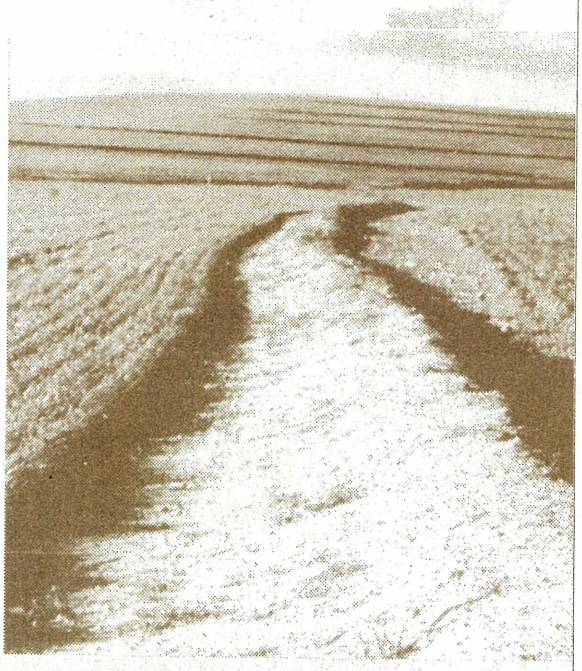
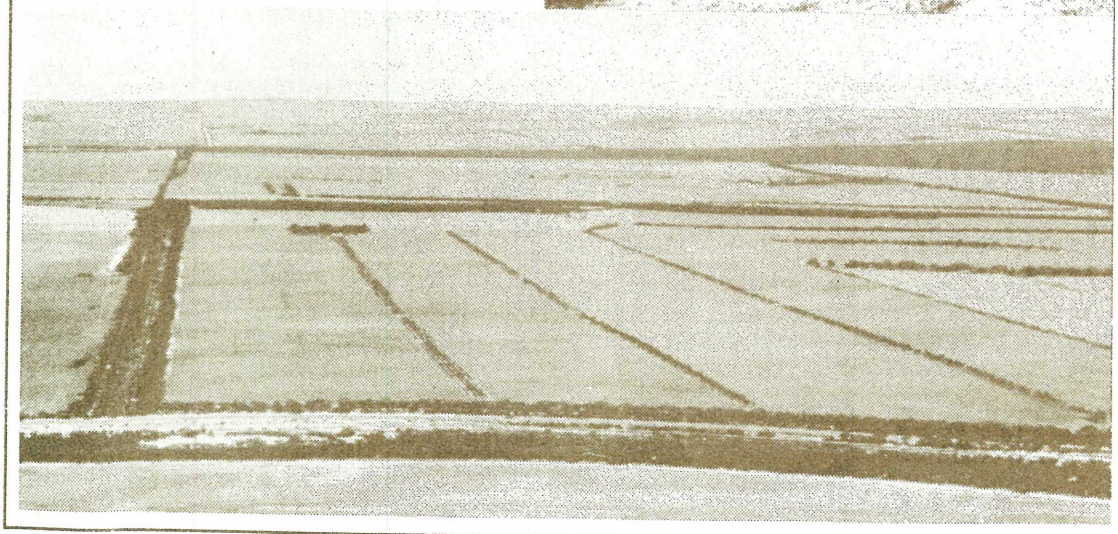
AGDEX 510

South Australian Agriculture

LAND MANAGEMENT





DEPARTMENT OF AGRICULTURE
SOUTH AUSTRALIA

January, 1992

LAND MANAGEMENT STRATEGIC PLAN FOR SOUTH AUSTRALIA

Towards sustainable land resource management . . .

January 1992

FOREWORD

This strategic plan is one of a series which has been developed for the principal South Australian agricultural industries and the services provided by the Department of Agriculture.

Agriculture contributes a greater proportion of returns to the State's economy than that of virtually any other state in Australia. It is therefore important to review the potential for the further development of agriculture in South Australia. These plans have been prepared by the staff of the Department of Agriculture in association with representatives of the respective agricultural industries and farmer organisations. The aim has been to identify the production potential and the market potential for the respective commodities and to thereby evaluate the opportunity which the state has to further develop its agricultural industries. At the same time, consideration has been given to identifying the most important issues to be addressed in the coming years to enable the state to achieve its maximum economic potential from agriculture. These plans will be valuable for determining the future provision of services to the rural community.

I should like to acknowledge the hard work and creative thought which both departmental staff and participants from industry and the farming community have put into the preparation of these plans.

John C. Radcliffe

(John C Radcliffe)
DIRECTOR-GENERAL OF AGRICULTURE

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EXECUTIVE SUMMARY

The Land Management Strategic Plan has been developed in response to the growing recognition, within government and across the community, of the need to change the way South Australia's land resources are managed in order to sustain their productive use and conservation. The *Decade of Landcare Plan for South Australia*, which was released on 15 January 1991 forms the basis for the Land Management Strategic Plan of the Department of Agriculture.

The *Decade of Landcare Plan for South Australia* was developed by the Soil and Water Conservation Branch with input from a wide cross-section of the community, government and non-government sectors. The South Australian Plan is a component of the National Decade of Landcare Plan, initiated by the Australian Soil Conservation Council. The Commonwealth, State and Territory Plans integrate action by governments, individuals and the community to address land degradation and land management issues in Australia for the decade and beyond.

Land resource degradation

The degradation of the land resources in South Australia has occurred since settlement and, even though much has been done in the past fifty years to address this degradation, it is still a major problem and is occurring through processes such as dryland salinity, soil acidification, vegetation decline and the activities of feral pests, especially rabbits. Land resource degradation affects all South Australians to some extent. In its various forms, land degradation is costing South Australia at least $120 million annually in lost agricultural and pastoral production. The effect of this degradation on the environment and the South Australian community as a whole is also of major importance.

Framework for action

The Plan provides an outline of the infrastructure and programs that are in place, at the government and community level, to facilitate and encourage adoption of sustainable land resource management practices.

The Plan builds on the community focus of Landcare, the legislative base of the *Soil Conservation and Land Care Act (1989)* and other related Acts, and the infrastructure established at the Commonwealth, State, and local levels. The Soil Conservation Council has been established under the Soil Conservation and Land Care Act and reports to the Minister of Agriculture. The Act also provides for the establishment of Soil Conservation Districts and Boards. Twenty six boards have been established, covering most of the State. Each board has a membership of 7 residents of the district and the responsibility to promote sustainable land management and, in conjunction with local government and community groups, develop and support sustainable land management. More than 150 community groups have become involved in the Landcare program and, where appropriate are linked with their local Soil Conservation Board.

The community groups and soil conservation boards operate mainly in rural areas, but interest in Landcare is also growing in urban areas and the education system has adopted landcare into the curriculum. The corporate sector and non-government organisations are also contributing to the awareness and adoption of Landcare principles. The Department of Agriculture, in cooperation with other departments, is developing guidelines and programs to facilitate the preparation and adoption of district land management plans by soil conservation boards, and property management plans by land managers.

The goal

The overall goal of the *Decade of Landcare Plan for South Australia* is that by the year 2000, the majority of land resource managers in the State will have adopted systems that incorporate the principles of sustainable land resource management.

In the setting of goals and priorities for the plan a number of principles are

recognised and these are summarised in the following points:

- all South Australians must be encouraged to take a share of the responsibility for adopting sustainable land resource management by the use of land within its capability whether it be for either productive or environmental purposes
- land resource management problems are complex and interrelated and require well-planned, integrated, and long-term solutions that take into account the financial factors and will not place unrealistic burdens on any one sector of the community
- the State Government is responsible for providing direction and assistance to the community in the area of land resource use and management; this can be achieved by ensuring that government policies and programs provide for sustainable use and management of the State's land resources and that they facilitate collaboration and cooperation between State, Commonwealth, and local government and the community.

Action programs

The Plan addresses twelve, major, land resource degradation issues providing detail on the issues, remedial measures, focus for action, and a list of action targets.

The twelve issues addressed are as follows:

- Decline in nutrient, physical and biological state of soils
- Water erosion
- Wind erosion
- Dryland salinity
- Soil acidification
- Water repellence
- Waterlogging
- Decline in native vegetation in the agricultural zone
- Decline of arid zone vegetation
- Undesirable plants and animals
- Irrigation management
- Water quality and quantity.

Eight management programs have been developed to address land resource degradation and to facilitate and encourage adoption of sustainable land resource management practices. Each action program includes an objective, key ten-year targets and a summary of current and future actions. The eight programs cover the following areas:

- Regional planning and coordination
- Landcare group support
- Farm improvement and assistance (extension, training etc.)
- Public land
- Land management policy review
- Education and community awareness
- Resource assessment (land class evaluation)
- Research and development.

An indication of the priorities for action is provided in a tabular form in the Plan. The twelve major land resource degradation issues are ranked as either high, medium, or low priority under the eight management programs. For example, dryland salinity is rated as being a high priority issue under most of the programs.

Implementation and review

The *Decade of Landcare Plan for South Australia* has been prepared to give direction and to identify needs and opportunities for involvement by individuals, community groups, government and non-government organisations. The Department of Agriculture, on behalf of the Minister of Agriculture, will take the main responsibility for implementing and reviewing most of the projects and sub-programs falling under the eight land management programs of the Plan. Many of these projects fall within the Department's land management program. Implementation, monitoring and review will require extensive collaboration and cooperation between and within government departments, local government, non-government organisations and local communities.

Current Department of Agriculture Land Management Program

The Department of Agriculture conducts a wide range of land management programs and projects. Funding is drawn from the State Government - $3.5 million in 1990/1991, and external sources - $3.0 in 1990/1991, for a total expenditure of $6.5 million on land management in 1990/1991. The National Soil Conservation Program (NSCP) provides the major portion of the external funding - $2.8 million in 1990/1991. In 1991/1992 the Land and Water Resources Research Development Corporation (LWRRDC) took over responsibility for funding research projects previously funded under NSCP. External funding is also provided under the Murray-Darling Basin Natural Resources Management Strategy. Approvals for NSCP and LWRRDC projects in 1991/1992 total $3.1 million compared to $2.8 million in 1990/1991.

The work force figures for 1990/1991 indicate that 56.5 full time equivalents worked on State funded activites and 40.6 on activities funded by external sources giving a total work force for 1990/1991 of approximately 97 full time equivalents.

1

WHY HAVE A PLAN ?

1.1 INTRODUCTION

Today, perhaps more than at any other time since settlement, South Australians are vitally interested in ensuring that the environment is passed on to future generations in a better or at least similar condition to that which the current generation inherited.

The land resource, consisting of soil, water, vegetation and wildlife habitat, comprises the most important natural resource of South Australia's environment. This resource is crucial to the welfare of the people of South Australia for food, primary products for export and local markets, water, and recreation, as well as for the conservation of the State's native plants and animals. The development of this resource is a chief reason for the current standard of living experienced in this State, but it has been at some cost to the land resource.

South Australian soils are fragile and particularly susceptible to degradation. The soils are old and of low fertility, and they are virtually a non-renewable resource. During the State's development, these soils have been subject to different degradation, such as wind and water erosion. As a result of extensive clearing for agricultural purposes and urban development, native vegetation cover in some areas has reached a critical low from a conservation perspective. The state of both the soil and the vegetation cover affects the quality and quantity of water that flows within a catchment and that is stored within the ground, and as a consequence, the water resources of the State have declined in quality.

Some of the current problems are a legacy from past farming practices. Overgrazing of perennial vegetation in the Arid Zone was a feature of early European settlement. Poor understanding of the ecosystem and pressures to exploit the land by early European settlers led to the destruction of much of the perennial vegetation in some areas of the arid zone from clearing and overgrazing, as well as to the consequential extinction of a number of animal species.

Problems caused by the settlers' introduction of exotic animals and plants continue. Rabbits and feral goats cause severe degradation by competiting for stock feed, damaging crops and native vegetation, and by preventing natural regeneration. The estimated annual loss in production from these two introduced animals is $24 million, with the major proportion occurring in the Arid Zone. The colonising of exotic weeds in areas of the State has also contributed to the degradation of the land resource by crowding out desirable native and introduced species, and affecting grazing pressures.

Much has been accomplished since the 1930s to redress land resource degradation, but considerably more needs to be done. Changes in attitude and practice are required to ensure careful and sustainable management of the land resource. These changes should reinforce the need to conserve the environment for future generations and to retain a sustainable financial return.

A strategy is needed that will accelerate reductions in land resource degradation. This strategy must provide the means to gauge the effectiveness of past and current action and to propose future action in response to emerging issues. Increasing community awareness of the causes and implications of land resource degradation, coupled with recent legislative and administrative changes adopted by the Government, place South Australia in a good position to address the major land resource management issues facing the State.

It is recognised that the ability to address all of the land management problems is limited by the current economic situation. The Government of South Australia is of the view that the current economic situation emphasises the need to develop a Decade of Landcare Plan, to ensure that sustainable land resource management occurs to protect industries and the environment in the long term.

It is also recognised that changes will only occur if different sections of the community work together in partnership. Such a partnership and spirit of cooperation will help to ensure the necessary action to arrest degradation and conserve the land resource.

1.2 LAND USE PATTERNS

The total land area of South Australia is approximately 98 million hectares (980 000 km^2) used for a variety of purposes:

- intensive and extensive animal and crop production
- productive forestry
- conservation of native flora and fauna
- aboriginal lands
- water catchment and storage
- recreation
- transport and other infrastructures
- urban settlement
- extraction of minerals and petroleum products
- education and training.

About twenty percent is used for agricultural production. The remaining eighty percent is used for pastoralism, aboriginal reserve lands and conservation (Map 1). Approximately $2 billion worth of agricultural commodities (farm gate value) are produced from the agricultural and pastoral lands each year.

1.3 LAND RESOURCE DEGRADATION

Land resource degradation means the decline in quality of the land and its resources, commonly caused by inappropriate human usage.

It includes soil decline and erosion and the deterioration of natural vegetation, landscapes and water resources. It encompasses the adverse effects of overgrazing, excessive tillage, erosion, sediment deposition, urbanisation,road construction, the introduction of weeds or feral animals, and the decline in native plant communities.

The major forms of land resource degradation are widely distributed across the State (Appendix 1): a summary is provided in Table 1. Some of the land degradation issues, such as dryland salinity, are increasing in magnitude.

The land resource degradation issues often have complex interactions. For example, soil can be predisposed to water erosion by excessive tillage or by overgrazing with feral goats. The resultant water erosion may cause sedimentation in a water storage facility and may affect water quality and quantity. Such complexities call for an integrated approach to the control and prevention of land resource degradation problems.

1.4 IMPACT OF LAND RESOURCE DEGRADATION

Environmental

Land resource degradation affects the environment in the following ways:

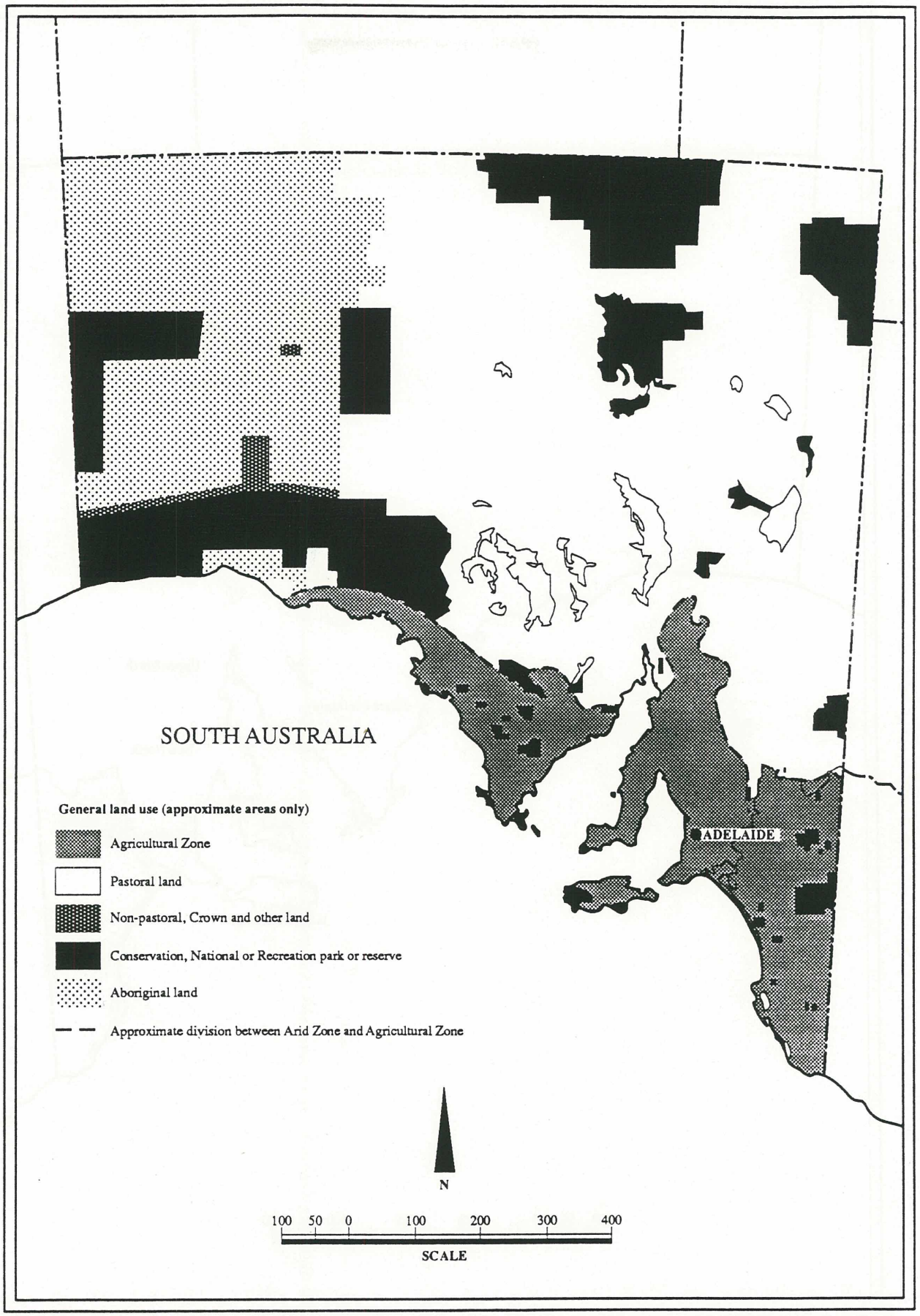
- genetic diversity is reduced because of vegetation decline and the subsequent effect on vertebrate and invertebrate fauna

- perennial species are lost and changes occur in flora and fauna associations

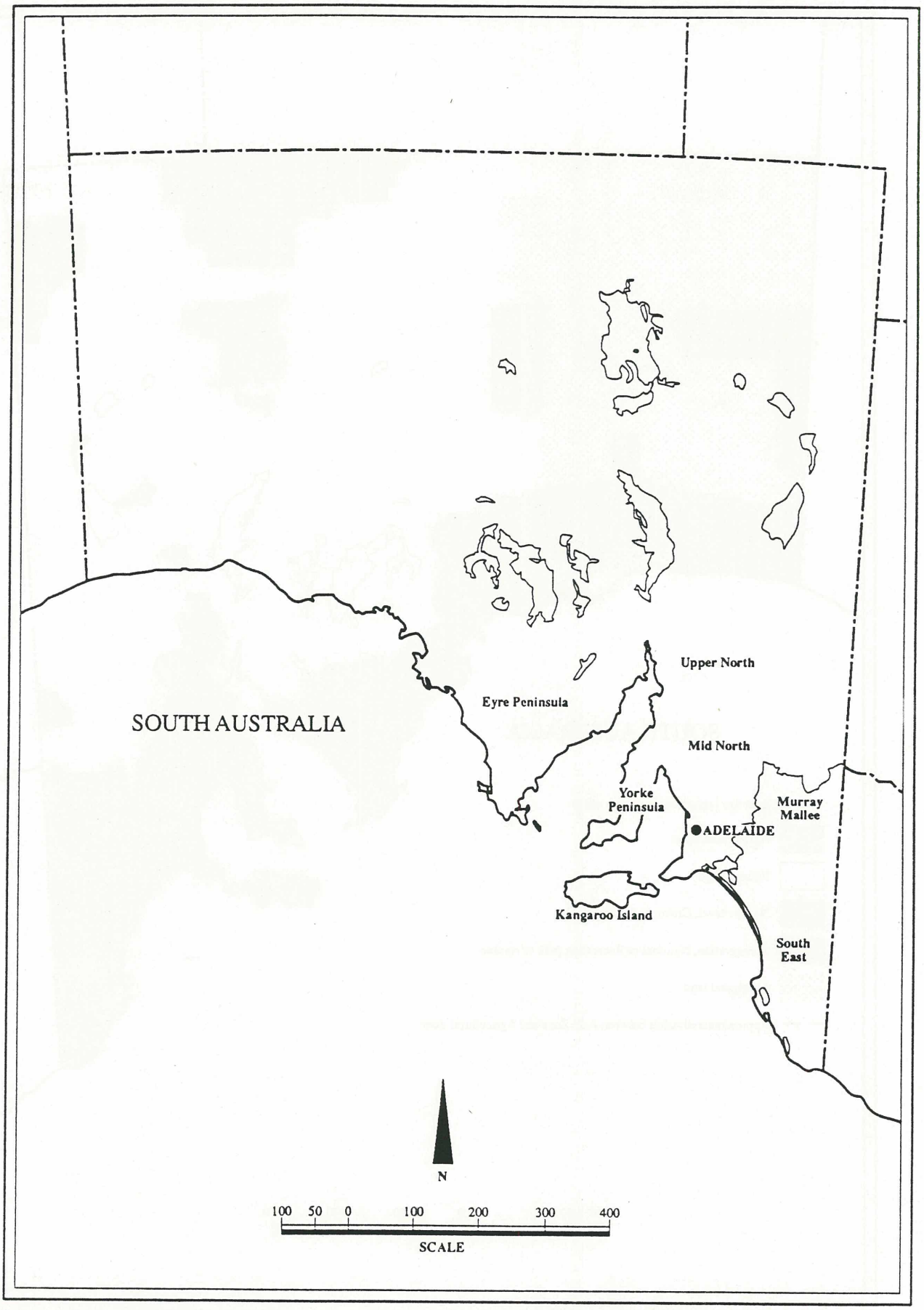
- diversity in the landscape is reduced severely as a result o f the loss of natural vegetation and the degradation of watercourses and drainage of wetlands

- remaining native vegetation is subjected to a wide range of land degradation pressures; for example in the South-east, a number of wetland swamps without natural drainage are subjected to increasing levels of salinity, which will result in the loss of their native vegetation and eventually the formation of salt pans

- water - based ecosystems lose aesthetic, natural, and recreational value as they are degraded; natural wetlands are among the most productive biological systems and their loss or degradation is a significant environmental problem; ultimately, these highly valued environments, and the plant and



Map 1: Land use and reserve areas of South Australia. Source: *General Reference Map of South Australia Edition 1*, Department of Lands 1990 and the *National Parks and Wildlife Act Reserves*, Department of Environment and Planning, June 1990.



Map 2: Regions of South Australia.

*Table 1: Major land resource degradation problems in South Australia: a summary**

- **Decline of the nutrient, physical and biological state of soils** due to inappropriate management practices is a problem throughout the State that causes an annual loss of approximately $60 million.

- **Water erosion** affects mainly duplex soils. It has the potential to affect 2.9 million hectares in the mid -north and Eyre Peninsula and extensive areas of the arid zone (Map 10).

- **Wind erosion** has the potential to affect 8.3 million hectares of agricultural land and much of the arid zone. Sandy soils, such as those found in the Mallee and on Eyre Peninsula and across 300 000 km^2 of the arid zone are affected particularly (Map 11).

- **Salinity** associated with rising groundwater levels affects more than 225,000 hectares of land on Kangaroo Island, Eyre Peninsula, Yorke Peninsula, in the mid-north, the Murray Mallee and the Upper South-east, and the area is increasing (Map 12). The annual loss of production to dryland salinity is valued at approximately $27 million.

- **Acidification of soils** is an increasing problem affecting the subterranean clover-based pasture country in the high rainfall regions of the South-east, Kangaroo Island, Mount Lofty Ranges and the higher rainfall cropping and livestock areas of the lower Eyre Peninsula and the lower, mid and upper north districts of the State. The total area of soils prone to acidification is estimated at 2.5 million hectares (Map 13). The annual cost of soil acidification is estimated as close to $10 million.

- **Water repellence** affects 2.2 million hectares of light-textured soils across the State: 1.5 million hectares in the South-east and southern Mallee, 0.5 million on Eyre Peninsula, and 0.2 million in the northern Mallee, Yorke Peninsula, and on Kangaroo Island (Map 14). The annual loss of production resulting from water repellence is valued at approximately $2 million.

- **Waterlogging** of soil affects mainly duplex soils— sandy topsoil over clayey subsoil— and poorly drained flats across the higher rainfall areas of the State.

- There is a **decline in extent and quality of the natural vegetation of agricultural lands** and an associated **loss of species diversity in both vertebrate and invertebrate fauna.**

- There is a **decline in the capacity of arid lands to maintain production and wildlife species diversity** due to the suppression of native vegetation species by the grazing pressure of domestic, feral, and native herbivores (Map 15). Such grazing pressure leads to long-term changes in surface cover and in the composition of native vegetation. The estimated annual loss to the pastoral industry from rabbits is close to $17 million (Map 16), with an additional $5 million loss in agricultural areas.

- There has been an **increase in undesirable plant and animal species** in both agricultural and arid zone lands. A wide range of exotic plants have colonised areas of land. Exotic animals include rabbits, feral goats, foxes and feral cats. These plants and animals have caused immeasurable problems across the State and have limited productivity and conservation of native plant and animal communities.

- **Salinisation of groundwater** occurs when water use exceeds recharge in groundwater aquifers used for irrigation. Excessive water application contributes to rising groundwater levels and **inflow of highly saline water into the River Murray** in the irrigation areas of the Riverland.

- There is a **decline in water resource quality and quantity** in surface and groundwater catchments, in wetlands, and along streams, due to increasing salinisation, turbidity, other contamination (eg bacteria, nutrients and chemicals), and siltation from soil erosion and urbanisation.

* loss figures are estimates based on research and production figures across the State.

Map 2 provides a general guide to the location of regions referred to in this table and in the plan.

animal species that live within them, may be lost altogether for future generations.

Economic

The loss figures provided in Table 1 are estimates based on research work by CSIRO and the South Australian Department of Agriculture, production figures for the various soil types, and the estimated areas affected. Experimental data collected by the Department of Agriculture indicates that severe wind or water erosion can reduce crop production by as much as 50-60 per cent in any one year on any particular site. The annual loss of agricultural and pastoral production from land resource degradation is estimated to exceed $120 million in South Australia. Dryland salinity (annual loss of $27 million) and salinisation of water sources are increasing in magnitude. The effect of overgrazing of the perennial vegetation in the arid zone by rabbits, feral goats and inappropriate numbers of domestic stock is cumulative. Not only is there an annual loss of $17 million from rabbits competing with stock, but there is the long-term effect on the perennial native vegetation to consider. Once eliminated it is difficult and costly to replace.

In recent years, the annual gross value of production from irrigated agriculture has averaged approximately $400 million, which represents close to 20% of the State's total agricultural production (gross value). A decline in the quality and sustainable quantity of the State's water resource will reduce the potential level of production from irrigation and substantially increase costs.

The cost of providing quality, potable water to urban communities is increasing, due to increases in the levels of salinity, major nutrients, and bacteria in catchment water. Farm water supplies are being affected by these contaminants also. Some land managers are being forced to find alternative sources of water, which incurs considerable cost. Maintenance of water-dependent industrial output and future urban expansion will be affected by the availability and cost of water of suitable quality.

Water erosion is only one of a range of serious land resource degradation issues being addressed across the State.

Decline in native vegetation across the State has contributed significantly to other forms of land resource degradation, such as water and wind erosion. The economic impact of decline in native vegetation is difficult to quantify. With a decline in native vegetation there is a subsequent loss of protection provided to the soil, crops and livestock and a reduction in stockfeed particularly in the pastoral lands (Table1).

Both the short-term and long-term costs of not taking action to control and prevent land resource degradation, need to be taken into consideration by not only the owners and lessees of land, but the wider community and government. Over 50% of the State is managed by those involved in earning a living from managing the land resource. The wider community of South Australia benefits both directly and indirectly from the produce of the land resource. It is in the interest of all South Australians that land resource degradation issues are addressed and viable and sustainable land resource management is practised. The economic impact of land resource degradation is felt at the individual and the community level both in urban and rural areas. Individual landholders experience production losses, some of which may be avoided by the adoption of certain management practices. Some forms of land resource degradation, such as dryland salinity and water erosion, can lower property values.

Economic conditions and individual financial situations can influence land resource degradation in a particular area. For example, in times of financial constraint a land manager may be under pressure to manage the land resource in a manner that may lead to further degradation. It is difficult to persuade a manager to adopt land management measures that are sustainable in the long-term but which result in financial hardship in the short-term.

Social

The social impact of land resource degradation is closely linked to the economic impact of land resource degradation on the community in general and individual landholders in particular. Lower returns on agricultural products together with the losses resulting from land resource degradation have contributed to significant changes in rural families and communities. For example, in some areas of South Australia, family properties have been sold or reduced in size, and members of families have had to leave the property and even the district to find work. In such areas, family relationships have become strained and stress has become a major problem. Some districts have lost significant numbers of families and individuals to the city and regional centres. These issues will have an impact on land management across the State.

The farming community is aging, since the younger members of farming families are usually the first to move in order to find work and to relieve the pressure on finances. Eventually, land managers will have to be replaced. The new mangers will not have the on-the-job training of existing farmers, but they may have a relevant educational background. From a land resource management perspective there will be a need for information and technology transfer that identifies critical long-term land management practices.

Availability and cost of water is already influencing the size of some rural communities. Both the extent of urban development and the standard of living will be influenced by the availability, quality and cost of water.

1.5 REMEDIAL ACTION TO DATE

Historically, the major emphasis of land management and conservation activities in South Australia has been directed at preventing wind and water erosion and rehabilitating eroded areas. More recently, vegetation decline in agricultural and arid lands has become part of land management and conservation activities. The framework and support for this action was established by the combined efforts of South Australian landholders, government departments and statutory bodies like the former South Australian Advisory Committee on Soil Conservation, the Pastoral Board and the Native Vegetation Management Authority.

Looking to the future, wind and water erosion and vegetation decline will continue to need attention. A wide range of other degradation issues, such as dryland salinity and soil acidification, are needing attention. Currently accepted remedial measures for the major land resource degradation problems are identified in appendix 1.

In most cases land degradation is the result of the combination of several causal 'agents'. Therefore, remedial measures need to be integrated at catchment or district level. District plans and three-year programs developed by Soil Conservation Boards provide a detailed review of problems that occur in a particular region and describe appropriate preventative or rehabilitation measures. Community and individual support is necessary to implement the practices recommended in the district plans or developed as a result of the three-year programs.

2

FRAMEWORK FOR ACTION

2.1 INTRODUCTION

There is a need for better and sustainable management if the land resource (soil, water, vegetation and wildlife habitat) is to remain productive and be protected for future generations.

Sustainable land resource management needs to be planned in a way that integrates management of all problems and allows for assessment of that management approach. This integrated approach to land resource management consists of the following:

- recognising the importance of biological diversity and ecological processes in land resource management
- developing an understanding of the capability of the land resource based on various assessment techniques
- using a land capability—based approach to develop property or district land resource management programs
- identifying the causes of the problems correctly and concentrating on the causal factors rather than the symptoms
- integrating problem-control strategies into overall land resource management programs that include the physical management, the land use (agronomy and grazing management) and the financial management of a property.

