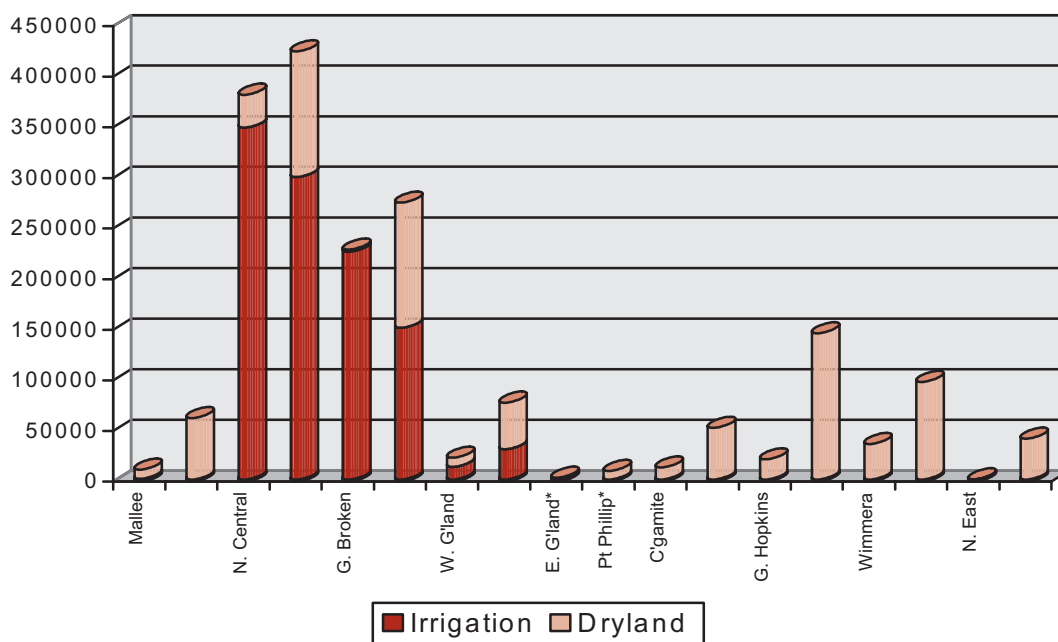
4.4 The Department of Natural Resources and Environment estimates that private contributions to the Salinity Management Program are 4 times public contributions. On this basis, private contributions equivalent to \$1.4 billion, in addition to State funds of \$257 million and Commonwealth funds of \$96 million, means that a total of \$1.8 billion has been spent on salinity in Victoria between 1990 and 2001.

EXTENT AND IMPACT OF WATERTABLES IN EACH REGION

4.5 Chart 4B shows the incidence of the total area affected by high watertables for each Catchment Management Authority for the years 1990 and 2000. The chart shows that watertables have fallen in the irrigation areas of the North Central and Goulburn Broken Catchment Management Authority's regions. However, watertables in the dryland areas of all Catchment Management Authorities have risen markedly over the past 10 years. The West Gippsland Catchment Management Authority has rising watertables in both dryland and irrigation areas.

4.6 This trend supports the widely held view that salinity management initiatives assisted by drier than normal climatic conditions have been effective in reducing the extent of shallow watertables in irrigation areas, but not as effective in managing rising watertables (and therefore salinity) in dryland areas over the past 10 years.

CHART 4B
AREA OF LAND WITH HIGH WATERTABLES (LESS THAN 2 METRES), 1990 AND 2000
(hectares)



Left hand columns = 1990, Right hand columns = 2000.

Source: Salinity Impacts (Draft), Salinity Planning Working Group, Victoria, March 1992; The 1999 Salinity Audit of the Murray-Darling Basin, Murray-Darling Basin Commission, 1999.

*1990 data not available for East Gippsland CMA and Port Phillip Catchment and Land Protection Board.

SALINITY IN RIVERS AND STREAMS

4.7 Salinity levels since 1990 in Victoria's rivers and streams have not followed a consistent Statewide trend²⁰. Decreasing salinity was common in the southern central region, represented by the Port Phillip Catchment and Land Protection Board and Corangamite Catchment Management Authority. On the other hand, increasing salinity levels generally occurred in the western and north-western regions, represented by the North Central, Wimmera and Glenelg-Hopkins Catchment Management Authorities. In the eastern half of the State, salinity was stable.

4.8 According to the Australian Dryland Salinity Assessment undertaken in 2000 as part of the National Land and Water Resources Audit, stream salinity increases westwards across northern Victoria to the Avoca River. Current and predicted flow-weighted stream salinity (i.e. the stream salinity concentration is weighted to account for the fact that the salt load in a stream with a higher volume of flow is diluted more than the same salt load in a stream with a lower volume of flow) at the end of the major Murray Basin river systems in Victoria are shown in Table 4C.

TABLE 4C
CURRENT AND PREDICTED FUTURE FLOW WEIGHTED STREAM SALINITY
(EC units)

<i>Location</i>	<i>Current</i>	<i>2020</i>	<i>2050</i>
Goulburn River upstream of Murray River	134	136	231
Broken River upstream of Murray River	114	231	968
Campaspe River upstream of Murray River	595	600	606
Loddon River downstream of Kerang Weir	871	883	903
Avoca River downstream of Marshes	1 444	1 468	2 216
Wimmera River upstream of Lake Hindmarsh	(a) 680	684	691

(a) According to advice received from the Wimmera Catchment Management Authority, this appears to be very low compared to the flow weighted salinity information that they have. The most recent report from the stream gauging station at Lochiel (near Dimboola) had an average flow weighted reading of 1 906 EC in 1997 and 1 128 EC was the average between 1993 and 1997. Source: Stream Salinity Monitoring in the Wimmera, Sinclair Knight Merz 1998.

Source: Australian Dryland Salinity Assessment 2000 component, National Land and Water Resources Audit, 2001.

4.9 Flow-weighted stream salinity in the Lower Loddon and Avoca Rivers either already exceeds or is predicted to exceed Murray-Darling Basin Commission benchmarks for water quality (800 EC for drinking water quality and 1 500 EC for farm animals and the natural environment).

²⁰ Victorian Water Quality Monitoring Annual Report: 1998, prepared for the Department of Natural Resources and Environment by Australian Water Technologies, Victoria. This report provides data, including salinity as measured in Electrical Conductivity units, for over 176 individual river and stream stations.

4.10 Water quality is more variable across south-west Victoria and does not have a consistent pattern of increasing salinity either westwards or downstream. Flow-weighted stream salinities in several of the major rivers (e.g. Barwon, Leigh, Woody Yallock, Hopkins and Wannon) already exceed Murray-Darling Basin Commission benchmarks and are generally greater than for streams in northern Victoria.

LANDCARE

4.11 The number of Landcare groups has increased substantially across rural Victoria since 1990 and numbered approximately 890 groups in 1998, with a total membership of 25 000 to 30 000 people.

Landcare achievements

4.12 Table 4D shows the achievements of salinity management activities undertaken by Landcare groups and organised by Catchment Management Authorities for 1990 to 2000.

**TABLE 4D
EXTENT OF SALINITY CONTROL ACTIONS
PER CATCHMENT MANAGEMENT AUTHORITY REGION**

CMA	Cumulative years of achievement	Native Revegetation/ tree planting (ha)	Perennial pasture (ha)	Whole farm plans (no.)	Discharge treatment/saline site revegetation (ha)
CCMA	1993 to 2000	3 496	16 039		1 134
GBCMA (a)	1990-91 to 199-98	3 941	6 560	1 374	930
GHCMA	1993 to 2000	52 400	210 000	950	3 050
MCMA	1992-93 to 199-98	378			617
NCCMA (b)	1998-99 and 1999-2000	272	10 550		
NECMA	1999 to 2001	300			
PPCALP	1994 to 1996	417	1 400		8
WCMA	1992-93 to 1999-2000	5 009	52 891	294	1 336
WGCMA (c)	1994-95 to 1999-2000		800	10	37
Totals		66 213	298 240	2 628	7 112

(a) Figures for perennial pasture and discharge treatment/saline site revegetation are estimates only.

(b) Revegetation figure is for 1998-99 only.

(c) Property management plan figures are for 1994-95 only; perennial pasture to 1995-96 only.

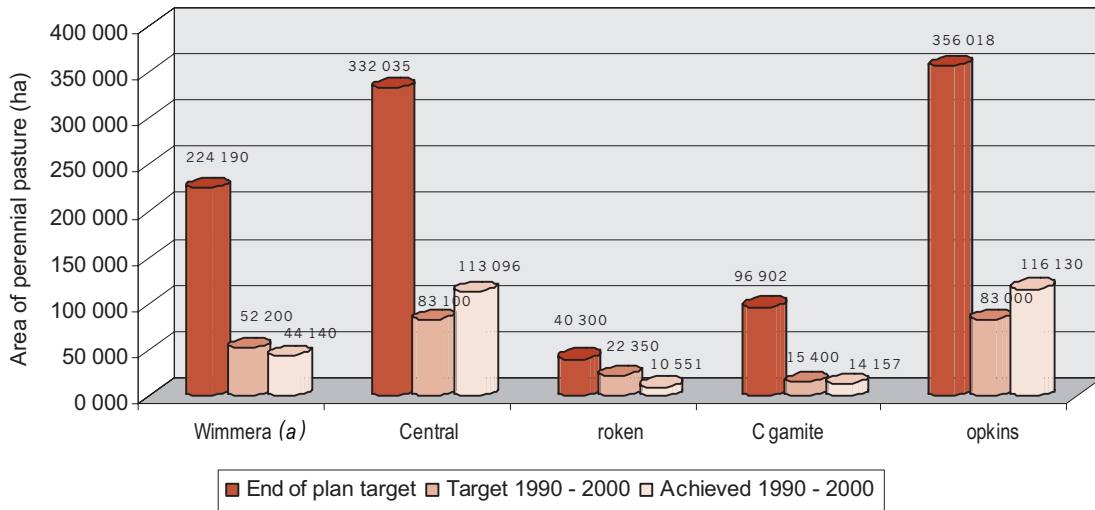
Abbreviations:

- CCMA Corangamite Catchment Management Authority.
- GBCMA Goulburn Broken Catchment Management Authority.
- GHCMA Glenelg-Hopkins Catchment Management Authority.
- MCMA Mallee Catchment Management Authority.
- NCCMA North Central Catchment Management Authority.
- NECMA North East Catchment Management Authority.
- PPCALP Port Phillip Catchment and Land Protection Board.
- WCMA Wimmera Catchment Management Authority.
- WGCMA West Gippsland Catchment Management Authority, discharge treatment category to 1996-97 only.

Source: Responses of Catchment Management Authorities to the Auditor-General's 2001 follow-up questionnaire for the 1993 *Salinity* performance audit. It is important to note that the above figures provided by the Catchment Management Authorities do not correlate with the figures provided by the Department of Natural Resources and Environment as shown in Charts 4E and 4F.

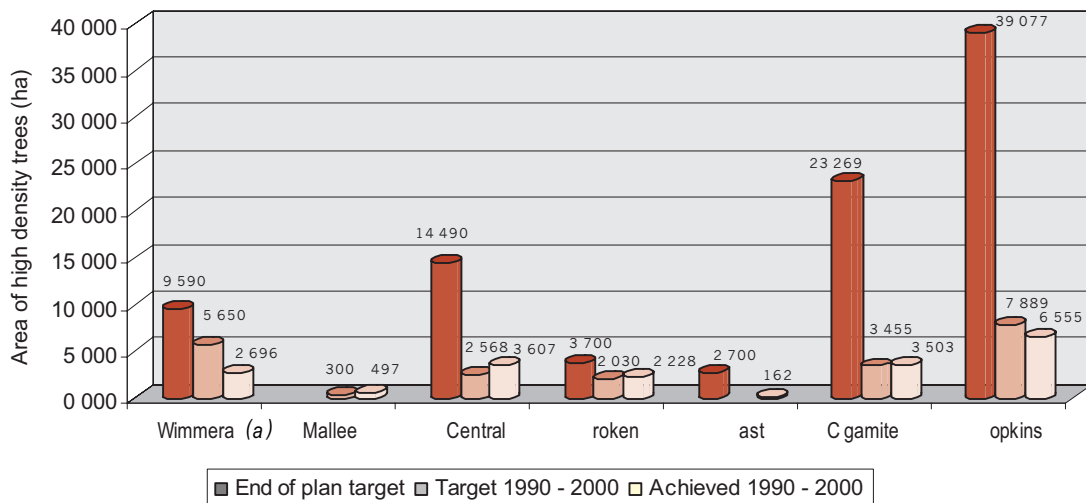
4.13 Chart 4E and Chart 4F show the respective total area of perennial pastures and native vegetation established against targets under the dryland salinity management plans of Catchment Management Authorities from 1990 to 2000.

**CHART 4E
LANDCARE ACHIEVEMENTS:
PERENNIAL PASTURES IN RECHARGE AREAS, 1990 TO 2000
(hectares)**



Source: Data supplied by the Department of Natural Resources and Environment to the Auditor-General, 2001.

**CHART 4F
LANDCARE ACHIEVEMENTS:
HIGH DENSITY TREES (NATIVE VEGETATION) IN RECHARGE AREAS, 1990 TO 2000
(hectares)**



(a) In the 1996 Wimmera Salinity Plan Review the original targets for pasture establishment were reduced by 1/2, native tree establishment targets were reduced by 1/3 and saline agriculture targets were reduced by 1/2, while crop-land targets remained the same.

Source: Data supplied by the Department of Natural Resources and Environment and the Wimmera Catchment Management Authority to the Auditor-General, 2001.

4.14 It is apparent from the above charts that only 2 authorities, namely the North Central and Glenelg-Hopkins Catchment Management Authorities, will reach their 30-year long-term salinity plan targets for perennial pasture establishment based on their past 10 year achievements. Only the Goulburn Broken Catchment Management Authority will reach its 30-year target for native revegetation.

4.15 Table 4G shows the State's 1988 Salinity Management Program revegetation targets, Landcare revegetation achievements and the proposed revegetation targets under the 2000 *Salinity Management Framework*.

TABLE 4G
TARGETS, ACHIEVEMENTS, 1990 - 2000 AND EMERGING CHALLENGES
(hectares)

<i>Management options</i>	<i>1988 Salinity Management Program targets (30 years)</i>	<i>1988 Salinity Management Program targets (10 years)</i>	<i>Landcare achievements 1990 - 2000</i>	<i>2000 Salinity Management Framework targets²¹ 2005-2015</i>
Perennial pasture	1 049 445	256 050	(a) 298 240	3 600 000
Native revegetation	92 826	21 892	(a) 66 213 (b) 19 248	3 300 000
Total	1 142 271	277 942	317 488 to 364 453	6 900 000

(a) Data aggregated from individual Catchment Management Authority survey returns – see Table 4D.

(b) Consolidated, Statewide data supplied by the Department of Natural Resources and Environment, 2001.

4.16 Although Victoria's community-led achievements are commendable, the revegetation targets set in the dryland salinity management plans of the early to mid-1990s are only a sixth of the estimated catchment area indicated in the 2000 *Salinity Management Framework* and now understood as needing revegetation. In view of the massive scale of the revegetation required by 2015, and the rate of revegetation for salinity management to date, there is a risk that the proposed regional-scale revegetation targets under the 2000 *Salinity Management Framework* will not be achieved. Further comments on this preparedness issue are contained in Part 5 of this Report.

²¹ The revegetation target under the 2000 *Salinity Management Framework* is "60 per cent of many catchments". The perennial pasture establishment target represents a coverage of 60 per cent of drylands with less than 600 mm/yr rainfall. The native vegetation target represents a coverage of 60 per cent of the State's remaining dryland area of 7.9 million hectares.

4.17 Surveys of the on-ground works undertaken by Landcare groups show that less effort was spent on salinity control works than on tree planting or remnant vegetation protection, weed control and pest animal control (refer paragraph 2.72). It is acknowledged, however, that at least 19 248 hectares of native revegetation was planted by Landcare groups over the past 10 years to control groundwater recharge. The surveys also disclosed that more time was spent by Landcare groups in preparing grant applications than on salinity control activities. The surveys indicate that, although most Landcare efforts are in tree planting or remnant native vegetation protection, this activity was not necessarily integrated with regional management plans to ensure multiple benefits such as salinity control outcomes.

4.18 The surveys demonstrate that Landcare funding and works generally occur on an *ad hoc* basis across a region or catchment due to limited co-ordination and support across Landcare groups and a lack of volunteer management skills. Since 1997 this has been exacerbated by a decline in government extension services, which reduced the level of facilitation and support for Landcare activities, and additional Natural Heritage Trust funding, which has increased the number of Landcare activities across the State.

4.19 Table 4H summarises some of the key findings of the Department of Natural Resources and Environment surveys of Landcare groups in the Corangamite, Glenelg-Hopkins and Goulburn Broken regions.

**TABLE 4H
SURVEY OF LANDCARE GROUPS 1999, SUMMARY OF RESULTS²²**

Activity	<p>There is a significant, positive relationship between activity and government funding. Landcare groups are operating at peak activity levels. Activity on salinity works has fallen to only 36 per cent of groups, but has been maintained for the control of rabbits (56 per cent) and weeds (79 per cent).</p> <p>Only 40 per cent of surveyed groups undertook catchment planning, while 68 per cent established annual priorities.</p> <p>Groundwater and salinity monitoring has declined by more than one-third since 1995, following a general decrease in monitoring activities.</p>
Leadership	<p>There are often difficulties attracting leaders. Lack of leadership and management training was a key concern, although workshops for leaders have been poorly supported.</p>
Administration	<p>Administration requires a large volunteer effort, and time spent on grant applications exceeded time spent on most on-ground works. Delays in applying for, and receiving, funding from Natural Heritage Trust (NHT) are linked to decreases in both on-ground works and new applications. New members are still being recruited but retention of volunteers is crucial.</p>
Volunteer commitments	<p>Time demands on groups is a major, and increasing, constraint for Landcare groups. Involvement of members in property management planning has decreased. Burnout is a concern.</p>
Funding and support	<p>Funding has generally increased from NHT, State rabbit and weed initiatives and Catchment Management Authority (CMA) levies. Sixteen per cent of Landcare groups receive 62 per cent of the total funds. Assistance from, and communication with, other Landcare groups has increased.</p> <p>Assistance from both government and non-government sources has decreased, but group satisfaction with general levels of support from government has changed little. Groups have good contact levels with government staff, but poor contact levels with paid co-ordinators.</p>
Sustainability	<p>Given the time and energy commitments required, current activity levels are unsustainable. Landcare members are approaching the limits of their capacity to contribute as volunteers.</p>

4.20 Program management issues for the Landcare movement identified through the surveys include:

- declining leadership effectiveness and membership renewal;
- inequitable distribution of funding between groups;
- need for greater administrative support; and
- better links between on-ground works to regional priority-setting and catchment-wide planning processes.

²² Curtis, Allan (March 2000). Landcare: Approaching the limits of voluntary action. *Australian Journal of Environmental Management* 7(1): 19-27.

Curtis, A. and Nouhys, M (March 1999). *Landcare in Victoria: Beyond on-ground work*. Charles Sturt University, The Johnstone Centre for Conservation and Restoration of Landscapes. Report No. 125.

4.21 Landcare has had a significant impact on increasing the awareness of land degradation issues and in facilitating a change in the attitude of farmers towards the value of revegetating landscapes for environmental outcomes. However, we were advised by the Department and Catchment Management Authorities, that the increase in awareness and changes in attitude towards natural resources management has not been translated into the widespread adoption of alternative, sustainable land use practices.

4.22 In conclusion, the Landcare movement has encouraged an attitude in the rural community towards managing private land for improved environmental outcomes. However, poor co-ordination of on-ground works at the farm or local landholder level may have adversely affected the achievement of regional salinity management outcomes. Moreover, it is unlikely that the Landcare movement alone will provide a sufficient catalyst for widespread adoption of sustainable agricultural practices.

4.23 Further comments regarding community participation are made in Part 5 of this report.

TRENDS FOR RARE AND THREATENED SPECIES, 1992 TO 1998

4.24 Table 4I shows the trend in the number of species of plants and animals (i.e. biodiversity) threatened by salinity between 1992 and 1998.

**TABLE 4I
NUMBER OF RARE AND THREATENED SPECIES, 1992 TO 1998**

<i>Region</i>	<i>Plants</i>		<i>Terrestrial vertebrates</i>				<i>Fish</i>	
	<i>1992</i>	<i>1998</i>	<i>All 1992</i>	<i>Birds 1998</i>	<i>Mammals 1998</i>	<i>Reptiles 1998</i>	<i>1992</i>	<i>1998</i>
North East	13	5	20	12	2	2	9	3
Goulburn Broken	10	16	26	23	4	4	10	6
North Central	55	21	38	22	1	4	9	3
Wimmera	16	32	16	19	1	2	6	7
Mallee	50	27	15	22	2	9	n.a.	7
Glenelg-Hopkins	10	13	15	26	2	2	5	5
Corangamite	26	7	17	22	2	1	3	2
Gippsland	5	2	21	11	0	0	4	1
Port Phillip	n.a.	8	n.a.	21	4	3	n.a.	2

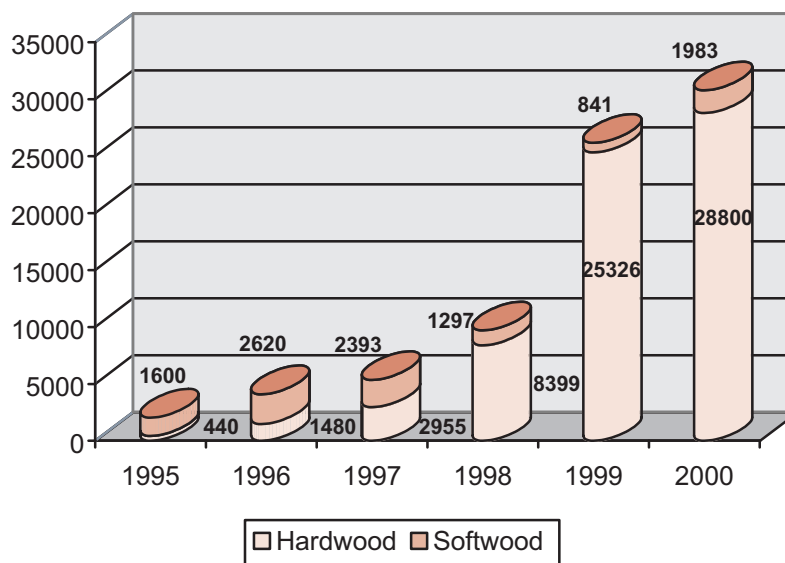
Source: Regional Salinity Impacts (Draft), Salinity Planning Working Group, Victoria, March 1992
The 1999 *Salinity Audit*, Murray-Darling Basin Commission.

4.25 An increase in the number of threatened species over time represents the collapse of supporting habitat systems, for example, due to salinity impacts on other inter-dependent species, for example, insects, micro-organisms and other salt-affected plants and animals. This illustrates an aspect of the impact of salinity on Victoria's biodiversity assets.

PRIVATE FORESTRY PLANTATIONS

4.26 Chart 4J shows the trend in forestry plantation establishments in Victoria from 1995 to 1999.

CHART 4J
COMMERCIAL FORESTRY PLANTATIONS, 1995 – 1999
(hectares)



Source: Bureau of Resource Science, National Plantation Inventory, Tabular report, March 2000. (The figures for 2000 are for proposed new plantations).

