2002

MARLA-OODNADATTA SOIL CONSERVATION BOARD
DISTRICT PLAN 2002

MARLA-OODNADATTA

SOIL CONSERVATION BOARD DISTRICT PLAN

Marla-Oodnadatta Soil Conservation Board

September 2002

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Cover photograph: The late Andy Smith, Macumba stockman, 1993.

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FOREWORD

When the Marla – Oodnadatta Soil Conservation Board was first gazetted during 1989 and its members appointed, it took on the task of preparing a dynamic and revisable District Plan.

This is the first revision of our original District Plan (1997). This is still a useful and informative document for local land users, whether they are pastoralists, miners, Aborigines, conservationists, tourists or land administrators, and for those who simply have a genuine interest in the area.

As the District Plan is a requirement under the *Soil Conservation* and *Land Care Act* of 1989 (which requires a "Duty of Care" over all land tenures), it has a particular relevance to all land users. The Board would like to stress however that while this Plan provides guidelines for sustainable land use, individual land managers will have their own localised strategies to achieve commercial productivity through sustainable use of the land.

The first part of this document is descriptive, describing the physical features and natural resources inherent to this District. Land Management is dealt with in the second section with a framework for a Three Year Program for the Board detailed at the end of the document. This first review will be again revisited and reviewed in 2005.

All past and present members of the Board are very much involved in land management within this District for which we are all particularly proud.

Finally, the Board promotes commercial productivity, which relies totally on the natural environment that has to be managed as an ongoing renewable resource with its yield sustained and improved for the continued enjoyment and benefit of future generations.

Digby Giles

Chairperson
Marla – Oodnadatta Soil Conservation Board

ACKNOWLEDGEMENTS

This review of the Marla-Oodnadatta District Plan was prepared on behalf of the Board by Frank Badman of Badman Environmental.

Thanks are due to the present soil board members for their input into the review, in particular to Digby Giles, Phil Gee, Andrew Smith and Andrew Clark. The input of past board members to the original District Plan and thus to the current one, is also acknowledged. Leisl Dunbar acted as a valuable interface with the Board. Many other people read drafts and had input into various sections. Sandy Gunter commented on numerous sections, while Nalini Klopp and Geoff Axford also provided information.

John Pitt of Rural Solutions SA provided information on pest plants and animals and Barb St John and Lisa Faraway of DEH provided information on kangaroo management. John Read and Katherine Moseby of WMC Limited provided information on the Arid Recovery Project at Roxby Downs. Dennis Hopkins of SARDI provided the information on pest insects.

Lloyd Sampson provided information on water management and the GAB. Phil Gee was consulted on the sections on camels and tourism. Justin Gum of Minerals and Energy Resources, PIRSA provided information and comment on the section dealing with mining and exploration.

Jenny Bourne of DEH made available a draft of the flora and fauna lists from the Witjira National Park resource document. Jeff Foulkes provided flora and fauna lists from the DEH databases. Jan Rowland of Sustainable Resources, Department of Water, Lands and Biodiversity Conservation updated the maps.

Rick Barratt of the State Indigenous Land Use Negotiation Team provided comment on the native title sections and provided the brochure on Native Title Act implications on pastoral diversification that is included as an Appendix.

The South Australian Bureau of Meteorology provided the climate data. All geological data are from the 1997 District Plan (MOSCB 1997)

Frank Badman took the photographs of the Baltana, Commonwealth, Paisley and Mount Margaret land systems. Bill Ryan provided photographs for the Federal, Finke and Simpson land systems. All other photographs are from the 1997 District Plan (MOSCB 1997).

Andrew Breeding prepared the cover from a photograph of the late Andy Smith, stockman at Macumba Station, taken by Philip Gee in 1993.

Frances O'Reilly assisted with editing the final draft.

SUMMARY

The Marla-Oodnadatta Soil Conservation District covers 132,000 square kilometres of the arid land in the central north of South Australia. Population density is extremely low and the only major towns are Oodnadatta with a population of 230 and Marla with a population of 240.

The dominant land use is beef cattle pastoralism, with some small areas dedicated to opal mining. Tourism is a growing industry in the District particularly for the two formal conservation reserves, Witjira National Park including Dalhousie Springs and Wabma Kadarbu Mound Springs Conservation Park near Coward Springs. The arid climate makes any other form of agriculture unviable. Most of the District is held under Pastoral lease, with the exception of the National Parks, the Pitjantjatjara Aboriginal Land in the north-west and the Coober Pedy Precious Stones Reserve in the south. Several Aboriginal communities are located within or just outside the District.

Land types are quite variable, the dominant type being characterised by flat gibber tablelands with gilgais and light dispersive soils, with a covering of grasses and chenopod shrubs. In the north-east, large intermittent creeks flowing into the northern reaches of Lake Eyre traverse extensive floodout plains on the fringes of the Simpson Desert. Extensive dune systems occur in the north-west and in the south and central parts, the eroding Bulldog Shale and saline soils create the distinctive "breakaway" country that supports predominantly chenopod shrublands.

The main land management issues in the District are centred on pastoralism, mining and tourism. They include the maintenance of native pastures, animal and plant pest control, wind and water erosion and mine site rehabilitation. Weeds are seen by the Board as a problem with the potential to worsen and this subject has been covered in greater detail here than in the previous District Plan.

This plan describes the District in terms of its physical characteristics, identifies and describes the dominant land management issues and makes recommendations for appropriate practices to maintain the current land uses and manage the natural resources in a sustainable way.

This document provides an overview of the District and useful information for all land managers and includes a three year programme of activities aimed at enhancing the sustainability of the current land uses and conserving the resource base.

INTRODUCTION

Membership of the Marla-Oodnadatta Soil Conservation Board

The Marla-Oodnadatta Soil Conservation Board was formed in 1989. The members of the Marla-Oodnadatta Soil Conservation Board (2002) are:

Digby Giles (Chairperson)	Wintinna Station	(08) 8670 7936	1993 - present
Andrew Clarke	Allandale Station	(08) 8670 7806	1998 - present
Philip Gee	William Creek	(08) 8672 3268	1998 - present
Andrew Smith	Tieyon Station	(08) 8956 0993	2000 - present
Bill Ryan	NPWSA	(08) 8648 5300	2001 - present

The inaugural Board consisted of:

Douglas Lillecrapp – Chairman	(1989 - 1998)
Pearce Dougherty (NPWS)	(1989 - 1991)
Hugh Frahn	(1989 - 1998)
Stuart Nunn	(1989 - 1993)
Shane O'Connell	(1989 - 1995)
Tony Williams	(1989 - 1995)
Serena Williams	(1990 - 1998)

Other members have been:

Trevor Naismith (NPWSA)	(1991 – 1995)
John Watkins (NPWSA)	(1995 – 2000)
Geoff Axford (NPWSA)	(2000 – 2001)
Garry Birchmore	(1995 – 1998)
Paul Williams	(1995 – 2000)
Susan Fuller	(1998 – 2000)
Grant McSporran	(1998 – 2001)
Wendy Buck	(2000 – 2001)
Paul Jonas	(1993).

Role of the Board

The role of the Board is one of education, coordination and cooperation; and is directed towards preventing land degradation through responsible land management. Other aspects of the Board's role are to:

- develop community awareness and understanding of land conservation issues;
- promote the principle that land must be used within its capability;
- develop and support community projects for land conservation and rehabilitation;
- provide advice and assistance to landholders regarding land conservation and rehabilitation;
- implement the provisions of the *Soil Conservation and Land Care Act 1989*;
- prepare District Plans and Three Year Programmes;
- approve property management plans.

Duty of Landholders

The Board feels that all people have a responsibility to care for soil, vegetation, water and other natural resources. The *Soil Conservation and Land Care Act 1989* states that it is the duty of all landholders to take all reasonable steps to prevent degradation of land.

Degradation of land means a decline in the quality of soil, vegetation, water and other natural resources of the land resulting from various activities or failure to take the appropriate action to prevent that degradation.

Aims of the Board

1. Develop the Soil Board's role in the community and promote its function.
2. Be a voice, network link and responsible mediation body on land use and management issues for the Marla-Oodnadatta Pastoral community to the Government and wider community.
3. Encourage better liaison and information transfer between the Soil Board and the Pastoral Program, Pastoral Board and land managers.
4. Increase knowledge and understanding of Board Members and the wider community about all aspects of the District.
5. Promote ecologically and economically sustainable land use in the District by maintaining and protecting the soil and native vegetation resources.
6. Maintain and protect the biodiversity of the region.
7. Protect the long-term viability of industry within the District.
8. Assist the development of property management plans which are consistent with achieving ecologically and economically sustainable land management.
9. Increase productivity of degraded areas by facilitating regeneration of native vegetation.

10. Promote sound stock management.
11. Facilitate and promote the formulation of codes of practice for responsible land use, including tourism, pastoralism, mining and conservation.
12. Initiate, promote, and support projects that involve participation from all sectors of the community.
13. Ensure the involvement of local managers in the administration of natural resource management and provide assistance as required.
14. Provide for, and promote the creation of, an inventory of the natural resources of the District and monitoring of the condition of those resources.
15. Record expertise in sustainable management of the land for use by those with local and administrative land management responsibilities and make this information available for use by school and community educators.

These aims form the basis for the development of the Board's programmes and activities.

Aims of the District Plan

This District Plan has been developed as required by section 36 of the *Soil Conservation and Land Care Act 1989* and aims to:

- Describe the district, including land systems, biodiversity, land capability, land uses and infrastructure.
- Describe the existing and potential soil and vegetation degradation problems.
- Identify the land management options best suited to preventing those problems and to rehabilitating degraded land.
- Enhance community awareness of optimum land management practices.
- Include a programme outlining the Board's aims and activities over the next three years.

Legislation

Numerous Acts of Parliament apply within the area covered by the District. The most important acts that affect the Board and the District are:

State Legislation

Aboriginal Heritage Act 1988
Animal and Plant Control Act 1986
Controlled Substances Act 1984
Country Fires Act 1989
Crown Lands Act 1929
Dangerous Substances Act 1979
Development Act 1993
Dog Fence Act 1946
Environment Protection Act 1993

Explosives Act 1936
Heritage Act 1993
Highways Act 1926
Mines and Works Inspection Act 1920
Mining Act 1971
National Environment Protection Council (South Australia) Act 1995
National Parks and Wildlife Act 1972
Native Title (South Australia) (Validation and Confirmation) Amendment Act 1999
Native Vegetation Act 1991
Occupational Health, Safety and Welfare Act 1986
Opal Mining Act 1995
Outback Areas Community Development Trust Act 1978
Pastoral Land Management and Conservation Act 1989
Public and Environmental Health Act 1987
Road Traffic Act 1961
Soil Conservation and Land Care Act 1989
Water Conservation Act 1936
Water Resources Act 1997
Wilderness Protection Act 1992

Commonwealth Legislation

Aboriginal and Torres Strait Islander Commission Act 1989
Aboriginal and Torres Strait Islander Heritage Protection Act 1984
Australian Heritage Commission Act 1975
Endangered Species Protection Act 1992
Environmental Protection (Impact of Proposals) Act 1974
Environment Protection and Biodiversity Conservation Act 1999
Industrial Chemicals (Notification and Assessment) Act 1989
National Parks and Wildlife Conservation Act 1975
Native Title Act 1993
Occupational Health and Safety (Commonwealth Employee) Act 1991

This list is by no means exhaustive and several other acts may be applicable to current or potential enterprises within the District. Some of the Commonwealth Acts listed above have been amended several times since they were first proclaimed.

Review of the District Plan

The District Plan will be reviewed every three years (this may be extended to five years in the near future). Concerns and guidelines presented in this plan will be updated through the review. Ongoing consultation with the community is recognised by the Board as necessary to maintain the relevance of the plan and the Board's activities to the current land management issues within the District.

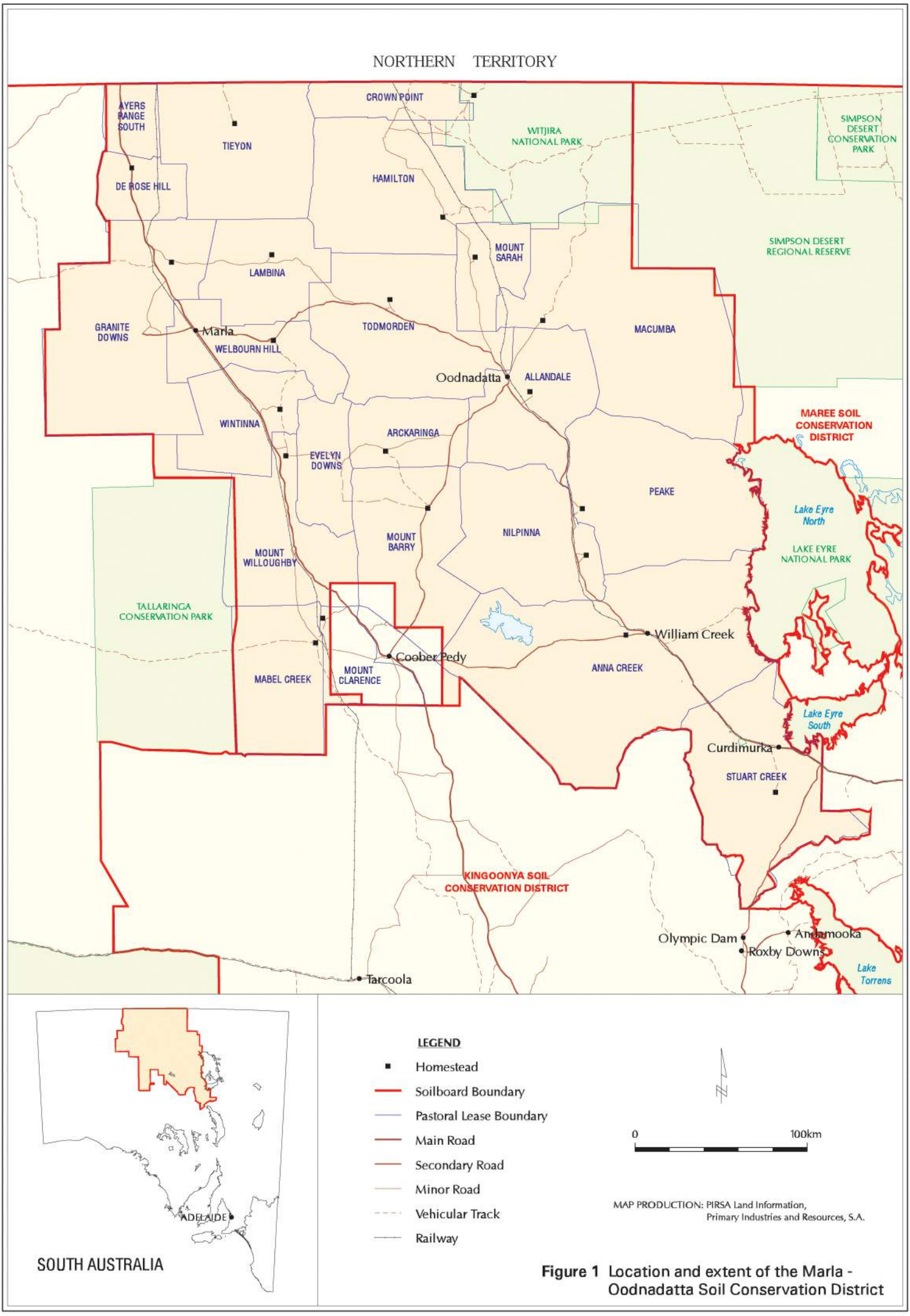

Figure 1 Location and extent of the Marla - Oodnadatta Soil Conservation District

DESCRIPTION OF THE DISTRICT

Introduction

The Marla-Oodnadatta Soil Conservation District[1] covers a vast area (132,400 square kilometres) in the north-west pastoral region of South Australia. From approximately 900 kilometres north of Adelaide, the District extends to the Northern Territory border. The District is bounded by the Simpson Desert and Lake Eyre on the east, the Great Victoria Desert on the west and the Northern Territory border to the north (Figure 1). Clay pans, red sandhills, gibber, creek lines, floodplains, mesas, plateaus and weathered hills are all features of the District. The elevation ranges from 647 metres above sea level at Mount Chandler in the north-west of the District to as much as 15 metres below sea level in parts of Lake Eyre.

It is an arid[2] region of temperature extremes. Rainfall averages for the District are between 150 mm in the southeast to 225 mm in the far northwest. The region can experience prolonged dry periods of no significant rain and flooding summer rains.

Twenty pastoral properties are located within the District and parts of two Northern Territory properties also extend into the District from the north. Three of these properties are Aboriginal owned, as are two small areas near Oodnadatta. The Witjira National Park and the Wabma Kadarbu Mound Springs Conservation Park lie entirely within the District. The Tallaringa Conservation Park, Lake Eyre National Park and the Simpson Desert Regional Reserve all border the District. The Breakaways reserve is located within the District, just to the north of Coober Pedy.

Coober Pedy, although not in the District, is a major service centre for the District and is the largest local population centre. Opal mining and tourism are the main industries at Coober Pedy, immediately to the south of the District. There are other smaller opal mining communities at Mintabie, also just outside the District to the north-west, and at Broken Leg and Seven Waterholes on Lambina Station.

Other settlements include: Marla, situated on the Adelaide - Alice Springs railway line and the Stuart Highway; William Creek, midway between Marree and Oodnadatta; and Oodnadatta, the oldest gazetted township in the District. Oodnadatta came into being in 1891because of the old, but now dismantled, Great Northern Railway. The remaining population is dispersed throughout the District at the 20 pastoral station homesteads, at Aboriginal homelands and at the tourist support facilities at Cadney Park and Mount Dare. The township of Indulkana and numerous other Aboriginal communities occur outside the District on the adjacent Pitjantjatjara Aboriginal Land and a large community exists at Finke, just north of the District in the NT.

Pastoralism, mining and tourism are the major industries; a significant portion of the State's beef cattle originate from the area and together Coober Pedy and Mintabie supply the majority of opal to the world's gemstone industry. Tourism is beginning to take on a more organised front with 4-wheel-drive vehicles travelling long distances to experience the "Oodnadatta Track", the mound springs and the old settlements

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[1] The former pastoral lease of Granite Downs (see Figure 1) is now *Restricted Aboriginal Freehold Land* and is managed according to the pokicies outlined in the *Stategy for Aboriginal Managed Lands in South Australia* (SAMLISA).

[2] A glossary of terms used in the text is given in Appendix A.

associated with the Overland Telegraph and Old Ghan Railway. Visitation rates to Witjira National Park are also increasing as people cross the Simpson Desert. Sheep were run in the District until the 1950s but none remain today. Mabel Creek and Evelyn Downs were the last properties to run sheep here.

The landscapes which characterise the District include gibber tableland and mulga woodland. The gilgai gibber tableland supports chenopod shrubland vegetation. These tablelands are dissected by creeks which form wide braided channels as they flow east towards Lake Eyre. Gidgee, coolibah and river red gums follow creek lines. Mulga woodland or sandhill cane-grass is associated with sandier soils and sand dunes. Annual vegetation is highly dynamic, ranging from a flush of brilliant green after rains to an appearance of parched land with seeds and dust waiting for a suitable rain.

The Marla-Oodnadatta Soil Conservation District is a region of dramatic climate changes with human and animal populations as well as industry responding to seasonal conditions and fluctuations. It is an area of unique and stark beauty.

Climate

The climate of the Marla-Oodnadatta Soil Conservation District is classified as arid (Bureau of Meteorology 1988) with hot to extremely hot, very dry summers and mild, dry winters. There is little variation in climate across the District due to its inland location and lack of major hills. In summer, the northern parts are weakly affected by the north-west monsoon and occasionally by warm, moist tropical air as it penetrates south producing thunderstorms with intense, but relatively short-lived rain showers. During the remainder of the year north-west cloud bands originating over the Indian Ocean are the major source of rain although less than half of these bring significant falls to the District.

Winds

Seasonal variations in wind patterns are controlled by the location of large-scale high-pressure systems which form part of the global sub-tropical ridge. During the warmer half of the year (October to March), the ridge is located south of the District and the prevailing surface winds over most of the District are from the south-east quadrant.

During autumn, the mean position of the ridge moves north and remains over the continent for the cooler months (April to September). The Marla-Oodnadatta District is located near the axis of the ridge from May to July and winds are generally lighter and more variable.

While large-scale pressure features determine the broad-scale wind flow across uniform terrain, local topography may influence wind speed and direction on a smaller scale. Wind observations are available from well-exposed sites at Oodnadatta, Marla and Kulgera (Northern Territory).

From October to March, the most frequent wind direction is from the south-east quadrant, with southerly winds predominate in the south-east of the District and more easterly (even north-easterly) flow occurring over the northern region. In April and May winds moderate and from May to August show little directional preference. Light wind regimes are most common from May to July and strong winds (in excess of 41 kilometres per hour) occur, on average, one day or less per month. During September the east to south-easterly winds are generally re-established. Gale force winds (in excess of 61 kph) are uncommon, being most frequent from October to

December when they are observed, on average, one day per month. Table 1 shows the average number of days each month when strong winds are recorded.

Table 1: Strong wind occurrence.

The average number of days per month when wind speeds between 41 and 61kph are observed at Kulgera, Marla and Oodnadatta. (* indicates less than 0.5 days per month).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kulgera	2	2	1	1	*	*	*	1	2	2	2	2
Marla	3	1	1	*	*	1	1	2	2	5	4	3
Oodnadatta	4	3	3	1	1	1	1	2	4	6	4	4

Rainfall

Rainfall variability in the Marla-Oodnadatta Soil Conservation District is among the highest in Australia, while average annual totals are amongst the lowest. South of Alberga, no seasonality in rainfall is apparent, but north of here a weak summer maximum occurs. Tables of monthly mean and median rainfalls, together with the mean number of rain days for selected stations are presented in Appendix B. Record daily falls of between 100 and 200 millimetres have been observed across the District.

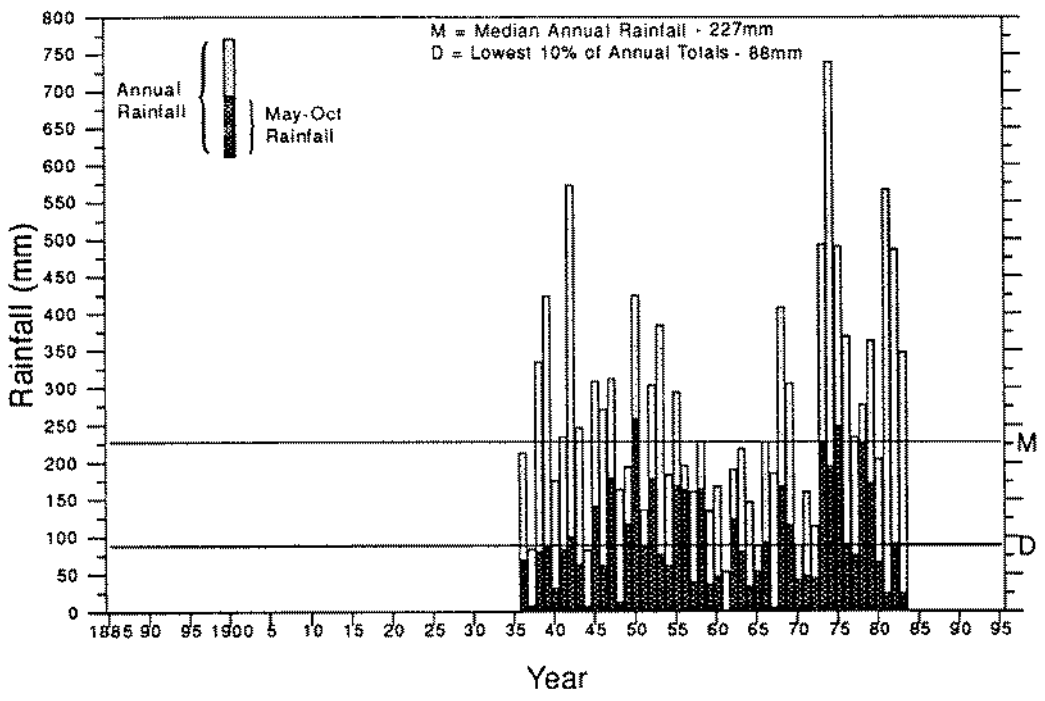


Figure 2 The long-term rainfall record for Anna Creek (Station No. 17004) at 28^0 54'S, 136^0 10'E (elevation 105m). Data are incomplete for the years 1925-1928.

As an indication of the range in and just outside the District, the historical rainfall records for Anna Creek and Ernabella are graphed in Figure 2 and Figure 3. These graphs highlight the year-to-year variability of the rainfall. Median annual falls range

from less than 120 mm in the south-east and near Lake Eyre (Anna Creek) to a little more than 210 mm in the north-west (Ernabella).

Decile tables for Oodnadatta, Anna Creek and Coober Pedy are given in Appendix C.

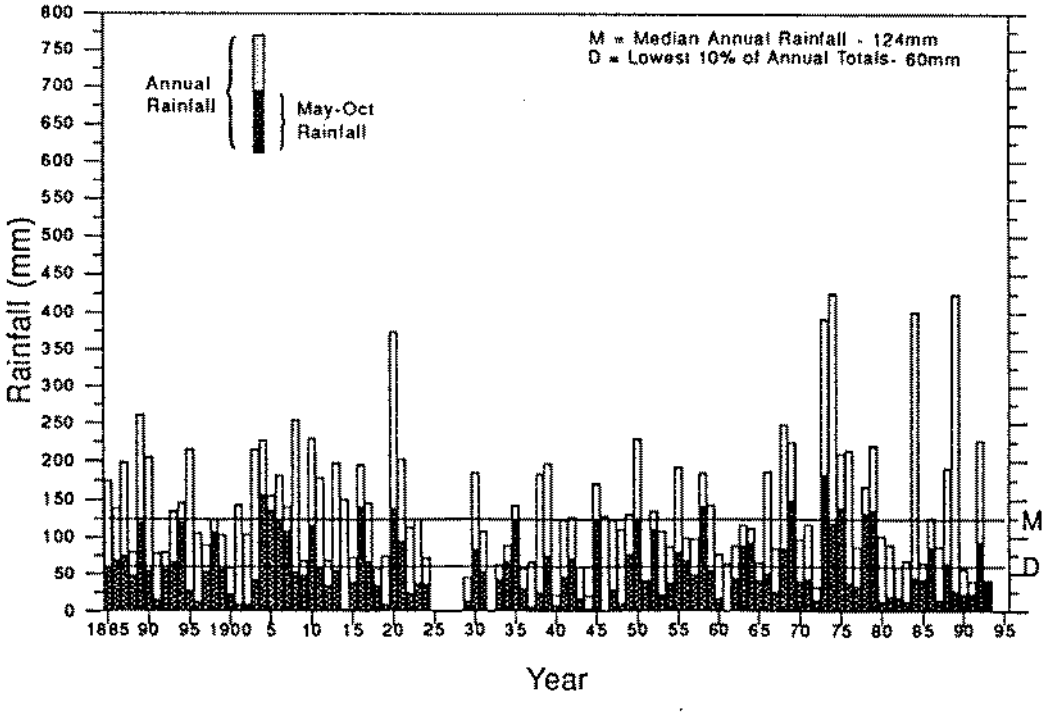


Figure 3 The long-term rainfall record for Ernabella (Station No. 16013) at 26^0 18'S, 132^0 08'E (elevation 676m). The 1983 annual total is estimated.

Potential Evaporation

Evaporation is dependent upon sunshine, temperature, humidity and wind. These are potential evaporation values, i.e. they represent the amount of evaporation possible given an unlimited water supply.

Average annual evaporation is greater than 3,400 mm over most of the Marla-Oodnadatta District. Evaporation totals of 3,300 to 3,400 mm are found in the extreme south and in the north-west of the District. The highest values, more than 3,800 mm, are found to the east of Oodnadatta. Mean monthly evaporation totals for the mid-season months are presented in Table 2.

Actual monthly rainfall exceeds actual monthly evaporation on all but very rare occasions.

Table 2 Average monthly evaporation estimates for the mid-season months.

Evaporation (mm)	January	April	July	October
North-east	500	250	140	350
South-west	450	225	130	325

Growing Season

The District's extremely variable rainfall and high evaporation means that herbaceous plants have no distinct growing season. This leads Lange and Fatchen (1990) to state "*The emergence and growth of herbaceous plants is episodic and infrequent, depending on chance combinations of water availability and temperature*."

Meteorological Drought Years

The term drought refers to an acute water shortage. It implies that rainfall for a given period is less than a certain threshold. Gibbs and Maher (1967) showed that years with an annual total in the first decile range (i.e. the lowest 10% of falls on record), corresponded well with droughts recorded in other sources. Using this simple guide and rainfall records from twelve or so stations, the following years since 1900 were identified as those in which significant areas of the District were in drought: 1900, 1915, 1918, 1928, 1929, 1934, 1937, 1940, 1944, 1951, 1959, 1960, 1961 1965, 1967, 1970, 1972, 1990, 1991, 1994 and 1996.

More rigorous methods, such as those used in Drought Review – Australia (Bureau of Meteorology 1994), will identify slightly different drought periods, including those of shorter duration and those that have extended well beyond twelve months. Many droughts occur over only a small part of the District and are therefore not included in the above list of drought years.

Temperature and Humidity

In the hotter part of the year (late October to March), average daily maximum temperatures exceed 30°C and during January and February average about 36-38°C. From December to February temperatures exceed 35°C on average fifteen to twenty days per month and are over 40°C on five to ten days per month. Temperatures over 40°C have been recorded in each month between September and April. Average minimum temperatures for the period November to March are around 20°C.

For the cooler months (April to September), average maximum daily temperatures range from the high twenties down to the high teens in June and July. Maxima in excess of 30°C have occurred in all months at most locations across the District. Average minimum temperatures are less than 15°C and fall to around 5°C in July. Minimum temperatures below zero have been recorded in each month between May and September.

As a typical example of the range of temperatures experienced in the District, graphs of average and extreme monthly maximum and minimum temperatures for Oodnadatta are shown in Figure 4. Comprehensive tables of temperature data are presented in Appendix D.

Relative humidity depends on temperature and moisture present in the atmosphere. It will generally be higher during the cooler part of the day and lower than average on very hot days. In January, the variation is from an average of about 25% at 9am to less than 20% at 3pm. In July, averages range from 60% at 9am to 35% at 3pm.

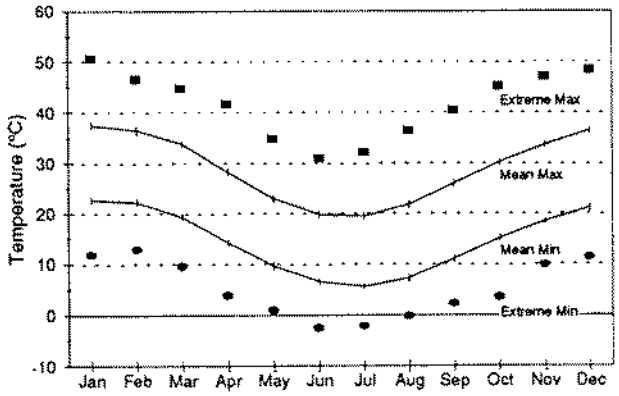


Figure 4 Mean and extreme monthly maximum and minimum temperatures for Oodnadatta. Average monthly maximum and minimum temperatures are shown as solid lines and extreme records are shown by symbols.

Frosts

Frosts occur in the cooler part of the year, when the nights are calm, the skies are clear and when there is little moisture in the air. The frequency of frost is dependent on local ground features including vegetation, soil moisture and topography. Some locations, such as hollows and depressions, are more prone to frost occurrence than others.

Frost is reported when ice deposits are observed, or when the ground surface (or terrestrial) temperature falls below -0.9^{0}C, whether or not a deposit of ice is observed. Frosts have been reported at Oodnadatta and Marla in all months from May to September but are most frequent from June to August (see Appendix D). In this three-month period, on average, eight frost-days occur at Oodnadatta and fourteen at Marla.

Thunderstorms

Thunderstorms can be expected at any time of the year, but are more frequent during the warmer months when storms can produce heavy rainfalls over short periods. Thunderstorms occur on an average of 10 days per year.

Dust storms

Dust storm data kept by the Bureau of Meteorology records only those events where the horizontal visibility is reduced to below 1,000 metres. Raised dust events of lesser severity are recorded as haze. Dust storm frequency is dependent on the state of the ground cover and will be greater during periods of drought. The annual average is five dust storms per year at Oodnadatta and, for the short record at Marla, four per year.

Sunshine Hours

Sunshine varies from an average of 10.5 hours a day in January to 8 hours a day in July. The annual average is 9.5 hours of sunshine per day.

Data Availability

Weather and climate observations are routinely recorded and archived from one location in the District, Marla, and from Coober Pedy, which lies just outside the District. Until 1985, synoptic observations were also undertaken at Oodnadatta. A volunteer network undertakes additional rainfall observations. Records are available from twenty-six locations in or adjacent to the District. All climate and rainfall observations are quality controlled and kept in the national climate database, to be made available to researchers and other interested users.

More information is available from the Bureau of Meteorology, 25 College Road, Kent Town, South Australia, 5071, E-mail climate.sa@bom.gov.au, telephone (08) 8366 2200, or from their web site at <http://www.bom.gov.au>.

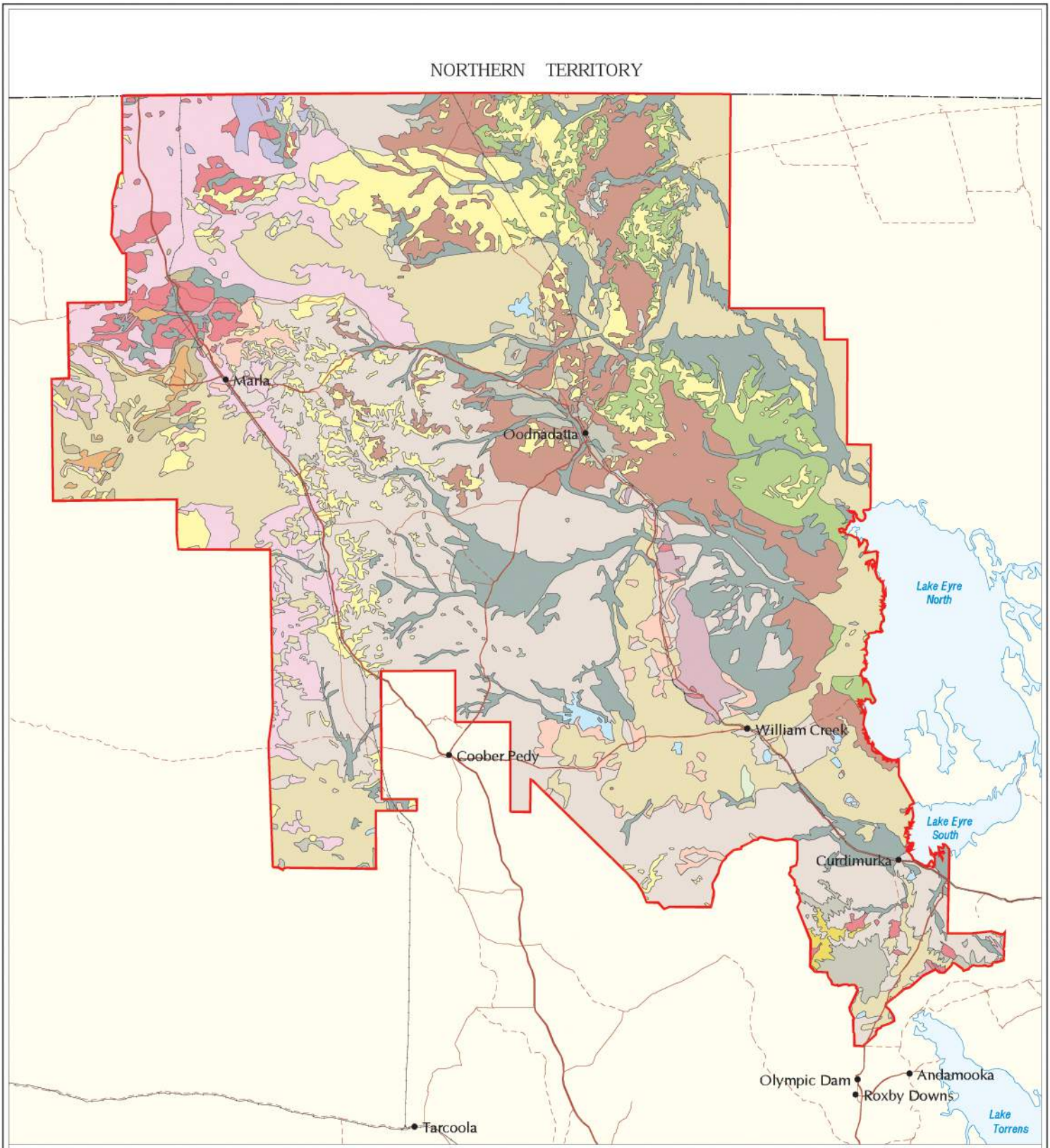
Geology

The Marla-Oodnadatta Soil Conservation District overlies sediments that are over 750 m thick and are over 500 million years old. Some of the deepest sediments are being explored for oil and gas in the Officer Basin; however of more immediate interest are the shallower and more widespread sediments of the Eromanga Basin, which form a very important artesian aquifer.

About 190 million years ago, extensive river systems deposited large thicknesses of sand up to 300 m thick in a huge subsiding basin. This sand unit is made up of the Algebuckinna Sandstone and the Cadna-Owie Formation and it contains impressions of fossil leaves and wood, which indicate a moist and temperate climate at the time of deposition. As the subsidence increased, the sea invaded the region from the north about 110 million years ago and deposited the dark grey and fine-grained Bulldog Shale and Oodnadatta Formation, which are up to 300 m thick. As the sea retreated 90 million years ago, marshes and shallow lakes were formed with extensive forests and ferns. Under these conditions, fine-grained lignitic sandstone and siltstone of the Winton Formation were deposited in great thicknesses (up to 400 m). The fine grained sediments of the Bulldog Shale, Oodnadatta Formation and Winton Formation were subject to erosion and weathering for many millions of years and where exposed today (Figure 5), have a hard silcrete capping on top of an intensely bleached weathered zone up to 25 m thick of white, yellow, pale grey or mauve clays.

In the eastern part of the Marla-Oodnadatta Soil Conservation District, the Eromanga Basin borders onto old basement rocks which are about 1,500 million years old and consist of granite and gneiss. Also on the western margin lie the sediments of the Officer Basin, which comprise sandstone, quartzite, siltstone and shale about 500 million years old. Crustal forces tilted these sediments, which now form prominent hills such as the Mount Johns Range near Marla. The opal deposits at Mintabie occur in a sandstone unit that was bleached and weathered by the same process that affected the Eromanga Basin sediments as described above.

Deposition began in the Lake Eyre Basin about 50 million years ago with extensive sand deposits of the Eyre Formation laid down by river systems in a warm and wet monsoonal climate. After another 25 million years, the climate became drier with the landscape dominated by extensive and shallow brackish lakes that led to the deposition of magnesium-rich limestone, dolomites and siltstone of the Etadunna Formation. These lakes dried up about 10 million years ago but evidence of ancient shorelines can still be seen in some areas.



MAP PRODUCTION: PIRSA Land Information,
Primary Industries and Resources, S.A.

Figure 5 Geology of the Marla - Oodnadatta Soil Conservation District

The geological events that shaped today's landscape occurred over the last million years when a drier climate led to the formation of the present day salt lakes and dune fields. At this time also, faulting along the western margin of the basin allowed the escape of artesian water from the deep aquifers to the surface, leading to the formation of the mound springs. Dry windy periods about 200,000 years ago formed the current dunefields. Between 25,000 and 40,000 years ago, much wetter periods filled the lakes beyond their present shorelines, leaving pebbly beach deposits around the lake margins which are well preserved, especially around the southern margin of Lake Eyre South.

In the eastern part of the Soil Conservation District, lie the Denison and Davenport Ranges, which are outliers of the same rocks that form the Flinders Ranges. They consist of much older sediments than those of the Eromanga and Lake Eyre Basins described above. They are about 1,000 million years old and are made up of shale, sandstones, limestone and glacial tillites.

Land Systems

Land systems are areas, or group of areas, throughout which there is a recurring pattern of geology, topography, soils and vegetation. Laut et al. (1977) described environmental associations for South Australia and NPWS (1983) described ecological associations for the Simpson Desert. The NPWS (1983) Wongkanguru ecological association is equivalent to the Simpson land system described below. McDonald (1992) was the first to describe land systems for the northern pastoral country of South Australia, although his work was in relation to land systems of the Kingoonya Soil Conservation District. Some of his descriptions also applied to the Marla-Oodnadatta Soil Conservation District. The Marla-Oodnadatta Soil Conservation Board then produced draft descriptions of the District's land systems (MOSCB 1993) and these were updated by Badman (1995a). Some changes were again made during the compilation of the first District Plan (MOSCB 1997). Badman (1999) expanded on some of these descriptions for land systems that occur in the Lake Eyre South drainage basin. A major revision of land systems in the Kingoonya Soil Conservation District, using computer classification of quantitative vegetation data (Badman 2002) gave improved descriptions of the vegetation within several of the land systems that occur mainly in the south of the District.

The texture, fertility and position in the landscape of soils determine which plants will occur and is related to the underlying geology. Soils in low-lying or run-on areas receive nutrients and eroded soil from run-off areas. These run-off areas become depleted of both topsoil and nutrients. The depth of available topsoil also influences which plants will grow there. Soils therefore provide a variety of habitats for plants and plants in turn reflect the texture, water holding characteristics and nutrient status of soils. The soils and the plant communities growing upon them create patterns in the landscape that are identified as a land system.

Figure 6 shows the distribution of the land systems of the Marla-Oodnadatta Soil Conservation District. This map and the accompanying land system descriptions, represent the state of current knowledge. Both the descriptions and the map will continue to be refined over time.