This integrated management of the land resource also needs to involve all sections of the community. The problems of land resource degradation are too great for one section of the community to bear alone. Without a spirit of partnership and cooperation there will be little progress towards sustainable land resource management. The *Decade of Landcare Plan for South Australia* offers direction and identifies opportunities for involvement not only in the implementation of change and action but in the monitoring, evaluation and review of the plan and achievements.

Why only for the decade? The plan is seen as a starting point for effort to continue at all levels well beyond the year 2000. It is recognised that many issues will require long-term efforts to understand the processes involved. Other issues will require considerable expenditure and time to redress. The Decade of Landcare plan will thus provide a focus for the planning of action programs that will be in operation well into the next century. These long-term action programs would address problems, such as soil structure decline, dryland salinity, and native vegetation decline.

2.2 ROLE OF THE INDIVIDUAL

The success of the Decade of Landcare plan programs will ultimately be measured by the change in attitudes and actions of individuals. The individual landholder has prime responsibility for managing the land and its component resources. Action taken by landholders on the land is cumulative and this action will have a significant effect on the future management and sustainability of the land resource.

The collective action of individuals will make sustainable land resource management a reality in South Australia.

Individuals, whether they are land managers or not, can contribute in a variety of ways:

- by becoming aware of the issues, by understanding the relationships between the land resource and its management, and by supporting appropriate action taken by government to address land management issues and conserve the land resources of the State
- by participating in groups and organisations that contribute to the enhancement or conservation of the State's land resources
- by using the land resources with care and due regard to their conservation for other and future South Australians, whether they be on a

farm, on an urban house block, on a recreational reserve such as a park, the beach or the River Murray

- by spreading the message that careful management of the land resource is essential for the benefit of the whole community and to future generations.

2.3 ROLE OF THE COMMUNITY

Local communities have a major responsibility to address local land resources management problems. This responsibility is being taken up by many community groups across the State. Their activities and interests can be broadly grouped under the following headings.

Land resource management

There are more than 150 community groups throughout the State with a specific focus on addressing land resource management issues. Many of these groups have formed since 1989. The greater portion of the membership comes from the rural sector but a number of groups also have members from towns.

Some groups are linked to the 'Community Landcare Program' (part of the 'National Soil Conservation Program') while others are linked to the 'Communities of Common Concern' Program (part of the 'Natural Resources Management Strategy' of the Murray-Darling Basin Commission). Agricultural Bureau branches have provided the membership of some groups. Some groups are linked closely to local school landcare groups.

Community groups focusing on land resource management issues can play a vital role:

- they link with the appropriate statutory body that oversees district land resource management, such as the District Soil Conservation Board, the Animal and Plant Control Board, or the local Water Resource Committee
- they identify land resource management problems
- they set priorities for local action
- they identify support needs and attract funding and sponsorship
- they facilitate and support 'on-the-ground' action in the district or catchment area or on the property
- they transfer technology between group members to other individuals within the community, which may lead to the adoption of sustainable land management practices.

Habitat management and conservation

Numerous groups are involved in tree planting, vegetation retention and enhancement, and wetland conservation. Other voluntary organisations also contribute towards the conservation of the natural environment.

The various consultative committees and the 'Friends of the Parks' groups provide voluntary input into the management of national parks and other reserves. 'Friends of the Parks' groups operate under the guidance of the local ranger. Their activities have to be approved as part of the management plan for the park.

Community representation on statutory bodies

The management of land resources in South Australia is based on integrated regional planning and regular review of plans. Regional communities have a role to play in the formulation and implementation of land resource management plans and the review of resultant programs.

District Soil Conservation Boards are responsible for the agricultural and

pastoral areas of South Australia (Map 3). Membership of each board is made up of seven residents of a district. In the Agricultural Zone, one member of each board is nominated by local government. The role of a board is to promote the use of land within its capability throughout the district and, in conjunction with local government and community groups, develop and support programs for the conservation and rehabilitation of land within its district. Under the *Native Vegetation Act 1991*, District Soil Conservation Boards can be consulted about the development of management guidelines for heritage agreements and about applications for minor clearance of vegetation.

South Australia is well advanced in the development of a regional network to advise the Government on water resource management issues also. Currently, there are ten Water Resources Committees in South Australia, with responsibility for a designated underground water area or watercourse. Most members are non-government people chosen for their expertise. The role of a committee is to ensure the effective and efficient use and management of the local water resource, with the support of the local community.

South Australia has a network of 16 National Parks and Wildlife Service Consultative Committees covering the State. The role of these committees is to advise the Minister of Environment and Planning on matters relating to the management of parks and wildlife in the local area. Members of the committees, who are appointed by the minister, represent the local and regional communities.

All the areas of the State covered by local government have Animal and Plant Control Boards, which employ an approximate total of 100 qualified officers. The role of these boards is to obtain landholder support to protect the land resource from proclaimed plants and animals. This is done through control programs and by monitoring the effectiveness of these programs. The provisions of the legislation enable local government to appoint representative membership from the community and enable State-wide coordination and guidance by the Animal and Plant Control Commission.

The regional community will have a vital role in the implementation of the major sections of the Decade of Landcare Plan for South Australia through both the relevant community groups and the various statutory bodies across the State.

2.4 ROLE OF OTHER ORGANISATIONS

A wide range of non-government organisations is actively involved in, or contributing towards, land resource management. These bodies have the responsibility to promote and encourage careful use of the land resource by their members, staff, or students and by the wider community. The following list is in no way complete, but it highlights some of the major contributors.

Landcare Australia Ltd

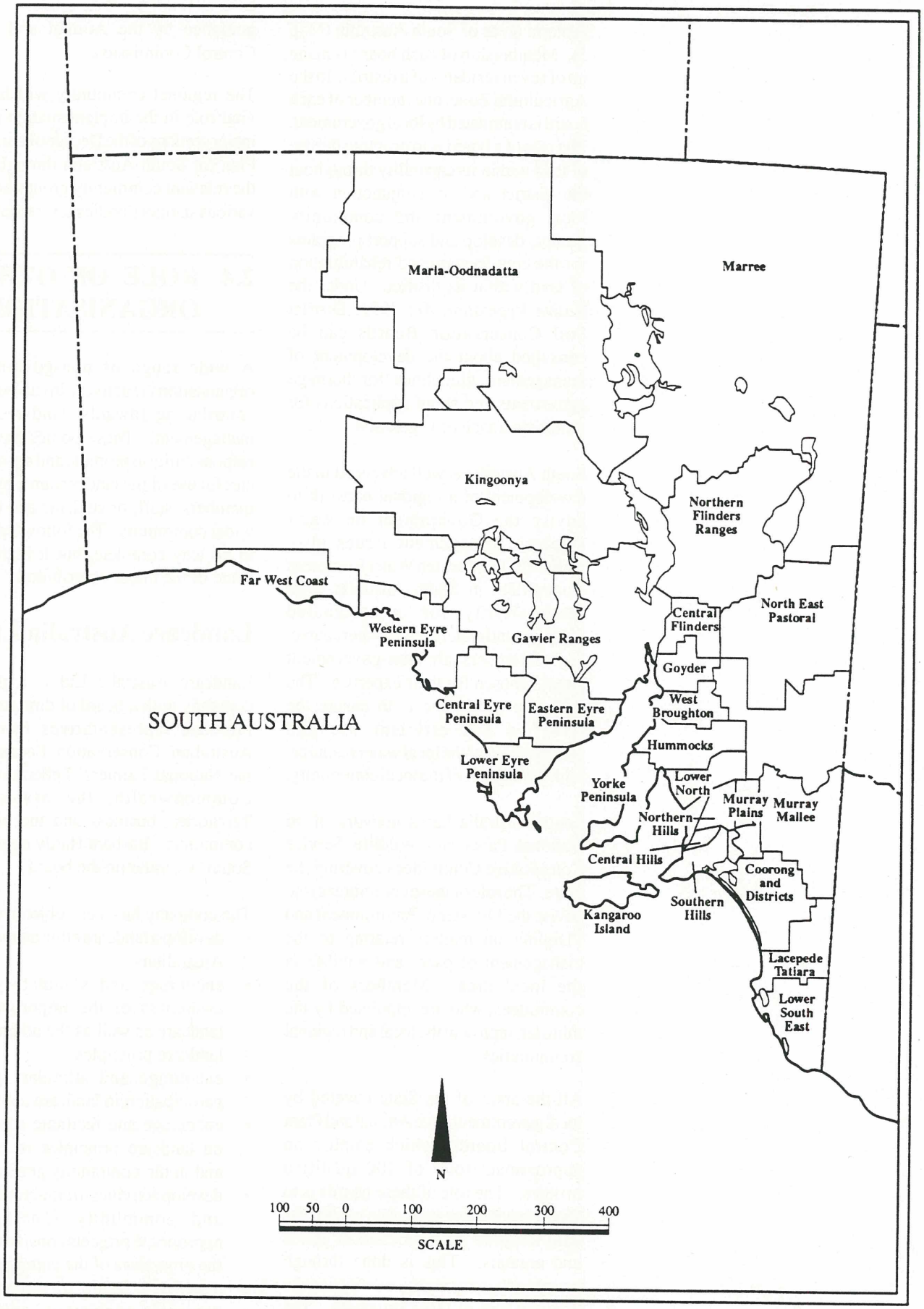
Landcare Australia Ltd is a private company with a board of directors that includes representatives from the Australian Conservation Foundation, the National Farmers' Federation, the Commonwealth, the States and Territories, business and the broader community. Barbara Hardy represents South Australia on the board.

The company has these objectives:

- develop a landcare ethic amongst all Australians
- encourage and stimulate public awareness of the importance of landcare as well as the adoption of landcare principles
- encourage and stimulate public participation in landcare activities
- encourage and facilitate education on landcare principles in schools and in the community generally
- develop activities to attract corporate and community funding for appropriate projects consistent with the objectives of the company
- distribute funds to appropriate projects consistent with the objectives of the company.

Initiatives include:

- national landcare awards



Map 3: Soil Conservation Districts covering the Agricultural Zone and the majority of the pastoral lands of South Australia (April 1992)

- sponsorship of newsletters and selected community group projects by BP Australia
- community service announcements on television as part of 'Life. Be in it'
- support for community landcare conferences.

State Management Committee for the Decade of Landcare—SA

The State Management Committee was appointed by Cabinet in 1989 to foster the landcare ethic throughout the Decade of Landcare. Barbara Hardy is the chairperson of the committee. Membership of the committee is drawn from a wide cross-section of the rural and urban communities. An executive officer appointed from the Department of Agriculture with support from the National Soil Conservation Program assists this committee and its seven subcommittees to coordinate State-wide promotional activities.

The seven subcommittees of the State Management Committee deal with the following areas:

- communications and promotions
- education and schools
- government department coordination
- local government and towns
- primary industry
- commerce and industry
- resource group.

The subcommittees facilitate the involvement of the various relevant government and non-government agencies in landcare initiatives. Through their membership, which includes representatives from the community, these subcommittees contribute towards the landcare program in South Australia.

A range of initiatives have been implemented to meet the objectives of the landcare program. The initiatives include the following:

- a landcare forum in 1989
- production of the 'Landcare News' newsletter
- a register of landcare groups and events
- development of promotional resources and a photographic library used at urban and rural events
- development of a State logo that incorporates the 'caring hands' theme of the national logo
- the State Landcare Awards
- provision of media training for landcare group and Soil Conservation Board personnel
- extensive coverage of landcare initiatives by the urban and rural media
- coordination of the 'Kids for Landcare' cross-curriculum program involving the Education Department, the Department of Agriculture, other government departments and non-government agencies.

Corporate sector

In South Australia, a wide range of companies are directly involved in land resource management, and many play leading roles. The mining industry, for example, has made valuable contributions to the knowledge of land rehabilitation, revegetation and natural regeneration. Specialised consultants contribute to landcare projects, district planning, revegetation projects, land resource evaluation, irrigation management, and general property management. The farm chemical industry also contributes in the areas of conservation farming (reduced tillage) and the control of specific problem weeds and other pests.

The corporate sector further contributes via sponsorship of certain landcare projects at the local, state and national level. SAGASCO, for example, sponsors the State Landcare Awards.

Research and education

Technical and Further Education (TAFE) colleges provide training courses covering a wide range of subjects relevant to land resource management and with strong practical emphasis. A land management certificate course has recently been offered as well as a course in rural property planning. Further

details of TAFE programs can be found in Chapter 3.8.

The University of Adelaide, Flinders University and the University of South Australia provide study opportunities for undergraduates and graduates in subjects and courses related to land resource management. Some of the graduates from these institutions will take up roles as land managers, researchers, teachers, consultants or advisors in the land resource management area.

The Universities are also actively involved in research into land resource management. The Centre for Groundwater Studies provides advice and conducts research on dryland salinity and other groundwater issues. The Cooperative Research Centre for Soil and Land Management has recently commenced operation and will contribute to the research, teaching, training, and technology transfer areas of land resource management.

Landcare-related national or State groups

The United Farmers and Stockowners (UFS) of South Australia is an association representing the majority of the land managers of the State. The UFS members support sustainable land resource management practices, and the association promotes this through its Natural Resources Committee. The UFS has a project linking schools to the rural sector to create awareness both in the rural sector and the wider community of the issues involved in landcare.

The Australian Conservation Foundation supports a planned community approach to integrated land resource management. It promotes management that integrates aspects of water, vegetation, and fauna management. The foundation researches land resource management systems that incorporate the principles of ecological sustainability.

Greening Australia (SA) is a non-profit community organisation that administers the 'One Billion Trees Program'. It is involved in the promotion of landcare principles, especially those related to trees and shrubs. It supports educational programs in schools, and community groups involved in revegetation, and it has attracted sponsorship for a direct-seeding program. The staff are located at the State Tree Centre.

Trees For Life is another non-profit community organisation that is involved in the collection of seeds of native vegetation and the propagation of those seeds. A network of some 7000 members has been established to propagate seedlings for distribution across the State. In excess of one million seedlings are distributed each year. Trees For Life is also based at the State Tree Centre and provides educational support to schools and community groups.

The Australian Trust for Conservation Volunteers (ATCV) is also a non-profit organisation that promotes practical land resource management projects by involving people on a voluntary basis. ATCV organises training programs for volunteers and schools and links volunteers with property owners, groups, and conservation projects. These works are carried out at low cost. The South Australian branch of ATCV was established in 1991 and is located at the State Tree Centre.

The Advisory Board of Agriculture and the Agricultural Bureau movement in South Australia support the concept of landcare and integrated land management practices. Concept and practice are promoted through the many branches of the bureau and the associated Womens' Agricultural Bureau and Rural Youth. The Agricultural Bureau has many educational landcare projects in place in South Australia.

Various other organisations active in landcare include bodies that are members of the Conservation Council of South Australia, service clubs, church groups, and associations.

2.5 ROLE OF GOVERNMENT

Government has an important role to play in land resource management. The *National Decade of Landcare Plan* of

which the South Australian Plan is a component, relies on cooperation between Commonwealth, State and Territory governments to support individual and community action.

In South Australia the three tiers of government (local, state and commonwealth) are increasingly working together and with the community to address land resource degradation and management problems. Continued cooperation is vital to integrate the various issues associated with the management of the land resource in South Australia.

Commonwealth Government

Commonwealth Government action in taxation, trade, marketing, quarantine, and the environment significantly affect land resource management issues. The Commonwealth Government has an important role in providing funding, leadership, and national direction. The Commonwealth Government provides leadership by establishing objectives, principles and models for coordinated and integrated natural resource management policies and programs. Strategies and plans provide direction to initiate, facilitate and review action at the State level. The direction of State or Territory, land resource management programs is influenced by Commonwealth Government funds. The following programs are being implemented by such funding:

- National Soil Conservation Program
- Landcare Australia Ltd
- Save the Bush Program
- One Billion Trees Program
- National Estate Grant Program
- Federal Water Resources Assistance Program
- The Murray-Darling Basin Natural Resources Management Strategy
- The Land and Water Resources Research and Development Corporation
- The States' Cooperative Assistance Program (Australian National Parks and Wildlife Service)
- Various industry funds

The Commonwealth Government has prepared a *Commonwealth Decade of Landcare Plan*, which outlines in detail the role it will play alongside local and State governments. The Commonwealth Government is also currently developing two strategies that will have considerable impact on landcare, namely, a strategy for ecologically sustainable development and a national, biological diversity strategy.

State Government

On behalf of the people of South Australia, the State Government has prime responsibility for the control and management of the land resources of the State. The State Government takes responsibility to direct and assist in land resource management through its agencies. It meets this responsibility in the following ways:

- by providing a policy and planning framework that encourages the implementation of appropriate land resource management strategies and provides the opportunity for the community to influence and review such policies and framework
- by ensuring that there is consistency between land resource management policies and other State policies in order to remove barriers to the adoption of sustainable land resource management principles
- by assessing and monitoring the condition of the State's land resources in order to provide a guide to landholders and statutory bodies for managing land within its capability
- by directing the State's limited resources to those land resource management issues that provide the greatest community benefit in both the short and long term
- by providing resources for research and development

- by initiating and supporting education and training programs at all levels of education
- by understanding the culture of its various clients and by initiating and supporting programs to encourage and stimulate appropriate change in attitude and practice
- by taking steps to ensure that community and government work together in a spirit of partnership and cooperation towards sustainable land resource management to ensure an integrated and holistic approach
- by ensuring enforcement of relevant regulations if the cooperative approach fails and by reviewing effectiveness and relevance of legislation.

State Government action will focus on helping local communities to work together to understand and address land resource degradation and management issues. In general, the Government will support the introduction of land resource management practices that are cost-effective for landholder and government alike. Where suitable long-term solutions are not known, research will be undertaken to identify possible solutions. Findings will be made available.

The State Government is committed to working alongside of the community to achieve sustainable management of the State's land resources (Appendix 2). Over $30 million of State funds were expended in 1990/91 on services and works directly related to land resource management in South Australia.

Legislative support

The Government's technical investigation, research and extension strategies are complemented by direct statutory controls. The primary objectives of the main legislation are described below:

- *Soil Conservation and Land Care Act 1989*. This Act requires a forward planning approach to soil conservation and landcare and also requires continual review of progress. It recognises that the land and its components (soil, water, vegetation, and wildlife) constitute the most important natural resources of the State and that the conservation of these resources is crucial to the welfare of the people of this State. This Act establishes the Soil Conservation Council and the Soil Conservation Boards.
- *Pastoral Land Management and Conservation Act 1989*. This Act's prime objective is to ensure that pastoral land is managed for sustainable production. It complements the Soil Conservation and Land Care Act by providing the mechanism for the monitoring of range condition, the prevention of degradation, and the rehabilitation of damaged lands. This Act establishes the Pastoral Board.
- *Native Vegetation Act 1991*. This Act brings to a close broadacre clearance of vegetation in South Australia and provides incentives and assistance to landholders to manage Heritage Agreement areas. It also provides for research on the management and retention of native vegetation. This Act establishes the Native Vegetation Council.
- *Water Resources Act 1990*. This Act requires that policies relating to water resources management be integrated with those for the management of the land and the environment. It also recognises that water is one of the most important, but limited, natural resources. It establishes a system that ensures the efficient use, maintenance of quality, and equitable sharing of the water resource. This Act establishes the Water Resources Council and the Water Resource Committees.
- *Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*. This Act provides for the control of animals and plants for the protection of agriculture and the environment, and for the safety of the public. This Act establishes the Animal and Plant Control Commission and the Animal and Plant Control Boards.
- *National Parks and Wildlife Act 1972*. This Act supports flora and

fauna management both inside and outside of parks. It enables considerable land rehabilitation to take place within the parks system, which now covers more than 17 per cent of the State.

- Other legislation relevant to management of land resources:
  Coast Protection Act 1972-75
  Planning Act 1982
  Local Government Act 1934
  Crown Lands Act 1929-86
  Mining Act 1971
  Petroleum Act 1940
  Mines, Works and Inspection Act 1920
  Forestry Act 1950-81
  Country Fires Act 1989

Coordination of State Government programs and activities

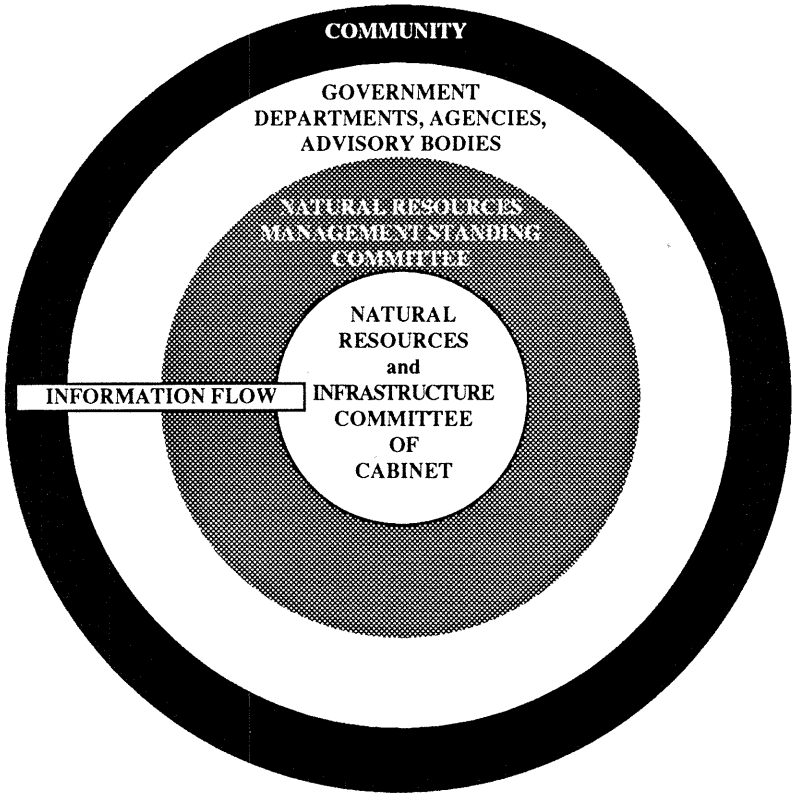
The Natural Resources and Infrastructure Committee of Cabinet is the Government's agent for the formulation of natural resource management policies and for the coordination of inter-agency activities relating to the identification, allocation, use, and management of the State's land resources. The Committee is made up of seven members representing the following portfolios:

- Transport, and Finance
- Agriculture, and Fisheries
- Housing and Construction, and Public Works
- Environment and Planning, Water Resources, and Lands
- Mines and Energy, and Forests
- Marine
- State and Local Government Relations.

The relevant statutory bodies, such as the Animal and Plant Control Commission, the Soil Conservation Council, and the Pastoral Board, report directly to the relevant Minister. The statutory bodies in turn link to regional or district statutory bodies, which provide an avenue for the community to influence government policy with respect to land resource management.

The Natural Resources Management Standing Committee comprises the chief executive officers from those departments responsible for aspects of land resource management. The committee reports to the Cabinet Committee and ensures the coordination and integration of government activities involving land resource management and use. A number of land resource management initiatives have been planned and implemented by this committee. A good example is the State's Dryland Salinity Strategy.

It is proposed to expand the membership of the Natural Resources Management Standing Committee to form a Natural Resources Council. This will be the peak advisory body that provides the Government with a broadly based source of information on the identification, allocation, use and management of the State's natural resources.



The Landcare information network in South Australia.

Local Government

Local Government is a system of government established under State legislation. There are 119 local councils

in the third of South Australia that is incorporated under the *Local Government Act 1934*. As a democratically elected sphere of government, local government acts as an advocate or as a voice for the local community. It is responsible for 'good government' and management of its area and for the proper discharge of the powers, functions and duties conferred on it by legislation.

The legislative reponsibilities of local government in relation to landcare are as follows:

Local Government Act 1934. Under this Act, responsibilities for landcare are associated rather than direct: control of reserves, septic tank inspections, garbage collection, construction and maintenance of bridges and roads.

Soil Conservation and Land Care Act 1989. Under this Act, councils within a Soil Conservation District are required to appoint one person to represent local government on the Soil Conservation Board for that district.

Animal and Pest Plant Control (Agricultural Protection and Other Purposes) Act 1986. With respect to this Act, the Governor may declare that a council may have all powers in relation to that area. Councils can appoint persons to be members of the local Animal and Plant Control Board.

Planning Act 1982. Under this Act, councils are responsible for regulatory land use control.

All local government councils in South Australia are members of the Local Government Association (LGA). The association provides services to councils to assist them in these ways:

- to provide good government in their areas
- to lobby on behalf of councils in State-wide and Commonwealth matters affecting local government
- to monitor and advise on new developments in local government
- to promote understanding of local government in the community and in other tiers of Government.

The LGA functions within its own constitution that is adopted at its annual general meeting. It is wholly supported by financial contributions from its members. The association can in no way direct councils to become involved in landcare. It can only inform, encourage and support councils that wish to take part in landcare activities.

Local government, due to its close affiliation with the community, is ideally situated to participate fully in landcare policy formation and program planning. The current recession and rural crisis have cut severely the resources available to local government, however, and are restricting the role that local government plays in landcare at present.

The current review of local and State Government relations offers an opportunity to involve local government in policy formation and implementation for landcare and to ensure that attention is given to the adequate resourcing of these activities. The review, established in October 1990, will examine all functional, financial, and administrative relationships between the two spheres of government. This will include an examination of the adequacy of the revenue base available to local government in the performance of its functions.

As part of their broader local and community responsibilities, councils are in a position to encourage wider adoption of landcare principles and practices. In fact, a number of councils have begun this. To achieve adoption of landcare, local councils can do the following:

- participate in local land resource planning
- develop revitalisation strategies for public land and roadside reserves
- act as an agency for State Government information on land resources and provide information and other support to community groups, such as landcare groups, communities of common concern, and schools
- participate in the planning and implementation of animal and plant control programs at the local and regional levels

- participate in the planning and implementation of fire prevention strategies.

2.6 BARRIERS TO ADOPTION

Certain hindrances exist that impede the adoption of integrated land resource management. Recognition of land resource degradation problems as problems and combating action lag behind the rate of decline of the land resource. There is a lack of understanding in the community, based on insufficient information and the fact that the outcome of current land management practice is often felt far from its source. Techniques to control the problems may be poorly understood also, particularly when the required control measures are complex. These problems in attitude and understanding can be alleviated, however, by a program of education and information and technology transfer as part of the integrated management approach.

Integrated and sustainable land resource management is hindered also by financial constraints and technical problems. Some landholders are unable to support the investment in land resource degradation control measures, or because some control measures are unreliable, the risk is perceived to be too costly. The lack of analysis of the cost of degradation weighed against the cost and benefit of its control does nothing to encourage landholders to work with these constraints as an acceptable risk.

3

ACTION PROGRAMS

3.1 INTRODUCTION

This section outlines the main action programs of the *Decade of Landcare Plan for South Australia*. It is anticipated that these action programs will provide a basis for community and government involvement in the development, implementation, and review of land resource management projects. The action programs will also provide an important guide to the allocation of funds from the various State and Commonwealth funding programs for the conservation and management of the State's land resources of soil, water, vegetation and wildlife habitat.

There are limits to the scope and depth of the action programs. This is inevitable in a plan that covers such a broad range of issues and resources. The ongoing development and review of the Decade of Landcare plan will allow for any problems to be identified and adequately covered in subsequent updated versions of the plan. For instance the plan does not detail water issues, since these will be addressed in more detail in the Water Resources Strategic Plan, which is currently being developed. Another issue that needs more attention than that provided by the this plan is the management of Aboriginal lands. Considerable consultation and collaboration with the Aboriginal community in general are required before any specific objectives and targets relating to Aboriginal lands and Aboriginal communities can be included in the updates of the Decade of Landcare plan.

3.2 PROGRAM GOALS AND PRIORITIES

In the setting of goals and priorities for the Decade of Landcare plan, the following principles are recognised:

- land resource management problems in the main directly affect rural landholders, but the wider community is demanding conservation and better management of our land resources; the demands and needs of both the rural and urban communities can best be served by the promotion of, and adjustment to, viable and sustainable agricultural and pastoral systems, by the use of land within its capability, by recognising its environmental values, and by encouraging the urban community to take a share of the responsibility

- land resource management problems are complex and require well-planned, integrated, and long-term solutions; while not all the answers or the necessary data are available, much can be done if the energies and expertise of individuals, community, and government are coordinated and harnessed

- since water resource management problems also affect both rural and urban communities, integrated use of land and water is the appropriate management framework to ensure sustainable development that preserves the soil, vegetation, water and wildlife for future generations

- the protection and management of biological diversity and genetic resources in parks and reserves and on private leasehold land should be seen as an integral part of the management of the State's land resources and as an investment for future generations

- the State Government is responsible for providing direction and assistance to the community in the area of land resource use and management; this can be achieved by ensuring that government policies and programs provide for sustainable use and management of the State's land resources and that they facilitate collaboration and cooperation between the three tiers of government and the community

- the *Decade of Landcare* is a period of change that will lead to long-term programs to promote and establish sustainable, land resource use and management.

The overall goal of the *Decade of Landcare Plan for South Australia* is that by the year 2000, the majority of the land resource managers in the State will have adopted systems that incorporate the principles of sustainable land resource management.

Sustainable land resource management can be defined as the management and use of the land resource in a manner that does not degrade it or any associated ecosystem, and maintains or enhances the ecological and economic viability of the resource.

In order to focus the efforts of the community and government on moving towards sustainable land resource management, the plan identifies the following components necessary to landcare action.

1. Economically and ecologically viable management systems for the rehabilitation and sustainable use or protection of the State's land resources need to be developed and promoted.

2. Communities must be provided with the information, organisational assistance, and support required to facilitate enhancement of degraded land and use of land within its capability.

3. Land-use decisions by all concerned must be based on district management plans that integrate action with respect to the soil, water, vegetation, and wildlife.

4. Both community and government agencies must be made aware of the issues and priorities. There must be cooperation across all groups and organisations in the use and protection of the land resource.

5. Progress towards sustainable land resource management needs to be monitored and evaluated against specific targets.

To tackle the twelve, major, land resource degradation issues (discussed in detail in appendix 1) eight management programs are being developed as part of the national strategy. Table 2 briefly identifies the twelve issues and the recommended focus for action to combat them. Table 3 then outlines the objectives of the eight management programs that establish a framework for management of the issues.

Priorities

The goal and objectives will help set priorities for the allocation of resources for the implementation of the Decade of Landcare plan. Table 4 provides an indication of the priorities for action.

3.3 REGIONAL PLANNING AND COORDINATION

Community involvement in the preparation and implementation of land resource management plans at the district or regional level is vital to sustainable use of the State's land resources. The preparation of such plans and associated guidelines for management will provide a means for the regional community and local and State government to work together for the conservation and rehabilitation of land resources and for the use of land within its capability. It will also provide opportunity for coordination of land resource management programs at the local level. It is anticipated that solutions will be found and decisions made about control measures, research priorities and funding. Soil Conservation Boards are taking a leading role in land resource management planning. Water Resources Committees and other land resource management or advisory bodies will be encouraged to develop action plans relevant to their responsiblites and which incorporate community consultation and support.

Objective

Ensure that the policy framework and the planning data are adequate to support the development at the regional or district level of coordinated, land resource management plans and action programs that incorporate community consultation and cooperation.