4.27 The Department advised us that commercial forestry plantations established since 1995, covering a total area of 284 575 hectares, have not generally been located in the critical landscape areas of highest recharge. However, according to the Department, nearly all of the native trees planted on farms since 1990, covering a total area up to the end of 1998 of 19 248 hectares, have been planted in recharge areas.

STATUS OF THE LAKES REPORTED IN 1993

4.28 We have made inquiries to both the Department and the Catchment Management Authorities regarding the status of the lakes investigated as part of our 1993 Salinity performance audit, namely Kerang Lakes, including Lake Tutchewop, Lake Corangamite and a number of other lakes. The new information²³ concerning the impact of dryland salinity predicts a far greater long-term impact on most of Victoria's wetlands than previously thought.

4.29 The following paragraphs describe the responses of the Department of Natural Resources and Environment and Catchment Management Authorities.

²³ 1999 *Salinity Audit: A 100 year perspective*, Murray-Darling Basin Commission, October 1999

Kerang Lakes, including Lake Tutchewop

4.30 The salinity levels of the Kerang Lakes have remained largely unchanged over the past 10 years. Research by the Department of Natural Resources and Environment since 1993 showed that some recommendations in the Kerang Lakes Salinity Management Plan are inaccurate. For example, the Reedy Lake bypass channel has a very low economic return and would not function properly during flood events.

4.31 Environmental management plans are under development for key wetlands in the Kerang Lakes area. The “no intervention” scenario, which means not undertaking any action to combat salinity, in the Kerang Lakes salinity management plan categorises wetlands as follows:

- Wetlands that are unflushed or are irregularly flushed and are perceived as already degraded, such as Duck Lake (North), Pelican Lake, Holloways Lake (previously known as North Drainage Lake and Highway Lake), North Woorinen Lake (previously known as South Drainage Lake and North West Lake), South Woorinen Lake (previously known as Woorinen South Lake), Foster’s Swamp, Stephenson’s Swamp and Lake Tutchewop. Lake Tutchewop will continue to degrade as part of the salt interception scheme;
- Wetlands that are only flushed by major floods and are perceived as less degraded, such as Lakes Wandella, Murphy, Elizabeth, Charm and Cullens, the Avoca Marshes, and Wandella and Mystic Park State Forests. According to the plan, Lake Wandella interacts with the local watertable and may be able to be managed as a terminal wetland. Lake Charm is now flushed via the Lake Charm pumping station and will improve over time. Lake Cullens is monitored as part of a lakebed flushing trial and modelling indicates that it will hold current salinity values or improve slightly. Detailed survey and modelling has been completed with the aim of improving the water quality of Lake Elizabeth. It is proposed to pump water to Micks Salt Lake. The recommendations of the Avoca Marshes Tree Health report, based on 8 years of monitoring, have been implemented. A management strategy and on-ground works to improve flood management in Wandella Forest have been implemented;
- Wetlands that are irregularly flushed and will degrade more slowly such as Lake Hird, Johnson Swamp, Golf Course, Round and Long Lake. We were advised by the Department and the North Central Catchment Management Authority that management and operation plans for Hird and Johnson’s Swamp have been completed and outfalls constructed to allow flushing programs to be undertaken. Investigations are underway to flush Golf Course and Round Lake to Long Lake, however, local opposition and disagreement on appropriate water levels for Golf Course Lake have delayed works from proceeding; and

- Lakes and streams that form part of the irrigation storage and supply system such as Kow Swamp, Pyramid Creek, Loddon River, Reedy, Middle and Third Lakes, Racecourse and Kangaroo Lakes and the Little Murray Weir Pool. According to the Department and the North Central Catchment Management Authority, there has been no significant change in the quality of these wetlands due to the water that continually flushes them. Until recently, minimal work was conducted, however, environmental investigations in response to impacts caused by high water levels are underway for Kow Swamp, the Reedy Lakes and Little Murray Weir.

4.32 Advice we received from the Department indicates that in 1998 the Lake Charm flushing channel was completed. To protect the internationally significant wetlands of the Wandella Forest, a bypass plan is under development to alleviate water logging. A detailed proposal for a Pyramid Creek salt interception scheme to reduce salt going into the lakes has been completed and submitted to the Murray-Darling Basin Commission. The Commission has agreed to progress the plan to a construction-ready stage as soon as possible. The Lake Leaghur Environmental Impact Statement has also been completed.

4.33 Further comments regarding the Kerang Lakes, including Lake Tutchewop, are outlined in Part 5 of this Report.

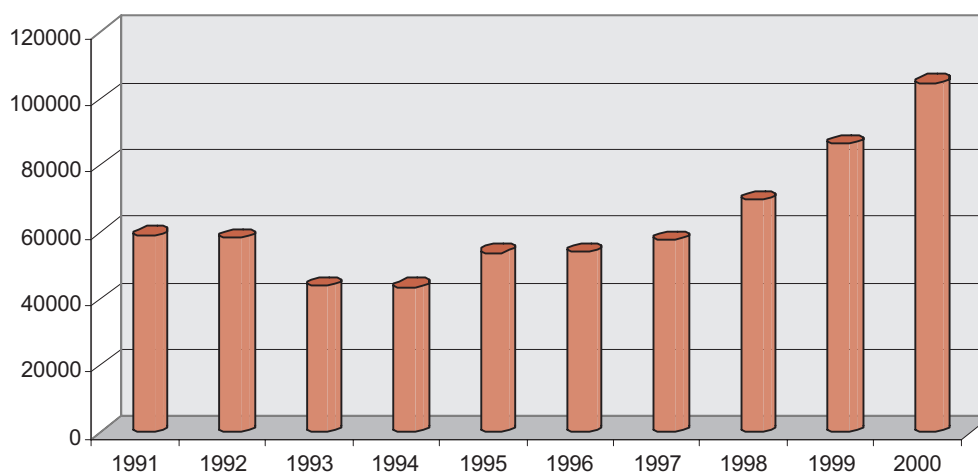
Lake Corangamite

4.34 Our 1993 *Salinity* performance audit noted the prospect of wetlands of international importance, such as Lake Corangamite, becoming biologically dead within a few years, highlighted the necessity of ensuring all environmental as well as economic factors are considered when planning major projects such as drainage schemes. The Department of Natural Resources and Environment has undertaken an assessment of the environmental values of Lake Corangamite for the purpose of planning salinity control measures that may impact on the Lake.²⁴

4.35 Chart 4K shows that salinity in Lake Corangamite has increased over time, almost doubling since monitoring began in 1991. Lake Corangamite is a terminal lake and as such its salinity readings respond to water volume in the Lake. The past 4 consecutive dry seasons have resulted in much lower than normal water flow and, accordingly, water level and salinity readings are higher than normal.

²⁴ See W. D. Williams (1995) Lake Corangamite, Australia, a permanent saline lake: Conservation and management issues. *Lakes & Reservoirs: Research & Management*, 1: pp55 – 64

CHART 4K
SALINITY TRENDS FOR LAKE CORANGAMITE, 1991 TO 2000
 (EC units)



Source: Corangamite Catchment Management Authority, 2001.

4.36 Fourteen automatic flow and salinity monitoring sites were installed in the Corangamite area as part of the Salinity Management Program. Lakes, wetlands and some streams are also monitored monthly. These results are reported annually and a pamphlet has been printed for general community information. Trend data and salt loads are also reported as part of the annual report on salinity management plans to the Minister.

4.37 Salinity degrades the Lake's environment when levels reach 50 000 EC to 58 000 EC which occurs when the Lake's water level drops below 116metres ADH (Above Datum Height). The current lake level is at about 114 metres above sea level and the salinity is 104 738 EC (200 per cent greater than seawater). This salinity level is within the extremes recorded since settlement; the highest water level was observed in 1875 with a reported salinity of 30 666 EC and the lowest water level was 113.4 metres above sea level in 1933 when the salinity was 175 000 EC.

4.38 Research shows that salinity reduces the Lake's biological health by reducing aquatic biota and in turn affecting the food chain for birds. Due to increased salinity, the Lake's margins no longer support submergent and emergent aquatic plants, thereby reducing the habitat available to fauna that would normally inhabit, nest and feed in such vegetation. There is firm evidence that the biological status of Lake Corangamite has changed and that it no longer satisfies the criteria which formed the basis of its selection as a wetland of international importance under the Ramsar convention.²⁵

²⁵ Williams, W. D. Op. cit

Other lakes and wetlands

4.39 The Murray-Darling Basin Commission has estimated that more than half of the salt mobilised in the Murray-Darling Basin will not be exported through rivers and out to sea, but stored elsewhere in the landscape, particularly in irrigation districts and floodplain wetlands. The consequences of this may include loss of productive land, damage to infrastructure and degradation of both aquatic and terrestrial environments, such as loss of biodiversity.

4.40 The Department advised that, according to a desk-top survey of Victoria's northern catchments undertaken by its Parks, Flora and Fauna Division, a number of lakes and wetlands are at risk from salinity. Ramsar²⁶ wetlands such as Barmah Forest, Gunbower Forest, Kerang Wetlands, Hattah-Kulkyne Lakes and Lake Albacutya are considered by the Department to be at moderate to high risk of salinity impacts to the water regime and chemistry, vegetation and wildlife habitat. Numerous smaller wetlands listed in "*A Directory of Important Wetlands in Australia*" are also at risk²⁷. However, comprehensive field studies and wider surveys have not been conducted in relation to the threat of salinity in Victoria's parks and reserves system. If the Department had commissioned more detailed surveys and specific salinity risk assessments of wetlands of State and regional significance, including wetlands located on private land and wetlands situated across all catchments of the State, this would have provided a complete picture of those wetland assets that could be protected from salinity.

4.41 We were advised by the Glenelg-Hopkins Catchment Management Authority that in the Glenelg-Hopkins region, salinity threatens many wetlands, including terminal lakes where saline groundwater now intrudes into the main water body. The Authority also believes that the region's current agricultural systems are unlikely to lower the ground water level and thereby manage the salinity threatening the catchment's wetlands.

4.42 The National Land and Water Resources Audit (2001)²⁸ reported that shallow watertables are predicted to increase under more than 30 000 hectares of land surrounding the Ramsar wetlands of the Western District lakes during the next 20 years. Wetlands in the Goulburn Broken and Corangamite regions, however, are expected to be the most affected, with over 40 per cent of wetlands situated over shallow watertables by 2050.

4.43 The Department is undertaking engineering works and revegetation in dryland areas to improve the water quality of degraded and threatened wetlands in the Kerang lakes region. However, predicted long-term increases in the salinity of streams and rivers from dryland farming and grazing areas will continue to threaten and degrade a significant number of Victoria's other freshwater wetlands over the next 20 to 50 years.

²⁶ *The Convention on Wetlands of International Significance especially as Waterfowl Habitat*, Ramsar, Iran, 1971 is an intergovernmental treaty on wetlands conservation. More than 1 000 wetlands have been designated for inclusion in the List of Wetlands of International Importance.

²⁷ Source: Department of Natural Resources and Environment, Parks, Flora and Fauna Division, *Stocktake for Murray-Darling Basin Commission of values and assets to be protected from salinity*, 2000.

²⁸ Natural Heritage Trust (2001) *Australian Dryland Salinity Assessment 2000*, National Land and Water Resources Audit, Land and Water Australia, Commonwealth of Australia. January 2001.

Recommendation

4.44 It is recommended that the Department, Catchment Management Authorities and the Victorian Catchment Management Council give priority to the identification of Victoria's most important, strategic and significant wetlands for inclusion in long-term biodiversity protection programs.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 4.44 Identifying the most important wetlands for biodiversity protection.

Victoria's most important wetlands have been identified and listed in "A Directory of Important Wetlands in Australia" database which is readily accessible on the Environment Australia website at <http://www.environment.gov.au/wetlands/wet.html>. This directory documents Ramsar wetlands and 159 other wetlands in Victoria which meet national significance criteria. It lists salinity threats as well as other risks. More specific salinity risk assessment has been done for wetlands in the Murray-Darling Basin, by Department of Natural Resources and Environment - Parks, Flora and Fauna, "Stocktake for Murray-Darling Basin Commission of values and assets to be protected from salinity", 2000.

*The Victorian Government is responsible for ensuring Ramsar obligations are met in Victoria. Obligations include maintaining the ecological character of Ramsar wetlands (wetlands of international importance listed under the Convention on Wetlands (Ramsar, Iran 1971); and ensuring the conservation and wise use of *all* wetlands. The Ramsar Convention calls for managing wetlands in a catchment framework.*

The Department of Natural Resources and Environment and Parks Victoria released a draft Strategic Directions Statement for managing Victoria's Ramsar wetlands in February 2001 for public comment. Submissions closed in March 2001 and the statement is being finalised. The statement sets strategic objectives for managing Ramsar sites in Victoria to guide preparation of individual site plans, which are also being prepared. Objective 3 in the draft was as follows: "Manage within an integrated catchment management framework.

Victoria's 10 Ramsar wetlands are readily identifiable:

- mapped on the Department of Natural Resources and Environment's Corporate Geospatial Data Library Ramsar layer;*
- shown on information sheets and maps on the Department's website (under "Parks and Reserves", "Wetlands"); and*
- included in "A Directory of Important Wetlands in Australia".*

The Department expects that revised salinity plans should identify Ramsar sites and important wetlands as documented above. They should also identify any other significant wetlands which have been recognised in regional planning frameworks.

Victoria is contributing to a report "Implications of Salinity for Biodiversity Conservation and Management", prepared for the Australian and New Zealand Environment and Conservation Council by a task force established by the Standing Committee on Conservation (June 2001). This provides comprehensive recommendations for policies to protect wetlands that are important for biodiversity from salinity.

Wetlands and lakes identified at different levels of risk and value would be included as part of the asset register referred to under paragraph 5.50.

Part 5

Preparedness for the emerging salinity challenge

5.1 To form an opinion about Victoria's preparedness to manage the emerging salinity problem, we have assessed whether:

- appropriate action has been taken in response to the key recommendations reported to Parliament in our 1993 Special Report No. 19 - *Salinity*, many of which have continued relevance now and in the future; and
- current measures place Victoria in a sound position to implement the State's 2000 *Salinity Management Framework*.

5.2 Our findings on the follow-up of our 1993 report have been integrated with our findings under the following key themes, which, except for private forestry plantations, arise from the recommendations of that report:

- outcomes, 1990-2000, including the achievement of output and revegetation targets and return on investment;
- cost-benefit analyses;
- structural re-adjustment and land retirement, and private forestry plantations;
- knowledge base and research capacity;
- accountability mechanisms;
- institutional arrangements;
- community participation; and
- other issues that comprise:
 - the Goulburn Broken Dryland Salinity Management Plan;
 - water supply system efficiency; and
 - cost-sharing arrangements.

OUTCOMES, 1990-2000

Achievement of output targets

5.3 We asked the Department of Natural Resources and Environment to provide us with details of the achievement of output targets under the Salinity Management Program over the past 10 years. Their response is provided in the following boxed paragraphs:

Performance of the salinity management plans against targets is variable. The 11 irrigation salinity management plans have made credible progress, mostly meeting or exceeding targets (see www.nre.vic.gov.au/catchmnt/conditn/salinity/irrigat.htm). In general, the irrigation plans can be divided into 3 groups:

- **Sunraysia** – hugely successful following the uptake of best management practices (conversion from furrow to pressurised irrigation systems including overhead and undervine sprinklers and drip systems) and reduction of drainage flows. Nangiloc drainage scheme completed and sustainable development objectives and targets, particularly salt disposal, for the Nyah to the South Australia border have been achieved;
- **Loddon Murray** – Plans have focused on living with salt and on-farm adjustment. Saline soils (class C and D) have been mapped and appropriate adjustment occurred. The establishment of water markets has greatly facilitated the achievement of objectives as well as the Loddon Murray 2000 redevelopment program; and
- **Shepparton** surface and sub-surface drainage targets have been exceeded with increased areas protected and strong uptake of best practice by irrigators.

For dryland salinity management plans, most on-ground works targets have been met, however, due to the financial crises facing broadacre farming and other factors, there have generally been lower rates of implementation of salinity control measures than was initially targeted.

The achievement of most dryland plan targets reflects the strong and dedicated effort by dryland farmers, Catchment Management Authorities and regional Department of Natural Resources and Environment staff. However, as more information has become available about groundwater processes and effectiveness of recharge control measures, it has become apparent that dryland salinity management requires greater “fine tuning” if an optimal level of salinity management is to be achieved.

5.4 Based on our examination of performance data provided by Catchment Management Authorities and expert commentary provided by our specialists, we confirm that performance against salinity management plan output targets has been variable. Regular reporting of the achievements against the targets set out in salinity management plans will become more important under agreements for Commonwealth National Action Plan funding. These agreements will link funding to the achievement of salinity and water quality targets. This, in turn, will ensure that comparable data are collected and reported on across the State.

5.5 The results of the Murray-Darling Basin Commission 1999 *Salinity Audit* indicate that implementation of the irrigation salinity management plans appear to be progressing well. The further evolution of the plans into land and water management plans, which include issues such as water quality, biodiversity and vegetation management, may require further development of the departmental planning guidelines, as the current draft guidelines (March 2000) are generally unsatisfactory for this purpose.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.5 Draft guidelines for salinity plans

The planning framework in Victoria has been well established, and includes Statewide planning policy documents such as the Victorian Salinity Management Framework and the draft Native Vegetation Framework.

In each of the 10 Catchment Management Authority regions, a Regional Catchment Strategy was prepared in 1997. This document sets the overall strategic directions in natural resource management for the catchment. Underpinning the Regional Catchment Strategies are the issue-based action plans such as the Salinity Management Plans and Land and Water Management Plans. Other action plans include Pest Plant and Rabbit Action Plans, Floodplain Management Plans and Water Quality Plans. These plans were prepared in response to detailed guidelines to ensure a consistent standard of presentation. These plans are widely acknowledged as being best practice in the Murray Darling Basin.

Draft guidelines are in preparation for the Second Generation Salinity Management Plans. The finalisation of the guidelines is awaiting the accreditation criteria for the National Action Plan for Salinity and Water Quality. Guidelines for the review and revision of the Regional Catchment Strategies are soon to be prepared, as there is a legislative requirement for those strategies to be updated by June 2002.

As a result of the introduction of the National Action Plan for Salinity and Water Quality, Second Generation Salinity Management Plans are not now due until June 2002.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.5

The comment on the evolution of Salinity Plans into all encompassing plans would seem to be inconsistent with the approach of governments (State and Commonwealth). The approach of governments is to have a Regional Catchment Strategy which is broad, and for underlying action plans to be developed (of which Salinity Action Plans are one) covering specific assets and threats. For example, the Victorian Government has initiated development of Regional Native Vegetation Plans since 1998. It is important that these action plans have strong linkages with each other but it is vital for Salinity Plans to remain focused on salinity. In the Mallee, recent decisions have led to 3 Irrigation Salinity Plans becoming more integrated, rather than broadening their scope to cover a much wider range of issues.

Meeting the revegetation targets set in the 2000 Salinity Management Framework

5.6 Over the past 10 years, the Department and Catchment Management Authorities have achieved most²⁸ of the revegetation targets in the State's 10 dryland salinity management plans; that is, revegetating an estimated 5 per cent of Victoria's dryland catchment area. However, the total 30-year revegetation targets set in the dryland salinity management plans of the early to mid-1990s are only a sixth of the estimated area now understood as needing revegetation. The revegetation target under the 2000 *Salinity Management Framework* is to cover 60 per cent of many catchments, which is about 20 times the revegetation achievements of the past decade²⁹. According to the Department there is still a long-term annual net permanent loss of 2 450 hectares of native vegetation on farms in Victoria because more trees are cleared than are planted.

5.7 By extrapolating the past 10-year revegetation achievements, we estimate that the Framework's revegetation targets will not be reached. Further achievement of the Framework's target for revegetating 50 per cent of "critical recharge areas" by 2015 will be open to interpretation because the Department has not defined or measured these "critical recharge" areas of the State's catchments. This lack of definition may have repercussions for the Department in terms of justifying future funding requirements for revegetation works.

5.8 The Department has not yet indicated how the Salinity Management Program will achieve the substantially higher revegetation targets required by the 2000 *Salinity Management Framework*. The Department is currently in the process of revising the 1997 *Private Forestry Strategy* and has been influential in promoting the plantation forestry industry. However, it has not fully developed the necessary incentives and other policy instruments or information to stimulate the scale of the revegetation works needed under the Framework. For example, the Framework has set a target for the Department of achieving a 70 per cent participation rate for landholders in Landcare by 2010. The target places a heavy reliance on voluntary labour for tree planting, but recent surveys by the Department place doubt on the Landcare movement's capacity to increase participation.

²⁸ Unmet 10-year targets for perennial pasture and native vegetation by Catchment Management Authorities and the Department are shown in Charts 4E and 4F in Part 4 of this report.

²⁹ The 2000 *Salinity Management Framework* revegetation target is 6 900 000 hectares, which is about 20 times the past 10-year revegetation achievement of between 317 488 to 364 453 hectares.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraphs 5.6 to 5.8 Policies to stimulate the scale of revegetation works needed under the Framework

The Department of Natural Resources and Environment acknowledges that the scale of revegetation required is an important issue. There is also the issue of strategic intervention in the landscape. Revegetation at a large-scale in some catchments will have a major impact on water yield and water quality. Research is currently being undertaken in this area.

Scientific knowledge is required to determine the appropriate area for revegetation that will return economic benefits to landholders and have a significant impact on salinity management. The Department of Natural Resources and Environment is currently conducting research in this area and utilising new information in determining on-ground actions.

The Department of Natural Resources and Environment has co-invested in a national consortium to develop a sub-catchment scale flow tube model which has the objective of analysing the level of intervention necessary in a given sub-catchment. This approach has been 12 months in development and training in its application is now underway.

The Draft Statewide Native Vegetation Management Framework has a Statewide goal of reversing the decline in extent and quality of native vegetation to achieve a Net Gain. Substantial revegetation will be required, in addition to native vegetation protection, to achieve this goal. Although the goal has a significant focus on biodiversity, the underlying principle of native vegetation management is to achieve multiple benefits and these include the amelioration of salinity impacts.

The Department of Natural Resources and Environment is currently preparing the Victorian Greenhouse Strategy which will build on and incorporate Growing Victoria's Greenhouse Sinks which included an extensive revegetation program using indigenous species as carbon sinks. This strategy will increase the revegetation effort primarily for greenhouse but will also provide salinity benefits.

Return on investment

5.9 Over the past decade, departmental records show that about \$353 million of Victorian and Commonwealth Government funds and an inferred \$1.4 billion in private contributions have been invested in the effort to manage and, until recently, control the salinity problem in Victoria. The Department estimates that implementation of irrigation salinity management plans over the past 10 years and for the next 20 years will achieve a \$2.5 billion improved net present value for Victoria in terms of the value of agricultural production in irrigation areas that would be forgone in the case of a “do nothing” scenario.

5.10 We found that measuring the outcomes resulting from the first decade of investment in the State’s 30-year Salinity Management Program is confounded by many practical, social, environmental and economic factors. For example;

- the long-term nature of management solutions under the program makes difficult even rudimentary estimation of outcomes after 10 years;
- the advent of new information, e.g. from hydrogeological studies and climatic trends impacting on the dynamics of groundwater systems complicate the attribution of salinity measures to the lowering of watertables;
- commercial incentives and commodity prices probably have a greater influence over changes in landuse management practice and the adoption of new agricultural pursuits than incentives offered by government programs; and

- long-term socio-economic change in rural Victoria has occurred for reasons other than specific government initiatives.