NORTHERN TERRITORY

AYERS RANGE SOUTH
CROWN POINT
TIEYON
DE ROSE HILL
HAMILTON
WITJIRA NATIONAL PARK
MOUNT SARAH
LAMBINA
GRANITE DOWNS
Marla
WELBOURN HILL
TODMORDEN
MACUMBA
Oodnadatta
ALLANDALE
WINTINNA
ARCKARINGA
EVELYN DOWNS
PEAKE
Lake Eyre North
MOUNT BARRY
NILPINNA
MOUNT WILLOUGHBY
William Creek
Coober Pedy
MOUNT CLARENCE
ANNA CREEK
MABEL CREEK
Lake Eyre South
Curdimurka
STUART CREEK
Marree
Olympic Dam
Andamooka
Roxby Downs

LAND SYSTEM LEGEND

HILLS AND UPLANDS
- Br Breakaway
- Ch Chandler
- Cg Coongra
- Cr Crispe
- Mm Mt. Margaret
- Oo Oodnadatta
- Py Paisley
- Wa Wantapilla
- Wi Wilyunpa

PLAINS
- Ba Baltana
- Mp Moon Plain
- Wo Wooldridge
- Mw Mt. Willoughby

SAND PLAINS
- Al Alberga
- Mo Moorilyanna
- Pi Piarooka
- Ti Tieyon

SAND DUNES
- Am Ammaroodinna
- Co Commonwealth
- Pe Pedirka
- Si Simpson
- Ww Wattiwarriganna

FLOODOUT AND LAKES
- Da Dalhousie
- Fe Federal
- Fi Finke
- Mc Macumba

0 100km

MAP PRODUCTION: PIRSA Land Information, Primary Industries and Resources, S.A.

Figure 6 Land Systems of the Marla - Oodnadatta Soil Conservation District

The following brief descriptions give a broad account of the land systems. A considerable amount of work is still required in order to produce detailed descriptions for some of the poorly known land systems (e.g. Alberga, Ammaroodinna, Chandler, Crispe, Mount Willoughby, Tieyon, Wilyunpa) that will bring them into line with other better known land systems. The majority of land system descriptions are based on subjective analysis of landform and qualitative vegetation data. Some are based on landform and multivariate analysis (classification) of quantitative vegetation data. Ideally, land system descriptions would be based on analysis of quantitative data from a large number of sites, as was done for the Kingoonya district (Badman 2002). The method used to obtain the description is explained for each land system.

In the interests of conformity, the common names used in these descriptions are generally those now commonly used by the Biological Survey and Monitoring branch of the Department for Environment and Heritage. Where these differ significantly from names used in the previous District Plan, the local name is given in brackets. Scientific names of all plants mentioned in this section are given in Appendix E.

The area covered by each land system within the District is shown, together with the percentage of the area of the District. References are given to previous publications that discuss each land system and thus track the history of its description. Descriptions of land systems remain largely unchanged from those in the previous Marla-Oodnadatta District Plan except those discussed by Badman (1999, 2002). The Mudla land system (McDonald 1992, KSCB 1996, MOSCB 1997) has been included in the Oodnadatta land system (Badman 2002) and the Stuart Creek land system has been included in the Wattiwarriganna land system (Badman 2002).

Alberga

Area 3,100 km^2 - 2.3% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This system includes the Alberga Creek and associated depositional flats and plains. The wide sandy drainage lines support river red gum, coolibah, ironwood and elegant wattle (prickly wattle), with the eucalypts being the main character species that distinguish this land system from the mulga-covered sandplains of the adjacent Pedirka land system which abuts it to the north. The larger creek channels separate it from the Wooldridge land system which abuts it to the south-east.

The vegetation of the alluvial plains and sand plains is dominated by mulga, with senna, umbrella bush (marpoo) and hairy-fruit emubush (Gile's emubush) and ground cover of woollybutt, spider grass (finger panic grass), bandicoot grass and woollybutt wanderrie. Sandhill cane-grass is common on the sandplains and in some sandy watercourses. The alluvial plains, adjacent to the drainage lines, also support mulga over a predominantly annual ground cover. The annual grasses are dominated by curly wire-grass (mulga grass), but common bottle-washers and leafy bottle-washers (woolly oatgrass) also occur. Ephemeral herbs include spear-fruit bindyi (spear-fruit copperburr), grey bindyi (grey copperburr), round-leaf parakeelya and blue heron's-bill (blue stork's-bill).

The small floodout flats with ironwood, elegant wattle (prickly wattle) and colony wattle (silver wattle) are a minor unit of this land system. Grasses include native millet, umbrella grass, kangaroo grass and bandicoot grass.

The small spur of this land system that separates areas of Pedirka and Wooldridge land systems on the eastern side is retained here in part because it has the same underlying geology as the Alberga land system. Further work is required to determine whether the overlying vegetation is compatible with that of the Alberga land system, or whether it should be placed in either Pedirka or Wooldridge.

Ammaroodinna

Area 7,410 km^2 - 5.6% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system describes a pattern of sand dunes and interdune areas in the region near Marla.

Ammaroodinna Land System

The dunes are formed from coarse red sand and loamy sand tapering into interdune swales. Some interdune corridors have more clay in the soil and open out to form small claypans, which usually support vegetation only at their margins.

Vegetation of dunes includes horse mulga, colony wattle, desert lantern bush (desert Chinese lantern), woollybutt wanderrie and tall kerosene grass.

Vegetation of the interdune areas is dominated by mulga with witchetty bush, umbrella bush (marpoo), flat-stalk senna (Y-cassia) and desert poplar as well as some dead finish. Understorey species include Johnson's bindyi (Johnson's copperburr), bandicoot grass, mulga grass and woollybutt.

Baltana

Area 6,270 km^2 - 4.7% of District. References: McDonald (1992), MOSCB (1993), Badman (1995a), KSCB (1996), MOSCB (1997), Badman (1999, 2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002). It still requires checking against data from the District.

The Baltana land system has formed where erosion of the silcrete capping has exposed the softer underlying Bulldog Shale. This has mixed with alluvium from the Stuart Range and has resulted in the formation of extensive undulating plains with numerous gilgais and some areas of sandsheet. It has distinct similarities with the nearby Oodnadatta Land System. Soils, which include silts, sands and grey clays, are covered with a lag of silcrete and quartzite gibbers. The soils comprise brown saline clay, which separates it from the softer grey clays of the Moon Plain land system.

No perennial species truly dominate the vegetation on plains and there are often large bare areas, which support ephemeral species following rain, between patches of perennial vegetation. Barley Mitchell grass, glassworts (*Sclerostegia* sp(p).) and tangled bindyi (poverty bush) are the most common species on the plains. Other species that may be common or even dominate over small areas include bladder saltbush, Oodnadatta saltbush, ball bindyi (cannonball), bristly lovegrass (neverfail), woolly bluebush, thyme sea-heath, black-seeded samphire and twiggy sida. Cotton-bush, two-horn saltbush (twin-horned copperburr) and bush minuria are widespread but not particularly common.

Baltana Land System

Vegetation associated with broad watercourses commonly has an overstorey of elegant wattle (prickly wattle), while river cooba is common in some places. Bladder saltbush is dominant in the understorey and cotton-bush, low bluebush, cane-grass (swamp cane-grass) and bristly love-grass (neverfail) are all common. Grey bindyi (grey copperburr), salt bindyi, tangled bindyi, mulga grass and common bottle-washers are also common in the understorey.

Soils of eroding watercourses contain large amounts of shales and gypsum and support very little vegetation. Any vegetation that does grow there usually consists of mainly ephemeral species. Tall scurf-pea (verbine) and Cooper clover are common here in good seasons.

Sandsheets have formed in some areas from residual yellow sands deposited on the underlying gibber plain. These areas support low open shrublands with Sturt's pigface prominent in the vegetation. Elegant wattle (prickly wattle) and bladder saltbush also occur here.

Breakaway

Area 9,340 km^2 - 7.1% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997), Badman (1999, 2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002). It still requires checking against data from the District.

This land system has formed from an eroding basement of Bulldog Shale, with a capping of residual silcrete. Eroding shales and silcretes have resulted in mixtures of silcrete gibber, grey shales and other variously coloured hard and soft shales. The various colours result from the amount of leaching of iron from the shales, with red coloured shales containing more iron and paler ones containing less.

Sparse low woodlands or tall shrublands of beaked red mallee, bastard mulga, mulga, northern myall and emubushes occur on the hills. Three-wing bluebush occurs in the understorey, with black bluebush, silver mulla mulla (silver tails) and sennas also present. The soils in this unit may be too shallow to allow more than sparse establishment of low bluebush. The understorey here commonly includes silver mulla mulla, ruby saltbush, grey bindyi (grey copperburr) and mulga grass.

Breakaway Land System

Little or no vegetation grows on the eroding shales of the slopes and footslopes or in shallow skeletal soils of hilltops. Vegetation becomes denser and sometimes includes areas of woodland where sediments have been deposited in pockets at the base of the hills and where sediments and nutrients have collected along watercourses.

Bladder saltbush is the dominant species on the outwash plains of this land system, with black-seeded samphire and spiny saltbush common. Native apricot, dead finish and umbrella bush (marpoo) are widely distributed across the outwash plains, usually as isolated plants or in small groves and often associated with drainage lines. Kidney-fruit saltbush, cotton-bush, inland shrubby groundsel and mulga grass are all widely distributed in the understorey but are not common overall.

Larger watercourses have mulga or coolibah woodland, with umbrella bush (marpoo) and bullock bush also present.

Chandler

Area 1,695 km^2 - 1.3% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Chandler land system consists of sandstone ridges, rocky rises and flat top hills. There are minor areas of gibber slopes and minor sand plains with low dunes.

The rocky sandstone rises and gibber slopes have similar vegetation, including mulga and emubush. The gibber slopes have in addition dead finish and crimson emubush. There are scattered perennial grasses on the rises including mountain wanderrie, woollybutt and mulga grass.

The ridge tops have isolated clumps of white cypress pine (northern cypress pine) with crimson emubush, senna and scattered mulga. Vegetation of the ranges includes occasional large scattered hills bloodwood, with striated mintbush (jockey's cap) and opposite-leaved emubush (twin-leaved emubush) also present. On the lower slopes, spinifex, scattered rock emubush, senna, silver mulla mulla (silver tails), round-leaf parakeelya and some heron's-bill (stork's-bill) occur.

The sandplains extend out from the gibber slopes, with mulga, some senna, round-leaf parakeelya and perennial grasses. The major grass is woollybutt with some bandicoot and spider grass (finger panic grass). The scattered dunes have similar vegetation to the dunes in the Ammaroodinna land system.

Commonwealth

Area 2,495 km^2 - 1.9% of District. References: McDonald (1992), MOSCB (1993), Badman (1995a), KSCB (1996), MOSCB (1997), Badman (2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002).

Commonwealth Land System

The Commonwealth land system is based on an extensive sand plain that is quite young in geological terms (Quaternary sands). It occurs in the south-western part of the district, between the Great Victoria Desert in the west and the Stuart Range in the east. Some low sandy rises have formed from the same sediments, but there are no dunes. Well-defined watercourses are largely restricted to the eastern margins. Numerous claypans catch any run-off, although most rainfall quickly infiltrates the sandy soils. Soils are mostly light and often shallow siliceous sands, earthy sand or sandy red earths, with calcrete or bedrock often close to the surface.

Vegetation of the sand plain is dominated by low open mulga woodland. Flat-stalk senna (Y-senna) is common in the shrub layer, which also includes dead finish, Australian boxthorn, crimson emubush and tar bush. The latter species are widespread and may be locally common, but they are not common over the whole land system. Satiny bluebush, pearl bluebush, rosy bluebush, silver mulla mulla (silver tails), ruby saltbush and spiny saltbush also occur here. Woollybutt is common in the understorey, but other perennial grasses, including bandicoot grass, cotton panic-grass and window mulga-grass, also occur. Mulga grass and bottle-washers are common in good seasons.

On clay and silty soils at the margins of claypans, where salinity is higher, mulga woodlands are replaced by chenopod shrublands dominated by bladder saltbush, with black bluebush, samphires and cotton-bush also common. Emubushes, sennas and mulla mullas are also present, together with many of the other understorey species found in nearby areas. Mulga still occurs here, but as scattered trees rather than as open woodland.

Coongra

Area 5,160 km^2 - 3.9% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system consists of vast sandstone and shale covered slopes, plateaus and plains dominated by bladder saltbush. Undulating stony tablelands with gilgais are dissected by an extensive drainage system although much of the initial drainage is into gilgais. Stones are rounded or angular and range in size from three to thirty centimetres in diameter. These form an erosion resistant layer unless they are disturbed.

The slopes are treeless but with occasional rock emubush tall shrubs. Sparsely distributed mulga occurs along shallow creek lines, with this species accompanied or replaced by gidgee on the eastern side of the land system. Coolibahs occur with river red gums along the larger watercourses, often with an understorey of Australian cupgrass.

On the tablelands bladder saltbush grows in association with perennial grasses such as the Mitchell grasses, native millet, ray grass (katoora), thyme sea-heath (bristly sea-heath) and occasional rock everlastings. Understorey plants include mulga grass, bottle-washers and hairy burr-daisy (Bogan flea). The majority of perennial plants growing here are the same as those growing on the Oodnadatta land system, with the major difference being that Oodnadatta saltbush is uncommon in the Coongra land system but is a dominant plant in the Oodnadatta land system.

After rain, the Coongra land system is very productive for the pastoral industry, growing a wide variety of annual, ephemeral and short-lived perennials. This productivity is mainly due to the perennial plant component.

Crispe

Area 4010 km^2 - 3.0% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Crispe land system comprises a large area of undulating gibber-covered tableland, which supports a variety of shrubs and grasses. The major shrubs on the plain are bladder saltbush, emubushes and sennas. Gilgais support grasses such as the Mitchell grasses, bristly love-grass (neverfail) and mulga grass. The tableland slopes support bladder saltbush on the heavier clay soils with areas of emubush and senna. Small creek lines with sandy soils support patches of mulga and mulga grass, while bladder saltbush, old-man saltbush, Queensland bluebush (golden goosefoot) and swamp wanderrie occur in watercourses with heavier soils.

Crispe Land System

Dalhousie

Area 610 km^2 - 0.5% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system is centred on the mound spring complex at Dalhousie, an internationally significant example of artesian springs. About sixty springs with permanent wetlands support a variety of wildlife, including three endemic species of fish and several endemic molluscs and crustaceans.

Tall stands of common reed and narrow-leaf bulrush (narrow-leaf cumbungi), fringed by inland paper-bark (white tea-tree) woodland with a few willow wattles (Broughton willow) and native myrtles, dominate the vegetation of the spring wetlands. The early settlers introduced date palms to the area and these are now naturalised and spreading

at the springs. These springs support several species of plants, some of them rare, which are not found at other habitats or land systems in this District.

A patchy low shrubland of nitre-bush, chenopods and samphires occurs on the white, crusty saline flats surrounding the springs. Some ephemerals also grow here after rain.

The Witjira National Park was dedicated to protect these springs and they remain the major attraction for park visitors. Some of the springs have extensive calcareous deposits that form mounds around the water source.

Dalhousie Land System

Federal

Area 440 km^2 - 0.3% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This relatively minor land system is located in the Witjira National Park and is dominated by a series of jumbled low pale-coloured dunes. Despite the fact that this land system lies entirely within a national park and is not grazed by domestic stock, rabbit numbers have often been high and it is probably the most degraded land system within the District.

The deep sands of the dunes support mulga, umbrella bush (marpoo) and the occasional silver needlewood (needlebush), while the shrub layer consists of senna, sticky hopbush, emubush and chenopods. Woollybutt and tall kerosene grass are also present on the dunes, but the dune understorey is generally sparse and much degraded because of grazing by rabbits. The prostrate species, native camomile is very common in the understorey of this land system.

Sandy floodouts, swamps and the relatively minor drainage lines support coolibah and umbrella bush. The understorey along drainage lines includes verbine, with cotton-bush present in sandy floodouts. Verbine, Mitchell grasses, neverfail (bristly love-grass), silky bluegrass (Queensland bluegrass), native millet and occasional Queensland bluebush (golden goosefoot) occur in swamps with heavy brown clays

and higher moisture retention. Some areas of shallow saline sands over clay support samphires.

Federal Land System

Finke

Area 525 km^2 - 0.4% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Finke land system also lies entirely within the Witjira National Park. It is closely allied to the course of the Finke River in the north-eastern sector of the Soil Board District and the National Park. The Finke River system is an ancient geological feature that now terminates in the dune fields of the Simpson Desert but once flowed on to Lake Eyre. Soils of the riverbed and floodplain are grey clays, with the floodplain often overlain by the red sands of the Simpson Desert.

Finke Land System

This ephemeral river system is subject to infrequent flood events and the broad flood plain land unit supports open woodland of coolibah, whitewood, willow wattle (Broughton willow) and elegant wattle (prickly wattle). Elegant wattle dominated this land system for many years following the major flood of 1974, but has now thinned out through natural attrition to again form a minor element, as it was prior to 1974. The shrubland understorey is variously dominated by lignum and old-man saltbush, but the two plants are seldom both common in the same area. Other chenopods, especially buckbush, cane-grass, sandhill cane-grass, tangled leschenaultia, neverfail (bristly love-grass), swamp wanderrie and verbine are also common in the understorey.

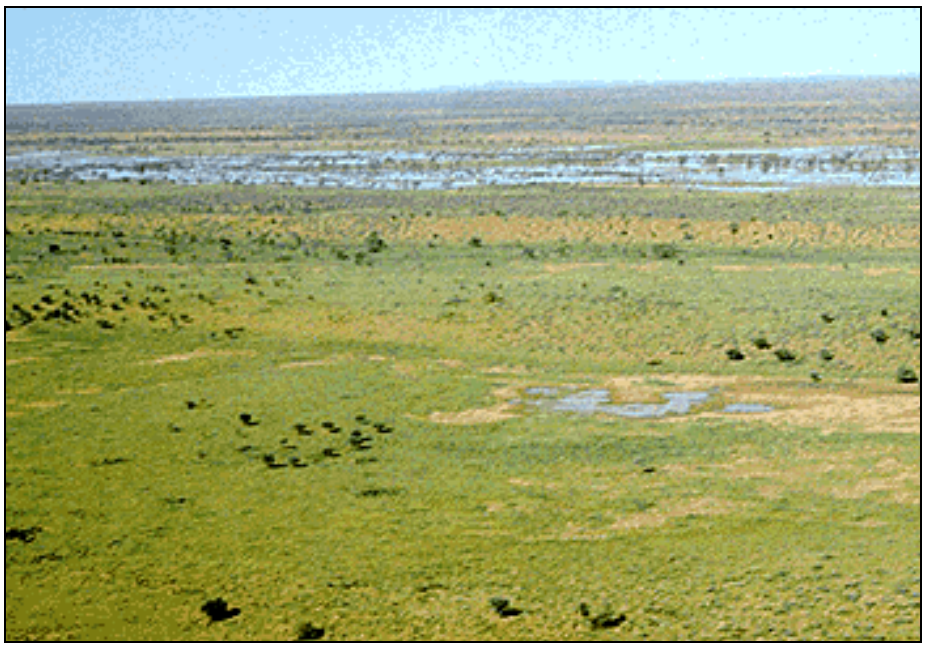
The narrower channel land unit features dense woodland of coolibah and whitewood, with many young trees resulting from exceptional rainfall and a series of flood events during the 1970s and 80s. Whilst the alluvial clays and silts offer enhanced water retention, it is not known if the current density of vegetation will persist.

Macumba

Area 3,160 km^2 - 2.4% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Macumba land system forms the southern and south-western boundaries of the Simpson Desert and consists of wide braided watercourses with grey clay soils, floodout plains with sandy-clay soils, and fresh-water swamps. This land system is bordered to the east by the red sand dunes of the Simpson Desert and to the north and west by the gibber plains of the Oodnadatta land system.

Coolibah is the dominant species of both channels and floodplains, with scattered occurrence of gidgee. Old-man saltbush, dead finish, cotton-bush, swamp wanderrie, silky browntop and neverfail (bristly love-grass) are common in both floodouts and watercourses. Bottle-washers, mulga grass and several species of bindyi occur on the floodplains. Flinder's grass, verbine and heron's-bills (stork's-bills) are all common along the creeks and floodplains following flooding or very heavy rainfall.



Macumba Land System

Stevenson Creek is a wide sandy creek with several channels lined with river red gum, coolibah and patches of red mulga (mineritchie). Soft sandy floodout plains with some sandhills occur to the west of the creek. Umbrella bush (marpoo) tall shrubland is common on small jumbled dunes, with emubushes and sennas also present. Mulga grass, woollybutt and chenopods are often included in the understorey. Bladder saltbush and Mitchell grasses are common on small areas of gibber plain, which occur as a minor unit of this land system.

Moon Plain

Area 1,930 km^2 - 1.5% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

Moon Plain Land System

This land system occurs north-east of Coober Pedy. Its dominant feature is an undulating plain with soft grey cracking gypseous clay soils that generally lack any cover of gibber or other stones. This soil type separates it from the heavier brown clays of the Baltana land system, which it abuts to the west, south and east. The Moon Plain has little drainage and becomes very boggy after rain. However, two major drainage lines cross the Plain and provide drainage following very heavy rain. They also provide a habitat for the majority of perennial shrubs found in this land system.

The Moon Plain has very little plant cover in most years, with only a small number of perennial species and individuals present. Mitchell grasses and neverfail are two of the few perennial grasses found on the Plain, together with annual saltbushes, including pop saltbushes, and mulka (mulka grass), pale bindyi (pale poverty-bush), tangled bindyi (poverty-bush), Black's bindyi (Black's copperburr) and buckbush.

Several species of samphire are common in the drainage lines, along with elegant wattle (prickly wattle), old-man saltbush, lignum, cane-grass (swamp cane-grass) and a few stunted coolibahs. Annual saltbushes, pop saltbush, leafy bottle-washers (limestone bottle-washers), orange swainson-pea (orange Darling pea), mulka (mulka

grass), buckbush and various bindyis (copperburrs) also occur. Numerous ephemerals, including Cooper clover, flourish after good soaking rains of more than 50mm.

Moorilyanna

Area 3,880 km^2 - 2.9% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

Moorilyanna Land System

The Moorilyanna land system is characterised by extensive sandplains, low rounded outcrops and associated stony slopes and plains. Minor units include small blocky ridge outcrops and smaller sandy drainage lines.

Sandplains form the major unit of the Moorilyanna land system. These areas have calcareous coarse red sands that support scattered mulga with flat-stalked senna (Y-cassia) over a mix of annual and perennial grasses. The dominant annual grass is mulga grass, while the perennial grasses are woollybutt, bandicoot grass and finger panic grass. Other species occurring in low but regular numbers in this land unit include satiny bluebush and bitter saltbush.

Sandplain units occurring adjacent to the minor drainage lines support open mixed woodland of long-leaf corkwood, dead finish, witchetty bush, colony wattle (sandplain wattle) and mulga. The ground layer consists of annual grasses including bottle-washers, five-minute grass, hairy burr-daisy (Bogan flea) and other forbs.

The undulating plains unit, which includes some stony patches, occurs between the sandplain and stony slopes. These areas have a chenopod shrubland of low bluebush, with bladder saltbush and various other shrubs such as satiny bluebush, bell-fruit bluebush (woody bluebush), silky bluebush and emubushes such as crimson emubush and turpentine bush. The understorey in these areas is characterised by chenopod forbs such as grey bindyi and woolly-fruit bluebush, with bottle-washers and umbrella grass.

The stony slopes and rises have red duplex soils with fine sandy loam surface textures and fine sandy clay loam at depth. They support a low open shrubland of rock emubush with grey senna (variable cassia), witchetty bush and dead finish over a mix of chenopods including satiny bluebush, bladder saltbush, bitter saltbush and three-wing bluebush. These occur with chenopod forbs such as western bindyi (western copperburr) and woolly-fruit bluebush (woolly-fruit copperburr). Annual grasses include mulga grass, five-minute grass and bottle-washers.

Granite outcrops form low rounded hills that support a variety of open woodland or tall shrubland vegetation. The larger hills with significant run-off may support a dense thicket of trees and shrubs at their base including coolibah, mulga and other acacias. Smaller outcrops have low densities of mulga, with dead finish, witchetty bush, rock emubush and green emubush. Satiny bluebush and needle-leaf three-awn also occur at these sites.

The blocky ridge outcrops occurring in the north-west of Granite Downs Station support native apricot, rock emubush, green emubush and annual grasses. The small sandy drainage lines, like the larger drainage line of the Alberga land system, are lined by river red gum and elegant wattle (prickly wattle).

Mount Margaret

Area 360 km^2 - 0.3% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997), Badman (1999). This description is derived from subjective analysis of qualitative data.

This is a small land system located about 70km west of Lake Eyre North and formed mainly from residual late Proterozoic dolomites, quartzites and slates, but also including areas of Mesozoic sandstones and conglomerates. It consists of rugged ranges with deep gorges and a deeply dissected plateau on top of the range. The slopes of the range are rough and rocky. These ranges were once beneath the sea and tidal ripple marks can be seen on rocks at the top of the range. The stripping process of the ancient soils is far more advanced here than in the Breakaway Land System, although residual formations of up to 50 m or more above the level of the surrounding Oodnadatta Land System are present. Soils may be up to several metres in depth.

Mount Margaret Land System

The upper parts of the creeks that flow from the ranges support the northern form of the river red gum, but this is replaced by the coolibah where the creeks leave the ranges and become wider with sandier soils. The creeks also support mulga, dead finish, chenopod shrubs and perennial grasses, including lemon grass (lemon-scented grass), cotton panic grass and swamp wanderrie, often on skeletal rocky soils. The steep rocky gorges at the head of many of the creeks support mountain wanderrie and spinifex on shallower soils.

An undulating gibber tableland occurs on top of the range, with a silcrete cap over underlying clay soils and numerous deep drainage lines. This tableland is covered with bladder saltbush, short-wing bindyi (copperburr), salt bindyi and Mitchell grasses. It is similar to the Oodnadatta land system, but lacks the Oodnadatta saltbush.

Steep rocky hill slopes support a tall open shrubland of bastard mulga, mulga, emubushes and sennas, with a sparse understorey of bladder saltbush, woolly bluebush, bindyis, mulla mullas (silver tails), shrub everlasting (perennial sunray), pale plover daisy, paper daisies, barley Mitchell grass, five-minute grass and common bottle-washers.

The lower undulating footslopes surrounding the ranges contain well-developed gilgais, which are much more pronounced than on the nearby Oodnadatta Land System. Almost all vegetation on the footslopes is confined to the gibber-free areas, which support numerous chenopods, mulga grass, Mitchell grasses and other vegetation similar to the Oodnadatta land system, although Oodnadatta saltbush never dominates here.

The vegetation of watercourses is similar to that of the footslopes, but greater availability of water and nutrients has resulted in greater cover and density of plants. Oodnadatta saltbush is often far more common here than on the footslopes and is often one of the dominant species in the vegetation.

The footslopes of this land system can be separated from the adjoining Oodnadatta land system by the domination of Oodnadatta saltbush in the Oodnadatta land system and the presence of ferruginous rather than quartzite gibbers in the Mount Margaret land system (Badman 1999).

Mount Willoughby

Area 5,640 km^2 - 4.3% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system is characterised by red pebbly clay plains with occasional low irregular sand dunes.

The hard flats support sparse to open mulga, with rock emubush also common. The sparser areas support the occasional emubush. These flats contain numerous small swamps or depressions that support dense mulga woodland, with emubushes, sennas and chenopod shrubs and sub-shrubs. Perennial grasses such as needle-leaved three-awn, cotton panic grass and bristly love-grass (neverfail), and annual grasses such as mulga grass and spear-grass are common. After rains, the harder flats grow an abundance of mulga grass and annuals such as round-leaf parakeelya and everlastings.

Mulga woodland occurs on both the dunes and interdune flats. Bristly love-grass (neverfail) and mulga grass dominate the understorey of the interdune areas, while

woollybutt, woollybutt wanderrie and tall kerosene grass are the main ground covers on dunes.

Several drainage systems feed into larger swamps, such as Wintinna Swamp. Mulga usually borders these creek lines, but they also support cotton-bush, neverfail (bristly love-grass) and cane-grass.

Oodnadatta

Area 40,310 km^2 - 30.5% of District. References: McDonald (1992), MOSCB (1993), Badman (1995a), MOSCB (1997), Badman (1999, 2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002). It still requires checking against data from the District.

The Oodnadatta land system is the largest and most extensive land system found in the Marla-Oodnadatta Soil Conservation District. It also includes a small area that was previously (MOSCB 1997) described as the Mudla land system. Badman (2002) has shown that Mudla is too similar to the Oodnadatta land system to be separated from it.

This land system is made up of extensive undulating plains with a lag of silcrete and quartzite gibbers and with numerous well-developed gilgais and occasional plateaus. It has an extensive drainage system with large braided watercourses such as the Neales River and Arckaringa Creek.

Oodnadatta Land System

Soils are saline and dispersive, being either deep red clays or clay loams. Gilgais vary in size from only a few metres to approximately 10 metres in diameter. The densest vegetation occurs in gilgais or along watercourses. The stony shelves between the gilgais are often bare or covered only with a few bindyis or sparsely distributed samphire. Gidgee is common along creek lines in northern parts of the land system and mulga grows along creek lines throughout the land system. Coolibah grows along the larger watercourses, often in association with gidgee and sometimes in association with river red gums.

Trees and tall shrubs are usually absent from the gibber tableland because of limited water storage, underlying salinity and excessive gypsum that is not leached out because of poor water penetration into the underlying soil. In contrast, gilgais are the most productive component of this land system. They are able to trap water run-off from the impervious stony flats that surround them. This water is then retained for extended periods by the clayey soil.

The main land unit is dominated by low shrublands of Oodnadatta saltbush, with bladder saltbush, grey samphire, ball bindyi (cannonball), short-wing bindyi (short-wing copperburr), tangled bindyi (pale bindyi) and barley Mitchell grass also common. Slender glasswort, salt bindyi, bottletree spurge, bush minuria, pale plover-daisy, cotton-bush, woolly bluebush, neverfail (bristly love-grass) and spreading scurf-pea are also widespread but are not common overall. Most species are more abundant and attain their largest size in gilgais where they receive water subsidies from the surrounding plain. After rain, the gilgais also grow a high proportion of annual and ephemeral grasses and herbs. The most common annual grasses are umbrella grasses, Australian cupgrass, Flinders grasses and bottle-washers.

Areas where Oodnadatta saltbush is not present or occurs only infrequently are dominated by bladder saltbush, with low bluebush, satiny bluebush and black bluebush also being common. Barley Mitchell grass, bush minuria, short-wing bindyi (short-wing copperburr), salt bindyi (salt copperburr), ray grass (katoora) and common bottle-washers are common in the understorey. Pin sida, jointed bottle-washers, bristly love-grass (neverfail), spiny saltbush, mulga grass and tangled bindyi are widespread in the understorey but are not common overall.

Coolibah woodlands with river red gum, gidgee and river cooba dominate large watercourses, with old-man saltbush dominant on the floodplains. Red mulga (mineritchie) occurs in the north of the District. Queensland bluebush (golden goosefoot), lignum, spotted emubush, cotton-bush and cane-grass (swamp cane-grass) are common. Splendid flat-sedge, silky brown-top and perennial cupgrass are common along creek banks. The floodplain understorey commonly includes tall scurf-pea (verbine), ruby saltbush, thyme sea-heath (bristly sea-heath), goathead bindyi, barley Mitchell grass, bristly love-grass, swamp wanderrie and common nardoo. Although river red gums are present in the upper reaches of some creeks and can be locally common in such places, they do not occur in lower parts of the creeks where soil salinity is higher. Claypans with heavy brown clays are generally bare other than at their margins.

Numerous mound springs occur in this land system. Springs vary from active with visible flows to extinct and include the whole range between the two extremes. Mound springs often support dense grasslands of common reed when they are not subject to persistent grazing. Prolonged grazing removes the common reed and the more resilient but much smaller bore-drain sedge replaces it. Badman (1999) gives a more detailed description of the spring vegetation.

Paisley

Area 3,380 km^2 - 2.6% of District. References: McDonald (1992), MOSCB (1993), Badman (1995a), MOSCB (1997), Badman (2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002). It still requires checking against data from the District.

The Paisley land system describes the Stuart Range, which extends north-west from Coober Pedy. Bulldog Shale commonly underlies the heavy clay soils, with infrequent silcrete outcrops. Silicified bands in the Bulldog Shale are the source of opals in the Coober Pedy area. Soils include texture contrast soils and brown clays, alluvial sands and loams. Chenopod low shrubland dominates on all units except watercourses.

Paisley Land System

Vegetation on silcrete rises is characterised by a low shrubland of bladder saltbush, low bluebush, three-wing bluebush, silky bindyi (silky copperburr) and round-leaf emubush on stony sandy-loam soils. Bladder saltbush, low bluebush, barley Mitchell grass, neverfail (bristly love-grass), long-spine bindyi (long-spine poverty-bush), silky bindyi (silky copperburr) and native apricot are found on stony red duplex and brown clay soils of low hills and rises and on the heavier soils of gilgais.

Outwash slopes, with stony red duplex soils, are characterised by bladder saltbush, low bluebush, round-leaf emubush, three-wing bluebush, limestone senna (limestone cassia) and pale poverty-bush. Mulga scrub occurs on alluvial sands and skeletal loams of watercourses, with dead finish, bladder saltbush, black bluebush, cotton-bush, Sturt's pigface and spiny saltbush all being common here.

On Mabel Creek Station, a specific unit exists which includes the floodout areas from Mabel and Woorong Creeks, with the floodout flats having silty clay soils and being overlain in places by longitudinal dunes which run parallel to the direction of water flows, creating flood channels between the dunes. A few fresh waterholes occur in the main channels of the creek.

Vegetation is dominated by coolibah, with weeping emubush and an extensive understorey of neverfail, umbrella grass, native millet and nardoos, with ephemeral herbs and grasses present following flooding. There are many claypans around which grow tea-tree, lignum and, occasionally, nitre goosefoot.

Pedirka

Area 3,770 km^2 - 2.8% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system consists of a series of parallel dunes running north-east to south-west, with interdune areas up to one kilometre wide. Dunes are formed from deep red sands whilst the soils of the interdune areas are uniform deep red loamy sands.

Pedirka Land System

Vegetation of this land system is dominated by dense mulga woodland over a variety of perennial shrubs and grasses. Annual and ephemeral plants grow after rain, but never form a very dense cover. The vegetation community varies in composition depending on the season, with more grasses growing after summer rain and more forbs growing after winter rain.

This land system is bounded to the north by Hamilton Creek, a wide sandy creek lined with river red gum, coolibah, mulga, dead finish and elegant wattle (prickly wattle). Grasses include silky brown top and native millet. Species such as verbine grow thickly after flooding.

A dense shrubland with a grassy understorey occurs in the interdune areas. The shrubs include satiny bluebush, Giles' emubush, weeping emubush and spiny saltbush. Woollybutt, three-awn wanderrie (broad-leaf wanderrie), mulga grass and bandicoot grass are the most common grasses with annuals like mulga grass growing after rains. The dunes support open mulga woodland, with an understorey including tall kerosene grass and woollybutt.

Piarooka

Area 1,500 km^2 - 1.1% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

Piarooka is a small land system occurring mainly between two branches of the Neales River just west of Lake Eyre. It consists of an undulating plain with red clay-loam soil, overlain in places by a few parallel dunes of saline yellow sands. A few pebbly rises or low hills are also present, with gypseous saline brown clay soils. The saline channels of the Neales, with several salt waterholes, form all of the northern and much of the southern boundaries of the land system.

Pebbly flats, rises and low hills support a low shrubland of glassworts, dead finish and cotton-bush with an understorey dominated by mulga grass and baldoo (flat-top saltbush). Softer flats with no stone support sparse tall shrubland or dense grassland vegetation. Shrubs include dead finish, elegant wattle (prickly wattle), Sturt's pigface and old-man saltbush, while grasslands are dominated by mulga grass.

Vegetation of the dunes is dominated by hummock grassland of sandhill cane-grass, with tall kerosene grass, loose-flowered rattlepod (loose-flowered bluebush pea) and grey bindyi (grey copperburr) common in the understorey. Sturt's pigface is present on some dunes.

Watercourse vegetation is dominated by coolibah in the north and by samphires in the south. Willow wattle (Broughton willow), nitre-bush and samphires are also common in the northern channel, with native millet common in the understorey. Lignum occurs as scattered plants or in small colonies. Nitre-bush and willow wattle also occur in the southern channel.

Simpson

Area 4,250 km^2 - 3.2% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Simpson land system is an extensive area of active longitudinal dunes running generally in a south-north direction, down wind from sand sources derived from the Macumba River. Disorganised short longitudinal dunes are associated with the active flood plains of the Finke and lower Macumba Rivers. This land system occurs in the eastern section of the District.

The deep sands of the dunes support hummock grasslands of sandhill cane-grass with patchy distributions of mulga, horse mulga, colony wattle, umbrella bush (marpoo), silver needlewood (needlebush), narrow-leaf hopbush and sennas. Loose-flowered rattlepod (loose-flowered bluebush pea) and birdflower rattlepod are also common on dunes. The understorey contains tall kerosene grass and mulga grass, while poached-egg daisies, fleshy groundsel and everlastings are abundant in good seasons.

The interdune swales have more clayey soils and support spinifex hummock grassland with umbrella bush (marpoo), colony wattle (sandplain wattle), emubushes, sandhill riceflower and other sparsely distributed shrubs. Ephemeral herbs, particularly daisies and everlastings are common following winter rainfall.

Clay pans and salt lakes also occur in the swales and are usually devoid of vegetation, although they often have dense stands of samphire at their margins.

Simpson Land System

Tieyon

Area 2,070 km^2 - 1.6% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Tieyon land system occurs in the north-west of the District. It consists of extensive flat to undulating sandplains and low stony rises. The sandplains have coarse sandy surface soils grading to clay loam with depth. The vegetation is low open mulga woodland with senna, dead finish, beefwood, fork-leaf corkwood and various bluebush species with an understorey of grasses dominated by woollybutt and common bottle-washers.

The low stony rises with sandy clay loam soils also support low open mulga woodland with a similar shrub composition to the sandplain, but with less grasses and forbs in the understorey.

Low stony rises with rough quartz gravel and red duplex clay loams support a low shrubland of rock emubush, senna, dead finish, and elegant wattle (prickly wattle), with scattered occurrence of mulga. The understorey consists mainly of grasses especially native millet, kangaroo grass and bandicoot grass.

Wantapilla

Area 2,280 km^2 - 1.7% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

The Wantapilla land system is typified by silcrete-capped mesas or flat topped hills and associated extensive gibber slopes, extensive alluvial plains and sandy plains and rises. Sand plains, stony rises, fluvial flats in areas of relict drainage lines, and minor swamps occur between the hills and the gibber slopes.

Mesas support scattered mulga with blunt-leaf senna over occasional clumps of mountain wanderrie and window mulga grass (slender-headed mulga grass). The lower slopes have witchetty bush with scattered chenopod shrubs including pale-fruit bluebush, satiny bluebush, bindyis and herbs.

Gibber slopes and interdune flats have red duplex soils. The vegetation is a low open shrubland of rock emubush and harlequin emubush (harlequin fuchsia bush) with pockets of low bluebush, bladder saltbush, bell-fruit bluebush (woody bluebush) and satiny bluebush, with an understorey of bindyis, button-grass, and bottle-washers.

Gently undulating alluvial plains, sandy rises and sandplains have coarse red sandy soils and support open woodlands dominated by mulga, witchetty bush, ironwood, emubushes and flat-stalk senna (Y-cassia). Emubushes include crimson emubush, Gile's emubush and short-leaf emubush. Grasses and forbs in the understorey include the bandicoot grass, window mulga grass, woollybutt, finger panic grass, woollybutt wanderrie, mulga grass, tall kerosene grass, leafy bottle-washers (woolly oatgrass) and bindyis (copperburrs).

Low dunes have low woodland of horse mulga with colony wattle and mulga over woollybutt, woollybutt wanderrie and tall kerosene grass.

Stony rises have an open shrubland of witchetty bush, dead finish, rock emubush, harlequin emubush (harlequin fuchsia bush) and low bluebush, with scattered mulga also present. The ground layer has silver mulla mulla (silver tails), satiny bluebush, bindyis and ball bindyi (cannonball).

Hard alluvial flats are characterised by sandy clay loam soils and mulga open woodland with dead finish, flat-stalk senna and harlequin emubush. The ground layer typically has a mix of satiny bluebush, woolly bluebush, cotton-bush, silver mulla mullas, woollybutt, silky bindyi and seasonal forbs.

Swamp vegetation is dominated by lignum, with Queensland bluebush (golden goosefoot), nitre goosefoot, dead finish and occasional mulgas. The understorey contains forbs and annual grasses such as button grass. Within this unit, scattered rises occur with mulga, elegant wattle (prickly wattle) and dead finish. The soils are loamy sand over light clay.

Wattiwarriganna

Area 12,665 km^2 - 9.6% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997), Badman (2002). This description is based on analysis of quantitative data from the Kingoonya SCD (Badman 2002), much of which (for this land system only) was collected in the MOSCB.

The Wattiwarriganna Land System is formed from a series of large parallel sand ridges overlying an older gibber plain, with swales usually containing a gibber pavement. Dunes are generally from 100 m to 500 m apart and up to 10 m in height. The quartzite and silcrete gibbers are gravel rather than scree size because they have been sorted as they travelled further from their source. Numerous claypans, swamps and large watercourses occur throughout this land system. Dunes usually have deep red sandy soils, although dunes in this land system on Billa Kalina Station in the Kingoonya SCD (Badman 2002) and the area described as the Stuart Creek land system (MOSCB 1997) are generally paler. Sandy or clay-loam soils occur in the swales, which are generally flat, but may contain low sandy or calcareous clay rises. The swamps have brown clay, or cracking grey or brown clay, or yellow or red sandy-loam soils.

Numerous large watercourses dissect the land system. The dunes have deep red sandy soils and sandy-clay soils occur in the swales. This land system includes the Stuart

Creek land system (MOSCB 1997), which was included with the Wattiwarriganna land system by Badman (2002).