Table 2: Land resource degradation issues

Issue	Focus for action
Decline in nutrient, physical and biological state of soils	Maintain and improve the fertility levels of soils across the State. Improve soil surface protection, reduce the number and impact of tillage passes and improve the level of organic matter in soils. Integrate control practices and management to prevent the build-up of undesirable biological species and products while encouraging desirable biological species and systems.
Water erosion	Reduce runoff by improving soil structure, increasing vegetation cover, and controlling and facilitating safe disposal of runoff.
Wind erosion	Stabilise sandy soils by improving vegetation cover, improving soil fertility, and increasing the resistance of the surface soil to erosion.
Salinity	Reclaim the saline land or increase the productivity of that land (on-site or discharge). Investigate catchments and identify where the water is coming from, how it gets into the groundwater system, and why the saline soil occurs where it does. Increase water use on land that is not affected but is within the catchment (off-site or recharge) in order to minimise groundwater recharge.
Acidification	Manage crops and pastures to treat the symptoms and factors contributing to acidification.
Water repellence	Adopt modified tillage and seeding practices to minimise the effect of water repellence.
Waterlogging	Ensure drainage and management of pastures, and management of stock and crops.
Decline in native vegetation in agricultural zone	Rehabilitate and manage remnant native vegetation and increase rural and urban revegetation.
Decline of arid zone vegetation	Manage the arid zone within its capability in order to prevent native vegetation decline and loss of species diversity.
Undesirable plants and animals	Treat infestations of exotic plants and rehabilitate invaded land. Integrate control of feral animals with management of native animals. Both can have a negative impact on the land resource.
Irrigation management	Improve efficiency of irrigation practices.
Water quality and quantity	Manage water use and waste water disposal.

Purpose

The purpose of the program is to put in place across the State a coordinated set of community-based, land resource management plans. This will be achieved through the Soil Conservation Boards and other regionally based statutory bodies. The program will integrate the findings of community and state land resource management programs into guidelines for sustainable management of the soil, vegetation, water and wildlife components of the land resource.

Policy

Local communities will take responsibility for the management of their local, land resource degradation problems through the District Soil Conservation Board or a similar body.

Ten-year targets

- Soil Conservation Boards across the State will prepare a district plan within five years. They will prepare and review action programs every three years based on the needs and priorities of their district.

- Soil Conservation Boards, the Department of Agriculture and other government departments available to assist landholders to develop property plans, and provide guidance on the integrated management of the land resource for which they are responsible.

- District plans and action programs will focus on the prevention and repair of land affected by land resource degradation, such as water erosion, wind erosion, dryland salinity and will tackle the decline in native vegetation where relevant in the district. The decline in water quality and quantity, and the treatment of problem weeds and feral animals, particularly rabbits, and other relevant issues will also be addressed as needed.

- The community in all districts will be committed to the preparation of

Table 3: Land resource management programs

Program	Objectives
Regional planning and coordination	Ensure that the policy framework and planning data are adequate to support the development at the regional or district level of coordinated, land resource management plans and action programs that incorporate community consultation and cooperation.
Landcare group support	Provide the means and support by which the community, through group action, can reduce land resource degradation and promote the adoption of sustainable, land resource management practices.
Farm improvement and assistance	Deliver through appropriate channels the services, guidelines, and planning tools, and the financial and technical information to help land managers evaluate, test, and adopt practices that will lead to economically and ecologically viable, land resource use.
Public land	Prepare and implement guidelines and codes of practice that will ensure the sustainable use and management of the State's public land resources for the benefit of both current and future South Australians.
Land management policy review	Develop and implement policy that provides for integrated control of land resource degradation and sustainable management of the State's land resources.
Education and community awareness	Increase or develop awareness, education, and training to ensure that South Australians have the opportunity to understand and contribute to landcare.
Resource assessment	Assess and describe the land resources of the State in terms of basic characteristics, condition, and capability to support various activities.
Research and development	Continue with research and development programs that address the physical, economic, and social issues associated with land resource degradation and sustainable land resource management and use in South Australia.

District planning, property planning and the use of land within its capability are critical elements to sustainable management of the land resource of South Australia.

district plans and the implementation of action programs.

- All plans and action programs will be based on land resource capability.

Actions

The development of district plans in collaboration with the community is a new concept in South Australia. It requires technical assistance for the boards to allow them to gather the information, prepare the plans, consult with the community, and implement the three-year program.

The State Government, with support from the Commonwealth, will continue to provide the technical support necessary to assist Soil Conservation Boards to prepare their plans and implement appropriate action programs. The Department of Agriculture will be the lead agency in this support role, although it is envisaged that officers of the Department of Environment and Planning, the Woods and Forests Department, and the Animal and Plant Control Commission and its boards will also provide support.

The Pastoral Board and the Pastoral Management Branch of the Department of Environment and Planning will work closely with the pastoral Soil Conservation Boards during the preparation of district plans for pastoral areas. When land assessments are complete, the collected information will be used to review and refine the district plans.

Table 4: Priorities for action

Program / Issue	Regional planning and coordination	Landcare group support	Farm improvement and assistance (extension)	Public land	Land management policy review	Education and community awareness	Resource assessment	Research and development
Decline nutrient, physical and biological state of the soil	L	H	H	L	L	H	H	H
Water erosion	H	H	H	L	L	M	H	M
Wind erosion	H	H	H	L	L	M	H	M
Salinity	H	H	M	H	H	H	H	H
Acidification	L	M	H	L	L	M	H	M
Water repellence	L	M	H	L	L	M	H	H
Waterlogging	L	M	L	L	L	L	H	H
Decline in native vegetation in agricultural zone	H	H	H	H	M	H	M	M
Decline of arid zone native vegetation	H	H	M	H	M	H	H	M
Undesirable plants and animals	H	M	H	H	M	H	M	H
Irrigation management	M	M	H	L	H	M	M	H
Water quality and quantity	H	M	M	H	H	H	H	H

H - priority for action—either an increasing problem and new resources required or resources already committed.
M - medium priority—either critical research or management element needing completion prior to further increased activity or problem of limited extent.
L - low priority—either the issue a minor component of program or information, knowledge, or resources being insufficient to address the issue at this time.

Assessment of the various components of the land resource is an important aspect of developing district and property plans. Such assessment will be done on a more extensive basis in the Arid Zone, than in the Agricultural Zone.

3.4 LANDCARE GROUP SUPPORT

In South Australia, the number of landcare groups has grown rapidly since the inception of the Community Landcare Support Program in 1989. There are now more than 150 groups that address land resource degradation issues and represent sections of the community. Community landcare groups are a vital element in the implementation of the objectives and programs of the Decade of Landcare plan. They will also play an important role in reviewing and recommending modifications to the landcare plan.

Many of these groups have developed to the stage where they are addressing quite complex issues, so they need technical support. The relevant government advisory services have had to cope with significant increases in demand for technical advice and guidance, particularly in the areas of district, catchment, and property management planning, conservation farming, land rehabilitation, and vegetation management.

Objective

Provide the means and support by which the community, through group action, can reduce land resource degradation and promote the adoption of sustainable, land resource management practices.

Purpose

Landcare group support provides for the formation of landcare groups and encourages them to take a direct role in landcare. Support helps particularly to encourage landcare groups to take part in the development and promotion of land resource management practices that will enhance sustainable and productive use of land local to the group.

Policy

The program allows for support for the formation and activities of community-based landcare groups to continue and makes available as many resources as possible to meet the increasing demand for technical advice and direction. The program also keeps the Commonwealth and State funding sources informed of the funding and resource needs of landcare groups.

Landcare groups should be linked with their respective Soil Conservation Board and local Department of Agriculture offices to ensure a coordinated approach to landcare planning and targeted action to the major management issues.

Ten-year targets

- An adequate level and quality of integrated technical support will be available to landcare groups throughout the State. For example, the provision of property management planning and catchment management advice and guidance.

- Landcare groups will be formed to address the major landcare issues, with particular focus on the decline of the nutrient, physical and biological state of the soil, dryland salinity, the decline in native vegetation and biodiversity, and water and wind erosion.

- Landcare groups will be strategically positioned across the State, so as to give each rural landholder the opportunity to be involved in, or at least aware of, local landcare action and findings.

- Landcare group activities will be integrated and coordinated with Soil Conservation Board programs and Animal and Plant Control Board programs.

- Landcare groups extending (transferring) information and technology, acquired by them, to the wider community.

- Landcare groups implementing sustainable, land resource management practices in the local district and adoption of such practices by members of the groups.

- An adequate level of information on land resource degradation and management will be made available to the Aboriginal communities of South Australia.

- Aboriginal communities will be encouraged and supported to form landcare groups.

- The formation of groups with a landcare focus by urban residents and special interest groups will be encouraged.

Actions

The activities and the support needs of landcare groups vary considerably.

Geographically, landcare groups are spread from the far north of the Arid Zone to the lower South-east of the State. The majority of the groups are concentrated in the Agricultural zone, which covers the cereal-livestock, viticulture, horticulture, and high-rainfall, grazing industries. Seven groups cover the pastoral areas of the Arid Zone. In terms of social composition rural land managers make up the greater percentage of group membership, but groups have attracted members from agribusiness, other enterprises, and government in rural towns, and, in some cases, from urban areas. Some groups have formed from special interest groups, such as tree and revegetation groups. Two aboriginal groups are involved in addressing landcare issues. The range of issues being addressed is wide also. Individual groups initially tended to focus on one or two land resource degradation issues, such as dryland salinity and water erosion. As groups have developed, however, they have begun to address a range of issues and adopt a more integrated approach. So landcare support needs to provide a broad technical and information base that takes into account the different types of problems each group will encounter according to its location, the surrounding land use, the kind of degradation that exists, and the experience of the group's members.

Technical and group facilitation support will continue to be provided by the State Government through the key departments. The Department of Agriculture has research programs and district extension teams operating across the State. District extension teams include officers with expertise in various aspects of land resource management, such as agronomy, livestock management, and soils. Specialists in areas such as property and financial planning, economics, conservation farming, dryland salinity, soil characterisation, district planning, arid lands management, management of native vegetation, and revegetation are available at either regional centres or headquarters of the Departments of Agriculture, Environment and Planning, Engineering and Water Supply, Mines and Energy, and Woods and Forests.

The district teams have been complemented by eleven, landcare officers and three 'Communities of

Table 5: Organisations providing support to landcare groupos

Department of Agriculture	Department Employment and Technical and Further Education
The South Australian State Management Committee for the Decade of Landcare	Department of Road Transport
Landcare Australia Ltd	Woods and Forests Department
District Soil Conservation Boards	Department of Mines and Energy
Advisory Board of Agriculture	Local government
Agricultural Bureau movement, the Womens' Agricultural Bureau and Rural Youth	Universities
'Save the Bush' program within the Department of Environment and Planning	Education Department
Other sections of the Department of Environment and Planning	Various divisions of CSIRO
Animal and Plant Control Commission and local boards	Greening Australia (SA)
Engineering and Water Supply Department	Australian Trust for Conservation Volunteers
Water Resource Committees	Trees for Life
Department of Lands	Private consultants
	Various agribusiness and corporate agencies

Common Concern' project officers, who provide direct support for community-based landcare groups. These officers are stationed at key centres throughout the State and are funded under the National Soil Conservation Program and the Natural Resources Management Strategy Program.

The many organisations and bodies providing technical and other support to landcare groups are summarised in Table 5. The landcare support program will adjust to providing a greater degree and variety of technical support to groups in the future.

The Minister of Agriculture, Mr Arnold presenting 'National Soil Conservation Program' cheques to representatives of two of the first community landcare projects.

The Adelaide Hills Potato Grower's Landcare Group have been particularly active in testing and promoting better land management practices in the Mount Lofty Ranges. They were one of the first groups to receive funding under the 'National Soil Conservation Program'.

One way in which the Government and other agencies have provided support to landcare groups is through funding. With the major funding programs the groups are expected to match the funding with similar contributions, either in kind or in cash. The five main sources of funding are as follows:

Commonwealth
- National Soil Conservation Program—Community Landcare Support Sub-Program
- Murray-Darling Basin Natural Resources Management Strategy—for 'Communities of Common Concern'
- Save the Bush Program

Greening Australia (SA)
- One Billion Trees Program

State
- Rural Tree Grants

Some groups have been able to obtain sponsorship or funding from local, State, or national private or corporate businesses. Not all groups have sought or received outside funding, Maps 4, 5, 6 and 7 give an indication of the number and spread of projects financed by the listed programs.

Urbanisation and temporary land use

Alienation of agricultural land, particularly in the high-rainfall areas of South Australia, for the establishment of hobby farms, housing, industry, and accompanying services is a significant contributor to land resource degradation, because as land use changes so do the management practices, and not always for the benefit of the land resource. Incoming land managers inherit existing degradation problems that they do not always understand, and the change in land use often only exacerbates the degradation. Poor management of urban developments can in itself lead to soil erosion, vegetation decline and degradation of water resources.

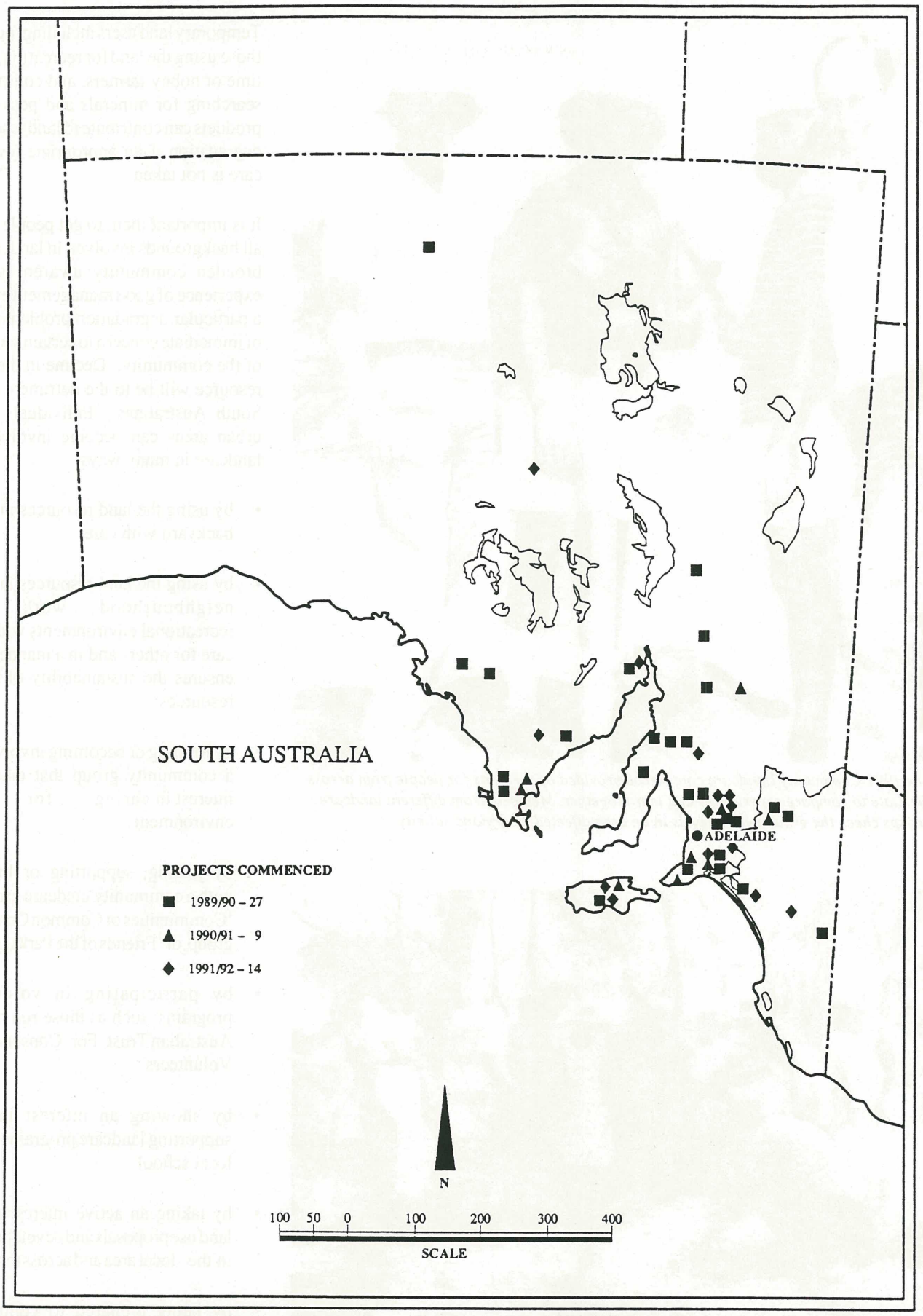
The 1991 Community Landcare conference provided opportunity for people from across the State to compare experiences and learn together. Members from different landcare groups check the groundwater levels in an area affected by dryland salinity.

A botanist from the Department of Environment and Planning provides information on native vegetation at a field day and seminar program for community groups. Staff from the departments of Environment and Planning and Technical and Further Education presented the program.

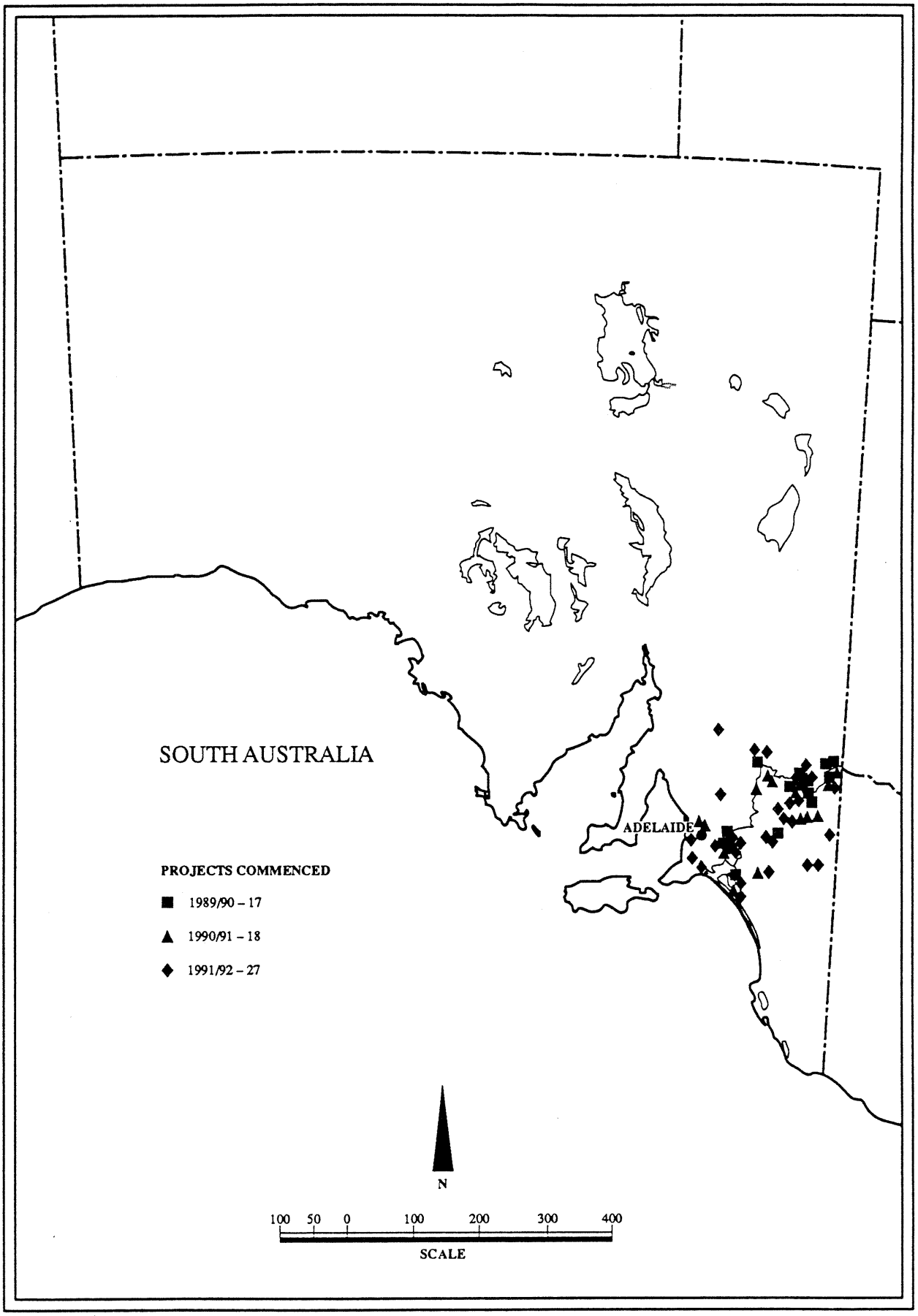
Temporary land users including tourists, those using the land for recreation, part-time or hobby farmers, and companies searching for minerals and petroleum products can contribute to land resource degradation if an appropriate level of care is not taken.

It is important then, to get people from all backgrounds involved in landcare to broaden community awareness and experience of good management even if a particular degradation problem is not of immediate concern to certain sections of the community. Decline in the land resource will be to the detriment of all South Australians. Individuals from urban areas can become involved in landcare in many ways:

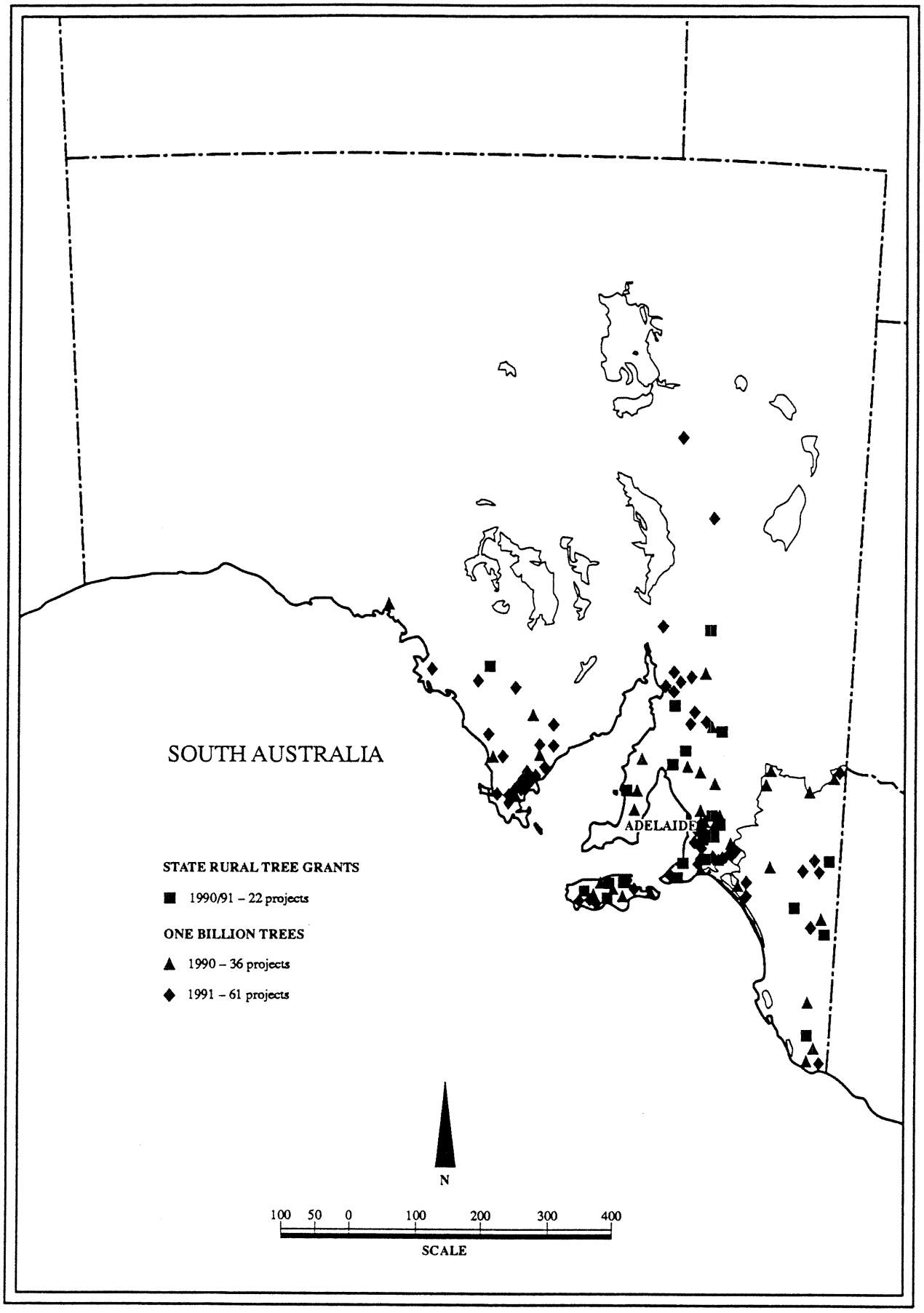
- by using the land resources in their backyard with care
- by using the land resources in their neighbourhood, work, and recreational environments with due care for others and in a manner that ensures the sustainability of those resources
- by forming or becoming involved in a community group that takes an interest in caring for the environment
- by joining, supporting or linking with a community landcare group, a 'Communities of Common Concern' group, or 'Friends of the Parks' group
- by participating in volunteer programs, such as those run by the Australian Trust For Conservation Volunteers
- by showing an interest in and supporting landcare programs in the local school
- by taking an active interest in the land use proposals and developments in the local area and across the State
- by being prepared to contribute towards some of the cost carried by land managers and government in adopting sustainable land management.



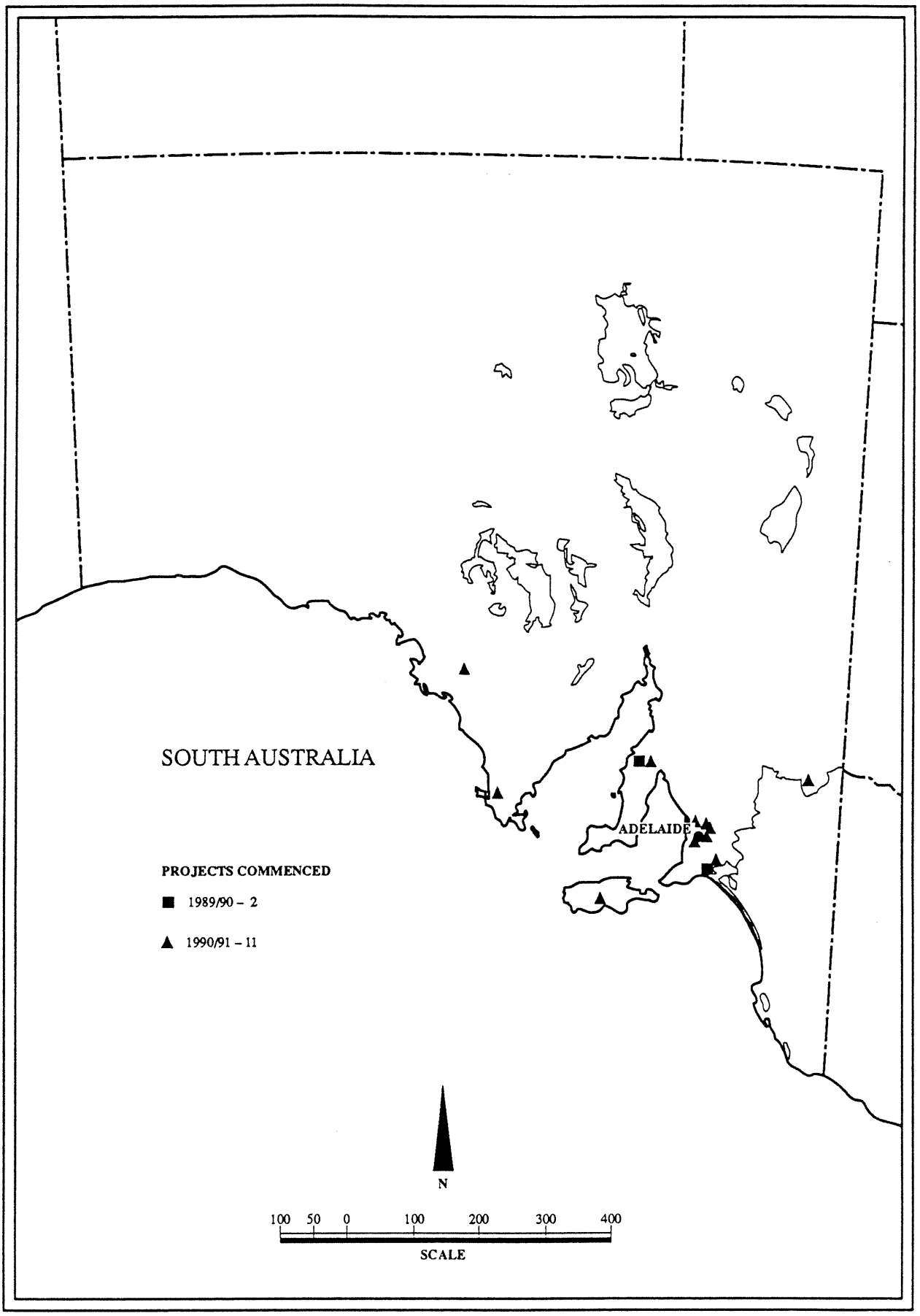
Map 4: Distribution of projects funded under the National Soil Conservation Program Community Landcare Sub-program in South Australia.



Map 5: Distribution of community projects funded under the Natural Resources Management Strategy Communities of Common Concern Program.



Map 6: Distribution of community projects funded under the State Rural Tree Grants and One Billion Trees (Greening Australia—SA) Programs.



Map 7: Distribution of community projects funded under the Save the Bush Program in South Australia, 1989 to 1991.

3.5 FARM IMPROVEMENTS AND ASSISTANCE

In the long term, the success of the Decade of Landcare plan will be measured by the number of land managers who adopt or continue with sustainable, land resource management practices. Sustainable, land resource management involves using land within its capability.

The Department of Agriculture and the Soil Conservation Council have been entrusted with the role of encouraging land managers and the community to adopt practices that will lead to sustainable, land resource management systems. The department and council are supported in this role by other government departments and various statutory and advisory bodies. For example, in the Arid Zone, the Pastoral Board ensures that pastoral lands are well managed to sustain yield and are also used prudently. In the Agricultural Zone, the Animal and Plant Control Boards cooperate in the development and implementation of coordinated programs for the destruction or control of proclaimed plants and animals.

Objective

Deliver through appropriate channels the services, guidelines, and planning tools, and the financial and technical information to help land managers, evaluate, test, and adopt practices that will lead to economically and ecologically viable, land resource use.

Purpose

The farm improvement and assistance program focuses on assisting land managers to test and adopt practices that incorporate the principles of economically viable and sustainable management. A major component of this program is the provision of extension services, which transfer information and technology, by the lead agencies. These services will be provided essentially through community groups rather than on an individual basis.

Policy

The Government will continue to provide extension services where demonstrated public benefit can be identified. The current review of government services may mean that some services in the future carry a charge. Where appropriate, agribusiness and non-government agencies will also contribute to the provision of extension services. Property management planning, which incorporates economic evaluation and financial planning, will be promoted as a key step towards the adoption of sustainable, land management practices. Guidelines, group programs, and demonstrations will be used also to promote these practices.