5.11 The Department of Natural Resources and Environment advised us:

Outcomes were set by each salinity management plan separately. These were derived by making a comparison between “with plan” and “without plan” scenarios. Most, but not all, salinity management plans made explicit statements of outcomes. In most cases, the development of outcome targets has been very difficult as we have been working with incomplete knowledge of how groundwater systems and soil/plant water interactions have operated.

The subsequent assessment of the attainment of outcome targets, like changes in area salinised, are notoriously difficult as there are large time lags, sometimes 50 years, between an action being taken and an impact being felt, and there are seasonal and climatic variations clouding the change that occurs. Data collection associated with determining impact is very costly. Examples of the sort of outcomes set for salinity management plans can be found on pages 72 and 73 of the Campaspe Dryland salinity management plan.

Improving knowledge of salinity processes and concern regarding the effectiveness of the originally proposed salinity control measures have prompted a renewed effort at setting objectives for each of the salinity management plans. A commitment was given in August 2000 to develop end of valley stream salinity targets in *Victoria's Salinity Management Framework – Restoring our Catchments*.

Targets for the implementation of salinity control measures were provided in each of the original salinity management plans and, following creation of the Catchment Management Authorities, in their regional management plans.

5.12 Given these complexities, we could not form a conclusion on whether appropriate outcomes have been achieved for the moneys invested in salinity management over the past 10 years. Further comments relating to evaluating strategy outcomes are contained in paragraphs 5.74 to 5.76 of this Part of the report.

COST-BENEFIT ANALYSES

5.13 In 1993 we recommended that:

- the Government develop clear guidelines for community working groups with regard to the valuation of environmental and social considerations when preparing salinity management plans; and
- future proposals for the establishment of evaporation basins should only proceed if it can be clearly demonstrated that productivity gains and environmental and social benefits exceed the economic costs involved in the development.

5.14 The Department of Natural Resources and Environment provided us with the following comment in relation to implementing our recommendations to place economic values on social and environmental considerations in cost-benefit analyses:

Guidelines for inclusion of social and environmental values

New guidelines “Using Multi-Criteria Analysis – A manual for ranking impacts of land and water degradation” was developed in partnership with the Victorian Catchment Management Council and issued to regional staff in 1997.

Further research has been conducted into environmental and socio-economic impacts, in partnership with the National Dryland Salinity management program, the Murray-Darling Basin Commission and Australian Bureau of Agriculture Research Economics.

The Department is currently developing an evaluation framework for the Second Generation salinity management plans, including a new cost-benefit analysis and guidelines for identifying environmental and social assets and placing non-financial values on these indicators. The new cost-benefit analysis refers not to a new format or style of cost-benefit analysis, but to a re-assessment taking into account updated data and understanding obtained in the 10 years since the original cost-benefit analyses. One particular change called for is that benefits of salinity control measures are to take account of changes in land use to higher value or more salt-tolerant crops, not just increased productivity of the original crop. This will be done as the second generation salinity management plans are prepared.

Evaporation basin development

Major irrigation infrastructure works require an Environmental Impact Assessment and appropriate cost-benefit analysis (that includes social as well as economic cost and benefits) and in many cases, proposals must comply with the Commonwealth’s *Environment Protection and Biodiversity Conservation Act 1999*.

5.15 Our inquiries revealed that, due to the costs and processes involved in following the 1997 Multi-Criteria Analysis guidelines, most regional staff discontinued multi-criteria analysis for ranking land and water degradation. A more recent development is a Geographic Information System (GIS)-based method utilising a “composite index approach”. The North Central Catchment Management Authority has used this method to rank priorities for action across 119 sub-catchments. The method relies on an index of social, economic and environmental values for catchment assets and is, therefore, not responsive to changes over time. The Department’s Centre for Land Protection Research is presently working in partnership with the North Central Catchment Management Authority to develop and implement a Salinity Decision Support Framework³⁰ for 20 sub-catchments by 2003.

³⁰ The Salinity Decision Support Framework is also referred by the Department and regional staff as an integrated catchment salinity risk and prioritisation tool (ICSRP).

5.16 Most salinity management intervention has revolved around biophysical solutions with some economic analysis to assist with the choice of options, but with little reference to the socio-economic context or analysis of the impact on communities and local economies. As a consequence, there is little understanding of the socio-economic impact of dryland salinity options, be they plant-based or engineering interventions.

5.17 Some of the environmental and social impacts of growing tree plantations and perennial pastures, such as reduced catchment water yield, socio-economic impacts on the size and viability of rural towns, loss of agricultural productivity and weed invasions of natural habitat by perennial pasture species used for salinity control, have only been identified in recent years and are not included in the cost-benefit analyses for salinity management plans.

5.18 Similar to other jurisdictions in Australia, the Department has experienced difficulties in placing values on the predicted social and environmental consequences of salinity management options. The Department advised us that it has elected to move towards describing social and environmental impacts rather than placing dollar values on these considerations. The assignment of economic values to social and environmental considerations has not reached the level of sophistication needed for cost-benefit analysis to fully support decisions for managing the salinity problem.

Position noted in certain authorities

5.19 In 1993 we recommended that a detailed analysis of the non-economic salinity benefits (i.e. environmental and social) be undertaken in the Goulburn Dryland sub-region, and a thorough analysis be completed of the social and environmental effects of salinity prior to the finalisation of other dryland plans.

5.20 In 1995-96 the Goulburn Broken Catchment Management Authority reviewed the revised Shepparton Irrigation Region Land and Water salinity management plan, based on an economic analysis using the *Guidelines for the Preparation of salinity management plans* (August 1988). The following considerations were detailed in the evaluation:

- the environmental costs of trees were included, however, their environmental benefits were uncosted;
- the cost of farm re-use systems was accounted for, however, the external benefits of a reduction in farm nutrient outfall to downstream users were not included in the analysis; and
- the ecological and socio-economic costs of the revised plan were not identified or evaluated.

5.21 The Authority concluded from its own analysis that after 5 years it was able to demonstrate that benefits have exceeded costs “showing a net present value (NPV) [Cost/benefit ratio] of 1:17 across the revised plan”. However, it also concluded that it was “still unable to demonstrate, with a high level of confidence, that the ecological processes have been maintained or enhanced”.

5.22 With regard to specific comments made in our 1993 Report on the need to analyse the non-economic salinity benefits for the Goulburn dryland plan, the Goulburn Broken Catchment Management Authority supplied the following information:

The detailed analysis recommended in the 1993 audit was not conducted, however, recent studies have been undertaken to analyse the costs, rather than the environmental and social benefits of managing dryland salinity.³¹

The preliminary costs of dryland salinity and high water tables in the Goulburn Broken region for damage to infrastructure and lost agricultural production were estimated by these studies at \$25.7 million per year. The actual cost will be higher when environmental, cultural heritage and socio-economic impacts are also taken into account. The final costings may provide a guide as to the level of investment of government and community resources justified for the Goulburn Broken region.

5.23 We believe the above costings would only provide a guide for public investment if it were possible to separate the benefits of undertaking action, otherwise there is the risk that the State will be investing with little net impact on the salinity problem. For instance, to assess whether current actions will recoup all the current costs, cost-benefit analyses should use the costs of actions and not just the current cost of degradation. Using this approach may show that the Goulburn Broken Catchment Management Authority, for example, should invest more in engineering solutions to protect infrastructure than on revegetation in some local areas.

5.24 Information provided by 9 Catchment Management Authorities indicated that detailed assessments of the environmental and socio-economic benefits of their dryland salinity management plans had not been conducted. The Corangamite and Mallee Catchment Management Authorities had undertaken broad environmental studies for their dryland salinity management plans, however, these were not detailed assessments of the impacts of dryland salinity in their regions. The Glenelg-Hopkins Catchment Management Authority advised us that there has been no real assessment of the cost-benefit of regional scale revegetation works undertaken in its catchment, or an assessment of the socio-economic implications.

³¹ Wilson, S. *The Cost of Dryland Salinity to non-agricultural stakeholders in selected Victorian and New South Wales Catchments*. Interim Report, Part 1 (June 2000).

Ivey, A. T. P. *The Cost of Dryland Salinity to agricultural landholders in selected Victorian and New South Wales Catchments*. Interim Report, Part 2 (June 2000).

5.25 According to specialist advice, because of the lack of environmental and socio-economic impact valuations in cost-benefit analyses and appropriate guidelines for measuring environmental and socio-economic impacts of salinity, the Government and community may now be faced with unforeseen costs, such as the cost to manage weed invasions or lower catchment water yields. The continued application of cost-benefit analyses without factoring in all social costs and environmental benefits, and the application of economic discount rates to decide on investment options, may not result in ecologically sustainable developments.

Recommendation

5.26 It is recommended that the Department invest in evaluative tools to measure the socio-economic, environmental and economic impacts of proposed salinity management options. This will provide a basis for sound decision-making in terms of identifying appropriate management options and establishing funding priorities.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.26 Evaluative tools to measure socio-economic and environmental impacts of options

Because of the inherent difficulty, if not impossibility, of objective comparisons of the various economic, environmental and social effects of salinity and other management measures, a generally accepted and easily applied methodology has not been found in Australia.

Salinity plan guidelines have generally required cost-benefit evaluations of major works, with qualitative consideration of ecological and other assets that are not susceptible to monetary valuation. The Department of Natural Resources and Environment accepts that conventional cost-benefit analysis is not adequate to handle all the assets at stake, yet the basic concept of comparing costs and benefits will remain central to our future evaluations.

Multi-criteria analysis is also accepted as a fundamental concept, since it provides for all the relevant criteria to be accounted for, although a particular formulation of it attempted by the Department of Natural Resources and Environment was found too demanding and time-consuming for regional communities to apply. However, elements of it remain relevant for Statewide investment allocation and the development of policy options.

Subsequently, several new approaches are being tried in the Department of Natural Resources and Environment:

- A project has been developing a generic decision support system based on multi-criteria analysis, with links to spatial data sets, and options for weighting different assets to enable trade-offs and help reach optimal decisions. The “Catchment Decision Assistant” has been trialled with a number of natural resource management issues: determining weed control priorities; determining areas best suited for various land uses; and identifying priority areas for revegetation. The application of the Catchment Decision Assistant is still quite laborious, data hungry, and not appropriate for all natural resource issues. The Catchment Decision Assistant is, nevertheless, available to groups wanting to use it, but has not been promoted widely among regional groups at this stage;*
- Another form of decision support system (or integrated catchment salinity risk and prioritisation tool) being developed by Agriculture Victoria Bendigo (Centre for Land Protection Research) is more oriented to prioritising catchments for salinity risk. This accesses spatial data sets which at present are bio-physical but are planned to be extended to economic and other environmental assets. It has been trialled quite successfully in North Central region; and*

RESPONSE provided by Secretary, Department of Natural Resources and Environment -
continued

- A further modelling approach is being developed in conjunction with the Murray-Darling Basin Commission. The Department of Natural Resources and Environment is developing information systems that will allow alternative salinity and other interventions to be compared and handle multiple outcomes that arise from most interventions in the landscape. The Landmark project, implemented in partnership with the Murray-Darling Basin Commission, employs a range of hydrology models that connect site with broader landscape impacts. The Department is currently applying models that estimate the change in water yield, change in recharge, change in river salinity, nutrient load and sediment and the change in biodiversity associated with different forms of intervention. This project also uses the Monash Multi Region Forecasting Model (Monash MRF) to estimate the impact that these landscape changes might have on factors such as the demand for labour and capital and the impact on economic output for regions within the State. There is potential for these models (hydrology-based, biodiversity and socio-economic) to be applied to evaluate salinity activities.

The Department of Natural Resources and Environment accepts that further development and integration of these efforts to establish an acceptable evaluation framework are needed as a matter of priority, and is currently engaged in work to ensure this happens.

Further research is being undertaken by the Department of Natural Resources and Environment in how a culture of information use can be better established within the Department and across the broader community. Transparency and trackability of decision-making are fundamental objectives of this research (Victoria Future Landscapes). This work is set within a broader community capability framework which recognises that the community will often hold implicit knowledge that can significantly add value to institutional knowledge.

STRUCTURAL RE-ADJUSTMENT AND LAND RETIREMENT

5.27 In our 1993 Report, we recommended that, in the process of formulating the salinity management plan for the Kerang Lakes sub-region, a decision be made on whether there is a need for:

- discussion of all significant salinity control options in salinity management plans, even those that may be regarded as unpalatable, such as the large-scale retirement of irrigated land;
- large-scale changes in agricultural patterns by removing water from unproductive soils and concentrating irrigated farming activity, salinity control measures and government funds on the most productive areas;
- long-term structural re-adjustment, for example, to a sustainable dryland farming industry or by concentrating irrigated agriculture on areas of high quality soils; or
- large-scale land retirement, relocating farming communities to more economically viable parts of the State.

5.28 In response to our inquiries about structural re-adjustment and land retirement in Victoria over the past 10 years, the Department of Natural Resources and Environment provided the following insight:

Land-owners are responsible for the management of retired land, and the *Catchment and Land Protection Act 1994* requires landholders to exercise a duty of care in relation to managing off-farm impacts. Government assistance is available to fence off highly saline land and to plant that area with salt tolerant plants.

The Government's approach is to facilitate voluntary retirement of degraded land and this is achieved by providing information about productive capacity of irrigated lands and establishing water markets to facilitate movement of irrigation water away from low value use. Other market drivers will increase pressures for change as irrigators recognise that they can no longer afford to apply water to low value irrigation activities.

This approach has resulted in structural adjustments in the Kerang and Tragowel Plains area, where the Loddon Murray 2000 program encouraged sustainable regional development as well as environmental outcomes with land retirement.

In relation to salinity management in dryland areas, there has been a strong movement away from a sole focus on revegetation activities to a focus on the sustainability of a particular farming system in a specific location. For example, the rate of perennial pasture adoption in south-west Victoria is closely related to the profitability of the wool industry and the climatic outlook for any particular year.

5.29 We were advised by the Department that long-term socio-economic change in rural areas had been occurring due to the changing demographics of country Victoria, particularly the ageing farm population, rural community decline and the rapid uptake of commercial opportunities in new agricultural and forestry industries. Our research indicates that the major land use trends in Victoria are:

- an increase in the area of land under cropping at the cost of annual pastures in the western and north-central regions;
- increases in rain-fed dairying in the higher rainfall foothills country of central and southern Victoria;
- increased horticultural, dairying and vineyard establishment in irrigation districts;
- increasing plantation forestry development in the high rainfall areas at the expense of grazing pastures in the west and south-west of Victoria, partly as a result of the removal of impediments as part of the 1997 *Private Forestry Strategy*; and
- the substitution of annual pastures by perennial pasture systems growing lucerne and *Phalaris*, albeit, mainly in Victoria's higher rainfall areas.

5.30 There is scope for expanding mechanisms for managing structural re-adjustment in dryland farming communities. For example, the Glenelg-Hopkins Catchment Management Authority advised us that long-term structural re-adjustment to a sustainable dryland farming industry has not been considered in its catchment. Opportunities had not been harnessed for managing recharge in high-risk salinity areas through direct rural re-adjustment. For example, at one end of the spectrum, according to the Victorian Catchment Management Council and certain staff members of the Department and Catchment Management Authorities, there is an opportunity to aggregate rural holdings and manage dryland salinity through sustainable farming systems that require large economies of scale to operate effectively. Sustainable agricultural systems such as grazing perennial pastures become more economically feasible when undertaken on a large-scale. In some regions large industry stakeholders also have a greater financial capacity to implement farm practices to promote agricultural sustainability, as well as environmental management and quality assurance systems. At the other end of the scale, small hobby rural holdings are becoming significant around major regional centres and are more likely to adopt tree-planting strategies for aesthetic, land stewardship or biodiversity purposes.

5.31 The feasibility of new markets for alternative farm industries based on increased water use-efficient farm systems, which are suggested in the 2000 *Salinity Management Framework* as potential salinity management solutions, have not been fully evaluated by the Department e.g. Mallee oil for alternative fuel production, lucerne as livestock fodder and saline water for marine aquaculture.

5.32 We were advised that there is a growing need for rural social support and counselling services for ageing farmers who may wish to retire from the land. This demand for rural counselling services is expected to increase if rural structural re-adjustment programs under the Salinity Management Program are implemented.

5.33 We could not find any guidelines for the management of retired land. Incentives and assistance are provided to identify more saline soils and to retire land from irrigation. Our specialists advised us that current incentives for land retirement are only applicable in irrigation areas. Such incentives comprise Transferable Water Entitlements where irrigation farmers can sell water that is destined for use on low production, salt-affected soils. In dryland rain-fed areas, individual farmers who retire land from production usually manage their land for other uses, such as planting native vegetation for biodiversity enhancement. It was encouraging to find that the Wimmera and North East Catchment Management Authorities had initiated Rural Land Stewardship Programs, which aim to encourage the alternative uses of land in dryland areas, for example, through the promotion of revegetation to reduce recharge³².

³² The Wimmera and North East Catchment Management Authorities are implementing land stewardship schemes to encourage and facilitate a change in environmental ethics for participants, e.g. towards ecologically sustainable land management practices, and to apply regional approaches to biodiversity conservation.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.31 Investigating the feasibility of new markets

Victoria has contributed to a project under the National Dryland Salinity Program called Options for the Productive Use of Salinity (OPUS). The draft report was made available in December 2000. This analyses the market potential and prospects for options such as saltbush, date palms, fish, seaweed and salt harvesting. Significant developments in salt harvesting technology have been made under Victoria's research work aimed at improving the sustainability of Lake Tutchewop evaporation basin.

In addition, the Department of Natural Resources and Environment's Private Forestry program seeks to promote the multiple benefits of plantation development. The Department of Natural Resources and Environment and private companies have developed a project proposal for an industrial venture growing blue mallee for eucalyptus oil, activated carbon and electricity and associated landcare benefits.

Paragraph 5.33 Guidelines for the management of retired land

There have been a number of plans for use of retired land in specific regions, although the Department of Natural Resources and Environment recognises that there are no guidelines on a Statewide basis. However, the Department of Natural Resources and Environment has embarked on developing a Statewide approach through its Land Stewardship program. A steering committee has been established with representation from Catchment Management Authorities, the Victorian Catchment Management Council and the Department of Natural Resources and Environment Regions.

Work in specific regions has included:

- *plans in the Goulburn Broken catchment in the mid-1980s;*
- *Tragowel Plains guidelines for use of unproductive land for growing halophytes;*
- *work underway in the Tambo Valley;*
- *investigations by North Central Catchment Management Authority and Goulburn-Murray Water which have led to a major pilot project reviewing policy options for retirement of land that is no longer suitable for irrigation; and*
- *work on land stewardship with Wimmera (relating to steep hill country) and North East Catchment Management Authorities(as acknowledged in audit text).*

Other land stewardship-type options being explored include the creation of markets for the purchase of ecosystem services such as biodiversity and catchment water quality. The Ecosystem Services Project - a joint initiative by the CSIRO, the Goulburn Broken Catchment Management Authority, Land and Water Australia and the Myer Foundation - is working to describe the value of Australia's ecosystem services. This is an important step toward development of opportunities for landholders to receive payment for dedication of land for ecosystem services through private sector investment.

Private forestry plantations

5.34 The former Government established the Private Forestry Council of Victoria in 1998 to advise the Minister and, with the State's 4 regional plantation committees, to implement national and state private forestry policy in Victoria. The Council is reviewing the Government's 1997 *Private Forestry Strategy* with the aim of creating sustainable private forestry growth. There is potentially over 6 million hectares of farmlands in Victoria with an average rainfall of 600 millimetres per year or greater, which is suitable for private forestry. A further 2 million hectares of farmlands has an average rainfall of 500 to 600 millimetres per year that is sub-optimal for plantations but may be suitable for planting with specialty timbers.

5.35 In 1999-00 there were 25 326 hectares of commercial hardwood plantations established in Victoria. Now these plantations cover 284 575 hectares, comprising 219 197 hectares of softwood and 65 378 hectares of hardwood. A further 28 800 hectares of hardwood and 1 983 hectares of softwood plantations are proposed for 2000-01.³³ The majority of these plantations are large industrial plantations to supply woodchips to the Japanese paper industry. The Private Forestry Council has found that if plantation and farm forestry continues to expand at its current rate, the private forestry industry will be worth \$6 billion in 2020 and will create 10 000 jobs in rural Victoria.

5.36 To maximise forest yield, private forestry plantations for timber are generally established in higher rainfall areas, that is, with an average rainfall greater than 800 millimetres per year. In these areas, trees do not reduce groundwater recharge and therefore do not significantly reduce salinity. In high rainfall regions, plants do not have the capacity to utilise all of the rainwater that falls and surplus water evaporates, becomes surface run-off to enter streams or leaks past the plant root zone and recharges the groundwater system.

5.37 In lower rainfall areas, revegetation of the scale envisaged may have a positive effect on salinity by lowering the watertable, but may have a short-term detrimental effect on surface water yield because the higher water using plants used in revegetation will intercept a higher proportion of the rainfall and significantly reduce runoff from reaching streams and dams. A reduction in stream volumes through reduced surface runoff will increase stream salinity in the short-term. As well, incentives will be required if there are to be tree plantings in sub-commercial environments, such as the 500 to 600 millimetres per year rainfall zone, because such areas cannot support a profitable tree plantation industry due to lower, unreliable growth rates.

³³ Source: Bureau of Rural Sciences, National Plantation Inventory, Tabular report, March 2000.

5.38 The Government may need to provide an incentive for trees to be planted in areas that are not commercially viable but would assist salinity management. Our specialists advised us that the incentives that would be required now might be substantially greater than the value of the salinity benefit. Carbon credits, which are a form of currency in an economic market yet to be created to control the global emission of carbon dioxide, could be a lever to encourage plantings in sub-optimal rainfall regions. However, the costs of establishing private forestry in lower rainfall areas may exceed total benefits from salinity reductions and carbon credits. Artificial market mechanisms involving government regulation and the establishment of markets for salinity credits, or tradeable permits for grants (whereby landholders are funded on the basis of their offers to conduct works in natural resource management) have not been tested at the scale that would be required to meet the targets of the 2000 *Salinity Management Framework*. In addition, the implementation issues have not been fully explored.

Recommendations

5.39 We recommend a thorough investigation of the potential impacts of policy instruments and commercial incentives for Victoria's private forestry industry on total catchment water yield, socio-economics of regional areas and the environment.

5.40 Given that the main thrusts of the State's 2000 *Salinity Management Framework* are the introduction of sustainable alternative land use practices across the dryland agriculture areas and Victorian rural communities must adjust to the rate of change, it is recommended that:

- greater focus be placed on providing support services for landholders and other members of the rural community adversely impacted by structural re-adjustment associated with managing the salinity problem; and
- long-term trends in land use change be monitored to identify opportunities for multiple benefits.

KNOWLEDGE BASE AND RESEARCH CAPACITY

5.41 As discussed earlier, the salinity problem, particularly in Victoria’s dryland areas, is worsening i.e. groundwater is rising and there is evidence of increased salting of the State’s land and capital resources, and deteriorating water quality in some of our streams. We were informed by our specialists that for irrigation areas the extent of the problem, management options and salinity impacts are relatively well, but not fully, understood and further investment in salinity management is justified by the high economic and social value of irrigated agriculture. Given the gains already made, there is a challenge ahead to maintain this impetus and continue to build the knowledge base in salinity management in irrigated areas. However, research shows that for dryland areas there are large uncertainties about the extent and impact of the salinity problem, the management options available and their effectiveness of these options in different regions. Furthermore, because of the lead times required for reducing the impacts of salinity through plant-based solutions, a “no-action” response is not appropriate.