Umbrella bush (marpoo) is the most common tall shrub on the dunes, while mulga, horse mulga, narrow-leaf hopbush, silver needlewood and sandhill cane-grass also occur. White cypress-pine (northern cypress-pine) may occur as scattered trees where this land system is close to the Roxby land system. Loose-flowered rattlepod (bluebush pea) and sand-sage are also common. Tall kerosene grass is common in the understorey on dunes.

Wattiwarriganna Land System

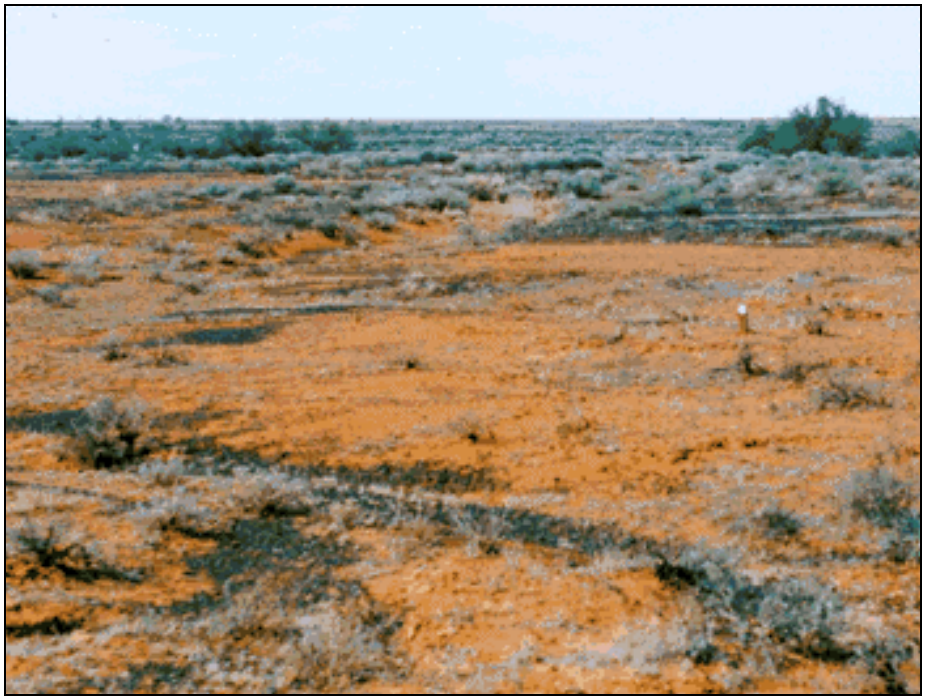
Interdune corridors include both sandy flats and claypans. Bladder saltbush is usually the dominant species on swales supporting chenopod low shrubland, with Sturt's pigface, cotton-bush, salt bindyi and neverfail (bristly love-grass), as well as mulga grass, also common. Mulga grass is often the most common species on swales where few shrubs are present, although Sturt's pigface and bristly love-grass also occur here. Some claypans support cane-grass (swamp cane-grass), old-man saltbush, cotton-bush, bristly love-grass and lignum. Bluerod is common at the claypan margins.

Large sandy watercourses and numerous swamps occur in the Wattiwarriganna Land System. Creeks are often bordered by coolibahs and sometimes by river red gum, while lignum and nitre goosefoot are common in the shrub layer. Goat-head bindyi, tangled bindyi, bristly love-grass (neverfail) and mulga grass are common in the understorey. Cane-grass (swamp cane-grass) is common at some swamps and claypans. Swamps have similar understorey vegetation to watercourses but usually lack the associated riparian woodlands.

Several mound springs occur within this land system and support vegetation including common reed, bore-drain sedge, cutting grass, bare twig-rush, sea rush and salt couch.

Wilyunpa

Area 3,750 km^2 - 2.8% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.



Wilyunpa Land System

This land system occurs near the Northern Territory border, with most of the Crown Point Pastoral Lease lying within the Wilyunpa land system. The western part consists of small steep hills and broken stony plains, with sandy red earth soils and iron buckshot clad natural scalds. Undulating stony plains with texture contrast soils and gilgais dominate the south-eastern parts of this land system.

The dominant plants of the hills and broken stony plains are bastard mulga, mulga and rock emubush. Small mulga-lined creeks dissect these hills, with bladder saltbush, woollybutt, swamp wanderrie, feather-top wire-grass and various bindyis (copperburrs).

Undulating stony plains with texture contrast soils and gilgais supporting bladder saltbush and Mitchell grasses dominate the south-eastern portion of this land system. A few of the larger creeks are lined with coolibah and mulga, with gidgee replacing mulga in watercourses and narrow valley floors in the eastern part of the land system. Queensland bluebush (golden goosefoot), cotton-bush, swamp wanderrie, cotton panic grass, umbrella grass, leafy bottle-washers (limestone bottle-washers) and Mitchell grasses occur in the understorey.

Wooldridge

Area 2,820 km^2 - 2.1% of District. References: MOSCB (1993), Badman (1995a), MOSCB (1997). This description is derived from subjective analysis of qualitative data.

This land system forms a transition between the gibber plains and plateaus of the Oodnadatta land system and the mulga woodlands of the Pedirka land system. It contains a combination of highly calcareous open flats, wide braided watercourses fringed by sand dunes, and clay pans. There are also some coolibah swamps and salt pans. Dune soils are typically deep red sands, with alluvial silts and clays in flooded areas and hard red clay on the flats.

Wooldridge Land System

The calcareous flats grow open communities of sparsely distributed mulga and dead finish, with low bluebush and/or bladder saltbush. Areas of bare ground, where predominantly annual grasses and herbs grow after rain, separate these two communities. These annual grasses are usually dominated by mulga grass and bottle-washers. Ball bindyi (cannonball), poverty-bush, buckbush and various emubushes and sennas also occur.

The dunes between the open flats support a greater range of perennial plants, most of which are palatable to livestock. The overstorey vegetation is dominated by mulga, with umbrella bush (marpoo) sometimes more frequent than the mulga. Dead finish and emubushes are also present. Grasses, especially mulga grass, leafy bottle-washers (limestone bottle-washers) and tall kerosene grass dominate the understorey. Numerous species of annual and ephemeral plants that are considered valuable for fattening livestock also occur after rain.

Watercourses contain gidgee, mulga, dead finish, river red gum and coolibah, with understorey shrubs including cotton-bush, lignum and Queensland bluebush (golden goosefoot). Mitchell grasses, cane-grass (swamp cane-grass), silky browntop and native millet are the most common grass species. After flooding, watercourses and low-lying areas grow an abundance of annuals, including button grass, verbine, Cooper clover and common purslane (munyeroo).

Western myall occurs in greyish loam over limestone on the hard plateau near Mount Alice, although this area is dominated by a low shrubland of bladder saltbush and low bluebush. Mitchell grasses, spear grass and bottle-washers occur in the understorey.

Water Resources

The average annual rainfall of this District ranges between 150 and 225 mm making this one of the lowest rainfall areas in the world where cattle grazing is carried out successfully. Consequently, ongoing access and availability of ground and surface water are essential for human occupation, continued utilisation of the land's resources and the success of the pastoral industry.

Natural venting of the Great Artesian Basin (GAB) as mound springs occurs predominantly near the Oodnadatta Track. These springs were of paramount importance to the early settlers as were the many large waterholes in the major creeks.

Since the publication of the first District Plan (MOSCB 1997) there have been several significant developments with regards to water management in the far north of South Australia. Most of these have dealt with the GAB and preservation of the resource for sustained use. These have included:

- Formation of the GAB Consultative Council (GABCC) and development of a Strategic Management Plan for the GAB (released in September 2000). The GABCC also compiled a Resource Study in November 1998 that provided a snapshot of the nature of the GAB, water extraction and the impacts of that extraction, existing arrangements for groundwater management and significant issues for groundwater management within the basin.
- Formation of the Arid Areas Water Catchment Management Board (AACWMB) (formerly the Arid Areas Water Resource Committee). This committee is responsible for the development of a water management plan for the whole of the Arid Areas. A water allocation plan for the GAB is currently being developed.
- The GAB Sustainability Initiative (GABSI). The Commonwealth government has committed $31 million over 5 years to accelerate the bore rehabilitation and bore drain replacement programmes in NSW, SA and QLD. Funding arrangements are such that each state is to match the federal funds and pastoralists are required to contribute. In South Australia, the GABSI programme will see the completion of the bore rehabilitation programme (previously funded by NHT) and commencement of the bore drain replacement programme. It is anticipated that flow savings from the bore drain replacement programme will match that of the bore rehabilitation programme.
- Formation of the Lake Eyre Basin Catchment Group (LEBCG) to set up and implement a catchment wide management strategy.

Several new Environmental Protection Policies have been released by the State Environment Protection Agency and one of these relates to water quality. The Lake Eyre Basin Agreement relates to the management and use of surface water within the Lake Eyre catchment. This agreement has been signed by the relevant ministers in South Australian and Queensland and by the Commonwealth.

Little has been undertaken with regards to surface water in the District. However, the Neales River is included in the Arid Flow Project, which aims to determine the environmental significance of river flows in the arid region. Harvesting of floodwaters for aquifer storage and recovery has been raised as being of potential value for the District, but this issue still requires further investigation.

Groundwater

The best quality groundwater occurs in the main aquifer of the Great Artesian Basin (GAB) which is the popular name for the water bearing sediments of the Eromanga Basin. This consists mostly of the Algebuckinna Sandstone and Cadna-Owie Formation described earlier. The aquifer outcrops at the surface to the west of Coober Pedy and deepens in a north-easterly direction to about 250 m at Lake Eyre and over 1000 m at Purni Bore. Water enters the aquifer from rainfall in the Great Dividing Range in Queensland and moves in a south-westerly direction into South Australia at the very slow rate of about one metre per year, which means it takes about 2 million years to travel to Lake Eyre. Water also enters the aquifer from rainfall in the south-east corner of the Northern Territory and on higher ground along the Stuart Highway where the aquifer is close to the surface. The aquifer is confined by the overlying fine-grained Bulldog Shale, which keeps the groundwater under pressure.

Groundwater discharges from the Basin by mound springs and flowing bores, and by diffuse upward leakage through the Bulldog Shale at slow rates. Mound springs form along fault lines or fractures which allow the groundwater to discharge more easily through the confining Bulldog Shale, for example, as at Dalhousie Springs. A large amount of groundwater has been wasted through uncontrolled flowing bores, which also reduces the pressure of the GAB. Since 1977, the Water Resources section of the Department of Water, Land and Biodiversity Conservation (DWLBC) (formerly within the Department of Mines and Energy) has rehabilitated all but 11 of these uncontrolled bores. Control of the remaining bores, which are the most difficult bores within the District to rehabilitate, will be completed over the next four years as part of the GABSI programme. This work is vital, for if too much pressure is lost, mounds springs and bores would cease to flow, resulting in the localised extinction of mound spring dependent plants and animals and increased costs from bore pumping. Rehabilitated bores will have their steel casing, which is prone to failure through erosion, replaced by fibreglass casing. (Bore rehabilitation involves, where possible, re-lining wells with fibre glass casing. If rehabilitation is not possible, then the well is plugged and abandoned and a replacement well is drilled.)

Due to the lower relief, the free flowing bores and mound springs occur in the eastern part of the District (Figure 7). Further to the west there is not enough pressure in the aquifer to cause the water to flow to the surface: the water level in the aquifer is progressively lower towards the west until it is below the overlying confining layer, resulting in the water no longer being under pressure.

The salinity and mineral content of the GAB aquifer increases to the south-west with increasing distance from the recharge areas (Figure 8) because the water dissolves salt from the aquifer material as it moves through it. To the west of Lake Eyre South, the water is high in sulphates and is extremely corrosive. Water from the main recharge area is higher in carbonates, of better quality and less corrosive (Kinhill 1997). Nevertheless, salinities are generally low (less than 5000 parts per million total dissolved solids) and are of good stock quality with the exception of the area south of Coober Pedy.

Apart from the main GAB aquifer, there are few sources of useable groundwater. In the sandy dune country, good quality groundwater can be found at shallow depths adjacent to the major watercourses (e.g. the Alberga and Hamilton Rivers). In the Marla area and to the west, the GAB aquifer contains very little water, with significant water supplies found only in the older sandstone sediments of the Officer

Basin. These supplies are generally more saline and less reliable than those from the GAB to the east, although good water has been found in the outcropping fractured rock aquifers that form the higher country to the west, e.g. in the Indulkana Range. Water quality is extremely variable in this area, but generally is less than 5000 ppm.

Improvements for the management and distribution of water are of great importance to the sustainable management of the land's groundwater resources. Such improvements include windmills, rotary pumps, submersible electric pumps, stationary motors and solar pumps. There is increasing use of poly-pipe to convey water to storage tanks and troughs. The use of these improvements for land management will be discussed later in this document.

Surface Water

Many dams have been constructed throughout the District wherever good clay and clay silt beds are found. The high annual evaporation rate in the District significantly reduces the available water in surface catchments. Dams have to be maintained by cleaning out silt tanks regularly, keeping wing banks in good repair and removing silt from dams every few years. Depth of dams close to Lake Eyre is restricted by a relatively shallow saline watertable, which flows into dams deeper than 3-4 metres. The depth at which this water enters dams increases with distance and height from the lake.

Waterhole in the Peake Creek on Nilpinna Station

Natural waterholes occur along major and some minor drainage lines. Water lasts in many of these waterholes for six months or more, with some lasting over 12 months.

In some areas, the construction of smaller dams can provide a short-term (3 - 6 months) source of water after rains. This takes the grazing pressure off the major water points and spreads it more evenly over the larger paddocks, particularly where the permanent water supply can be turned off or stock can be denied access through fencing.

Hurdle Creek Dam in the Oodnadatta Land System.

Stock Requirements

Dry cattle maintain healthy growth on water with a salinity of up to 4,000 ppm and can tolerate 10,000 ppm. The moisture and salt content of available feed affects the ability of cattle to tolerate salts in water. Sheep generally have a higher salt tolerance than cattle. Camels can subsist on water with a salinity of 19,000 ppm.

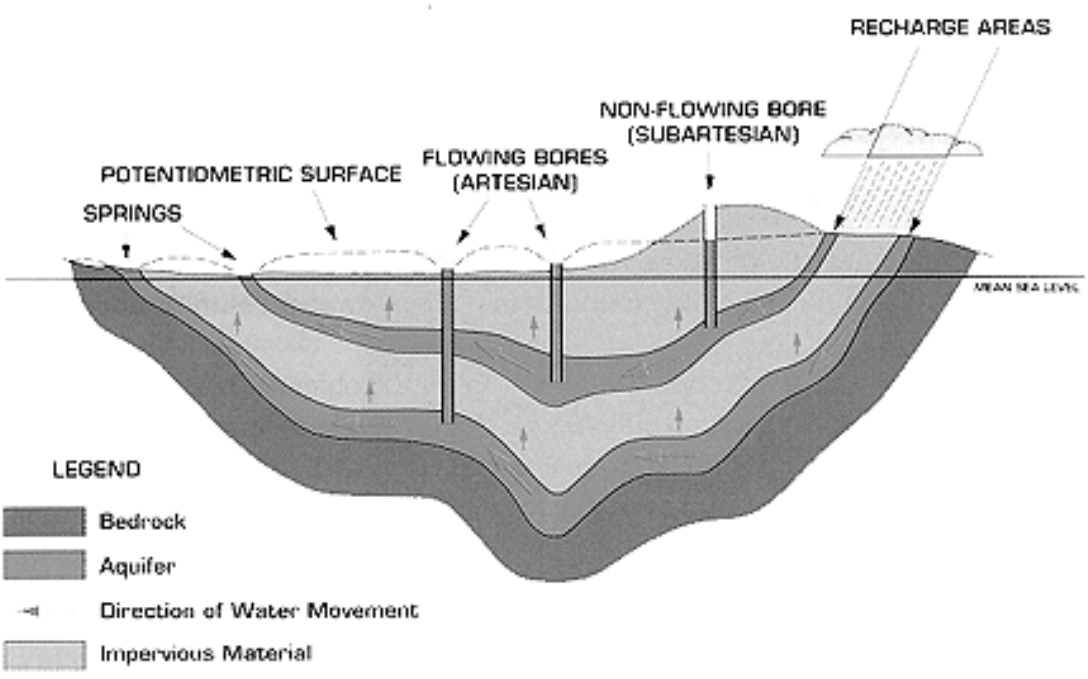
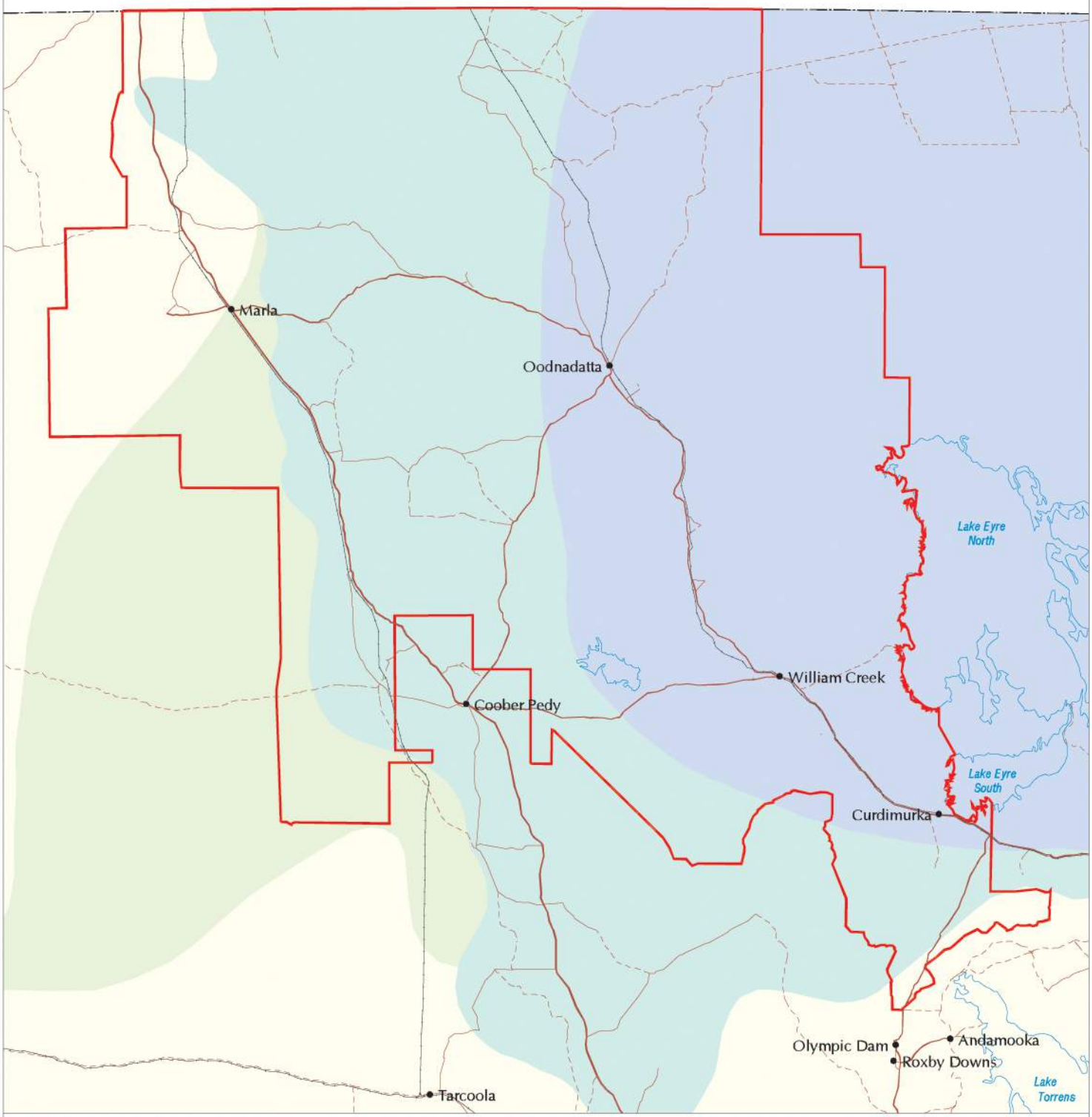


Figure 7: Cross-section of the Great Artesian Basin.



MAP PRODUCTION: PIRSA Land Information,
Primary Industries and Resources, S.A.

Figure 8 Great Artesian Basin margins and approximate locations of the various aquifers

Potable Water

Most towns and homesteads rely on catchment from roofs into rainwater tanks for potable water and on bore or dam water for other domestic use. However, the water from some bores and dams is of a sufficiently good quality to allow it to be used for all domestic purposes. Water is pumped from bores on the Moon Plain to Coober Pedy, which is just outside the District, for domestic use after desalination.

Land Use

History of Land Use

Aboriginal Inhabitants

Traditionally, the Aboriginal people who occupied most of the District were the Arabunna, with a traditional focus on Anna Creek. However, several other groups are known to have frequented parts of the District, including the Kujani, Southern Aranda, Antakirinja and Yankunytjatjara.

Arabunna people were few in number, particularly when compared with more favourable areas to the south. The Kokotha bordered the Arabunna people on the south, the Dieri and Kujani to the east, and the Southern Aranda and Wangkangurru to the north (Lance and Moffitt 1996).

Western Desert peoples slowly pushed the Arabunna people out of their own country in the early twentieth century (Tindale 1974), aided by white, Asian and 'Afghan' Australians. Some Aboriginal people were employed on pastoral stations as early as 1867 (Gee 2000).

As in many other parts of Australia, early contact between indigenous societies and Europeans was characterised by the interplay of a number of factors such as drought, foreign species (e.g. horses, cattle, camels, sheep etc.), cultural mixes between Aborigines, Europeans and other ethnic groups, internecine conflicts, police activities, introduced diseases and Christian missions.

Contemporary Arabunna people are now dispersed throughout southern Australia. The majority have migrated to Port Augusta and Marree, outside the traditional Arabunna homeland.

Witjira National Park also makes up part of the lands associated with Lower Southern Aranda and Wangkangurru people. Some of these Aboriginal people live at Finke (Aputula) and Santa Teresa in the Northern Territory, Birdsville in Queensland and at Marree, Oodnadatta, Port Augusta, Adelaide and other places in South Australia. They have a strong spiritual attachment to the land and regard it as an area for which they have a management responsibility. In 1989, these people formed the Irrwanyere Aboriginal Corporation to promote their interests and to try to secure tenure over lands with which they held a traditional association. The Irrwanyere community is engaged in joint management of Witjira with South Australian National Parks and Wildlife.

Explorers

European settlement originated with exploration. In 1858 John McDouall Stuart explored the region, motivated by private interests in mineral rights and pastoral grazing land, and the South Australian government's intention to open up the interior.

At the same time, Babbage was sponsored by the State Government to survey the lakes country and to find a way north between the salt lakes. Lakes Eyre, Torrens and Frome were then believed to form a continuous horseshoe shape, with no known route between them.

By 1862, a south-north route had been blazed by John McDouall Stuart to the north coast of Australia. This route followed the line of mound springs between Marree and Oodnadatta and, following subsequent upgrading to main road status, became known as the Oodnadatta Track in 1979.

European Settlers

The first settlers arrived in 1859 (Gee 2000). They were pastoralists using bullock, donkey and horse teams to shift their belongings. Pastoralists extended as far north as the Neales River by 1862. Philip Levi took up Peake Station (then Mount Margaret Station) with cattle and John Warren, William Bakewell and Julius Jefferies ran sheep at Strangways Springs.

Pastoralists and prospectors moved together in their development of explored areas but the prospectors were mainly disappointed.

Afghans and Camels

In 1866, Thomas Elder invested in the first shipment of commercial camels to Australia from India and Afghanistan. Their handlers were mainly from India and Pakistan, but all camel handlers from the Indian sub-continent generally became known as "Afghans". Camels were instrumental in opening up outback Australia. Camels enabled new settlers to develop pastoral interests by transporting requirements and supplies from the railhead such as fencing wire, tools, food and everyday living requirements. From 1884 until the 1920s, Marree was the hub of a vast pack-camel transport network.

Overland Telegraph

Since the 1850s, the ambition of the SA Government had been to link Australia with the world economy. The Overland Telegraph line played a major part in fulfilling this ambition.

An approximate route for the Overland Telegraph was pioneered between 1858 and 1862. Over five gruelling expeditions, John McDouall Stuart explored south-north travel routes right across the continent. The physical hardship of these expeditions took its toll on Stuart and he died in 1866.

His discoveries then enabled John Ross to survey the Overland Telegraph route during 1869-70.

The Overland Telegraph Line was completed in 1872 under the supervision of Charles Todd (later Sir Charles), South Australian Superintendent of Telegraphs and Government Astronomer.

The construction of the Overland Telegraph Line provided the lifeline for Central Australia - it was a safe route along permanent waters used for further explorations and expansion for pastoralists. Prior to the 1870s, no pastoral leases had been taken up north of the Neales River.

Railway

From the late 1870s until 1929, the "Great Northern Railway" was constructed northward from Port Augusta to Alice Springs. It was seen as a progressive step in transportation, lifting the prestige of the debt ridden, fledgling South Australian colony, with the ultimate goal of linking Adelaide with Darwin. Construction of the railway followed on from the communication breakthrough provided by the Overland Telegraph.

At the time, it was widely believed that the plough would follow the railway and improve the prosperity of the state. The railway was seen as a means of conveying wool, livestock and agricultural produce to ports and markets.

Construction west and then north-west from Marree commenced on 16 July 1884, "for the purpose of finding work for the unemployed" and was open to traffic to Angle Pole (the early name for Oodnadatta) on 7 January 1891. Oodnadatta was the railhead until 1927 whilst the politicians considered the merits of extending the railway to become truly transcontinental. The railway from Pt Augusta to Angle Pole had cost £2,318,242 - all borrowed funds with little return. During this period, Oodnadatta was the focal point for this District. A successful artesian bore was put down in 1893 which enabled the holding of livestock prior to railage and the establishment of an Afghan cameleers' base. The cameleers carried freight over a vast area to Alice Springs and beyond. For a time Oodnadatta was the largest settlement between Port Augusta and Port Darwin.

The Pastoral Industry

The pastoral industry's initial momentum was gained from the reports of the first explorers. A devastating drought in the early years (1864-66) ruined the pioneers, but the completion of the Overland Telegraph Line in 1872 renewed interest and pastoral development continued beyond the Neales River. Early lessees were Edward Bagot at Dalhousie and Joseph Gilbert at Macumba.

The camel transporting business became the foundation upon which the pastoral industry could develop. When the railway came in the 1880s the camels moved north with the railhead and the pastoralists benefited with easier access to beef markets and supplies.

During the 1880s, the Artesian Basin was discovered and this resulted in a sufficient demand for windmills, to pump from sub-artesian bores, to enable their mass production and therefore they became more affordable (Simpson and Simpson 1988). The railhead continued moving northward creating great optimism for pastoralists now able to send stock south by train. This optimism encouraged expansion.

From 1891 to 1927 Oodnadatta was the northern-most railhead in SA. This was also the shakeout period in the pastoral areas. The reality of seasonal variations struck home. Small properties were not viable (e.g. Wondillina on Allandale and Cootanoorina on Nilpinna/Mount Barry) and were assimilated into larger runs. The rationale for this has a well established historical precedent; larger leases were considered to have a better chance of benefiting from the random but stock-saving summer rainstorms. The smaller runs too often missed out and, during these early years, thousands of head of stock were lost as a result. At this time, the cost of drilling bores was prohibitive (Fuller 1975).

Between 1899 and 1927, up until the mechanisation of the British colonial armies in the 1930s, some stations (e.g. Nilpinna and Todmorden) bred remount horses for the Indian Army in conjunction with cattle.

It is interesting to note that from 1834 Australian stock owners started selling horses for remount purposes. Because most came from New South Wales, they became known as Walers.

The 1930s saw the establishment of the shape, size and function of stations as we know them today. This was a result of pastoralists and government coming to terms with the nature of the country and the unpredictable climate. Today, the pastoral industry is the most extensive land user in the District.

Transport

During the period from 1870 until the 1930s, camel, donkey and bullock teams distributed goods from railheads. Cattle were walked to railheads and transported south by train. Marree and Oodnadatta were centres of railway transport in northern South Australia. Kurt Johansson was a pioneer of cattle trucking in the 1930s. Up until the 1980s, mobs of cattle were usually walked to the railhead. From the early 1980s improved roads saw an increase in road transport of cattle and goods. Apart from the speed and efficiency of road and rail transport, droving was not practical during the Brucellosis and Tuberculosis Eradication Campaign (BTEC) because of the risk of spreading disease through country that had already been cleared.

During the mid 1990s, trains on the Adelaide to Alice Springs railway line ceased stopping to pick up livestock from local rail sidings and eventually stopped carrying them from Alice Springs. All stock entering and leaving the District must now be carried by road transport.

Communications

Prior to the arrival of the railway to Oodnadatta in 1891, the only quick form of communication was by way of the Overland Telegraph, with repeater stations at Peake and Strangways within the District. Once the railway arrived at Oodnadatta and continued on to Alice Springs in 1927 the mail service improved, but communication was still very slow by today's standards.

During the 1950s, a few stations like Anna Creek, adjacent to the Overland Telegraph, tapped into the service.

Skipper Partridge organised the installation of an HF radio in the Oodnadatta Hospital during the 1950s and assisted with the installation of HF radios on stations. People on these stations could then talk amongst themselves and more importantly were able to contact the Royal Flying Doctor Service (RFDS). HF radio communication improved further in 1977 with Single Side Band operation and later in 1982 with the Radphone facility. Radphone enabled the radio user to be linked into the telephone network via an operator at the RFDS radio base. The Radphone service through the RFDS is now no longer available except in the case of an emergency. Telstra offers a commercial service similar to the old RFDS Radphone. This allows a transceiver at one end to be connected to a telephone at the other.

More recently many stations acquired UHF radio and at least seven UHF repeaters have been strategically located in the District.

During 2002, most stations will be linked to the Internet via Telstra's Big Pond Broadband 2-way Satellite Internet.

Legislation Affecting Pastoral Tenure and Land Management

The first Pastoral Act was passed in 1893. This Act established three classes of land depending on the distance to the nearest railhead. Amendments to this Act in 1895 created a Pastoral Board, which administered all unoccupied land under consideration for pastoral leasehold and all abandoned leases. Numerous other pieces of legislation were passed during the succeeding years, resulting in a very complex set of laws governing the operation of a pastoral lease in South Australia (Gee 2000).

In 1898, a Royal Commission was held to report on the condition of the pastoral lands and to make recommendations on actions that should be taken by Parliament to induce the occupation and development of the pastoral lands. The Commission recommended that the land classification system should be abolished and new lease terms and conditions introduced. This resulted, in 1904, in the consolidation of 15 different types of leases which operated under seven different Acts and a reduction in the compulsory stocking rates to five sheep per square mile in the first seven years (Gee 2000).

In 1926, another Commission of Inquiry was appointed to report on tenure, land classification and conditions that could be imposed with any alteration of tenure. A new classification of lands was recommended, with the value based on average rainfall, proximity to rail or seaports and accessibility to markets.

Despite evidence of stock causing land degradation since 1861, no legislative action was taken to remedy this until 1939. During the 1920s, Cecil Goode, a temporary pastoral inspector, criticized the contemporary stock-management practices and eventually resigned in frustration at the lack of Government action (Gee 2000). In 1939, the *Pastoral Act* was amended to give the Pastoral Board power to limit the number of stock on a lease to a number that was unlikely to permanently damage the land. This amendment was also incorporated under the *Soil Conservation Act 1939* following reports of soil erosion on the pastoral lands (Anon 1938). Included in the amendments were provisions for the control of inappropriate stocking levels and a reduction on the requirement for a minimum stocking level. This amendment also allowed the Pastoral Board to place maximum stocking rates in the lease covenants.

This was the first time that overgrazing by stock was given statutory recognition as a major cause of land degradation in South Australia. Up until this time, degradation had been attributed to rabbits and drought.

The *Pastoral Land Management and Conservation Act 1989* is the latest State legislation dealing with the land management of the pastoral country. This Act places emphasis on the maintenance or improvement of the condition of the land and provides several avenues for the prevention of land degradation. These include destocking when the Pastoral Board considers there is a likelihood of damage from stock grazing or any other cause.

Suggested amendments to the *Pastoral Land Management and Conservation Act 1989* have been delayed until the situation regarding land claims under the *Native Title Act 1993* have been clarified. A test case involving De Rose Hill Station is currently before the Federal Court, with a determination expected in late 2002.

These suggested amendments would recognise the 407,000 square kilometres of pastoral lease in South Australia as rangelands. The Pastoral Board would be expanded to an eight member Rangeland Board. Amendments would cover tenure security, resource monitoring, multiple use demands, diversification opportunities, the aspirations of Aboriginal people and the travel interests of the wider Australian community.

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* has the potential to affect pastoral operations. Any action that is likely to affect rare or endangered flora, fauna or plant communities can trigger this Act.

Brucellosis and Tuberculosis Eradication Campaign (BTEC)

During the 1970s, Australia was under international pressure to eradicate brucellosis and tuberculosis from all cattle herds. Eradication was necessary to preserve export markets.

Industry, Federal and State Government agencies together formulated strategies to bring about a successful testing programme with the aim of eradicating both diseases by the early 1990s. Funding for the programme came from Government and stamp duty on the sale of stock. The State Governments provided the personnel for testing stock and implementing the programme.

All cattle had to be individually tested for each disease and identified. Cattle with the same disease status were separated from cattle with different disease status. Stock that could not be tested due to difficulty of mustering, or high incidence of disease were shot on sight or sent for slaughter.

To enable a successful testing programme stock management practices had to be improved so that mustering and testing would be an efficient operation. This led to the development of extensive station improvements including fencing, stock yards and races, loading ramps and drafting facilities and the development of appropriate watering points within these paddocks and yards. Many properties were for the first time enclosed by a complete boundary fence during this period.

To obtain tax deductibility for these improvements station management had to prepare a plan of their proposed fencing and yard improvements and submit them to the BTEC Advisory Committee for approval.

The BTEC was the turning point in station management in this District. Prior to BTEC, cattle were not so much managed as harvested from open range grazing. In some areas, there were large numbers of stock and the exact number of stock on a property was sometimes unknown. With a reduced herd and more control over stock movements, the breeding and health of the herd received greater attention, which enabled more emphasis on eliminating inferior stock. The new infrastructure also needed to be protected from the detrimental effect of brumbies, camels and donkeys, leading to more emphasis on the control of these feral animals.

Present Land Use

Table 3 summarises the land use at the time of preparation of this plan. There is potential for change and expansion in some land use enterprises.

Table 3 Land Use: Marla-Oodnadatta Soil Conservation District

LAND USE	DESCRIPTION	POTENTIAL FOR EXPANSION
A. Pastoral	Beef cattle and sheep (minor)	Predominant land use. Well established. No further expansion likely. Changing management strategies.
B. Mining	Opal Haematite Coal	Major land use with potential to grow considerably. Large coal deposits in area and interest in exploration for diamonds.
C. Tourism	Tourist bases: Coober Pedy, Marla, Cadney Homestead, Oodnadatta, William Creek.	Tourism is a growing industry in the District. It generally focuses on few key locations such as Dalhousie Springs. The industry is expanding in diverse directions with nature-based tourism a major growth area. Tourist interest spots include the Oodnadatta Track, Simpson Desert, Witjira National Park, Arckaringa Hills, Copper Hills and pastoral properties.
D. Conservation	a. Conserving Heritage sites both European and non – European	Algebuckinna Bridge, Peake ruins, Edwards Creek, Curdimurka Railway Siding, Dalhousie ruins and Strangways ruins.
	b. Dedicated Conservation Land	Heritage Agreement – Copper Hills. Heritage Agreement – Arckaringa Hills. Mound Springs – Aboriginal Heritage sites, several mound springs are conserved by agreement on Kidman Holdings Ltd Pastoral Leases and under similar arrangements on the adjoining Nilpinna and Allandale Stations. Bubbler and Blanche Cup were dedicated NPWSA Reserves in 1995. Coward Springs – Camping Ground and Flora and Fauna Park.
	Witjira National Park	Joint NPWSA and Irrwanyere Community management is formalised for the Witjira National Park. Management Plan was produced in October 1995.
	Arid Recovery Project Arid Recovery Reserve	The Arid Recovery Reserve at Roxby Downs extends into the extreme south-east of the District. Its main purpose is the elimination of introduced

LAND USE	DESCRIPTION	POTENTIAL FOR EXPANSION
		animals and reintroduction of locally extinct medium sized mammals.
E. Aboriginal Lands	Witjira National Park Dunjiba Hookey's Waterhole Mabel Creek Station Mt Willoughby Station Mt Clarence Station Granite Downs – Witjintitja / Wallatinna Indulkana community are located just outside the District.	Joint NPWSA and Irrwanyere Community management is formalised for the Witjira National Park. Management Plan was produced in October 1995. Aboriginal people use the land to carry out traditional pursuits, as well as other enterprises. Dunjiba Community Council (ALT). Dunjiba Community Council (ALT). Includes beef cattle enterprise. Includes beef cattle enterprise. Includes beef cattle enterprise. Includes beef cattle enterprise. Other potentials for expansion within the District are likely to be discussed in Indigenous Land Use Agreements (ILUAs).
F. Towns, small freehold allotments and Public Land	Oodnadatta Common Moon Plain Townships of Marla, William Creek, Mintabie, Oodnadatta.	Dedicated for specific public purpose, (i.e. travelling stock and teamsters - 48 hour reserve)

Mining and Mineral Exploration

In 1997, about 77 existing or pending Exploration Licences covered about 60% of the District, with activities directed towards potential deposits of opal, coal, copper, clay and gold. Opals are mined at Coober Pedy and Mintabie in the Proclaimed Precious Stones Fields, and at Lambina on pastoral lease country. Kaolin has been mined at Arckaringa and copper at Copper Hills, Warrina, Boorthanna, and Coominaree (MOSCB 1996) and in the Denison, Davenport and Kingston ranges. Petroleum companies have an ongoing interest in several areas.

Tourism

The 1980s and 90s have seen a boom in tourism in the Marla-Oodnadatta Soil Conservation District. There are a number of reasons that have led to this and these include:

- higher disposable incomes together with increases in available recreation time of some urban dwellers, particularly amongst the increasing number of retirees
- increased marketing and sales of recreational 4WD vehicles
- the development of the Oodnadatta Track as an alternative to the Stuart Highway as a tourist route

- the expansion of National Park reserves in the region
- increased interest in the area generated by television documentaries and nature-based and off-road vehicle magazines
- an increasing interest in the environment and conservation of arid lands.

Tourism makes a significant contribution to the Gross Domestic Product (GDP) of South Australia and this is likely to continue. Successive governments have put considerable effort into tourism development and the current trend towards environmental based tourism is likely to focus further attention on the rangelands.

Many visitors to the District are keen to be involved in nature-based activities to enhance their experience. Accredited eco-tourism operations must now provide an educational and interpretive component to their product and adopt environmentally aware minimum impact codes of practice. One business running camel tours and based in William Creek is now accredited. Development of culturally based commercial tourism ventures is of great interest to Aboriginal people.

The twice-weekly mail run from Coober Pedy to William Creek and Oodnadatta and return to Coober Pedy across the moon plain has been successfully carrying tourists for several years. Other experienced operators with local knowledge run "tag-along" tours from Coober Pedy, where the operator acts as a guide for other people in their own vehicles.

Like any other enterprise involving the use of land, all tourism requires careful management. High visitation to the District can have a negative impact, including:

- fire wood usage;
- littering, particularly with non-biodegradable rubbish;
- disturbance to livestock;
- disturbance to native fauna and their habitat;
- contamination of water;
- cutting of living trees;
- damage to improvements;
- leaving shut gates open, or open gates shut;
- increased use of station tracks; and
- illegal shooting and fishing.

The last two points include an increased occupational health and safety aspect for station managers and their employees, particularly in scrubby country with poor visibility.

Vehicles are allowed on pastoral leasehold land if prior permission has been obtained from the lessee or manager. However, when vehicles are driven improperly, in the wrong places, or at the wrong times, these vehicles can seriously damage vegetation, disturb wildlife and stock, scar the landscape, create soil erosion and water pollution, or damage costly facilities. Unless visitors learn to use these vehicles in appropriate ways, more and more land may be closed to their use.

The vast majority of those involved in outdoor recreation are not affiliated with any organization. As a result, they learn about outdoor recreation through trial and error. This lack of knowledge leads to the continuing repetition of damaging actions and problems for land managers, which can be minimised by tourists acting responsibly. This involves:

- travelling only where permitted;
- becoming proficient in driving in difficult conditions;
- respecting the rights of others to enjoy their activities undisturbed;
- educating themselves about the land they wish to visit; and
- avoiding damage and/or disturbance to watercourses, steep terrain, wetlands, wildlife and livestock.

The Board acknowledges that tourism is an integral component of the District's economy and supports public interest in arid land management. Consultation with pastoral lessees ensures that appropriate arrangements are in place to minimise visitor impact. However, even a small proportion of poorly educated recreational off-road drivers has the potential to do considerable damage and land owners, being acutely aware of this, are consequently becoming increasingly reluctant to provide consent for ad-hoc 4WD access onto their properties.

Any proposal for a wide network of public access routes (PARs) on station tracks is a cause for concern for many pastoralists, although PARs can resolve the problem of liability for pastoralists, with the Government assuming this responsibility on PARs once they are gazetted. Identification of public access routes needs to be based on existing use. Maintenance and public liability arrangements for station tracks that currently carry tourist traffic need to be formalised. The construction of new cattle grids by the State Government on Public Access Routes, in consultation with the lessee, would assist with the problem of visitors leaving gates open or closing gates that should be left open.

The Board actively fosters liaison between pastoral lessees and regional tourism associations, progress associations and other organizations and individuals involved in the management, development and marketing of the tourism assets of the area.