Ten-year targets

- Baseline data on awareness and knowledge of land managers with respect to land resource degradation and sustainable management practices must be established.
- Adequate support for community groups will be provided through planned extension programs in a state-wide network.
- An adequate coverage across the State of demonstration sites to support the extension programs.
- Extension programs will focus on the adoption of profitable and sustainable, land resource management and will target those issues towards management options that reduce water erosion, wind erosion, decline in the nutrient, physical and biological state of the soil, soil acidification, decline of native vegetation, and the impact of weeds and feral animals (especially rabbits).
- Property management planning methodology and resources will be provided for all agricultural and pastoral lands.

- Case studies will be documented with economic evaluations of appropriate conservation and management practices.

- Financial planning tools will be available for land managers and extension staff.

- Guidelines will be prepared for land managers and extension staff on the management of land to maintain the nutrient, physical, and biological state of different soils.

- Guidelines will be available for land management within ground and surface water catchments to sustain water resource quality and quantity and to reduce land degradation from water erosion.

- Guidelines will be prepared and extension projects initiated for specific problems, such as soil acidification and dryland salinity.

- Vegetation management guidelines will be available for all areas where landholders may be required to submit a vegetation management plan in support of financial assistance for a voluntary Heritage Agreement.

- Native vegetation management will be promoted as part of overall farm and property management.

- Revegetation programs, including the incorporation of agroforestry for better land management, will also be promoted as part of the property management planning process.

- Regional information on revegetation and regeneration methods will be improved.

- The necessary information, technology, and incentives will be provided for managers of arid and agricultural lands to undertake ecologically sound and effective rehabilitation of degraded land resources.

- The adoption of integrated catchment management to protect and sustain the quality and quantity of the water resource will be promoted.

Past action

Land managers across the State continue to implement a wide range of desirable land management practices (Appendix 1). There is a general feeling that land managers are becoming more aware of the need to adopt an integrated and planned approach to land resource management. Land managers are certainly aware of the need to manage land resources in a manner that is economically viable and also sustains the land resource.

Various methods of extending information and technology to land managers are used by agency staff. Soil Conservation Boards, branches of the Agricultural Bureau, Animal and Plant Control Boards, and recently, landcare groups are the main vehicles by which extension assistance reaches land managers. Demonstrations and specific training programs are also used with success. 'Soils — good farmers manage them' and 'Right rotations' are two training programs that have been received favourably by land managers. Many land managers prefer a personal explanation and/or demonstration prior to their deciding whether to adopt a certain land management practice.

Many issues have been targeted in extension programs:

- conservation farming
- amelioration of soil acidity
- introduction and management of crop and pasture legumes
- improvement of soil nutrient levels
- integrated catchment plans to control water erosion
- salinity, both dryland and irrigation
- management of land prone to wind erosion
- rehabilitation of Arid Zone lands
- management of native vegetation
- rabbit and proclaimed plant control.

Property management planning allows focus for the review and adoption of new technology on properties, so Soil Conservation Boards encourage and help landholders in their districts to

The physical plan of a property is a good starting point for planning, developing, and adopting changes to land management. Discussing the current features and proposed changes with other farmers and staff from government agencies can be beneficial to all involved.

prepare property plans. Interest in property management planning is also generated by the Department of Technical and Further Education's 'Rural Property Planning' course and the Community Landcare Program. In anticipation of a high demand for property management planning services from land managers, the Department of Agriculture has established a Property Management Planning Centre, for development of planning methodology, at Clare. The centre is being financed jointly by the State and Commonwealth Governments.

The State Government implemented the 'Rural Tree Planting Program' in 1989 in response to the need for a coordinated approach to revegetation and the need for integration with other land management programs. The program established a State Tree Centre within the Department of Agriculture to house the Rural Tree Coordinator, Trees for Life, Greening Australia (SA), and the Australian Trust for Conservation Volunteers. Regional revegetation officer positions across the State and an annual grants scheme are also part of this initiative. This program is complemented by the regional revegetation services of the Woods and Forests Department and the Native Vegetation Management Branch of the Department of Environment and Planning.

Staff of the Animal and Plant Control Commission and local Animal and Plant Control Boards continue to provide advice and technical direction on the identification and control of proclaimed plants and animals and on general land management in both the Agricultural and Arid zones.

CSIRO, private consultants, agribusinesses, farm chemical companies, farm machinery companies, mining companies also provide information, demonstrations, and services related to land resource management.

Future action

The State Government will continue to provide an extension service on land management issues through officers of the Department of Agriculture and other departments. These officers are strategically stationed around the State and can work closely with landholder groups such as branches of the Agricultural Bureau and landcare groups.

The Property Management Planning Centre will develop a coordinated strategy to assist individuals and small groups to prepare property plans. Plans will have three components: the physical plan, the land management plan, and the business management and financial plan. The centre will also develop training programs for extension staff and will nominate specific regional staff to conduct group training for land managers. Guidelines and manuals will be produced on all aspects of property management planning. Economic evaluation and financial planning packages will be developed to show how the adoption of the various management options will affect viability of the enterprise and the property. These packages will form the basis for the

Two innovative farmers, Ray and Wayne Altmann, developed their own contour levelling device to facilitate changes to management on their property in the Adelaide Hills.

business and financial management of a property plan.

Sustainable land management in the Arid Zone will be promoted through the lease assessment program. Sustainable land management will be promoted also in the guidelines being developed as part of district plans. The Pastoral Management Branch of the Department of Environment and Planning is the agency responsible for both. The Pastoral Board and the Pastoral Management Branch of the Department of Environment and Planning will work closely with the pastoral Soil Conservation Boards to develop guidelines for the management of pastoral leases. Information for the development of these guidelines will come from the pastoral lease assessment program currently underway but not due to be completed until 1998.

Specific programs will concentrate on the following:

- understanding soils and land capability
- conservation farming techniques and improved rotations
- surface and subsurface soil problems in specific areas of the State, including nutrient decline, structure decline, water repellence, and soil acidification
- catchment management for the control of water erosion and the management of both groundwater and surface water quality and quantity
- reduction of water erosion, and the use of engineering structures in soil conservation
- dryland salinity management
- arid lands management and revegetation
- management and conservation of native vegetation
- establishment and management of vegetation — local and introduced species — for better farm management and for wildlife conservation
- vertebrate pest control.

Financial assistance

Financial assistance to help individuals adopt land resource management practices in South Australia is available under the 'Rural Adjustment Scheme' and soil conservation loans administered by the Department of Agriculture. The financial assistance and loans are provided at favourable interest rates and conditions.

Prior to 1991, the *Native Vegetation Management Act 1985* offered considerable financial incentives to

Field days and demonstrations are proven methods of extending information and technology to farmers in South Australia.

landholders in the form of compensation for land going under an Heritage Agreement as a consequence of a clearance refusal. Discretionary payments were made in respect of redundant fencing, water improvements and over capitalised farm machinery. Areas were fenced at government expense. Since 1985, $45 million have been paid or committed to 535 landholders in respect of 423 000 hectares of native vegetation.

The new *Native Vegetation Act 1991* follows on from the previous Act and provides incentives and assistance to land-owners to protect and manage their native vegetation for wildlife and to prevent land degradation. Heritage Agreements still form the legal basis for this assistance. The new Act provides the opportunity for a land-owner to enter an Heritage Agreement to protect and manage an area of native vegetation, without the land-owner's need to apply first for permission to clear the area. The type and level of assistance will be different from that provided in the past after a refusal of an application to clear. Under the new Act, a land-owner may be eligible for financial assistance to manage existing vegetation or re-establish native vegetation. The internal fencing of an Heritage Agreement will be paid for by the Government.

With the exception of the loans and the Heritage Agreements, the following grant schemes are usually restricted to community groups and organisations.

Commonwealth:
- National Soil Conservation Program, Community Landcare Sub-Program for groups
- Murray-Darling Basin Natural Resources Management Strategy for 'Communities of Common Concern'(CCC's)
- 'Save the Bush' for community groups dealing with native vegetation

State:
- Soil Conservation Loans*
- Native Vegetation Heritage Agreements*
- Rural Tree Grants
- Rural Adjustment Scheme loans or assistance*

Greening Australia:
- 'One Billion Trees Program' for groups and local government

3.6 PUBLIC LAND PROGRAM

Public land totals somewhat less than 20% of the State, and is under the control of various government agencies. This land consists of conservation parks, reserves, beaches, water catchment, forests, and roads. Objectives similar to those for the management of private land have been identified for the management of public land.

Objective

Prepare and implement guidelines and codes of practice that will ensure the sustainable use and management of the State's public land resources for the benefit of both current and future South Australians.

Purpose

The State Government, through a number of departments, has the responsibility of ensuring that land that is neither owned nor leased by private

*available to individuals

citizens or bodies is allocated and managed for the long-term benefit of the State. This responsibility requires application of practices that protect biological diversity and wildlife habitat, enhance degraded areas, and prevent degradation of the land resource. In fulfilling this responsibility, the Government seeks community involvement, where appropriate, in the planning and implementation of management and remedial programs on public lands.

Policy

The Government's public land management policy is to implement management practices that ensure the sustainable use and management of the State's soil, water, vegetation, and wildlife for the benefit of all South Australians. This will be achieved in a number of ways:

- by conducting surveys of natural resources
- by the use of integrated management practices for the enhancement of the land resource
- by establishing standards for the management of the land resource
- by rehabilitation of degraded land resources including the reintroduction of vegetation and wildlife species where appropriate
- by the control of pest plants and animals, such as rabbits

The Government accepts the obligation to practise a sensitive regard for the environment as it manages public land and its genetic stock for the benefit of all South Australians.

Ten-year targets

- Integrated management of public lands within accepted land capability and district planning criteria will be implemented to ensure the protection of water resources, the control of dryland salinity, the control of water and wind erosion, an improvement in native vegetation and wildlife habitat, and the control of undesirable weeds and animals, with due regard to other land uses in the district and/or catchment.

- A network of reserves to conserve representative examples of South Australian vegetation, wildlife, and land systems, and a network of corridors and blocks of native vegetation to link reserves on public and private lands will be established.

- Roadside vegetation management plans will be implemented for all areas of South Australia in conjunction with local government and other bodies. The plans will take into consideration local requirements for movement of livestock, farm equipment, and wildlife.

- Management strategies that will ensure sustainable use, and if necessary, protection, of public lands will be identified.

- Community participation in the rehabilitation and management of public lands will be encouraged.

- All temporary land users and the management requirements and concerns pertaining to their land use (eg public access, camping, opal mining) will be identified.

- Guidelines or codes of practice for land use will be developed and made available for temporary user groups.

- The condition of the land resource and effectiveness of management systems at selected sites will be monitored and evaluated.

Past action

Conservation and recreation

The Government seeks to ensure that lands that have significant value for conservation and public recreation are retained in public ownership. A network of reserves dedicated to appropriate authorities under the Crown Lands Act and related legislation has been established and is managed by the departments of Environment and Planning (including the National Parks and Wildlife Service), Engineering and Water Supply, Lands, Woods and

Forests, and Road Transport. In addition, substantial areas are managed by local government, including road reserves and areas for recreational purposes.

Public lands managed for conservation and recreation make up a significant portion of the total area of public land in South Australia. The total area of parks and reserves administered by the National Parks and Wildlife Service is 16.7 million hectares (17% of the State). The Woods and Forests Department manages more than 20 000 hectares of native vegetation for conservation and recreation. The Engineering and Water Supply Department reservoir areas also fulfill a conservation function. The extensive network of road reserves across the State further represent a significant conservation and recreational resource.

Catchment management

Land resource management has a major impact on the quality of water supplies throughout the State. Through the administration of the Engineering and Water Supply Department, the State Government ensures that water quality within catchments (on both private and public land) is enhanced by appropriate management and monitoring practices.

Public lands within catchments controlled by the Engineering and Water Supply Department are managed according to this policy. The more sensitive areas, such as reservoir and aqueduct buffers, are owned and directly managed by the Engineering and Water Supply Department to ensure optimum protection of water supplies.

Within catchment areas public lands are also controlled by other departments, such as Environment and Planning, Woods and Forests, and Road Transport, as well as by local government. A consistent set of management guidelines for these departments is being developed.

Transport corridors

Regional planning for the management of roadside vegetation is necessary in South Australia, due to the fact that in some parts of the State, the only significant remnant native vegetation is to be found on roadsides and other areas dedicated for transport purposes, such as railways and travelling stock routes. In many areas, this vegetation has been badly degraded. There are currently four regional roadside vegetation plans being prepared by the Department of Environment and Planning in conjunction with local government and other State government agencies.

Productive forestry

Forestry, as a land use in the higher rainfall areas of the State, has a useful role in preventing water erosion and in ameliorating degraded sites on both public and private land. Through the Woods and Forests Department, the State Government manages 133 400 hectares of forest reserves comprising plantation and native forest (> 20 000 hectares). These reserves are managed primarily for timber production and conservation. More than 1000 hectares of Engineering and Water Supply Department reserves are also managed for sustainable timber production. In environmentally sensitive areas, which include the Mount Lofty Ranges, management guidelines are used for logging plantation establishment, and maintenance operations. Interdepartmental working groups are currently preparing guidelines on 'Firebreak Management' and 'Prescribed Burning Practices'. Government policy also provides for ongoing monitoring and research within the forests.

Unallotted Crown land

The Department of Lands is responsible for the management of all unallotted lands within the State. The department has prepared a 'land resource inventory' of all public lands that provides the basis for land assessment prior to allocation. Such assessment determines whether any remedial action is necessary before land is alienated for private use, or indeed, whether the land should be retained in public ownership.

The Animal and Plant Control Commission has the responsibility for the control of proclaimed plants and animals on unallotted land.

Environmental management guidelines

The Department of Mines and Energy released *Environmental management guidelines for mineral exploration in the conservation reserves of the Far West District of South Australia* in August 1991. These guidelines were prepared in conjunction with staff of the Department of Environment and Planning. The document describes the procedures and standards to be achieved by mineral exploration companies operating in the reserves. Its central aim is to ensure that the transient and dispersed nature of mineral exploration should not affect the sustainability of the environment in those areas where exploration is undertaken. The Department of Mines and Energy has also released guidelines to reduce or avoid environmental impact resulting from seismic exploration, drilling, and workover operations in the South-East district of South Australia.

Future action

Guidelines for the management of public land will be developed and implemented in a coordinated manner. Criteria relating to land capability will be considered in future planning decisions for public and private land.

The effects of waste and emissions in natural environments will be monitored, especially for coastal and recreational reserves.

The various government agencies that administer public lands have a commitment to landcare principles. The Road Transport Department will continue to work closely with other government and non-government bodies to minimise the impact of road projects and to develop ecological rebuilding and roadside revegetation programs. The Animal and Plant Control Commission will develop and implement policies for the control of proclaimed plants and animals. The Engineering and Water Supply Department will ensure that reservoir buffer zones will be revegetated progressively with local native species. The Department of Environment and Planning, the Engineering and Water Supply Department, and the Woods and Forests Department will liaise with the the Country Fire Service and bushfire prevention committees in order to incorporate fire prevention plans into their land management strategies.

Local government will continue to be responsible for land resource management on council-owned land, on lands dedicated to council control, and on roadsides adjoining such land. Local government will, of course, continue to be involved with land resource management on public lands and transport corridors through membership on the various, natural resource, regulatory bodies and advisory committees. Local government will also continue to contribute to the formulation and implementation of land resource management programs on public lands and local government land.

3.7 LAND MANAGEMENT POLICY REVIEW

The State has in place comprehensive legislation and policy covering the natural resources of soil, water, vegetation and wildlife. The Government recognises that this legislative and policy framework may need to be further strengthened, however, in order to facilitate the attainment of the goals and objectives of the Decade of Landcare plan. The development of legislation and policy to facilitate the management of the State's land resources in an ecologically sustainable way must involve an integrated and cooperative approach. The ongoing review, evaluation, and rationalisation of the legislation, policy, and organisational structure are essential components of the plan.

The Government recognises that while there may be a need for regulation and control in some circumstances, the best approach to addressing land resource degradation and achieving sustainable, land resource management is one of integration and cooperation.

Objective

Develop and implement policy that provides for integrated control of land resource degradation and sustainable management of the State's land resources.

Purpose

The 'Land Management Policy Review' program has been initiated in order to meet the objective of an integrated approach to the operation and review of all legislation relating to management of the land resource.

Policy

The Government will ensure that the relevant legislation and procedures are reviewed and altered to meet the changing needs of land resource management. It will encourage interaction between the agencies responsible for the relevant Acts, facilitate an integration of relevant Acts over time, and ensure consistency in the management of these Acts.

The following Acts relate to land use and management:

- *Soil Conservation and Land Care Act 1989*
- *Pastoral Land Management and Conservation Act 1989*
- *Native Vegetation Act 1991 (replacing the Native Vegetation Management Act 1985)*
- *National Parks and Wildlife Act 1972*
- *Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*
- *Planning Act 1982-85*
- *Forestry Act 1950-81*
- *Crown Lands Act 1929-86*
- *Water Resources Act 1990*
- *Mining Act 1971, Petroleum Act 1940 and Mines, Works and Inspection Act 1920*
- *Coast Protection Act 1972*
- *Country Fires Act 1989*
- *Fences Act 1975*
- *Dog Fence Act 1946*

Ten-year targets

- A procedure will be established for coordinating and integrating the activities under the various Acts that deal with land resource management and that are carried out by the related statutory bodies and government departments.

- A planned strategy to implement the objectives of the various land resource management Acts will be prepared.

- All legislation pertaining to land use and management in South Australia will be reviewed. Closely aligned Acts may be amalgamated. Administering bodies will ensure adequate public consultation and involvement in the review.

- The *Soil Conservation and Land Care Act 1989* will be reviewed in 1995 for its effectiveness and changes will be made as required.

- Regional bodies will be formed to facilitate the operation of the various land resource management Acts across the State (eg Soil Conservation Boards and Water Resource Committees).

- A program of active interaction between the Soil Conservation Council, the Pastoral Board, the pastoral District Soil Conservation Boards, and the departments of Agriculture, Environment and Planning and Lands will be developed to ensure maximum cooperation and effectiveness in the implementation of soil conservation and pastoral legislation.

- Adequate secretarial and technical support for the State regulatory bodies and the regional bodies will be provided to enable them to undertake the functions ascribed to them under their respective Act.

Past action

During 1989, the passage of legislation covering both the agricultural and

pastoral lands provided South Australia with an up to-date legislative base from which to encourage improved land management. The *Pastoral Land Management and Conservation Act 1989*, and the *Soil Conservation and Land Care Act 1989*, establish new frameworks for the management of the land resources of the State. More recent changes to the legislative framework have occured with the passage of the *Water Resources Act* in 1990 and the *Native Vegetation Act* in 1991. These Acts are described in Appendix 3.

The Natural Resources Management Standing Committee comprises the chief executive officers of the Government's natural resource managing agencies. It is regarded as the peak forum within government for the formulation of natural resource management policies and the coordination of interagency activities relating to the identification, allocation, use, and management of the State's land resources. The committee has developed an integrated, natural resource management approach to issues that are broader than the interests of any one agency.

A number of land resource management initiatives have been planned and implemented by this committee. A recent task of this committee has been to prepare for the establishment of a natural resources council for South Australia, which will ultimately replace the Natural Resources Management Standing Committee.

Future action

Each of the Acts with the primary function of the management of a component of the natural environment establishes a council, commission or board to ensure the most appropriate management of the resource. These bodies have a responsibility to review their operations regularly. All subordinate legislation is required to be reviewed in South Australia every seven years and appropriate action taken to re-establish it. This often leads to a review of the Act.

A rigorously defined review process is included in the Soil Conservation and Land Care Act, where the Soil Conservation Council of South Australia is required by 1995 to report to the Minister of Agriculture on the operation and effectiveness of the Act. The report will examine the management of the State's land resource particularly with respect to the Act and other relevant legislation.

A ministerial 'Native Vegetation Supplementary Development Plan' is being prepared to complement the intent of the *Native Vegetation Act 1991*. This plan aims to minimise the amount of clearance possible under the exempting regulations of the Native Vegetation Act.

A Natural Resources Council will soon be established to provide integrated advice on the management of natural resources in South Australia. Government intends to have a regular source of advice on natural resource issues, with wider community involvement in the discussion and presentation of that advice. The council will provide the Government with broad-based information on the State's natural resources. The council will report to the Natural Resources and Infrastructure Committee of Cabinet.

The council will have an independent presiding officer and a balance ofgovernment and non-government members including the chief executive officers of the government agencies responsible for natural resources. The council will provide a mechanism for initiation and regular coordination of government programs and activities. One of the responsibilities of the Council will be to convene a Natural Resources Forum at least twice a year. The forum will enable an effective public contribution to natural resource policy-making.

3.8 EDUCATION AND COMMUNITY AWARENESS

The impact of land management issues extends far beyond those that manage the land. Every member of the South Australian community is affected to some degree by degradation of the land resource. Due to the widespread economic, environmental, and social effects of land resource degradation, there is a need to bring the issues of land management to the attention of as much of the South Australian community as possible. A recent survey of the Australian population ranked land degradation fourth in importance as a resource issue after the disposal of hazardous waste, air pollution, and energy use. But only 57% of those surveyed indicated that they had seen soil damage, and most were only aware of water and wind erosion as types of degradation. The majority of land managers in South Australia have not had a full formal education or further education in land resource management.

Although those most directly and seriously affected by land resource degradation are usually land managers, an aware and understanding community is essential to provide the physical, financial, and social support that land managers need as they struggle with these problems. There is considerable evidence to show that members of the wider community are becoming more aware and interested in the state of our land resources and are demanding information and the opportunities to become involved.

General awareness of the problem is important, but it is even more important that the whole community understands the concepts of land resource management and feels encouraged to become involved. Only then will attitudes begin to change and people begin to take action that will contribute to landcare.

Objective

Increase or develop awareness, education, and training to ensure that South Australians have the opportunity to understand and contribute to landcare.

Purpose

The purpose of the education and community awareness program is to encourage the adoption of a landcare ethic by all South Australians and to encourage and facilitate their participation in land resource management initiatives throughout and beyond the decade.

Policy

The education and community awareness program is designed to create understanding, concern, and a sense of responsibility in all South Australians with respect to land resource degradation and the need to use our limited land resources in a manner that will ensure ecologically and economically sustainable land use in the long term. The program will provide opportunities for children and adults from both rural and urban communities to become involved in tackling land resource degradation.

This program seeks to initiate State-wide programs that will support the other facets of the plan and the various local activities and groups that address land resource management issues. The program utilises the media and the formal and informal education networks throughout the State to raise community awareness and understanding and to increase support for land resource management issues.

Ten year targets

- The majority of South Australians will be aware of the extent of land resource degradation and its implications for them.

- The majority of South Australians will understand the whole community's reliance on the rural sector for their economic and social well-being.

- The majority of South Australians will be aware of the major State, landcare initiatives, the need for personal and community action, and the opportunities for action.

- Urban and rural communities will be participating in tandem in landcare activities.

- The majority of rural South Australians will be aware of the interrelationship of the land's natural resources; they will feel a responsibility towards degradation problems and will be aware of the long-term, economic and ecological advantages of adopting sustainable land management strategies.

- A contemporary landcare issues curriculum will be included in all primary and secondary schools that complements and enhances existing curricula.

- Opportunities for relevant, post-secondary education and training in land resource management will be provided for students, land managers, technicians, advisers, researchers, and teachers via courses or subjects at tertiary and further education levels and via training programs run by various government and non-government agencies.

- Collaboration and cooperation between those agencies providing education and training in land resource management will be promoted and facilitated.

- Training programs will be developed for land managers, community representatives and groups, staff of government and non-government agencies, and the members of State or regional, statutory and advisory bodies.

- Education and training programs that focus on specific issues and needs will be conducted (for instance, on dryland salinity, water quality, rabbit control, native vegetation management, property management planning, revegetation, and group dynamics).

- Relevant education and training opportunities in land resource management will be provided for Aboriginal communities and other groups not adequately covered by existing programs.

Past action

Community awareness programs

A wide range of government and non-government agencies are involved in programs that focus awareness on land resource management and use:

- Landcare Australia Limited
- Department of Agriculture
- State Management Committee for the Decade of Landcare
- Department of Environment and Planning
- Department of Engineering and Water Supply
- Education Department
- Department of Lands
- Department of Employment Technical and Further Education
- Woods and Forests Department
- local government
- the various Statutory and Advisory Bodies
- Greening Australia (SA)
- Trees for Life
- Australian Trust for Conservation Volunteers
- Country Women's Association
- Agricultural Bureau and Women's Agricultural Bureau of SA
- Rotary
- KESAB — Keep South Australia Beautiful
- Life. Be in it
- the media
- Australian Conservation Foundation
- United Farmers and Stockowners Association
- Friends of Parks groups
- various professional associations and special interest groups
- corporate sector

Particular programs and activities include the following:

- 'Operation Landcare' — an overview program for the Decade of Landcare
- 'Kids for Landcare' — the landcare education program in schools
- 'Landlink'— links urban and rural students on farms
- 'Save the Bush' — overview program focussing on native vegetation and wildlife
- 'Landcare News', 'Bush Chronicle', 'Outback', 'BP Landcare Challenge', 'Treespeak', 'Trees for Life', 'Digest of News and Events' and other newsletters of local groups
- Landcare Awards — State and National which recognise achievements in promoting and adopting sustainable land management
- Ibis Awards — promote and acknowledge sound land management and conservation

Shown at the launch of 'Operation Landcare' in February 1990 the Minister of Agriculture, Mr Arnold, the Chairperson of the State Management Committee for the Decade of Landcare, Barbara Hardy, Nathan Hayden of the Salisbury Heights Primary School and the Director-General of Agriculture, Dr John Radcliffe.

- 'Life. Be in it - every little bit helps' — landcare community service notices on television, Dairy Vale milk cartons, posters etc.
- press, radio and television coverage of specific issues
- displays and presentations at the Royal Adelaide Show, conferences, field days, shopping centres
- widely distributed pamphlets and fliers on programs and issues

Primary and secondary education

Children are the land managers, the educators, the tax payers, and the voters of tomorrow, and as such, they need to develop an awareness and understanding of land resource management issues. Children are also an avenue for influencing the adults in a community. A number of the community awareness programs listed involve children. The main program aimed at children is the 'Kids for Landcare' program.

'Kids for Landcare' is an education program that involves the Education Department, the Department of Agriculture, other government departments and non-government agencies, as well as independent and Catholic schools. Important elements of the 'Kids for Landcare' program are as follows:

- a ten-year commitment by the education fraternity to the Decade of Landcare
- the injection of $715 000 by the Education Department for the establishment of 26 school 'centres of excellence' focussing on the environment and landcare (Map 8)
- the provision by the Education Department, the Department of Agriculture and National Soil Conservation Program of salaries and operating funds for curriculum writing and for coordination and promotion of landcare in schools
- the preparation and distribution of two of a planned nine landcare curriculum packages to support

teachers developing environmental education in schools

- a State-wide poster competition (tied to the 1990 State Landcare Awards)
- the initial development of 'Landlink' and curriculum support material to enable urban students to visit country schools and farms and rural students to visit urban centres
- the development of student involvement in the environmental monitoring programs, 'Saltwatch', 'Frogwatch', and 'Wormwatch', as part of the strategy to raise student and community awareness of landcare and the environment in general
- the establishment of a steering committee integrating State, independent, and Catholic schools, the Department of Technical and Further Education, and community representatives involved in landcare education.

Tertiary and further education and training

There is a wide range of education and training opportunities provided in South Australia that relate to land resource management. These opportunities cater for students, land managers, technicians, advisers, teachers or trainers, and workers in related fields.

The University of Adelaide provides the following opportunities:

- Bachelor of Applied Science (Natural Resources Management)
- Bachelor of Applied Science (Agriculture)
- Bachelor of Agriculture
- Graduate Diploma in Natural Resources
- Graduate Diploma in Agriculture
- Masters Degree and Graduate Certificate in Soil Management and Land Evaluation
- Post-graduate courses in Soil and Water Quality
- Research degrees on land management issues
- Land resource management subjects can also be taken as part of other degree programs.

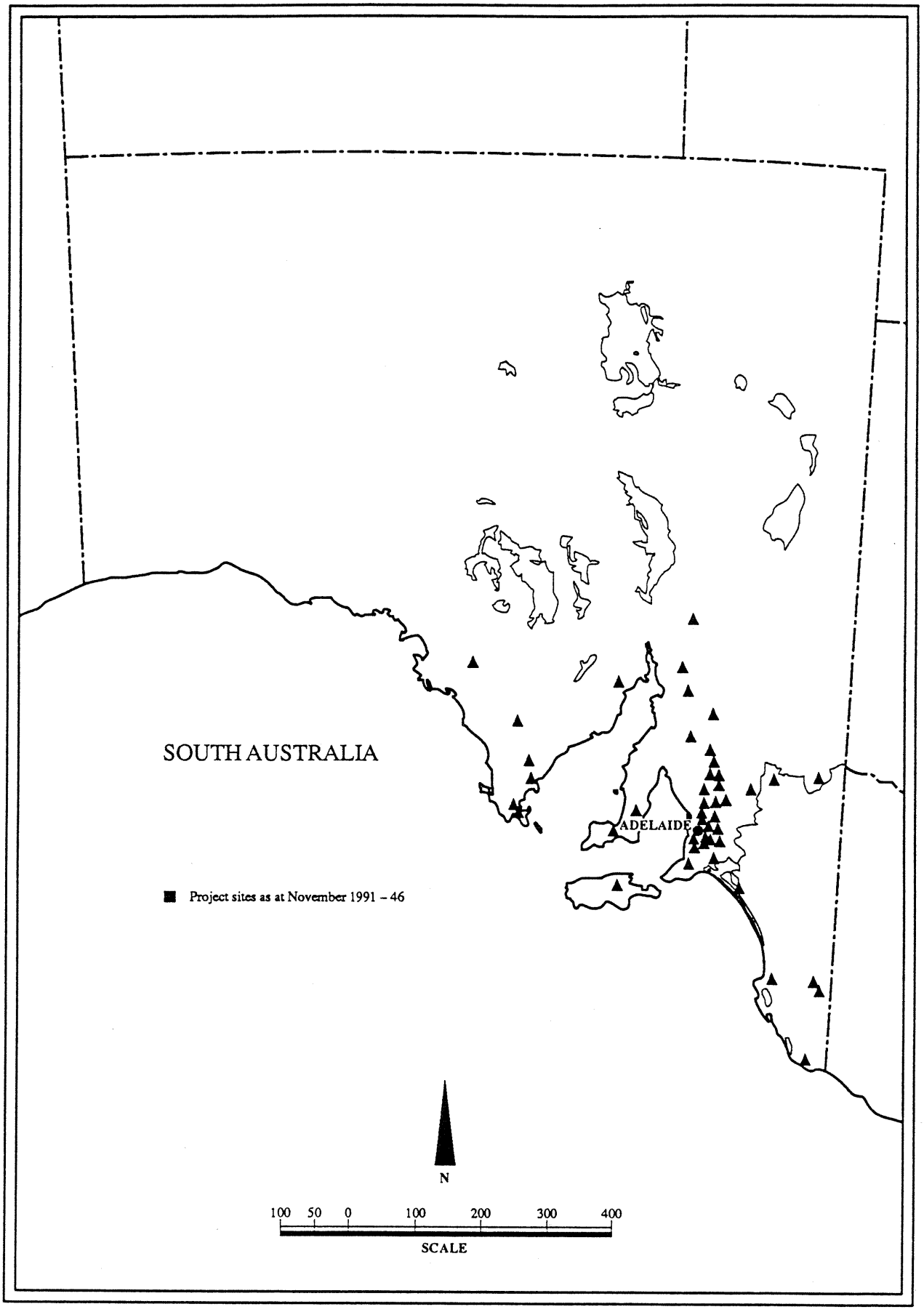
The University of South Australia provides the following opportunities:

- Bachelor of Applied Science (Conservation and Park Management)
- Honours Degree in Conservation and Park Management
- External Associate Diploma (Conservation and Park Management)
- Environmental Studies major as part of other degree programs

Flinders University of South Australia offers various subjects relevant to land resource management as part of its undergraduate degree and post-graduate research programs. For example, the School of Earth Sciences offers course work and research on hydrology and geophysics. The School of Earth Sciences is closely affiliated with the National Centre for Petroleum Geology and Geophysics and the Centre for Research in Groundwater Processes. The Schools of Biological Sciences, Physical Sciences, and Social Sciences also offer topics that can provide students with an understanding of environmental systems and the related economic and social issues.