*An example of a discharge site, the result of dryland salinity.
(Photograph courtesy of CSIRO Land and Water Division.)*

5.42 The Department of Natural Resources and Environment provided the following view of Victoria's research capacity in salinity, land and water management:

Victoria is a national leader in salinity research. Our investment in groundwater and agronomic research has resulted in a strong understanding of salinity processes and management options.

There has been a progression to a program that looks at all 3 aspects of salinity management - the biophysical, the social and the economic. This has required a diversification in our approach to research, to extension and to monitoring and evaluation.

There have been many assumptions made throughout the salinity program. In dryland areas, plan implementation proceeded on the basis of a "no regrets policy". Revegetation activities were supported because of multiple benefits generated and, as better information became available, targeting of these activities was refined. Through our evaluations and reviews, we have discovered that our reliance upon perennial pastures to solve the problem of dryland salinity was not appropriate. Landholders are not always able to manage pastures for maximum water use because of stocking numbers due to commodity prices and general farm management.

Trends in the agriculture industry are increasingly recognised as being a major factor in the adoption of salinity management practices. The wool industry downturn in the early 1990s limited the ability of farmers to invest in recommended works. Conversely, the expansion of the dairy industry has facilitated investment in water efficiency technology in irrigation areas.

The social implications of salinity management are now better understood than they were 12 years ago. Research is now directed into social science and understanding the demographics of the "community". This will help with the targeting of extension and incentive packages. It will also assist in improving the understanding of the social impacts of dryland and irrigation salinity.

5.43 We acknowledge the Department's view that salinity is not managed as a single issue and should be managed to deliver multiple benefits as part of the natural resources management program for the State. The Department has identified various challenges that lie ahead in understanding catchment processes:

- *"To further our understanding of the extent of the existing dryland salinity problem"; and*
- *"Although the identification of management options based on the degree of salt risk is critical to future land use investment decisions, its practical application is currently hampered by limited information on the socio-economic and environmental impacts of different management options, and the biophysical characteristics of some environments".³⁴*

³⁴ 2000 *Salinity Management Framework*, Government of Victoria, August 2000.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.41

The knowledge gap in dryland catchments is particularly relevant to the North East. The region receives little financial support from the State to investigate the dryland salinity mechanisms relevant to the area.

Lake Tutchewop

5.44 In our 1993 Report, we recommended that, if Lake Tutchewop was to be used as an evaporation basin, the research program proposed in the draft Kerang Lakes plan should be dramatically accelerated in order to expedite recommendations aimed at:

- preventing any further environmental damage to Lake Tutchewop;
- minimising the costs of salt disposal to be borne by future generations;
- avoiding any potential adverse consequences facing the sub-region from greater salinity in the area due to increased leakage from the Lake; and
- the research program for Lake Tutchewop to encompass the lakes used as evaporation basins in the Tresco and Woorinen areas.

5.45 The Department of Natural Resources and Environment provided the following details of the past and future management of the Lake Tutchewop salinity evaporation basin system:

The original tasks in the research program were not necessarily accelerated, but a new project to research methods of minimising degradation of Lake Tutchewop was begun by the Department of Natural Resources and Environment, with additional separate funding from Strategic Investigations Research Fund. Hence timelines for the original tasks were not necessarily changed. The final salinity management plan recognised the importance of ensuring that the Lake Tutchewop evaporation basin continued to operate into the future. The management of Lake Tutchewop will be undertaken by the Murray-Darling Basin Commission commencing 2001, as part of its *Salinity and Drainage Strategy*.

The Government, in partnership with the Murray-Darling Basin Commission, has undertaken feasibility studies aimed at ensuring cost-effective salt disposal options are available in the future. In partnership with the Murray-Darling Basin Commission, the Department of Natural Resources and Environment has been supporting research programs to explore commercial options for processing salt from evaporation basins. Salt harvesting will maintain the Lake Tutchewop's evaporative capacity and there are engineering options with extra ponds to extend its life by 50 years.

The area surrounding Lake Tutchewop is constantly monitored to measure the impact of any leakage. Detailed hydrogeological investigation and research undertaken in 1995-1997 indicated that leakage from Lake Tutchewop was minimal and that current drainage disposal management priorities, while offering Murray River water quality protection, would lead to reduced evaporative capacity within 30 years.

The investigation of commercial-scale development included an audit of “opportunities” at other disposal basins throughout the Murray-Darling Basin. The audit identified the total availability of accumulated salt loads and the effectiveness of the Lake Tutchewop system in reducing salt loads to the Murray River. Based on the audit findings it was decided to confine future salt interception works to developing the Lake Tutchewop system.

5.46 The North Central Catchment Management Authority advised us that the Draft Kerang/Swan Hill salinity management plan included a number of recommendations in relation to restoring the environmental qualities of Lake Tutchewop, however, in recognising the importance of the Lake as an evaporation basin, they were rejected by the Government.

5.47 North Central Catchment Management Authority supplied the following information:

The alternative operational plan for Lake Tutchewop involves using the disposal basins in a series rather than individual lakes (i.e. Lakes Tutchewop, Little, Kelly and William) as terminal basins. The plan involves improving water quality in Lakes Little and Kelly, maintaining Lake Tutchewop salinity levels such that its environmental value as a saline wetland is maintained and using Lake William as a final salt disposal basin. Lake William’s environmental values will therefore decline.

The purpose of this approach is to extend the overall evaporative capacity of the Tutchewop system for an additional 80 years. The availability of new technical and market-based processing systems would be further evaluated during this time.

The research program for Lake Tutchewop was not widened to encompass the lakes used as evaporation basins in the Tresco and Woorinen areas because the program, conducted in partnership with the Murray-Darling Basin Commission, focussed on commercial options for ensuring long-term sustainability of evaporation basins. Lake Tutchewop was selected as part of this program because of its high, accumulated salt load.

5.48 There were several public interest issues surrounding the conservation of Lake Tutchewop in 1993. For instance, authorities advised us in 1993 that Lake Tutchewop would be used in the short-term (up to 10 years) as a salinity evaporation basin³⁵. The thrust behind our recommendation for further research at Lake Tutchewop was to determine an approach for the lake’s rehabilitation following its use as an evaporation basin. However, Victoria’s agreement with the Murray-Darling Basin Commission in October 1993 to commit to the Murray-Darling Basin *Salinity and Drainage Strategy* provided the opportunity to plan future irrigation development through salinity credits generated by the continuation of the Lake Tutchewop salt interception scheme.

³⁵ *Salinity*, Special Report No 19, Victorian Auditor-General’s Office, March 1993. Lake Tutchewop was initially planned as a temporary salt evaporation basin, to be restored to its natural state after 10 years.

5.49 In our opinion, the Lake Tutchewop issue illustrates the difficult decisions and trade-offs that have been made between opportunities for future economic development and the choice of preserving significant environmental values. If the evaluative cost-benefit model under development for future salinity management options were to require economic values to be placed on environmental considerations, it would enable difficult decisions involving such trade-offs to be based on more robust information.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraphs 5.44 to 5.49 Lake Tutchewop and evaluation of economic and environmental trade-offs

Owing to the importance of Lake Tutchewop to the Murray Darling Basin, the Department of Natural Resources and Environment successfully negotiated that the Murray-Darling Basin Commission be responsible for the long-term sustainable management of the Lake. This includes the Department of Natural Resources and Environment working closely with the Murray-Darling Basin Commission and Goulburn-Murray Water to establish a salt harvesting scheme to sustain the long-term evaporative capacity of the Lake and to hold down salinity levels to protect its Ramsar wetland values. This process included a detailed Environmental Impacts Assessment (EIA) under the auspices of Environment Australia. This assessment also established the desired salinity thresholds to preserve the Ramsar values.

More generally, environmental assessments are routinely conducted before undertaking salinity projects that impact on environmental values including wetlands, with the scale of EIA depending on the importance of the wetland or nature of the project. Where “matters of national environmental significance” (NES) are involved, an EIA is a requirement of the Commonwealth Environmental Protection and Biodiversity Conservation Act 2000. Ramsar Wetlands and listed migratory species are matters of NES.

The environmental assessment and cost-benefit analysis are integrated as part of the overall project evaluation. At this stage, the Department of Natural Resources and Environment does not believe that there are acceptable methods to assign dollar values to environmental values. However, the evaluation tools referred to under paragraph 5.26 should assist in informing trade-off decisions such as in this case.

Statewide salinity register

5.50 One of the important recommendations contained in our 1993 Report was that consideration should be given to the development of a Statewide salinity register to ensure that funding is directed to salt affected areas requiring immediate attention.

5.51 The Department advised that salinity maps of biophysical data are a means of directing funds to salt-affected areas requiring attention at a catchment or sub-catchment level. For example, the Centre for Land Protection Research in Bendigo maintains a database of dryland salt affected areas, while the Institute for Sustainable Irrigated Agriculture at Tatura maintains a more detailed database for irrigation areas that comprises results of soil salinity surveys. However, the thrust of our recommendation was for a broader register of the social, economic and natural assets in this State threatened by salinity. Soil salinity surveys for irrigation regions and maps of salt-affected dryland areas cannot by themselves inform government-level decision-making because there are many other social, environmental and economic values that need to be considered.

5.52 Investment in dryland salinity management has a lengthy payback period, which tends to make the benefits, in the short-term at least, economically unattractive. Expert opinion provided to us indicated that, in those areas where salinity is to be contained, there might be a case for implementing salinity control options that are shown to be uneconomic in an attempt to safeguard assets of high intrinsic value. Some States in Australia (e.g. Western Australia) have moved towards asset identification and protection strategies in these areas. Victoria has not yet identified private and public infrastructure or biodiversity assets at risk. There is a clear need to undertake asset valuation and identification of priorities for asset protection as a basis for future salinity management.

5.53 It is important that the next generation of salinity management plans should take a stronger perspective on the risks in the next 20 to 50 years to ensure that future policies are targeted at those economic, environmental and social assets that the Victorian community most wants to protect. Assets would include the lakes and wetlands at risk from salinity, e.g. as identified in surveys by the Department of Natural Resources and Environment - Parks, Flora and Fauna Division³⁶. The focus of the Plans should be to protect the high value assets in conjunction with the adoption of an all-encompassing management approach.

5.54 A centralised asset identification and value system would be appropriate for setting Statewide funding priorities between catchments. Based on what is now known about the potential extent of dryland salinity in Victoria, over the past decade the most potentially threatened dryland salinity areas of the State may not have received an appropriate share of funding to address salinity problems. A more complete understanding of salinity impacts may have led to a different funding allocation. We note that the Commonwealth Government's National Action Plan for Salinity and Water Quality will be focusing additional funds on the 4 catchments in Victoria most at risk, namely, the Glenelg-Corangamite, Goulburn-Broken, Avoca-Loddon-Campaspe and Lower Murray catchment regions.

³⁶ The desk-top survey by Department of Natural Resources and Environment, Parks Flora and Fauna Division "Stocktake for Murray-Darling Basin Commission of values and assets to be protected from salinity" only covers the wetlands in the Murray-Darling Basin. There has not been a Statewide comprehensive study of salinity risks to wetlands.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraphs 5.50 to 5.51 Statewide salinity register

The Department of Natural Resources and Environment understood the thrust of the Victorian Auditor-General's 1993 recommendation to be calling for "... a salinity register consolidating the salt-affected land and water throughout the State" (Paragraph 8.21, p. 130 of 1993 report). This has been addressed by the database and mapping work for dryland and irrigation areas referred to in the follow-up audit report.

The Department also sees merit in developing a broader concept of the register of assets threatened by salinity, such as agricultural, infrastructure and ecological. This is being developed in work by the Centre for Land Protection Research, related to the decision support system referred to under paragraph 5.26 above. The Australian Dryland Salinity Assessment 2000 has assisted in the development of an asset register across Australia.

Paragraphs 5.52 to 5.54 Use of register of assets at risk from salinity in allocating funds

Consistent with its integrated approach to catchment management, the Department is developing a database of assets threatened by any processes, and the corresponding threatening processes, including salinity, grazing, erosion, acidification and weed infestation, would be linked to the asset database. The Department of Natural Resources and Environment has spatial datasets indicating the severity of such threats across the State, but there is a further need to identify assets other than biodiversity values, including infrastructure and social assets at risk. The decision support system referred to under paragraph 5.26 will assist in this process.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.54

It is noted that the NE Catchment Management Authority region is not a priority catchment within the National Action Plan for Salinity and Water Quality proposed by the Commonwealth. This will seriously affect the ability of the region to implement catchment improvement programs that will reverse the dryland salinity trend in North East Victoria. The North East catchments produce some 38 per cent of the water within the Murray-Darling Basin, however, these catchments are not proposed to receive support through the National Action Plan process.

Research underlying decision-making

5.55 The Department has allocated past dryland salinity expenditures (strategies) on a “no regrets” basis and options for on-ground actions on the “best bet”. The “no regrets” approach meant that the Department would invest in dryland salinity management options without knowing for certain the long-term effectiveness of the treatments undertaken. The “best bet” approach was used for targeting local actions in areas where there was little understanding of landscape processes and hence, the potential effectiveness of the measures implemented. Generally, dryland salinity measures were implemented even though the level of understanding of catchment processes across Victoria was limited. With the benefit of hindsight, an undesirable outcome of this approach has been demonstrated by recent departmental research, which shows that funds disbursed through the Land Protection Incentives Scheme³⁷ for the establishment of perennial pastures in higher rainfall areas (greater than 600 millimetres per year³⁸) would have been wasted in terms of providing any reduction in groundwater recharge.

5.56 We found the approach particularly influential in data-poor areas, that is, in regions that have not had a long history of dryland research activity. Discussions with the Glenelg-Hopkins and Corangamite Catchment Management Authorities, for example, revealed that based on the “best bet” approach they had positioned revegetation works over critical recharge areas, rather than wait for research to fully inform their decisions. New biophysical data and recent hydrogeological studies indicate that practices such as planting trees and perennial pastures based on visual assessments of where the rainfall collects, or on hill tops, may have been ineffective as salinity control measures for different locations within these regions.

5.57 The Department reported that Victoria has had a strong presence in national irrigation salinity research and has Australia’s largest irrigation research facility in the Tatura Institute for Sustainable Irrigated Agriculture. Our specialists advised us that in terms of dryland salinity research, however, Victoria does not have a broad intellectual resource base and there has been a diminishing research capacity over the past decade. Targeted research and applied investigation in those areas identified in recent reports³⁹ as critical to the success of future salinity management (such as research of catchment processes at the local-scale and viable sustainable agricultural solutions) are essential, preferably through appropriate levels of technical support across the State.

³⁷ Verification of the order of the funds so expended was not within the objectives or scope of this audit. Grants of up to \$100 per hectare for the establishment of perennial pasture are available under the Land Protection Incentives Scheme.

³⁸ The maximum potential area of agricultural land with average annual rainfall over 600mm a year in Victoria is 6 million hectares, of which a maximum of 2.6 million hectares is already planted with perennial vegetation. The State’s 10 dryland salinity management plans have a 30-year target for perennial revegetation of 1 049 445 hectares and authorities had achieved 298 240 hectares planted between 1990 and 2000.

³⁹ For example, Murray-Darling Basin Commission *Salinity Audit*, 1999; National Land and Water Resources Audit *Australian Dryland Salinity Assessment*, 2000, Natural Heritage Trust.

5.58 Due to the complexity of the dryland salinity problem, there is a significant knowledge gap in relation to future salinity impacts, i.e. economic, social and environmental impacts. The Department has researched plant-based solutions for dryland salinity for some time. However, according to our specialists, this effort has not been as comprehensive as national approaches. National approaches under the National Dryland Salinity Program involve a co-ordinated research effort between research bodies such as the CSIRO, State agencies, private industry and universities to develop new, sustainable agricultural practices that help to reduce recharge. In our view there is scope for the Department to improve the level of understanding of plant-based solutions, their applicability across Victorian landscapes, feasibility and salinity benefits at both local and regional scales. The announcement of a Co-operative Research Centre for plant-based solutions for dryland salinity to be co-located in Victoria, will help to address these concerns.

5.59 In relation to dryland salinity there is a need to quantify the impact of interventions and their response times. Our review of research literature suggests that most of the known, researched solutions have not been tested for their suitability or adaptation to Victoria's local areas and conditions. There is no single plant-based solution that is applicable across all regions and all biophysical conditions. Our specialists advised us that the Department has a good understanding of the large, biophysical issues but more research is needed on other issues, ranging from growing lucerne to extracting magnesium from salt. In the next few years, the Department and Catchment Management Authorities should allocate resources to innovative research, particularly, matching salinity management options with knowledge of land systems and groundwater processes at a local level.

5.60 Victoria helped to develop the methodology for the conduct of the Murray-Darling Basin Commission *Salinity Audit*. Our specialists' advice confirmed that the modelling techniques adopted were sound, within the limitations and assumptions stated, and were based on the best available information at the time. There is potential for further methodology development to advance these techniques and build scientific consensus on the future extent of the salinity problem.

5.61 We were informed that the long-term effects of climatic changes on catchment hydrological processes would mask, in the short-term, the landscape's hydrologic response to changed land use. For example, in recent years, drought conditions have led to lower watertables and the reverse would apply during wetter periods. Fully understanding these influences, and being able to separate positive salinity trends caused by land use change from climatic effects, are key questions to understanding the effectiveness of management solutions.

5.62 Knowledge generation is identified as a key requirement of the 2000 *Salinity Management Framework* and the Department has been building its knowledge base. This knowledge base would be strengthened by an increase in access to expert resources and greater involvement of independent research bodies such as universities and the CSIRO. A key issue for the Salinity Management Program is achieving the appropriate balance between research, planning, resources to support implementation and on-ground works. A strong case can be put that, due to the high level of uncertainty, further investment in planning, support of implementation and research is required.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.55 Best-bet approach

The “best bet” approach was adopted as a reasonable approach in an environment of partial knowledge. By its nature, it may have led to revegetation works in some areas which later prove to be of limited effectiveness. The “best bet” proposals in the early salinity program were based on the research and information nationally available at the time in the 1980s. Given the continued damage from rising watertables, it is not sensible to wait for full knowledge before taking some actions.

Our scientific knowledge of groundwater processes has evolved much since the early salinity program, but is still incomplete. It may take 20-50 years before the evidence of effectiveness can be seen in some catchments. The term “waste” is not appropriate when describing a program in its infancy in terms of knowledge and action on the ground. The important issue is that Victoria has identified the less effective actions on the ground and has moved to a more strategic and targeted approach. For example, since the completion of the Murray-Darling Basin Commission Salinity Audit, Victoria has a much better understanding of the impact of dryland salinity on the Murray River in Victoria. Programs are now targeted to reduce inflows to the Murray in critical areas.

This example reinforces the need for the 5-yearly review process that was undertaken for all of the salinity management plans, as well as supporting the requirement for second generation salinity planning.

Initiating “best-bet” on-ground actions also promotes social benefits in terms of community awareness and engagement which need to be accounted for. The Government and the community in partnership have been through a learning experience and as a result, the partnership has been strengthened and the knowledge base increased. There has been no false expectation from the community that the Government has all of the answers at hand, and the community has accepted responsibility for discovering and developing some of the management options.

Paragraph 5.57 Diminished research capacity

Some reduction in State funding for research has possibly occurred in the last decade in line with increasing community pressure for smaller public sector budgets and a complex of other drivers. They include the declining attractiveness of science to students, the demographic profile of public service recruitment, the relative attractiveness of private sector employment and an earlier belief that some areas of biophysical research were no longer the strategic priority of government.

At the same time, there has been a broadening of the research agenda to include wider issues - social and economic, in addition to biophysical science. Other initiatives, such as decision support, risk analysis, market-based mechanisms, modelling, planning provisions and private sector investment have demonstrated that a higher level of process understanding and fundamental data collection is required to meet acceptable confidence intervals.

RESPONSE provided by Secretary, Department of Natural Resources and Environment -
continued

Rather than disappearance of research capacity, it has partly involved a transfer of scientists such as groundwater specialists to the private sector. Thus the resources remain available in a competitive market, although there are trade-offs such as a potentially less integrated viewpoint.

The Department has countered this effect to some extent by investing in collaborative research arrangements at a national and international level. The Department continues to contribute to, and derive benefits from, these collaborative arrangements.

At a State level, research capability has been enhanced through the development of close links and organisational structures that span the Department of Natural Resources and Environment research base. This organisation of the research capability represents a significant increase in research capability in many disciplines, and has the potential to place a floor under the research disciplines that have been in decline.

Paragraph 5.59 Testing known solutions for suitability to Victoria's local conditions

The Department accepts that plant-based systems have not been tested comprehensively. Nevertheless, there are good examples of the sub-catchment trialing of research, such as trees and lucerne at Burke's Flat, Marnoo, a paired catchment trial of deep-rooted vegetation at Great Western, and a network of agroforestry trials in different areas across the State. Resources are limited, and research must to some extent compete with extension and implementation works, with the result that it has not been possible to fund research for every local land type. Regional communities have a strong influence in the salinity program, and in the early stages of the program were reluctant to support extensive research at the expense of on-ground works.

Victoria can expect to obtain research benefits from partnerships it has developed with the CSIRO, other States and national level bodies. The National Dryland Salinity Program, Co-operative Research Centre for Plant-based Management of Dryland Salinity and Co-operative Research Centre for Catchment Hydrology are illustrations of partnerships where Victoria can get greater value by contributing to joint research programs, both to obtain national research results and applications for Victorian catchments.

Devolution of funding and responsibility for strategic planning to regions through the Catchment Management Authorities can be expected to promote research on appropriateness of management options in local conditions.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.55

The region supports an integrated approach to land and water management, which includes both trees and perennial pasture. It is too early to determine if the "best bet" approach has been ineffective. Social benefits, awareness and community engagement are critical to the success of the entire program, along with biophysical benefits.

Paragraph 5.59

The Catchment Management Authority supports the need for innovative research, however, without access to adequate resources for research, the North East will be disadvantaged.

RESPONSE provided by Chief Executive, Wimmera Catchment Management Authority

Paragraph 5.59

The Great Western Trial Site is a scientifically robust paired catchment project established in 1996 with partnership between State Government, regional authorities and the local landholders. It compares best salinity management practice for the upper Wimmera of perennial pastures on the lower and mid-slopes and native vegetation on the upper slopes to the control catchment, which remains as annual pastures. It is an excellent example of known solutions being trailed in local conditions.

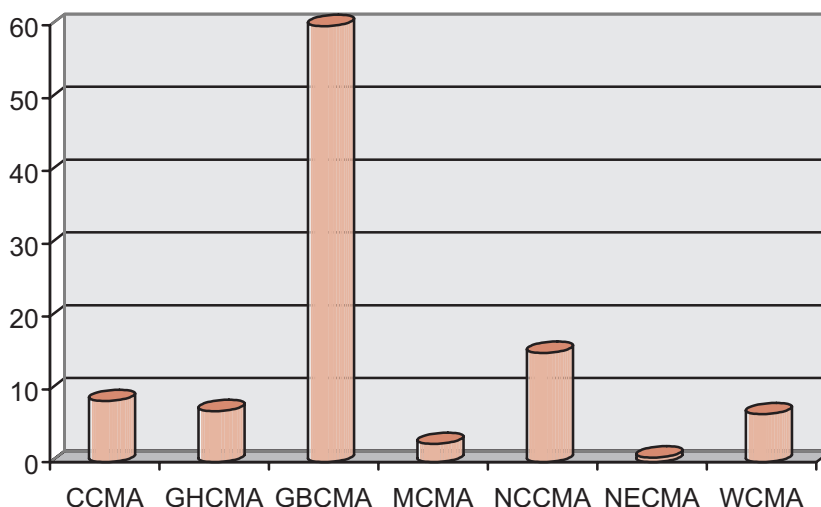
Salinity management plans

5.63 Victoria's groundwater processes, recharge and discharge areas are mapped by the Department of Natural Resources and Environment at a regional catchment-scale and in many cases at a sub-catchment level. This information was used as the basis for developing salinity management plans for dryland and irrigation regions. Assessment of the plans through the Government-endorsement process was used to determine the most significant regions for investment. There was limited targeting of actions within regions, other than according to broad land management classes.