Public Access Routes

Six gazetted *"Public Access Routes"* currently exist in the District. The oldest of these are the Tallaringa Track (which joins the Anne Beadell Highway), the Pedirka Route from Hamilton to Dalhousie Springs (in Witjira National Park) and the road into the Curdimurka Railway Siding. The three other roads are the road from just south of William Creek to Halligan Bay in the Lake Eyre National Park and the roads into the Peake and Strangways Telegraph Station ruins. The Tallaringa Track stretches west from Mabel Creek Homestead to the Dog Fence.

These Public Access Routes are designated under Section 45 of the *Pastoral Land Management and Conservation Act 1989* and their establishment and maintenance is covered by agreements between the relevant pastoral lessees and the Minister for Primary Industries and Resources. Management plans cover items such as the responsibility for and frequency of maintenance, re-routing around pastoral watering points or other infrastructure, replacing some gates with grids, continuity of public access, camping provisions, conditions for temporary closure, public liability and

signage. Responsibilities of members of the public regarding their use of these routes is described both in the Act and on signs erected at appropriate locations.

The Pastoral Board's policy on Public Access Routes is:

- The Pastoral Board will identify and formally delineate public access routes to points of interest on and through land held under pastoral lease as needs and resources permit
- The process of identification of public access routes will involve close consultation with lessees, conservation interests, tourism operators, off-road vehicle clubs and other interest groups
- After agreement by consultation with the lessee affected, a management plan (Heads of Agreement) will be executed by the Minister, the lessee and the Board's Presiding Member. The track will be signposted before being formally gazetted in accordance with procedures specified under section 45 of the Pastoral Land Management and Conservation Act.
- Lessees who carry out approved work on access routes can seek reimbursement from the Secretariat
- Lessee's rights relating to the designated track area cease when the routes are formally surrendered from the lease. The responsible Minister has agreed to indemnify lessees against any liability arising from work done to maintain the access route.
- Lessee's stock are not required to be kept off the route.
- Unless otherwise specified a public access route will be defined as a corridor of 100m width; and with the track as centreline. Camping will normally be allowed within this corridor only.
- The Secretariat will attempt to promote the existence of all gazetted Public Access Routes, and to inform those producing or distributing maps of the status of all roads and tracks which are not either Public Access Routes or Public Roads, and which therefore require the lessee's approval for access by vehicle, horses or camels.

This policy is under review and may be updated in the near future.

Permits must be obtained to travel off PARs onto Aboriginal Freehold Land..

Infrastructure and Services

Transport

The road transport network in the Marla-Oodnadatta Soil Conservation District is improving and increasing. The major road passing through the District is the bitumen Stuart Highway. In contrast, the other major transport link, the Australian National Standard Gauge Railway (Adelaide - Alice Springs) is now of little use to people living and working within the District because trains no longer stop at local rail sidings. The Stuart Highway and the unsealed roads maintained by the Department of Transport are shown in Figure 1.

There are six all-weather airstrips in the region, chiefly maintained by community groups. The Progress Associations of Marla, Oodnadatta and Mintabie, the Indulkana

community and the Coober Pedy District Council each maintain an all-weather airstrip.

All station homesteads have airstrips, which they maintain for their own use as well as for RFDS operations.

Communications

In 1987, many pastoral properties were directly linked for the first time to telecommunications services. Prior to the installation of the Digital Radio Concentration Telephone System (DRCTS), the only means of communication for stations in the District was a weekly mail service, radio and radiophone. The DRCTS provides telephone, facsimile and e-mail facilities with the rest of Australia and the world. E-mail download times are slower than in more closely settled areas, but transfer to satellite systems over the next year will give a much improved service. DRCTS automatic exchanges are located at Marla and Coober Pedy.

The RFDS operates a 24-hour station on HF radio for emergencies and regular sessions for other medical calls.

UHF radio is popular in the region for on-station communication because it is much cheaper and more reliable than HF radio. The construction of UHF repeater towers throughout the District now gives almost complete coverage for UHF radios. This facility is also widely used by travellers through the District.

STD telephone telecommunications became available during the 1980s with VHF telephone links available to stations along the Tarcoola to Alice Springs railway during 1983 and the commissioning of the DRCTS network from Marla to William Creek by mid 1987. STD telecommunications have provided facilities such as facsimile, STD and ISD telephone contact and computer network links.

Television services were introduced to the District via satellite in 1986. This initially enabled the reception of two channels, ABC and Imparja, but two other channels, SBS and Central 7, are now available in most settlements. Many stations also have access to ABC programmes from more than one state.

All mail distribution was once by contract from Oodnadatta with a fortnightly delivery to stations as far west as Kenmore Park. Today there are twice-weekly surface mail contracts originating from Oodnadatta, Cadney Homestead and Coober Pedy. An aerial service from Alice Springs services several stations.

Services

The RFDS provides regular clinics throughout the District. There are hospitals at Oodnadatta, Coober Pedy and Mintabie and there is a Day Clinic at Marla.

There are primary schools at Marla, Oodnadatta, Indulkana and Mintabie, while children on stations and secondary students are educated through the *School of the Air* and *Open Access*.

Passenger services and freight deliveries occur almost daily for stations close to the Stuart Highway and less frequently elsewhere. Large freight deliveries can be arranged by individual stations at any time.

Visitors to the District can obtain fuel, food supplies and various other services at Oodnadatta, Marla, Cadney Park, William Creek and Mount Dare, although Coober Pedy, just outside the District, is the largest centre for tourist services.

LAND MANAGEMENT

Land Capability

Land capability is the ability of the land to sustain a type and intensity of use permanently, or for specified periods under specific management. A land use is 'within' the capability of the land if it maintains or improves the condition of the land.

The capability of the land depends on the nature of the physical characteristics or limitations of the land and environment.

The low annual rainfall and high variability of the rainfall in the Marla-Oodnadatta Soil Conservation District limits the opportunities for production to extensive land uses such as grazing stock on native pastures. Soil chemistry (salinity, chemical toxicity and nutrient content) and structure also limit production options.

In areas used for grazing stock on native vegetation, land capability can be equated to the sustainable carrying capacity, that is, the estimated long term stocking rate the land can support without a decline in the sustainability or condition of the vegetation and soil resources.

Any use of land must be sustainable. Land resources cannot be sustained where over-use occurs. Inappropriate use of land results in *degradation*, the long-term loss of land condition and land resources. It follows that land uses, of whatever sort, need to be managed to stay within land capability and that restoration measures are needed where the land capability has been exceeded and the land resource degraded.

This District Plan puts particular emphasis on pastoral use, the most extensive land use in the District and the primary concern of the Soil Conservation Board. However all uses and all systems of management have the potential to exceed land capability and to lead to land degradation.

Rangeland Condition

> *Rangeland condition is the 'health' of the plant and soil resources, relative to their potential condition in that particular area at a given time.*

Changes in rangeland condition, whether as improvement or otherwise, can occur rapidly or accumulate over a long term. They can be a result of a single event, for example a fire, a brief episode of over stocking or rabbit grazing at the onset of drought conditions, a localised heavy rainfall, hailstorm or a major flood occurrence.

Longer-term changes can be driven by climate variation. On the one hand, the almost continuous series of droughts from the turn of the century to the late 1940s contributed to loss of rangeland condition over much of arid SA. On the other hand, less arid seasons over the last 40 years have assisted improvement in condition.

In the Marla-Oodnadatta SCD, the production of cattle is solely dependent on native vegetation as the grazing resource. The vegetation:

- protects the soil from erosion

- provides pasture for stock and native animals
- provides habitat for wildlife and is fundamental to biodiversity
- provides shelter for livestock.

The sustainable management of the land must therefore conserve the condition of the rangeland and its vegetation, which includes maintaining:

- soil stability and soil structure
- plant density
- plant diversity
- mixed age stands of vegetation
- the vegetation's ability to respond to seasonal influences (e.g. put on fresh growth and set seed in response to rain; provide adequate root stock to re-shoot after drought)
- the soil lichen crust.

Plants are used as indicators of rangeland condition or the 'health' of the vegetation or pasture. The grazing impact on palatable species needs to be managed so that these species are maintained in the pasture. Where the mixture of species is altered, degradation of the plant community has occurred.

Vegetation diversity, vegetation cover and the susceptibility of soils to erosion is determined by:

- land capability
- previous and current land use and management.

Alterations to the soil resource, which result in a decline in the quality and condition of the soil, are called soil degradation. Acceleration of soil degradation in the pastoral areas (compared with natural wind or water erosion) most often follows removal of the vegetation and/or stone or lichen soil surface cover. Accelerated erosion includes gullying, drift and scalding and results in the loss of nutrients and topsoil. Where the soil environment is changed, the plant community will also change. Weeds and unpalatable native species, are likely to establish in degraded areas and production will often be decreased in the long term.

Extreme weather conditions, such as thunderstorms, hail, fire or a run of drought years, can also alter the condition of the land and affect nutrient cycles and the dynamics of the ecosystem. The affects of these natural phenomena are made worse by artificial events such as overgrazing by domestic livestock.

Condition is determined by comparing similar soil and vegetation sites under different land use pressures (e.g. through monitoring). Changes in rangeland condition may occur over short or long periods and may be reversible, irreversible and detrimental to long-term productivity. Rangeland condition is often a reflection of past management.

Management of Rangeland Condition

Sound management of the vegetation resource is the key to the health of rangelands. Pastoral rangeland condition is influenced by total grazing pressure from domestic,

native and feral animals. The introduction of exotic weeds and vertebrate pests such as rabbits, camels, donkeys and brumbies have also been contributing factors in changing the condition of the native vegetation and have often frustrated effective regeneration of degraded areas.

Indicators of high grazing pressure include:

- loss of the more palatable perennial species and/or the remaining perennial plants being in poor condition
- replacement of perennial species with annual and ephemeral species
- replacement of palatable species with less palatable species, e.g. replacement of bladder saltbush by bindyis (copperburrs)
- bare unstable soil surfaces with associated water and wind erosion
- increased grazing of normally unpalatable species.

Trees and perennial shrubs provide year round protection to the soil. Stock should be managed to ensure that the mix and density of perennials is maintained and, in degraded areas, is improved. The condition of the vegetation needs to be monitored closely and managed to allow for seed set and seedling establishment. Management of the vegetation resource also needs to recognise the stresses of drought; in very dry seasons annual plant cover and a proportion of the perennial cover will die and be removed by wind. During drought, the vegetation resource needs to be spared the additional stress of stock and feral animal grazing.

Grazing pressure is generally highest where stock congregate, such as around watering points and dam catchments. High grazing pressure and poorly positioned waters in relation to fencing and topography can be major causes of poor rangeland condition.

To manage the health of the vegetation resource, total grazing pressure needs to be managed through:

- stocking paddocks and waters with numbers appropriate to the condition of the vegetation and season and destocking areas before vegetation is damaged beyond its ability to 'come back'
- management of feral animals (rabbits, camels, donkeys and brumbies); this is achievable but requires ongoing commitment
- locating waters and fences to encourage an even spread of grazing pressure
- continual monitoring of vegetation and stock condition
- timely sale of cull stock.

Total grazing pressure

The two main factors most directly influencing rangeland condition are seasonal conditions and total grazing pressure. The latter includes domestic stock, native animals, rabbits, other feral herbivores and insects. It is important to separate these factors when assessing changes in rangeland condition.

To manage total grazing pressure, the impact of all the relevant herbivores must be taken into account. Kangaroo populations need to be monitored and managed at a sustainable level, particularly where there have been large increases in numbers

following dingo-baiting campaigns. Rabbits contribute significantly to total grazing pressure. Biological control is generally seen as the only feasible method of controlling the rabbit population in areas as vast as the Australian arid zone. However, while rabbit numbers are low following the spread of Rabbit Calicivirus Disease (RCD) through the District in 1996, selective warren-ripping programmes can be very successful in slowing the rate of their return. Domestic livestock are relatively easy to regulate by comparison. Stocking rates must be tailored to suit seasonal conditions. Indicator species and stock condition should be closely monitored to minimise the degradation associated with overgrazing.

Average carrying capacity for the District varies considerably depending on land type and season and ranges from almost zero in land systems such as Moon Plain to 2 - 3 cattle / km^2 in the highly productive floodouts such as those of the Macumba land system. Prescriptions cannot be given: these figures are extremely reliant on flushes of ephemeral feed and may not be sustainable over a longer term.

As a rough measure for comparison, Table 4 gives some equivalents with respect to the grazing impacts of different herbivores.

Table 4 Equivalent Grazing Impacts of Herbivores

Cattle	Camel	Brumby	Donkey	Kangaroo	Sheep	Rabbit
1	1	1	2	8	7	80

Production Indicators and Constraints

For simplification, the District has been divided into generalised land types. These fall into broad categories, with numerous variations and a variety of pasture types within each category. These generalised land types are:

- tablelands with gilgai, gibber and chenopod shrubland
- sandy plains and dunes with mulga woodland
- sandy country with chenopod swales
- uplands and hills
- floodouts and lakes.

Following are brief notes describing some characteristics of these broad land types:

Land Systems - An indication of which land systems are encompassed by the generalised land type.

Inherent factors affecting production - a description of some of the land factors that affect pastoral production irrespective of management.

Indicator Species - Plants which can be used to indicate levels of range condition through their occurrence or abundance for a particular soil - vegetation association are referred to in this section as “indicator plants”.

Stock Management - A description of some of the stock management principles appropriate to the land type.

Indicative carrying capacities are given for some land systems or land types. These are based on experience of grazing effects in the District. They are expressed as a range rather than an absolute number in order to take account of variations within the land systems, both in terms of land condition and seasonality and in the extent of development of the watering system. Indicative carrying capacity, based on the assumed condition level, can be expressed in terms of number and type of livestock (breeds, age and sex). These indicative carrying capacities should be used only as a guide and are subject to the normal management considerations. District plans need not discuss the setting of a stocking rate for a specific area because this is a further separate step that needs to take into account the particular characteristics of any grazing unit. Set stocking is not appropriate in all land types because of the significance of ephemeral growth in response to seasonal events in many areas, particularly on floodouts and lakes.

Indicative carrying capacities expressed in this district plan are subject to review as more monitoring information becomes available.

Tablelands with gilgai, gibber and chenopod shrubland

Land Systems

The Oodnadatta, Baltana, Crispe, Paisley and Coongra land systems are included in this landform.

This land type is the most widespread in the District and occupies 45% of its total area.

Inherent factors affecting production

Factors influencing production include:

- Hard stony country is hard on the cattle's feet, hence their grazing radius of 7 - 8 km is less than on softer country.
- Hard sparsely vegetated land provides run-off into gilgais where perennial grasses re-shoot quickly in response to light rainfall.
- Gully erosion is likely where stone cover has been removed.
- Stock do not need to be provided with salt and mineral supplements on this country.
- Water is not a limiting factor because hard gibber flats and hillsides provide good run-off for dams, storm banks and naturally occurring depressions such as gilgais.

Indicator species

Indications that the country is being over utilised and stock numbers should be reduced include:

- Perennial grasses such as Mitchell grasses and neverfail (bristly love-grass): grazing of these species to less than 120 mm (5") indicates that the country will no longer be able to improve stock condition.
- Oodnadatta saltbush: this is not a favoured species and tends to be grazed by brumbies and donkeys more than by cattle. Cattle eat it only when the more palatable species have been fully utilised. De-stocking is therefore required as soon as anything other than light grazing of this species is observed.
- Bladder saltbush: stock numbers should be reduced when heavy grazing is noted.

Stock Management

- Grazing radius is 7 – 8 km: stock with up to 100 cows with calves or 150 dry stock/steers per watering point.
- Locate waters 14 – 16 km apart to ensure that some country remains in reserve for use when surface water is available. This allows country near the permanent waters to be rested. Shift stock from permanent waters where possible to encourage grazing in new areas and allow vegetation a spell for growth and seed set. Grasses need at least 6 weeks spell after a suitable rain in order to set seed.
- Rotate grazing areas: spell grazed areas and reserve areas for use during dry/drought times.
- Opportune spelling:
    - spell areas occasionally after rain for chenopod shrubs and Mitchell grasses to set seed
    - encourage stock to spread out into the areas away from permanent water after rain.
- Fencing:
    - large paddocks with more than one watering point (about 400 km^2 depending on management preference) allow spelling of areas around permanent waters when gilgais contain water
    - makes stock management procedures such as mustering easier, especially when there is a holding paddock and loading facility nearby
    - enables the separation of weaners from cows
    - stock in large paddocks are more likely to benefit from isolated rainstorms than those in small paddocks without management intervention
    - holding paddocks need to be at least 10 - 15 km^2 to maintain rangeland condition
- When annual feed has been grazed or dried off, it is necessary to lighten stock numbers quickly to avoid stock and perennial vegetation losing condition.

- Where surface water is available, stock will hold condition for a short period (up to 6 months) on chenopod shrubs. Remove stock when heavy grazing of these shrubs becomes evident.
- Stock will lose condition in chenopod shrubland when forced to drink bore water of >2,000 ppm.
- Country needs to be stocked according to season; the condition and amount of vegetation determines the length of the grazing season; e.g. move cattle out to a storm bank where there is enough feed and water for a few months to allow vegetation around permanent waters time to recover. Strong dry winds in October will dry out feed and stock will need to be moved.
- Gilgais maintain productivity: perennial plants protect the structure of gilgais and when removed the gilgai may fill with silt. This in turn may lead to increased soil salinity and a changed soil environment where plants are less able to grow.

Sandy plains and dunes with mulga woodland

Land Systems

The Ammaroodinna (dense scrub), Commonwealth, Moorilyanna, Mount Willoughby (dense scrub), Pedirka, Piarooka, Tieyon (dense scrub), Simpson and part of the Wooldridge land systems are included in this landform.

This land type covers 25% of the total District area.

Inherent factors affecting production

- It is prone to soil drift where vegetation cover is sparse.
- It is deficient in minerals; stock need phosphorus supplements where there are no chenopod shrubs.
- Sandy country with a mulga overstorey is quite resilient, with the soil being stabilised by the mulga and grasses that recover well from grazing. It has a more stable carrying capacity than areas of saltbush, which when overgrazed take a long time to recover. It is also more resistant to erosion because the mulga protects the soil from wind and water.
- Mulga and other woody overstorey species compete for soil moisture and reduce the production of palatable species such as grasses.
- It is susceptible to woody weed invasion, particularly when the grass component is removed and there is no competition with woody weed seedlings.
- There is a limited opportunity for harvesting surface water because there are few areas that have clay soil.
- Sandy country responds to good winter rains (>20 mm) with growth of desirable fodder plants such as parakeelya and annual herbs.
- It does not respond well to summer rain, although good summer rainfall enables perennial grasses to re-shoot and promotes recruitment of tall kerosene grass, mulga grass and woollybutt.

- Sandy country is prone to bushfires, especially where tall kerosene grass and/or mulga grass is present. The Ammaroodinna and Commonwealth land systems can sometimes have sufficient combustible fuel loads to carry a bushfire.

Indicator species

Indicators that the country is being overgrazed or is becoming degraded and that stock should be moved or their numbers reduced include:

- Woollybutt, neverfail (bristly love-grass) and woollybutt wanderrie are grazed to less than 120 mm (5").
- Satiny bluebush, ruby saltbush and spiny saltbush are sustaining heavy grazing.
- Weeping emubush is grazed.

Presence of the palatable bandicoot grass indicates country in good condition.

Stock Management

- Cattle will walk further in sandy country, giving a grazing radius of 8 - 10 km: stock with up to 100 cows with calves or 150 dry stock per watering point.
- Permanent watering points should be located approximately 16 - 20 km apart (but not on drainage lines) to allow for even grazing and spelling.
- A higher level of infrastructure is needed to manage stock in sandy country because mustering is more difficult here. This includes trap facilities at watering points (control watering points), trap yards of 1 - 2 km^2 and holding paddocks.
- Country should be fenced to the land system boundaries; cattle do not like this country and will move to tableland country if possible.
- Locate waters centrally to enable best utilisation of the pasture.
- Sandy land systems should be kept in reserve for dry seasons: the tableland country is more productive.

Sandy country with chenopod swales

Land Systems

The Alberga, Wattiwarriganna and part of the Wooldridge land system are included in this landform.

It includes 13% of the total District area.

Inherent factors affecting production

- Grazing radius is 8 – 10 km because cattle will walk further on soft country than in stony areas.
- It is subject to wind erosion, which is exacerbated by loss of perennial vegetation cover.

- Bushfire, generally started by lightning, can be a problem when fuel loads are high.
- Kangaroos are in high numbers and add significantly to total grazing pressure (especially in Alberga and Wooldridge).
- Rabbits are a major problem in this country.

Indicator species

Grazing or heavy grazing of the following species indicates that the more palatable species have been largely removed and it is time to reduce or remove grazing pressure:

- Sandhill cane-grass: stock will graze the green tips, but when they start on the woodier bulk of the tussock stock will lose condition.
- Neverfail (bristly love-grass), woollybutt and woollybutt-wanderrie are grazed to less than 120 mm (5").
- Ruby saltbush and spiny saltbush are sustaining heavy grazing.
- Bladder saltbush is being heavily grazed.

If good quality water is available, stock will graze chenopods. In these situations, bladder saltbush, low bluebush and satiny bluebush can be used as indicators of grazing pressure and stock need to be removed once bush has been pruned back to 50% of its original cover.

Stock Management

- Grazing radius is 8 - 10 km: permanent waters should be placed 16 - 20 km apart and stocked with 100 head of cattle per water.
- Stock numbers can be increased when claypans provide fresh water, but must be reduced once grasses dry off.
- Locate waters on harder country to minimise erosion.

Uplands and hills

Land Systems

The Breakaway, Chandler, Mount Margaret, Wantapilla and Wilyunpa land systems are included in this landform.

It includes 13% of the total District area.

Inherent factors affecting production

This country is highly variable, so it is difficult to generalise stocking management guidelines. However, the following points apply:

- This is suitable country for dams because of good run-off and availability of clay.
- Tableland areas on breakaway plateaus hold water in gilgais.
- It is difficult to muster where there is rugged terrain.

- Access and the construction of roads and fences are often difficult.
- It is a haven for brumbies and donkeys and they are difficult to eradicate.
- Bore water is deep and salinity is quite high (5,000 - 7,000 ppm) making surface water availability critical.
- Only stunted vegetation exists on top of the silcrete capping of breakaways.
- Cattle prefer softer ground along watercourses.
- Gully erosion may occur in hilly parts, particularly in the Breakaway land system.
- Chandler and Mount Margaret land systems are of minimal stocking value because of their rugged, stony terrain.

Indicator Species

The country is deteriorating and stock must be moved when the following indicators are seen:

- Mitchell grasses are grazed to less than 120 mm (5”).
- Bladder saltbush is being heavy grazed.
- Any of the other chenopod shrubs are heavily grazed.

Stock Management

- Tableland areas, especially gilgai country, should be stocked according to season. Use storm banks and creek waterholes to spread grazing pressure after rain and then dam water (some dams last 12 months) when these are dry.
- Grazing radius is 7 - 8 km. Terrain affects grazing radius and drainage lines act as corridors for stock movements.
- Stock up to 100 cows with calves or 150 dry stock per watering point depending on terrain and water point location.
- Breakaway country needs careful monitoring because of its susceptibility to gully erosion.

Floodout and lakes

Land Systems

This landform includes the Dalhousie, Federal, Finke and Macumba land systems.

It includes 4% of the total District area.

Inherent factors affecting production

- Rabbits are a significant problem, particularly on sandhills and after flooding.
- It is able to produce significant pulses of ephemeral plant growth.
- Waterholes close to Lake Eyre turn salty as they evaporate.

- Because of low rainfall, the Stevenson does not flow very often and seldom floods. Big floods occur on average every 10 years, when they damage fences and cause problems with stock control. The channel floods, on average, once in every five years.
- Difficult access after flooding hinders ability to take advantage of ephemeral plant growth.
- Dams do not hold water well. Groundwater is shallow but hard to find and is of limited supply and poor quality.
- Feral animals, mostly camels, migrate from the Simpson Desert, increasing total grazing pressure, competing for water and damaging fences.
- Soil-drift is a problem in sandhill country during dry periods.
- Waterholes close to Lake Eyre turn salty and are not good for stock after they become half empty
- Plants
    - The Stevenson produces munyeroo, button grass and some Cooper clover and verbine after floods or winter rain.
    - Cooper clover grows in swamps after floods recede in autumn.
    - Queensland bluebush and cotton-bush grow in swamps at Macumba.
    - Silky browntop grows on the banks of Stevenson and Macumba Creeks.
    - River red gum grows along the Stevenson.
    - Red mulga (mineritchie) grows along watercourses on the harder country.
    - Coolibah grows where there is saline water in the lower reaches of the Macumba River, but near Lake Eyre, salinity is too high even for coolibah.

Indicator Species

Stock must be moved to bores when the following grazing conditions apply:

- bristly love-grass (neverfail) is grazed to less than 100 mm (4”).
- Queensland bluebush (golden goosefoot) and cotton-bush become heavily grazed.
- The ephemeral munyeroo (common purslane) along the Stevenson has been eaten, or has dried off and blown away.

Stock Management

- This is primarily opportunistic grazing country: set stocking rates per watering point are not appropriate in this country.
- Larger paddocks allowing flexibility for stock to move are preferred.

- Once channel floods fill claypans and swamps, there is plenty of water and stock can be sold or moved as feed is utilised. Stock will keep moving back to fresh water, so there is a need to control/manage stock movements. If channel floodwater goes before the feed, the system self regulates.
- At Macumba, when there are big rains (about every 10 years) water in the swamps can last for 12 months. Stock leave the swamps when either the feed or the water runs out and this system is therefore self-regulating.
- In the dry months, the feed dries off in the sandhill country and even though water may still be in the swamps, stock must be removed from this area.
- Small rains may give plenty of feed but no water: the area cannot be stocked for more than a few days following a storm.
- Feed comes in big flushes and stock cannot be moved in or out quickly enough to maximise its use. Truck access is difficult in sandy country and road construction is expensive because roads need to be clay topped.
- Macumba Creek can handle more permanent stocking because there is easy access for stock from waterholes to the tableland country of the Oodnadatta land system for grazing.
- Camels from the Simpson Desert add to the total grazing pressure.
- Cattle move out when it floods because they do not like boggy ground.

Water Resources Management

Surface Waters

Natural surface waters can provide the majority of stock requirements in some parts of the District and it is therefore very important to manage them appropriately. Following are some brief notes and management guidelines.

Waterholes, Claypans and Swamps

- These are often self-maintaining because the water supply is depleted before the feed.
- They tend to silt up if perennial vegetation on the surrounding country is lost. However, they may occasionally be flushed out by a big flood.
- Manage for stock use in much the same way as a dam.
- Freshwater fish, crustaceans and amphibians live in the bigger waterholes (e.g. frogs, yellow belly, speckled perch and bony bream).
- The more extensive surface water systems are in the north and east of the District. These can hold water for up to 12 months after good rain.
- Surface water along the lower reaches of the Neales and Peake Creeks becomes saline as it dries up.
- Less extensive creek systems occur in the western part of the District, but do not hold water for more than 3 - 4 months.
- Gilgais provide temporary surface waters.

- Canegrass and coolibah swamps are widespread.
- Claypans can last up to 4 months after 75 – 100 mm of rain. They are a valuable water resource, especially during cooler months of the year.

Dams and Storm Banks

- Dams should be sited on gentle drainage lines, not in the main part of a creek. Look for a natural by-wash on a less erodible area to allow for overflow and creek maintenance.
- Do not site dams and storm banks on fast flowing watercourses.
- The size of a dam needs to complement the feed situation (i.e. the water in the dam needs to last only as long as the feed in the area).
- Check soil profile type and suitability of site for holding capacity and catchment.
- Aim for more depth and less surface area to limit losses through evaporation.
- The depth of dams is limited by salinity in the soil profile in the eastern parts of the District
- Most dams need to be cleaned out, so it is best to have a dam silt tank. Silt tanks need large catchments and fluming and are costly to build.
- There is a need to be careful when mechanically desilting dams not to go too deep and allow access to the deeper salty aquifers or saline water table. This is particularly important in eastern parts of the District.
- Numerous smaller storm banks provide relief-watering points that scatter the cattle after rain and decrease grazing pressure on permanent watering points.

Groundwater

Groundwater complements or takes the place of natural surface water throughout the District and provides secure and guaranteed stock water. As a rule of thumb, most country in the District about 100 m above sea level or lower has free flowing artesian water of good quality. All pastoral leases have access to groundwater at varying depths and qualities, although the extreme west of the District is outside the Great Artesian Basin (Figure 8). Following are some brief notes and management guidelines:

Artesian Bores

- Completely shutting off artesian bores for long periods can lead to sand blockages and loss of flow. They may need to be turned on periodically to clear any sand build-up.
- Allowing artesian water to flow uncontrolled is considered a wasteful use of this valuable resource.
- Salinity of GAB water varies. High mineral content causes corrosion and increases maintenance costs.

- Wetlands created from some large flowing bores provide significant wildlife habitat (e.g. Purni Bore and Coward Springs Bore), mainly for waterbirds (Badman 1987), but they can also provide feral animal habitat.
- Hot GAB water needs to be cooled in a wetland area before it can be piped away, either using high-class poly pipe or through a cooling tank holding pond. (Water from the free flowing Snake Creek Bore is at 68^0C.)
- Cattle prefer to drink from water troughs near the bore head rather than from bore drains, except where the water is too hot to drink.

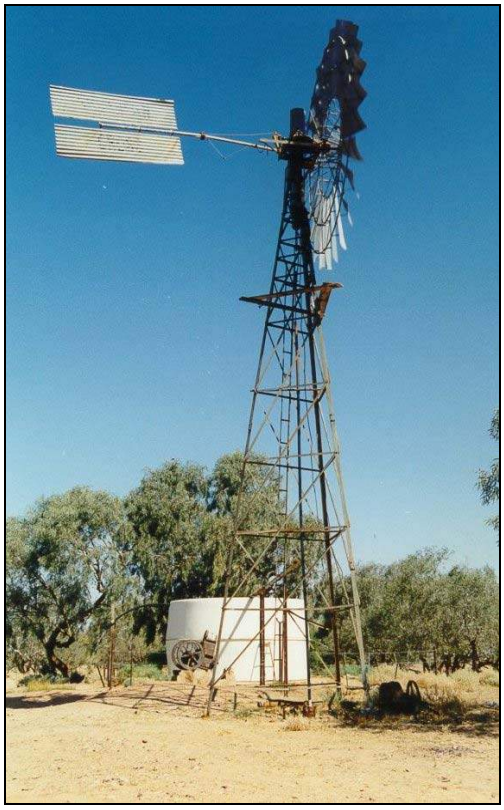
Mound Springs

- Mound Springs occur in the Witjira National Park (Dalhousie Springs), Wabma Kadarbu Mound Springs Conservation Park (Blanche Cup and Bubbler) and on Peake, Allandale, Nilpinna, Stuart Creek and Anna Creek stations.
- They are generally not located in good cattle country because they are usually surrounded by extensive saline flats that grow little except halophytic chenopod shrubs and sea heaths.
- The Department for Environment and Heritage (DEH) has fenced some springs on Nilpinna, Peake and Allandale for conservation purposes. A report has been prepared on management issues and recommendations for these springs (Fatchen 1999).
- If left in an undisturbed state, common species will displace rare species (Fatchen and Fatchen 1993).
- Native reeds can dominate at some springs where cattle are excluded, sometimes to the detriment of other flora and fauna, and biodiversity in general (Fatchen and Fatchen 1993, Badman 1999).
- The greatest plant diversity at springs occurs during periods of change when a dominant species is being replaced by different species, which may then also become dominant. This often occurs after very heavy grazing or fire (Fatchen and Fatchen 1993).
- Giant reed (bamboo) grows in abundance at one fenced spring. Cattle control it at an adjacent unfenced spring. Where it grows unchecked, it reduces the amount of available water (through evapotranspiration) as tall native grasses do at some other springs.
- Springs are not a major water source on Nilpinna, where they have variable water quality.

Sub Artesian Bores

- There are many sub artesian bores, some from the GAB and some from local aquifers.
- Good equipment maintenance is required to maintain a reliable supply. It is sometimes desirable to place water in marginal land and make cattle walk to better country to feed.

- There is a poor understanding of recharge and the extent of the aquifers: excessive use may cause depletion or an increase in salinity.
- The western side of the District has lower water yields from unconfined aquifers.
- Finding sub artesian water is a very 'hit and miss' affair.
- Water supply is pumped to tanks or turkey nest tanks. This may necessitate use of a mono-pump due to the occurrence of sand in some bores. Water is distributed to stock via troughs. Mineral crystals lead to oxidisation and corrosion when troughs are left dry.
- Corrosion problems can be handled using fibreglass, poly-pipe or stainless steel.
- Windmills are still an efficient way to pump water where it is less than 30 m deep. Two tanks (2 x 45,000 litres) are required for about 100 head of cattle.
- Solar power is desirable and is now becoming more cost effective than it was a few years ago.
- Mono-pumps with diesel motors are required for deeper bores.



Edward's Creek bore with windmill

Stocking Strategies

Most cattle from this District are aimed at the feedlot market. This means that some stock are turned off at each muster (up to 3 times a year), with animals being 12 - 15 months of age. However, some lessees aim for the export market and this has

implications for the choices available for adjusting stocking rates in response to seasonal conditions. Drought is a natural, inevitable event in this District and land management needs to reflect an acceptance of this rather than a response to it.

Duncan's bore cattle trough

Stock Management Principles

- In good seasons, wean at 6 – 8 months, fatten and market direct. In dry/drought seasons, wean at 3 months and send to a feedlot or supplement feed until feedlot age. Effective weaning needs good facilities (i.e. yards, trucking yards and holding paddocks).
- Irrespective of season, reduce older breeding herd and cull heifers heavily.
- Breeding requirements should take into account the need for high quality, good-muscle, good confirmation, good walking ability, soundness, fertility and quiet temperament.
- Quality heifers should be retained as replacement breeders.
- Where the breeding herd is of a fixed size, the natural increase should be turned off annually. Those sold would include cast-for-age cows, steer weaners and cull heifers.
- Bulls are run with the herd all year round to spread calving times.
- Aim for at least two musters per year to enhance herd quality and keep cattle from becoming uncontrollable.
- Aim for central water point location in paddocks.
- Fencing to land system boundaries is desirable wherever possible.
- Avoid fencing close to and parallel to drainage lines. This creates corridors and limits stock movements.

- Good machinery, facilities, working plant and access tracks make cattle management more efficient and less environmentally damaging.
- Use poly-pipe to move water to the most appropriate places in paddocks[3] with respect to land system and rangeland condition.
- Place storm banks to spread grazing pressure over the entire paddock.
- Move stock off ephemeral growth as soon as nutritional value is depleted.
- In dense mulga country, waters need to be controlled with good trap yards and trucking facilities.

Cattle yards for ease of stock handling

Transporting cattle

[3] If water is introduced into previously ungrazed areas, this amounts to clearance under the *Native Vegetation Act 1991* and requires the approval of the Native Vegetation Council or the Pastoral Board.

Rabbits

Following their release to the wild in the 1800s, rabbits have been a big problem in the east and far north-west of the District, particularly on sandy plains and dunes, but also on the calcareous plains and rises. The release and spread of RCD in 1996 has significantly reduced rabbit numbers in the District. However, populations may still return to former high levels in the long term unless there is a commitment to ongoing control. Although eradication would be the preferred goal of the Board, this is not a feasible option. Ongoing active management by other than biological means is viable only in areas with high cultural, social or environmental values. Local land managers fully support ongoing research into biological control methods for the rabbit.

The impact of rabbits can be summarised as follows:

- Even low numbers of rabbits suppress regeneration of perennials and can contribute to the replacement of a perennial plant community with an annual or ephemeral plant community or to an increase in the density of unpalatable plants.
- Grazing by rabbits, particularly when warrens are numerous, contributes to total grazing pressure and denudation of an area. This can lead to increased erosion, especially in sandy country.
- Twelve rabbits graze the equivalent of one dry sheep equivalent (DSE) (Linton and Cook 1997) and hence they compete directly with livestock and native animals for available feed. Localised destocking may become necessary where rabbits have grazed heavily.
- Rabbits provide a food source for dingoes, cats and foxes enabling these animals to reach higher numbers, which then impacts on native wildlife and livestock.

In the past and prior to the spread of RCD, rabbits supported a small opportunistic harvesting industry that earned export income and provided some jobs, although the distance from markets was always been a barrier to this becoming a viable industry in the District.

Warrens provide refuge for some bird and animal species during hot seasons, as did the warrens of locally extinct burrowing marsupials. These benefits are far outweighed by the ecological damage caused by rabbits.

Control

Rabbits are difficult and expensive to control. Rabbit control methods in this District are the same as the rest of the State and include 1080 baiting, fumigation, warren destruction and biological control.

Biological control of rabbits is often seen as the only real option in the extensive areas of the rangelands (MOSCB 1997), but is usually most effective when used in conjunction with other control methods (Cohen 1997, Williams 1997) as part of an integrated control programme. Myxomatosis is sometimes still effective in reducing rabbit numbers and its effectiveness was expected to improve through the release of the Spanish Rabbit Flea. However, release of this flea throughout the District has proved to be less effective as a vector for spreading myxomatosis than was expected.

RCD has substantially reduced rabbit numbers. However, no biological control measure will eradicate a host species and rabbits will continue to be a pest unless further control measures are implemented. It is essential that advantage be taken of the low rabbit numbers caused by disease, whether it is myxomatosis, RCD or something else, and that other control measures continue to be implemented. One such measure is to destroy rabbit warrens according to a plan that considers the productivity of the land and the costs and benefits of such a programme. Rabbit population control through genetic engineering may prove to be the long-term solution to the rabbit problem in the Australian arid zone, but this is still some way off. Preliminary research has started on fertility control by modifying the myxoma virus to spread an antigen to fertilisation.

Any rabbit control programme therefore needs to be planned to maximise benefits by targeting areas of high use and/or productivity and by designing a programme of manageable size.

Warren destruction is the key to rabbit control because rabbits rarely breed away from a warren. Control is most effectively carried out when numbers are low. Warren destruction is the most effective form of rabbit control and is recommended in "harder" country that is more productive. In sandy country, control is more difficult because warren-reopening rates are higher.

Work should be done in summer or during a dry spell when rabbit numbers are low to take advantage of:

- dry, friable soil (which readily collapses into the warren)
- low rabbit numbers (less likelihood of warrens being re-opened)
- heat. (Rabbits without the shelter of their warrens tend to be in poorer condition because they have no refuge from heat and dehydration and are more vulnerable to predation.)

It is important to rip any open warrens that could shelter rabbits. Trials conducted by the Kingoonya Soil Conservation Board on Billa Kalina Station found that the best results were obtained when warrens were ripped to a depth of at least 70 cm and at a spacing of no more than 50 cm. Ripping should extend three metres beyond the visible edge of the warren to ensure the destruction of the entire warren structure.

Cross ripping is essential unless winged boots are used on the ripping tines to minimise reopening.

Warrens that have been re-opened by rabbits must be re-ripped or fumigated to ensure the effectiveness of the ripping programme. The complete destruction of all warrens is vital for effective long-term rabbit control.

Other Feral Animals

Lessees and land managers have legal obligations under the *Animal and Plant Control Act 1991* to control populations of proclaimed feral animals. The Animal and Plant Control Commission (APCC) and Boards, formed under this legislation, assists with feral animal control. Government, landholders, NPWSA and PIRSA undertake pest control programmes consistent with State policies.

Large introduced herbivores are a problem in some parts of the District: horses and donkeys are more destructive grazers than cattle, often completely uprooting or

destroying plants. Camels from the Simpson Desert are quite numerous in the adjoining areas. All of these animals contribute to total grazing pressure.

Feral animals may compete directly with livestock and native wildlife for forage, or impact on areas that are not used by livestock. Their effects when uncontrolled are similar to the effects of uncontrolled domestic grazing, with overgrazing resulting in land degradation.

Both brumbies and donkeys are reliable breeders: adult females are able to produce a foal every year. They are less tied to water points than cattle. Some brief notes and management guidelines for the main problem species are listed below.

Horses

- Aim should be to eradicate all feral horses (brumbies)
- once a widespread problem, but they are now largely under control
- they contribute to total grazing pressure
- control by mustering and trucking, with shooting to mop up remaining animals.

Donkeys

- Aim to eradicate
- they contribute to total grazing pressure
- they are a significant problem on the eastern side of the District
- There has been no viable market for donkeys since 1978
- control by shooting.

Camels

- Aim to eradicate on most pastoral leases, or to manage numbers in a manner that balances environmental protection concerns with future prospects for the camel in Australian pastoralism
- monitor populations in north and north-east of the District, in the adjacent Simpson Desert where numbers are significant
- they damage fences and are very mobile
- domesticated camels (requires Pastoral Board approval) must be managed in the same way as domestic stock
- opportunistic harvesting of camels should be discouraged
- control by mustering, trapping and trucking and shooting.

The Board recognises the potential economic and environmental benefits of the dromedary camel as an alternative commercial rangelands stock animal. Several lease holders committed resources to this potential during the 1990s (Tieyon, New Crown, Stuart Creek) but to date an economically viable market has not been found. In this regard, the Board is committed to maintaining a strict control on feral camel numbers within its District boundary and adjacent desert areas.

However, early indications in the new millennium indicate that this situation may rapidly change with many new camel export markets being successfully negotiated by

the Northern Territory based Central Australian Camel Industry Association (CACIA). The Board maintains strong links with CACIA. The CACIA can be contacted on 08 8951 8183 or via their website (www.camelsaust.com.au).

Camels are used within the District by commercial camel trekking operations at William Creek, Peake Station and Coward Springs and have been used as a novelty-event race animal at local race meetings since 1984.

Dingoes and Wild Dogs

Dingoes are now considered a native species, having been in Australian for about 5000 years. Their numbers have decreased in areas where baiting programmes have been carried out, although Gee (2000) considered that dingo numbers are much higher now than they were at the time of European settlement. Dingoes are known to harass and kill stock.

Control programmes are carried out by pastoral lessees near the Dog Fence and opportunistically by individual pastoralists in some other areas. The Animal and Pest Plant Control Board injects the 1080 poison into the landowner's baits. No control is implemented in conservation reserves unless individual animals become a problem, usually to campers.