The Department of Employment and Technical and Further Education in

The 'Kids for Landcare' program provides opportunity for school children in urban and rural areas to learn about and experience Landcare.



Map 8: Kids for Landcare projects funded under the Education Department's Centres of Excellence Program.

South Australia offers a range of certificates and short courses relevant to land resource management through its TAFE colleges, which are located regionally in South Australia. Certificate courses are available in the following areas:

- land management
- farm practice (for the training of future farmers and farm workers)
- pest control
- weed control
- farm chemical safety
- rural management and rural office practice

Short courses are designed for specific needs and are offered at strategic centres:

- rural property planning
- revegetation techniques
- vegetation management
- sustainable agricultural systems
- local vegetation and wildlife

State Youth Affairs recently introduced the Youth Conservation Corps, an initiative of the Minister of Youth Affairs designed to meet the needs of unemployed young people. The program combines practical, conservation projects with formal training through a TAFE college. The program aims to provide young people with opportunities for the development of vocational, personal, and enterprise skills through participation in conservation projects of lasting benefit to the community.

The South Australian Rural Industry Training Committee aims to ensure that training and education for those involved, or who will become involved, in the rural industry in South Australia is adequate for the future needs of the industry. Members reflect a cross-section of involvement, interest, and knowledge in rural production, training, and education.

Apart from the various TAFE courses, training programs, workshops, seminars and conferences are provided by government departments, non-government organisations (eg Greening Australia), the Universities, professional associations and industry bodies, and the corporate sector. Training is often directed at internal staff but these organisations also direct training programs at outside clients. Greening Australia, Trees for Life, Australian Trust for Conservation Volunteers, and some private companies have been involved in the provision of training opportunities in the establishment and management of vegetation. The Agricultural Bureaux of South Australia also provide training opportunites for their members, such as the recent 'Right Rotations' program conducted across the Agricultural Zone and their regional conference programs.

State government agencies have provided a number of training opportunities:

- dryland salinity workshops for government staff
- property management planning for Department of Agriculture staff and community groups
- revegetation techniques
- soil surveying and identification for community groups and agency staff
- native vegetation and wildlife management for individuals, groups and schools
- landcare inservice training for teachers
- principles and practices of vertebrate pest control for local government and relevant State government staff

Future action

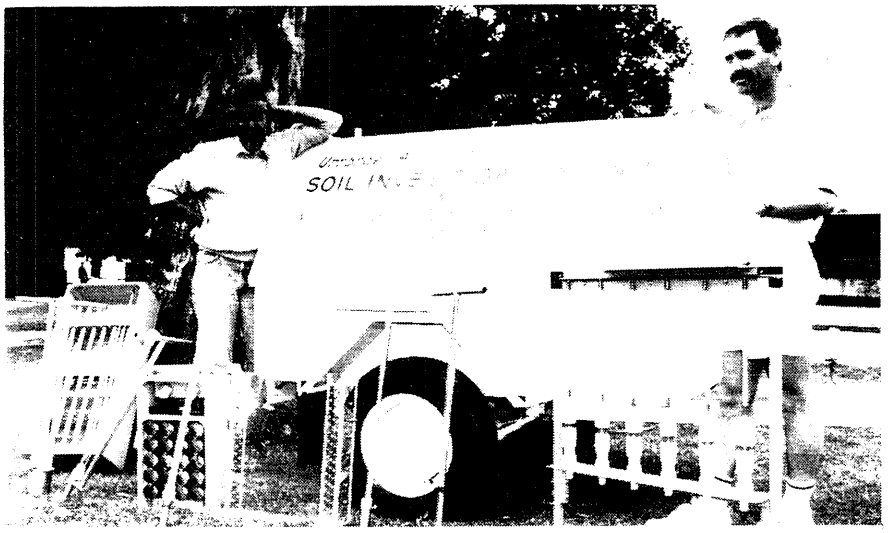
To bring about change in attitudes and behaviour, it is essential to target different sections of the audience and move them through the stages of awareness and education towards participation. The education and community awareness program in South Australia will target adults and children in two major groups, namely, the rural community and the urban community (Table 6). It is accepted that the awareness and education components of the program will require further breakdowns, depending on prior knowledge of the issues and their immediate relevance to the community, the cultural background and geographical location of the sections of the community, and the capacity for involvement of the various groups within the South Australian community.

Greening Australia's 'Baby Green Machine' has been a popular and practical way of introducing children to Landcare in general and direct-seeding in particular.

The access and support mechanisms to facilitate this component of the Decade of Landcare plan are already in place. But it is envisaged that the two overview programs, 'Operation Landcare' and 'Kids for Landcare' will provide the groundwork for the community awareness and school-age education on land resource management. The State Management Committee for the Decade of Landcare, the Department of Agriculture, and other key government and non-government agencies will support these two programs. Tertiary and further education institutions will be encouraged to collaborate and cooperate to ensure that ongoing, relevant training and educational opportunities are provided in an efficient manner.

Table 6: Education and Community Awareness

	Urban — Adults	Urban—rural links — Children	Rural — Adults
AWARENESS	Clear understanding by the community of its reliance on the rural sector for economic and social well-being	Understanding of how environmental issues are interrelated and that land management issues are part of the whole environmental scene	Awareness of the interrelationship of the land's resources; responsibility towards the degradation problems; awareness of the long-term advantages of adopting sustainable land management strategies.
EDUCATION AND TRAINING	Understanding of land management issues; understanding of the democratic power individuals have to influence the policy-making process; understanding of opportunities for participation and relevant education and training	Landcare curriculum materials made available and based on the Environmental Education Policy Statement. Environmental skills seen as one of the 9 essential Skills and Understanding for all R to 12 students.	Acquisition of experience and skills necessary to adopt sustainable land management practices; the initial focus will be on education and training in property planning, conservation farming, vegetation management, rabbit control and salinity.
PARTICIPATION	Individuals will be encouraged to provide practical help to landholders by participating in revegetation, other 'on-ground' schemes, and urban-rural links and to apply the landcare ethic in practical terms within their own environment.	Schools will be encouraged to take action and become involved in programs such as revegetation 'Saltwatch', 'Frogwatch', 'Landlink', etc.	Adoption of sustainable land resource management practices; involvement in landcare groups and land resource planning and action bodies, such as the Soil Conservation Board.



Staff members at Urrbrae Agricultural High School took the initiative to develop equipment and a program to help schools and landcare groups understand different soils.

The Department of Agriculture will continue to train staff working in land resource management and related areas from government departments and organisations. Appropriate training programs will also be run for members of the Soil Conservation Council, other statutory bodies, the District Soil Conservation Boards, landcare and other community groups. Training programs will cover the technical, economic, and social issues affecting land management. Training methods will include workshops, seminars, 'hands-on' field exercises and field trips and exchange visits.

3.9 RESOURCE ASSESSMENT

Fundamental to the Decade of Landcare plan is information about the State's land resources and their capability to support various land uses on a sustainable basis. South Australia has a strategy for the assessment of land resources that involves a land resource mapping program of the agricultural areas (Department of Agriculture) and the pastoral areas (Department of Environment and Planning), a biological survey program (Department of Environment and Planning), and a groundwater systems and geological survey program (Department of Mines and Energy).

In the agricultural areas, the main soil groups and land classes are mapped on the standard 1:100 000 scale map sheet. In areas, such as the Mount Lofty Ranges land use is far more intensive and 1: 50 000 scale map sheets are used to provide the degree of detail required for the smaller size properties and the more intensive management practiced. Land use in the pastoral lands is very extensive and the properties are extremely large. Therefore, the pastoral lands are being mapped at 1: 250 000 scale map sheets to identify different broadscale land systems. The program will meet the information requirements for the proposed 'National Land Capability Assessment' initiated by the Australian Soil Conservation Council.

The mapping unit boundaries are being digitised for storage in a geographic information system. This facility will be able to produce colour plots of a land class map, overlay additional information, and produce maps showing the distribution of specific land or soil conditions. Biological survey information is also being stored in this manner.

The geological survey is a continuing, statewide mapping program, at various standard scales (1: 50 000 to 1: 1 000 000); that provides the basis for establishing terrain systems throughout the State, as well as all geotechnical issues, such as engineering and groundwater activities, mineral and petroleum industry operations, geoheritage data, earthquake monitoring, 'volcanowatch', and slope stability. Computerised digital data management systems are currently being developed in order to facilitate the efficient storage, retrieval, use and presentation of environmental data.

Maps showing areas of sensitivity to water pollution are being put together also. Development controls are being formulated for areas of high sensitivity. In less sensitive areas, development under certain conditions may be permitted by the Engineering and Water Supply Department.

Objective

Assess and describe the land resources of the State in terms of basic characteristics, condition, and capability to support various activities.

Purpose

The land resource assessment programs undertake the description, mapping, and characterisation of land types so that land managers, communities, and local government can make decisions about appropriate management strategies. The programs will help with the following:

- the determination of priorities from the extrapolation of research and demonstration results by providing information on the extent and distribution of particular soil types, landscape features, vegetation and wildlife communities

- the preparation of district plans by Soil Conservation Boards; an inventory of the physical resources and soil conservation problems of districts will provide a sound basis for the recommendation of appropriate management options (eg farming by soil type), and for the determination of priorities for demonstration, extension and research activities

- the establishment of an ecologically based evaluation of the land condition and carrying capacity, in order to set conditions on pastoral leases and to monitor long-term change in management practices

- the provision of assistance to landcare groups and individuals in the preparation of local and property plans via a land description framework from which more detailed soil and land class maps can be developed

- ensuring informed decision-making by land use planners about new developments, particularly in areas such as the Mount Lofty Ranges where there are conflicting land use interests; alienation of productive agricultural land and the subdivision of land susceptible to erosion can be avoided if land class maps are used in the planning process, and new agricultural developments can be sited in areas where suitable soils and water are available

- the equipping of land managers and technical staff with the skills to describe and understand soils as an essential step in developing appropriate soil management strategies

- the gathering of information vital to the development of scientifically justified land resource management policies, such as the identification of areas sensitive to water pollution

- the identification of areas of natural habitat containing rare plants and animals as a basis for the development of protection and management strategies

Policy

Data sets will be collected for all land in South Australia to allow for interpretation for specific purposes according to the needs of the users. The data and interpretation will form the basis of land management and land use policy decisions by the State Government, District Soil Conservation Boards, other statutory bodies, local government, community groups, and individuals in the preparation of land resource management plans.

Ten-year targets

- Soil landscape and land capability maps will be provided for the whole of South Australia.

- Adequate definition of the chemical, physical, mineralogical, and biological properties of the State's main agricultural soils will be provided. This analytical data will be incorporated in the land-attribute data base of the State's soil landscape mapping program.

- The biological survey of the State's natural resources will be completed. This data will be presented in a form that will contribute to land resource management decisions.

- Detailed lease assessments will be completed for every pastoral lease and will include an evaluation of land condition and specific recommendations for rehabilitation of degraded areas.

- Planning systems based on land capability will be available for all agricultural and pastoral lands in South Australia.

- Training programs will be conducted for land resource managers and technical staff in land evaluation and use of data in district and property management planning.

- Records on the population and distribution of proclaimed plants and animals throughout the State will be collated.

Action

A land classification system has been devised that can be used to summarise most physical limitations affecting a parcel of rural land. The system can be used in all districts and can be applied equally well at the district and property level.

Mapping unit legends have been developed for different regions because a standardised system of map unit labelling across a region is essential if all the component map sheets are to be compatible. The forward program of the mapping program is detailed in Table 7.

Soil characterisation similar to that used in the United States is proposed, whereby the physical, chemical, mineralogical, and biological characterisation of representative examples of the State's key agricultural soils are made. Soils will be selected according to their significance as indicated by the soil mapping program. This program is compatible with the aims of the proposed 'National Soils Inventory' and will be documented in publications as well as being incorporated into the mapping data base.

Soil recognition training exercises have been run for landholders and government staff. An understanding of the local soils is seen as fundamental to better land management.

Biological surveys have been carried out on Kangaroo Island, the Nullarbor Plain, offshore islands, the northern Eyre Peninsula and in the Murray Mallee. The mining industry have prepared intensive biological surveys in the Arid Zone in preparation for 'environmental impact' studies for Olympic Dam, Moomba, Moomba—Stony Point Pipeline and Beverly Uranium prospect. Extensive biological surveys have been carried out in the Innamincka Regional Reserve, the Yellabinna Regional Reserve, and at Dalhousie Spring complex.

The geological survey is continuing and the geological map status as at the end of 1991 is shown in Map 9.

Pastoral land assessment field days have been held with landholders in two districts covered by Soil Conservation Board and will be extended to all Soil Conservation Board districts in pastoral areas.

In the pastoral lands of the Arid Zone, land assessment and evaluation will develop methods for identifying and mapping land systems and for assessing and monitoring trends in soil erosion. Assessment will also evaluate land condition and carrying capacity for grazing use, as well as identifying vegetation types. These programs are compatible with the 'National Rangeland Inventory'.

Identification of the groundwater base and an understanding of the hydrology of catchment areas will also be required in the arid/pastoral lands.

The Animal and Plant Control Commission has been investigating the adequacy of assistance to local Animal and Plant Control Boards to collate and maintain records of the species, population density, and distribution of proclaimed plants and animals.

Table 7: Status of land class mapping in South Australia as at 1991

District	Status	Completion
Eyre Peninsula (49 000 km2)	Commenced April 1990	March 1995
Nthn Agricultural (16 500 km^2)	50% complete	June 1993
Yorke Peninsula (12 000 km^2)	Commenced September 1990	December 1992
Kangaroo Island (4000 km^2)	Commenced September 1990	December 1993
Marginal lands (20 000 km^2)	Commenced April 1989	March 1992
Murray Plains (7000 km^2)	To commence 1992	1996
Mt Lofty Ranges (7000 km^2)	Commenced September 1987	December 991
Nthn Mallee (15 000 km^2)	75% complete	June 1992
Sthn Mallee (15 000 km^2)	To commence 1992	1996
Upper South-east (7500 km^2)	60% complete	June 1991
Lower South-east (15 000 km^2)	To commence 1992	1996
Pastoral lands (460 000 km^2)	Commenced 1990: Kingoonya 1991, Gawler Ranges 1991/92, Flinders 1992, North East 1992/93	1998

3.10 RESEARCH AND DEVELOPMENT

Land resource degradation problems are complex issues needing integrated control and management. Continuing research is required to develop solutions that are practical, acceptable to the community, and economically and ecologically sustainable.

Objective

Continue with research and development programs that address the physical, economic, and social issues associated with land resource degradation, and sustainable land resource management and use in South Australia.

Purpose

The purpose of the research and development program is to establish new or modified, land resource management practices to achieve economically and ecologically sustainable land use. Research will be conducted to improve the understanding of the technical, environmental, economic, and social factors relevant to land resource management in South Australia and to develop control measures and management methods to meet the needs of land managers, the wider community, and the long-term sustainability of the land resource.

Policy

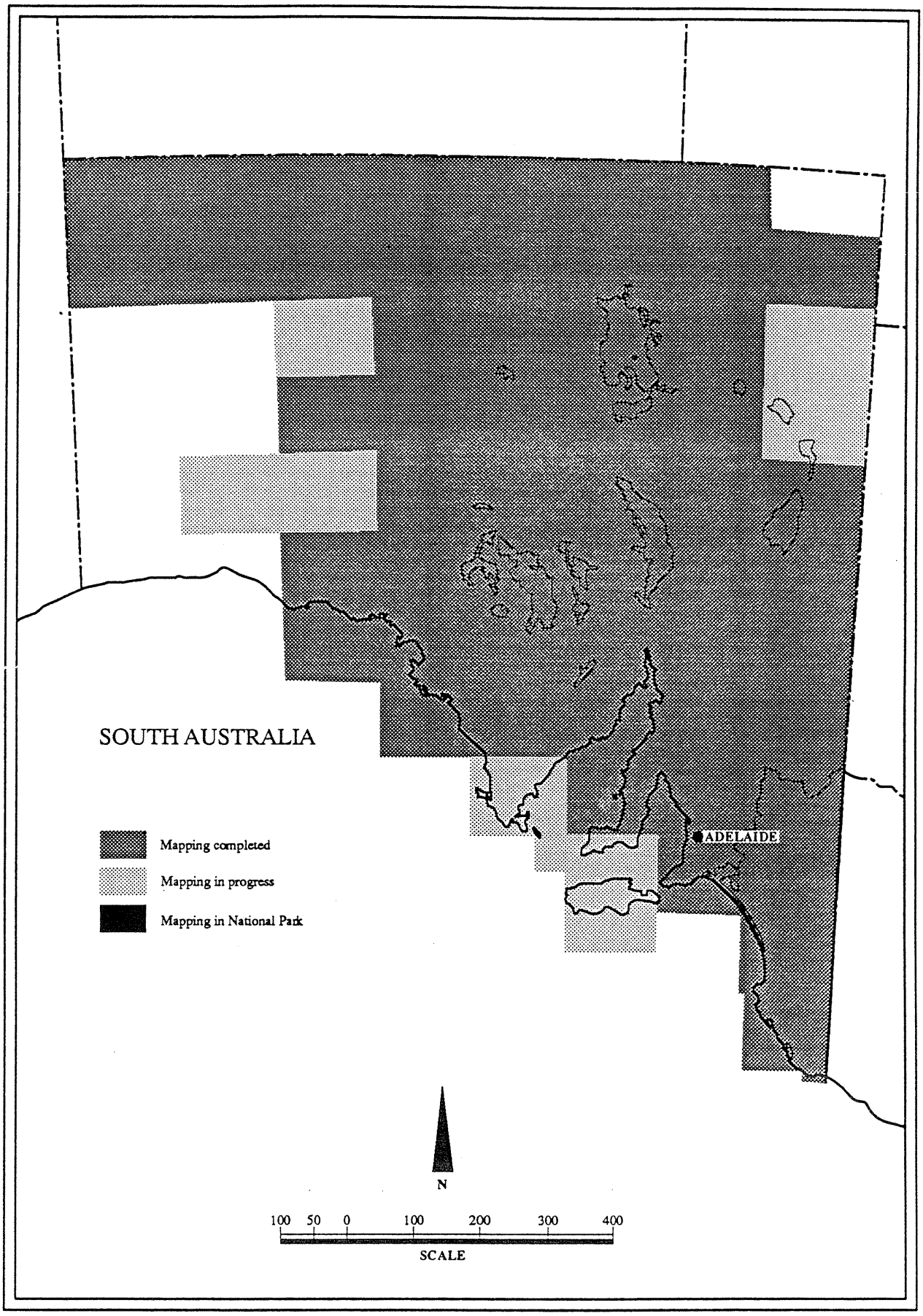
The Government will encourage research and development programs in land resource management that maintain or enhance the productive capacity of the land and at the same time incorporate the principles of sustainable management for the benefit of the land manager, society in general, and the environment.

Ten-year targets

Over the next ten years, the aim is to establish and/or continue research and development projects in the following priority areas.

Economic evaluation and financial planning

There is an urgent need to collect further economic data and develop a structure for decision-making to facilitate the economic evaluation of land resource degradation and management practices. Priority areas for economic research in South Australia are the cost of land resource degradation and benefit/cost ratios for land resource management measures, such as 'conservation farming' and management of arid lands.



Map 9: South Australian Geological Survey Program as at the end of 1991 (1:250 000).

Catchment management

Catchment management relates to the integrated use and protection of all land resources in a particular geographic area, as well as to planning for action and the division of responsiblities between individuals, community, regulatory bodies and government. A broad target is to understand the issues and processes involved in particular catchments and to develop integrated programs for the sustainable management of each catchment as a whole and its component private and public properties .

Dryland salinity

A technical strategy to address dryland salinity in South Australia has been prepared to provide direction for program development and coordination. Some ten State and Commonwealth government agencies are involved. The strategy indicates five, key, research and development targets:

- the identification of the extent of dryland salinity in South Australia
- the development of a system to monitor salinisation trends and the impact on soil, water, vegetation and wildlife
- the determination of how salinisation occurs in the main problem areas of the State
- the development of effective technical measures to combat salinity based on the 'whole catchment approach' to management
- the quantifying of the contribution of high—water-usage plants in combating salinity.

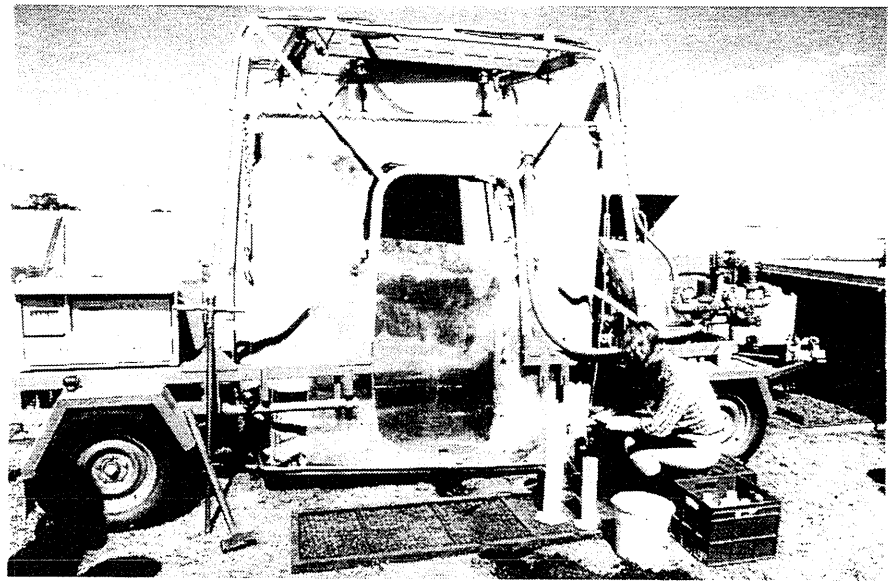
Dryland salinity investigations are involving wide range of agencies and are being conducted throughout the Agricultural Zone.

Surface and subsurface soil management

Specific, ten-year research targets relating to surface and sub-surface soil management include the following:

- support for a holistic approach to research on surface and subsurface soil management, to ensure integration of research into land management, and to provide 'best-bet' management options for land managers, and to identify knowledge gaps
- development of a system of management involving stubble management, tillage, rotations, and use of soil additives, to improve the structure, rainfall infiltration capacity, stability and overall fertility of the State's farming soils and the long-term sustainability of land use and productivity
- development and refining of techniques and models to help technical staff and land managers assess the effects of management on soil structure, organic matter, and the nutrient and biological state of their soils
- development of methods to improve the subsoil nutient and structure state; includes the development of plants or cropping methods to improve the accumulation and/or utilisation of subsoil water and nutrients
- development of methods to introduce and establish beneficial soil organisms that are genetically engineered, exotic or naturally occurring, with due regard for appropriate safeguards and enviromental impact assessment

Determination and monitoring of groundwater levels are important aspects of dryland salinity research.



A rainfall simulator is used to assess the risk or benefit of different management practices in the areas prone to water erosion, in South Australia.

- determination of the influence of various land management practices on soil organisms, and development of management strategies to modify the activities of beneficial and detrimental populations of these organisms

- development of practical and economic methods that will overcome water repellence in the sandy soils of South Australia

- development of programs to combat soil pollution problems, to rehabilitate polluted soils, and to prevent movement of pollutants in soils and catchments

- identification of the best methods of ameliorating soil acidity, development and demonstration of systems that will reduce the rate of acidification, and monitoring the rates of acidification across the State and rates of reacidification following the use of ameliorative measures

- identification and assessment of innovative, alternative methods of surface and subsurface soil management.

Decline of vegetation in the arid zone

Ten-year research and development targets to address the decline of vegetation in the arid zone are as follows:

- the development and transfer of information, technology and decision-making tools to land managers to enable them to achieve sustainable, multiple land use

- the implementation of ecologically sound, integrated, pest management programs

- the understanding of the dynamics of arid ecosystems and the influence of humans.

Management of native vegetation

Considerably more needs to be known about managing and maintaining the biological diversity of broadscale native vegetation. The more traditional issues of fire control, vermin control, and fencing for fauna movement are being addressed. These areas require further investigation:

- the enhancement and maintenance of individual plant species under natural conditions

- the effect of domestic, native and feral grazing for limited periods on native species and the reasons why various herbivores are attracted to certain species

- the effect of adjoining land use on native vegetation
- the way to increase the plant diversity of degraded native vegetation
- the development of strategies for protection and management of endangered species
- the role of fire in achieving management aims.

Revegetation

Research is needed into techniques to revegetate native vegetation to enhance degraded land and to contribute to sustainable land management. Priority areas for further work are as follows:

- continuing development of cost effective and practical revegetation
- improvement in reliability of revegetation on difficult sites (eg scalds)
- assessment of benefit/cost ratios for revegetation programs
- improvement in species and provenance selection, and breeding with emphasis on indigenous plants

Animal and plant control

An important function of the Animal and Plant Control Commission is to conduct and direct research into the control of proclaimed animals and plants. The following long-term targets are of importance:

- research on pest plants and animals to assess their actual or potential impact on agriculture and the environment
- development of appropriate control methods based on adequate understanding of an organism's biology and the need to protect the State's resources
- research into the control of proclaimed animals, such as rabbits and goats, by biological, chemical, and physical methods, and development of integrated control programs, with special emphasis on rabbit control in the Arid Zone
- development of contingency plans to maximise any accidental release of rabbit heamorthagic disease; supplementary mechanical control to remove remnant populations surviving biological control
- research into alternative, plant control techniques, such as the establishment of native trees, shrubs, and grasses on roadsides to out-compete weedy species.

Social research

The *Decade of Landcare Plan for South Australia* identifies the importance of community involvement in the planning and implementation of most of the action programs. It also recognises that long-term success of the programs will be measured by the number of land managers who adopt or continue with sustainable, land resource management practices.

To encourage and facilitate effective individual and community involvement in landcare programs, it is important to understand the community's knowledge and perceptions of landcare. Social research should be conducted to establish what different sectors of the community know and believe about landcare, and the degree of awareness and experience of land managers and community groups with respect to land resource degradation problems and sustainable management practices. The community's perception of priorities, solutions, and impediments to the adoption of effective management measures should also be established. Research is also needed to identify which policies and programs will be most effective in changing attitudes and behaviour of rural and urban communities towards sustainable land resource management and how best to monitor changes in attitude and behaviour and to assess progress as programs are conducted.

Setting the research agenda

The research agenda for land resource management is established in South Australia by several means.

Key government departments establish research objectives and programs within their own structure with the help of appropriate advisory bodies, such as the Native Vegetation Council, and the Pastoral Board, and regional bodies, such as Soil Conservation Boards, and Regional Agricultural Councils and Committees.

Interaction between departments occurs through the Natural Resources Management Standing Committee or on a direct, department-to-department basis. For example, the State Dryland Salinity Committee includes members from the Departments of Agriculture, Mines and Energy, Environment and Planning, Engineering and Water Supply, and Lands. This committee also includes members from the University of Adelaide and the CSIRO divisions of Soils, and Water Resources. A major role of this committee is to develop and review a research agenda for dryland salinity.

A research strategy for arid land issues has been prepared by a working group comprising representatives from government, educational institutions, pastoralists and conservationists. This research agenda is included in *Technical strategy to address research, education and extension in the arid lands of South Australia.*

The various land resource programs have State assessment panels to rank and review research projects relevant to their program and to submit projects for funding. These panels have representation from government, research, education, conservation, industry, and the community.

The Australian Cooperative Research Centre for Soil and Land Management, established in Adelaide in late 1991, brings together key staff of the CSIRO Division of Soils, the University of Adelaide, and the Department of Agriculture to establish a research agenda for soil and land management and to coordinate research activities. The Chief of CSIRO Division of Soils, the Dean of the Faculty of Agriculture and Natural Resource Sciences for the University of Adelaide and the Director-General of Agriculture for South Australia, together with the Centre's director, are members of the centre's board of management. An advisory committee, consisting of representatives from a wide range of professional, interests and geographical areas, will provide managerial and policy advice to the Board.

Research facilities and programs

Facilities or programs for research on land resource management are provided by the following organisations and centres:

- State government departments of Agriculture, Environment and Planning, Mines and Energy, Engineering and Water Supply, Road Transport, and Woods and Forests
- Animal and Plant Control Commission
- CSIRO Division of Soils and Division of Water Resources
- the Australian Cooperative Research Centre for Soil and Land Management
- the Centre for Groundwater Studies
- University of Adelaide (incorporating the Waite and Roseworthy campuses and the National Key Centre for Teaching and Research in Dryland Agriculture and Land Use Systems)
- University of South Australia
- Flinders University
- the corporate sector (eg mining and farm chemical companies)
- consultancies

Role of community research

Rural communities in South Australia have for a long time been involved in land management research, working alongside researchers from the State Government, CSIRO, industry, and the tertiary education institutions. The implementation of the 'Community Landcare' and the 'Communities of Common Concern' support programs has resulted in the initiation of a number of research projects by community groups. These projects are supported

by researchers from government and tertiary education institutions. Such initiatives will be encouraged, but it is important to ensure that appropriate problem identification, planning, treatment, and evaluation methods are used. Government funding for community-based, land management research will be allocated and reviewed by the appropriate State and/or Commonwealth body.

Dissemination of research results

Established networks for the dissemination of research results are already in place in South Australia. The Department of Agriculture has a wide network for disseminating results relevant to rural land managers and others involved in the rural industry. This network is based on technical extension and research staff stationed at key, regional and district centres. These officers will continue to link with industry, statutory bodies, community groups, and individual land managers. The media will continue to be used, and results will also be extended through publications and guidelines.

Other government and non-government agencies use similar networks to disseminate research findings. Innovative use is being made of rural women's groups to disseminate information on soil and vegetation management.

Increasing use will be made of demonstration projects on farms. The cooperating land manager and other local managers will be encouraged to be directly involved in the planning and execution of such projects.

Future action

Future action in the research and development program focuses on the ten-year targets and ensuring the following:

- an appropriate level of cooperation and coordination exists between agencies and programs
- adequate funding is available and used efficiently for priority programs
- barriers to adoption of research recommendations are identified and targeted by programs to overcome them
- research teams and projects are established to address the key land resource management problems
- opportunities are provided for local communities and users to participate in setting research priorities and implementing projects
- research activities are coordinated where appropriate
- the most effective use is made of both government and non-government resources and skills in research and development
- appropriate land management data is collected and stored in readily accessible form
- the wider testing and application of research findings is encouraged
- the wide dissemination of research results throughout government, non-government, land managers and the general community is facilitated.

4

IMPLEMENT AND REVIEW

4.1 MONITORING, EVALUATION AND REVIEW

The *Decade of Landcare Plan for South Australia* has been prepared to give direction and to identify needs and opportunities for involvement by individuals, community groups and government. It is intended to be dynamic, capable of being modified to cover deficiencies, and to respond to changes in community and government needs. The *Decade of Landcare* is seen as the beginning of realistic long-term programs to achieve sustainable land resource management.