5.64 The basis for prioritising funding between salinity management plans at a State level is not apparent and priorities set by the Department have remained relatively static over the past few years. For example, Chart 5A indicates that the Goulburn Broken and North Central Catchment Management Authorities, which include the State's main irrigation districts, received more salinity funding over the past 10 years than the Corangamite, Mallee, Wimmera, North East and Glenelg-Hopkins Catchment Management Authorities, which cover a majority of the State's dryland agricultural areas⁴⁰. It does not appear that these funding differences reflect the relative salinity problems and comprehensive asset valuations in these regions, although we concede that this disparity may be an outcome of a lack of knowledge and uncertainties about the actual scale of dryland salinity before 1998-99.

⁴⁰ In 1999, there were 619 300 hectares of agricultural land under irrigation in Victoria, compared with 12 million hectares of dryland agricultural farmlands.

CHART 5A
STATE FUNDING FOR THE SALINITY MANAGEMENT PROGRAM BY
REGION, 1990 TO 2000
 (\$million)



Abbreviations:

CCMA – Corangamite Catchment Management Authority, 1990-91 to 2000-01.

GHCMA – Glenelg-Hopkins Catchment Management Authority, 1990-91 to 1999-00.

GBCMA – Goulburn Broken Catchment Management Authority, 1990-01 to 1998-99.

MCMA – Mallee Catchment Management Authority, 1992-93 to 1996-97.

NCCMA – North Central Catchment Management Authority, 1990-91 to 1999-00.

NECMA – North East Catchment Management Authority, 1994-95 to 1999-00.

WCMA – Wimmera Catchment Management Authority, 1990-91 to 2000-01.

Source: Catchment Management Authorities, 2001.

5.65 One mechanism used to determine priorities for action between sub-catchments is to set “end of valley” targets, which focus the attention of managers on a tangible and measurable outcome. This mechanism will be implemented as part of the 2000 *Salinity Management Framework* and through the State’s Salinity Management Program. However, the setting of these targets is difficult, given the lack of information on catchment processes and the effectiveness of management options. There is a need to increase certainty in the end-of-valley targets and the costs of achieving those targets that have already been established. The uncertainty regarding the quantum of the problem means there is a risk that Victoria could be committing to targets under the Murray-Darling Basin *Salinity Management Strategy* without a clear understanding of the investment that will be required to meet them. A more objective basis for prioritising investment between salinity management plans and catchments and in setting water quality targets, is an asset protection approach, which recognises the social, environmental and economic value of assets to be protected.

5.66 The Department is currently reviewing all salinity management plans in light of new information about the broader, long-term impacts of dryland salinity on Victoria's land and water resources. The review will result in new land and water management plans, labelled "second generation plans" by the Department. That review, and development of sound and comprehensive second generation plans, are essential to the next stage of the Salinity Management Program. The plans, however, will only be as good as the research, resourcing and expertise used to develop them. It is not clear whether adequate provision for this purpose has been made at this time.

Recommendations

5.67 We recommend that:

- the level of research, planning and implementation support be increased in those areas identified as deriving the greatest benefit;
- future actions should:
 - be determined according to the value of assets, the benefits of intervention, the cost and how long it will take for the options to result in a benefit; and
 - include a risk appraisal of the problem and management options;
- the Department, in partnership with the Victorian Catchment Management Council and Catchment Management Authorities, establish a centrally accessible Statewide salinity register to help identify catchment assets at risk from salinity impacts and to inform decision-making, funding assessments and funding allocation processes;
- the aggregated Statewide targets of the 2000 *Salinity Management Framework* be expanded by identifying specific objectives and quantifying asset protection targets at a regional, sub-regional and local level; and
- the Department research the costs associated with meeting the end-of-valley targets, as agreed under the Murray-Darling Basin Commission's *Salinity and Drainage Strategy* for Victoria.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.64 Allocation of salinity funds between regions

Allocations have to a degree reflected salinity problems and assets; for example, the high-value agricultural assets in Goulburn Broken and North Central irrigation areas. More generally, the original salinity plans were funded on the basis of their business case, not level of problems.

Besides the more easily quantified indicators, the original allocations also reflected the likely effectiveness of the actions, and the communities' capacity to undertake the planning and subsequent implementation of a salinity management plan. This includes the level of confidence in the proposed solutions, the capacity of the community to undertake the work and the economic drive to implement land use change.

Minor adjustments to regional allocations have been made annually in response to changes in priorities.

RESPONSE provided by Secretary, Department of Natural Resources and Environment -
continued

Paragraph 5.65 Investment required to meet end-of-valley targets

*Victoria, along with other States, has agreed to **interim** targets while their feasibility is being tested. The Department of Natural Resources and Environment is currently developing principles for determining end of valley targets. Despite the requirements to have targets for the Murray Darling Basin and the National Action Plan, no process or guidelines have been developed by the Commonwealth for catchment communities.*

The investment required to meet targets for each of the catchment communities will vary enormously. The cost will depend upon the proposed intervention and the social and biophysical characteristics of the catchment. The evaluative tools being developed will assist in this process.

An important principle of the target setting is to understand that initial targets are interim only. This will provide regional communities the opportunity to determine the cost and appropriateness of each target as new technical information is provided.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.64

The region supports the comments made on funds allocation, as it does not reflect asset protection objectives. A key element is that the North East Salinity Strategy was only recognised by government as an approved plan in December 1999. This was well after the majority of salinity plans were implemented within the context of salinity programming within the State. The implication for this region is the need to expect a reasonable level of longer-term funding for programs including on-ground works and monitoring. There is limited funding available to the region from State programs. The region has relied heavily on the support of the Natural Heritage Trust to fund the plan. The review of Salinity Management Plans will hopefully address this issue.

Paragraph 5.65 to 5.66

End-of-valley targets will affect priorities, but Victoria does not have a clear understanding of the investment required to meet the targets. The region supports the audit comments. The National Action Plan process and plan reviews will greatly influence the NE Salinity Strategy implementation program.

The comments on adequate research and support provided for reviewing Salinity Management Plans are supported, however, the Regional Catchment Strategy and Salinity Management Plan reviews will lead to integrated approaches in the future.

RESPONSE provided by Chief Executive Officer, West Gippsland Catchment Management Authority

Paragraph 5.66

The State Government did not adequately resource regions to meet guidelines for the development of second Generation Salinity Management Plans with a significant proportion of the cost being met by the region, with the majority by the Catchment Management Authorities. This meant that some funding needed to be taken from operating programs to meet the requirements.

Paragraph 5.67

“End-of-valley targets” as agreed and applied by the Murray-Darling Basin Commission (e.g. EC limits) are not as relevant in those regions outside of the Murray-Darling Basin Commission.

ACCOUNTABILITY MECHANISMS

5.68 In examining accountability mechanisms, we followed-up the recommendations made in 1993 for:

- monitoring output targets and performance indicators;
- evaluating strategy outcomes; and
- public reporting.

Monitoring output targets and performance indicators

5.69 In 1993 we recommended that the measurement of output targets under the Salinity Management Program, such as the area of land planted with perennial vegetation or protected through sub-surface drainage, be more comprehensively monitored.

5.70 This audit disclosed that the Department, Catchment Management Authorities and the Victorian Catchment Management Council had improved target setting and measurement, and had made significant progress in establishing an appropriate reporting framework in relation to catchment condition, and land and water management activities. The reporting arrangements involve annual reports on outputs and achievements to the Minister for Conservation and Environment. However, we found that reporting against specific activities, such as revegetation targets and on-farm salinity works, had not occurred in 3 catchment authorities over the last few years. This inhibits effective monitoring.

5.71 We also recommended in 1993 the development of performance indicators to evaluate the extent to which the Salinity Management Program has been effective in improving, or at least maintaining, the productive capacity, environmental quality and social well-being in salt-affected areas. The Department of Natural Resources and Environment advised us of its progress in implementing this recommendation, as follows:

A performance monitoring regime for the State's Salinity management program through the *Victorian Statewide Salinity Monitoring Strategy – Our Commitment to Evaluation of Victoria's Salinity management program*, was completed in 1995.

Reporting against the indicators in the *Salinity Monitoring Strategy* can be found at the "Know Your Catchments" web site. (The "Know Your Catchments" web site is at www.nre.vic.gov.au/catchmnt/conditn/. This report is updated every 5 years; the next update is due in 2002.)

Since the creation of the Victorian Statewide Salinity Monitoring Strategy, the salinity specific indicators have been incorporated within the broader effort to report against all natural resource management issues through the Catchment Indicators project. The ability to report against the condition and management of Victoria's land and water resources is driven by the legislative requirement of the Victorian Catchment Management Council and Catchment Management Authorities to report to the Minister.

5.72 We are satisfied that the Department has developed a Statewide salinity monitoring strategy for the Salinity Management Program, which entails monitoring surface water salinity, groundwater data trends, mapping saline areas, the rate of perennial pasture resown, irrigation and dryland management practices, and conducting salinity awareness surveys. Catchment Management Authorities monitor a similar set of quantitative or output measures on a regional-scale for annually reporting to the Minister on the condition and management of land and water in their regions.

5.73 Victoria has a comprehensive network for monitoring dryland salinity (i.e. groundwater observation bores) and stream water quality. Data has been collected over the last 10 to 15 years, providing a baseline from which to measure the effectiveness of salinity control measures. Recommendations have been made by recent reviews⁴¹ in relation to closing gaps in the coverage of the monitoring network and to rationalise areas with too many observation bores. For example, the main objective for improving Victoria's monitoring network should be to expand the network's representation of different landforms, geologies and geologic regions, particularly in the higher elevations.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.70 Reporting against specific activities by Catchment Management Authorities

With the introduction of Catchment Management Authorities, many implementation committees for salinity plans were instructed by their Catchment Management Authorities to include their annual reporting within the Catchment Management Authorities' annual reports. In some cases, this led to a reduction in the level of detail provided. A number of implementation committees are now reactivating their annual reports to ensure provision of more detailed reporting.

Reporting on outputs and performance indicators for funding occurs annually to the Department of Treasury and Finance. This is provided by the Department of Natural Resources and Environment on a Statewide consolidated basis, but includes outputs resulting from funding to Catchment Management Authorities. Much of the work undertaken in natural resource management is integrated with multiple benefits derived from the funding expended; therefore, it is often not appropriate to isolate salinity benefit derived from a particular funding source.

The Victorian Catchment Management Council is required to prepare catchment condition reports on a 5-yearly basis. This work has been proceeding with the next report due in 2002.

⁴¹ National Land and Water Resources Audit: Theme 2 – Dryland Salinity: Extent and impact of dryland salinity in Victoria, November 2000. Sinclair Knight Merz and Department of Natural Resources and Environment.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.70

It should be noted that the majority of revegetation in the Mallee region has been funded by programs other than the salinity program. For example, Tree Victoria, Bushcare, One Billion Trees etc. One of the problems encountered in reporting is that a region reports on the outputs of the fund source rather than the work type. The focus in the Mallee has been on multiple outcomes – Biodiversity enhancement and recharge control.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority:

Paragraph 5.69

The Catchment Management Authority supports the need for greater accountability.

Evaluating strategy outcomes

5.74 A difficulty with reviewing the effectiveness of the Salinity Management Program has been the unclear statements of expected social, environmental and economic objectives and outcomes from the various salinity management plans. Progress in implementation has been inferred from the range of activities implemented, such as the area of trees or perennial vegetation established and sub-surface drainage, against the assumptions made in the original plans about their effectiveness. For example, the 30 year revegetation target was assumed to be the level at which dryland salinity is controlled, whereas that assumption is now known to be incorrect. To measure future progress against objectives, outcomes and assumptions based on biophysical processes need to be identified, monitored, analysed and updated as necessary, and reported against at regular intervals on a plan-by-plan basis.

5.75 The Victorian Catchment Management Council advised us that the biophysical indicators developed under the Catchment Condition Indicators project⁴² for measuring catchment health, such as the indicators for the Index of Stream Condition, in many respects are well developed. However, the Council is aware of deficiencies in the social condition and economic/financial condition indicators.

⁴² The Catchment Condition Indicators project was commenced in 1997 by the Victorian Catchment Management Council. Ten catchment condition indicators and 14 catchment impact indicators have been developed (see Victorian Catchment Management Council, Annual Report, 1998-99).

5.76 This State does not have a comprehensive evaluation program, nor a comprehensive set of objectives or performance indicators, covering the productive capacity, environmental quality and social well-being of salt-affected areas, as recommended in our 1993 Report. Consequently, the key outcome targets of the 2000 *Salinity Management Framework* of achieving agricultural sustainability (i.e. agricultural practices that do not impact on the natural resource base⁴³) for 25 per cent of Victoria's produce by 2005 and 50 per cent sustainability by 2015, are not supported by a baseline of appropriate agricultural sustainability indicators. (Agricultural sustainability indicators monitor the impact of agricultural practices on the natural resource base) The Department is not currently able to measure the main outcomes of the Framework's strategies and actions against an appropriate set of performance indicators.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.74 Statements of objectives in plans

At the time the original plans were prepared, Victoria had less understanding of salinity processes and relationships. Hence, it was more difficult to specify a link between management measures and a resulting outcome for salinity and watertable levels. Our scientific knowledge and modelling ability have improved since then, though they are still far from perfect.

The Department will address this issue of clarifying objectives in the second generation salinity plans currently being prepared.

Paragraph 5.75 Indicators of social and economic/financial condition

The Catchment Condition Indicators referred to by the Victorian Catchment Management Council do in fact attempt to report on social and economic conditions as they relate to catchment management. Three indicators relate to these areas of interest, these being:

- *An "indicator complex" examining the landholders' capacity to change (adopt new practices etc), which includes indicators of: "agricultural domination of the landscape"; "agriculture in the regional workforce"; "farm age demographics"; and*
- *"Net Farm Worth" which is a measure of long-term sustainability; and*
- *"Gross Value of Production", which reflects the economic performance of the agricultural sector.*

Although there is not a wide range of objectives relating to the economic and especially social accounts, it should be noted that the social indicators are influenced by a large set of factors beyond salinity. These indicators reflect more on the environment within which salinity management needs to occur, than the achievement of targets.

There is also a Catchment Condition Indicator that reflects the achievement of agricultural sustainability. Although still in development, the "Land use impact index" will quantify the area of land management practices that are inappropriate given the inherent capabilities of the land. Results from this indicator will be posted onto the Department of Natural Resources and Environment's Catchment Indicator webpage in October 2001 along with results from the other previously mentioned indicators.

⁴³ The natural resource base refers to the soil, land, water, plants and animals, see *Sustainable Agriculture: Assessing Australia's Recent Performance*, A report to SCARM of the National Collaborative Project on Indicators for Sustainable Agriculture. SCARM Technical Report No. 70.

RESPONSE provided by Secretary, Department of Natural Resources and Environment -
continued

The audit report calls for the reporting of indicators of agricultural sustainability, but it should be noted that salinity management control is potentially moving away from such a strong reliance on agricultural solutions. Victoria contributes to a national report on the Sustainability of Agriculture produced by the Standing Committee on Agriculture and Resource Management at 5-year intervals. Planning for the second report is well advanced. As indicator programs are costly, we need to ensure that additional indicator reports are cost effective.

Paragraph 5.76 Program for evaluation and set of objectives and performance indicators.

The Department has a wide-ranging program of monitoring and performance indicators, but accepts that there are areas that can be improved. End-of-valley targets are a significant new indicator of progress. Regular groundwater and surface water monitoring is undertaken across the State for a range of parameters including salinity levels. The Index of Stream Condition is published on the Department of Natural Resources and Environment's webpage.

Monitoring of the condition of wetlands and native vegetation is a more difficult objective to achieve. However, work has been proceeding since the release of Victoria's Draft Native Vegetation Management Framework with the development of a measurement tool called "habitat hectares" for measuring the quality of native vegetation. Specific changes in biophysical parameters resulting from works undertaken are difficult to measure due to the long lag times between cause and effect. For example, the effect in terms of salinity of clearing native vegetation over 50 years ago is only now becoming apparent.

Performance indicators for economic/social factors are addressed under paragraph 5.75 above.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraphs 5.74 to 5.76

The comment made in this section in respect to spelling out assumptions when setting targets is precisely the reason we need to do Second Generation Salinity Plans. The Authority agrees with the statement that there are still deficiencies in social and economic indicators. There is a good set of indicators being developed in the Mallee and other regions along the Murray River. The model uses an accounting system based on actual or best estimates of salt debits and credits that accrue from actions/works under each Salinity Plan. The accounting system is being refined over time but is robust enough for Victoria to distribute salt credits under the Murray-Darling Basin Salinity Management Strategy.

Public reporting

5.77 Our 1993 Report found that annual reporting to Parliament on the Salinity Management Program could be improved by:

- upgrading the quality and timeliness of information;
- reporting consolidated activities and achievements of the Program on a Statewide basis; and
- including financial and non-financial performance data (such as technical information) and funds provided by Commonwealth, State and local government, including contributions from local communities, e.g. landholders.

5.78 Information on the following Department of Natural Resources and Environment websites explain the present extent and trends in salinisation, and the extent of uptake of the major salinity control measures:

- **Extent of dryland salinity** www.nre.vic.gov.au/catchmnt/conditn/salinity/dryland.htm
- **Salinity of streams** www.nre.vic.gov.au/catchmnt/conditn/streams/electric.htm
- **Tree planting** www.nre.vic.gov.au/catchmnt/conditn/vege/trees.htm
- **Perennial pasture establishment**
www.nre.vic.gov.au/catchmnt/conditn/salinity/peren.htm
- **Trends in watertable depth**
www.nre.vic.gov.au/catchmnt/conditn/salinity/trends.htm
- **Adoption of irrigation management practices against targets**
www.nre.vic.gov.au/catchmnt/conditn/salinity/irrigat.htm
- **Awareness of salinity as an environmental issue**
www.nre.vic.gov.au/catchmnt/conditn/salinity/aware.htm

5.79 The Department of Natural Resources and Environment provided the following information in relation to the recommendation made by us in 1993:

The requirement for the Department of Natural Resources and Environment to annually report to Parliament is set by legislation. A specific report on salinity management is not currently included as a requirement under the legislation or the Directions of the Minister for Finances. The Department's annual report does not provide specific information on salinity management, but includes several relevant performance measures such as:

- areas in management plans where recommended practices have been established;
- percentage of farmers participating in Landcare and Farm\$mart; and
- area of native vegetation protected or rehabilitated.

5.80 The importance of the salinity issue justifies a high level of accountability to Parliament and the community. It is acknowledged that some reporting on Statewide salinity activities occurs as part of the Department's annual report to Parliament and that the Department complies with its legislative requirements under the annual reporting provisions of the *Financial Management Act* 1994.

5.81 The annual report of the Department of Natural Resources and Environment does not provide an adequate synopsis of progress, so it has been difficult for this audit to piece together a comprehensive, contemporary picture of salinity and the effectiveness of its management. For instance, the Department's consolidated activity reporting for tree establishment, perennial pastures, mapping and survey activity, socio-economic trends, research of catchment processes, private and local government cost-share contributions, private investments in on-farm salinity control measures and an overall analysis of the Program's performance are not publicly reported.

5.82 In 1994, in a review of the 1989 Salinity Control Program, consultants Marsden Jacob identified the need to develop and report on clear program objectives, which included agricultural productivity, environmental benefit, water quality impact and regional community benefit.

5.83 We recognise the difficulty in disaggregating the total natural resource program budget and apportioning funds for salinity benefits as opposed by other multiple benefits, e.g. native revegetation programs for biodiversity, tree farms and plantations for commerce and investment, lucerne and *Phalaris* for large-scale farm productivity, tall wheatgrass for rehabilitating saline discharge sites and improved grazing potential, or salt evaporation basins for salinity credits and the salt harvest industry. However, we believe that the Department has not adequately addressed our recommendation, limiting the accountability to Parliament.

5.84 Our examination also disclosed that the departmental requirement for annual reporting across all 21 salinity management plans by Catchment Management Authorities to the Minister for Conservation appears to have ceased in 1997, although the Implementation Committees for the State's 11 irrigation salinity management plans have maintained their annual reports to the Minister.

5.85 In reviewing the 1999-2000 annual reports of the Victorian Catchment Management Council and Catchment Management Authorities, we found that there was a lack of reporting on salinity management in the Council's annual report. The level of detail in 3 of the ⁴⁴ annual reports for salinity control action was adequate. The majority, however, had poor levels of detail and an absence of reporting on progressive outcomes for the State's Salinity Management Program.

5.86 The Victorian Catchment Management Council has reporting obligations under the *Catchment and Land Protection Act* 1994, which provides for a report on the management and condition of Victoria's catchments every 5 years. The first report was tabled in Parliament in 1997 and the Council's next report is due in 2002. We were advised that the Council, in partnership with the Department, has developed 24 catchment condition and catchment impact indicators, which will be reported against in future reports.

Recommendations

5.87 We recommend that:

- The Department develop a baseline of appropriate agricultural sustainability indicators;
- The evaluation approach for the second generation of salinity management plans include an appraisal of probable long-term changes and outcomes. The surrogate measure for the short-term could be an assurance that assumptions are valid and the monitoring system and data collection is in place and it is appropriate and valid for long-term trend analysis;

⁴⁴ Mallee, Wimmera and North Central Catchment Management Authorities provided quantified outputs for revegetation.

- Reporting be improved by:
 - ensuring that comprehensive information on the progress of the Salinity Management Program and its overarching 2000 *Salinity Management Framework* is disclosed in the Department's annual report; and
 - establishing consolidated reporting for salinity actions across the State;
- Annual reports of the Catchment Management Authorities provide more relevant and detailed appraisals of the outcomes of their catchment management activities under the 2000 *Salinity Management Framework*; and
- Independent and comprehensive reviews of the Salinity Management Program be undertaken at regular intervals to enable critical evaluation of progress and refocusing of strategies, where warranted.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.78 Information on catchment condition

The Department of Natural Resources and Environment's website is the most highly "hit" natural resources website in Australia.

Paragraphs 5.81 to 5.86 The Department's and Catchment Management Authorities' annual reports to Parliament

The Department of Natural Resources and Environment's annual report meets the statutory requirements, and generally aims to provide an overview of progress across the wide range of the Department's responsibilities without extending to detailed data on single issues like salinity.

Reporting on an annual basis is not the most appropriate time frame for an issue like salinity where the outcomes need to be tracked over the longer-term. Consequently, the principle statutory requirement for reporting is the Five-Year Catchment Condition Reports under the Catchment and Land Protection Act. The next such report is due in 2002.