Wild dogs are generally only a problem near settlements, where they chase stock and will kill sheep and calves. They are usually considered less of a problem in this District than in sheep country to the south.

Cats

Feral cats are present throughout the District and take a heavy toll on small native wildlife (Read and Bowen 2001). A very small number of these may be shot or trapped, but this has no effect on the total population. There is no successful control agent for this animal.

Foxes

Foxes are present throughout most of the District and are known to have taken a heavy toll on the medium sized Australian mammals (Morton 1990). Fox numbers were once controlled to some extent by shooting for the fur trade, with large numbers taken off some properties. This industry has now collapsed due to concerns for animal welfare and foxes continue to take their toll on native Australian wildlife. This may have been exacerbated by the shortage of rabbits following the spread of RCD. Some experts consider this may have caused prey-switching to native fauna.

Insects

The Soil Conservation Board has recognised the potential for insect pests to contribute to rangeland condition. Only the locust is of special concern within the District:

Management Strategies

Locusts

Locusts may occasionally build up in parts of the District, but neither PIRSA nor the Australian Plague Locust Commission (APLC) carries out regular control measures in this area. Most locust control is done further south, e.g. between Parachilna and Jamestown in PIRSA programmes or in the areas which abut the Queensland or NSW

borders (i.e. the eastern part of the state) by the APLC. These control programmes occur about every three or four years. The last plagues in SA were in 1992, 1997 and 2000, with a very small one in 1993. PIRSA considers that it is not practical or necessary to implement any locust control measures in the District.

Saltbush caterpillars

Several different species of caterpillars have been recorded on saltbush. These are in the families Pyralidae and Noctuidae and are all native species. Management of any of these is considered impractical. These may periodically build up their numbers and cause some localised damage, but over-all this is probably not very significant.

Kangaroos

The extended water network within the District has dramatically increased the breeding capability, local population size and distribution of Red Kangaroos. Red Kangaroos are advantaged even more where dingo numbers are controlled by pastoralists, and through reductions in traditional Aboriginal hunting. Euros occur within the District in isolated pockets involving very small numbers of animals, although their numbers are thought to be increasing. These populations will not be harvested or disturbed in any way. Western Grey Kangaroos do not occur within the District.

High populations of kangaroos can place grazing pressure on rangeland ecosystems with ecological consequences for perennial vegetation and economic consequences for the pastoral industry. Kangaroos may contribute significantly to the total grazing pressure on a property.

Regional Kangaroo Management Strategies

Regional management strategies have been developed (see below) through a consultative process involving the Department for Environment and Heritage, the District Soil Conservation Boards and other relevant regional bodies.

The following District figures for Red Kangaroos are current for late 2001.

Year	Kangaroo Density/km^2	Total Number of Kangaroos	Quota
1996	3.5	111 000	17 000
1997	6.2	198 000	60 000
1998	6.2	198 000	60 000
1999	9.4	298 000	90 000
2000	8.3	263 000	78 000
2001	8.8	278 000	84 000

The kangaroo quota is calculated in two parts: a sustainable use quota and a land management quota. Both are calculated as up to 15% of the total population, but the land management quota is not allocated in all years (e.g. 1996). Due to logistical

problems within the kangaroo industry, the complete quota is not harvested in most years.

The Board is of the opinion that the kangaroo industry should be supported (with suitable quotas, etc.) so that it can assist the beef industry when kangaroo numbers peak. The kangaroo industry is supported as an adjunct to cattle grazing.

Marla-Oodnadatta SCB Kangaroo Management Strategy

Status – ADOPTED

Red kangaroo numbers have been monitored in the Marla-Oodnadatta Soil Conservation District since 1995. Aerial survey figures indicate a mean red kangaroo density of 7.13 per km^2 during that time.

Management objectives proposed under the South Australian Kangaroo Management Program:

Objective 1 To harvest red kangaroos as a sustainable resource.

Action Issue a sustainable use harvest quota of 15% of the estimated population on each property annually, based on survey results of the previous year. Permits are to be issued in full at the beginning of each year.

This approach seeks to prevent the build up of very high numbers of kangaroos, facilitate the development of a kangaroo harvesting industry capable of sustaining the required harvest and, where possible, enable an economic return to landholders from kangaroo harvesting.

Objective 2 To avoid excessive increases in red kangaroo numbers and the concentration of excessively large numbers of this species on dwindling food and water resources during the onset of drought.

Action Encourage the utilisation of the 15% sustainable use quota across the entire Soil Conservation District on an annual basis. This should avoid rapid increases in numbers under most conditions.

Seek an additional kangaroo harvest quota (land management quota) in years where kangaroo densities are above 2.0 per km^2.

Use the Land Management quota to prevent increases in numbers when seasonal conditions are good and kangaroo numbers high.

In years where drought conditions are developing, the Board will seek to achieve a lowering of kangaroo densities in the region.

Objective 3 To protect isolated colonies of euros that occur within the district.

Action No harvesting of euros will occur in the district.

Wind Erosion

Wind erosion occurs where soil surface protection is low, especially where the ground surface is disturbed and soil particles are small enough to be moved by the wind (often referred to as drift). It is a localised issue within the District.

The major cost of wind erosion to the land manager is the loss of fine soil particles and organic matter, with a corresponding loss of nutrients. The loss of the most productive part of the soil reduces the productivity of the site and increases its susceptibility to further erosion. The sand blasting effect of eroding soil may damage plants, particularly seedlings.

Soil loss by wind erosion is most likely to occur in areas where vegetation has been removed. This can occur through stock and feral animal grazing and fire, or hailstorm in small isolated patches. Any disturbance of the soil surface leaves it vulnerable to soil drift.

Soils prone to drift are the sandy soils of the sand plain and dune land systems. The land systems in which sandy soils occur to a significant extent are:

- Wattiwarriganna
- Simpson
- Piarooka.

Sandy loams and other light soils are prone to wind erosion, leading to the possible development of scalds (see section on scalding). Further information on the effects of wind erosion can be found in Matheson (1992a) and Powell (2000a).

Land Management and Rehabilitation

Prevention of wind erosion is cost effective and much easier than revegetating areas after erosion has occurred.

Measures to prevent wind erosion and maintain or increase the density of perennial vegetation cover include:

- maintaining annual pastures to maximise grasses and litter cover on sandy soils
- avoiding locating access tracks and water points on sandy soils
- managing fire affected areas to ensure maximum recruitment of plants and establishment of perennial plants in the longer term
- controlling water run-off on to and across the scald
- controlling or, if possible, eradicating rabbits
- maintaining the lichen crust on soil surfaces.

In order to revegetate areas where wind erosion has occurred, it is necessary to restrict total grazing pressure. Providing a seed source and nutrient traps in the form of dead timber or rough soil surfaces will contribute to the re-establishment of vegetation.

Water Erosion

Gully erosion can result from high intensity rainfall events when the protective stone cover has been removed from gibber country. It is a localised issue within the District.

Creek systems are prone to natural erosion, especially following high intensity rainfall events.

The following land systems are particularly prone to gully erosion:

- Breakaway
- Coongra
- Crispe
- Wilyunpa
- Oodnadatta.

Further information on the effects of water erosion can be found in Matheson (1992b) and Powell (2000b).

Land management and rehabilitation

Gully erosion of the gibber land systems is likely to occur where the stone cover has been removed. The stone cover needs to be maintained when building tracks, which should be on the contour or on a gentle grade so that gully erosion is avoided. Water control banks may also be necessary to control the flow of water along tracks.

Scalding

Scalds are bare areas produced by the removal of the surface soil by wind and/or water erosion. The result is exposure of the more clayey subsoil, which is, or becomes, relatively impermeable to water. Scalds are a typical erosion form of texture contrast soils in semi-arid and arid regions.

Scalds result from the removal of protective plant cover (e.g. by high grazing pressure, hailstorm or the effects of drought) followed by the removal of topsoil by high intensity rainfall and/or winds. Scalds should not be confused with natural claypans, which are drainage sumps where water lies for extended periods following large rainfall events.

Scalds are difficult to revegetate due to the lack of topsoil, low soil permeability and often saline surface.

Texture contrast and calcareous soils are susceptible to scalding, which in this District is largely confined to some parts of Moon Plain. Scalding in this District appears to be minor. Natural claypans occur in other parts of the District, particularly in the Wattiwarriganna land system.

Land management and rehabilitation

Plant cover needs to be maintained to prevent scalds from developing on susceptible soils. Plant cover protects the soil from the erosive actions of water and wind and provides niches for the accumulation of organic matter, wind blown soil and seeds. Perennial shrubs provide the best soil protection because they are still present in dry times when the soil is most vulnerable to erosion.

Scalds have a smooth, crusty and often saline surface that is unsuitable for seed lodgement, germination and seedling establishment. A successful revegetation programme alters the environment to provide conditions suitable for seeds and plant growth.

To rehabilitate scalds:

- assess the expected benefit against cost
- control water run-off

- reduce wind velocity at the soil surface
- provide adequate moisture of suitable quality to allow seed germination and seedling establishment
- select suitable sites for seed germination and growth
- ensure a seed source is available at the site, either from mature bushes of appropriate species within 150 metres of the site and on the same level or above the site, or by direct seeding.

These needs can be met by mechanically altering the site. Furrowing and water ponding have been shown to be successful treatments for reclaiming scalds. Disc pitting has been used extensively in trials, but is often not successful on scalded areas because the soil slakes and/or disperses when wet and the pits quickly fill with soil and crust over. No formal trials on scald rehabilitation have been completed in this District.

Water ponding techniques have progressed rapidly in recent years at both Port Augusta and interstate. Rural Solutions SA will provide advice and a surveying service, for a fee, to pastoralists considering using water ponding.

Fire

Prior to European occupation, Aboriginal people used fire in some areas to promote fresh feed for kangaroos and to assist with hunting.

Bushfires are generally a rare occurrence in the Marla–Oodnadatta Soil Conservation District because continuous areas of flammable vegetation generally do not exist. Only in or following a year of exceptionally high rainfall does growth of this nature occur. Late in the 19th Century, the north-western part of the District, together with a larger area to the west, was described as being heavily timbered mulga country (Carruthers 1892). In 1914, Capt. S.A. White wrote "Leaving Todmorden [heading west]….we plunged into the dense mulga scrubs and soft sands that were to be our surroundings for a long time to come" (White 1915). However, a large bushfire burnt from about Roxby Downs to well into the Northern Territory in the early 1920s (Hayes 1987) and destroyed much of the mulga[4]. The fire was spread by heavy fuel loads following heavy rainfall during 1921. Mr Doug Fuller (personal communication to Frank Badman, August 1992) described the country as having little mulga present when he first moved to De Rose Hill Station in the early 1930s. Regeneration of mulga was suppressed by a severe drought through the 1920s and it was not until heavy rainfall occurred over two consecutive summers at the end of that decade that there was a massive regeneration of mulga. The rainfall in one year produced a flood in the Alberga that swept away the Old Lambina Homestead. Many young mulgas were established at Lambina in 1943 (McGilp 1944). The fact that fire destroyed much of the mulga is contrary to the suggestion of Brown (1992) who used the dearth of mulga to support the theory that degradation of the country was due to cattle grazing. In fact, mulga often benefits from disturbance (Lange 1966) and juvenile mulgas are generally unpalatable to cattle (Jessop 1995).

[4] The fire would probably have had to skirt the District on its western side in order to do this.

Late in 1974, large fires occurred along the western side of the District on the then Granite Downs Pastoral Lease. This was also a year of consistent high rainfall, which resulted in enough fuel loads to carry a fire. Dense areas of mulga grass and tall kerosene grass grew, which provided a large fuel load that carried fires over large areas. The first summer thunderstorms in November 1974 started over large areas of the District and the lack of fire fighters and poor access to the country enabled these early fires to burn virtually unhindered. In some areas, they burnt for many weeks before cooler weather and sporadic light rains extinguished them.

The main land systems prone to bushfire are:

- Alberga
- Moorilyanna
- Tieyon
- Ammaroodinna
- Commonwealth
- Pedirka
- Dalhousie.

Effects on vegetation

The ecological effects of fire in the arid zone are poorly understood, however some plant responses have been documented (Lay 1976). Woody shrub species may establish in high densities after fire, although most research into this subject has been carried out in areas with higher rainfall than occurs in this District. Fortunately, these species are generally short-lived and are eventually replaced by long-lived species such as mulga. Woody shrubs are more likely to become a problem if grazing pressure on the fire-affected area is not managed during the early recruitment phases. Woody shrub seedlings are not palatable to grazing animals.

With a reasonably intense and complete burn, mulga, horse mulga and western myall are easily killed. Western myalls and mulgas die by complete destruction of the trunk, even in low intensity fires. Mulga, white cypress-pine, sennas and saltbushes in particular, are killed when complete scorch of the canopy occurs, even if no part of the plant is actually burnt. Some bluebushes are susceptible to fire, often failing to re-sprout after a low intensity burn. Other species have remarkable tolerance to fire. In particular, bullock bush, native apricot, quandong and mallee have shown 100 per cent survival. Most perennial grasses can re-sprout from the base. Burning affects the composition of ephemerals appearing after the next rains and brings on widespread regeneration of mulgas from seed in some areas. This regeneration should be protected where possible until established.

Fires of similar proportions probably occurred as natural events at irregular intervals before European settlement. Because the average life span of the trees readily killed by fire is in the order of 100 to 300 years or more, it can be assumed that there is an interval of several generations between fires of this magnitude. In fact, some Aboriginal people think that European settlers of Australia have not yet been around long enough to understand the long-term cycles in weather patterns that occur here (Baker and the Mutitjulu Community 1992). Regeneration of these trees has seldom occurred since European settlement and their continued existence is dependent on

current populations. With the grazing pressure of rabbits, large feral animals and domestic stock, these seedlings may not survive. In the meantime, it would be foolish to suggest that because such fires are natural events, they be allowed to burn. The loss of perennial plants for drought fodder and for preventing soil de-stabilisation has long-term implications for ecology and productivity.

Land management and rehabilitation

Where fire has removed vegetation cover, management of the area needs to ensure that seedling germination and establishment is given the best possible opportunity to occur. Keeping the area free from grazing pressure and disturbance will maximise revegetation following rain. Stock numbers need to be reduced in proportion to the area that has been burnt. It is likely that annual species will germinate and establish cover in the first growing season, with perennial species taking several growing seasons to re-establish. The species of mature seeding plants in close proximity to the site will determine which species colonise the burned area first.

In a study at Roxby Downs in the Kingoonya Soil Conservation District, Badman (1995b) found that there was a significant increase in the incidence of introduced weeds on a recently burnt area, but that these were replaced by perennial native grasses following good rainfall during the next summer. The initial increase was thought to be due to increased soil nutrients caused by the fire. Once the native grasses became established, they prevented the establishment of annual weeds during the following winter. This emphasises the need to minimise grazing pressure until native vegetation has had time to establish on burnt areas.

Woody Shrub Increase

Woody shrub increase is a worldwide phenomenon. Suggested causes include things such as reduced burning, soil disturbance, increased atmospheric carbon dioxide (Hamerlynck et al. 2000), reduction of understorey through grazing, species introductions and other factors such as long-term climate change that are beyond the control of the landholder.

An increase in the density of woody shrubs is a localised response to soil disturbance often related to past overgrazing. The species showing tendencies to become a woody shrub problem are broom emubush and flat-stalk senna.

Research interstate, although mainly from higher rainfall areas, indicates that woody species increase where the vegetation and soils have been disturbed and/or where there is a lack of competition for soil moisture from grasses. In these situations, the growth of woody shrub seedlings is not limited by competition and shrubs may establish in high densities.

Woody shrub increase, mainly of legume species, is not an extensive problem in the District. However, the natives *Senna* spp. and dead finish are increasing in some drainage lines and sweet acacia (mimosa) is increasing around Dalhousie Springs and at Mount Sarah. Increase of introduced shrubs is currently not a problem within the District.

Prolific regeneration of mulga and high densities of gidgee also hinder mustering in some areas. Because there have been few fires in the District since 1975, mulga is very dense in some areas. This increase in density has been aided by the spread of RCD because there are no longer sufficient rabbits to prevent recruitment of mulga seedlings.

Cool burns (i.e. where flames do not reach or affect the mature tree canopy) may now be required to control mulga recruitment in some areas. Cool burns kill seedlings but do not harm mature trees. In order to enable cool burns to be carried out, it may be necessary to destock a portion of the country each year to provide a sufficient fuel load in the understorey to carry a fire. This may not be possible in areas that have high kangaroo numbers.

The use of fire to control mulga, or any other native woody shrub, is defined as clearance under the *Native Vegetation Act* 1991 and requires Native Vegetation Council or Pastoral Board approval.

Land management and rehabilitation

It is likely the local rainfall is too low for woody shrub increase to become an extensive problem in the District. Stocking country so that the density of palatable perennial bush species is not reduced and soil stability is maintained will also assist in preventing establishment of woody shrubs.

It is tempting to treat the symptoms of this problem rather than the cause. Destroying woody shrubs is not the entire solution to the problem. Soil needs to be stabilised and a good cover of vigorous deep-rooted plants is necessary.

Approval from the Soil Conservation Board, the Pastoral Board and the Native Vegetation Council is required prior to removing native vegetation.

Introduced Weeds

Weed management is one of the most important issues in rangeland areas. It is a dynamic area requiring land managers to keep alert in order to stay ahead of the problem.

Introduced weeds are currently not a major problem in the District. Many weed species originated from areas with higher rainfall and are incapable of long-term survival in the Australian arid zone. However, some species can remain as "sleepers" for many years before eventually spreading and becoming a problem, possibly as a result of a string of favourable seasons or other factors. Others may be well adapted to survival in the arid zone, but have not yet been introduced there. Establishment of a single species, especially one like Parkinsonia, could have devastating effects on the economy of the District. New exotic species are still being discovered outside but close to the District. A recent example is *Neurada procumbens* (Neuradaceae), a native of Jordan, which was recently found to the north on Andado Station in the Northern Territory.

Naturalised species make up only 96 of the 1093 taxa (8.8%) that have been recorded in the District. This is slightly less than the 10% suggested by Badman (1999) for the northern rangelands of South Australia and the 12% figure recorded for the adjacent Kingoonya Soil Conservation District. The weed species recorded in the District are listed in Appendix F, together with an estimate of their status within the District.

Weed species can be introduced in many ways including:

- deliberate introduction as shade, stock feed or for soil stabilisation
- introduction as garden species, e.g. Athel pine, pepper-tree and prickly pear
- introduction as food plants, e.g. date palms at Dalhousie

- accidental introduction on animals of burr weeds, or in an animal's gut e.g. Indian acacia (prickly acacia)
- accidental introduction of seeds on vehicles, equipment, etc
- accidental introduction of seed in imported goods, e.g. seed in imported hay.

The introduction of seeds in hay is one of the most common ways that weeds have been introduced to the District, but it can be avoided through careful purchase from a weed-free property. It is one of the main reasons for the large number of naturalised species that have been recorded only at homesteads and around stockyards. In most cases, these do not become established in the surrounding country. The Pastoral Board discourages the use of imported fodder. Where it is used, they consider it should be restricted to confined areas.

The Pastoral Board also has a policy that prohibits the deliberate introduction of alien "pasture" species without Board approval.

Natural dispersal by either wind or water will spread weed seed. Athel pine has been spread along the channels of the Finke River in the Northern Territory by seed or by small pieces broken from an adult tree taking root and becoming established further downstream. This has not yet occurred along the Finke in South Australia and the species may not be truly naturalised within the District. Date palms were planted at Dalhousie Springs in the late 1800s. They have become a problem where they have spread along some spring tails (Noack 1994). NPWSA and the Irrwanyere Board of Management have found it necessary to remove many young plants to protect the native vegetation and the natural biodiversity of the mound springs.

The colonisation and naturalisation of weeds depends on their ability to grow and propagate in the region in successive seasons and to be able to withstand drought. Disturbance is a key factor in most weed establishment. Any form of disturbance, whether large, small or subtle, creates a niche that is available for an invasive plant species to exploit. Disturbance in the arid zone is a natural phenomenon caused by things such as drought, flood, fire, windstorm, or even an emu pad, but the types and scale of disturbance have increased greatly since European settlement (Michelmore 1995). Roadsides, mine-sites, townships and stock waters are areas where this disturbance is greatest.

A detailed study of the spread of weeds in the South Australian arid zone was carried out by Badman (1995b). Although this study examined quantitative data from Roxby Downs in the Kingoonya Soil Conservation District and from a transect from Port Augusta through Roxby Downs to Lake Eyre, it also examined the spread of exotic species throughout the northern pastoral country. These findings were also reported and some data updated as part of the Lake Eyre South Study (Badman 1999).

The main findings of Badman's study that are relevant to the District are:

- The first alien species to reach an arid area will not necessarily be the ones that will become established.
- There has been an increase in the distribution of alien species since 1975, but this may be partially due to increased collecting and recording effort on the part of biologists.
- There is evidence to suggest that the increase in occurrence of alien species may now be levelling off or decreasing following the adoption of more

conservative land management practices, although new species are still entering the pastoral country.

- There are two suites of alien species in the northern pastoral country of South Australia: those that are widespread across the country and those that are restricted to wetter areas around human settlements. The latter species are generally not spreading into the surrounding countryside.
- Alien species were out-competed by native species, particularly grasses, following the exceptional rainfall events of the first half of 1989 and in 1992. There was an actual decrease in the incidence of alien species in both years.
- Summer rainfall produces native grasses, which then prevent the establishment of alien species by occupying niches which the aliens might otherwise have occupied.
- A high incidence of alien species follows a fire, but was not maintained once the high nutrient levels left by the fire are exhausted, especially if summer rainfall allows the establishment of native grasses.
- A decrease in the incidence of alien species following control of rabbits inside a rabbit-proof fence coincided with an increase in total vegetation cover.
- Control of short-lived alien species is not feasible at present other than by way of improved land management techniques.

The finding that alien species were out-competed by native grasses was in relation to short-lived weed species. This is unlikely to be the case with perennial species, particularly the introduced buffel grass that is widespread in many riparian corridors in the north of the District.

Buffel grass has established mainly in watercourses, often because of direct seeding. It usually does not become established in this District unless there is a big rain to get it going. Once it is established, it remains and displaces perennial native species. Introduction of this species is now contrary to the Pastoral Board's policy on the introduction of improved pasture species. The introduction of this species has direct implications on the local biodiversity (see subsequent section on *Conservation and Biodiversity*).

Weed control strategies

Due to the relatively low productive value of pastoral land and high cost of weed control, it is important to control new infestations of weeds as soon as possible. Once annual species become established it is almost impossible to control them with the resources available within the District. Perennial plants are easier to control, but should still be tackled before they become well established. Because most of these plants produce numerous seeds that remain viable for many years, it is important to destroy them before they have been able to set seed.

Badman (1995b) suggested that some new weed invasions are likely to come from the north. This is the case with rubber bush, which has become established in borrow pits alongside the Tarcoola to Alice Springs railway line. Other species are likely to spread north along the Stuart Highway, from seed carried in mud or dust on vehicles. Several new species have been recorded on the road verges in the Kingoonya Soil Conservation District in recent years. Salvation Jane appears to be spreading along the Stuart Highway north of Coober Pedy.

There is a distinct possibility that new weed species will be introduced into the District in cattle trucks. All trucks should be washed before entering the District from interstate. The Board is in favour of the construction of a high-pressure wash-down facility for trucks in Port Augusta.

Identify new plants first: many desirable native plants can remain dormant for years and then 'reappear' as a 'new' plant. Unknown plants can be posted to PIRSA Port Augusta for identification. Specimens for identification should include leaves, flowers and seed pods/fruits. Wrap the specimen in newspaper, not plastic, before posting.

Troublesome Native Plants

The main species causing concern in the south-east of the District is the desert riceflower, which is in fact a native plant. This species is toxic to stock and is responsible for Saint George's disease. The desert riceflower often grows in gilgais and persists there after other short-lived plants have gone. The plant is not eaten by stock, but it is believed that the toxic agents are ingested by cattle inhaling close to dried plants.

Developing a Weed Control Programme

It cannot be over-stressed that early action can prevent the establishment and spread of a new weed species, whereas it may be almost impossible and extremely expensive to control it once it becomes established and spreads over a large area. Regular surveys of any recently disturbed land, particularly where this involves developments by a third party, will allow the removal of new species before they are able to spread. The areas that are most prone to invasion include tourist stops, camping areas and watercourses.

Many Pastoral Lands Notes are available to pastoralists as guidance in developing appropriate control programmes for specific weeds. Once the weed has been identified, some common actions are required:

- Analyse the present and likely future spread.
- Identify whether the plant density is increasing within a given habitat. Has there been a management practice or some other change in environmental conditions that may have promoted this increase?
- Identify the concerns the weed will cause if it spreads to its maximum in the area.
- Identify costs and methods, and monitor the effectiveness of control.
- Determine the extent of the control programme. Is the aim to be:
    - Eradication
    - Control to contain
    - Control to minimise economic damage
    - Monitoring.
- Follow the guidelines of the APCC where applicable and identify legal requirements.
- Implement the control programme.

- Review the programme regularly.

There is a need to acknowledge existing strategies at national, state and regional level and for individual species where these exist. With weed management, it is important to work collectively wherever possible.

Principles of Control

Hygiene

Buy only weed-free hay, stock and equipment. Hold new stock in a holding paddock for 10 days to clear intestinal weed seeds before putting them into the main paddocks. Try to ensure that trucks or machinery from infested areas, particularly earthmoving plant, is thoroughly washed before entering properties within the District.

Mechanical Control

The most common methods of mechanical control are by hoeing or slashing of short-lived plants and bulldozing of large perennial trees and shrubs. If annuals are hoed or slashed just above ground level they often re-shoot. If they are hoed just below ground level, they generally die. If perennials are hoed to 100 mm below ground level, they generally die. Most trees and shrubs die if bulldozed 150 mm below ground level. Use herbicides on regrowth or hard-to-kill plants.

However, herbicides are often more cost effective than mechanical control methods and have the advantage of not disturbing the soil.

Hand pulling

Most annuals die once hand pulled. If plants break off at ground level, they often re-shoot.

Herbicide

Poor results will be achieved with herbicides if plants are not actively growing, if poor quality water is used, if label or recommended rates are not followed or if the herbicide is not evenly applied.

Management

Seek advice before commencing an extensive control programme using fire or grazing pressure in the rangelands.

> **Management strategies that conserve the native vegetation will generally succeed in minimising the establishment and spread of weeds.**

Burning of any pulled plant material should be undertaken wherever possible if it contains any seeds. Such material can be stored on a bare area, such as in an old borrow pit, until plants have dried out enough to burn, weather conditions are suitable or during the fire ban season.

For further information and to obtain copies of Pastoral Lands Notes on weeds contact the Animal and Plant Control Adviser, DWLBC Port Augusta.

Conservation and Biodiversity

Although conservation of native habitats and species is the primary role of National Parks and Wildlife SA, it is also the overall responsibility of all land managers and land users. Not all ecosystems are represented within the reserve system and therefore the maintenance of biodiversity needs to include off-park conservation strategies. Even an apparently barren area such as the Moon Plain, which has low pastoral value, is now known to have high biological importance (John Read, pers. comm. June 2002).

Privately initiated on-property conservation provides the opportunity for a potentially large and effective conservation strategy for rangelands in the District. It is a widely held view that long-term survival of many plant and animal species will only be possible if active management of animal and plant diversity by landholders and managers occurs. An idea of the proportion of the District's flora and fauna that are conserved within the Witjira National Park, the District's major conservation area, compared with the rest of the District may be gained from the tables in Appendices G and H.

Conservation of the diversity of flora and fauna in the District requires an inventory of native plant and animal species and their distribution, abundance and conservation significance. This district plan contains lists of plants (Appendix G) and animals (Appendix H) that are known to occur in the District. Additional species will be added to these lists as more survey work is carried out. Management strategies for habitats in which species of conservation significance occur may then be developed and implemented. All land managers have the responsibility to protect and manage the habitats within their control. Fifty-five species of plants that occur in the District have current State conservation ratings (see Appendix G) and three species have National conservation status. Of those with State conservation ratings, 43 are considered to be rare and 12 to be vulnerable. None are considered endangered at the State level. Table 5 lists those species with National conservation ratings and those considered vulnerable at the State level.

A few exclosures have been built to protect particular plant species, such as the one at Strangways Springs that was built to protect the vulnerable shrub *Hemichroa mesembryanthema* (Chinnock and Badman 1986, Davies 1995). Most other exclosures have been established as reference areas and are too small to have a significant effect on conservation and biodiversity. However, the Arid Recovery Reserve (see below) at Roxby Downs is an exclosure on a much larger scale that has allowed the re-introduction of animals that had become locally extinct as well as protecting and increasing the local biodiversity.

Habitat management is complex. It involves managing to minimise the impacts of degrading influences and establishing or maintaining viable populations of desirable animal and plant species. In parks, degrading influences can include feral animals, pest plants and tourists; on pastoral leases, stock also alter the natural landscape.

While all land needs to be managed in a sustainable way, some environments require specific management approaches.

Riparian areas (creeks and their environs) are of particular significance. Some riparian areas provide suitable conditions for remnant communities common in the region during wetter geological eras. Riparian areas provide drought refuge for native animals (Morton 1990) and stock, which rely on and compete for the water supply and

nearby forage (Badman 1999). Predators also concentrate in these areas. Threatened species whose ranges are reduced by drought are particularly vulnerable to population decline or extinction by predation or catastrophe.

Table 5: Plant species with national conservation ratings or considered vulnerable in South Australia

Species	National Status		Vulnerable in South Australia
	Vulnerable	Endangered	
Cyperus dactylotes			+
Embadium johnstonii			+
Frankenia plicata		+	
Halosarcia cupuliformis			+
Hemichroa mesembryanthemum			+
Maireana melanocarpa	+		+
Orobanche cernua var. *australiana*			+
Ptilotus aristatus var. *eichlerianus*			+
Sclerolaena symoniana			+
Stemodia "Haegii" (J.Z.Weber 9055)		+	
Swainsona minutiflora			+
Swainsona procumbens			+
Swainsona viridis			+
Typhonium aff. *alismifolium*			+

During the 1800s large numbers of stock perished around waterholes during drought. This concentration of stocking pressure caused denudation of vegetation and soil erosion, in particular scalding of large areas near the near-permanent waterholes. The recovery of these areas is very slow and has been hampered particularly by the impact of rabbits, but also by other gazing animals. They will not recover unless grazing pressure is reduced for several decades.

The most heavily grazed areas are around water points where a piosphere (or grazing halo) effect is discernible through a radiating reduction in palatable species, with the greatest effects closest to the water. The conservation of pasture and sustainable grazing management of these areas is dependent on the species mix and plant density being maintained, improved or re-established depending on its current condition. Management strategies include sustainable grazing of stock, reduction of feral animal grazing, appropriate stock water location and distribution, and revegetation.

The combined grazing pressure of all herbivores leads to soil disturbance and a reduction in the density of palatable plants. This leads to an increase in density of unpalatable plants (increaser plants) and a decrease in density of palatable species (decreaser plants). This change in the plant species mix may threaten the local survival of palatable plant species and their plant communities.

Introduced plants reduce the integrity of native plant communities. In some circumstances, pest plants are beyond total eradication. Reducing grazing pressure and soil disturbance for several decades may decrease their density (e.g. wild turnip).

Other species such as prickly pear and other prescribed plants (*Animal and Plant Control Act 1991*) require eradication.

High rabbit populations contribute considerably to vegetation destruction, soil erosion and sustained high populations of predators, i.e. foxes and cats. Cats and foxes prey on native species and lambs, particularly during crashes in the rabbit population following drought or disease. Foxes in particular may focus their predation on one species (episodic hunting), leading to dramatic decreases in the populations of those animals.

Tourism associated with the pursuit of "remote area" experience can also lead to local impacts on vegetation, soils and animals. These may include:

- soil erosion caused by off-road driving, particularly in hilly locations
- disturbance of wildlife and stock
- pollution associated with waste management, including litter and wastewater disposal
- soil compaction and erosion
- vegetation disturbance
- removal of wood for fires and the resultant loss of fauna habitat
- introduction or spread of weeds.

Biodiversity

There is no simple and unarguable definition of biodiversity, although true biological diversity is more than simply a list of species. It is the variety of life and includes the numbers of individuals and types of animals and plants in an area or habitat.

The sustainable management of the grazing enterprise achieves plant conservation. The maintenance of biodiversity will also maintain a viable grazing operation. Plant and animal species of the arid and semi-arid lands contribute to the biological wealth of the country and may have values yet to be discovered (Biological Diversity Advisory Committee 1992).

For lists of plant and animal species known to occur within the Marla-Oodnadatta Soil Conservation District, refer to Appendices G and H. Table 6 summarises the number of taxa within the District and within conservation areas. Data on conservation status are mainly from the Witjira National Park. Few data are available on the biological resources of the Wabma Kadarbu Mound Springs Conservation Park.

Threats to Biodiversity

Five main threats to biodiversity have been identified: habitat loss, introduced species, pollution, population growth and over-consumption. The human race is directly responsible for all five threats.

Habitat loss, including habitat fragmentation, is generally recognised at the greatest threat to biodiversity. This loss is greatest in higher rainfall areas when land is cleared for farming or urban development, but can also be caused by overgrazing. Overgrazing is not restricted to introduced herbivores: kangaroos can have an equally devastating effect when present in very high densities, as they often are in the southern rangelands because of the presence of additional permanent watering points and the exclusion of dingoes by the Dog Fence.

Table 6: Summary of numbers of plant and animal taxa known to occur and to be conserved within the District.

	No. of taxa in District	No. of taxa in conservation areas[1]	No. of introduced taxa
Plants	1093	938 (86%)	96 (9%)
Birds	210	188 (90%)	3 (1%)
Mammals	53	39[2] (89%)	9 (17%)
Reptiles	101	60 (60%)	0
Fish	12	6 (50%)	1 (8%)
Amphibians	6	3 (50%)	0
Aquatic invertebrates	35	35 (100%)	0

[1] NPWSA (2001). However, the Witjira records appear to include several taxa from outside the park boundaries and may therefore be overstating what is actually conserved (F.J. Badman, pers. comm. April 2002).
[2] Excluding introduced species.

The CSIRO and the South Australian Government now considers that the placing of new watering points in areas that were previously considered to be beyond the normal grazing range of stock may represent a threat to local biodiversity (Landsberg et al. 1997). Areas outside what is considered to be the normal grazing range of sheep and cattle are considered to be safe from stock damage and reduction in biodiversity. In practice, all areas of a pastoral lease are grazed in good years, but most damage to country is done during dry periods (Morton 1990) when native and domestic herbivores are competing for the remaining resources around permanent watering points.

Introduced animals have a significant impact on native fauna. Animals such as the fox have a direct impact on native fauna through predation. The fox has been implicated in the disappearance of some of Australia's medium sized mammals. The impact of introduced herbivores is less direct, resulting in alteration to, or destruction of, the animals' habitat. The impact of the rabbit on vegetation (habitat) is discussed elsewhere in this plan. Introduced plants often prosper in native vegetation associations, where they sometimes become established faster than native species. This can happen where a suitable niche becomes available, through either drought or overgrazing. Badman (1995b) found that wild turnip was able to dominate vegetation within parts of the Kingoonya Soil Conservation District when native perennial grasses were removed and winter rainfall occurred before any follow up summer rainfall allowed their re-establishment. However, wild turnip was displaced by these grasses when good summer rains preceded any winter rainfall.

Pollution is not a widespread problem in the District, although pollutants have caused some localised damage to vegetation near some homesteads and settlements.

In densely populated areas, human population pressures can result in the over-grazing and over-planting of marginal lands in order for the population to subsist. This threatens much of Earth's land surface with desertification. The low human population within the District means that this is not an inherent problem, although the effects of population pressure on local habitats can be seen around the larger settlements. This is often in the form of multiple tracks left by off-road vehicles.

Consumption of natural resources faster than they can be replenished is not generally a problem within the District. Although it may occur following local droughts, it was a greater problem in the past and is now better managed because of the current state of environmental awareness throughout the rangelands.

Although many of the medium sized Australian mammals are now extinct (Morton 1990), such extinctions are now uncommon or rare events. Despite this, one animal, the Black-footed Rock Wallaby, appears to have become extinct within the District since the first District Plan was published. The reasons for this are not yet confirmed.

Management

Habitat conservation requires an integrated approach that considers cause and effect of actions and how to combine these to best effect. Considerations include:

- the biology of the species involved
- interactions between species and prey switching
- timing of controls
- the regional perspective
- budgetary constraints
- monitoring the strategy.

Witjira National Park and Wabma Kadarbu Mound Springs Conservation Park are the only two formal National Parks and Wildlife (NPWSA) reserves in the District. Their conservation effort has been supplemented in recent years by the Arid Recovery Reserve at Roxby Downs, which has the advantage of having excluded all introduced herbivores. A large part of the biodiversity conservation effort in the District must still come from lessees and pastoral land managers.

Witjira National Park

Prior to its gazettal as a national park, sheep and later cattle grazed the area for over one hundred years, with the most intensive grazing in the Dalhousie Springs area and along the Finke floodplain. The dedication of Witjira included the first significant tract of stony tableland and gibber country within the South Australian reserve system. In addition, the Park provides for the conservation of the terminal floodplain of a major arid zone river system, that of the Finke River. The Park offers visitors a place of solitude and varied perspective. Its principal tourist attractions are the Dalhousie Springs and the track from Dalhousie to Birdsville across the Simpson Desert.

Since the Park's inception in 1985, tourist numbers have increased steadily, particularly with the sealing of the Stuart Highway and the construction some years previously of a formed track, the "Rig Road", across what is now the Simpson Desert Regional reserve and Simpson Desert Conservation Park. Witjira is becoming part of the 'outback experience' for visitors from southern centres as well as from the Northern Territory. In 1990[5], over 6,500 people visited Dalhousie Springs (DENR 1995).

Proclamation still allows for mineral and petroleum exploration under the *Petroleum Act 2000* and Section 43 of the *Mining Act 1971*.

A management plan was formalised in 1995 outlining the arrangements for joint management between the Irrwanyere Aboriginal Corporation and DEH. This ensures Aboriginal cultural and customary concerns are taken into account in park

[5] More recent data for a full year are not available.

management. It also ensures the involvement of the Aboriginal rangers in the day-to-day park running of the park.

The Arid Recovery Project

The Arid Recovery Project is a joint initiative between WMC Resources Ltd, National Parks and Wildlife SA, the University of Adelaide and Friends of the Arid Recovery Project. An area of land, of sixty square kilometres, has been fenced[6] to exclude all introduced ground-dwelling animals and to control the number of kangaroos. These animals have been progressively eliminated from within the fenced areas. The final thirty square kilometres was completed during 2001. The first stage was on the Olympic Dam Mine Lease and Roxby Downs Station, with later expansions extending on to Stuart Creek, Mulgaria and Billa Kalina stations. Of the total area, two km^2 is within the Marla-Oodnadatta Soil Conservation District. The total cost of fencing has been in the order of $10,000 per kilometre for materials only. Most of the labour was provided by volunteers and Greencorps teams.

Four species of mammal that formerly inhabited the area have been reintroduced to the exclosure: they are the Greater Stick-nest Rat, Burrowing Bettong, Greater Bilby and Western Barred Bandicoot. In 1998 and 1999, 100 Greater Stick-nest Rats were introduced to the exclosure and these are showing a pattern of breeding up from autumn to spring, but declining during January and February. Their numbers are now in the hundreds. It is expected survival of young will be greater once nests become larger and better insulated. Thirty-five Burrowing Bettongs were released in late 1999 and early 2000 and these have bred almost continuously since that time. They have constructed many warrens, often opening up old rabbit warrens, some of which are thought to have been old bettong warrens. Eleven bilbies released in April 2000 have bred up to a population of at least 25. Bilbies have been very active in burrowing and turning over the soil. During one period, they sought out grubs in the roots of hopbushes, leading to the deaths of many juvenile plants (perhaps a natural control for woody weeds). Eleven Western Barred Bandicoots were released in 2001. All of these animals began to breed as soon as they were released into the exclosure.

The cover of annual plants within the reserve is now significantly greater than it is outside. This is due both to the absence of rabbits and to the control of kangaroos.

The Arid Recovery Project won a SA Great Award in 2001.

Community support has been vital in the establishment of this project, particularly that given by the local Friends of the Arid Recovery Project group. Further information can be obtained from:

Friends of the Arid Recovery Project
C/o Environmental Department
P.O. Box 150
Roxby Downs SA 5725.

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act came into operation on 16 July 2000. Its implications for the District are likely to be limited to future developments in areas that provide habitat for rare or

[6] 30mm rabbit netting was used around the exclosure. Some other exclosures in the District (e.g. those around Blanche Cup and The Bubbler, have used standard 40mm rabbit netting, which does not exclude young rabbits.

endangered plant or animal species and wetlands that provide habitat for migratory birds. Migratory bird habitat is provided by several ephemeral wetlands throughout the District.

Three plant species have National conservation ratings (Table 5) and the potential disturbance of any of these would trigger the Act. These are *Maireana melanocarpa* (rated vulnerable), *Frankenia plicata* (rated endangered) and *Stemodia* "*haegii*". The former is known to occur on sandplains in the north of the District. *Frankenia plicata* occurs in the Breakaway land system, where it is sometimes quite common (Brandle 1998, Badman 1999). *Stemodia* "*haegii*" is known from a few collections from the Moon Plain.

Cultural Heritage

Aboriginal Heritage and Culture

Due respect by all land managers and visitors must be given to all Aboriginal heritage sites and sites of cultural importance. Failure to do so can leave the land manager open to prosecution under the *Aboriginal Heritage Act 1988*. The Aboriginal culture is active and land managers need to understand and respect the importance of land to Aboriginal people.