Evaluating and assessing the progress of the Decade of Landcare plan towards achieving the objectives and targets will require extensive collaboration and cooperation across the community. It is essential that the Plan be reviewed regularly, which will require continual monitoring at various levels. The State Government will take responsibility for initiating and coordinating thorough reviews of the plan in 1994, 1997, and 2000. Public consultation and participation will be an integral part of the review process. It is anticipated that the review process will revise some of the existing objectives and targets and bring them into line with the social, economic, and environmental conditions of the time.

The preparation of district plans, water catchment and regional vegetation plans, and the assessment and monitoring of the condition of the land resources will form the basis for both the implementation and evaluation of the plan and its component programs. The *1989 Soil Conservation and Land Care Act* entrusts the Soil Conservation Council with the responsibility for monitoring and evaluating the progress and effectiveness of those land management programs that lead to the enhancement of the land resource and the adoption of sustainable land management practices by both public and private land managers.

The Government will encourage the Soil Conservation Council, the Pastoral Board, the Water Resources Council, the Native Vegetation Council, and the Animal and Plant Control Commission to work together to ensure adequate monitoring and to facilitate effective evaluation of the various programs implemented, so that the goals and objectives of the Decade of Landcare plan are achieved. The lead government agencies will provide the expertise and support necessary to facilitate the monitoring and evaluation processes. These agencies will evaluate their participation in the action programs at each review of the Decade of Landcare plan.

The various Acts direct the statutory bodies involved in land resource degradation management to involve the community as widely as possible in the programs designed to conserve or rehabilitate the land resource. The community can contribute to the monitoring, evaluation and review of landcare activities and programs at a local level through their respective district or regional soil, water or vegetation boards and committees. Individuals and communities will also be given opportunity to contibute to and respond to district plans covering management of the land resources. They will be able to contribute to the evaluation and review of the Decade of Landcare plan at the State level through the public consultation programs in 1994, 1997, and 2000.

It is anticipated that a group of officers from the lead agencies will oversee the monitoring and evaluation of the Decade of Landcare plan and its component programs for the Government. This group will play a leading role in the triennial reviews. They will do this to measure progress and gauge the need for changes in direction in response to feedback from the community and government.

4.2 RESPONSIBLITIES

The responsibility for implementing the plan will be shared by the whole community.

The Minister of Agriculture, on behalf of the State Government will take the

main responsibility for the Decade of Landcare plan but will work closely with ministers responsible for other portfolios that have a natural resource component. The Natural Resources and Infrastructure Committee of Cabinet, supported by the Natural Resources Management Standing Committee, is the main overseer of the State's natural resources programs.

The South Australian Soil Conservation Council has a legislative responsibility to provide advice to the Minister of Agriculture on the priorities for soil conservation, and as such, it has a major role in reviewing the implementation of the plan. Other statutory and advisory bodies appointed by the State Government have responsibilities with respect to the water, vegetation and wildlife components of the plan.

While the Department of Agriculture has the main responsibility for the landcare program, the departments of Environment and Planning, Engineering and Water Supply, and Education also have major roles in the development and operation of a number of the action programs of the plan. These four departments will prepare and implement projects relevant to the action programs of the plan. Other government departments may be involved in various components of the plan. The management of public land is the responsibility of a number of departments, which will ensure appropriate management of these lands and set an example to other land managers.

Local government has an obligation to manage land directly within its care in a manner that contributes to the long-term sustainability of land resources. Local government also has an obligation to encourage and support sustainable land management practices on private land. This responsibility will entail involvement with community groups addressing land resource management issues.

Non-government agencies, such as Greening Australia, Australian Trust for Conservation Volunteers, Trees For Life, United Farmers and Stockowners, and Friends of the Parks can help with respect to various areas highlighted in the plan. These organisations have responsibility to advise and inform their own members and to participate in areas such as revegetation, management of native vegetation and wildlife and community awareness and education and identified in the action programs of the plan.

The educational institutions and training bodies have a responsibility to deliver high quality, relevant education and training in land resource management.

Community groups (both regulatory and non-regulatory) and individuals have a responsibility to become aware of land degradation issues facing this State, to become involved in those aspects of the action programs that directly affect them, and to use or manage the land resources in a manner that ensures their sustainability. Individuals and groups will be given opportunity to contribute to the Statewide evaluation and review of the plan and its action programs in 1994, 1997, and 2000.

APPENDICES

APPENDIX 1: LAND RESOURCE DEGRADATION ISSUES

DECLINE OF NUTRIENT, PHYSICAL AND BIOLOGICAL STATE OF SOILS

The problem

The nutrient, physical and biological health of the surface and subsurface layers of the soil affects both land degradation and agricultural production. These factors are interrelated in a complex manner and their decline contributes to other forms of degradation, such as wind and water erosion.

Nutrient state (fertility)

The majority of agricultural soils in South Australia were naturally low in the major nutrients, phosphorus and nitrogen. To overcome this deficiency, landholders have invested huge amounts of money on artificial fertilisers since the early days of property development. In particular, single superphosphate has been used extensively throughout the State, and in recent years, high analysis fertilisers have increased in popularity. In most areas, trace element applications have also been essential for optimum crop, pasture, and animal production.

The use of these fertilisers on legume-based pastures has seen a dramatic improvement in the nitrogen and organic matter state of soils. With closer cropping rotations and the pasture management problems of the '70s and '80s, however, a general decline in soil nitrogen levels has been noted.

Physical structure and rainfall infiltration capacity

The physical structure of a soil is the arrangement of soil particles and the air spaces between them. A soil of good structure is a stable soil allowing optimum water infiltration, aeration, good seedling emergence, and maximum root growth. Such a soil also has a good level of resistance to wind and water erosion.

Soil structure degradation can result from various land use practices and is often related to the intensity of cropping, and the number and kind of tillage operations. Structure decline is also linked to reductions in soil organic matter.

Soil structure decline leads to poor (impeded) rainfall infiltration, increased run-off and subsequent water erosion, poor internal drainage, restricted root and shoot development, and reduced uptake of nutrients. In South Australia, these problems are common in soils that disperse readily and in duplex soils. It is estimated that there are some 4.5 million hectares with soils at risk of structural decline.

Biological state

The decline in desirable biological agents (eg worms) and the build-up of undesirable species and products are linked to past and current land management practices. Pesticides, for example, are an important tool used in both conventional and conservation farming systems for the control of pests (weeds, insects, pest animals, and diseases) in crops, pastures, and livestock. The inappropriate use of pesticides, however, can lead to problems such as the build-up of resistant pest populations (eg herbicide-resistant ryegrass), the accumulation of active pesticide residues in soils, groundwater, plant and animal tissue, and general loss of production.

Implications

It is estimated that soil structure decline and reduced rainfall infiltration cause a loss in production of approximately $60m annually. The production of annual crops requires cultivation of the soil, but cultivation of the soil is the prime cause of soil structure and organic matter decline. Organic matter (measured as organic carbon) is vital to nutrient levels and soil structure. Trials in the grain production areas of South Australia show that organic carbon levels decline quickly under a continuous cropping rotation (grain crop

planted each year) where crops are sown using a conventional cultivation program. The trials show that with a pasture—wheat rotation using conventional cultivation organic carbon levels still decline, but only slowly. In these trials the fallow-wheat and continuous cereal rotations lost about 14% of initial fertility and grain yields continued to decline during the period of study. Even with large inputs of up to 80 kg/ha of nitrogen, soil fertility declined. The results from these trials indicate the need to change not only the cultivation practices, but also the cropping rotations used in the grain producing areas of the State. Without appropriate changes the structure and fertility of many of cropping soils will continue to decline leading to loss in productivity and further degradation.

Once organic carbon levels drop, it is a slow process to return the soil to its original state and this further enforces the need to change crop production methods. Results from tests show that an extra tonne of stubble is needed to counter the decline in organic carbon from a single cultivation. Increasing organic carbon by 0.1% would boost grain yield by 150 kg/ha and, at the broader level, would increase the State yield by 0.42 million tonnes of grain per year. It can also boost grain protein and attract premium prices for wheat crops.

Earthworm numbers under a no-till (no cultivation) system have been shown to be double that under a conventional tillage system. Earthworms play a major role in improving soil fertility and structure further enforcing the need for changes in cropping practices.

Remedial measures

Nutrient (fertility) decline

The following measures are promoted to maintain and improve the fertility levels of soils across the State:

- use of rotations which incorporate grain legumes and legume pastures
- addition of appropriate forms and rates of fertilisers in the crop and pasture phases based on soil and/or tissue tests and paddock history
- prevention of wind and water erosion, which removes soil nutrients
- reduction in the amount of leaching by use of appropriate water management where applicable (eg in irrigation areas) and by use of appropriate fertilisers.

In recent years there has been an increase in the use of grain legumes and pasture legumes to maintain and improve soil fertility in the cropping areas of the State, as well as an increase in the use of tests to indicate the nutrient state of the soil and required additions for optimum crop production and maintenance of soil fertility.

Physical structure decline and reduced infiltration

The following measures are promoted to prevent the decline and where possible improve the physical structure and infiltration of soils across the State:

- retention of adequate crop stubbles and pasture residues
- reduction and modification of tillage practices
- maintenance and build-up of organic matter in the soil through the incorporation of an improved pasture phase in the rotation
- use of sustainable crop/pasture rotations and grazing practices
- use of soil amendments (eg gypsum on red-brown earths)

There are a number of factors that indicate these measures are being adopted by a good percentage of the farmers in the cropping areas. Records of the numbers of permits to burn crop residues have indicated that in many areas of the State, this practice has been significantly reduced, and in some areas, almost entirely eliminated, resulting in greater retention of crop stubbles. The adoption of new and modified equipment (such as the changes to seeding machinery) and the use of chemicals in fallow and seedbed preparation indicate that the number and severity of tillage operations has declined markedly in recent years. Farmers with hard-setting soils are known to be using gypsum although there are no records of the extent or amount that has been used.

Biological state

There is a broad range of measures available to integrate control practices and management to prevent the build-up of undesirable biological species and products, while at the same time encouraging desirable biological species. These measures are being promoted:

- integrated pest management for the control of insects, weeds, plant diseases and other biological pests; this will involve the use of rotations and resistant or tolerant crop or pasture varieties; effective control of cereal cyst nematode (CCN) for example, requires a two year break from host species in the crop or pasture rotation.
- the use of chemicals with due regard to the local and wider environment, and understanding of the target pest, the range of potential control products and the overall crop pasture, and animal management systems
- close monitoring of crop, pasture, and animal management for early warnings of problems; this may include the use of appropriate bio-assays and other testing services.

Adoption is difficult to quantify, but there has been significant response from land managers, chemical suppliers, contractors, and technical advisers to awareness and training programs on the safe and effective use of agricultural chemicals. Farmers in irrigated crop areas of the upper South-east have been quick to adopt the commercial Integrated Pest Management Service.

The development of resistance in annual ryegrass to various chemicals and the improved understanding of biological problems, such as cereal root diseases, crop insect pests, and chemical residue problems, have alerted many land managers and advisers to the need to apply due care and for an integrated approach to the control and management of biological problems.

Program targets

Nutrient (fertility) decline

- Organic carbon (organic matter) levels in cropping soils will be improved.
- Use of pasture legumes in crop rotations will be increased.
- The severity and number of tillage passes will be reduced.
- Appropriate alternatives to traditional cropping practices need to be developed and introduced.
- Strategic use must be made of major and minor nutrients.
- Efficient fertilisers must be available for specific soil types.
- Use of soil and plant tissue tests to determine nutrient requirements of crops and pastures will be increased.
- Species and varieties of crops and pastures will be selected that adapt to the lower fertility levels and nutrient imbalances of South Australian soils.

Physical structure and rainfall infiltration

- Water run-off and waterlogging problems will be reduced.
- Crop and pasture emergence problems will be reduced.
- Organic carbon (organic matter) levels will be improved in cropping soils
- Use of pasture legumes in crop rotations needs to increase.
- The severity and number of tillage passes to establish crops will be reduced.
- Greater retention and improved management of crop stubbles and pasture residues is required.
- Appropriate use of soil amendments, such as gypsum, must be encouraged.
- Areas worked on the contour must increase in those land classes prone to water erosion.

Biological state

- Development of, and increase in the use of, alternative, economically viable methods of insect, feral animal, rodent, and plant disease control that will reduce the use of chemicals (pesticides) in agricultural production is necessary.
- Assessment of alternative management practices that maintain or improve biological activity must occur.

- Assessment of the long-term effects of continued pesticide use on biological activity in agricultural soils needs to be carried out.
- Analysis of the economics of alternative management strategies will be continued.

WATER EROSION

The problem

Water erosion affects mainly duplex soils and has the potential to affect 2.9 million hectares in the Agricultural Zone as well as extensive areas of the Arid Zone (Map 10).

Sheet, rill, and gully erosion are the major forms of water erosion seen in South Australia. These forms of water erosion occur mainly on sloping land where there is insufficient groundcover to prevent erosion. Substantial areas of both the Agricultural and Arid Zones are susceptible to these forms of water erosion. Surface soil is removed in sheet erosion by raindrop splash and run-off. Rill erosion is the removal of soil by run-off, whereby numerous small channels up to 30-centimetres deep are formed. A gully is an open, incised erosion channel down which run-off flows, often carrying sediment and resulting in problems further afield.

In the Arid Zone water erosion usually occurs in areas with a history of overgrazing by livestock or feral animals, particularly along the edges of the tablelands and in the outwash areas along the ranges and major hills and in the vicinity of watering points. Water courses throughout the Arid Zone are susceptible because of the high rainfall intensity that is a feature of the climate of the zone. Sheet and gully erosion are common in these areas. Extreme events, such as fire, build-up of goat numbers, and prolonged droughts, dramatically increase the risk of water erosion in these areas.

In the Agricultural Zone, serious gully, rill, and sheet erosion has occurred in the areas extending north from Adelaide to Wilmington, in parts of Central Yorke Peninsula, and on eastern and lower Eyre Peninsula.

Water erosion is also a problem in the high-rainfall areas of the Mount Lofty Ranges. It is mainly associated with land used for annual horticultural crops, and areas where inappropriate management practices, such as excessive clearing and overgrazing, have occurred.

Gully erosion has become less prevalent due to better management by landholders. Sheet erosion continues to remove large quantities of topsoil.

Any management practice that bares or tills the surface soil increases the risk of water erosion. Soil and water management practices have changed markedly over the past few decades with a significant reduction in erosion risk as a result. More extensive adoption of soil management practices, which minimise disturbance, improve water use, and nutrition, will further reduce water erosion and consequent long-term production loss.

Implications

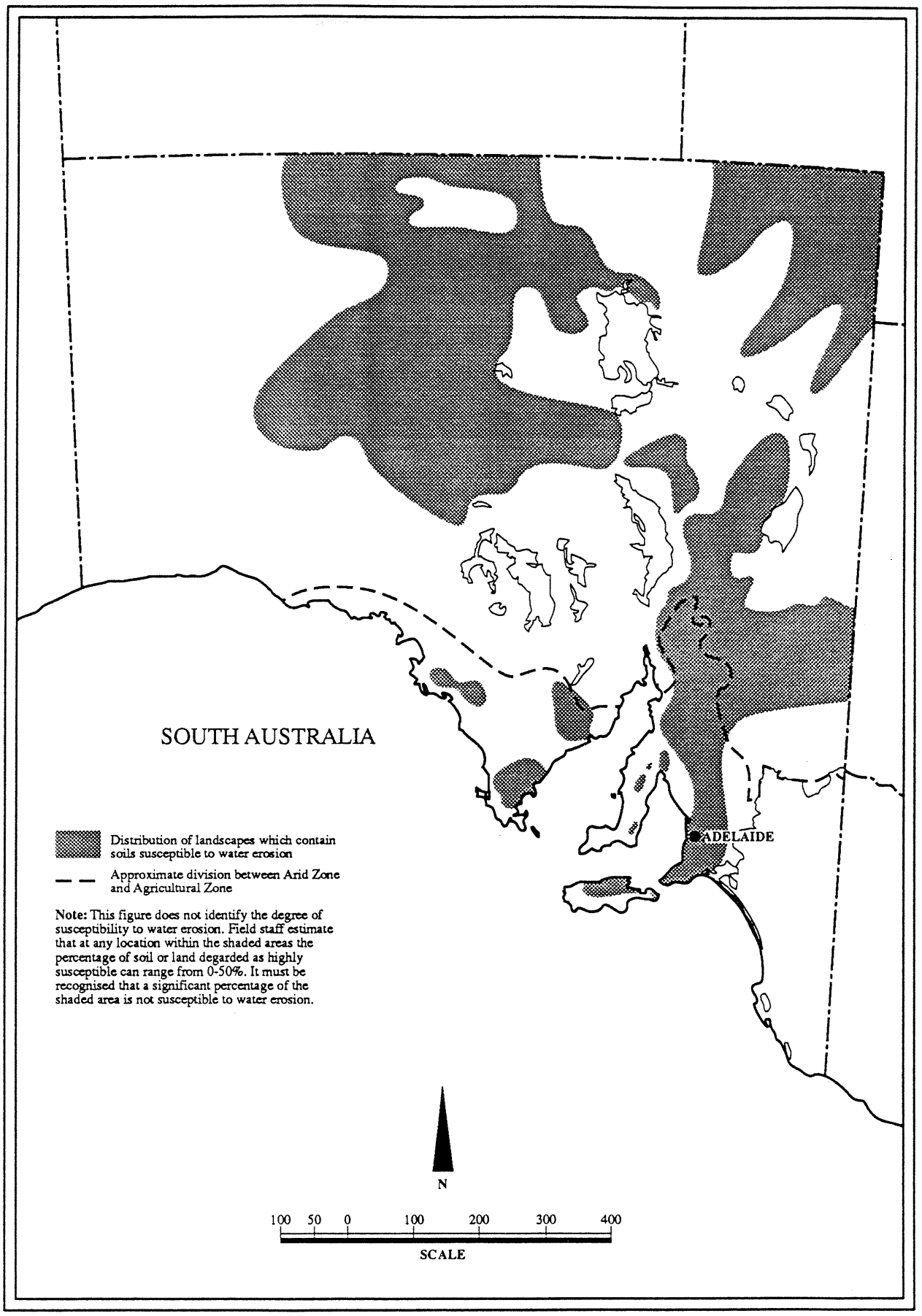
A loss of one millimetre of topsoil represents 10 to 12 t/ha. Such losses occur frequently on both bare and sloping soils and often go unnoticed. Experiments in the mid-north at Mintaro indicate that wheat yield is reduced by 120 kg/ha for every centimetre of soil lost with a yield reduction of up to 40% depending on the depth of soil lost. Fertiliser applications of nitrogen and phosphorus can help to overcome losses but at some cost.

Stubble cover of 2-3 t/ha (60-75 per cent ground cover) is required to reduce the risk of water erosion. When soil loss is high, nutrients will be lost, particularly nitrogen and phosphorus, which is undesirable.

The cost of control structures (eg contour banks) is estimated at $10-15/ha, which is relatively inZZexpensive.

Remedial measures

Water runoff needs to be reduced by improving soil structure and infiltration, and by increasing the vegetation cover. There also needs to be control and safe



Map 10: Estimated distribution of soils susceptible to water erosion in South Australia.

disposal of any runoff that occurs. Measures promoted to reduce runoff, improve infiltration, control water flow, and facilitate safe disposal include the following:

- rotation and cropping practices that reduce the number of tillage operations
- promotion of healthy and vigorous crops and pastures to utilise water on-site
- crop stubble retention through appropriate management
- pasture improvement and grazing management practices that maintain and/or improve soil surface cover, especially during peak risk periods
- construction of structures, such as contour banks and furrows, permanent waterways, dams, and drains
- maintenance and/or improvement of the physical structure and fertility of soils by addition of fertilisers and soil amendments where appropriate
- revegetation of drainage lines where appropriate
- rationalising location and number of watering points and fences to minimise grazing pressures, particularly in arid lands
- retention of native vegetation cover or agroforestry on steep slopes.

Contour banks provide good protection to land prone to water erosion in cropping areas.

About one-third (260 000 hectares) of the area at risk of water erosion has control structures such as contour banks and waterways. In the northern cereal districts, it is estimated that 80% of landholders have adopted a stubble-retention and reduced-tillage system for cropping in areas prone to water erosion.

In the Arid Zone, approximately 600 sq km have been treated by contour furrowing or disc-pitting to stop water erosion and to promote vegetation establishment. This still represents a minor component of the area affected. The principal measure that needs wider adoption is the management of grazing pressure to maintain adequate plant cover.

Program targets

- The water erosion hazard of South Australia's land will be reduced by managing it according to land capability.
- Survey and construction of contour banks, waterways, and other control structures will be carried out for the safe disposal of surface runoff on all land classes prone to water erosion, particularly land used for regular cropping.
- Rainfall infiltration and surface cover needs to be improved on all soils prone to water erosion.
- New areas of water erosion caused by human activity or lack of appropriate management must be prevented.

WIND EROSION

The problem

Wind erosion is the process in which soil is detached and transported from the land surface by the action of the wind. The potential for wind erosion depends on soil texture (amount of clay, sand, and silt), soil fertility, rainfall

reliability, water repellence, exposure and aspect. Soils are most susceptible to wind erosion when they are dry, lacking vegetation or stubble cover, and exposed to the prevailing winds due to elevation of the landscape and/or lack of protection from surrounding trees.

Wind erosion is most obvious when fine soil particles are transported long distances as dust storms and when large quantities of sandy soils are swept from one site to another and cover fences or roads. While such events occur from time to time, they are almost always linked to an extended period of drought. Much of the Eyre Peninsula and Murray Mallee are typified by soils that are susceptible to wind erosion, and both areas have low, variable rainfall (250-400 millimetres per year). These two factors pose serious problems for farm management in these areas. Falls in rural commodity prices and high interest rates have tended to exacerbate these problems, since there is greater pressure to maximise returns during such times.

In recent years, the decline in farmers' terms of trade (the ratio between prices received for products and prices paid for inputs) has led to a trend to rotate crops closely. An increase in cropping intensity reduces the nutrient state of the soil, and unless appropriate management practices are applied this may lead to a reduction in soil cover during periods of high risk to wind erosion.

The financial pressures that lead to overcropping have also caused some farmers to reduce fertiliser applications or to leave sandhills unsown because they are less productive. Shortages of labour on properties restricts the amount of time and effort that can be spent on stabilising and managing areas prone to wind erosion. All these factors increase the potential for wind erosion.

Wind erosion on Eyre Peninsula was widespread in the 1930s and has been a continuing problem in drought years, such as 1944, 1957, 1967, 1972, 1977, and 1988. At the height of the drought in 1977, 165 000 hectares of land were affected by wind erosion. In 1988, after a number of poor seasons, wind erosion was again widespread, with an estimated 234 000 hectares affected by sweeping drift. It was estimated that 10% of the affected area suffered severe movement of topsoil.

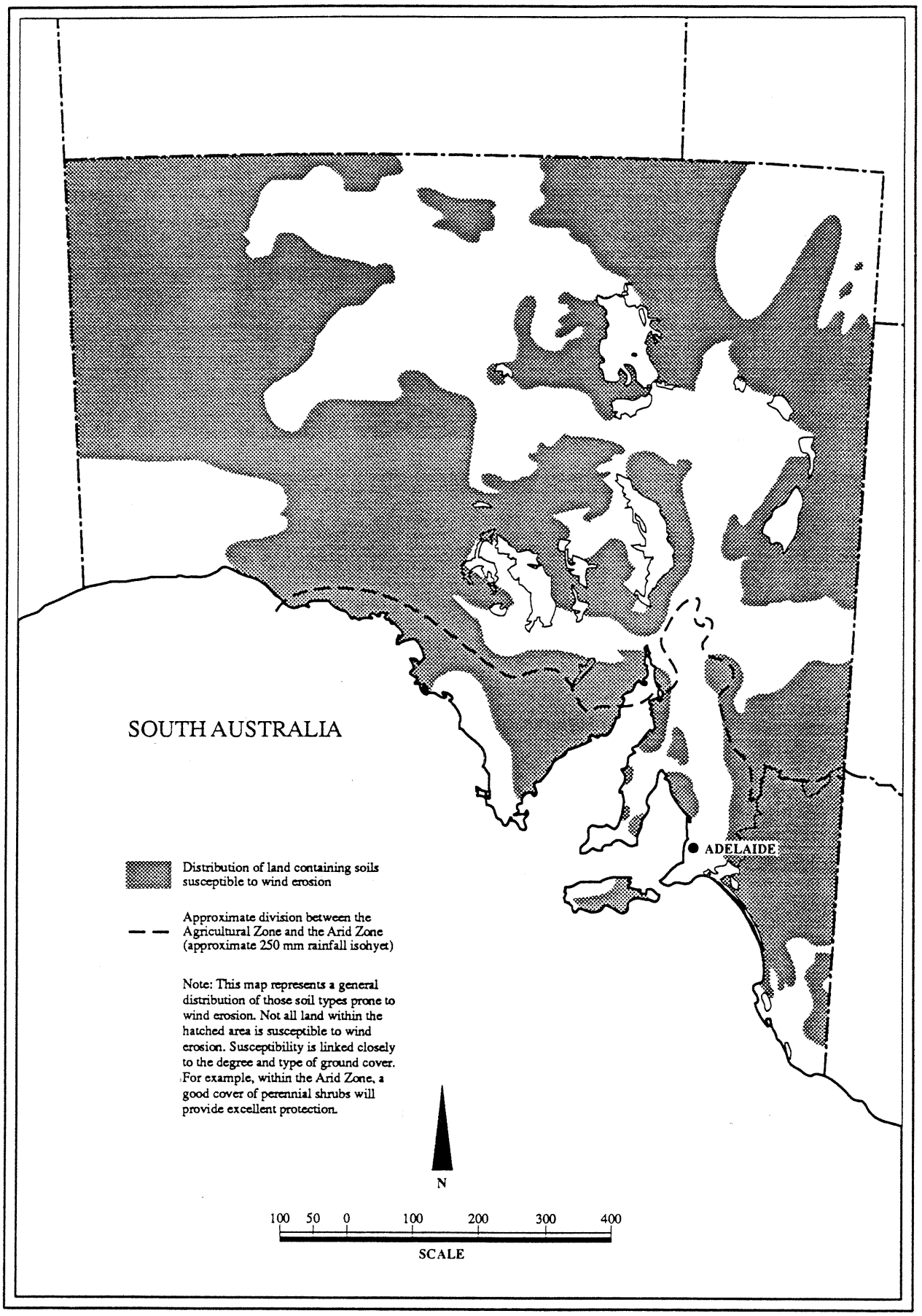
Other areas of the Agricultural Zone with soils that have the potential to drift include parts of the mid- and upper North, Murray Mallee, Yorke Peninsula, Kangaroo Island and coastal areas of the upper South-east. Whilst there are some 8.3 million hectares of soils in the Agricultural Zone of the type prone to wind erosion (Map 11), the actual area affected is largely dependent on climatic factors and accordingly varies considerably from year to year.

The Arid Zone contains an estimated 300 000 square kilometres of land with characteristics that make it susceptible to wind erosion (Map 11). The dune fields at the edge of the deserts and major lakes are the areas most susceptible to damage from overgrazing, particularly by feral animals. Once again, the susceptibility of these areas to wind erosion is related to surface cover, and hence, to climatic conditions, grazing management, and extreme events such as fire, prolonged periods of drought, and rabbit numbers.

Implications

The damage caused by wind erosion has both obvious and insidious effects. The obvious effects include drifting sandhills with blowouts, flats eroded down to the infertile subsoil, sand-blasted crops, and damage to fences and roads by drift. The insidious effect is the loss of the fine soil particles as dust. Some of the obvious damage can be repaired but the clay particles, organic matter, and nutrients carried away by the wind are lost from that site.

An indication of the amount of nutrients that can be lost was provided by wind tunnel experiments conducted in the Murray Mallee as part of the Department of Agricultures's 'Murray Mallee Farm Management Project' in 1990. At one site, the equivalent of 56 kilograms of soil per hectare was lost in one minute from an area rated as having low to moderate potential for wind erosion during the course of a simulated wind of



Map 11: Estimated distribution of land containing soils susceptible to wind erosion in South Australia.

75 km/hr. This represented a loss of 0.167 kg/ha of nitrogen and 0.351 kg/ha of phosphorus every minute at a total replacement cost of 20 cents/ha. Thus, if such an event lasted for an hour, it would cost approximately $12/ha to replace the lost nitrogen and phosphorus with fertiliser. Of even greater importance was the loss of organic matter, measured as organic carbon. The organic carbon loss was 1.4 kg/ha/minute, equivalent to 84 kg/ha every hour of such an event. Successful replacement of organic matter, vital to nutrient levels and soil structure, takes considerable time and involves the use of rotations with vigorous legume-based pastures, reduced tillage, and retention of stubbles.

In areas where a thin layer of sandy soil overlies a heavy infertile clay, loss of topsoil reduces potential rooting depth and the water-holding capacity of soil and results in substantial crop and pasture yield reductions. In the Arid Zone, loss of topsoil hinders natural regeneration and makes revegetation difficult.

Due to the variability of wind erosion events across the State from one year to the next and the insidious effect of wind erosion, it is almost impossible to quantify the value of annual production lost due to wind erosion. But the evidence from tests indicate that the cost to replace lost nutrients and the long-term environmental effect of lost organic matter represent major expenses to the land manager and to the State as a whole.

Remedial measures

To limit wind erosion, sandy soils must be stabilised by improving vegetative cover and improving soil fertility, and by increasing the resistance of the surface soil to erosion. The following measures are recommended depending on whether the land is located in the Agricultural or the Arid Zone:

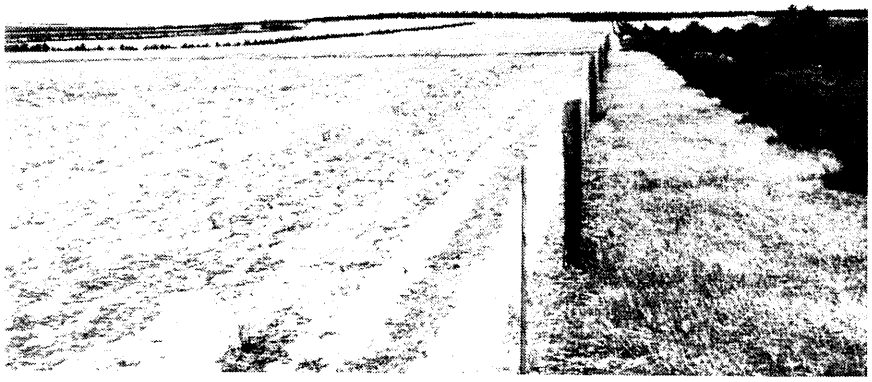
- levelling and fencing off of exposed sandy rises and blowouts and the establishment of veldt grass, cereal rye, and/or lucerne, and other stabilising methods, such as clay additions for water repellence control in the South-east
- establishment and maintenance of vigorous crops and pastures
- stubble management to ensure adequate retention of cover at all times
- reduced and/or modified tillage and seeding practices
- maintenance of ground cover by better grazing management, including feedlotting of sheep during dry periods
- the setting of stock levels based on carrying capacity of the land system and destocking during dry periods
- rabbit control
- establishment of permanent vegetation cover on sandy rises and provision of windbreaks
- retention and management of native vegetation on soils most prone to wind erosion
- location of fences and watering points to minimise the effects of grazing and an increase in the number of watering points for the same reason

Most farmers in the areas prone to wind erosion do not see wind erosion as a major threat to their long-term viability. Years in which major wind erosion occurs (usually drought years) are relatively infrequent and are accompanied by other farm management and financial problems, which may distract farmers from the damage caused by wind erosion and place them in a position in which they would be unable to do much about wind erosion should they be aware of it.