Paragraph 5.87 Regular independent and comprehensive reviews of program

Comprehensive reviews are costly, and there is a need to ensure that they are necessary and achieve the desired end. It is often better to examine components of large programs, which is what has occurred through a number of reviews, many of which are listed in Appendix A. The salinity management plans also have a requirement of a 5-year review to assess progress against targets and appropriateness of management options.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.85

The North East Catchment Management Authority can provide quantified revegetation outputs. This has been provided in the summary annual reports for 1998-99 and 1999-00. However, due to printing errors they were not transcribed in the full reports.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.85

A local decision was made in July 2000 to alter the format of the annual report for the Mallee Catchment Management Authority. Consequently the report did not follow the Statewide guidelines, rather the format was linked to the relevant Regional Management Plan (business plan) and was able to show targets and performance measures against funding. Hence, the clarity of reporting for the Mallee region.

RESPONSE provided by Chief Executive Officer, West Gippsland Catchment Management Authority

Paragraphs 5.70, 5.80, 5.84, 5.85 and 5.87

With the introduction of Catchment Management Authorities, many Implementation Committees were instructed by the Catchment Management Authorities to include their annual reporting within the Catchment Management Authority's annual report. This no longer allowed the Implementation Committees to provide the detail they had previously provided. A number of Implementation Committees are now re-activating their own annual reports to the Board to ensure the appropriate amount of detail is provided.

INSTITUTIONAL ARRANGEMENTS

5.88 Responsibility for the delivery of the State's Salinity Management Program now rests with one agency and Division, the Catchment and Water Division of the Department of Natural Resources and Environment. Catchment Management Authorities are responsible for the co-ordination and implementation of the State's salinity management plans and are supported by the regional and technical resources of the Department of Natural Resources and Environment, such as the Catchment and Agriculture Services group.

5.89 We believe that good institutional arrangements are fundamental to effectively and efficiently addressing the salinity problem. These arrangements should:

- focus on integrated catchment management;
- involve key stakeholders;
- permit the effective use and management of collaborative partnering agreements; and
- enable effective functioning with limited duplication and appropriate information sharing.

5.90 Recent international and national reports have recognised Victoria's institutional arrangements for integrated catchment management as a model for other jurisdictions to imitate. Although we agree with these assessments, there are opportunities for further improvements from the perspective of salinity management.

5.91 There are a number of other State agencies for whom salinity is relevant, for example, the Departments of Infrastructure (local government, protection of public infrastructure and asset valuations), State and Regional Development (regional economic development programs), Education (education and training programs) and Human Services (rural counselling services, assessment of public health impacts on drinking water, water quality and water treatment plants).

5.92 Collaborative partnership agreements have been established between the Commonwealth Government and Victoria for federal funding under the Natural Heritage Trust program, the Department and Catchment Management Authorities for regional service delivery and between the Department (in partnership with the Catchment Management Authorities) and community Landcare groups for on-ground works. For 1999-2000, Victoria received \$12.3 million from the Commonwealth Natural Heritage Trust program, of which \$5 million was allocated to Landcare groups for on-ground works.

5.93 We were advised by various stakeholders that there are poor links between activities occurring at a local level (i.e. on farms) and regional priorities set in Regional Catchment Strategies by Catchment Management Authorities, with very little monitoring of the effectiveness of grant expenditures. For example, evaluations of the effectiveness of Natural Heritage Trust grants for Landcare activities that have included a salinity component have not been undertaken over the past 4 years. Catchment Management Authorities are of the view that they do not have the resource to monitor the effectiveness of grants for community-led salinity works.

5.94 We reviewed the content of collaborative partnership agreements⁴⁵ between the Department and Catchment Management Authorities and found the following areas that could be strengthened;

- to achieve the service delivery outcomes intended, such as sustainable resource use and targeted implementation of actions, there is room for better communication protocols between the partners;
- a greater definition of the roles and responsibilities for monitoring, review and evaluation;
- the level of accountability, performance assessment and program review;
- the articulation of certain commitments and the expected level of performance under the agreements could be made clearer, for example, the links to the Environment Protection Authority could be made more specific and intellectual property could be covered;
- the roles and duties of the Department's regional Catchment and Agriculture Services group and Catchment Management Authorities for monitoring performance; and
- the identification of performance measures and provisions for public transparency in terms of reporting on outputs and outcomes.

⁴⁵ The audit criteria used in this review are detailed in a Report of the Auditor-General of Canada *Collaborative Arrangements: Issues for the Federal Government*, April 1999. (Available at <http://www.oag-bvg.gc.ca/dominio>).

5.95 We also noted that the recent Commonwealth parliamentary inquiry into catchment management found that the bi-lateral partnership agreements for Natural Heritage Trust funds did not contain credible and effective enforcement measures for any failure to honour the agreements reached.⁴⁶

5.96 We received the following information from the Department in relation to information sharing by Catchment Management Authorities:

There are many formal and informal processes for sharing information, experiences and directions between regions and Catchment Management Authorities. These include:

- Regular and formal meetings of the Chairs of the Catchment Management Authorities and the CEOs. Senior Department of Natural Resources and Environment officers participate in these meetings;
- Victorian Farmers Federation-Department of Natural Resources and Environment “Victorian Landcare & Catchment Management” quarterly magazine;
- Department of Natural Resources and Environment activities: websites and databases (e.g. Regional Data Net, Water Data Warehouse), research papers and seminars, newsletters, workshops on a variety of topics, officer to officer contacts, Regional Managers forum, Catchment and Agriculture Services Managers’ forum, regional visits, steering committees and working groups;
- Victorian Catchment Management Council: agenda items, papers, seminars, annual conference;
- Catchment Management Authority forums: Waterway Managers, Nutrient Management Coordinators, Floodplain Managers;
- Professional organisations: eg River Basin Management Society seminars and newsletter; and
- Research and Development organisations: RipRap magazine, Workshops, partnership programs (Land and Water Australia), Co-operative Research Centre websites, publications and seminars.

5.97 We have participated in some of the above forums and visited the websites and databases established by the Department and other organisations. We found that there is a wealth of detailed information and performance-based data on the salinity issue available to the public.

⁴⁶ The Parliament of the Commonwealth of Australia *Co-ordinating Catchment Management – Report of the Inquiry into Catchment Management* House of Representatives Standing Committee on Environment and Heritage, December 2000, Canberra (paragraph 3.85).

5.98 We found that:

- The Catchment Management Authority structure and regional community partnerships with government (e.g. Landcare) are proving effective in implementing regional salinity priorities, but may be less effective in targeting local priorities. Current evidence indicates that the Department's regional objective of reducing groundwater recharge will be more effectively implemented through the cumulative impacts of many and varied specific local solutions, rather than broadly applying a minimal number of management options across all landscapes. For this to occur, Catchment Management Authorities will need to undertake detailed local investigations of landscape processes and to apply specific solutions for particular localities. This could be achieved by providing them with greater control over technical and operational resources, which are currently supplied under purchaser-provider service agreements with units of the Department of Natural Resources and Environment;
- Current institutional arrangements do not ensure the direct involvement of all the key internal and external agency stakeholders (e.g. the Agriculture Industries Division and the Parks Flora and Fauna Division of the Department, Environment Protection Authority, Department of Infrastructure and Local Government). These stakeholders, particularly internal departmental units and other government agencies, could play a more direct role in the implementation of the Salinity Management Program; and
- The consolidation of functions within the Department of Natural Resources and Environment has had substantial benefits, which have resulted in the identification of certain annual deliverables, relatively streamlined processes and improved accountability. However, some Catchment Management Authorities faced financial constraints that reduced their access the Department's technical information, such as Geographic Information System data and maps. This problem will need to be addressed to enhance the knowledge capacity, especially for data-poor authorities, to effectively deal with the emerging salinity problem.

Recommendations

5.99 We recommend that institutional arrangements be improved by:

- structuring collaborative partnering agreements to improve accountability of Catchment Management Authorities and community groups;
- strengthening the capacity of Catchment Management Authorities to respond to local salinity management priorities;
- greater direct involvement and co-ordination of key internal and external agency stakeholders such as the Agriculture Industries, and Parks, Flora and Fauna Divisions of the Department;
- improving information sharing between agencies, particularly technical information; and

- the Department reviewing its provision of Geographic Information System data and maps to internal units and Catchment Management Authorities, and implement alternative purchasing arrangements under the Salinity Management Program, if required.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.93 Links between activities occurring at a local level and regional priorities

In general, Regional Catchment Strategies set the priorities for government funding, as discussed under paragraph 5.138. Hence, while this statement would be accurate in some cases, it would not generally be.

Paragraphs 5.88 to 5.94 Role definition and accountability of Catchment Management Authorities and community groups

The Department of Natural Resources and Environment acknowledges that the relationships and processes established between the Catchment Management Authorities, Regions and the Department's Head Office policy groups need to be improved as the Catchment Management Authorities develop as entities. A Catchment Partnership Review between the Catchment Management Authorities and Regions has recently been completed with a view to improving the relationship and process for operating agreements.

In addition, a review of the Department's business model is currently being undertaken in response to the need for improvements in the procurement process. A review of governance arrangements for Catchment Management Authorities, is currently being undertaken by KPMG on behalf of the Department, is due for report at the end of June 2001. Recommendations will be made on future governance arrangements, accountability requirements for Catchment Management Authorities and possible amendments to legislation. The arrangements made under the National Action Program will also strengthen the partnerships and role definitions between the Department and regional groups.

Paragraph 5.98 Effectiveness of Catchment Management Authorities in targeting local priorities

Catchment Management Authorities' strategies set regional priorities, and these are then translated to allocations of resources at a local level. The co-ordination between Catchment Management Authority regional strategies and local priorities is also discussed below under paragraph 5.138.

Paragraphs 5.98 to 5.99 Need to strengthen the capacity of Catchment Management Authorities to respond to local priorities and provide greater control over technical and operational resources

The Department accepts that the capacity of Catchment Management Authorities could be strengthened to improve the implementation of natural resource management. However, the Catchment Management Authorities' charter in salinity management is strategic rather than operational. The Department provides technical and operational resources to Catchment Management Authorities through its Regions and Institutes. These are needed for planning and co-ordination, but it is not necessarily appropriate to provide technical resources to Catchment Management Authorities for operational work in order for them to achieve their goals.

RESPONSE provided by Secretary, Department of Natural Resources and Environment -
continued

Through the Department's Regional Data Net (RDN) initiative, the concerns raised about Catchment Management Authority access to Geographic Information System data and maps are being addressed. Through the RDN, the Department has invested in a network of servers and protocols that will distribute the departmental data at no cost to the Catchment Management Authorities. Coupled with data licensing arrangements being organised with each of the Department's business units, the Catchment Management Authorities will have faster, cheaper access to a wider range of data sets than has previously been available.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.94

The authority agrees that partnership agreements need strengthening between the Department of Natural Resources and Environment and Catchment Management Authorities.

Paragraph 5.98, third dot point

The authority agrees that the Mallee region is data rich but information poor. We are just starting to get into the field of geographic information systems. However it must be pointed out that better access to information alone will not solve our salinity problems.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraphs 5.98 to 5.99

The region supports the need to strengthen the capacity of Catchment Management Authorities to respond to local priorities, along with having greater control over technical and operational resources, such as access to geographic information systems.

RESPONSE provided by Chief Executive Officer, West Gippsland Catchment Management Authority

Paragraph 5.93

The statement that "... there are poor links between activities occurring at a local level (i.e. on farms) and regional priorities set in Regional Catchment Strategies by Catchment Management Authorities, with very little monitoring of the effectiveness of the grants for community-led salinity works" is too general and is not factual for all programs in all regions across Victoria.

Paragraph 5.98

In regards to the statement "... in providing [Catchment Management Authorities] with greater control over technical and operational resources ... which are currently ... with the Department of Natural Resources and Environment.", it needs to be recognised that the Catchment Management Authority's charter in salinity management and programs is strategic rather than operational.

RESPONSE provided by Chief Executive, Wimmera Catchment Management Authority

Paragraphs 5.98 to 5.99

The Wimmera Catchment Management Authority agrees that the capacity for Catchment Management Authorities to respond to local priorities needs to be strengthened with the use of tools such as the Geographic Information System (GIS). The GIS is an invaluable planning tool for analysing data and making decisions with community members of the authority. The authority has been a willing partner in the Statewide Regional Data Net project and this is vital for Catchment Management Authorities to be effective and implement best practice in their strategic role in salinity management. This information is made readily available for the Department of Natural Resources and Environment and other groups who are involved in salinity on-ground works.

COMMUNITY PARTICIPATION

5.100 As the salinity strategies under the 2000 *Salinity Management Framework* are community driven, one of the biggest challenges confronting the Department is to encourage the adoption of new farming practices by landowners. Victoria differs from other States due to the high density of its rural holdings (i.e. a larger number of smaller landholdings), which may not support agricultural production of a sufficient scale to be viable in the long-term. Many smallholdings are not viable and landowners are reliant on off-farm income to support them. There is also an expansion of the urban fringe with hobby farming, particularly around larger regional centres, where there is no major focus of deriving a primary income from the land.

5.101 Salinity management in this State will require large-scale changes in land use, but to do this the economic benefits to farmers in changing land use practices will need to be promoted. In effect, farmers will be expected to invest for future generations, since it will take 50 years or more in dryland areas for the expected benefits to be realised. Some will not have the financial capacity to make such an investment or even to match the grants that have been provided for salinity management (e.g. by the Natural Heritage Trust).

5.102 The move to off-farm income, an aging rural population and the changing social structure of rural communities, particularly in dryland areas, have affected the capability of rural communities to implement salinity management projects that rely on volunteer input. These social and economic changes may have limited the choice of optimal salinity management solutions or, on the positive side, could provide new opportunities, such as the aggregation of small rural holdings for the establishment of larger, sustainable agricultural farms. As indicated earlier, the ultimate effect of implementing new opportunities such as this are not known at this stage.

5.103 The Department advised us that programs implemented over the past decade have engaged those farmers willing to adopt new farming practices and now the more resistant farmers need to be engaged. Apart from the challenge to engage traditional farmers in landscape change, other constraints to implementing the 2000 *Salinity Management Framework* include issues relating to seed supply, paid labour for tree planting and protecting biodiversity for native grasslands and public reserves (e.g. the perennial species used in salinity management, such as *Phalaris* and tall wheat grass, have escaped from paddocks and invaded native habitat⁴⁷). Effective and economically viable land use alternatives are yet to be developed.

5.104 To support community participation, in 1993 we recommended regular monitoring or oversight of the development of salinity management plans to prevent significant delays and costs, and to improve the skills of community working groups. We also recommended greater government involvement in salinity plan development and that the then Salinity Bureau take a more pro-active role in ensuring adherence to planning deadlines by closely monitoring progress against predetermined milestones.

5.105 In response to our follow-up questions in relation to the community's involvement in salinity management planning, the Department of Natural Resources and Environment provided the following comments:

The issue is not directly relevant because plan development finished in 1994. However, it raises the broader question of maintaining community support and involvement in natural resource management over time. The Government recognises this challenge and is currently developing options to support the future direction of support for Landcare, through the Second Generation Landcare Taskforce.

As plans moved into implementation, new community members volunteered for membership of community salinity implementation groups, consequently providing renewed energy for community input.

Part of the challenge of maintaining community involvement was the recognition that a number of related programs (e.g. water quality and Landcare) required the same degree of community input and community leaders were often required to be involved in several different committees. This was rationalised with the establishment of Catchment Management Authorities and new community involvement structures put in place.

Focus on community consultation and engagement has increased as community processes now form an important part of the integrated catchment management approach in Victoria. This includes the preparation and delivery of community engagement processes/public awareness activities/engagement of stakeholders on various Natural Resource Management issues.

⁴⁷ Carr, G. and J. Yugovic. "The Impact of *Phalaris* and *Tall Wheatgrass* invasions on the natural habitats of parks, reserves and wetlands in Victoria", Department of Natural Resources and Environment, 2000.

The Department of Natural Resources and Environment's role in ensuring that planning deadlines are met is essentially that of the purchaser. Each year, Regional Management Plan guidelines for the following financial year are distributed to the service providers. Some of these dates are determined under legislation, through the *Catchment and Land Protection Act* 1994 and the *Water Act* 1989. Monitoring and reporting arrangements are in place to ensure that these planning deadlines are met.

For each Key Project, a departmental representative from the Catchment and Water Division is assigned as Key Project Leader. The Leader negotiates with the service providers in agreeing on outputs and performance measures, including timelines.

5.106 We are satisfied that the Department has addressed our recommendations in the context of the implementation phase of salinity management plans through institutional changes and legislative requirements introduced with Catchment Management Authorities in 1997. However, despite these developments, we observed similar delays in the planning process for the Department's development of second generation salinity management plans, which were originally to be completed in August 2000. The Department has advised us that some plans will not be finalised until December 2001 and all plans should be completed by February 2002. There has been a delay of 6 months with the timetable for these reviews due to a need to wait for agreed national guidelines and accreditation requirements.

RESPONSE provided by Secretary, Department of Natural Resources and Environment:

Paragraph 5.106 Planning process for Second Generation Salinity Management Plans

The development of second generation salinity management plans was to be completed by September 2001 according to Victorian Salinity Management Framework. The Framework was released in August 2000. Following this, the National Action Plan for Salinity and Water Quality (NAP) was announced by the Commonwealth Government in October 2000 and agreed to by all States and Territories through the Council of Australian Governments in November 2000. Given that the salinity management plans are fundamental to the successful implementation of the NAP, it was considered necessary that their preparation not pre-empt any requirement under the NAP. This has meant a delay in completion of the plans, but will prevent duplication or further review of work in the future under the NAP.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.103

The authority agrees with the inference that we have worked mostly with landholders who have volunteered to undertake works, and there is much yet to be done to achieve landscape change. However, some hard decisions in this aspect have already been made in the Mallee through Salinity Impact Zoning, which is currently being refined for the irrigation zone and being investigated for dryland land use.

RESPONSE provided by Chief Executive Officer, West Gippsland Catchment Management Authority

Paragraph 5.106

With the emphasis on the Murray-Darling Basin, much of the framework criteria is not relevant to those regions outside of the Murray-Darling Basin Commission. For instance, the Gippsland Region is significantly different to the Murray-Darling Basin – in both soil type and topography. The timeline is too short to adequately review and develop second generation plans. There is also the question as to who takes responsibility and funds past and future generation works and their maintenance.

RESPONSE provided by Chief Executive, Wimmera Catchment Management Authority

Paragraph 5.103

The current government/Catchment Management Authority contributions to projects are not enough incentive to engage more “resistant” farmers in salinity control works. This needs to be revised to reflect the true community benefit of salinity control works to protect water quality, biodiversity and public infrastructure assets. The Wimmera Catchment Management Authority is unsure if the scientific understanding of salinity processes is robust enough to enlist compliance or enforcement as another tool to the salinity management “kit bag”.

Encouraging community involvement

5.107 The scale of the intervention required to address the salinity problem, its long-term nature, and the nature of the options for effective salinity management, will require a high rate of participation by the community. The contributions made by the State and community in attempting to control dryland salinity in the past have had limited success, mainly because the enormity of the problem was not fully realised and the original targets set for revegetation, in retrospect, were set too low.

5.108 Based on research findings by the Department⁴⁸, there is a risk that the national Landcare movement in Victoria might already have reached its maximum effectiveness and that the increased output of the volunteer movement anticipated under the *2000 Salinity Management Framework* will fail to materialise. That research also found that the changed environmental ethic in Victoria’s farming community stemming from the growth of the Landcare movement has not translated to the widespread adoption of sustainable farming systems by farmers.

5.109 There are also fundamental socio-economic constraints to the uptake of sustainable agricultural systems in dryland areas due to low farm incomes, small land holdings, an aging farm population, uneconomic plant-based solutions and to the preference of farmers to maintain the *status quo* with regard to farming practices, supporting current economic markets and traditional agricultural systems. It is not certain whether rural structural re-adjustment involving extensive tree planting and the aggregation of rural holdings may contribute to the necessary agricultural system change in the near future.

⁴⁸ Surveys of Landcare by the Johnstone Centre, Charles Sturt University, Albury. For example, Curtis, A. *Landcare: Approaching the Limits of Voluntary Action*, Australian J. Environmental Management, March 2000.

5.110 While there have been some reviews nationally and in Western Australia regarding the suitability of farming practices that use more rainfall, there is a need to develop a suite of new commercially viable farming systems, that have been demonstrated at a farm-scale as ready for adoption by Victoria's dryland farmers.

Recommendations

5.111 We recommend that the Department:

- consider its options in the event that the predicted increases in Landcare participation rates fail to materialise; and
- focus on providing information on commercially viable options and appropriate incentives to encourage community involvement in land use change.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.111 Need to consider options if increase in Landcare participation does not occur, and focus on providing information on commercially viable land use options

The Victorian Salinity Management Framework is not predominantly based upon Landcare group participation. It focuses also on farmers operating as individuals or commercial entities rather than as members of a group. Nevertheless, Landcare, as an ethic, has broader effects on farm awareness, and the Department will continue to endeavour to improve support for it.

These audit comments are taken as applying mainly to the dryland areas, as there have been widespread voluntary positive changes in irrigations areas.

Our ability to provide more viable options will be enhanced by Victoria's participation in the national research programs and projects such as Options for the Productive Use of Salinity (OPUS) referred to under paragraph 5.59.

Nevertheless, it is not clear at this stage to what extent the research will be successful, or whether voluntary measures will achieve the degree of land use change needed. It may prove to be impossible to bring about the required land use changes through commercially profitable activities, yet the changes could be worthwhile for environmental and social aspects. This uncertainty raises the issue of the extent to which governments should use various approaches of suasion, incentives, enforcement and legislation to bring about change. Innovative options being investigated in conjunction with the National Dryland Salinity Program include mixtures of regulation and market activities such as creating markets for salt credits, carbon and biodiversity.

GOULBURN BROKEN DRYLAND SALINITY MANAGEMENT PLAN

5.112 In our 1993 report, we saw a need for more on-ground works funded within the Goulburn Dryland salinity management plan.

5.113 The Department of Natural Resources and Environment provided the following information in response to that recommendation:

Audit's attention is directed to the Response from the managing agency in the 1993 Salinity Audit, in particular the issue of Statewide research being a component of the overall plan budget and the fact that extension is as important as on-ground works. Statewide research funding was transferred out of the Goulburn Dryland budget in 1997-98 resulting in a more accurate reflection of the proportion of funds spent on "Grants". The information disclosed in the Report does not correctly show the total on-ground works effort, and much will be attributed to extension effort where no direct funds were provided.

Dryland salinity has not been controlled by the implementation of the plan. The overall objective is the management rather than control of salinity. The efforts in the Goulburn Broken dryland area reflect this by its investment in a major study by Sinclair Knight Merz (1996), Goulburn Broken Dryland *Catchment Salt and Water Balances*. This study indicated changes to areas that the plan needed to target.

The appropriate level of salinity management will be determined in consultation with the regional community and take into account long-term trends, and the land management and structural adjustment opportunities open to the community. There is a strong level of confidence that the Land Management targets will be achieved, but whether this results in an acceptable salinity outcome still needs to be determined.

5.114 The Goulburn Broken Catchment Management Authority's response to the recommendation was:

The proportion of total funds for on-ground or on-farm works fell from the levels recorded for 1990-91 (26.3 per cent) and 1991-92 (27.1 per cent) in the subsequent period to 1998-99. Since 1999-2000 the proportion of funds expended for on-ground works has surpassed the 1990 to 92 benchmarks, however, this has been due to a large fall in total allocations to the region's dryland salinity management program.