Land managers are encouraged to develop good relationships with Aboriginal groups active in their areas and take reasonable steps to ensure that Aboriginal sites are not disturbed. Before development takes place near or on known or potential sites of Aboriginal cultural importance, relevant government departments should be contacted for advice, the proponent should contact the Department for State Aboriginal Affairs (DOSAA) and, in the case of pastoral lease land, the Department of Water, Land and Biodiversity Conservation's Pastoral Program. The *Aboriginal Heritage Act 1988*, which came into force in March 1989, provides for the protection and preservation of Aboriginal Heritage, including Aboriginal tradition, archaeology and history. In this context, Sections 20 and 23 of the Act are the most relevant parts and cover obligations with respect to reporting and disturbance of Aboriginal sites, objects or remains.

With respect to mining, Part 9B of the *Mining Act 1971* sets out what the holder of an exploration licence or mineral claim over *native title land* must do in order to be able to conduct exploration. It applies to registered mineral claims and to exploration licences granted, renewed or varied after 17 June 1996. Nothing in Part 9B of the *Mining Act 1971* affects the operation of the *Pitjantjatjara Land Rights Act 1981* or the *Maralinga Tjarutja Land Rights Act 1984.*

What is Native Title Land?

Native title land is defined in the *Native Title (South Australia) Act 1993* to mean land in respect of which native title exists or might exist. A plain English guide to the Native Title Act is given in Appendix I.

The law on what land is or might be native title land is unclear. This is a problem throughout Australia and is a matter on which tenement holders should take their own legal advice.

The South Australian Government considers that previous grants of freehold and some leasehold interests have extinguished native title on land because such grants

were inconsistent with the continued existence, enjoyment or exercise of native title on the land. However, views may differ on this matter.

The High Court indicated in the Wik decision, involving Queensland pastoral leases that native title interests had not been extinguished by the grant of a pastoral lease and that native title could coexist with the interests of the pastoral lessee. The same may be said about pastoral leases in South Australia, although there has still been no court decision on South Australian pastoral leases. The question of whether native title has or has not been extinguished in a particular instance in respect of particular land is one on which legal advice should still be sought.

The current situation regarding the implications of the Wik decision is outlined in Appendix J.

Eight Native Title Claims are currently lodged over parts of the District[7]. These are:

- De Rose Hill (claim SG6001/96)
- Adnyamathanha (claim SG6002/98)
- Kujani (claim SG6004/98)
- Antakirinja (claim SG6007/98)
- Eringa (claim SG6010/98)
- Wangkangurru/Yarluyandi (claim SG6016/98)
- Yankunytjatjara/Antakirinja (claim SG6022/98)
- Arabunna (claim SG6025/98)
- Dieri Mitha (claim SG66/98)
- Kokatha (claim SG6013/98).

The De Rose Hill claim has been heard and a decision by the Federal Court is expected in late 2002, although this decision is likely to be appealed whatever the outcome. The final decision may not be known for some time.

Disclaimer. This information is intended as a guide only. Persons wishing to carry out any activity that may have native title implications should seek independent legal advice. The Marla-Oodnadatta Soil Conservation Board and Badman Environmental expressly disclaim all and any liability to any person in respect of anything done or omitted to be done by any such person in reliance, whether wholly or partially, upon any part of the information contained in this District Plan.

European Heritage and Culture

The Soil Conservation Board recognises that its District contains some of the oldest pastoral runs in outback Australia, with origins dating back to 1859. For example, the Stuart Creek lease was surveyed and held by the famous South Australian explorer John McDouall Stuart prior to his successful crossing of the continent in 1861-62.

[7] Information on Native Title Claims has been taken from a map prepared by the Land Services Group of the Department of Administrative and Information Services and was current at 22 May 2001.

The eastern part of the District is crossed by the historic communication and transport routes of the south-north Bullock Road, Overland Telegraph Line and the original Ghan Railway, all of which are now overlain by the contemporary Oodnadatta Track. The Oodnadatta Track is in fact Australia's most historic and heritage-rich outback trail.

The Board requests all land managers to respect all sites of historical significance. Land managers are urged to liaise with relevant government departments regarding appropriate methods of preservation or conservation of such sites.

Several sites associated with early European settlement of the area now have some form of protection. These include the ruins of the Overland Telegraph stations at Peake, which is listed on the State Heritage Register and Strangways, which has been fenced off from the rest of the pastoral lease. Access roads to both sites now have Public Access Road status. The Dalhousie Station ruins are also conserved within the Witjira National Park. In addition, some buildings that are significant to the original narrow-gauge Ghan railway are preserved at Curdimurka and Oodnadatta. Ruins of buildings and the remains of other infrastructure such as yards, dams and water towers can be seen alongside the old railway embankment. The Algebuckinna rail bridge across the Neales River is of particular significance.

Other areas of interest such as the old Bullocky Road (Gee 2000) are harder to find and are not yet covered by any interpretive displays. A full understanding of their importance to the District requires the assistance of expert knowledge and interpretation.

Tourism and Recreation

Tourism

Tourism is a developing industry within the District, as it is in many other parts of outback Australia. Beginning with the official and celebratory "Year of the Outback" in 2002, the forthcoming decade will see a substantial increase in the number of tourists and tourism operators. Many of the latter will be virtually resident in the District during the cooler months of the year. Coober Pedy already has a well-established tourist industry and many of the visitors to Coober Pedy extend their activities into the District. William Creek and Oodnadatta derive most of their income from tourism.

Research for the next State Tourism Plan has shown that South Australia will seek to create tourism experiences that are memorable and focus more on ecologically sustainable developments. Visitors are fascinated by the District's natural and cultural heritage. Popular scenic attractions include the spectacular and colourful Breakaways and Arckaringa Hills, the barren Moon Plain, the saline Lake Eyre and the major watercourses that flow into that lake from the west. Equally, the unique gibber plains, vast mulga scrublands, complex dunefields and in particular, the unique natural heritage associated with mound springs and artesian seeps in the east, are all significant attractions for the visitor.

Organised tour ventures within the District include camel tours based out of William Creek, the Peake Station and Coward Springs Campground and several 4WD tours based out of Coober Pedy. Travelling on the twice-weekly mail route from Oodnadatta to Coober Pedy and return via William Creek is very popular. Aerial

tours over the District and especially Lake Eyre from William Creek are also popular, particularly when the lake contains significant quantities of water.

Tourism is also seen by many pastoralists as the preferred option for diversification away from the traditional pastoral enterprise.

Proper planning for tourism developments is essential, even for minor developments. Planned tourist facilities and regional strategies will ultimately benefit all landholders through improved roads, communications, commercial developments and social services. Pastoralists and tourism managers who integrate their combined expertise toward sustainable and cooperative development will benefit the region. Education backed by a legal framework will provide the best interaction between visitors and the local population.

Human impact

Human visitation has a range of environmental, infrastructure and economic impacts including:

- damage to roads after rain
- off-road vehicle damage, particularly through getting bogged, but also through damage to vegetation
- littering
- pollution of watering points with soap
- disturbance of wildlife and wildlife habitat
- disturbance to stock
- interference to stock management infrastructure (fences, gates, water sources, etc.)
- removal of vegetation, including dead timber for fires
- increased fire risk
- spoiling of key attractions, especially through vegetation trampling and vehicle tracks
- graffiti damage to historic places.

Different forms of tourism have different effects on the land:

- bush walkers and camel safaris leave very little sign of passage
- conventional vehicles usually stay on public roads and public access routes (PARs)
- a minority of 4WD operators see steep hills, sandy creeks and wet conditions as a challenge and most damage usually occurs in such situations. A single set of wheel tracks down a steep incline can become deeply rutted after rain and, apart from being unsightly, can lead to a serious erosion problem.

The vision is to see regional tourism growing in an ecologically, culturally and economically sustainable way, while also contributing to the wealth of the community.

At present, most tourism marketing is directed at the self-drive domestic motorist, most of who come from regions where the climate is more moderate and are therefore not familiar with local conditions and etiquette. This lack of knowledge can lead to the damage described above, or to other undesirable actions such as illegal shooting of wildlife or stock, illegal fishing or significant damage to land or roads.

Rubbish Disposal

Rubbish disposal around the larger settlements and key visitor destinations is an ongoing issue that is currently managed by local progress associations and National Parks and Wildlife SA. However, as visitor numbers increase these management regimes will become strained and improvements will be necessary.

The Board supports the principle that visitors should be educated to take out whatever they bring in. Local communities should also be encouraged and assisted to take greater responsibility for the disposal of things such as used oils, batteries and tyres. Inevitably, visitors will be unimpressed and discouraged by poorly managed and inadequate waste disposal systems.

Animal Welfare

A lack of understanding of animal husbandry principals on the part of visitors can lead to problems for livestock and pastoralists. Tourists need to understand that:

- camping near stock waters is prohibited as it may prevent stock from coming in to water
- gates must be left as they are found
- grazing is a viable and sustainable land use.

Public Access

Public access is one of the major issues currently confronting landholders, administrators and the broader community (Chappell 2001). This has been largely due to a rapid emergence and recognition of a diverse array of non-pastoral values in the rangelands such as Aboriginal culture, tourism, recreation and biodiversity (Holmes 2000).

The Board acknowledges that the District has a need for a strong regional economy that is both ecologically benign and sustainable. In this regard, it recognises the importance of these non-pastoral values and the role they may play in the development of a diversified regional economy.

Notwithstanding the above, Section 48 of the Pastoral Land Management and Conservation Act sets out the rules for access on to pastoral leases in very precise terms: vehicular and animal access, other than on public roads or public access routes, requires lessee consent while bushwalkers must give notice of entry. Public Access Routes (PARs) and public roads generally serve to satisfy the vast majority of the District's visitors, although the Board concedes that the implementation of a good network of PARs has been slow. Recent gazettals bring to six the number of PARs within the District. The Board also recognises that there is a legitimate access requirement for responsible third party enterprises within the District, particular for those related to tourism.

The Pastoral Board Secretariat recently commissioned Professor John Holmes of Queensland University to provide a national perspective on the issue of rights of third

parties to access leases in order to carry out commercial enterprises that are non-pastoral in nature (Holmes 2000). The report makes several key points:

- The community's values are changing with respect to our pastoral lands, with increasing importance being placed on indigenous land rights, public access and biodiversity conservation with a parallel demand for sustainable management practices and a duty of care.
- The need for pastoralists to diversify into non-pastoral activities is recognised.
- Non-pastoral resources (e.g. scenic or heritage) are reserved to the State and not the pastoral lessee.
- Some priority is awarded to incumbent lessees in capturing income from non-pastoral activities which are complementary to pastoralism.
- Recreational and tourism activities are clearly non-pastoral and the State retains its property rights over the use of this resource.

Public access is topical at the time of writing and no clear policy is forthcoming from the Pastoral Board Secretariat. The Marla-Oodnadatta Soil Conservation Board recognises the needs of the community at large and urges all landholders to balance the needs of their own interests with those of third parties and the principles of environmental and economic sustainability.

Education

Education and the provision of information to visitors can address and reduce problems caused by ignorance. For these reasons it is recommended that information on how to travel with minimal impact on the environment be:

- displayed at public rest areas
- included in tourist information
- made available at hotels, shops, police stations, petrol stations etc.

Mining and Exploration

The Lambina Opal Fields currently contain the only operating mines within the boundaries of the Marla-Oodnadatta Soil Conservation District, although several other opal fields are situated just outside the District. There are also extensive coal reserves within the District. Most of the District is covered by mineral exploration leases.

Exploration work is carried out on pastoral land and it is therefore imperative that good relations exist between landholders and those involved in mineral exploration. Good relationships are based on each party understanding the interests of the other. Whilst the *Mining Act 1971* gives mining companies and prospectors access to land for exploration purposes, it also recognises the rights of landowners and procedures must be followed. The Act lays down clear obligations for the explorer to notify and consult with lessees, to repair damage to improvements, to reinstate disturbed areas and to pay compensation for financial loss, hardship or inconvenience. Both government and industry have their own guidelines that cover the behaviour of miners and explorers. Guidelines for establishing and maintaining good relations between the two parties are given in Appendix L.

Fossickers (those who gather minerals as a recreation and do not disturb the land or water with machinery or explosives) are not subject to the *Mining Act 1971* but can still enter the land only with the lessee's permission.

Any human activity has some effect on the environment. In the past, most people saw land and the environment as a relatively limitless resource. In many cases, little or no attention was given to the question of future land use after mining activities ceased. More recently, other land values and the value of the environment have been recognised. This has led to a situation where no land is subject to major disturbance by mining without planning for its restoration and later use. In addition, the actual extent of the disturbance can be minimised by careful planning and strict controls. Where all or most of the mined material is removed from the site, restoration may be aimed at removing all rubbish from the site, reducing the grade of batters to a safe level, smoothing the final contours and reducing the visual impact through re-vegetation.

The community measures the mining industry by the standard of its environmental management. To maintain community support for mining, the minerals industry must demonstrate high standards of environmental management, backed by a commitment to continual improvement.

There has been a growing community awareness of the importance of environmental protection and conservation. This awareness is shared by the mining industry, which contributed to the development of the National Conservation Strategy for Australia. The industry has also embraced the concept of sustainable development, which emerged from the work of the United Nations' World Commission on Environment and Development. This calls for a balance between conservation and development.

Many factors must be considered in the implementation of sound environmental policies to achieve a balance between economic necessities and ecological goals. Land use planning in relation to mining can be complicated. This is particularly so today as most new deposits are found in areas with a pre-existing land use. Mineral deposits may be found after land-use decisions have already been made and implemented. Greater potential exists for environmental damage in the more fragile areas, such as the breakaways, and these may require different and more costly management techniques to those employed on country that is more resilient.

There is also the question of relative permanence. Some mining operations continue in a particular area for decades while others may disturb an area for only a short time. No matter how long the operation continues, disturbance can be minimised by careful planning and strict supervision.

Today, two land use changes occur where mining takes place. The first involves disturbance caused by surface mining and the construction of buildings, plant and roads. The second is the return of the land from mining to its original or some other agreed use.

All mining operations must prepare a Declaration of Environmental Factors (DEF) prior to receiving government approval to mine. The DEF outlines appropriate and workable plans for all aspects of the environmental management of a mine. Adequate funds must be set aside by the company in advance for this environmental work to be done.

Today, the mining industry recognises final rehabilitation of the landscape as part of the total mining operation. Therefore plans and budgets are made in advance for

long-term environmental programmes. With rehabilitation costs frequently exceeding $10,000 per hectare, companies are anxious to ensure their programmes are environmentally acceptable and are recognised as such by the community. Rehabilitation does not cease with earthworks, seeding or planting. The effectiveness of a rehabilitation programme can only be determined by comprehensive monitoring.

The four common stages of a rehabilitation programme are:

- Determining the future land use of the disturbed area, i.e. rehabilitation for what future use?
- Earthworks to provide safe slopes and prevent erosion and measures to maximise surface suitability for plant growth.
- Establishing vegetation by replacing topsoil and its seed bank, direct seeding, or in special circumstances (in this District) by using tube stock planting.
- Monitoring and research to ensure the desired long-term ecological outcomes are attained.

Opal Mining

Mining of opal is covered by specific legislation, the *Opal Mining Act 1995*, which takes precedence over the *Mining Act 1971*. This Act requires that in all opal mining areas outside the Proclaimed Precious Stones Fields, operators rehabilitate their campsites and minesites to the satisfaction of the relevant pastoralist and the Department of Mines and Energy. The details of these rehabilitation measures are set out in *"Deeds of Cooperation"* between the pastoral lessee and the South Australian Opal Miners Association.

No rehabilitation is required under this legislation for operations within any of the five Proclaimed Precious Stones Fields of Coober Pedy, Mintabie, Andamooka, Stuart Creek and Lambina. The Lambina opal field is within the District, while the others are just outside the District's boundaries.

Coal

Extensive coal deposits occur within the central part of the District, stretching roughly west to east from the Westfield deposit just west of the Stuart Highway on Mount Willoughby Station to the Weedina deposit on Nilpinna Station in the east. There are no immediate plans to mine any of these resources.

Petroleum Exploration

Oil and gas reserves may exist in the District. The infrastructure associated with oil and gas would be outside the Board's responsibilities. However, the Board may have concerns with any future seismic lines, particularly those that are graded rather than rolled, with construction of rig roads, and with their future rehabilitation or use for other purposes.

The *Mining Act*, the *Petroleum Act 1940* and the *Environmental Protection Act 1993* all cover environmental management. The *Development Act 1991* may also apply in the case of a major development and the special case of *the Cooper Basin (Ratification) Act 1975*. Santos Ltd, the main petroleum explorer and producer that has operated within the District, has an environmental management group, including a member of a pastoral soil board, to oversee both general environmental and land

conservation issues. The level of communication and direct assistance to the Board is good.

Other oil companies have also explored for oil and gas reserves within the District. There is a requirement under the Petroleum Act to liaise with landholders and where pastoral lease improvements are altered, the landholder must be compensated. None of this directly affects the Board.

In all cases, explorers are required to provide a DEF to PIRSA for approval of proposed programmes. They are also required to rehabilitate areas to the levels specified by PIRSA, once the exploration programme has been completed. The DEFs are effectively an abbreviated Environmental Impact Statement that is provided to PIRSA rather than for general circulation. Legally, in the present process, the Board has neither to be informed nor asked for its advice.

The petroleum industry is already highly regulated and it may not be appropriate for the Board to request information or comment on individual DEFs. However, the petroleum industry Codes of Environmental Practice are now drafted with input from community groups. The Soil Board may need to become more involved with this process.

Property Management Planning

Many station managers have been successfully developing and implementing property management plans for decades, although many of these have never been formally recorded. Plans that are not documented are difficult to critically review, develop and discuss with family and financiers.

The documentation of plans assists with the management of a high-risk enterprise. In an environment where the producer is unable to control prices of produce, market variability is high and costs of production are increasing, there is little tolerance for sub-optimal management.

The State and Federal Governments are promoting Property Management Planning (PMP) in a number of ways. For pastoralists in the Marla-Oodnadatta SCD there is a FarmBI$ facilitator located at the Port Augusta PIRSA office. The role of the facilitator is to assist groups of interested pastoralists with developing their own plans and to access funds that are available under the FarmBI$ programme.

Property Management Planning is a flexible programme that is designed by the group that is choosing to develop a property management plan. It is designed to identify and address the needs and issues of the group. PMP can be accessed by new or existing groups and is available to all primary producer (pastoral) businesses.

PMP courses are:

- a series of interactive group activities designed by the pastoralists involved
- a proactive way to plan for the future of your property and the people involved in it
- a series of activities that look at all areas of the property including enterprises, finances, natural resources and the people involved in the business.

Funding is available through the national ‘Skilling Farmers for the Future’ project. Funding levels for this project are 75% of the total cost of the programme.

Updated paddock plans produced by the Pastoral Program using accurate standard map bases provide an excellent basis for property planning. They show features such as fences, watering points, tracks and paddock areas. The maps are updated following inspections.

The Branch can also overlay a map grid or add a land system layer to the maps. Additional copies are available on request from the Pastoral Program, DWLBC.

Pastoral Lease Assessment

The Pastoral Program of DWLBC, in accordance with the provisions of the *Pastoral Land Management and Conservation Act 1989*, undertakes assessment of Pastoral leasehold lands. In this District, these assessments were completed during 2000. The District now has a complete coverage of Landsat imagery and a comprehensive land type classification, which will help to refine the current land system mapping. This assessment process includes the establishment of photographic monitoring points, land system mapping and in the cattle country, a grazing gradient analysis centred on specific watering points.

Areas close to water generally have a high impact from the combined effects of grazing and trampling by stock and there is generally an increase in vegetation cover associated with distance from water (Jessop 1995). Where stock numbers are too high, the impact area may be significantly expanded resulting in dramatic grazing gradients from water. There may be a large bare area or these areas may become dominated by unpalatable woody shrubs. The 'normal' cover levels and species mix may not be evident for a considerable distance from the water.

Satellite imagery can be used to detect vegetation cover levels. Fence line contrasts are often visible on the imagery where cover changes have been substantial. To be capable of sustaining grazing, the country should have the potential to recover following good rainfall. This will generally occur if the soil surface is intact and seed sources are available. A grazing gradient is then only temporary, until the vegetation-cover has been restored. Bare areas around waters may have lost topsoil and seeds and may not respond to rainfall, thus removing their potential to bounce back. Indeed, they may respond in an unexpected way and bounce back as something else (Westoby *et al*. 1989a, 1989b). This is sometimes in the form of an increase in unpalatable woody shrubs.

This information, together with the description of paddocks and land management issues, tenure, stock and rainfall details, is drawn together to form the Assessment Report. This report is part of an ongoing monitoring programme of Pastoral Leases in South Australia. Following the Assessment it is intended that all leases will be re-visited at least every 3 years (some leases more frequently) by a Pastoral Inspector working with a Rangelands Officer. This will involve the traditional Pastoral Inspection as well as a detailed review of the issues identified by the Lease Assessment. In addition to the Assessment Report, all information including photographs collected at photo points is provided to the lessee or manager in a Photo point Manual. An updated Paddock Plan and a land systems or land type map are also produced as an aid to management planning.

Figure 10 shows a grazing gradient that continues to five kilometres from water associated with the loss of bladder saltbush and perennial grasses. The shaded area

represents the loss of cover associated with past grazing impact. Figure 11 shows the same vegetation type but with no apparent gradient.

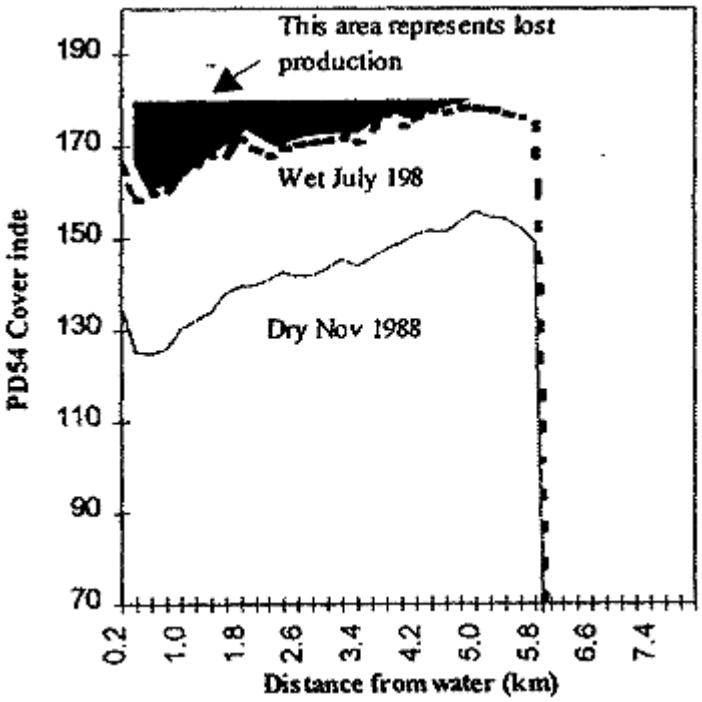


Figure 10 Grazing gradient on saltbush tableland paddock in poor condition.

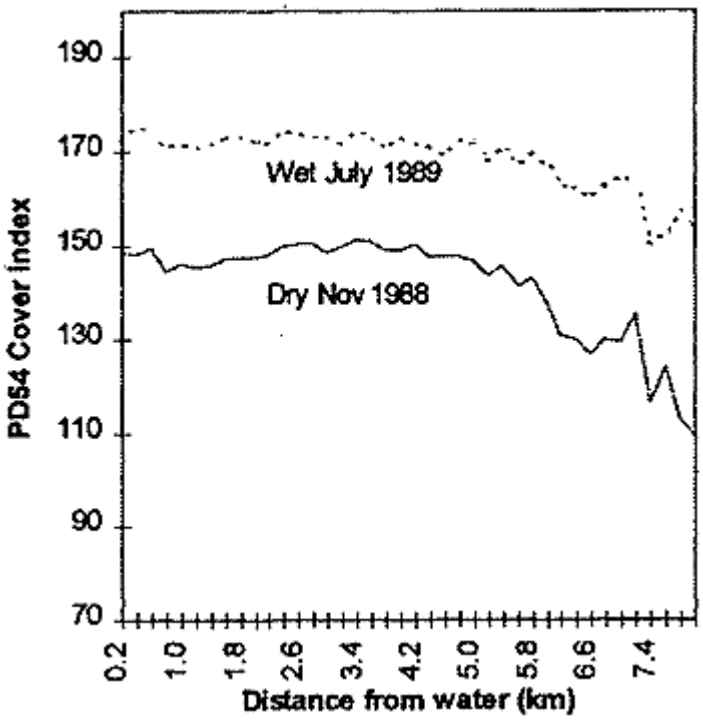


Figure 11 No grazing gradient evident on saltbush tableland paddock in good condition.

Diversification

In recent years, diversification away from the traditional pastoral pursuits of beef and wool production has been carried out on many pastoral leases. This is also the case within the District, although perhaps not to the same extent as in areas such as the Flinders Ranges.

The Pastoral Board's policy on diversification is:

- Any proposed tourism or ecotourism development on a pastoral lease which is incidental to the running of a livestock grazing enterprise does not require approval from the Board. This would include use of existing accommodation, production of pamphlets to facilitate self-drive tours and walking tracks or trails.
- The Board will consider any proposal for a change of land use to embrace a tourism venture, provided:
    - the Board receives an application for a change of land use
    - this application is accompanied by a development or operational plan which covers the main environmental impacts likely to result from the development
    - the development receives approval from Planning SA
- *These developments could include:*
    - the destocking of all or part of a lease and dedication of the area to a tourism or ecotourism venture
    - construction of purpose-built infrastructure, such as cabins or other accommodation, serviced camping areas, new tourist roads and tracks etc
- Approvals for this change of land use will be conditional upon adequate environmental safeguards being put in place and any monitoring of land condition resulting in no significant degradation occurring as a result of the operation.

Changes in land use away from traditional pastoral pursuits are also likely to be regarded as "future acts" under the Native Title Act and would require negotiations with the relevant native title claimant group. A brochure prepared by the South Australian Attorney-General's Department that outlines the implications of native title on pastoral diversification is included in Appendix K.

Landcare Activities

Federal funding through the National Landcare Program has assisted some very worthwhile projects in the District. These have included the Welbourne Hill Revegetation Trial which investigated rehabilitation techniques including ponding, pitting and direct-seeding.

A plant identification course was run for all land users in the District. This involved field days covering plant specimen collection and identification and the production of individual plant reference collections for each property, school and community and a more comprehensive collection for the Board. A book was produced describing the

vegetation and flora of the District (Badman 1995a) and this was distributed to all holders of the reference collections and was made available to the public.

Revegetation was undertaken around Copper Hills homestead. A Feral Animal Eradication Programme was established with the assistance of Federal funding. Shooting of donkeys is ongoing; with 2500 shot prior to 1997 and a similar number shot in a second campaign in 2001. Further funding is being sought through the Natural Heritage Trust to continue this programme.

The Marla-Oodnadatta Soil Conservation Board has had input into the Lake Eyre Basin Steering Group, which is involved in catchment management.

Three local station managers, from Mount Barry, De Rose Hill and Todmorden, have won regional Ibis Awards. Todmorden went on to win the 1997 State Award. Ibis Awards are given in recognition of excellence in sustainable land management practice. The Commonwealth Bank is the major sponsor.

In 1997, Landcare funding was replaced by the National Heritage Trust (NHT), which looked more broadly at all aspects of environmental management. The focus for this funding has become more regionally based. An integrated natural resource management committee has been set up for the rangelands and this committee will determine future funding priorities.

All landowner groups and soil conservation boards can apply for funds to carry out approved activities. During the period 1997 – 2001, the Marla-Oodnadatta Soil Conservation Board utilised the NHT funding to undertake the following projects:

- feral animal control
- removal of Athel pines from the Oodnadatta Common
- a weeds identification field day
- a field day on alternative power sources (solar, batteries, etc.).

The Board intends to apply for more funding from this source to carry out ongoing feral animal control work.

The Soil Board was also involved in the formation of the Rangeland Soil Board Executive Committee (RSBEX), and continues to have a representative on this Committee. RSBEX was pivotal in the development of the Rangelands Regional Strategy released in 1998. This strategy identifies key priorities for action in the areas of environment, economics and social management. The Rangeland Action Project was developed as a response to the Regional Strategy and is now the primary source of funds for natural resource management work in the soil board area and across the rangelands, with a particular focus on the enhancement of biodiversity.

The Rangeland Action Project, managed by RSBEX, offers rapid processing of grant applications for natural resource management projects to both individuals and groups wishing to undertake on-ground activities that will enhance native vegetation, biodiversity and sustainable production. The Rangeland Action Project began in 1999 and Phase 1 is due for completion at the end of 2002.

The future direction of funding for the region is through the newly formed Rangeland Integrated Natural Resource Management Group (INRM), which will be the peak natural resource management group in the region. The INRM Group will be responsible for integrating natural resource management across the region via the

development of an INRM Plan. This plan will identify regional priorities for action and research projects and obtain Commonwealth, State and private funding for these projects. All the Soil Boards will play a role in setting the direction of this group, via their established District Plan.

The first role of this group will be to secure funds for the region through the second phase of NHT. Commonwealth funds have been allocated to NHT for an additional five years, with the programme due for completion in 2007.

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THREE YEAR PROGRAMME

Aims of the Soil Conservation Board

The aims of the Marla-Oodnadatta Soil Conservation Board, as outlined in the District Plan, are to:

- Develop the Soil Board's role in the community and promote its function.
- Be a voice, network link and responsible mediation body on land use and management issues for the Marla-Oodnadatta Pastoral community to the Government and wider community.
- Encourage better liaison and information transfer between the Soil Board and the Pastoral Program, Pastoral Board and land managers.
- Increase knowledge and understanding of Board Members and the wider community about all aspects of the District.
- Promote ecologically and economically sustainable land use in the District by maintaining and protecting the soil and native vegetation resources.
- Maintain and protect the biodiversity of the region.
- Protect the long-term viability of industry within the District.
- Assist the development of property management plans which are consistent with achieving ecologically and economically sustainable land management.
- Increase productivity of degraded areas by facilitating regeneration of native vegetation.
- Promote sound stock management.
- Facilitate and promote the formulation of codes of practice for responsible land use, including tourism, pastoralism, mining and conservation.
- Initiate, promote, and support projects that involve participation from all sectors of the community.
- Ensure the involvement of local managers in the administration of natural resource management and provide assistance as required.
- Provide for, and promote the creation of, an inventory of the natural resourcesof the District and monitoring of the condition of those resources.
- Record expertise in sustainable management of the land for use by those with local and administrative land management responsibilities and make this information available for use by school and community educators.

Goals and Strategies to Meet Aims

Administration

GOAL: Better administration and more effective use of the Board's resources.

Strategies:

- Employ a half-time (full time position shared with the Marree Soil Conservation Board) Chief Executive Officer to:
    - Assist with everyday running of the Board
    - Secure funding for projects in line with the Board's Three Year Programme
    - Oversee the projects on behalf of the Board
    - Attend conferences on behalf of the Board and keep the Board informed of the latest developments in relevant fields.

TIME FRAME: Before the end of 2002.

Feral Animal Control

GOAL: Manage, or if feasible eradicate, feral populations of rabbits, brumbies, donkeys and feral camels within the District.

Strategies:

- Encourage land managers to plan and undertake mechanical rabbit control programmes on their properties.
- Support all research efforts into control methods, including biological control, of rabbits by assisting with trials and experiments.
- Demonstrate, monitor and publicise the economic and ecological impact of rabbits.
- Educate land managers in the District about the latest available control techniques.
- Identify priority areas for the re-release of RCD.
- Encourage coordinated and planned programmes for the eradication of feral herbivores.
- Seek funding for large-scale feral animal control.
- Monitor the trends in feral animal populations.

TIME FRAME: Ongoing

Weed Control

GOAL: Control the spread of problem plants in the District.

Strategies:

- Promote the establishment of a weed database to be collated and maintained by PIRSA.
- Continue collection of baseline data on weeds within the District and of those that may become a problem in the future.
- Promote successful weed control techniques and demonstrate their effectiveness.
- Obtain funding for ongoing weed control programmes.

- Educate the District community on the identification of proclaimed plants and environmental weeds.

TIME FRAME: Ongoing

Property Management Planning

GOAL: Promote the wider acceptance and benefits of property management planning.

Strategies:

Continue to promote property management planning within the District.

TIME FRAME: ongoing.

Pastoral Productivity

GOAL: Sustainable pastoral productivity of the land.

Strategies:

- Encourage pastoralists to rehabilitate low productivity areas by spelling, stock control and trialling revegetation techniques.
- Encourage a planned approach to water distribution and fencing improvements through Property Management Planning.
- Investigate alternative commercial land uses.

TIME FRAME: Ongoing

Biodiversity

GOAL: Record and protect the District's biodiversity.

Strategies:

- Promote the continued collection of data on the flora and fauna of the District.
- Promote sustainable land use measures that maximise the protection of biodiversity.
- Identify threats to biodiversity within the District.
- Promote and carry out feral animal and pest plant control measures.

TIME FRAME: Ongoing

Profile of the Soil Board

GOAL: Raise the profile and understanding of the Marla-Oodnadatta Soil Conservation Board's role and its activities.

Strategies:

- Produce a newsletter for distribution to land managers in the District.
- Publish articles for local and state-wide press.
- Promote the Board's activities by radio interviews and events notices.
- Hold annual information sharing meetings for local and invited people.
- Promote the Board and its activities by erecting displays at local race meetings and social events.

- Promote appropriate land care activities and assist with funding applications.

TIME FRAME: Ongoing

Relationships between the Board, Government Agencies and Industry

GOAL (1): Enhance the relationship between the Soil Board, the District community and the Pastoral Board, Pastoral Program, DWLBC, other Government agencies and industry.

Strategies:

- Invite Pastoral Board and Pastoral Program members to field days and other Board activities.
- Arrange annual joint meetings of the Soil Conservation Board and the Pastoral Board to discuss common issues and activities.

TIME FRAME: Ongoing

GOAL (2): Enhance the relationship between the mining industry and the Soil Board.

Strategies:

- In collaboration with the industry, develop codes of practice to minimise environmental impacts.
- Liaise with PIRSA officers, mining companies and pastoral lessees.

TIME FRAME: Ongoing

GOAL (3): Enhance the relationship between the tourism industry and the Soil Board.

Strategies:

- In collaboration with the industry, develop codes of practice to minimise environmental impacts and enhance the visitors' experience.
- Develop a set of criteria to measure the impacts of tourism.
- Liaise with Outback Tourism officers, tourist operators and pastoral lessees.

TIME FRAME: Ongoing

Relationships between the Board and Native Title Claimants

GOAL: Enhance the communication, information exchange and networks between the MOSCB, pastoralists, DLWBC, mining companies, tourism ventures, and the native title claimant groups in the District.

Strategies:

- Invite native title claimants to MOSCB field days and other MOSCB activities;
- Encourage research and project collaboration between all land users within the District.

TIME FRAME: Ongoing.

Great Artesian Basin Management

GOAL: Ensure management of the Great Artesian Basin as a regional water resource is sustainable.

Strategies:

- Support the GABCC in conservation of the GAB.
- Keep informed on artesian flows, water quality and water tables in the District, particularly through involvement with the Lake Eyre Basin Coordinating Committee.

TIME FRAME: Ongoing

Tourism

GOAL: Promote responsible visitor behaviour.

Strategies:

- Liaise with outback tourism associations and operators.
- Lobby for the Board to be fully informed of all activities and potential developments in the District from appropriate government agencies.
- Provide advice when requested on potential impacts of tourism events and activities.

TIME FRAME: Ongoing

APPENDICES

APPENDIX A: Glossary

ALIEN PLANT

A plant that has been introduced into Australia from another country and has now become naturalised in a particular area.

ALLUVIAL SOIL

A soil developed from Alluvium.

ALLUVIUM

An extensive stream laid deposit which may include gravel, sand, silt and clay. This is the dominant soil of many floodplains.

ANNUAL PLANT

Plants which germinate, flower and seed in one season or year, e.g. button grass, common blown-grass (fairy grass). (See perennial plant.)

ARID

Refers to climates or regions that receive insufficient rainfall to allow crop production or extensive improved pastures: it is usually defined as a climate with annual average rainfall less than 250 mm (10 inches).

BRUMBY

A feral horse.

BUSHFIRE

Uncontrolled extensive burning of native vegetation: often started by natural factors such as lightning strikes.

CARRYING CAPACITY

An estimation of the long term stocking rate land can support without a decline in the sustainability or condition of the vegetation and soil resource.

CAST FOR AGED COWS (CFA)

Cows over 10 years old that are surplus to a station's breeding requirements.

CHENOPOD

A plant which is a member of the drought and salt tolerant Chenopodiaceae family (e.g. saltbush, bluebush, bindyi).

CLAYPAN

A shallow depression or hollow in the ground with an impermeable clay base which holds fresh water after rain.

CONDITION

The condition or 'health' of plant and soil resources, relative to their potential: it is determined by comparing similar sites under different grazing impacts.

CONDITION TREND

The trend in condition or 'health' of the soil and plant resource as determined by monitoring: the trend could be described as stable, declining or improving.

COVER

The proportion of ground surface covered by plants, litter or stone (usually expressed as a percentage). Cover is one of the most important factors in reducing soil erosion.

CULL HEIFER

Young female cow of undesirable breeding quality.

DECREASER PLANTS

Plants which are preferred by stock and which decrease in density and are eventually eliminated from zones of high grazing pressure. Bladder saltbush and Mitchell grass are decreaser plants. (See desirable species, indicator species.)

DEGRADATION

Degradation of land is the decline in the quality of the natural resources of the land resulting from human activities.

DESTOCKING

The removal of stock from a grazing area, generally to reduce the grazing pressure on the area and often to provide the vegetation in the area an opportunity to resprout, seed or recruit.

DIRECT SEEDING

Application of seed directly into the area in which the seedlings are to germinate and grow to maturity.

DISPERSABLE SOIL

A structurally unstable soil which readily disperses into its constituent particles (clay, silt, sand) in water. Highly dispersible soils are normally highly erodible. (See soil erodibility.)

DOMINANT SPECIES

Plant species that are the most visually obvious in a vegetation association: they may be the species with the highest density or the highest projected foliage cover.

In some vegetation associations the dominant species can be the tallest plant species present at a site. There must be many individuals of the plant present at the site for it to be the dominant species.

DUPLEX SOIL

A soil in which there is a sharp change in soil texture between the A horizon (topsoil) and B horizon (subsoil). In the pastoral areas, these soils are common and are prone to scalding.

ECOLOGY

The study of relationships between living organisms and their environment.

EXCLOSURE

An area of rangeland from which domestic and / or feral or native animals are excluded for the purposes of studying the effects of grazing on vegetation. Such an area may vary in size, however exclosures established by the Pastoral Program are normally in pairs, each 50 x 50 metres. One exclosure is stock, rabbit and kangaroo proof while a second exclosure is stock and kangaroo proof: a third area of the same size, the control, is marked and monitored but not fenced.

FLUVIAL

Of or pertaining to streams or rivers; existing, growing or living in or about a stream or river; produced by the action of a stream or river.

GILGAI

The micro-relief of soils produced by long-term expansion and contraction with changes in moisture, found in soils that contain large amounts of clay. It is characterised by a markedly undulating surface with mounds and depressions. Often referred to locally as “crab holes”, gilgai is an Aboriginal word meaning “small waterhole”.

GRADATIONAL SOIL

A soil in which there is a gradual change in soil texture from the A horizon (surface soil) to the B and C horizons (subsoil).

GROUND COVER

Material which protects the soil from erosion: ground cover can include plants, stone, plant litter and lichens.

GULLIES

An open incised erosion channel in the landscape greater than 30 cm deep. The main factor contributing to the formation of gullies is the concentration of surface runoff; gullies are often associated with drainage lines.

GYPSUM

A naturally occurring soft crystalline material containing approximately 23% calcium and 18% sulphur: gypsum is commonly used to improve soil structure and reduce crusting in hard setting clays.

HUMMOCKING

The mounding of windblown material at the base of plants. (See wind erosion.)

INCREASER PLANTS

Plants which are not preferred by stock for grazing and which increase in density and eventually dominate zones of high grazing pressure (replacing decreaser plants). Poverty bushes, mulla mullas (silver-tails) and umbrella bush (sandhill wattle, marpoo) can be increaser plants in some situations. (See indicator plants, invader plants..)

INDICATOR PLANTS

Plants that can be used to indicate levels of range condition through their occurrence or abundance for a particular soil or vegetation association. (See increaser plants, decreaser plants..)

INFILTRATION

The downward movement of water into the soil: factors affecting infiltration include soil structure, soil surface and plant density.

INVADER PLANTS

Plants which establish on, and may subsequently dominate sites on which they were formerly scarce or absent. The invasion usually occurs after, or because of, disturbance such as vegetation clearance, fire, flood or high grazing pressure. (See increaser plants.)

LAND CAPABILITY

The ability of land to sustain a type and intensity of use permanently, or for specified periods under specific management.

LAND CONDITION INDEX

An index which provides an objective estimate of the relative overall condition of all the leases in a Soil Conservation Board District. (Previously known as the Weighted Average Condition (WAC) index.) A manual developed for each Soil Conservation District which provides criteria and photographic standards for assessing the condition (good, fair, poor) of each pasture type and component within the district.

LAND SYSTEM

An area of land distinct from surrounding areas with a relatively uniform climate and throughout which there is a recurring pattern of topography, geology, soils and vegetation. Land systems are most commonly delineated on a map. (See land unit, vegetation association.)

LAND UNIT

An area with uniform landform, geology, soils and vegetation. A land unit may occur repeatedly at similar points in the landscape over a defined region. A land unit is a constituent part of a land system. (See vegetation association.)

MECHANICAL REHABILITATION

The rehabilitation of degraded land using mechanical implements such as opposed disc ploughs and pitter planters.

MESA

An isolated flat-topped hill with steep sides, found in landscapes with horizontal strata.

MONITORING

Collection and comparison of information to determine type, extent and cause of change.

OUTLIER

In a geological context, a spatially minor occurrence of a geological formation or structure lying at a distance from, or detached from the main, larger occurrence.