The adoption rate of management practices to control or reduce the risk of wind erosion during normal seasons appears to be gradually improving. Even so, during periods of climatic and economic stress, such as a drought, significant areas drift, much of which

can be attributed to management that either fails to recognise the risk or for some reason is incapable of responding in such periods of stress.

A provision under the old Soil Conservation Act (1939) that related to the clearing of native vegetation helped to restrict the areas of native vegetation being cleared, particularly on the light mallee soils of Eyre Peninsula, but also in the Murray Mallee and the upper South-east. There were loopholes in the provision, however, and considerable areas of native vegetation in the light sandy areas of the State were cleared and many areas were also destroyed by overgrazing and by efforts to control rabbits. The loopholes were closed in 1978, but by the time the Heritage Agreements were introduced in the early 1980s, over eighty per cent of the original vegetation had been cleared from the Agricultural Zone.



Stubble retention, good property layout, fencing and revegetation combine to provide good prevention against wind erosion.

Today, much of the 350 000 hectares of native vegetation either under, or approved for, permanent protection by Heritage Agreement is scattered throughout the areas most prone to wind erosion. The cover provided by this vegetation will contribute to the general stabilisation of surrounding areas.

Interest is growing in establishing permanent vegetation cover on sandy rises. Finance is a critical restraint, but development work by a range of people and organisations is helping to reduce costs and to ensure greater reliability for broadscale revegetation techniques in both the Agricultural and Arid Zones.

The costs of adopting management practices to reduce the likelihood of wind erosion and minimise the actual effects will vary considerably from site to site and will depend on the measures adopted.

Program targets

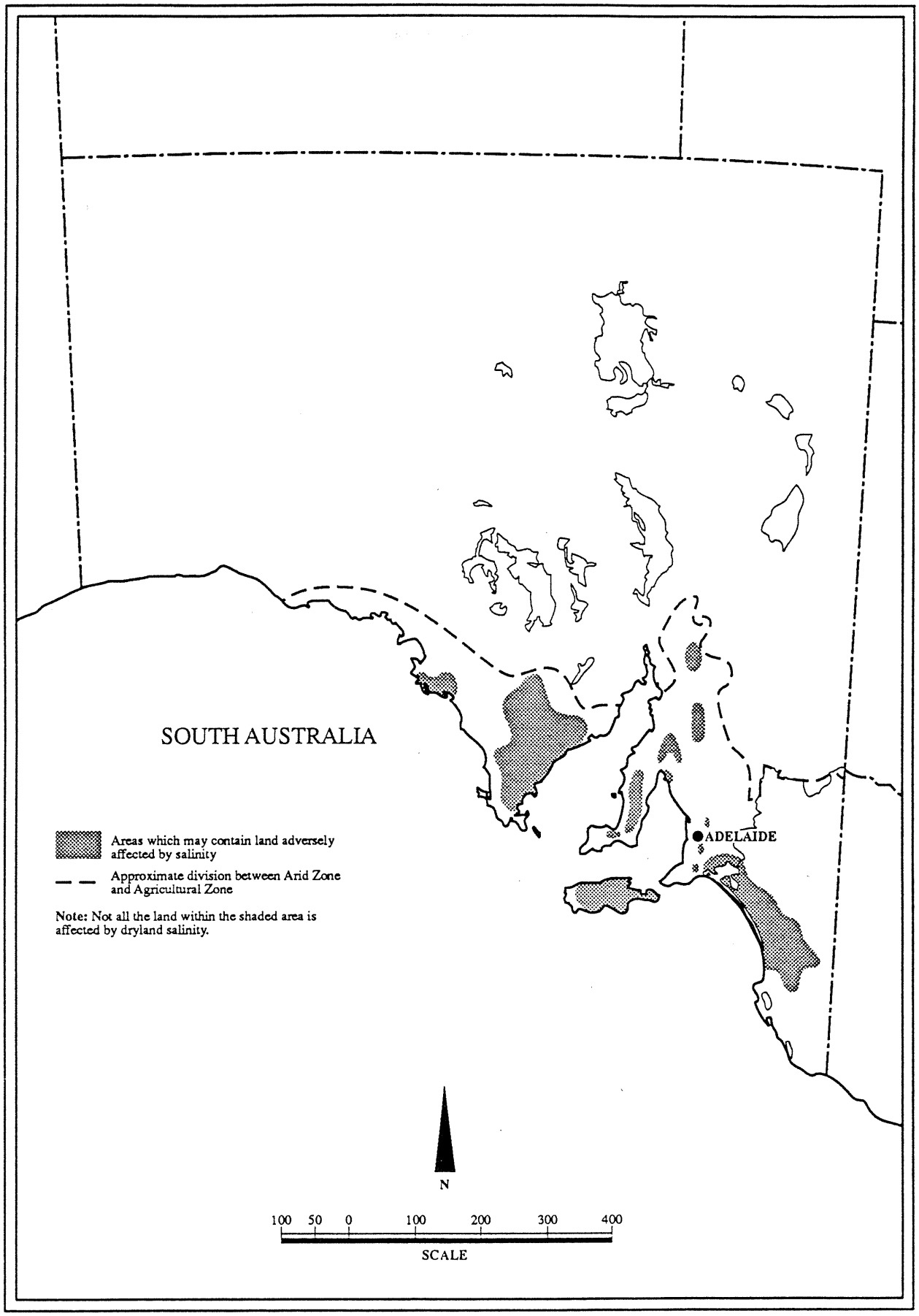
- The wind erosion hazard of South Australian soils will be reduced by managing the soils according to land capability in both the Agricultural and Arid Zones.
- The adoption of stubble retention practices by farmers on wind—erosion prone soils will be encouraged.
- The area of drift that occurs during droughts needs to be reduced by at least 50%.
- 'Blowouts' caused by wind erosion in the Agricultural Zone to be stablised in at least 50% of the cases.

DRYLAND SALINITY

The problem

More than 225 000 hectares of land on Kangaroo Island, Eyre Peninsula, Yorke Peninsula, and in the upper South-east, the Murray Mallee and the lower to upper north of the State are affected by salinity associated with rising groundwater levels (Map 12). Preliminary land evaluation in South Australia indicates that the area affected is increasing and has been substantially underestimated in the past. Barnett (1988) predicts a 50% increase in dryland salinity in the low-lying region from Tailem Bend to Keith alone within the next 30 years if current trends of groundwater rise continue along the margins of the Murray geological basin.

Dryland salinity or saline seepage occurs when groundwater levels (watertables) on non-irrigated lands rise, which results



Map 12: Estimated distribution of non-irrigated soils affected by dryland salinity in the Agricultural Zone.

in an accumulation of salts in the upper and surface layers of the soil. In most situations, dryland salinity has been caused by the removal of deep-rooted native vegetation and its replacement by shallow-rooted species used in cropping or grazing enterprises. These shallow-rooted species allow greater recharge of groundwater aquifers, which cause the aquifers to rise to or near the soil surface.

Implications

The annual loss of production attributed to dryland salinity in South Australia is approximately $27 million, and the area affected is increasing. Salinity poses serious problems to the upper South-east and lower Eyre Peninsula, as well as its being widespread in most regions of the State.

Dryland salinity on cropping land in the Agricultural Zone.

The accumulation of salts in the upper layers of the soil restricts, or prevents altogether, the growth of traditional crop and pasture species and many native species. This not only lowers annual production but reduces the value of the land, and creates significant cropping and grazing management problems.

Another important effect of rising, saline groundwater levels is the salinisation of streams, and rivers. The Todd River on Eyre Peninsula, the Middle River on Kangaroo Island, and streams in the catchments of the northern reservoirs and the Mount Lofty Ranges are affected in this manner. The same phenomenon is already affecting the River Murray substantially. Salinisation of the water resource will lead to a decline in water quality and subsequent problems with irrigation, as well as increases in the cost of providing quality water for human and livestock use.

Remedial measures

Dryland salinity treatment and prevention has three components: reclaiming the saline land or increasing the productivity of that land (on-site or discharge); catchment investigation that identifies where the water is coming from, how it gets into the groundwater system, and why the saline soil occurs where it does; and increasing water use on land that is not affected but is within the catchment (off-site or recharge) in order to minimise groundwater recharge. These measures are to be promoted by:

- early identification of salt-affected areas, and education on testing and monitoring
- fencing of affected areas and exclusion of stock to allow establishment of ground cover and to control grazing
- planting of salt-tolerant pasture plants, shrubs, and trees on or adjacent to degraded areas in conjunction with effective rabbit control programs
- drainage and/or diversion of water from saline sites
- catchment investigation to define the processes involved in key areas
- catchment planning and management, including the establishment and effective management of high-water-use species of trees, shrubs, crops and pastures on recharge areas.

There has been greater recognition amongst farmers of the symptoms and problems of dryland salinity, as well as of the benefits to be derived from introducing saltland management

practices on areas previously considered worthless (eg the use of tall wheat grass, puccinellia, or saltbush as an autumn feed source). With some specific areas of dryland salinity, it is difficult to identify and determine the causes without detailed investigation, and this in turn limits the adoption of preventative measures.

Extension activities, such as demonstrations, and farm walks involving landcare and other groups, together with exposure in the media, and other awareness activities, have contributed to this greater recognition and subsequent adoption of management techniques by farmers. Many of these activities are being guided by the *State Dryland Salinity Strategy*.

The cost of planting salt-tolerant pasture species ranges from $30—$60 per hectare excluding the cost of fencing the area. Charges for establishing salt-tolerant shrubs and trees using a direct-seeding method range upwards from $80 a hectare; the costs of planting recharge areas is of a similar order. An increase in the efficiency of water use for pasture and crops will have the benefit of increasing yield. The costs of achieving this will vary from property to property.

The costs of remedial measures, such as large-scale drainage schemes and large-scale revegetation programs to reduce regional groundwater recharge, will require commitment from the three tiers of government, the relevant statutory bodies, local community groups and individual land managers.

Program targets

- The rate of salinisation from rising groundwater levels will be reduced.
- Hydrogeological investigations will be carried out to define trends in groundwater levels and the resulting salinisation in key areas in the Agricultural Zone.
- Viable on-site (discharge) and off-site (recharge) management methods for land affected by dryland salinity will be developed and promoted.
- Integrated catchment management programs will be established for control of dryland salinity and will be coordinated on a district or regional basis.
- The extent of landholder recognition of dryland salinity will be assessed and landholders will receive education on how to recognise the early signs.
- Landholders will be encouraged to include appropriate rabbit control in any revegetation program.

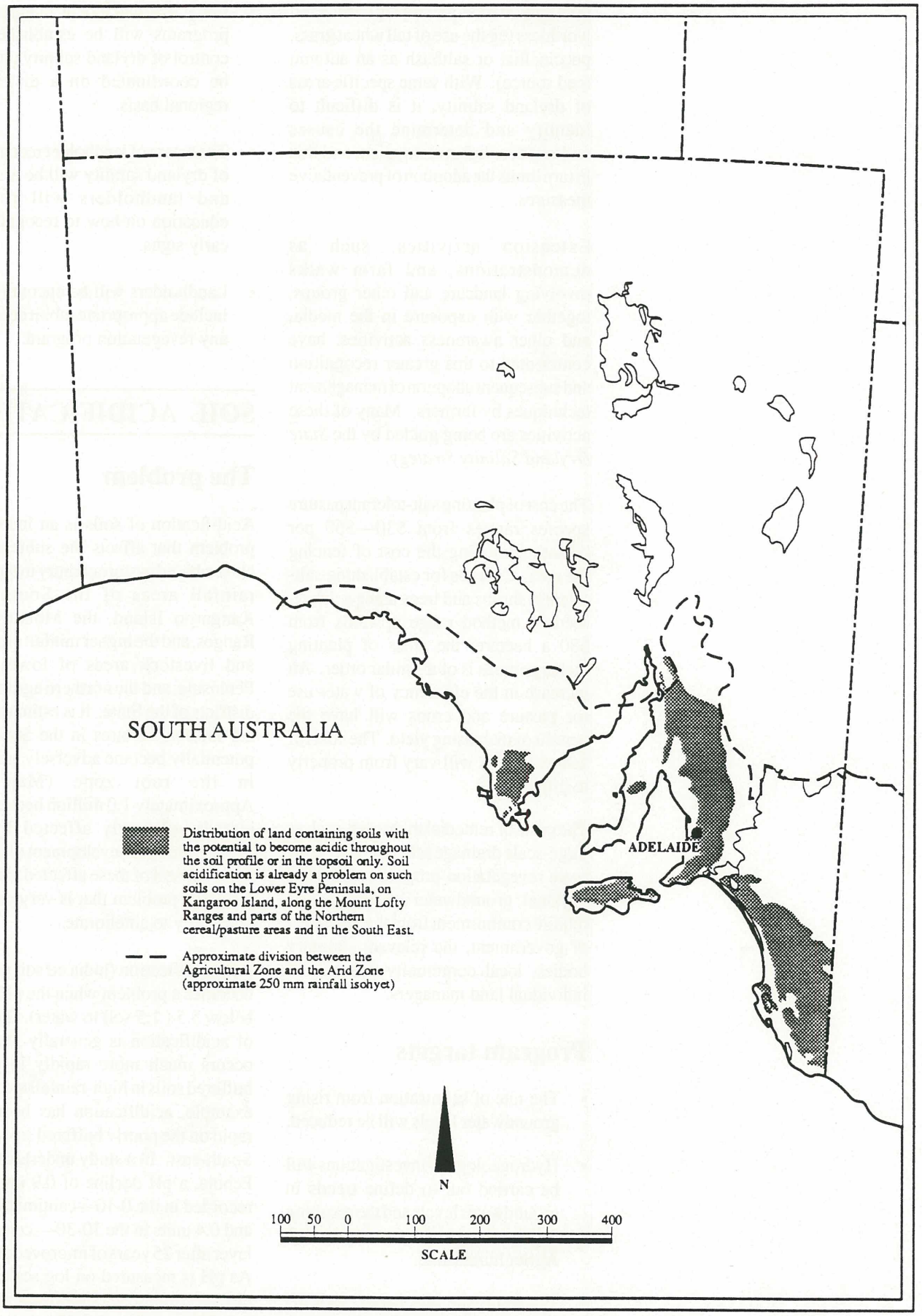
SOIL ACIDIFICATION

The problem

Acidification of soils is an increasing problem that affects the subterranean clover-based pasture country in the high-rainfall areas of the South-east, Kangaroo Island, the Mount Lofty Ranges, and the higher rainfall cropping and livestock areas of lower Eyre Peninsula, and the northern agricultural districts of the State. It is estimated that 2.5 million hectares in the State may potentially become adversely acidified in the root zone (Map 13). Approximately 1.0 million hectares are already adversely affected by soil acidity. Further development of acidity in the subsoil of these affected soils will present a problem that is very difficult and costly to ameliorate.

Soil acidification (induced soil acidity) becomes a problem when the pH drops below 5.5 (1:5 soil to water). The rate of acidification is generally slow but occurs much more rapidly in poorly buffered soils in high-rainfall areas. For example, acidification has been very rapid on the poorly buffered soils of the South-east. In a study undertaken near Penola, a pH decline of 0.9 units was recorded in the 0-10—centimetre layer and 0.4 units in the 10-30— centimetre layer after 25 years of improved pasture. As pH is measured on log scale, these changes represent a significant increase in acidity (decline in pH).

Current farming systems, particularly those based on shallow-rooting legume



Map 13: Areas of potential soil acidity in South Australia.

pastures, hay production, and the use of nitrogen fertilisers, appear to be accelerating the process of acidification.

Implications

The adverse effects of soil acidity (pH below 5.5) are complex and range from toxicities of aluminium and manganese to deficiencies of molybdenum and calcium, all of which adversely affect plant growth and production. Other problems associated with soil acidity include defective nodulation, increased incidence of root disease, and nutrient leaching.

The annual cost of soil acidification is estimated as approximately $10 million.

Remedial measures

The measures to manage crops and pastures to treat the symptoms of and factors contributing to soil acidification are as follows:

- recognising and monitoring of, soil pH (identification of problem)
- liming at appropriate rates, of good-quality lime
- establishment of acid-tolerant plant species
- adoption of less-acidifying farm practices, such as the use of more perennial species in pastures and the appropriate use of nitrogen fertilisers.

The use of lime as an indicator of treatment is increasing. The area limed each year is estimated to be between 40 000 and 60 000 hectares annually.

South Australia has low-cost ($9-$27/tonne), high-quality sources of lime widely distributed throughout the State. The commonly recommended rate is 2-2.5 tonnes per hectare but the rate at which responses occur depends on soil type. In the Adelaide hills, the average cost to purchase and spread the recommended rate of lime is between $55-75 per hectare and may be required every 10-15 years.

Program targets

- The rate of adoption or use of practices that lead to a reduction in the rate of soil acidification need to be improved substantially. Improvement in production from affected areas, for instance by the increased use of lime, must occur also.

WATER REPELLENCE

The problem

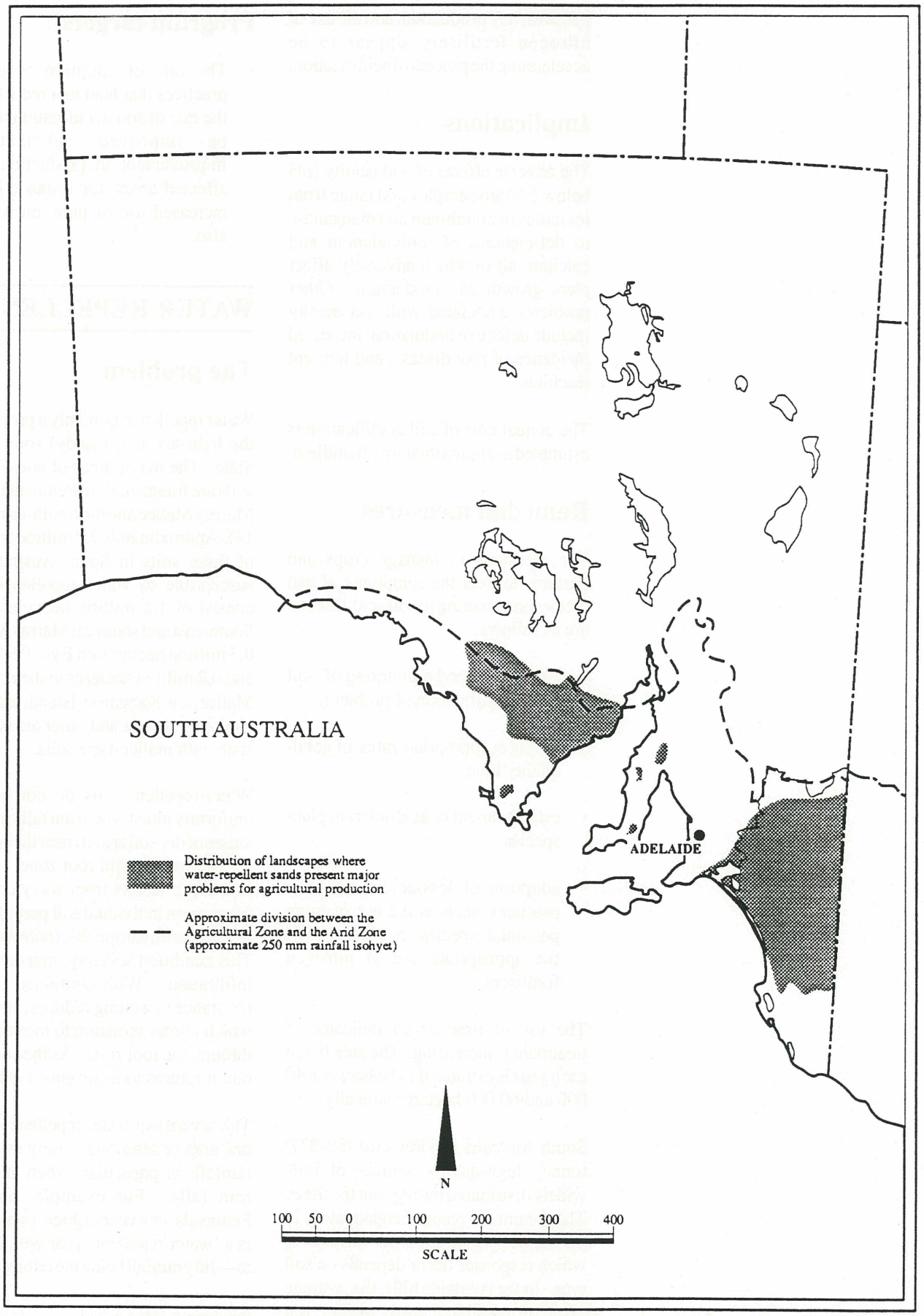
Water repellence is mainly a problem in the light-textured (sandy) soils of the State. The major areas of non-wetting soils are found on Eyre Peninsula, in the Murray Mallee and the South-east (Map 14). Approximately 2.2 million hectares of these soils in South Australia are susceptible to water repellence, and consist of 1.5 million hectares in the South-east and southern Murray Mallee, 0.5 million hectares on Eyre Peninsula, and 0.2 million hectares in the northern Mallee, on Kangaroo Island, northern Yorke Peninsula and other areas of the state with mallee-type soils.

Water-repellent soils do not become uniformly moist when rain falls; instead lenses of dry soil are left near the surface, usually in the main root zone. Water repellence results from waxy coatings forming on individual soil particles that makes them hydrophobic (non-wetting). This condition severely impedes water infiltration. With continued rainfall resistance to wetting reduces, however, which allows moisture to move evenly through the root zone. As the soil dries out, it returns to its original condition.

The severity of water repellence in any one area or season is closely related to rainfall, in particular, when and how rain falls. For example, on Eyre Peninsula, one year in three, on average, is a 'water repellent' year with May—to—July rainfall being the critical factor.

Implications

Water repellence or non-wetting can result in delayed or patchy emergence



Map 14: Estimated distribution of water-repellent sands in the Agricultural Zone of South Australia.

of crops or pastures, limited production, and the predisposition of the affected area to other problems, particularly wind erosion but also weed problems. The annual loss of production resulting from water repellence is valued at approximately $2 million

Remedial measures

Modified tillage and seeding practices must be adopted to minimise the effect of water repellence. Measures that will be promoted include the following:

- use of modified tillage and seeding equipment for crop and pasture establishment (eg press wheels and tyne arrangement)
- vigorous mixing and/or soil inversion
- working wet, that is, in the rain, and where possible, delaying seeding until the seedbed is evenly wet
- the addition of clay to non-wetting soils.

The use of modified tillage and seeding methods is common in areas with water repellence problems. The addition of clay to non-wetting sandhills by Clem Obst in the South-east has proved a long-term solution to the problem. Mr Obst has used clay from the preparation of dams in his flat country and spread it evenly over the problem areas. The source of clay is close to the problem areas (within one kilometre). At 1991 prices, the cost would be $150/hectare, but it has provided long-term benefits in crop and pasture establishment and production. The Department of Agriculture, and a research student from the University of Adelaide are looking at the types of clay that can be used, and the rates and methods of application required. Much of the water repellence problem lies in areas without ready access to suitable clays, however, so that the cost of treatment would appear to far outweigh the benefits even in the long-term. This method is viewed as too expensive for cereal cropping areas but may be economic in the high-rainfall, pasture districts.

Program targets

- Landholders with soils susceptible to water repellence will be made aware of its potential implications.
- Clay addition and other amelioration trials will be conducted and implications for broadscale farming evaluated.
- Evaluation and promotion of appropriate tillage and seeding techniques will be continued.

WATERLOGGING

The problem

Waterlogged soil is soil that is saturated with water and lacking most or all of its soil air. The condition may be caused by excessive rainfall, poor soil drainage, or excessive irrigation. Soil compaction may also contribute to waterlogging.

The duplex soils — sandy topsoils over clayey subsoil — are among the main problem soils. Poorly drained flats are also areas that experience waterlogging. Waterlogging is a problem in pockets of country across the higher rainfall areas of the State.

Implications

Waterlogging of soil inhibits root development, and the availability and uptake of nutrients. Depending on the plant species and the degree and period of waterlogging, plant growth can be restricted. When the problem is associated with a impermeable clay layer close to the surface, plants may mature and dry off very quickly in the spring.

Saline areas subjected to waterlogging present particular problems. Research in Western Australia has shown that the interaction between waterlogging and salinity has a more adverse effect on plant growth and survival than either of these two factors individually. The combined problems lead to increased uptake of salt by the plants, reduced growth, chlorosis, leaf drop, and death.

Waterlogging in South Australia restricts the productivity of grain crops, annual pastures, and perennial pasture species, especially lucerne. The total area affected and the cost in lost production and required control measures are not known.

Remedial measures

Drainage and management of pastures, stock and crops must be implemented. The following measures are recommended:

- use of shallow interceptor drains on sloping ground
- early sowing with long-season cereals that are semidormant when waterlogging is most likely to occur
- use of crop and pasture varieties, trees, and shrubs that tolerate waterlogging
- establishment techniques to reduce the effects of waterlogging, such as direct drilling of crops and pastures and late-season planting
- split applications of nitrogen to replace that lost by leaching and denitrification
- use of gypsum and deep working to improve water infiltration into the soil.

Some of the measures have already been implemented in parts of South Australia. There has been some use of interceptor drains on Eyre Peninsula and other areas of the State. Deep placement of gypsum has been used in the lower north of the State to improve infiltration.

Bank construction is estimated at $125 per kilometre or $10 -$15 per hectare.

Program targets

- Techniques to map the extent of the problem must be developed.
- Appropriate control and management techniques (eg shallow drains, reverse interceptor drains, and selective use of appropriate crop and pasture species) must be promoted.

DECLINE OF NATIVE VEGETATION IN AGRICULTURAL LANDS

The problem

Historically, the clearance of native vegetation in South Australia and its replacement with crops and pastures were encouraged to provide a strong rural base for the State. As a result, over 80% of the original, native vegetation cover has been removed from the agricultural lands of the State. Urbanisation has also contributed to loss of native vegetation and some associated fauna, particularly on the Adelaide plains, and in the Mount Lofty Ranges. In some districts, less than 1% of the original, vegetation cover remains, much of which is contained on roadside reserves and can be a constraint to road construction. In such situations, private land is being resumed for new road construction, for instance, along the Port Wakefield road between Two Wells and Port Wakefield.

Implications

The decline in species diversity of both vertebrate and invertebrate fauna in South Australia is closely linked to the decline in native vegetation. Many species of native flora and fauna have been lost forever. Other species have been severely reduced in number and diversity. In many cases, the effort and cost of improving diversity and population numbers are considerable.

The benefits of revegetation outweigh the cost. The protection of existing vegetation, together with the encouragement of natural regeneration and active revegetation, can provide shelter belts for stock, windbreaks for crops, stock, and people, and wildlife habitat. The value of the amenity correspondingly increases, which is to the advantage of the whole South Australian community.

Remedial measures

Rehabilitation and management of remnant native vegetation and an

increase in rural and urban revegetation are the focus of the following remedial measures:

- the planting of indigenous species using locally collected seed, in order to conserve genotypes adapted to local conditions
- the planting of appropriate species where the changed physical conditions demand species other than those indigenous to the area, for instance, where groundwater levels have risen or severe scalding of the soil surface has occurred; care must be taken to avoid introducing native species that will interbreed with the local populations
- encouragement of natural regeneration (for example, by reducing weed competition and ensuring a high level of rabbit control)
- enactment of legislation, namely, the *Native Vegetation Act 1991* to prevent further broadscale clearance and to provide for the permanent protection of native vegetation under Heritage Agreement
- exclusion of stock, feral herbivores, especially rabbits, and undesirable plants (weeds) from native vegetation
- control of bridal creeper, african boxthorn, olive, boneseed, and other exotic plants
- the linking of blocks of native vegetation, on properties and in districts, with other blocks and with plantings of indigenous species, to form corridors
- maintenance and management of vegetation on roadsides and public land
- adoption of broadscale revegetation techniques
- integration of revegetation and vegetation management programs into normal, farm-management practices

More than 310 000 hectares of privately owned native vegetation has now been retained under Heritage Agreement at a cost to the Government of over $40 million. The Native Vegetation Management Branch of the Department of Environment and Planning provides assistance and advice on the retention and management of native vegetation.

Over seven million seedlings were established in South Australia, by either direct seeding or planting, as part of both public and private revegetation programs during the 1989/90 financial year. Both trees and understorey species have been used. Plantings have included small revegetation programs, corridor establishment, windbreaks, and large-scale programs. Much of the seed for these plantings has been collected from plants native to the area to be planted.

The community from both rural and urban areas has been directly involved in these revegetation programs. A wide range of both government and non-government agencies have assisted those establishing and encouraging native vegetation. Schools have played a big part in some of these programs.

The Animal and Plant Control Commission and its local boards either control proclaimed plants and animals or provide advice on control measures where these plants or animals are a threat to the native vegetation. The commission and local boards have a major role in ensuring implementation of effective rabbit control as a component in the management of native vegetation.

Protection of vegetation costs from $1000 — $3000 per kilometre for fencing. The Department of Environment and Planning has a policy to provide funding for fencing Heritage areas, although it must give priority to high conservation value areas or areas with special management requirements, since funding is limited

Techniques for revegetation and increasing species diversity range in cost from less than one hundred dollars per hectare to several thousand dollars per hectare depending on the site, soil type, annual rainfall, the techniques used and labour arrangements.

Program targets

- Revegetation (including agroforestry) will be increased to complement and improve agricultural production.
- Revegetation and vegetation management will be incorporated into district and individual property management planning.
- Retention of native vegetation will increase and management of areas of native vegetation will be improved.
- Increased understanding of the dynamics of vegetation communities must be encouraged and applied to revegetation and regeneration techniques and programs.
- Plant diversity and regeneration of degraded native vegetation need to increase.
- Community input into revegetation projects will be encouraged.
- Landholder revegetation and vegetation management skills will be improved.
- Further research is required to improve the cost-effectiveness of revegetation technology.
- Incentives for fencing areas of native vegetation available.
- High-level rabbit control will be promoted for areas where native vegetation is given a high priority.