Chart 5B shows the expenditure trend for on-ground works for the Goulburn Broken dryland salinity management plan from 1990.

The increase in expenditure for on-farm works in the last 3 years is due to a change in cost-sharing principles to include real costs and other benefits, such as native vegetation and water quality, in the cost-benefit analysis.

The objectives of the Goulburn Dryland management plan have been achieved with respect to meeting its tree planting targets, however, the targets for revegetation with deep-rooted perennial pastures, such as lucerne and *Phalaris*, have not been achieved.

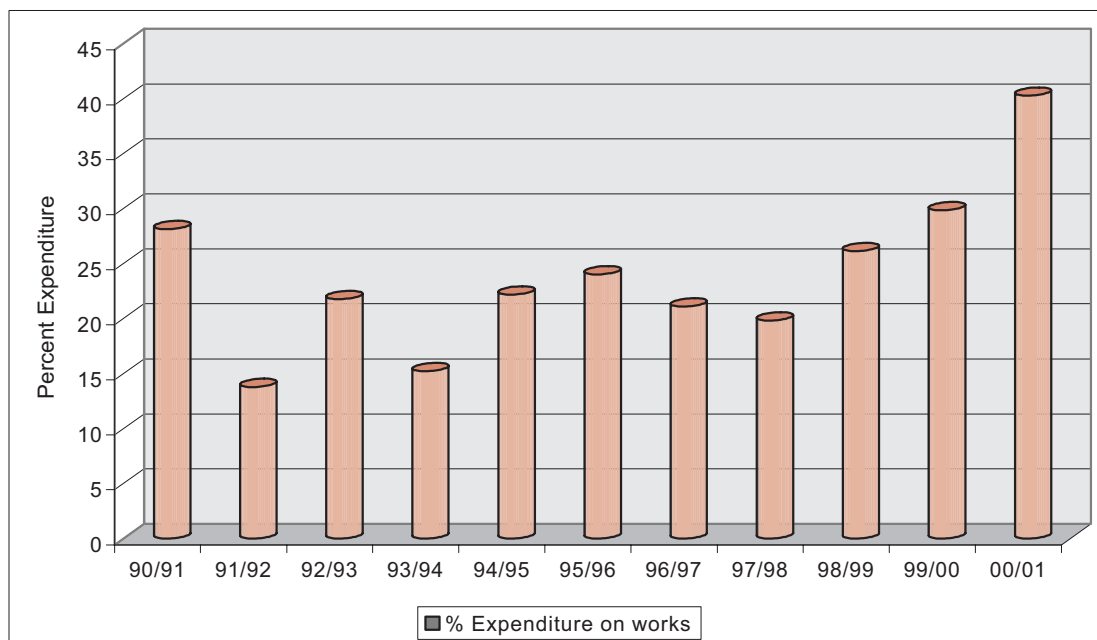
There is a high level of confidence in achieving specified works targets, however, our confidence that salinity outcomes will be achieved in the long-term is low. The lower confidence level is due to a developing knowledge of the relationship between works (revegetation) and groundwater control. Significant effort has gone into developing models to test this relationship, including:

- a major study in 1996 on understanding the salt and water balances of the catchment, which identified 2 high priority areas for works⁴⁹; and
- a current study that will more effectively simulate the impact of land-use change in the sub-catchments of the Goulburn Broken Catchment.⁵⁰

⁴⁹ Sinclair Knight Merz (1996) *Goulburn Broken Dryland Catchment Salt and Water Balances*.

⁵⁰ ICAM, ANU, CSIRO Land and Water and Salient Solutions Australia P/L (2001) (in preparation).

CHART 5B
EXPENDITURE ON WORKS FOR THE GOULBURN BROKEN SALINITY
MANAGEMENT PLAN, 1990 – 2000
 (per cent)



Source: Goulburn Broken Catchment Management Authority, 2001.

The average annual expenditure on salinity management in the Goulburn Broken Catchment Management Authority from 1990 to 1999 was \$10.6 million.

5.115 The major concern raised by the above agency responses is the lack of confidence in the long-term effectiveness of the on-ground works implemented to control salinity.

Recommendation

5.116 We recommend that the Department work in partnership with the Goulburn Broken Catchment Management Authority to develop well-researched salinity management solutions and sustainable agricultural options.

***RESPONSE** provided by Secretary, Department of Natural Resources and Environment*

Paragraphs 5.112 to 5.115 1993 audit report call for more on-ground works and confidence in the effectiveness of on-ground works in the Goulburn Broken dryland plan

*The increase in on ground works **has** occurred as demonstrated by Chart 5B. There are still significant questions about the most effective on-ground options for control of dryland salinity, and the role of vegetation and agronomic solutions. This has been acknowledged for other parts of Victoria and is the case nationally. However, the appropriate response has been to continue with a combination of on-ground works and research, adjusting the strategy and works program allocations as our knowledge evolves.*

WATER SUPPLY SYSTEM EFFICIENCY

5.117 In 1993, controlling channel leakage in irrigation areas was identified as an opportunity for reducing groundwater recharge and increasing system efficiency. We recommended tree planting to intercept leakage from irrigation supply channels, with the associated costs of improving the efficiency of water delivery systems being shared by beneficiaries.

5.118 The Department of Natural Resources and Environment provided the following information in relation to determining cost sharing arrangements for improvements in system delivery efficiencies:

Through the process of providing Bulk Water Entitlements to Rural Water Authorities, the Government has established a framework where distribution losses have been quantified and requirements to reduce losses imposed and there is a direct financial incentive for Authorities to invest in seepage control and capture the water savings, which can then be sold. Government may invest directly in these works and claim a share of the savings in proportion to its investment. This strategy is being pursued as part of the program to return water to the Snowy River.

Costs are shared between government and the rural water customers in the programs to reduce channel leakage. An outcome of the full cost recovery policy is irrigator's pay for the bulk supply of water to the irrigation system including the system losses. This has provided a direct incentive for irrigators to reduce the losses in the system.

Cost of tree planting is shared 50:50 between the Government and landholders. During remodelling, cost share is negotiated on a site-by-site basis between the Department of Natural Resources and Environment and the irrigation authority.

Tree planting along channels is not now seen as a critical option for reducing losses. Other options are preferred.

5.119 Various authorities advised us of measures introduced to reduce leakage from open irrigation channels and evaporation basins into the groundwater system. We set out below specific responses:

- In the North-Central Region, priority works to reduce channel seepage have been continually implemented since 1990 by Rural Water Authorities and the Department. For example, in the Barr Creek catchment, jointly funded works between the State Government and the Goulburn-Murray Rural Water Authority have upgraded supply channels to reduce leakage and outfalls into drainage and groundwater systems. The Goulburn-Murray Rural Water Authority has maintained expenditure on these works in excess of \$80 000 per year;

- In the Woorinen area, plans to pipeline the horticultural district are well-developed and construction will commence shortly. The Goulburn-Murray Rural Water Authority estimates water savings of 2 100 megalitres⁵¹ per year will be achieved through the pipeline;
- While evidence indicates that groundwater seepage interception is not economically justified, the Goulburn-Murray Rural Water Authority treats specific areas through channel upgrades and tree planting adjacent to supply channels as part of Victoria's *Water for the Snowy* program. Costs are shared equally between landholders and government. Tree protection requirements during channel remodelling works are negotiated on a site-specific basis between the Goulburn-Murray Rural Water Authority and the Department of Natural Resources and Environment;
- The Sunraysia Rural Water Authority and the First Mildura Irrigation Trust have addressed irrigation channel leakage, which will have salinity benefits but is not part of the region's salinity management program; and
- The Wimmera Mallee Rural Water Authority has completed 5 of 7 stages of the Northern Mallee Pipeline to replace domestic and stock supply channels, which will result in water savings of 50 000 megalitres per year.

5.120 In confirming the Department's information with Catchment Management Authorities and the Goulburn-Murray Rural Water Authority, we are satisfied that adequate action has been taken to address our recommendation.

5.121 The adoption of water efficient farming practices is fundamental to both the irrigation and dryland salinity management plans. However, our specialists advised us that the most effective and direct methods for controlling irrigation salinity in the short-term are the adoption of engineering solutions, such as sub-surface drainage. Because these solutions create the risk of degrading water quality elsewhere when disposing of saline groundwater, management options have emphasised reduction of groundwater recharge through improved irrigation efficiency in irrigation areas. These methods include practices such as laser grading, re-use of sub-surface water, retirement of salinised land from agriculture and groundwater recycling.

5.122 The role of water efficient farming practice is just as critical in dryland agriculture areas where there is a greater need for farming practices to increase the use of rainfall by plants through, for example, the establishment of appropriate tracts of perennial vegetation.

5.123 The current most common measure of water use efficiency in irrigation enterprises is the economic water use efficiency measure (\$/megalitre) rather than environmental water use efficiency measure (megalitre of groundwater recharge per megalitre of applied water). These 2 measures are not interchangeable in many cases. Improved incentive systems and program responses are likely to result if the environmental water use efficiency is also applied.

⁵¹ Megalitre = one million litres, which is about the volume of an Olympic-sized swimming pool.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.123 Measure of environmental water use efficiency

An indicator for deep drainage is included on the Department of Natural Resources and Environment website. Further, the Department of Natural Resources and Environment co-ordinating group for on-farm water use efficiency is currently considering options for measures of water use efficiency in irrigation areas, which will reflect economic and environmental outcomes. The group recognises the benefits of environmental measures such as volume of recharge or deep drainage per unit of water applied. However, they involve severe practical problems as to measurement and accounting for the significant variation that occurs over space and time.

RESPONSE provided by Chief Executive Officer, West Gippsland Catchment Management Authority

Paragraph 5.121

In areas of moderate to highly permeable soils, conversion from flood to spray irrigation is considered the best solution. Where it is not possible or uneconomic, then higher flows on smaller laser-graded bays is considered the better option.

Paragraph 5.123

Water Use Efficiency should also be measured in terms of optimum pasture needs (megalitre/hectare) with anything beyond the optimum going to recharge or run-off.

COST-SHARING ARRANGEMENTS

5.124 In our 1993 Report, we recommended that:

- where major industries reap sizeable benefits from salinity control measures, they should be required to make direct or “in kind” contributions to share in the costs associated with on-ground works⁵²;
- avenues under which upstream communities would be required to bear some portion of the costs of salinity control in terms of their current activities should be investigated; and
- consideration should be given to penalties for landholders in upper catchment areas who clear native vegetation from their properties.

⁵² “On-ground” as opposed to bureaucratic costs, refers to where the action is taken, which is usually on privately-owned farm land.

5.125 In response to our inquiries in following-up the outcomes of our above recommendations, the Department of Natural Resources and Environment provided us with the following details:

Major industries

Cost sharing guidelines, where the primary beneficiary pays, are appropriate to cover the implementation of salinity measures. The major source of private investment is through farmers, either directly or through industry funding mechanisms. A salinity levy has also been applied to ensure all beneficiaries pay for the future cost of salt disposal in irrigated areas. This levy is charged based on the current cost of providing an EC credit under the salinity market created by the Murray-Darling Basin Commission.

Landcare Australia Limited (the Landcare Foundation in Victoria) collects significant levels of funding for research and development and on-ground works. The amount of sponsorships, tax deductible donations and licence fees received by Landcare Australia was \$2.67 million in 1998-99 and \$2.94 million in 1999-2000.

Upstream communities

Salt disposal and drainage rules require upstream communities to purchase salt disposal credits if they intend to invest in works that will increase salt loads such as drainage and new irrigation development. The purchase of credits offsets the impacts of the new activities.

Current knowledge indicates relatively weak linkages between upper catchment recharge areas and lower catchment discharge areas except for those linkages measured by stream salinities. For existing and projected future diffuse source salt loads arising from upper catchment areas, a whole-of-catchment approach is needed to efficiently manage the salt loads. Incentives for revegetation works in the upper catchment require a direct contribution from landholders.

Native vegetation clearance

Native Vegetation Clearance controls require a permit, issued by local government, for clearing, and fines are imposed for clearing without a permit. Native vegetation clearance is regulated by local government under the *Planning and Environment Act 1987*, through the Native Vegetation Retention controls for which the Department of Natural Resources and Environment is the referral authority.

The Department of Natural Resources and Environment works towards a net gain target with respect to the revegetation of native plants and local councils are encouraged to act similarly. Ensuring compliance with Native Vegetation Retention controls relies more on community education and participation to gain support for biodiversity policies than on enforcement.

5.126 An example of an innovative measure to involve industry in cost-sharing is a co-operative approach to jointly fund plantation expansion on recharge areas. Under the Department's proposal, the North East Catchment Management Authority and landholders are to jointly fund plantation establishment, while industry will lease the land for commercial forestry.

5.127 Catchment Management Authorities advised us that as part of cost-sharing arrangements, the Department of Natural Resources and Environment is investigating avenues under which upstream communities would be required to bear some portion of the costs of salinity control according to impacts on downstream, or "end of valley", salinity levels.

5.128 Based on information supplied to us by various Catchment Management Authorities, other examples of cost-sharing arrangements in certain catchments are:

- The North East Catchment Management Authority determines cost-share incentives for on-ground works according to the principle of beneficiary pays, which generally means "in kind" contributions by the community in the form of time, equipment and labour;
- Most costs of salinity control works in the Glenelg-Hopkins Catchment Management Authority region are borne by the farming community;
- In the Mallee "in kind" contributions at least match government contributions and landholders also fund private salinity control works;
- Landholders and the community in the Wimmera region have invested \$49.2 million in salinity control works over the past 10 years compared with the State's contribution of \$6.6 million and a Commonwealth input of \$1.1 million. This level of contribution is much higher than most of the estimates of community cost-shares by other Catchment Management Authorities; and
- Between 1993 and 1997, landholder contributions of \$6.7 million for salinity works in the Corangamite region are close to double the State's contribution of \$3.9 million over the same period, and industry funding since 1992 has totalled over \$2 million. The funds of the wool, grains, meat and livestock industries (\$1 million) and of a major export industry (\$1 million) based in the south-west, were made available for the following purposes:
 - to fund Landcare activities by the Woody Yaloak Catchment group since 1992 and to promote education in natural resources conservation and management by the Warrambeen Education Centre (East of Rokewood);
 - to develop wool production and land use sustainability programs;
 - to continue research and investigations into land use practices for the Sustainable Grazing Systems Program; and
 - to maintain sustainable cropping programs and an Environmental Management System Project.

5.129 Progress has been made with the farming community in relation to applying cost-sharing arrangements for on-ground salinity control works. We found that community and landholder contributions were higher than those made by agriculture industry groups. Local Government and urban communities had not, however, been sufficiently engaged or targeted for making “in kind” contributions for on-ground works.

Recommendation

5.130 We recommend that the Department investigate ways to further engage urban communities and local government to enhance the potential for “in kind” contributions for on-ground works.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraphs 5.129 to 5.130 Targeting urban communities and local government for in-kind contributions for on-ground works

There are numerous cases of urban communities contributing to Landcare projects. The Australian Trust for Conservation Volunteers has been one vehicle for in-kind contributions by urban residents to revegetation and other projects. Some local governments have rate rebates schemes for taking land out of production for landcare. While some work is already occurring in this area, it can be enhanced.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.129

Two water authorities and 2 councils in the Mallee have adopted rate rebate schemes for eligible non-productive land in their jurisdiction. For example, the Shire of Buloke and Shire of Hindmarsh are adopting rebate schemes for protected native vegetation under management agreement. Wimmera Mallee Water has a 100 per cent rebate for salt-affected land undergoing treatment and for protected remnant vegetation. This latter rebate covers the full-cost of the area component of the water tariff - \$2.80 per hectare if criteria are met. These schemes have been initiated or encouraged by Catchment Management Authorities for multiple outcomes. The Mallee Catchment Management Authority submission to the performance audit mentioned irrigation levies on water use by growers. A similar levy is also paid by urban water users in Sunraysia. There is also a salinity levy applied to transferred water for new irrigation development. These funds are held in trust for future works to offset salinity impacts as mentioned in paragraph 5.125.

CONCLUDING AUDIT COMMENT

Extent and impact of watertables

5.131 Watertable depth is now accepted nationally as a measure to assess the salinity risk of a region. Changes in watertable levels in irrigation areas over the last 10 years show a declining trend. This is due to a combination of the State's salinity management initiatives and the prevailing dry climatic conditions across Victoria over the period. The effectiveness of the State's salinity management initiatives in irrigation areas will become more evident in future periods of extended, wet climatic conditions. Under the same dry climatic conditions, however, there has been a long-term trend in rising watertables in most of the State's dryland agricultural regions.

5.132 Since 1990, the salinity levels in Victoria's rivers and streams have not followed a consistent Statewide trend. Decreasing salinity was evident in the Corangamite and Port Phillip catchment regions covering the southern central region of Victoria. Increasing salinity was evident for rivers and streams in the western and north-western regions of the State, within the responsibility of the North Central, Wimmera and Glenelg-Hopkins Catchment Management Authorities. In the eastern half of the State, salinity was predominantly stable.

5.133 Stream salinity in the Lower Loddon and Avoca Rivers, and for several major rivers in south-western Victoria (e.g. the Barwon and Hopkins Rivers), already exceed benchmarks for water quality set by the Murray-Darling Basin Commission.

5.134 Official predictions are that there will be a 10-fold increase in the area affected by salt by 2050. Official estimates put the direct cost of salinity in Victoria at \$50 million per year. Independent reviews predict that the annual cost of salinity due to lost agricultural production will increase to between \$77 million and \$166 million by 2050. As well, salinity impacts on rural and regional infrastructure and the environment, including plants, animals, rivers, soils, aquifers and wetlands.

5.135 In view of these projections, it is not surprising that the Department of Natural Resources and Environment views salinity as one of the greatest natural resource management challenges in Victoria. The Department has recently conceded that it is too late to eradicate or control salinity and that it has to be managed to some acceptable level of impact in the future.

Recent initiatives

5.136 Recent initiatives include the release of Victoria's 2000 *Salinity Management Framework*, which includes a series of directions and targets to guide future action. Earlier actions included the incorporation of salinity management as a component of an integrated catchment management program, the creation of Catchment Management Authorities to develop and co-ordinate regional catchment strategies and community involvement in the State's Salinity Management Program, established in 1988.

Landcare

5.137 Landcare originated in Victoria in 1986 to become a national voluntary movement involving community groups in the restoration of local land and water resources through government-funded programs. The number of Landcare groups has increased substantially in Victoria over the past decade. In 1998 there were between 25 000 and 30 000 volunteers in approximately 890 Landcare groups.

5.138 Recent departmental surveys of trends in on-ground works undertaken by Landcare groups show that more effort could have been spent on activities that directly impacted on salinity. Much activity focussed on weed control, pest animal control, tree planting or remnant vegetation protection, which although indirectly related to revegetation for salinity control, may have had only a limited impact on the amount of water entering groundwater systems. The surveys also indicated that there was only limited co-ordinated activity across regional groups and we were informed that Landcare onground activities were not necessarily aligned with priorities set in the regional management plans of Catchment Management Authorities.

5.139 Although the Landcare movement in Victoria has facilitated a positive change in the attitude of landowners towards the environment, this increased awareness has not resulted in the widespread adoption of sustainable agricultural systems or practices at the levels believed necessary to alleviate the salinity problem in dryland areas. Surveys conducted by the Department also indicate that the Landcare movement in Victoria has reached its limits in terms of growth and penetration of the farming community. Nevertheless, Landcare remains a central plank of the Government's implementation strategy for the revegetation targets under its 2000 *Salinity Management Framework*.

5.140 Salinity management activities across Victoria over the past decade, mostly through Landcare, have achieved most of their annual salinity management plan targets for perennial pasture and native revegetation. Based on their past 10-year achievements, only 2 of the 10 Catchment Management Authorities, namely, the North Central and Glenelg-Hopkins Catchment Management Authorities, will reach their 30-year dryland salinity management plan targets for perennial pasture establishment. In relation to native revegetation, only the Goulburn Broken Catchment Management Authority will meet its 30-year target. The remaining Catchment Management Authorities may reach their 30-year revegetation targets, depending on funding levels, community commitment and the success of strategies under the 2000 *Salinity Management Framework*.

5.141 The 30-year revegetation targets set in the dryland salinity management plans of the early to mid-1990s, which equate to some 1.1 million hectares, are only a sixth of the estimated catchment area of 6.9 million hectares inferred in the 2000 *Salinity Management Framework* and now understood as needing revegetation. In view of the massive scale of the revegetation required by 2015, and the rate of revegetation for salinity management to date, there is a risk that the proposed regional-scale revegetation targets under the 2000 *Salinity Management Framework* will not be achieved.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.138 Allocation of effort by Landcare groups and integration of Landcare activities with regional plans

Landcare groups are voluntary autonomous community groups, which have a wider range of objectives than just salinity control. They make significant in-kind voluntary contributions in addition to government grants they receive, and clearly retain a degree of autonomy. It has been estimated that groups invest 4-5 dollars for every dollar of government assistance. Nevertheless, most of their works will have some cumulative benefit for the control of salinity recharge or treatment of salinity discharge.

The activities mentioned in the audit report, such as weed control, pest animal control, tree planting and remnant vegetation protection, are major components of an integrated salinity program, while having multiple benefits. The control of pest plants and animals, for example, is often a prerequisite for successful revegetation. These techniques are part of an integrated natural resource management program, the approach now adopted by the Department of Natural Resources and Environment, Landcare groups, Catchment Management Authorities and industry (e.g. the Grains Research and Development Corporation).

There is, in fact, considerable co-ordination between Landcare group activities and regional plans due to the funding processes. To obtain government funding, Landcare groups need to meet the priorities set in Regional Catchment Strategies and specific action plans such as salinity and rabbit control plans. The majority of grants from regional allocations go to Landcare or community groups. Landcare groups play a critical role in planning and implementation of salinity programs at the sub-catchment level. Almost 70 per cent of groups are members of Landcare networks which facilitate co-ordination at a regional/catchment scale. The Government does invest in the facilitation of Landcare groups and encourages Landcare groups to work in clusters as part of this facilitation process.

Paragraph 5.140 Achievement of annual salinity plan targets, mostly through Landcare

Much of the on-ground work has been done by individual landholders, although they are undoubtedly influenced by the Landcare ethic and broader community objectives.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

Paragraph 5.138

The statement made here that pest animal control, tree planting and remnant protection have little benefit on recharge control is not valid. This aspect of recharge is one of 2 major thrusts of the Mallee Dryland Salinity Plan. Landcare groups tackling these issues are meeting regional priorities. The other major thrust of the Mallee Dryland Plan is the use of deep-rooted perennial pasture (income) in the long-term annual cropping rotation. This priority has not been widely adopted by dryland farmers. In view of the fact that all funds going to Landcare groups must pass the scrutiny of the Regional Assessment Panel, and the basis of assessment in the Regional Priorities Document, the Mallee Catchment Management Authority is confident that projects meet priorities.

Paragraph 5.140

The same issue of reporting against the source of funds is relevant here as in response to paragraph 5.70.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.138

Comments on poor integration are not supported. Priorities are set by the Regional Catchment Strategy (under review) and relevant action plans. Landcare groups have to retain some autonomy and cannot be dictated to by the Government.

Paragraph 5.140

It is important to highlight individual landholder efforts in land management, not just Landcare on its own. Landcare groups play a critical role in planning and implementation of salinity programs at the sub-catchment level.