PASTURE COMPOSITION

The species and proportion of each species present in the pasture. Pasture species composition can change in response to grazing, fire or seasons. Undesirable changes

may include a shift from perennial to annual species, or from palatable to less palatable species, or an increase in the proportion of woody shrubs and / or weeds in the pasture. (See increaser plants and decreaser plants.) If an undesirable change in species composition is thought to be the result of grazing, it is referred to as vegetation degradation.

PEDESTALLING

The removal of soil from the base of a plant exposing the roots: this is often caused by wind and stream-bank erosion.

PERENNIAL PLANT

A plant whose life cycle extends for more than two years (e.g. bladder saltbush, mulga). Some perennials, such as grasses and herbs, have above-ground parts which die off in unfavourable seasons leaving an underground structure, such as a bulb or rhizome, to produce new growth when the season is favourable, (e.g. Mitchell grass). (See annual plant.)

PHOTOPOINT

A photopoint is a marked site from which photographs are taken to monitor change over time. Photopoints are set up as part of the pastoral lease assessment process. At these sites vegetation condition is usually also monitored.

PIONEER PLANTS

Plants which colonise bare areas.

PIOSPHERE

The zone of altered vegetation density and composition resulting from stock pressure associated with a water point. (Pio = water.)

PLANT DENSITY

The number of plants in a defined area: usually expressed as plants per unit area.

PLAYA

A flat area or hollow at the lowest point of an undrained desert basin, underlain by clays, silts, sands and commonly by soluble salts, and from which water evaporates quickly.

RANGELAND

Land used for extensive grazing of sheep, cattle or other domestic stock. Rangeland vegetation is typically native or naturalised pasture and the country in general does not have the capability to sustainably support the economic production of crops. (See land capability, sustainable use.)

RANGELAND CONDITION

Describes the current condition of rangeland in relation to the potential condition of the particular area for the extensive grazing of domestic stock. (See condition trend, sustainable use.)

RE-ASSESSMENT

When used by the Pastoral Program, this refers to monitoring of established monitoring sites (photopoint sites), determining a Land Condition Index for a lease

and making comments regarding the condition of the land subsequent to the initial lease assessment required under the Pastoral Land Management and Conservation Act 1989.

REFERENCE AREA

A reference area is an area of land representing a particular pasture type, which is used to separate the effect of the grazing of stock from that of climate / season. Some reference areas include exclosures which are used to separate the effect of the grazing of stock from that of feral animals. The Pastoral Land Management and Conservation Act 1989 provides for the establishment of reference areas and specifies that they will not be greater than 1 km^2.

REGENERATION

The re-establishment of native pastures by self-seeding and growth.

REHABILITATION

The treatment of degraded or disturbed land to achieve an agreed level of capability and stability, preferably at least equal to that which existed prior to degradation or disturbance. Rehabilitation may involve cultivation, earthworks, direct seeding etc. (See mechanical rehabilitation, land capability.)

REVEGETATION

The re-establishment of plants on an area where the vegetation has previously been depleted, often to provide protection against soil erosion. (See regeneration, direct seeding.)

ROBUSTNESS INDEX

A number calculated from the Land Condition Index for each lease which gives an indication of the ability of the land in the lease to sustainably carry stock compared with other leases in the District.

RUNOFF

The portion of precipitation not absorbed into or detained upon the soil and which becomes surface flow.

SANDSHEET

A large irregularly shaped plain of Aeolian sand, lacking the discernible slip faces that are common on dunes.

SCALD

A bare area produced by the removal of the surface soil by wind and / or water erosion or salination. The result is exposure of the more clayey subsoil, which is, or becomes, relatively impermeable to water. Scalds are a typical erosion form of duplex soils in the semi-arid and arid regions. Scalds are difficult to revegetate due to the lack of topsoil, low permeability and often-saline surface.

SEMI-ARID

Refers to climates or regions which lack sufficient rainfall for regular crop production: usually defined as a climate with annual rainfall greater than 250 mm but less than 375 mm.

SOIL EROSION

The detachment and transportation of soil and its deposition at another site by wind, water or gravitational effects.

Natural erosion

Erosion occurring under natural environmental conditions and without the influence of human activities.

Accelerated erosion

Erosion which is attributable to the influence of human activities, including overstocking. (See also scald, hummocking and pedestalling.)

Water erosion

An erosion process in which soil is detached and transported from the land by the action of rainfall, runoff and seepage.

Types of water erosion include:

- Splash erosion - The spattering of soil particles caused by the impact of raindrops on the soil; an important component of sheet erosion.
- Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by wind and raindrop splash and / or runoff. No rills are formed.
- Rill erosion - The removal of runoff from the land surface whereby numerous small channels are formed. Rills are defined as small channels up to 30 cm deep.
- Gully erosion - The removal of soil by water whereby large incised channels (> 30 cm deep) are formed. The severity of gully erosion may be recorded as minor, moderate, severe or very severe. Gully erosion processes may include the removal of soil from the land surface by concentrated runoff or the dispersion of unstable subsoils.
- Stream bank erosion - The removal of soil from stream banks by the direct action of steam flow and/or wind /wave action. Typically occurs during periods of high flow.

Wind erosion

The removal and transportation of soil by wind. (See sheet erosion.)

SOIL ERODIBILITY

The susceptibility of a soil to the detachment and transportation of soil particles by erosive agents: erodibility is a function of mechanical, chemical and physical characteristics.

SOIL PROFILE

A cross-sectional exposure of a soil, extending downwards from the soil surface to the parent material (bedrock). A soil profile is generally composed of three major layers designated A, B and C horizons.

SOIL TEXTURE

The coarseness (sand content) or fineness (clay content) of soil.

SOIL SURFACE CONDITION

Refers to the stability or form of degradation of the soil.

STABILISING PLANTS

Plants used for the stabilisation of areas that have been eroded or disturbed.

STEER WEANER

Castrated bull calf up to about 200 kg live weight.

STORM BANK

Mechanically created depression and / or bank in a drainage line to harvest and store short-term surface water.

SUSTAINABLE USE

The use of the resource, (e.g. pastoral land), in such a manner that the productivity and quality of the resource is maintained indefinitely.

UNIFORM SOIL

A soil in which there is little if any change in soil texture between the A (surface) and B (subsoil) horizons.

VEGETATION ASSOCIATION

A stable plant community of definite composition presenting a uniform appearance and growing in uniform habitat conditions.

VEGETATION CONDITION

Refers to the condition, composition and density of the plants in an area. (See pasture composition, plant density.)

WEEDS

Any plants growing in an undesirable place. In a pastoral context, weeds may be undesirable plants or increaser species which grow where desirable or decreaser plants have been removed. Weeds also include plants that are alien to the area but which have become naturalised. (See increaser plants, invader plants.)

WOODY WEEDS

Trees or shrubs which have increased in density to the point where productivity or management is adversely affected. (See increaser plants, invader plants.)

APPENDIX B: Mean and Median Rainfall for Selected Stations

Station: 015603 **Kulgera** (previously 015126); 25° 51'S, 133° 18'E; elevation 510m.

Means and Medians for the period 1968 to 1992 using all available data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean Rainfall (mm)	36.9	26.7	43.0	13.7	11.2	14.9	8.2	11.8	20.9	19.0	20.4	27.1	**242.4**
Median Rainfall (mm)	16.8	11.7	20.3	2.2	4.7	3.7	0.9	3.0	4.6	8.0	9.9	18.9	**214.9**
Mean No. of Raindays	4	3	3	2	3	3	2	2	3	3	4	3	**35**

Station: 016047 **Todmorden**; 27°08'S, 134°45'E; elevation 200m.

Means and Medians for the period 1949 to July 2001 using all available data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean Rainfall (mm)	22.9	22.4	15.8	16.7	15.9	13.0	9.9	7.2	10.4	14.4	14.2	20.0	**181.8**
Median Rainfall (mm)	8.4	4.9	1.7	2.3	7.8	6.6	2.0	2.0	4.5	6.0	8.1	14.8	**164.0**
Mean No. of Raindays	2	2	2	2	3	2	2	1	2	2	2	2	**24**

Station: 017043 **Oodnadatta**; 27° 34'S, 135°27'E; elevation 113m.

Means and Medians for the period 1951 to July 2001 using all available data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean Rainfall (mm)	21.4	20.5	15.8	11.5	9.6	12.7	9.2	7.2	7.6	9.6	10.9	15.5	**148.6**
Median Rainfall (mm)	4.8	3.4	0.5	0.0	3.2	4.1	0.0	1.5	2.0	2.8	5.4	6.6	**116.2**
Mean No. of Raindays	3	2	2	2	3	3	2	3	3	3	3	3	**32**

Station: 017004 **Anna Creek**; 28°54'S, 136°10'E; elevation 105m.

Means and Medians for the period 1883 to July 2001 using all available data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean Rainfall (mm)	17.4	18.4	14.1	8.0	9.8	13.7	8.3	8.7	8.8	11.1	9.7	13.8	**141.9**
Median Rainfall (mm)	3.8	4.1	0.7	0.3	3.2	5.1	1.0	3.7	2.4	3.1	4.8	5.5	**123.9**
Mean No. of Raindays	1	1	1	1	1	2	1	1	1	1	1	1	**13**

Station: 016007 **Coober Pedy**; 29°01'S, 134°45'E; elevation 215m.

Means and Medians for the period 1921 to July 2001 using all available data

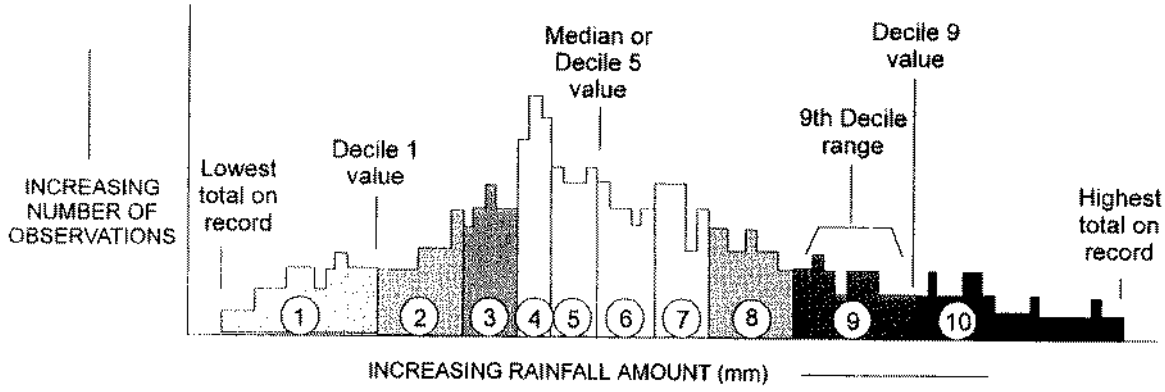
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Mean Rainfall (mm)	17.4	23.4	13.9	6.7	14.0	14.4	8.1	9.4	8.7	15.2	11.5	15.6	**148.6**
Median Rainfall (mm)	5.2	10.0	2.6	1.7	4.8	6.4	3.4	3.5	2.5	7.2	4.7	10.2	**132.6**
Mean No. of Raindays	2	2	2	2	3	3	2	3	2	3	3	3	**30**

APPENDIX C: Explanation of Rainfall Deciles

Most people are familiar with the term mean or average rainfall, which is calculated by adding rainfall totals over a long period and dividing by the number of years of records. However, because there may be a large number of years of low rainfall and a few years of high rainfall, the mean can give a misleading impression of the rainfall regime. This is particularly so in the drier parts of Australia and in the drier months of the year.

The median gives a better guide to rainfall. It represents the middle value of all observations. In other words, in 50% of years the rainfall exceeds the median and in 50% of years it is less than the median.

Deciles are an extension of this idea. All rainfalls received (for a year or a particular month or a series of months) are ranked in order from lowest to highest. The lowest 10 per cent are delineated by the decile 1 value, and belong to decile range 1 (see figure below). The next 10 per cent are in decile range 2, and so on, the highest 10 per cent being in decile range 10. The median is equivalent to the decile 5 value. Decile ranges shown in tables and in maps give a better indication of how dry or wet the month or year has been than does the departure from the 'mean' or 'average'.



Decile range	Extent of range	description
1	Lowest 10% of records	Very much below average
2	2nd lowest 10% of records	Much below average
3	3rd lowest 10% of records	Below average
4, 5, 6, 7	Middle 40% of records	Average
8	3rd highest 10% of records	Above average
9	2nd highest 10% of records	Much above average
10	Highest 10% of records	Very much above average

Source: Bureau of Meteorology, May 1995

Rainfall Deciles for Oodnadatta (1939 - 1985)

Deciles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
low	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	0	0	0	0	1	2
3	1	1	1	0	1	2	1	1	1	2	2	2
4	3	3	1	1	3	2	1	1	2	3	4	8
median 5	9	7	3	3	5	5	2	2	5	6	7	10
6	16	15	9	5	9	8	5	3	8	11	9	13
7	28	31	11	11	18	12	10	8	11	13	13	20
8	37	52	13	17	25	21	24	19	19	21	16	27
9	79	70	36	32	51	46	30	34	31	40	28	36
high	273	303	224	97	80	64	54	58	67	94	50	48
Years	46	46	46	47	47	47	46	46	46	45	46	46

Rainfall Deciles for Anna Creek (1883 - 1992)

Decile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
low	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	1	0	0	0	1	3	0	1	1	1	2	2
median 5	3	4	1	0	3	5	1	4	2	3	4	6
6	7	7	5	3	7	8	3	5	5	6	7	11
7	12	14	8	8	12	14	7	8	10	11	9	15
8	19	28	18	13	19	26	15	14	17	21	14	30
9	43	57	40	29	30	42	26	31	27	37	31	10
high	356	154	336	64	82	79	59	64	58	62	61	88
Years	106	106	104	103	104	105	105	105	105	105	105	105

Rainfall Deciles for Coober Pedy (1921 - 1992)

Decile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
low	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0	0
3	0	1	0	0	1	1	0	1	0	3	2	1
4	2	5	2	0	4	2	2	3	2	3	3	4
median 5	5	9	3	2	7	5	3	4	3	6	4	8
6	11	16	7	4	9	9	6	5	5	10	9	13
7	15	22	13	6	18	16	7	8	7	15	16	20
8	22	41	20	11	27	24	12	15	15	31	19	30
9	44	83	39	24	53	42	26	39	30	38	31	42
high	166	165	268	42	87	91	51	60	44	104	84	79
Years	62	62	61	62	62	62	62	64	61	63	63	62

APPENDIX D: Temperature Data for Oodnadatta, Marla & Kulgera

Oodnadatta

	Minimum(°C)		Maximum(°C)		Average number of days		
	Extreme	Mean	Mean	Extreme	>40°C	>35°C	>30°C
Jan	11.7	22.7	37.6	50.7	10	22	29
Feb	12.8	22.3	36.5	46.5	7	19	26
Mar	9.5	19.3	33.7	44.9	2	13	24
Apr	3.8	14.2	28.2	41.8	0	2	11
May	0.9	9.8	23.1	35.0	0	0	1
Jun	-2.6	6.5	19.8	31.0	0	0	0
Jul	-2.2	5.7	19.4	32.2	0	0	0
Aug	-0.2	7.3	21.9	36.5	0	0	1
Sep	2.2	11.2	26.3	40.5	0	2	7
Oct	3.4	15.0	30.2	45.1	1	6	15
Nov	9.8	18.4	33.7	47.1	4	12	22
Dec	11.3	21.1	36.3	48.3	8	19	28

Marla

	Minimum(°C)		Maximum(°C)		Average number of days		
	Extreme	Mean	Mean	Extreme	>40°C	>35°C	>30°C
Jan	12.5	21.9	37.1	49.0	9	22	29
Feb	11.8	21.3	36.0	46.1	6	18	25
Mar	8.2	18.1	33.0	43.2	2	12	23
Apr	1.5	13.0	27.8	38.4	0	1	9
May	-2.2	9.2	22.8	33.9	0	0	2
Jun	-3.5	6.1	19.5	32.2	0	0	0
Jul	-3.9	5.1	19.3	30.2	0	0	0
Aug	-2.0	6.2	21.6	33.9	0	0	1
Sep	-0.2	10.8	26.7	38.9	0	2	8
Oct	4.8	14.2	29.8	43.8	1	6	15
Nov	7.0	17.5	33.0	44.4	4	11	21
Dec	9.5	20.2	35.0	45.5	5	17	26

Kulgera

	Minimum(°C)		Maximum(°C)		Average number of days		
	Extreme	Mean	Mean	Extreme	>40°C	>35°C	>30°C
Jan	7.6	21.8	36.4	44.8	7	20	27
Feb	11.0	21.5	35.6	45.5	4	16	24
Mar	7.0	17.8	32.0	42.3	1	10	21
Apr	1.5	13.3	27.2	39.5	0	1	8
May	-1.9	9.2	22.4	34.0	0	0	1
Jun	-3.8	5.8	18.9	32.0	0	0	0
Jul	-4.7	4.8	18.7	30.0	0	0	0
Aug	-2.0	6.7	21.8	34.5	0	0	1
Sep	0.6	10.9	26.6	38.0	0	2	8
Oct	2.9	14.9	30.0	43.0	1	7	15
Nov	6.0	18.5	33.5	44.0	4	11	21
Dec	10.1	20.6	35.1	45.2	5	16	25

APPENDIX E: Scientific Names of Plants Referred To In the Plan

* denotes introduced taxa

Common Name	Scientific Name
athel pine	**Tamarix aphylla*
Australian boxthorn	*Lycium australe*
Australian cupgrass	*Eriochloa australiensis*
baldoo	*Atriplex lindleyi ssp. conduplicata*
ball bindyi	*Dissocarpus paradoxus*
bamboo	**Arundo donax*
bandicoot grass	*Monachather paradoxa*
bare twig-rush	*Baumea juncea*
barley Mitchell-grass	*Astrebla pectinata*
bastard mulga	*Acacia stowardii*
beaked red mallee	*Eucalyptus socialis*
beefwood	*Grevillea striata*
bell-fruit bluebush	*Maireana campanulata*
bindyi	*Sclerolaena sp.*
bird-flower rattle-pod	*Crotalaria cunninghamii*
bitter saltbush	*Atriplex stipitata*
black bluebush	*Maireana pyramidata*
Black''s bindyi	*Sclerolaena blackiana*
Black's copperburr	*Sclerolaena blackiana*
black-seed samphire	*Halosarcia pergranulata*
bladder saltbush	*Atriplex vesicaria*
blue heron''s-bill	*Erodium crinitum*
blue stork's-bill	*Erodium crinitum*
bluebush	*Maireana sedifolia*
bluebush	*Maireana sp.*
bluerod	*Stemodia florulenta*
blunt-leaf senna	*Senna artemisioides ssp. helmsii*
Bogan flea	*Calotis hispidula*
bore-drain sedge	*Cyperus laevigatus*
bottletree spurge	*Euphorbia stevenii*
bottle-washers	*Enneapogon sp.*
bristly love-grass	*Eragrostis setifolia*
broad-leaf wanderrie	*Eriachne aristidea*
broom emubush	*Eremophila scoparia*
Broughton willow	*Acacia salicina*
buckbush	*Salsola kali*
bullock bush	*Alectryon oleifolius ssp. canescens*
bush minuria	*Minuria cunninghamii*
button-grass	*Dactyloctenium radulans*
cane-grass	*Eragrostis australasica*
cannonball	*Dissocarpus paradoxus*
colony wattle	*Acacia murrayana*
common blown-grass	*Agrostis avenacea*
common bottle-washers	*Enneapogon avenaceus*
common nardoo	*Marsilea drummondii*
common purslane	*Portulaca oleracea*
common reed	*Phragmites australis*
coolibah	*Eucalyptus coolabah ssp. arida*
Cooper clover	*Trigonella suavissima*
copperburr	*Sclerolaena sp.*
cotton panic-grass	*Digitaria brownii*
cotton-bush	*Maireana aphylla*
crimson emubush	*Eremophila latrobei*
curly wire-grass	*Aristida contorta*
cutting grass	*Gahnia trifida*

Common Name	Scientific Name
date palm	**Phoenix dactylifera*
dead finish	*Acacia tetragonophylla*
desert Chinese-lantern	*Abutilon leucopetalum*
desert Chinese-lantern	*Abutilon otocarpum*
desert lantern-bush	*Abutilon leucopetalum*
desert lantern-bush	*Abutilon otocarpum*
desert poplar	*Codonocarpus cotinifolius*
desert riceflower	*Pimelea simplex*
desert senna	*Senna artemisioides*
elegant wattle	*Acacia victoriae ssp. victoriae*
emubush	*Eremophila sp.*
everlasting	*Chrysocephalum sp.*
everlasting	*Rhodanthe sp.*
feather-top wire-grass	*Aristida latifolia*
finger panic grass	*Digitaria coenicola*
fissure-plant	*Maireana sp.*
five-minute grass	*Tripogon loliiformis*
flat-stalk senna	*Senna artemisioides ssp. petiolaris*
flat-topped saltbush	*Atriplex lindleyi ssp. conduplicata*
fleshy groundsel	*Othonna gregorii*
Flinder's-grass	*Iseilema sp.*
fork-leaf corkwood	*Hakea eyreana*
giant reed	**Arundo donax*
gidgee	*Acacia cambagei*
Gile’s emubush	*Eremophila gilesii*
glasswort	*Sclerostegia sp.*
goat-head bindyi	*Sclerolaena bicornis*
golden goosefoot	*Chenopodium auricomum*
green emubush	*Eremophila serrulata*
grey bindyi	*Sclerolaena diacantha*
grey copperburr	*Sclerolaena diacantha*
grey samphire	*Halosarcia halocnemoides*
grey senna	*Senna artemisioides nothossp. sturtii*
hairy burr-daisy	*Calotis hispidula*
hairy-fruit emubush	*Eremophila gilesii*
harlequin emubush	*Eremophila duttonii*
harlequin fuchsia bush	*Eremophila duttonii*
hills bloodwood	*Corymbia eremaea ssp. eremaea*
horse mulga	*Acacia ramulosa*
Indian acacia	**Acacia nilotica*
inland paper-bark	*Melaleuca glomerata*
inland shrubby groundsel	*Senecio cunninghamii var. serratus*
ironwood	*Acacia estrophiolata*
jockey’s cap	*Prostanthera striatiflora*
Johnson’s copperburr	*Sclerolaena johnsonii*
Johnson's bindyi	*Sclerolaena johnsonii*
kangaroo grass	*Themeda triandra*
katoora	*Sporobolus actinocladus*
kidney-fruit saltbush	*Atriplex quinii*
leafy bottle-washers	*Enneapogon polyphyllus*
lemon-grass	*Cymbopogon ambiguus*
lemon-scented grass	*Cymbopogon ambiguus*
lignum	*Muehlenbeckia florulenta*
limestone bottle-washers	*Enneapogon polyphyllus*
limestone cassia	*Senna artemisioides ssp. oligophylla*
limestone senna	*Senna artemisioides ssp. oligophylla*
long-leaf corkwood	*Hakea suberea*
long-spine bindyi	*Sclerolaena longicuspis*
long-spine copperburr	*Sclerolaena longicuspis*

Common Name	Scientific Name
loose-flowered bluebush pea	*Crotalaria eremaea*
loose-flowered rattle-pod	*Crotalaria eremaea*
low bluebush	*Maireana astrotricha*
marpoo	*Acacia ligulata*
mimosa	*Acacia farnesiana*
mineritchie	*Acacia cyperophylla*
mountain wanderrie	*Eriachne mucronata*
mulga	*Acacia aneura*
mulga grass	*Aristida contorta*
mulka	*Eragrostis dielsii var. dielsii*
mulka grass	*Eragrostis dielsii var. dielsii*
munyeroo	*Portulaca oleracea*
nardoo	*Marsilea sp.*
narrow-leaf bulrush	*Typha domingensis*
narrow-leaf cumbungi	*Typha domingensis*
narrow-leaf hop-bush	*Dodonaea viscosa ssp. angustissima*
native apricot	*Pittosporum phylliraeoides var. microcarpa*
native camomile	*Gnephosis eriocarpa*
native millet	*Panicum decompositum var. decompositum*
native myrtle	*Myoporum montanum*
needlebush	*Hakea leucoptera*
needle-leaf three-awn	*Aristida capillifolia*
neverfail	*Eragrostis setifolia*
nineawn	*Enneapogon sp.*
nitre goosefoot	*Chenopodium nitrariaceum*
nitre-bush	*Nitraria billardierei*
northern cypress-pine	*Callitris glaucophylla*
northern myall	*Acacia calcicola*
old-man saltbush	*Atriplex nummularia ssp. nummularia*
Oodnadatta saltbush	*Atriplex nummularia ssp. omissa*
opposite-leaved emubush	*Eremophila oppositifolia*
orange Darling-pea	*Swainsona stipularis*
orange swainson-pea	*Swainsona stipularis*
pale bindyi	*Sclerolaena divaricata*
pale plover-daisy	*Ixiolaena chloroleuca*
pale poverty bush	*Sclerolaena divaricata*
pale-fruit bluebush	*Maireana appressa*
paper daisy	*Rhodanthe sp.*
pepper-tree	**Schinus areira*
perennial cupgrass	*Eriochloa pseudoacrotricha*
perennial sunray	*Chrysocephalum pterochaetum*
pin sida	*Sida fibulifera*
poached-egg daisy	*Polycalymma stuartii*
pop saltbush	*Atriplex holocarpa*
pop saltbush	*Atriplex spongiosa*
poverty bush	*Sclerolaena cuneata.*
poverty bush	*Sclerolaena intricata.*
prickly acacia	*Acacia nilotica*
prickly pear	**Opuntia sp.*
prickly wattle	**Acacia victoriae*
Queensland bluebush	*Chenopodium auricomum*
Queensland bluegrass	*Dichanthium sericeum ssp. sericeum*
ray grass	*Sporobolus actinocladus*
red mulga	*Acacia cyperophylla*
river cooba	*Acacia stenophylla*
river red gum	*Eucalyptus camaldulensis*
rock emubush	*Eremophila freelingii*
rock everlasting	*Anemocarpa podolepidium*
rosy bluebush	*Maireana erioclada*

Common Name	Scientific Name
round-leaf emubush	*Eremophila rotundifolia*
round-leaf parakeelya	*Calandrinia remota*
ruby saltbush	*Enchylaena tomentosa*
salt bindyi	*Sclerolaena ventricosa*
salt copperburr	*Sclerolaena ventricosa*
salt couch	*Sporobolus virginicus*
samphire	*Halosarcia sp.*
sandhill cane-grass	*Zygochloa paradoxa*
sandhill riceflower	*Pimelea penicillaris*
sandplain wattle	*Acacia murrayana*
sand-sage	*Dicrastylis sp.*
satiny bluebush	*Maireana georgei*
sea rush	*Juncus kraussii*
senna	*Senna sp.*
short-leaf emubush	*Eremophila battii*
short-wing bindyi	*Sclerolaena brachyptera*
short-wing copperburr	*Sclerolaena brachyptera*
shrub everlasting	*Chrysocephalum pterochaetum*
silky bindyi	*Sclerolaena eriacantha*
silky bluebush	*Maireana villosa*
silky blue-grass	*Dichanthium sericeum ssp. sericeum*
silky brown-top	*Eulalia aurea*
silky copperburr	*Sclerolaena eriacantha*
silver mulla mulla	*Ptilotus obovatus*
silver needlewood	*Hakea leucoptera ssp. leucoptera*
silver tails	*Ptilotus sp.*
silver wattle	*Acacia murrayana*
slender glasswort	*Sclerostegia tenuis*
slender-headed mulga grass	*Neurachne munroi*
spear-fruit bindyi	*Sclerolaena patenticuspis*
spear-fruit copperburr	*Sclerolaena patenticuspis*
spear-grass	*Stipa sp.*
spider grass	*Digitaria coenicola*
spinifex	*Triodia sp.*
spiny saltbush	*Rhagodia spinescens*
splendid flat-sedge	*Cyperus exaltatus*
spotted emubush	*Eremophila maculata*
spreading scurf-pea	*Cullen patens*
sticky hop-bush	*Dodonaea viscosa*
stork’s bill	*Erodium sp.*
striated mintbush	*Prostanthera striatiflora*
Sturt's pigface	*Gunniopsis quadrifida*
swamp canegrass	*Eragrostis australasica*
swamp wanderrie	*Eriachne ovata*
sweet acacia	*Acacia farnesiana*
tall kerosene grass	*Aristida holathera var. holathera*
tall scurf-pea	*Cullen australasicum*
tangled bindyi	*Sclerolaena cuneata*
tangled bindyi	*Sclerolaena intricata*
tangled leschenaultia	*Lechenaultia divaricata*
tar bush	*Eremophila neglecta*
tea-tree	*Melaleuca sp.*
three-awn wanderrie	*Eriachne aristidea*
three-wing bluebush	*Maireana triptera*
thyme sea-heath	*Frankenia serpyllifolia*
turkey-bush	*Eremophila sp.*
turpentine bush	*Eremophila sturtii*
twiggy sida	*Sida intricata*
twin-horned copperburr	*Dissocarpus biflorus*

Common Name	Scientific Name
twin-leaved emubush	*Eremophila oppositifolia*
two-horn saltbush	*Dissocarpus biflorus*
umbrella bush	*Acacia ligulata*
umbrella grass	*Enteropogon acicularis*
umbrella grass	*Enteropogon ramosus*
umbrella grass	*Enteropogon sp.*
variable cassia	*Senna artemisioides ssp. sturtii*
verbine	*Cullen australasicum*
verbine	*Cullen patens*
weeping emubush	*Eremophila longifolia*
western bindyi	*Sclerolaena parallelicuspis*
western copperburr	*Sclerolaena parallelicuspis*
western myall	*Acacia papyrocarpa*
white cypress-pine	*Callitris glaucophylla*
white tea-tree	*Melaleuca glomerata*
whitewood	*Atalaya hemiglauca*
wild turnip	*Brassica tournefortii*
willow wattle	*Acacia salicina*
window mulga-grass	*Neurachne munroi*
window mulga-grass	*Thyridolepis mitchelliana*
witchetty bush	*Acacia kempeana*
woody bluebush	*Maireana campanulata*
woolly bluebush	*Maireana eriantha*
woolly oatgrass	*Enneapogon polyphyllus*
woollybutt	*Eragrostis eriopoda*
woollybutt wanderrie	*Eriachne helmsii*
woolly-fruit bluebush	*Eriochiton sclerolaenoides*
woolly-fruit copperburr	*Eriochiton sclerolaenoides*
Y-cassia	*Senna artemisioides ssp. petiolaris*

APPENDIX F: List of Alien Plant Species Recorded from the Marla-Oodnadatta SCD

Abundance: C = common – many plants present
U = uncommon – few plants present
R = rare –plant seldom found within the District
S = single plants – only one to a few plants present

Distribution: W = widespread: occurs across the whole District
P = patchy distribution across the District, or occurs in a single habitat
H = occurs only or mainly around water points or human settlements
L = known from only one or a few populations

Species with a widespread or patchy distribution are considered to be those most likely to spread. Those classified as "S" or "L" are considered unlikely to spread from their present distribution.

Family/Scientific Name	Common Name	Abundance	Distribution
AIZOACEAE			
Aptenia cordifolia	heart-leaf iceplant	S	L
AMARANTHACEAE			
Aerva javanica		S	L
ASCLEPIADACEAE			
Calotropis procera		R	L
BORAGINACEAE			
Buglossoides arvensis	sheepweed	S	L
Echium plantagineum	Salvation Jane	U	P
Heliotropium curassavicum	smooth heliotrope	U	P
Heliotropium europaeum	common heliotrope	C	W
Heliotropium supinum	creeping heliotrope	U	P
CARYOPHYLLACEAE			
Gypsophila tubulosa	annual chalkwort	U	P
Spergularia diandra	lesser sand-spurrey	C	P
Spergularia marina	salt sand-spurrey	C	P
Spergularia rubra	red sand-spurrey	U	P
CHENOPODIACEAE			
Chenopodium murale	nettle-leaf goosefoot	U	H
Monolepis spathulata		S	L
COMPOSITAE			
Aster subulatus	aster-weed	S	L
Calendula arvensis	field marigold	S	L
Centaurea melitensis	Malta thistle	R	P
Cotula coronopifolia	water buttons	C	P
Gnaphalium polycaulon	Indian cudweed	U	P
Hedypnois rhagadioloides	Cretan weed	R	P
Lactuca saligna	willow-leaf lettuce	R	P
Lactuca serriola	prickly lettuce	S	P
Matricaria matricarioides	rounded chamomile	S	L
Sonchus asper ssp. *glaucescens*	rough sow-thistle	U	W
Sonchus oleraceus	common sow-thistle	U	W
Sonchus tenerrimus	clammy sow-thistle	C	W
Taraxacum officinale	dandelion	S	L
CONVOLVULACEAE			
Ipomoea carnea		S	

Family/Scientific Name	Common Name	Abundance	Distribution
CRUCIFERAE			
Brassica tournefortii	wild turnip	C	W
Capsella bursapastoris	shepherd's purse	R	P
Carrichtera annua	Ward's weed	R	P
Raphanus raphanistrum	wild radish	R	L
Rapistrum rugosum ssp. *rugosum*	turnip weed	R	L
Sisymbrium erysimoides	smooth mustard	C	P
Sisymbrium irio	London mustard	U	P
Sisymbrium orientale	Indian hedge mustard	U	P
CUCURBITACEAE			
Citrullus colocynthis	colocynth	C	W
Citrullus lanatus	bitter melon	C	W
Cucumis myriocarpus	paddy melon	U	W
CYPERACEAE			
Cyperus hamulosus	curry flat-sedge	R	L
EUPHORBIACEAE			
Ricinus communis	castor oil plant	S	L
FRANKENIACEAE			
Frankenia pulverulenta	Mediterranean sea-heath	S	L
GENTIANACEAE			
Centaurium spicatum	spike centaury	C	P
Centaurium tenuiflorum	branched centaury	R	P
GERANIACEAE			
Erodium aureum		W	C
Erodium cicutarium	cut-leaf heron's-bill	W	C
GRAMINEAE			
Alopecurus geniculatus	marsh fox-tail	R	P
Arundo donax	giant reed	S	L
Avena barbata	bearded oat	R	H
Avena fatua	wild oat	R	H
Bromus catharticus	prairie grass	R	P
Bromus diandrus	great brome	R	L
Cenchrus ciliaris	buffel grass	C	P
Cenchrus longispinus	spiny burr-grass	S	L
Cenchrus pennisetiformis	buffel grass	U	P
Chloris gayana	Rhodes grass	U	P
Chloris virgata	feather-top Rhodes grass	C	W
Critesion murinum ssp. *glaucum*	blue barley-grass	C	H
Critesion murinum ssp. *leporinum*	wall barley-grass	C	H
Cynodon dactylon	couch	C	P
Eragrostis barrelieri	pitted love-grass	R	P
Eragrostis cilianensis	stink grass	R	P
Hainardia cylindrica	common barb-grass	S	L
Hordeum vulgare ssp. *distichon*	barley	R	H
Panicum schinzii	sweet panic	S	L
Parapholis incurva	curly ryegrass	S	L
Pennisetum villosum	feather-top	S	L
Phalaris minor	lesser canary-grass	S	L
Poa annua	winter grass	S	L
Polypogon monspeliensis	annual beard-grass	C	P
Rostraria pumila	tiny bristle-grass	U	W
Schismus barbatus	Arabian grass	U	W

Family/Scientific Name	Common Name	Abundance	Distribution
GRAMINEAE			
Setaria verticillata	whorled pigeon-grass	R	P
Triticum aestivum	wheat	S	L
JUNCACEAE			
Juncus capitatus	dwarf rush	S	L
LEGUMINOSAE			
Medicago orbicularis	button medic	S	L
Medicago polymorpha var. *polymorpha*	burr-medic	U	H
Melilotus indica	King Island melilot	S	L
MALVACEAE			
Malva parviflora	small-flower marshmallow	U	P
ONAGRACEAE			
Oenothera stricta ssp. *stricta*	common evening primrose	S	L
PALMAE			
Phoenix dactylifera	date palm	C	L
PAPAVERACEAE			
Papaver hybridum	rough poppy	S	L
PLANTAGINACEAE			
Plantago coronopus ssp. *commutata*	bucks-horn plantain	S	L
POLYGONACEAE			
Acetosa vesicaria	rosy dock	C	P
Polygonum aviculare	wireweed	U	P
POTAMOGETONACEAE			
Potamogeton pectinatus	fennel pondweed	U	P
SCROPHULARIACEAE			
Kickxia elatine ssp. *crinita*	twining toadflax	S	L
SOLANACEAE			
Datura leichhardtii	native thorn-apple	U	P
Lycium ferocissimum	African boxthorn	S	L
Lycopersicon esculentum	tomato	S	L
Solanum elaeagnifolium	silver-leaf nightshade	S	L
Solanum nigrum	black nightshade	U	H
TAMARICACEAE			
Tamarix aphylla	athel pine	C	P
URTICACEAE			
Urtica urens	small nettle	S	L
VERBENACEAE			
Verbena supina	trailing verbena	R	P
ZYGOPHYLLACEAE			
Tribulus terrestris	caltrop	U	P

APPENDIX G: List of Plants Recorded from the Marla-Oodnadatta SCD

* denotes introduced species
National and State conservation ratings are given following the scientific name:
· E = Endangered - in serious risk of disappearing from the wild state within one or two decades if present land use and other causal factors continue to operate;
· V = Vulnerable - not presently endangered but at risk of disappearing from the wild over a longer period (20-50 years), or which largely occur on sites likely to experience changes in land use that would threaten the survival of the species in the wild;

· R = Rare - species which are rare in Australia but which overall are not considered endangered or vulnerable. Such species may be represented by a relatively large population in a very restricted area, or by smaller populations spread over a wider range or some intermediate combination of distribution pattern.
Data Sources (Source codes in parentheses indicate that the source does not indicate a sub species:
1. Plants of the Marla-Oodnadatta Soil Conservation District (Badman 1995a) and F.J. Badman unpublished data
2. People, Land, Plants and Animals - Witjira National Park SA. DRAFT June 2001 (NPWSA 2001). (As modified by NPWSA Biodiversity Survey and Monitoring; Roger Playfair (RMP Environmental); and Jenny Bourne (NPWSA Outback Region.)
3. Department of Environment and Heritage database records (to November 2001). All database records east of 133^0E are included here, so a few records from the western side of the area may be just outside the District.
Taxa marked (?) are considered doubtful records for the District.