DECLINE OF ARID ZONE VEGETATION

The problem

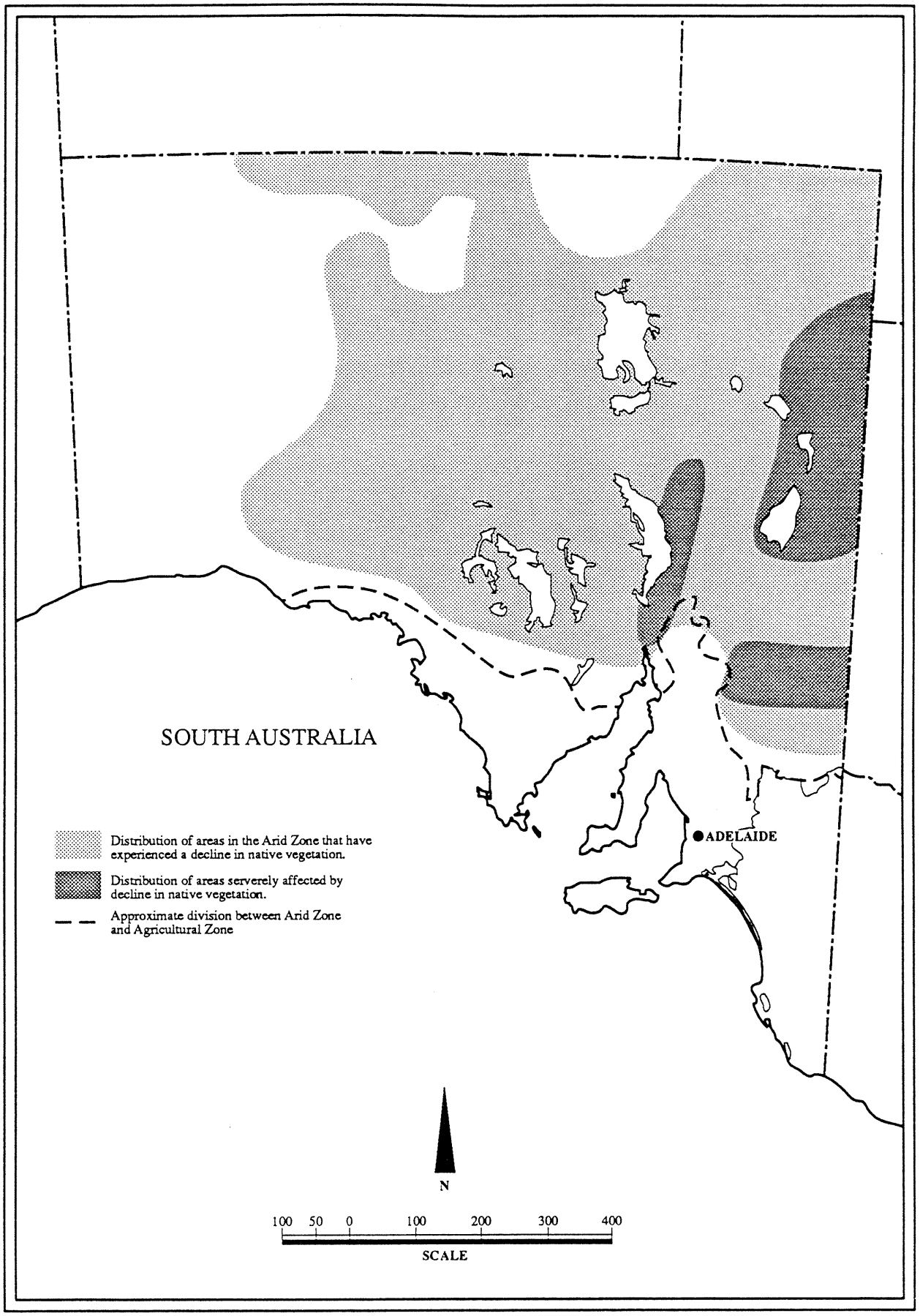
Mismanagement of perennial vegetation in the Arid Zone pastoral lands was a feature of early European settlement. Even until recent times, poor understanding of the ecosystem, exploitation of the resource, and the desire to establish crops have led to the destruction or partial destruction of perennial vegetation from clearing and overgrazing. In some areas, less palatable species have replaced the original vegetation, and in the worst affected areas, perennial species have been completely eliminated (Map 15).

It is generally agreed that the persistence and regeneration of native vegetation under pastoral lease has been suppressed by the introduction of exotic herbivores (rabbits, sheep, cattle, goats), as well as by the provision of a large number of stock-watering points, which have encouraged a dramatic increase in numbers of kangaroos. Rabbit plagues in the far north have caused severe degradation problems, while feral goats in the Gawler Ranges, Flinders Ranges and Olary Spur are also a cause for concern. In sufficient numbers, which depend on the carrying capacity of the country, these feral pests will destroy the most palatable species first, usually the new seedlings or regrowth. This has depressed the regeneration of some native species. Revegetation and regeneration are threatened by the combined grazing pressure of sheep, cattle, rabbits, goats, and kangaroos. Map 16 gives an indication of the extent of rabbit activity in the Arid Zone.

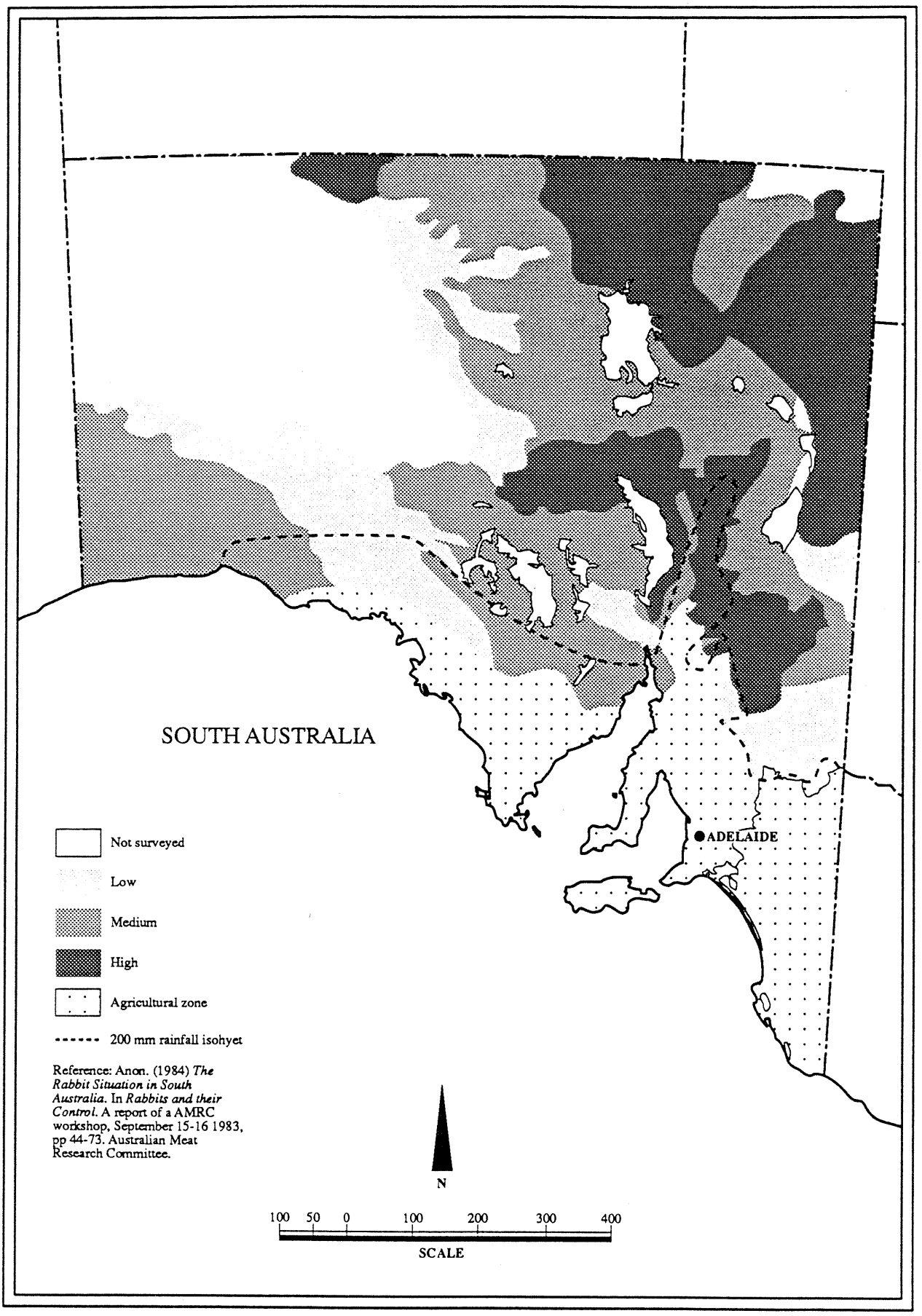
The seasons of 1974-75 and 1975-76 saw huge fires burn across large tracts of the Arid Zone. Fires of such proportions are quite uncommon, because in most years, continuous areas of inflammable vegetation do not exist. Observations indicate that many valuable trees and perennial shrubs have been destroyed, though some perennial species have shown remarkable tolerance. Widespread regeneration of mulgas from seed has been observed. As slow growers, they have of course been very susceptible to grazing pressure from rabbits, goats, and domestic stock. Brendan Lay (1976) has concluded, "....it would be foolish to suggest that because such fires are natural events, they be allowed to burn. The stakes, perennial plants for drought fodder and soil stabilisation, are too high."

Implications

There has been a considerable decline in the capacity of the arid lands to maintain livestock production,



Map 15: Decline in Arid Zone Native Vegetation.



Map 16: A map of South Australia showing the relative impact of rabbits on the vegetation and soils of the Arid Zone.

protection for the soil, a diverse flora, and wildlife habitat. This has mainly been due to the suppression of perennial native vegetation species under excessive grazing pressure exerted by domestic stock and feral animals.
There have been long-term changes to the surface cover and composition of vegetation, exotic and less productive native plants have colonised areas, and soils have been exposed to wind and water erosion resulting in scalding and gullying.

The estimated annual loss to the pastoral industry from rabbits alone is $17 million compared to an annual loss to rabbits in the Agricultural Zone of $5 million. The culling of feral goats generates some income, but the presence of the goats is estimated to cause a net loss through competition with sheep of $2 million each year.

Disc-pitting used to encourage regeneration of vegetation in the Arid Zone.

The most productive areas of the Arid Zone, those under native perennial shrubs (approximately 240 000 square kilometres) are under greatest threat. So improved productivity is linked to improvement in revegetation and regeneration of native vegetation in these areas.

Remedial measures

The Arid Zone must be managed within its capability in order to prevent native vegetation decline and loss of species diversity. The following remedial measures are to be encouraged:

- the monitoring and adjustment of stock numbers and grazing pressure to suit the capability of the land unit and its vegetation cover, especially in times of drought, fire, and rabbit or goat plagues
- control of rabbits and goats; this will require integrated programs involving the cooperation of land managers, researchers, and the relevant government and non-government agencies
- continuation of a kangaroo management program, which recognises the need to retain the species, but also to provide for the harvest of excess numbers identified through an approriate survey process
- control of exotic plant species eg woody and other weeds
- strategic location of watering points and fencing
- reclamation and regeneration of damaged areas, for example, by pitting, contour furrowing, and direct seeding with species, such as chenopod shrubs (saltbush).

The recent development of legislation addressing management of land in the Arid Zone has resulted in increased awareness among landholders and the wider community of the major causes of vegetation decline and the need to manage land within its capability. Over the period 1990-98, a comprehensive evaluation of land condition and capability will be completed for all pastoral leases. Stocking levels will be set accordingly and ongoing conditions monitored.

Significant work to implement land reclamation by the use of disc pitting, contour furrowing, and rabbit control has already been undertaken and activity of this type is increasing. The cost of contour furrowing and disc pitting varies depending on access to equipment and the need to control grazing and rabbits. An estimated 600 square kilometres has been treated.

Control of feral animals (particularly goats and rabbits) and weeds is limited due to the relatively high costs of such operations in the pastoral areas. In some of the more productive pastoral areas, however, extensive rabbit control programs are being implemented. Cooperation between agencies and lessees is being encouraged to maximise effectiveness of effort. Rabbit control costs are approximately $5—$10 per warren and there are indications that the benefit/cost ratio can be favourable, depending on wool and beef prices. This is also the case with goat control.

Program targets

- Pastoral lands will be assessed to establish appropriate stocking rates and to gain understanding of the total impact of native, domestic, and feral animals on perennial vegetation communities.

- Land management practices in the zone will be adjusted to achieve acceptable grazing pressure on perennial vegetation.

- Information and management tools, such as 'Range Pak', will be provided to facilitate productive and sustainable management of the pastoral lands.

- Programs for the re-establishment of perennial plant communities on degraded land (with preference for indigenous species) and to encourage natural regeneration on degraded land will increase.

- Integrated programs will be developed for control of feral animals (rabbits and goats) and coordinated, effective, long-term control programs will be implemented.

- The impact of exotic plants (woody and other weeds) will be assessed and practical control programs will be implemented.

- A district and property management planning approach to management of pastoral lands will be developed and adopted.

- Codes of practice for temporary uses of the Arid Zone land resource will be developed and promoted by extension services. Campers and mining exploration companies will be required to observe these codes.

UNDESIRABLE PLANTS AND ANIMALS

The problem

The invasion of the Agricultural and Arid Zones by exotic plants and feral animals is a major, land degradation problem. Exotic plants and feral animals are increasing their ranges and threatening both productivity and the environment. Many exotic plants in the agricultural areas of the State cause problems in cropping, grazing enterprises, and management of conservation parks and other public lands. Feral animals, particularly rabbits and goats, cause huge problems in the Arid Zone that often lead to permanent loss of valuable perennial vegetation and expose soil to wind or water erosion. Rabbits also cause a wide range of problems in agricultural lands, especially in the lighter soils prone to wind erosion. Problems, such as heavy grazing of crops, pastures and native vegetation exposing the soil surface to wind, or even water erosion. Foxes and feral cats cause huge problems in wildlife communities.

At times, certain native wildlife species can have a negative impact on the land and its sound use. For example, excessive numbers of wombats, kangaroos, and cockatoos may require specific management. In pastoral areas, unpalatable woody plants, both native and introduced, are continuing to colonise areas of desirable perennial vegetation. This usually occurs after the native vegetation is weakened by overgrazing, an increase in rabbit or goat numbers, fire, or drought.

Implications

Weeds that are threatening new areas may be proclaimed under the *Animal*

and Plant Control (Agricultural Protection and other Purposes Act 1986. Landholders are obliged to control proclaimed plants present on their property. This can prove quite difficult and expensive. Apart from the cost of control weeds, compete for moisture, space and nutrients and usually result in lower productivity. For example, invasive weeds such as silver leaf nightshade can reduce productivity by up to 60% in sandy soils. New weeds increase management costs and can increase the need for cultivation and herbicide use. Weeds can thus contribute to wind erosion, water erosion and a decline in soil nutrients, structure and biological state.

Significant benefits would be obtained from the effective control of goats and rabbits. The productivity of the pastoral industry would be greatly improved and the pressure on the perennial vegetation would be significantly reduced. Costs from loss of primary production through rabbit competition total $17 million a year in the pastoral lands and $5 million each year in the agricultural lands. The net loss in grazing production from goats in the pastoral lands is $2 million each a year. These estimates have been made by the Animal and Plant Control Commission and do not include a value for the damage caused to the soil, or native vegetation and animals (see 'Decline of Arid Zone vegetation').

Remedial measures

The remedies to undesirable animals and plants focus on the treatment of infestations of spreading exotic plants, the rehabilitation of invaded land, integrated control programs for feral animals, and management of native animals that have a negative impact on the land resource.

Measures to be promoted are as follows:

- identification of new, isolated infestations of weeds
- control of spread of weeds by preventing seedset
- integrated control programs for feral animals
- retention of competitive vegetation (for weed control)
- coordination of control programs by local Animal and Plant Control Boards in local government areas and Animal and Plant Control commission in Arid Zone.

Coordinated control programs are in place across the Agricultural Zone. Control programs in the Arid Zone are partially implemented; further improvements will be accomplished as evaluation of the land condition is carried out. The cost of feral animal control in pastoral areas is an inhibiting factor to wide-scale adoption.

Program targets

Pest animals and plants

- Research will be conducted into pest animals (especially rabbits) and plants, their control, and the wider effects of such control measures.
- Integrated programs for rabbit and goat control in the Arid Zone will be developed and effective coordination of these control programs is considered a necessity.
- Control efforts will increase when rabbit and goat numbers are reduced by droughts.
- Rabbit, fox, and feral cat control measures will continue in the Agricultural Zone.
- Further development and implementation of measures for the control of proclaimed plants and proclaimed animals other than rabbits, foxes, and cats, are required in the Agricultural and Arid Zones.
- Adequate funding research will be available for research and coordinated control programs.

Native animals

- A kangaroo management program will be developed and implemented in pastoral areas.
- Complete management strategies for large cockatoo species will be incorporated into the planning process.

- The provisions of the wombat management plan will be implemented and its effectiveness will be reviewed.

IRRIGATION MANAGEMENT

The problem

There are two major problems related to irrigation in South Australia. Wherever groundwater is used for irrigation, water use eventually exceeds recharge. This leads to falling water levels, an increase in pumping costs, and increasing salinity. The salt comes from inflow of surrounding saline groundwater. Inefficient irrigation, and excessive irrigation, for example, from the River Murray, cause drainage through the root zone and can result in rising groundwater levels. This drainage mobilises salts and contributes highly saline water into the River Murray.

Implications

For sustainable irrigation, withdrawal of water from groundwater systems must not exceed recharge. Where use exceeds recharge, the industry has to contract or relocate.

Approximately 40% of the salt level recorded at Morgan on the River Murray is contributed by inflows within South Australia. So although South Australia inherits a larger problem from the upstream States, salinity inflows caused by inefficient and excessive use and natural sources in this state are considerable.

The estimated economic cost of river salinity on urban, industrial, and agricultural users in 1986 was $37 million. It is expected that by the year 2000 the cost will exceed $46 million (1986 dollars).

Remedial measures

Efficiency of irrigation practices must improve. This can be promoted by the following measures:

- legislation to balance water use to recharge of groundwater aquifers
- development of irrigation practices that avoid excessive water application
- adoption of engineering works to prevent saline groundwater reaching the River Murray.

Traditional irrigation practices remain acceptable to both users and the wider community. In general, water users are not applying the best available technology. As a result irrigation efficiencies are poor, water wastage and drainage are high, and optimum crop and financial returns are not achieved.

A significant barrier to the adoption of improved water management has been that engineering consulting services, which can be used by farmers to test irrigation systems, have only recently been established and then, only in the Riverland (in 1987). These services do not exist in other irrigated areas. Recent records indicate approximately 20% of the irrigators in the Riverland have engaged the services of the Department of Agriculture's Irrigated Crop Management Service (ICMS). Private services are also being used.

Program targets

- Strategies wil be developed to balance use with recharge for those groundwater areas proclaimed under the Water Resources Act. Use in other areas will continued to be monitored to avoid the necessity of legislative control being implemented.
- Sustainable production methods will be developed and promoted, which incorporate accurate scheduling or irrigation to reduce drainage and manage salinity.
- Emerging chemical and biological pollution of groundwater supplies will be monitored and remedial or control measures will be adopted as necessary.

DECLINE IN WATER RESOURCE QUALITY AND QUANTITY

The problem

Rivers and streams throughout most of the Agricultural Zone and the peri-urban and urban areas have undergone an increase in salinity as a consequence of the removal of vegetation, the subsequent greater infiltration of rainfall, and the rise in groundwater levels mobilising stored salt. The salinity of the River Murray has increased as a result of excessive land clearance and irrigation, and this in turn has led to an increase in the rate at which saline groundwater flows into the river.

Levels of the major nutrients (nitrogen and phosphorus) have increased in many streams, including those of the Mount Lofty watershed, as a consequence of inappropriate management of land used for both perennial and annual crops, grazing, and urban and recreational uses. Inappropriate management of such areas has also contributed to increased levels of turbidity, bacteria, pesticides, and algal blooms. Turbidity refers to the muddy condition of water resulting from the presence of suspended solids.

Streambank erosion and soil erosion induce silt transportation by water and lead to siltation of reservoirs. Siltation adds to the decline in water quality.

Chemical and biological pollution of groundwater supplies are also significant emerging issues that affect sustainable production; for instance, increasing nitrate levels in the groundwater of the South-east could threaten irrigated crops, livestock, and wetland environments.

Water-based ecosystems, including rivers, streams, lakes, and wetlands, are being progressively degraded due to regulation of river flows and increases in water use, salinity, nutrients and other contamination, turbidity and siltation. Surface drainage schemes can also adversely affect flora and fauna.

Overuse of surface water and groundwater, due mainly to irrigation, has resulted in the reduction of the quality and quantity of water available in some areas.

Remedial measures

Water use and waste-water disposal must be managed.

The Minister of Water Resources has delegated responsibility to the Engineering and Water Supply Department for the management of government programs related to the continued availabliity of water of appropriate quality and to the protection of the environment from water-related pollution. The minister is assisted in the development of policy and the administration of the *Water Resources Act 1990* by advice from the South Australian Water Resources Council and local Water Resource Committees. A number of policy and management initiatives have been implemented:

- an embargo of new water licences from the River Murray since 1968
- capital works programs in collaboration with the Murray-Darling Basin Commission to address salinity problems along the River Murray and other catchment and water management problems
- non-capital works in collaboration with the Murray-Darling Basin Commission including the 'Natural Resources Management Strategy' and the 'Wetlands Management Program'
- proclamation of groundwater areas that prevents further exploitative development and establishes control over land management that affects groundwater quality
- improved land resource management within supply catchments (private and public)
- improved irrigation practices to ensure water-use efficiency and to reduce pollution of the water resource
- increased water use efficiency in urban areas

- improved control, management and disposal of urban stormwater.

The broad framework for the management of water resources is outlined in the report, *Water South Australia — Managing the resource into the the next century*. Programs are being developed that cover the following five aspects:

- community consultation
- integration of land use and water resource management
- establishment of a business-like approach towards water management
- consideration of the social and environmental effects of water use
- monitoring and research.

Legislative and capital works programs have been implemented. User participation programs have been initiated, but adoption rates will depend on community awareness and on the provision of incentives in interdepartmental programs for change in water-use patterns.

Program targets

- A set of complementary water resource management programs and targets will be developed by June 1992 that coordinates the management objectives of the Engineering and Water Supply Department and the South Australian Water Resources Council.
- Water-quality objectives will be established for rivers and water bodies throughout the State.
- Research will be carried out on the interrelationship between land use and the quality of receiving waters.
- Policy and codes of practice will be developed with respect to the disposal and management of water run-off from urban and rural lands into waterways, wetlands, marine and wildlife habitats, and groundwater systems.

APPENDIX 2: CURRENT DEPARTMENT OF AGRICULTURE LAND MANAGEMENT PROGRAM

The Department of Agriculture conducts a range of land management programs and projects at the State and Regional levels. Funding sources include the State Government and the Commonwealth's National Soil Conservation Program. The following tables provide details on funding and expenditure for land management programs and projects in 1990/91 and 19991/92. The tables do not detail all the individual land management projects, but they have been compiled to give an overall picture of how State and Trust (external) funds are used, as well as an indication of the spread of project activity.

Table 8: Land management expenditure 1990/91 by function

Function	Expenditure ($) Fund type		
	State	Trust*	Total
Research	1 255 208	1 266 621	2 521 829
Diagnostic Services	67 793	—	67 793
Extension	1 236 329	1 555 340	2 791 669
Industry Development	84 563	—	84 563
Regulatory	334 292	—	334 292
Policy	31745	—	31 745
Administration	502 476	175 520	677 996
Research Administration	19 560	—	19 560
Totals	**3 531 966**	**2 997 481**	**6 529 447**

* See Table 12 for details on external funding sources.

Table 9: Land management expenditure 1990/91 by cost centre

Cost centre	Expenditure ($) Fund type		
	State	Trust*	Total
Plant Industries & Natural Resources Div	1 154 075	809 357	1 963 432
Central Region	564 018	642 238	1 206 256
Eyre Region	222 421	351 776	574 197
Murraylands Region	354 532	507 207	861 739
Northern Region	133 899	47 064	180 963
South East Region	251 067	122 242	373 309
Other (see table 11)	851 954	517 597	1 369 551
Totals	**3 531 966**	**2 997 481**	**6 529 447**

Table 10: Land management work force 1990/91

Fund type	Full time equivalents for period 1990/91
State	56.484
Trust	40.552
Total	**97.036**

Note: Five (5) full time equivalents should be added to the above figure to cover the input of Soil Managers and other managers into Land Management Programs.

ADJUSTED TOTAL 102 full time equivalents

Table 11: Details of 'other' land management expenditure (from table 9)

Program/project	Expenditure ($) 1990.91 State
State Chem. Lab's	198 628
ASCC and special activities	21 223
Soil Conservation Council & Boards	235 172
SSCP—Masters Course	14 184
ESCP—Staff Training & Dev.	27 532
Landcare Newsletter and Publicity	41 200
State Management Committee	31 196
State Tree Centre, Committee & Grants	251 019
UFS Coordinator	31 800
Totals	**851 954 (State funds)**
	Trust
Community Landcare Projects	377 391
Small Project Support	3 425
Special Purpose Equipment	39 995
Flinders Ranges Land Survey (DEP)	71 725
Community Landcare Training	25 061
Totals	**517 597 (Trust funds)**

Table 12: Major external funding sources for land management

Program	Detail and objectives
National Soil Conservation Program (NSCP)	The NSCP is a Commonwealth Government initiative with the following broad goals: • all land in Australia to be used within its capability • land use decisions to be based on whole catchment/regional management planning concepts • all land users and levels of government to meet their respective responsibilities in achieving soil conservation • there to be effective cooperation and coordination between all sectors of the community, disciplines and agencies involved in the use and management of land and water resources • the community to adopt a land conservation ethic. The NSCP provides funding under the following three sub-programs: • Community Landcare Sub-Program • Major Program Support Sub-Program • Public Participation, Education and Training Sub-Program.

Table 12: Major external funding sources for land management (*cont.*)

Program	Detail and objectives
Land and Water Resources Research and Development Corporation (LWRRDC)	The LWRRDC provides national leadership and coordination in land and water research and development including responsibility for the research component of NSCP and the Australian Water Resources Advisory Council program (AWRAC).
Murray-Darling Basin Natural Resources Management Strategy (NRMS)	The Strategy is a blueprint for coordinated government and community action to tackle the degradation problems of the Basin. The aims of the Strategy are quite broad but involve the prevention and the restoration of natural resource degradation as well as sustainable resource use planning and management. The Engineering & Water Supply Department administers the funding within the State. The Department of Agriculture receives funding under this program for a number of projects involving land and vegetation evaluation and management.

Note: A number of projects also receive funding from the Grains Research Development Corporation.

Table 13: National Soil Conservation Program (NSCP) components 1990/91 and 1991/92

Components	Approvals 1990/91	Approvals 1991/1992
Community Landcare Sub-Program - group projects	377 816	620 008
Community Landcare Sub- Program - State agency support	798 257	814 847
Major Program Support	839 369	1 004 027*
Research	585 133	405 129** 33 333***
Public Participation, Education and Training	225 500	188 040
Totals	**2 826 075**	**3 065 384** **(2 626 922 NCSP & 438 462 LWRRDC)**

* Includes $85 173 for 2 projects operated by the Department of Environment and Planning.

** The Land and Water Resources Research Development Corporation (LWRRDC) took over responsibility for research projects previously funded under NSCP in 1991.

***The LWRRDC also took over responsibility for a land management project previously funded by the Australian Water Resources Advisory Council (AWRAC).

Table 14: National Soil Conservation Program (NSCP) Community Landcare Group Projects by Region - 1990/91 & 1991/92

Region	Fund allocation			
	1990/1991		1991/1992	
	Number of projects	Total $ value	Number of projects	Total $ value
Central	18	252 136	41	414 290
Eyre	5	57 415	13	99 122
Murraylands	3	23 950	3	30 215
Northern	3	24 315	4	28 725
South East	1	20 000	6	47 656
Totals	**30**	**377 816**	**67**	**620 008**

Note: Funding for Community Landcare group projects is distributed and administered by the Plant Industries and Natural Resources Division of the Department of Agriculture. The regions provide technical and group support to these groups.

Table 15: National Soil Conservation Program (NSCP) Community Landcare State Agency Support Projects - 1990/91 & 1991/92

Project	Funding allocation	
	1990/1991	1991/1992
Community Landcare Coordination	474 782	465 777
Community Landcare Technical Support	-	45 700
County Cardwell	47 347	49 116
Lower Eyre Peninsula Soil Conservation Board	34 548	38 073
Mt Lofty Ranges Soil Erosion Mgt.	47 575	-
Community Landcare Revegetation	59 105	26 579
Community Landcare Group Train'g	35 000	-
Small Projects	3 800	-
Administration Support	56 100	53 132
Special Purpose Demonstration Equip't	40 000	-
Community Involvement in Catchment Mgt.t	-	38 690
Rabbit control and Rehabilitation of Arid Lands	-	48 153
Agronomic Strategies for Managing Dryland Salinity	-	49 627
Totals	**798 257**	**814 847**

Table 16: National Soil Conservation Program (NSCP) Major Program Support Projects - 1990/91 & 1991/92

Project	Funding allocation 1990/1991	1991/1992
Marginal Lands Mapping	64 159	32 397
Northern Marginal Lands Soil Mgt.	38 654	51 666
Pastoral Soil Conservation Extension	64 740	49 000
Soil Conservation Plan'g - Methodology	58 074	96 800
Soil Conservation Plan'g - Information	96 719	72 539
Land Capability of SA - Riverland	41 786	-
M/Mallee Farm Management	50 452	-
District Soil Conservation Plan'g EP	87 310	80 952
Land Class Mapping - YP and KI	63 488	37 921
Land Class Mapping - EP	81 844	46 989
Flinders Ranges Land Resource Survey	75 725	35 173*
Soil Acidity Investigation and Extension	59 373	65 390
Establishment of Property Management Planning Systems	57 045	118 725
Land Evaluation and Soil Interpretation Training	-	203 735
Economic Assessment and Financial Planning	-	48 427
A GIS to support District Planning	-	14 313
Integrated Vegetation and Land Use Management - Eyre Peninsula	-	50 000*
Totals	**839 369**	**1 004 027**

* These projects are operated by the Department of Environment and Planning.

Table 17: Research Projects 1990/91 & 1991/92

Project	Funding allocation 1990/1991 National Soil Conservation Program (NSCP)	1991/1992 Land & Water Resources Research & Development Corp. (LWRRDC)
Identification and Mgt. of Saltland	134 297	136 821
Best Mgt. Practices	72 611	-
Tillage &Stubble Systems	65 496	75 925
Dryland Salinity Catchment Investigation	100 398	95 740
Amelioration of Water Repellence	43 665	44 295
Erosion Prediction Application	51 186	-
Infiltration Measurement & Modelling	48 770	-
Rhizoctonia barepatch control	68 710	52 348
Salinity Mgt. Strategies for Grapevines (irrigated)	*	33 333
Totals	**585 133**	**438 462**

* This project was originally funded by the Australian Water Resources Advisory Council (AWRAC).

Table 18: National Soil Conservation Program Public Participation, Education & Training Projects - 1990/91 & 1991/92

Project	Funding allocation 1990/1991	1991/1992
Landcare Public Education & Promotion	97 296	38 347
1990 Year & Decade of Landcare	74 381	50 000
Promotion of Conservation Farming	53 823	39 310
Awareness, Promotion & Education - Horse Paddock Management	-	12 000
Development of Community & Formal Education Packages for Landcare	-	45 883
WAB - Soil School for Rural Women	-	2 500
Totals	**225 500**	**188 040**

Table 19: Murray-Darling Basin Natural Resources Management Strategy (NRMS) Land Management Projects - Department of Agriculture - 1990/91 & 1991/92

Project	Funding allocation 1990/1991	1991/1992
Chowilla Flood Plain Rehab'n	42 246	55 500
Regional Strategy for Reveg'n of the Murray Mallee	79 819	67 300
Project Officer for Communities of Common Concern	68 828*	74 000
Sustainable Land Management for the Murray Mallee	-	64 500
An Education & Training Program to extend technology via ICMS concept	-	58 200
Totals	**190 893**	**319 500**

* Expenditure on this project in 1990/91 was not included under land management expenditure in tables 8 & 9.