Private forestry plantations

5.142 The Department advised us that commercial forestry plantations established since 1995, covering a total area of 284 575 hectares, have not generally been located in the critical landscape areas of highest recharge. These critical areas are in the lower rainfall regions of the State, where plant-based solutions are effective in limiting the amount of water entering groundwater systems. The Department further advised us, however, that 19 248 hectares in native tree plantings from 1990 to 1998, were planted in high recharge areas.

5.143 The private forestry industry is rapidly expanding in Victoria and presents an opportunity for the Government to encourage this trend as a strategy under its 2000 *Salinity Management Framework*. Before the Government considers further incentives for private forestry plantations in Victoria, their potential impacts on catchment water yield, socio-economics and the environment need to be balanced with industry development, to achieve desired, long-term dryland salinity management outcomes.

Preparedness for the emerging salinity challenge

5.144 This audit highlights the following key areas where further action is required:

- Apart from mapping the wetlands and National Parks threatened by salinity in northern Victoria and in parts of the Corangamite catchment region, the Department has not comprehensively identified public infrastructure or biodiversity assets at risk from salinity and has not prioritised key assets for protection, based on assigning values to those assets, on a Statewide basis. It therefore has a limited information base for decision-making;
- While action is underway to improve cost-benefit analyses to inform decisions about the direction of salinity management, the incorporation of environmental and socio-economic considerations has not reached the level of sophistication signalled by us in 1993. The Department is of the view that qualitative assessments of social and environmental values are more feasible than assigning economic values to these non-economic considerations. However, the use of economic discount rates to decide on salinity investment options, without factoring in all social costs and environmental benefits, may not result in ecologically sustainable developments;

- There is scope for expanding mechanisms to encourage structural readjustment in dryland farming communities for the purpose of managing recharge (i.e. limiting the amount of water entering the groundwater system) in high risk salinity areas. For example, incentives could be created to encourage greater aggregation of rural land holdings. The Department is developing a model of land stewardship for the Wimmera and North East catchment regions. This concept could be developed Statewide for landholders of small farms, to further encourage the adoption of sustainable land use practices;
- We acknowledge that the Department is currently in the process of revising the Government's 1997 *Private Forestry Strategy* and has been influential in promoting the development of a plantation forestry industry in Victoria. There is further scope, however, for the Department to develop policy instruments, incentives and environmental assessment tools to achieve the scale of revegetation works needed under the Salinity Management Framework. As indicated earlier, based on past revegetation achievements, we do not believe that the revegetation targets under the Framework will be met;
- Although the Department has researched plant-based solutions for dryland salinity for some time, according to specialist advice this effort has not been as comprehensive as national approaches. There is scope for improving the level of understanding in relation to the applicability, feasibility and impacts of dryland salinity management options at both the local and regional-scale;
- There is room for enhancing accountability mechanisms associated with the State's Salinity Management Program. Objectives and performance indicators covering the productive capacity, environmental quality and the social well-being in salt affected areas can be strengthened, as well as the reporting of these matters in the Department's annual report to Parliament; and
- While it is acknowledged that there are positive features of the current institutional arrangements, a greater involvement of all major internal and external agency stakeholders and greater access at local and regional levels to technical information, is required in the future implementation of the Program;

5.145 Given that the Department has acknowledged that salinity remains a substantial and growing issue that represents one of the greatest challenges for natural resource management in Victoria, research should be targeted urgently at:

- better understanding the extent and impacts of the dryland salinity problem; and
- developing sustainable farming systems⁵³ or other land uses that can be widely adopted for their intrinsic commercial value.

⁵³ A sustainable farming system is one that does not degrade the natural resource base over time, that is, it employs farming practices that have minimal impacts on water balance, soil structure and chemistry, nutrient levels, and on plants and animals.

5.146 Such research may have a positive long-term impact in reducing the need for large contributions from the public purse into perpetuity. However, managing for a commercial return on agricultural production in marginal areas may not be possible. In this latter scenario, we believe the difficult question for government will be who is going to bear the cost of “living with salt” in those marginal areas where agriculture proves to be uneconomic, but farming is to continue.

Audit conclusion

5.147 The State’s Salinity Management Program has had a much greater impact on managing salinity in the State’s irrigation areas than in dryland regions. This is due mostly to a greater knowledge of irrigation salinity, resulting in the implementation of management options in irrigation areas at a much earlier stage than for dryland areas. While dryland salinity has been recognised in Victoria for a number of decades, the enormity of the problem and its fundamental, long-term impact on overall river and stream salinity have only recently been appreciated.

5.148 There are major challenges and constraints faced by government authorities and the community in managing the salinity problem. These challenges are shared nationally, and relate to:

- Substantial uncertainties in assessing the extent and impact of dryland salinity, the management options and their effectiveness due to imperfect scientific knowledge in the area;
- The need to maintain impetus and continue to build the knowledge base in salinity management in irrigated areas, given the gains already made;
- Increasing the adoption of new land management practices by landholders, while acknowledging their limited financial capacity and uncertainty regarding the financial viability of any new practices. Landholders will be expected to invest in salinity management options essentially for future generations, because the investment, particularly in dryland salinity management, has a lengthy payback period. Our observations indicate that commercial incentives and commodity prices are more likely to have a greater influence on changes in land use management practice than incentives that could be funded by government;
- The difficulty in directly measuring outcomes due to the time lag of 50 years or more between action taken and the realisation of any impact; and
- The confounding influence of climatic variations on groundwater levels, which complicates the analysis of watertable trends.

5.149 Bearing in mind the difficulty in dealing with these issues and the uncertain effect that they may have on the success of the Government's long-term Salinity Management Program, we are reasonably assured that Victoria is moving in the right direction in implementing the State's 2000 *Salinity Management Framework*. However, the size of the problem is so enormous that proposed actions may not be sufficient to effectively manage salinity. While some progress has been made in attending to our 1993 recommendations, the audit revealed that some recommendations had not been adequately addressed by the Department of Natural Resources and Environment. Attention directed at the matters raised in this follow-up report will enhance the quality of decision-making by promoting the identification of appropriate options and funding priorities for the next phase of salinity management in Victoria.

RESPONSE provided by Secretary, Department of Natural Resources and Environment

Paragraph 5.147 Impact of salinity program on irrigation and dryland areas.

A major reason for the greater success in irrigation regions is their greater capacity to pay for works (due to the higher productivity), allowing the generation of greater investment from the private and industry sector. They have also found more cost-effective solutions, such as groundwater pumps, which can demonstrate more certain and quicker benefits than revegetation in dryland catchments. Nevertheless, the achievements in irrigation areas are threatened by growing salinity in dryland areas, and an integrated approach is necessary.

RESPONSE provided by Chief Executive Officer, Mallee Catchment Management Authority

The focus of the audit has been on irrigation and dryland salinity, however, there could be greater emphasis of obligations under various agreements to protect the Murray River from the impact of salinity. Linkages to the Murray River as a recipient of discharge from both dryland and irrigation areas are not strong enough.

RESPONSE provided by Chief Executive Officer, North East Catchment Management Authority

Paragraph 5.144

The lower Ovens River is a declared Heritage River under the Heritage Rivers Act for its environmental values, and it is affected by a rising trend in salinity.

The following general comments are made in relation to the report:

- *Overall the document is a good reflection of the current situation.*
- *Social issues are driving many of the changes in farming systems in the North East region. This factor makes decisions based entirely on economic values unviable.*
- *Planning for the National Action Plan for Salinity and Water Quality does not include the North East region.*
- *The complex structure of institutional arrangements and partnerships has not been reflected in the document.*
- *There is a lack of reference to water authorities and local government, particularly in their involvement in planning activities.*
- *It cannot be expected that all new land uses will be commercially viable. It can be expected that there will be a net financial cost in some cases, but the particular measures may be worthwhile for environmental and social aspects.*

Appendix A

Reviews undertaken, 1990 to 2000

The Department of Natural Resources and Environment provided the following list of reviews undertaken since 1994 for issues and Salinity Management Plans under the Victorian Salinity Management Program:

- Independent Review of the Environmental Aspects of Northern Victoria's Surface Drainage Programs in Irrigation Areas, Nolan-ITU, for Department of Natural Resources and Environment and Murray-Darling Basin Commission, 2001.
- Management Audit of the Public Groundwater Pump Programs in the Shepparton and Lake Wellington Irrigation Areas, Department of Natural Resources and Environment, CAW & URS.
- Management Audit of Proposed Drainage for the Wandella Catchment, Department of Natural Resources and Environment, CAW.
- Management Audit of the Development of the Shepparton Surface Drainage Program, Department of Natural Resources and Environment, CAW.
- Management Audit of the Implementation of the Nyah to the South Australia Border Salinity Management Plan, Department of Natural Resources and Environment, CAW.
- Review of How Goulburn Murray Water Cost their Bills.
- Review of the Channel Leaks and Outfall Program in the Tragowel Plains, Department of Natural Resources and Environment, CAW.
- Review of Salinity Monitoring Sites in Corangamite, Department of Natural Resources and Environment, CAW.
- Review of the Sustainable Farm Irrigation Program.
- High Impact Zones (HIZ) and Low Impact Zones (LIZ) – Salinity Risk in the Mallee Region (Tim Cummins).
- Review of the Loddon Murray Surface Drainage Strategy, SKM, in progress.
- Review of the Shepparton Irrigation Region Surface Drainage Strategy, SMEC, in progress
- Review of the Shepparton Irrigation Region Sub Surface Drainage Strategy, SKM, in progress.
- Five year Review of the Shepparton Irrigation Region Salinity Plans, Goulburn Broken Catchment Management Authority.
- Mallee Salinity Management Plans: Simultaneous Review, Dec. 1999, SKM & Mallee Catchment Management Authority.
- Independent Economic Review of the Lake Wellington Salinity Management Plans, Reid Sturgess.
- Review of the Barr Creek Catchment Management Plan.

- Review of the Implementation of the Tragowel Plains Salinity Management Plan – “Tragowel Plains – The Success Story” by Julie Brookman & Deidre Stevens, Department of Natural Resources and Environment, 2000.
- Review of Research & Investigation Program of Goulburn Broken Dryland Salinity Management Plan, Brian Garrett, 1998.
- Review of the Goulburn Broken Dryland Plan.
- Review of the North Central Dryland Plans.
- Managing Dryland Salinity with Vegetation in North East Victoria, by C.Clifton, M.Reid and P.Ockenden, Sinclair Knight Mertz report for Department of Natural Resources and Environment and North East Catchment Management Authority, 2000.
- *Strategic Review of Sustainable Dryland Agriculture and Land Management Program Key Project in Victoria*, Catchment Management and Sustainable Agriculture Strategic Review 1-99, Department of Natural Resources and Environment and Victorian Catchment Management Council, 1999.
- *The Salinity Audit of the Murray Darling Basin*, Murray Darling Basin Commission, 1999.
- *Australian Dryland Salinity Assessment 2000*, Natural Heritage Trust, National Land and Water Resources Audit, 2001.
- National Dryland Salinity Program Review 1998.
- Review of the Statewide Planning Policy for Salinity Control.
- Review on the Use on Salinity Management Overlays in the Victorian Planning Scheme.
- Mid Term Review of investment in salinity management, Natural Heritage Trust.
- Sustainable Irrigation Development Review: Irrigation Land and Water Management Plan Implementation Targets and Achievements, Department of Natural Resources and Environment (Kularatne, Gyles & Morris), 2001.
- Midterm Review of Research Project: Improved Irrigation Practices for Forage production, Clive Lyle & Associates Pty. Ltd. March 2001.

Appendix B

Interviews conducted and key publications examined

INTERVIEWS CONDUCTED

Department of Natural Resources and Environment

- Peter Sutherland, Executive Director, Catchment and Water Division.
- Chris McRae, Director, Land Management.
- Campbell Fitzpatrick, Director, Water Resource Management.
- Shawn Butters, Science Director, Centre for Land Protection Research.
- Rod Taylor, Co-ordinator, Sustainable Irrigated Agriculture and Land Management.
- Caroline Douglas, Manager, Policy Integration.
- Carolyn Balint, Team Leader, Landscape Change.
- Helen Anderson, Salinity Officer, NRE South West Region.
- Greg Bell, Manager, Sustainable Agriculture and Land Management, South West Region.
- Ken Sampson, Co-ordinator, Shepparton Irrigation Region Catchment Strategy.
- Mark Reid, Hydrogeologist, Centre for Land Protection Research, Bendigo.
- Neil Barr, Senior Customer Research Officer, Centre for Land Protection Research, Bendigo.
- Steve Lottowitz, Research Officer, Centre for Land Protection Research, Bendigo.
- Greg Turner, Northern Irrigation Region.
- Craig Dyson, Centre for Land Protection Research, Bendigo.
- Neil Smith, Centre for Land Protection Research, Bendigo.
- Ken Ashton, Program Leader, Northern Irrigation Region.
- Bill Loane, Co-ordinator, Salinity Follow-up Audit by the Auditor-General.
- Danny O’Neil, Consultant, Salinity Follow-up Audit by the Auditor-General.

Catchment Management Authorities

- Colin Dunkley, CEO, Glenelg-Hopkins Catchment Management Authority.
- Alan Bassett, Corporate Manager, Glenelg-Hopkins Catchment Management Authority.
- Peter Codd, Land and Biodiversity Manager, Corangamite Catchment Management Authority.
- Bill O’Kane, CEO, Goulburn-Broken Catchment Management Authority .
- Carsten Nannestad, CEO, North Central Catchment Management Authority.

Independent sources

- Christine Forster, Chairperson, Victorian Catchment Management Council.
- Dr Barry Hart, Member, Victorian Catchment Management Council.
- Professor Russell Mein, Director, Co-operative Research Centre for Catchment Hydrology.
- John Ginnivan, Manager, Goulburn Murray Rural Water Authority.
- Craig Clifton, Senior Scientist, Land and Catchment Management, Sinclair, Knight, Merz (contracted to the Department).
- Ray Evans, Salinity Specialist (contracted to the Auditor-General for the Salinity Follow-up audit).
- Clive Lyle, Salinity Specialist (contracted to the Auditor-General for the Salinity Follow-up audit).

KEY PUBLICATIONS EXAMINED

Byron, I., Allan Curtis and Michael Lockwood 1999 *Providing improved support for Landcare in the Shepparton Irrigation Region*, Johnstone Centre, Charles Sturt University.

Curtis, Allan and Marike Van Nouhuys 1999 *Identifying Landcare group needs: A survey of Landcare groups in South West Victoria*. Department of Natural Resources and Environment. The Johnstone Centre, Charles Sturt University.

Curtis, Allan 1999, *Landcare: Beyond Ongoing work*, Natural Resource Management.

Curtis, Allan 2000 *Landcare Approaching the Limits of Voluntary Action*, Australian Journal of Environmental Management, Environment Institute of Australia, March 2000.

Murray-Darling Basin Commission, *Salinity Audit 1999: A 100-year Perspective*, Murray-Darling Basin Ministerial Council.

Murray-Darling Basin Commission, 1999 *Salinity and Drainage Strategy, Ten Years On* Murray-Darling Basin Ministerial Council.

Murray-Darling Basin Commission 1997 *Salt Trends: Historic Trend in Salt Concentration and Salt Load of Stream Flow in the Murray-Darling Drainage Division*, Dryland Technical Report No. 1.

National Land and Water Resources Audit, *Australian Dryland Salinity Assessment*, 2000.

National Land and Water Resources Audit, *Extent and impact of dryland salinity in Victoria*, November, 2000.

National Natural Resource Management Task Force, *Managing Natural Resources in Rural Australia for a Sustainable Future*, December 1999, Agriculture, Fisheries and Forestry Australia.

Neil Barr, John Cary 2000, *Influencing improved Natural Resource Management on Farms, A Guide to understanding factors influencing the adoption of sustainable resource practices*, August 2000, Bureau of Rural Sciences and Centre for Land Protection Research.

Parliament of the Commonwealth of Australia, House of Representatives Standing Committee on Environment and Heritage, *Report of the Inquiry into Catchment Management*, December 2000.

Petheram, Dr. R J, Andrew Patterson, Dr Kathryn Williams, Braden Jenkin and Ruth Nettle(2000) *Socio-economic Impact of Changing Land Use in South West Victoria*, Institute of Land and Food Resources, University of Melbourne.

Walker, Glen, Mat Gilfedder and John Williams 1999 *Effectiveness of Current Farming Systems in the Control of Dryland Salinity*. CSIRO Land and Water Division.

Appendix C

Glossary of terms and abbreviations used

GLOSSARY OF TERMS

Agroforestry	Forestry conducted on farms that are primarily used for producing other primary products such as meat, wool or cereal crops.
Agronomy	The study of the growing of crops and plants, e.g. saline agronomy includes the study of potential of halophytes (salt-adapted plants) for animal fodder and saline aquaculture.
Airborne geophysics	Remote sensing technique using electromagnetic surveys of the earth's surface to detect underground resources, e.g. salt stores, aquifers and rock types.
Annual	Plants that only live for one growing season.
Aquaculture	Cultivating aquatic (marine and freshwater) plants and animals, such as fish.
Aquifer	A layer of rock below the surface of the ground which stores and allows water to move through it, and from which water can be extracted.
Biodiversity	The biological diversity or variety of all living organisms e.g. plants, animals, bacteria and ecosystems e.g. rainforest, grassland.
Biophysical	The biological and physical natural resources of a region, e.g. soil, water and vegetation.
Cap	The water cap was established by the Murray-Darling Basin Commission to regulate the volume of water diverted from the Murray River for economic development.
Discharge	The seepage or evaporation of groundwater at the soil surface as a result of high water tables and/or depressions in the landscape.
Dryland salinity	All non-irrigated agricultural land affected by salting, either through natural or induced causes, or a combination of the two. Dryland farming includes grazing e.g. sheep and cattle, and cropping e.g. wheat and oats.
Ecologically sustainable development	Based on development principles that aim to ensure the ongoing supply of renewable resources for future generations.
Electrical conductivity (EC units)	Electrical conductivity (EC) provides an estimate of the salinity of water. 1 EC unit = 1 micro Siemens per cm, at 25°C.
End of valley targets	Salt load targets established for the confluence of key rivers under the Draft Murray-Darling Basin Salinity Strategy in response to the dryland salinity problem.
Evaporation basin	A shallow lake or pond into which saline surface water is deposited to allow it to evaporate, leaving behind a residue of concentrated salts.
Farm re-use systems	Systems for recycling water on farms, such as a lagoon to capture the water used to wash out a dairy, which is then used to irrigate crops or pasture on the farm.
Flushing	Introducing a new volume of water to a lake to replace the existing volume, which is either washed out of the lake through the outlet or, for terminal lakes (those without an outlet), washed through to the groundwater.
Geographic Information Systems (GIS)	Electronic mapping systems that store data on biophysical resources. GIS enables overlays of information to assist in the identification of priority areas within a region, e.g. identify land uses at risk of salinity by overlaying a land use map and a shallow water table map.

GLOSSARY OF TERMS - *continued*

Geology	Scientific study of the earth's origin, structure, composition and processes.
Geophysical	The physical characteristics of a region in terms of its geology.
Geospatial	The location of geological features within the landscape.
Groundwater	All free water found beneath the earth's surface, in layers of the
Groundwater recycling	Good quality groundwater is used for surface applications and returned back to groundwater following use if the quality is still acceptable.
Hydrogeology	The study of groundwater and its interaction with geological features.
Hydrology	The study of the physical or hydraulic properties of water in the landscape, such as the flows of groundwater, floods, rivers, or the changes in dam levels according to inputs and outputs.
Integrated Catchment Management	Managing catchments for a balance of environmental biophysical resources, social and economic outcomes.
Irrigation salinity	Irrigated agricultural land affected by salting, either through natural or induced causes, or a combination of the 2. Irrigation farming includes dairying, horticulture e.g. fruit trees and vegetables, cropping, e.g. barley and cereals, and grape growing.
Landscape processes	Processes of water recharge, discharge and movement through the various rock and soil profiles of the land.
Laser grading	The use of laser technology in grading a paddock, to form a slight slope across the paddock so that irrigation water flows from one end of the paddock to the other.
Ley phase	A phase in cropping and annual pasture systems when the land is left to recover from the previous season's harvest.
Local groundwater systems	Groundwater systems that have recharge and discharge sites in close proximity and/or a shallow water table and respond rapidly to recharge.
Local level	The local level refers to landscape processes measured at the farm-scale, as opposed to regional or catchment-wide landscape processes.
Lucerne	A plant (alfalfa, a legume) used as perennial pasture.
Native vegetation	Plants that are native to Victoria, ranging from grasses and aquatic plants to shrubs and trees.
Nutrients	Chemical elements essential to plant and animal nutrition. Nitrogen and phosphorus are the 2 most common nutrients and the major components of fertilisers. In low concentrations they benefit plant and animal growth but in high concentrations they become pollutants.
Pasture	Grass or other plant on which livestock are grazed.
Perennial pastures	Pasture plants that live for more than one year.

GLOSSARY OF TERMS - *continued*

Phalaris	A plant used as perennial pasture, which has a deep root zone and a capacity to utilise greater amounts of rainwater than annual pasture species.
Recharge	The addition of water to groundwater from the surface through processes such as rainfall filtration through the soil and river water entering the water table.
Regional groundwater systems	Groundwater systems that respond more slowly to recharge due to large distances between recharge and discharge sites and/or a deep water table.
Salinisation	Degradation of the soil or water through the accumulation of salts. Land salinisation usually occurs in response to the rise of saline moisture from a shallow watertable. Water salinisation usually results from increasing salinity of run-off and groundwater.
Salinity	The concentration of dissolved salts in the water, measured as EC units. At high concentrations, these salts are detrimental to plants and animals.
Salinity credit	A salinity credit (or EC credit) is a measure of salinity that provides a guideline for the impact that a particular activity in a catchment might have on the end-of-valley salinity target. Landholders may not undertake activities that increase salinity unless they first invest in activities to reduce salinity, for which they gain credits. For example, if a salt interception scheme removes 8 EC of salt from a river, this beneficial impact would give rise to a salt credit of 8 EC. This credit could be used to offset any activities that would worsen salinity by up to 8 EC.
Second generation salinity management plans	Revised and updated versions of the 21 Salinity Management Plans originally developed for Victorian catchments in the early 1990s. The second generation plans will be completed by September 2001.
Sub-surface drainage	Method of removing excess moisture from below the ground's surface, e.g. pumping groundwater to surface disposal areas to lower the watertable.
Sustainable agriculture	The use of farming practices and systems that maintain or enhance: the economic viability of agricultural production; the natural resource base; and other ecosystems influenced by agricultural activities.
Watertable	The upper level of groundwater, above which the soil is not fully saturated - as shown by the level of groundwater in a bore.
Water yield	The amount of rainwater flowing from a given area of the earth's surface, such as a catchment, and collected, e.g. in rivers and water storages.

ABBREVIATIONS USED

ANZECC	Australian and New Zealand Environment and Conservation Council
CALP Board	Catchment and Land Protection Board
CAS	Catchment and Agriculture Services (DNRE)
CAW	Catchment and Water Division (DNRE)
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organization
EPA	Environment Protection Authority
GIS	Geographic Information System
HIZ	High Impact Zone
LIZ	Low Impact Zone
NLWRA	National Land and Water Resources Audit
NRE	Department of Natural Resources and Environment
RAMSAR	A Convention on Wetlands of International Importance (Ramsar, Iran, 1971)
SCARM	Standing Committee on Agriculture and Resource Management
SKM	Sinclair Knight Merz
SMP	Salinity management plan

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