Family/Scientific Name	Common Name	Source
ACANTHACEAE		
Dipteracanthus australasicus ssp. *australasicus*		1 (3)
Rostellularia adscendens ssp. *adscendens* var. *latifolia*	pink tongues, red trumpet	1 (3)
Rostellularia adscendens ssp. *adscendens* var. *pogonanthera*	pink tongues, red trumpet	1
ADIANTACEAE		
Cheilanthes lasiophylla	woolly cloak-fern	1 3
Cheilanthes sieberi ssp. *pseudovellea*		1
Cheilanthes sieberi ssp. *sieberi*	narrow rock-fern, mulga fern	1 3
AIZOACEAE		
**Aptenia cordifolia*	heart-leaf iceplant, iceplant	1
Glinus lotoides	hairy carpet-weed	1 2 3
Gunniopsis calva		3
Gunniopsis kochii - R	Koch's pigface	1
Gunniopsis papillata	twin-leaf pigface	2 3
Gunniopsis quadrifida	Sturt's pigface	1 2 3
Gunniopsis septifraga	green pigface	1
Gunniopsis tenuifolia	narrow-leaf pigface	1 3
Gunniopsis zygophylloides	twin-leaf pigface	1 3
Mollugo cerviana	wire-stem chickweed	1 2 3
Sarcozona praecox	sarcozona	1 3
Tetragonia eremaea	desert spinach, annual spinach	1 2 3
Tetragonia tetragonioides	New Zealand spinach, Warragul cabbage	1 2 3
Trianthema pilosa		1 2 3
Trianthema triquetra	red spinach, small hogweed	1 2 3
Zaleya galericulata	hogweed	1 2 3

Family/Scientific Name	Common Name	Source
AMARANTHACEAE		
**Aerva javanica*		1
Alternanthera angustifolia	narrow-leaf joyweed	1 3
Alternanthera denticulata	lesser joyweed	1 2 3
Alternanthera nana	hairy joyweed, downy pigweed	1
Alternanthera nodiflora	common joyweed	1 3
Amaranthus grandiflorus	large-flower amaranth	1 2 3
Amaranthus interruptus	native amaranth	3
Amaranthus mitchellii	Boggabri weed	1 2 3
Hemichroa diandra	mallee hemichroa	1 2 3
Hemichroa mesembryanthema - V	pigface hemichroa	1 3
Ptilotus aristatus var. *aristatus - R*		1 2 3
Ptilotus aristatus var. *eichlerianus - V*		1 2 3
Ptilotus barkeri - R	Barker's mulla mulla	1 3
Ptilotus blackii	Black's mulla mulla	1
Ptilotus exaltatus var. *exaltatus*	pink mulla mulla, tall mulla mulla	1 2 3
Ptilotus gaudichaudii var. *gaudichaudii*	paper fox-tail, yellow ptilotus	1 2 3
Ptilotus helipteroides var. *helipteroides*	hairy mulla mulla, woolly tails	1 3
Ptilotus helipteroides var. *minor*	hairy mulla mulla , woolly tails	1 3
Ptilotus incanus var. *parviflorus*		3
Ptilotus latifolius var. *latifolius*	tangled mulla mulla, white fox-tail	1 2 3
Ptilotus macrocephalus	feather-heads, square-headed fox-tail	1 2 3
Ptilotus nobilis var. *nobilis*	yellow-tails, regal fox-tail	1 2 3
Ptilotus obovatus var. *griseus*	silver mulla mulla	2 3
Ptilotus obovatus var. *obovatus*	silver mulla mulla , silver-tails	1 2 3
Ptilotus parvifolius var. *parvifolius*	small-leaf mulla mulla, shrubby mulla mulla	1 3
Ptilotus polystachyus var. *polystachyus* forma *polystachyus*	long-tails, bottle-washers	1 2 3
Ptilotus polystachyus var. *polystachyus* forma *rubriflorus*	red long-tails, red pussytail	1 3
Ptilotus schwartzii var. *schwartzii* forma *schwartzii*		3
Ptilotus sessilifolius var. *sessilifolius*	crimson-tails, crimson fox-tail	1 2 3
AMARYLLIDACEAE		
Calostemma luteum	yellow garland-lily	1 3
Crinum flaccidum	Murray lily, Darling lily	1 2 3
ARACEAE		
Typhonium aff. alismifolium	black lily	3
ASCLEPIADACEAE		
**Calotropis procera*	rubber bush	1
Cynanchum floribundum	desert cynanchum	2 3
Marsdenia australis	native pear, austral doubah	1 2 3
Rhyncharrhena linearis	climbing purple-star, purple pentatrope	1 3
Sarcostemma viminale ssp. *australe*	caustic bush, caustic vine	1 2 3
ASPLENIACEAE		
Pleurosorus rutifolius	blanket fern	1
BIGNONIACEAE		
Pandorea pandorana	spearwood	3

Family/Scientific Name	Common Name	Source
BORAGINACEAE		
**Buglossoides arvensis*	Sheepweed, corn gromwell	1
**Echium plantagineum*	Salvation Jane, Paterson's curse	1
Embadium johnstonii	Johnston's slipper plant	3
Halgania cyanea	rough blue-flower, rough halgania	1 2 3
Heliotropium asperrimum	rough heliotrope	1 2 3
**Heliotropium curassavicum*	smooth heliotrope	1 2 3
**Heliotropium europaeum*	common heliotrope, potato weed	1 3
Heliotropium filaginoides		1 3
**Heliotropium supinum*	creeping heliotrope, prostrate potato weed	1
Heliotropium tenuifolium	bushy heliotrope, creeping heliotrope	1 3
Heliotropium undulatum		1 3
Omphalolappula concava	burr stickseed	1 2 3
Plagiobothrys plurisepaleus	white rochelia, white forget-me-not	1 3
Trichodesma zeylanicum	camel bush, cattle bush	1 2 3
CALLITRICHACEAE		
Callitriche sonderi – R	matted water starwort	1
CAMPANULACEAE		
Isotoma petraea	rock isotome	1 3
Lobelia heterophylla – R	wing-seeded lobelia	2 (?)
Wahlenbergia aridicola	dryland bluebell	1 3
Wahlenbergia communis	tufted bluebell	1 3
Wahlenbergia gracilenta	annual bluebell	2 3
Wahlenbergia queenslandica		1
Wahlenbergia stricta ssp. stricta	tall bluebell	3 (?)
Wahlenbergia tumidifructa	swollen-fruit bluebell, balloon bluebell	1 3
CAPPARACEAE		
Cleome viscosa	tickweed	1 3
CARYOPHYLLACEAE		
**Gypsophila tubulosa*	annual chalkwort	1
Polycarpaea arida		1 3
**Spergularia diandra*	lesser sand-spurrey, small sand-spurrey	1
**Spergularia marina*	salt sand-spurrey	1 2 3
**Spergularia rubra*	red sand-spurrey	3
CASUARINACEAE		
Casuarina pauper	black oak, belah	1 3
CENTROLEPIDACEAE		
Centrolepis eremica	dryland centrolepis	1 3
Centrolepis polygyna	wiry centrolepis	1 3
CHENOPODIACEAE		
Atriplex acutibractea ssp. *acutibractea*	pointed saltbush	2
Atriplex acutiloba		3
Atriplex angulata	fan saltbush, angular saltbush	1 2 3
Atriplex cordifolia		3
Atriplex crassipes var. *crassipes*		1 2 3
Atriplex eardleyae	small saltbush	2 3
Atriplex eichleri – R	Eichler's saltbush	1
Atriplex elachophylla		1 3

Family/Scientific Name	Common Name	Source
CHENOPODIACEAE		
Atriplex fissivalvis	gibber saltbush	1 2 3
Atriplex holocarpa	pop saltbush	1 2 3
Atriplex incrassata		1 3
Atriplex intermedia		1 2 3
Atriplex leptocarpa	slender-fruit saltbush	1 2 3
Atriplex limbata	spreading saltbush	1 2 3
Atriplex lindleyi ssp. *conduplicata*	baldoo	1 3
Atriplex lindleyi ssp. *inflata*	corky saltbush	1 3
Atriplex lindleyi ssp. *lindleyi*	baldoo	1 (2) 3
Atriplex lindleyi ssp. *quadripartita*	baldoo	1
Atriplex lobativalvis		1 2 3
Atriplex macropterocarpa		1 3
Atriplex muelleri	Mueller's saltbush	3 (?)
Atriplex nummularia ssp. *nummularia*	old-man saltbush	1 2 3
Atriplex nummularia ssp. *omissa*	old-man saltbush	1 2 3
Atriplex obconica		3
Atriplex pseudocampanulata	spreading saltbush, mealy saltbush	1 2
Atriplex quadrivalvata var. *quadrivalvata*		1 (3)
Atriplex quadrivalvata var. *sessilifolia*		1
Atriplex quinii	kidney-fruit saltbush	1 3
Atriplex spongiosa	pop saltbush	1 2 3
Atriplex stipitata	bitter saltbush, kidney saltbush	1 3
Atriplex suberecta	lagoon saltbush, sprawling saltbush	1
Atriplex turbinata		1 2 3
Atriplex velutinella	sandhill saltbush	1 2 3
Atriplex vesicaria	bladder saltbush	1 2 3
Chenopodium auricomum	golden goosefoot, Queensland bluebush	1 2 3
Chenopodium cristatum	crested goosefoot	1 2 3
Chenopodium desertorum ssp. *anidiophyllum*	mallee goosefoot	1 3
Chenopodium desertorum ssp. *desertorum*	frosted goosefoot, desert goosefoot	1 3
Chenopodium melanocarpum	black-fruit goosefoot, black crumbweed	1 3
**Chenopodium murale*	nettle-leaf goosefoot, sowbane	1
Chenopodium nitrariaceum	nitre goosefoot	1 3
Chenopodium pumilio	clammy goosefoot, small crumbweed	1 3
Chenopodium truncatum		2 3
Dissocarpus biflorus var. *biflorus*	two-horn saltbush, twin-flower saltbush	1 3
Dissocarpus fontinalis		1 3
Dissocarpus paradoxus	ball bindyi, hard-head saltbush	1 2 3
Dysphania glomulifera ssp. *eremaea*	globular crumbweed, red crumbweed	1 2
Dysphania kalpari	kalpari	1 3
Dysphania plantaginella	plantain crumbweed	1 2
Dysphania platycarpa	flat-fruit crumbweed	1 2
Dysphania rhadinostachya ssp. *rhadinostachya*	green crumbweed	3
Dysphania simulans	erect crumbweed	1 2 3
Einadia nutans ssp. *eremaea*	dryland climbing saltbush	1 3
Einadia nutans ssp. *nutans*	climbing saltbush, nodding saltbush	1(2) 3
Enchylaena tomentosa var. *glabra*	ruby saltbush	2 3
Enchylaena tomentosa var. *tomentosa*	ruby saltbush, barrier saltbush	1 2 3
Eremophea spinosa		1 2 3
Eriochiton sclerolaenoides	woolly-fruit bluebush	1 3
Halosarcia cupuliformis – V		1 3
Halosarcia fontinalis	mound spring samphire	1 2 3
Halosarcia halocnemoides ssp. *halocnemoides*	grey samphire, grey glasswort	1 2 3
Halosarcia halocnemoides ssp. *longispicata*	grey samphire, grey glasswort	1 2 3

Family/Scientific Name	Common Name	Source
CHENOPODIACEAE		
Halosarcia halocnemoides ssp. *tenuis*		1 2 3
Halosarcia indica ssp. *bidens*	brown-head samphire	1 2
Halosarcia indica ssp. *leiostachya*	brown-head samphire, brown-head glasswort	1 2 3
Halosarcia pergranulata ssp. *divaricata*	black-seed samphire, black-seed glasswort	1 3
Halosarcia pergranulata ssp. *elongata*	black-seed samphire, black-seed glasswort	1 3
Halosarcia pergranulata ssp. *pergranulata*	black-seed samphire, black-seed glasswort	1 (2) 3
Halosarcia pluriflora		1 2 3
Halosarcia pruinosa	bluish samphire, bluish glasswort	1 2
Halosarcia undulata		1 2 3
Maireana aphylla	cotton-bush, leafless bluebush	1 2 3
Maireana appressa	pale-fruit bluebush, grey bluebush	1 2 3
Maireana astrotricha	low bluebush, grey bluebush	1 2 3
Maireana campanulata	bell-fruit bluebush	1 3
Maireana carnosa	cottony bluebush	1 3
Maireana ciliata	hairy fissure-plant, hairy bluebush	1 2 3
Maireana coronata	crown fissure-plant, crown fissure weed	1 2 3
Maireana eriantha	woolly bluebush	1 3
Maireana erioclada	rosy bluebush, fleshy bluebush	1 3
Maireana georgei	satiny bluebush, slit-wing bluebush	1 2 3
Maireana integra	entire-wing bluebush	1 2 3
Maireana lanosa	woolly bluebush	1 2
Maireana lobiflora	lobed bluebush	3
Maireana luehmannii	Luehman's bluebush	1 2 3
Maireana melanocarpa V V	black-fruit bluebush	1
Maireana microcarpa	swamp bluebush, small-fruit bluebush	1 2
Maireana oppositifolia	salt bluebush	3
Maireana ovata		1 3
Maireana pentagona – R	slender fissure-plant, hairy bluebush	1 3
Maireana pentatropis	erect mallee bluebush, erect bluebush	1 2 3
Maireana planifolia	flat-leaf bluebush, low bluebush	1 3
Maireana pyramidata	black bluebush, shrubby bluebush	1 2 3
Maireana schistocarpa	split-fruit bluebush	1
Maireana radiata	radiate bluebush	3
Maireana scleroptera	hard-wing bluebush	1 2 3
Maireana sedifolia	bluebush, pearl bluebush	1 3
Maireana spongiocarpa	spongy-fruit bluebush	1 2 3
Maireana tomentosa ssp. *urceolata*		1 3
Maireana trichoptera	hairy-fruit bluebush, spike bluebush	1 3
Maireana triptera	three-wing bluebush	1 3
Maireana turbinata	top-fruit bluebush, satiny bluebush	1 2 3
Maireana villosa	silky bluebush, common bluebush	1 3
Malacocera albolanata	woolly soft-horns	1 2 3
Malacocera biflora	two-flower soft-horns	3
Malacocera tricornis	goat-head soft-horns, three-horned saltbush	1 3
**Monolepis spathulata*		1
Neobassia proceriflora	desert glasswort, soda bush	1 3
Osteocarpum acropterum var. *acropterum*	tuberculate bonefruit, water weed	1 2 3
Osteocarpum acropterum var. *deminutum – R*	wingless bonefruit, water weed	1 2
Osteocarpum dipterocarpum	two-wing bonefruit	1 2 3
Osteocarpum salsuginosum	inland bonefruit	3 (3)

Family/Scientific Name	Common Name	Source
CHENOPODIACEAE		
Rhagodia eremaea	tall saltbush	2 3
Rhagodia parabolica	mealy saltbush	3
Rhagodia spinescens	spiny saltbush, thorny saltbush	1 2 3
Salsola kali	buckbush, tumbleweed	1 2 3
Sarcocornia blackiana	thick-head samphire, thick-head glasswort	1
Scleroblitum atriplicinum	starry goosefoot	3
Sclerolaena articulata	jointed bindyi, jointed poverty-bush	1
Sclerolaena bicornis	goat-head bindyi, goat-head burr	1 2 3
Sclerolaena birchii	galvanised burr, galvanised bindyi	1 2
Sclerolaena blackiana – R	Black's bindyi, Black's copperburr	1 3
Sclerolaena brachyptera	short-wing bindyi, short-wing copperburr	1 2 3
Sclerolaena calcarata	redburr bindyi, redburr	1 2 3
Sclerolaena clelandii	Cleland's bindyi	1 2 3
Sclerolaena constricta		1 2 3
Sclerolaena convexula	tall bindyi, tall copperburr	1 2 3
Sclerolaena cornishiana	cartwheel bindyi, cartwheel copperburr	1
Sclerolaena costata	ribbed bindyi	1
Sclerolaena cuneata	tangled bindyi, poverty-bush	1 2 3
Sclerolaena decurrens	green bindyi, green copperburr	1 2 3
Sclerolaena deserticola	desert bindyi	1 3
Sclerolaena diacantha	grey bindyi, horned bindyi	1 2 3
Sclerolaena divaricata	tangled bindyi, poverty-bush	1 2 3
Sclerolaena eriacantha	silky bindyi, silky copperburr	1 2 3
Sclerolaena fontinalis	mound spring bindyi	1 2
Sclerolaena glabra	smooth bindyi	1 2 3
Sclerolaena holtiana – R	Holt's bindyi, grey bindyi	1 2 3
Sclerolaena intricata	tangled bindyi, poverty-bush	1 2 3
Sclerolaena johnsonii	Johnson's bindyi, Johnson's copperburr	1 2 3
Sclerolaena lanicuspis	spinach bindyi, woolly bindyi	1 2 3
Sclerolaena longicuspis	long-spine bindyi, long-spine poverty-bush	1 3
Sclerolaena muricata var. *muricata*	five-spine bindyi, black roly-poly	1 2 3
Sclerolaena muricata var. *semiglabra*	five-spine bindyi	2
Sclerolaena obliquicuspis	oblique-spined bindyi, limestone copperburr	1 3
Sclerolaena parallelicuspis	western bindyi, western copperburr	1 2 3
Sclerolaena parviflora	small-flower bindyi	3
Sclerolaena patenticuspis	spear-fruit bindyi, spear-fruit copperburr	1 2 3
Sclerolaena symoniana	Symon's bindyi	3
Sclerolaena tatei	Tate's bindyi	1 3
Sclerolaena uniflora	small-spine bindyi, grey bindyi	1 2 3
Sclerolaena ventricosa	salt bindyi, salt copperbush	1 3
Sclerostegia disarticulata	glasswort	2 3
Sclerostegia medullosa	glasswort	1 2 3
Sclerostegia tenuis	slender samphire, slender glasswort	1 2 3
Suaeda sp.	seablite	3
Tecticornia verrucosa	putulyu	3
Threlkeldia inchoata	tall bonefruit	1 2 3

Family/Scientific Name	Common Name	Source
CHLOANTHACEAE		
Dicrastylis beveridgei var. *beveridgei*	sand-sage	1 3
Dicrastylis beveridgei var. *lanata*	woolley sand-sage	3
Dicrastylis costelloi var. *costelloi*	sand-sage	1 (2) 3
Dicrastylis costelloi var. *eriantha*	sand-sage	1
Dicrastylis costelloi var. *globulifera*	sand-sage	1
Dicrastylis costelloi var. *violacea*	sand-sage	1
Newcastelia cephalantha var. *tephropepla*		2 (?)
Newcastelia spodiotricha		1 2 3
Spartothamnella teucriiflora	bead bush, red-berried stick-plant	1 3
COMPOSITAE		
Actinobole uliginosum	flannel cudweed, cotton weed	1 3
Anemocarpa podolepidium	rock everlasting	1 2 3
Anemocarpa saxatilis	hill sunray	1 3
Angianthus brachypappus	spreading angianthus, spreading cup-flower	1 2
Angianthus tomentosus	hairy angianthus	3
**Aster subulatus*	aster-weed, wild aster	1
Brachycome blackii	Black's daisy	3
Brachycome campylocarpa	large white daisy	1
Brachycome ciliaris var. *ciliaris*	variable daisy, fringed daisy	1 (2) 3
Brachycome ciliaris var. *lanuginosa*	woolly variable daisy, woolly fringed daisy	1 3
Brachycome ciliaris var. *lyrifolia*	lyrate-leaf daisy, lyrate variable daisy	1
Brachycome dichromosomatica var. *dichromosomatica*	large hard-head daisy, purple hard-head daisy	1 2
Brachycome eriogona – R		1 3
Brachycome iberidifolia	Swan River daisy	1 2 3
Brachycome lineariloba	hard-head daisy, dwarf daisy	1 3
Brachycome tesquorum	shrubby desert daisy	1 3
Bracteantha bracteata	golden everlasting	1 3
**Calendula arvensis*	field marigold, wild marigold	1
Calocephalus knappii	Knapp's beauty-heads	1 3
Calocephalus platycephalus	western beauty-heads, flattened beauty-heads	1 2 3
Calocephalus sonderi – R	pale beauty-heads, yellow poverty weed	1
Calocephalus sp. aff. *platycephalus*	beauty-heads	1
Calotis cymbacantha	showy burr-daisy	1 3
Calotis erinacea	tangled burr-daisy	1 2 3
Calotis hispidula	hairy burr-daisy, bogan flea	1 2 3
Calotis kempei	Kemp's burr-daisy	1 3
Calotis latiuscula	leafy burr-daisy	1 2 3
Calotis multicaulis	woolly-headed burr-daisy	1 2 3
Calotis plumulifera	woolly-headed burr-daisy	1 3
Calotis porphyroglossa	channel burr-daisy	1 3
Calotis scabiosifolia var. *scabiosifolia*	rough burr-daisy	3
**Centaurea melitensis*	Malta thistle, Maltese cockspur	1
Centipeda cunninghamii	common sneezeweed	1 2 3
Centipeda minima	spreading sneezeweed	1 3
Centipeda thespidioides	desert sneezeweed	1 2 3
Chrysocephalum apiculatum	common everlasting, small yellow button	1 3
Chrysocephalum eremaeum	sand button-bush, dryland button-bush	1 2 3
Chrysocephalum pterochaetum	shrub everlasting, perennial sunray	1 2 3
Chrysocephalum semicalvum ssp. *semicalvum*	scented button-bush, hill button-bush	1 2 3

Family/Scientific Name	Common Name	Source
COMPOSITAE		
Chthonocephalus pseudevax	ground-heads	3
**Cotula coronopifolia*	water buttons, button weed	1 2 3
Dichromochlamys dentatifolius		1 2 3
Dimorphocoma minutula		1
Eclipta alatocarpa		1 3
Elachanthus pusillus	elachanth	1
Epaltes australis	spreading nut-heads	1 2 3
Epaltes cunninghamii	tall nut-heads	1 2 3
Eriochlamys behrii	woolly mantle	1 3
Euchiton sphaericus	annual cudweed	3
Flaveria australasica	yellow twin-stem	1 3
Glossogyne tannensis	native cobbler‘s-pegs	1
**Gnaphalium polycaulon*	Indian cudweed, western cudweed	1 2
Gnephosis arachnoidea	spidery button-flower	1 2 3
Gnephosis eriocarpa	native camomile	1 2 3
Gnephosis tenuissima	dwarf golden-tip, dwarf cup-flower	1 2 3
**Hedypnois rhagadioloides*	Cretan weed, Cretan hedypnois	1
Ixiochlamys cuneifolia	Silverton daisy	1 3
Ixiochlamys filicifolia		1 3
Ixiochlamys nana	small fuzzweed	1 2 3
Ixiolaena brevicompta	plains plover-daisy	2 3
Ixiolaena chloroleuca	pale plover-daisy	1 2 3
Ixiolaena leptolepis	narrow plover-daisy, stalked plover-daisy	1 2 3
Ixiolaena tomentosa	woolly plover-daisy, woolly ixiolaena	1 3
Kippistia suaedifolia	fleshy kippistia, fleshy minuria	1
**Lactuca saligna*	willow-leaf lettuce, wild lettuce	1
**Lactuca serriola*	prickly lettuce, compass plant	1 3
Lawrencella davenportii	Davenport daisy, sticky everlasting	1 2 3
Lemooria burkittii	wires-and-wool	1 3
Leptorhynchos baileyi	Bailey‘s buttons	1 3
Leucochrysum fitzgibbonii	Fitzgibbon‘s daisy, glandular sunray	1 3
Leucochrysum molle	hoary sunray, soft sunray	1 3
Leucochrysum stipitatum	salt-spoon daisy, woolly sunray	1 3
**Matricaria matricarioides*	rounded chamomile	3
Millotia greevesii ssp. *greevesii* var. *greevesii*	creeping millotia	3
Millotia incurva		3
Minuria annua	annual minuria	1 3
Minuria cunninghamii	bush minuria	1 2 3
Minuria denticulata	woolly minuria	1 2 3
Minuria integerrima	smooth minuria	1 2 3
Minuria leptophylla	minnie daisy	1 2 3
Minuria rigida		1 3
Myriocephalus pluriflorus	inland woolly-heads	1
Myriocephalus rhizocephalus var. *rhizocephalus*	woolly-heads	1 3
Myriocephalus rudallii	small poached-egg daisy	1 2 3
Olearia stuartii	Stuart‘s daisy-bush	1
Olearia subspicata	spiked daisy-bush, shrubby daisy-bush	1 3
Othonna gregorii	fleshy groundsel	1 2 3
Othonna gypsicola – R	gypsum groundsel, gypsum othonna	1 3
Ozothamnus thomsonii	Thomson’s daisy	3
Picris angustifolia ssp. *angustifolia*	coast picris, hawkweed picris	1
Pluchea dentex	bowl daisy	1 3
Pluchea dunlopii	pink plains-bush, Dunlop’s plains-bush	1 3
Pluchea rubelliflora		1 2 3

Family/Scientific Name	Common Name	Source
COMPOSITAE		
Podolepis canescens	grey copper-wire daisy, bright podolepis	1 2 3
Podolepis capillaris	wiry podolepis, invisible plant	1 3
Podolepis davisiana	button podolepis	1 3
Podotheca angustifolia	sticky long-heads	3
Polycalymma stuartii	poached-egg daisy, poached eggs	1 2 3
Pseudognaphalium luteoalbum	Jersey cudweed, cudweed	1 3
Pterocaulon sphacelatum	apple-bush, fruit-salad plant	1 2 3
Pycnosorus eremaeus	golden billy-buttons, yellow drumsticks	1 3
Pycnosorus pleiocephalus	soft billy-buttons	1 2 3
Rhodanthe charsleyae		1 3
Rhodanthe citrina	pale immortelle	1 2 3
Rhodanthe corymbiflora	paper everlasting, grey sunray	1
Rhodanthe floribunda	white everlasting, white paper-daisy	1 2 3
Rhodanthe microglossa	clustered everlasting, clustered sunray	1 2 3
Rhodanthe moschata	musk daisy, musk sunray	1 2 3
Rhodanthe polygalifolia	milkwort everlasting, brilliant sunray	1
Rhodanthe pygmaea	pigmy daisy, pigmy sunray	1 3
Rhodanthe stricta	slender everlasting, urn paper-daisy	1 2 3
Rhodanthe stuartiana	clay everlasting, clay sunray	1 3
Rhodanthe tietkensii	Tietken's daisy, sand daisy	1 2 3
Rhodanthe uniflora	woolly daisy, woolly sunray	1 2 3
Rutidosis helichrysoides	grey wrinklewort	1 2 3
Schoenia ayersii	Ayer's button-daisy	3
Schoenia cassiniana	pink everlasting, schoenia	1 3
Schoenia ramosissima	dainty everlasting	1 3
Senecio cunninghamii var. *serratus*	inland shrubby groundsel, shrubby groundsel	1 2 3
Senecio glossanthus	annual groundsel, slender groundsel	1 3
Senecio lautus	variable groundsel, elegant yellow-top	1 2 3
Senecio magnificus	showy groundsel, tall yellow-top	1 3
Senecio runcinifolius	thistle-leaf groundsel, tall groundsel	1
Sigesbeckia australiensis	Australian sigesbeckia	3
**Sonchus asper* ssp. *glaucescens*	rough sow-thistle	1 (2) 3
Sonchus hydrophilus	native sow-thistle	1 2 3
**Sonchus oleraceus*	common sow-thistle, milk thistle	1 2 3
**Sonchus tenerrimus*	clammy sow-thistle	1 3
Sphaeranthus indicus		1
Streptoglossa adscendens	desert daisy	1 2 3
Streptoglossa cylindriceps		1 2 3
Streptoglossa liatroides	Wertaloona daisy	1 2 3
**Taraxacum officinale*	dandelion	1
Trichanthodium skirrophorum	woolly yellow-heads, woolly gnephosis	1 2 3
Triptilodiscus pygmaeus	small yellow-heads, common sunray	1
Vittadinia arida		1
Vittadinia eremaea	desert New Holland daisy	1 2 3
Vittadinia pterochaeta	rough New Holland daisy, fuzzweed	1
Vittadinia pustulata	ridged New Holland daisy	3
Vittadinia sulcata	furrowed New Holland daisy	1 3
Waitzia acuminata var. *acuminata*	orange immortelle	1 3
Wedelia sp.		3

Family/Scientific Name	Common Name	Source
CONVOLVULACEAE		
Convolvulus erubescens	Australian bindweed, pink bindweed	1 2 3
Convolvulus eyreanus	silver bindweed, native bindweed	1 3
Convolvulus remotus	grassy bindweed	1 3
Cressa cretica	rosinweed	1 2 3
Cuscuta victoriana		1 3
Evolvulus alsinoides var. *villosicalyx*		1 2 3
**Ipomoea carnea*		1
Ipomoea lonchophylla	cow-vine, common cow-vine	1 3
Ipomoea muelleri	native morning-glory	1 2 3
Ipomoea polymorpha	silky cow-vine	1 2 3
CRASSULACEAE		
Crassula colorata var. *acuminata*	dense crassula, dense stonecrop	1 2 3
Crassula sieberiana ssp. *tetramera*	Australian stonecrop, common crassula	1 3
CRUCIFERAE		
Arabidella eremigena	priddiwalkatji	1 2
Arabidella filifolia	thread-leaf cress	1 3
Arabidella glaucescens		1 3
Arabidella nasturtium	yellow cress	1 2 3
Arabidella procumbens	creeping cress	1
Arabidella trisecta	shrubby cress, native stock	1 3
Blennodia canescens	native stock, wild stock	1 2 3
Blennodia pterosperma	wild stock	1 2 3
**Brassica tournefortii*	wild turnip, Mediterranean turnip	1 2 3
**Capsella bursapastoris*	shepherd‘s purse	1
Carinavalva glauca		3
**Carrichtera annua*	Ward‘s weed	1 3
Cuphonotus andraeanus	downy mother-of-misery	3
Harmsiodoxa blennodioides	hairy-pod cress, May smocks	1 2
Harmsiodoxa brevipes var. *brevipes*	short cress	1 3
Harmsiodoxa brevipes var. *major*	short cress	1 3
Harmsiodoxa puberula	scented cress	1 3
Lepidium muelleri-ferdinandi	Mueller‘s peppercress	1 2 3
Lepidium oxytrichum	green peppercress	1 3
Lepidium papillosum	warty peppercress	1 2 3
Lepidium phlebopetalum	veined peppercress	1 2 3
Lepidium pseudoruderale – R		1
Lepidium rotundum	veined peppercress	2 3
Lepidium sagittulatum	fine-leaf peppercress	1
Lepidium strongylophyllum		1 3
Menkea crassa	fat spectacles	1 3
Menkea villosula		1 3
Phlegmatospermum cochlearinum	downy cress	1 3
**Raphanus raphanistrum*	wild radish, jointed charlock	1
**Rapistrum rugosum* ssp. *rugosum*	turnip weed, short-fruited wild turnip	1
**Sisymbrium erysimoides*	smooth mustard	1 3
**Sisymbrium irio*	London mustard, London rocket	1
**Sisymbrium orientale*	Indian hedge mustard, wild mustard	1
Stenopetalum anfractum	inland thread-petal	1 3
Stenopetalum lineare	narrow thread-petal	1 2 3
Stenopetalum nutans	nodding thread-petal, stinking thread-petal	1 2 3
Stenopetalum velutinum	velvet thread-petal, downy thread-petal	1 3

Family/Scientific Name	Common Name	Source
CUCURBITACEAE		
**Citrullus colocynthis*	colocynth, bitter apple	1 2 3
**Citrullus lanatus*	bitter melon, wild melon	1 2 3
Cucumis melo	Ulcardo melon, rock melon	1 2 3
**Cucumis myriocarpus*	paddy melon, gooseberry cucumber	1 3
Mukia maderaspatana	snake vine	1 2 3
Mukia micrantha	desert cucumber	2
CUPRESSACEAE		
Callitris glaucophylla	white cypress-pine, northern cypress-pine	1 3
CYPERACEAE		
Baumea arthrophylla	swamp twig-rush, fine twig-sedge	1 2 3
Baumea juncea	bare twig-rush, blue twig-rush	1 2
Bolboschoenus caldwellii	salt club-rush, salt club-sedge	1 2 3
Bulbostylis barbata		2
Cyperus alterniflorus "Oodnadatta form"	umbrella flat-sedge	1
Cyperus bifax – R	downs flat-sedge, downs nut-grass	1 3
Cyperus bulbosus	bulbous flat-sedge, bush onion	1 2 3
Cyperus centralis	inland flat-sedge	1 3
Cyperus dactylotes – R		1
Cyperus difformis	variable flat-sedge, dirty Dora	1
Cyperus exaltatus	splendid flat-sedge, tall flat-sedge	1 3
Cyperus gilesii	Giles' flat-sedge	1 3
Cyperus gunnii ssp. *gunnii*	flecked flat-sedge	1
Cyperus gymnocaulos	spiny flat-sedge, spiny sedge	1 2 3
**Cyperus hamulosus*	curry flat-sedge	1
Cyperus iria		1 3
Cyperus laevigatus	bore-drain sedge	1 2 3
Cyperus pygmaeus	pygmy flat-sedge, dwarf sedge	1
Cyperus rigidellus	dwarf flat-sedge	1 3
Cyperus squarrosus	bearded flat-sedge	1 3
Cyperus vaginatus	stiff flat-sedge	1
Cyperus victoriensis	yelka	1 2 3
Eleocharis acuta	common spike-rush, common spike-sedge	1
Eleocharis geniculata	spike-rush	2
Eleocharis pallens	pale spike-rush, pale spike-sedge	1 2 3
Fimbristylis dichotoma	common fringe-rush, eight-days grass	1 3
Fimbristylis ferruginea		1 3
Fimbristylis sieberana	Sieber's fringe-rush, Sieber's fringe-sedge	1 2
Fimbristylis sp. aff. *aestivalis*	fringe-rush, fringe-sedge	1
Gahnia trifida	cutting grass, coast saw-sedge	1 2 3
Isolepis australiensis	southern club-rush, southern club-sedge	1
Isolepis hookeriana	grassy club-rush, Hooker's club-rush	1 3
Lepidosperma sp.	Sword sedge/rapier sedge	3
Schoenoplectus dissachanthus	inland club-rush, blunt club-rush	1 3
Schoenoplectus litoralis	shore club-rush	1 2 3
Schoenoplectus pungens	spiky club-rusf, sharp-leaf club-rush	1
ELATINACEAE		
Bergia perennis ssp. *exigua*	perennial water-fire	1
Bergia trimera	three-part water-fire, small water-fire	1 3
Elatine gratioloides – R	waterwort	1

Family/Scientific Name	Common Name	Source
EUPHORBIACEAE		
Adriana hookeri – R	mallee bitterbush	2 3
Euphorbia "Marree" (F.J.Badman 776)		1 3
Euphorbia australis	hairy caustic weed, caustic weed	1 3
Euphorbia coghlanii		1
Euphorbia drummondii	caustic weed, flat spurge	1 23
Euphorbia inappendiculata		3
Euphorbia mitchelliana var. *mitchelliana*		1 3
Euphorbia parvicaruncula	rough-seeded spurge	1 3
Euphorbia stevenii	bottletree spurge, bottletree caustic	1 3
Euphorbia tannensis ssp. *eremophila*	desert spurge, bottle tree caustic	1 2 3
Euphorbia wheeleri	Wheeler's spurge	1 2 3
Phyllanthus fuernrohrii	sand spurge	1 2 3
Phyllanthus lacunarius	lagoon spurge, Caraweena clover	1 2 3
Phyllanthus maderaspatensis var. *angustifolius*		3
**Ricinus communis*	castor oil plant	1 2
Sauropus ramosissimus – V		2 3
Sauropus trachyspermus	rough-seed spurge, slender spurge	1 2 3
FRANKENIACEAE		
Frankenia cupularis – R		1 3
Frankenia foliosa	leafy sea-heath	1 2 3
Frankenia pauciflora var. *gunnii E R*	southern sea-heath	1 (2) (3)
Frankenia plicata		1 3
Frankenia serpyllifolia	thyme sea-heath, clustered sea-heath	1 2 3
Frankenia subteres – R		1
GENTIANACEAE		
**Centaurium spicatum*	spike centaury	1 2 3
**Centaurium tenuiflorum*	branched centaury	1
GERANIACEAE		
Erodium angustilobum		1 3
**Erodium aureum*		1 2 3
**Erodium cicutarium*	cut-leaf heron's-bill, cut-leaf stork's-bill	1 3
Erodium crinitum	blue heron's-bill, blue stork's-bill	1 3
Erodium cygnorum ssp. *cygnorum*	blue heron's-bill, blue geranium	1 2 3
Erodium cygnorum ssp. *glandulosum*	clammy heron's-bill	1 2 3
GOODENIACEAE		
Brunonia australis	blue pincushion	1 3
Goodenia anfracta – R		1 2 3
Goodenia berardiana	split-end goodenia, twin-head goodenia	1 2 3
Goodenia calcarata	streaked goodenia	1 3
Goodenia chambersii – R		1 3
Goodenia cycloptera	serrated goodenia	1 2 3
Goodenia fascicularis	silky goodenia, mallee goodenia	1 2 3
Goodenia glabra	smooth goodenia	1 2 3
Goodenia glauca	pale goodenia	1 3
Goodenia heterochila – R	serrated goodenia	1 2 3
Goodenia hirsuta		3
Goodenia lobata – R		3
Goodenia lunata	stiff goodenia, hairy goodenia	1 2 3
Goodenia modesta		1 3
Goodenia pinnatifida	cut-leaf goodenia, scrambled eggs	1
Goodenia pusilliflora	small-flower goodenia	3
Goodenia saccata – R	Flinders Ranges goodenia	1 3

Family/Scientific Name	Common Name	Source
GOODENIACEAE		
Goodenia triodiophila		3
Lechenaultia divaricata	tangled lechenaultia	1 2 3
Scaevola collaris		1 2 3
Scaevola depauperata	skeleton fanflower	1 2 3
Scaevola humilis	inland fanflower	2
Scaevola parvibarbata	small-beard fanflower	1 2 3
Scaevola spinescens	spiny fanflower, prickly fanflower	1 2 3
Velleia arguta	toothed velleia	3
Velleia glabrata	smooth velleia, pee-the-bed	1 3
GRAMINEAE		
Agrostis avenacea var. *avenacea*	common blown-grass, fairy grass	1 (3)
**Alopecurus geniculatus*	marsh fox-tail	1 3
Amphipogon caricinus var. *caricinus*	long grey-beard grass	1 3
Aristida anthoxanthoides	yellow three-awn, pale wire-grass	1 2 3
Aristida arida – R		1 3
Aristida capillifolia	needle-leaf three-awn	1 3
Aristida contorta	curly wire-grass, mulga grass	1 2 3
Aristida holathera var. *holathera*	tall kerosene grass	1 2 3
Aristida inaequiglumis		1
Aristida jerichoensis var. *subspinulifera*	Jericho three-awn	3
Aristida latifolia	feather-top wire-grass	1 3
Aristida nitidula	brush three-awn, small brush wire-grass	1 3
Aristida obscura	brush three-awn, small brush wire-grass	1 3
Aristida strigosa	rough three-awn, rough wire-grass	1 2 3
**Arundo donax*	giant reed, Spanish reed	1
Astrebla lappacea	curly Mitchell-grass, wheat Mitchell-grass	1 2 3
Astrebla pectinata	barley Mitchell-grass	1 2 3
**Avena barbata*	bearded oat	1 3
**Avena fatua*	wild oat, black oat	1
Bothriochloa ewartiana	desert blue-grass	1 2 3
Brachyachne ciliaris	hairy native couch	1 2 3
Bromus arenarius	sand brome	1 3
**Bromus catharticus*	prairie grass, rescue grass	1
**Bromus diandrus*	great brome, Kingston grass	1
**Cenchrus ciliaris*	buffel grass, black buffel grass	1 2 3
**Cenchrus longispinus*	spiny burr-grass, innocent weed	1
**Cenchrus pennisetiformis*	buffel grass	1
**Chloris gayana*	Rhodes grass	1
Chloris pectinata	comb windmill grass, comb chloris	1 2 3
Chloris truncata	windmill grass	1 3
**Chloris virgata*	feather-top Rhodes grass, feather windmill grass	1 2 3
Chrysopogon fallax	golden-beard grass	1 2
**Critesion murinum* ssp. *glaucum*	blue barley-grass, northern barley-grass	1
**Critesion murinum* ssp. *leporinum*	wall barley-grass, common fox-tail	1
Cymbopogon ambiguus	lemon-grass, scented grass	1 2
Cymbopogon obtectus	silky-head lemon-grass, silky-heads	1 3
**Cynodon dactylon*	couch, Bermuda grass	1 3
Dactyloctenium radulans	button-grass, finger grass	1 2 3
Dichanthium sericeum ssp. *humilius*	annual silky blue-grass, dwarf blue-grass	1 3
Dichanthium sericeum ssp. *sericeum*	silky blue-grass, Queensland blue-grass	1 2 3

Family/Scientific Name	Common Name	Source
GRAMINEAE		
Digitaria ammophila	spider grass, silky umbrella-grass	1 2 3
Digitaria brownii	cotton panic-grass, cotton grass	1 3
Digitaria coenicola	spider grass, finger panic-grass	1 23
Digitaria ctenantha	comb finger-grass	1
Diplachne fusca	brown beetle-grass, pale beetle-grass	1 2 3
Echinochloa inundata	channel millet	2
Elytrophorus spicatus	spike-grass	1 2 3
Enneapogon avenaceus	common bottle-washers, oat nineawn	1 2 3
Enneapogon caerulescens var. *caerulescens*	blue bottle-washers, blue nineawn	1 3
Enneapogon cylindricus	jointed bottle-washers, jointed nineawn	1 2 3
Enneapogon nigricans	black-head grass, black nineawn	1
Enneapogon intermedius	tall bottle-washers	3
Enneapogon polyphyllus	leafy bottle-washers, limestone bottle-washers	1 2 3
Enteropogon acicularis	umbrella grass, curly windmill grass	1 3
Enteropogon ramosus	umbrella grass, curly windmill grass	1 3
Eragrostis australasica	cane-grass, swamp cane-grass	1 2 3
**Eragrostis barrelieri*	pitted love-grass	1 3
Eragrostis basedowii	neat love-grass	1 2 3
**Eragrostis cilianensis*	stink grass, stinking love-grass	1
Eragrostis confertiflora	spike love-grass	1 2
Eragrostis dielsii var. *dielsii*	mulka, mallee love-grass	1 2 3
Eragrostis elongata	clustered love-grass, close-headed love-grass	1
Eragrostis eriopoda	woollybutt, naked woollybutt	1 2 3
Eragrostis falcata	sickle love-grass	1 2 3
Eragrostis kennedyae	small-flower love-grass	1
Eragrostis laniflora	hairy-flower woollybutt, woollybutt	1 2 3
Eragrostis lanipes	woollybutt, hairy-flower woollybutt	1 3
Eragrostis leptocarpa	drooping love-grass, slender love-grass	1 2 3
Eragrostis parviflora	weeping love-grass, soft love-grass	1 2 3
**Eragrostis pergracilis*	small love-grass	2 3
Eragrostis setifolia	bristly love-grass, narrow-leaf neverfail	1 2 3
Eragrostis speciosa	handsome love-grass	1 2 3
Eragrostis tenellula	delicate love-grass	1 2 3
Eragrostis xerophila	knotty-butt neverfail, neverfail	1 2 3
Eriachne aristidea	three-awn wanderrie, broad-leaved wanderrie grass	1 2 3
Eriachne helmsii	woollybutt wanderrie, buck wanderrie grass	1 3
Eriachne mucronata	mountain wanderrie, mountain wanderrie grass	1 2 3
Eriachne ovata	swamp wanderrie	1 2 3
Eriachne pulchella	pretty wanderrie grass	3
Eriochloa australiensis	Australian cupgrass	1 2 3
Eriochloa creba	tall cupgrass	2
Eriochloa pseudoacrotricha	perennial cupgrass, early spring grass	1 2 3
Eulalia aurea	silky brown-top, sugar-grass	1 2 3
**Hainardia cylindrica*	common barb-grass	1
**Hordeum vulgare* ssp. *distichon*		1
Imperata cylindrica	blady grass, Kunai grass	1 2 3
Iseilema eremaeum		1 2 3
Iseilema membranaceum	small Flinders-grass	1 2 3
Iseilema vaginiflorum	red Flinders-grass	1 2 3

Family/Scientific Name	Common Name	Source
GRAMINEAE		
Leptochloa digitata	umbrella cane-grass	1 2 3
Monachather paradoxa	bandicoot grass	1 2 3
Neurachne munroi	window mulga-grass, slender-headed mulga-grass	1 3
Panicum decompositum var. *decompositum*	native millet, Australian millet	1 2 3
Panicum effusum var. *effusum*	hairy panic	1 3
Panicum laevinode		1 3
**Panicum schinzii*	sweet panic	3
Paractaenum novae-hollandiae ssp. *reversum*	barbed-wire grass, reverse grass	1 (2) 3
Paractaenum refractum	bristle-brush grass	1 3
Paraneurachne muelleri	northern mulga-grass	1
**Parapholis incurva*	curly ryegrass, coast barb-grass	1
Paspalidium basicladum		1
Paspalidium clementii	Clement‘s paspalidium	1 3
Paspalidium constrictum	knotty-butt paspalidium, box grass	1 3
Paspalidium jubiflorum	Warrego summer-grass	3
**Pennisetum villosum*	feather-top, long-style feather-grass	1 2
Perotis rara	comet grass	2
**Phalaris minor*	lesser canary-grass, annual canary grass	1
Phragmites australis	common reed, bamboo reed	1 2 3
Phragmites karka	tropical reed	1 3
Plectrachne helmsii	Helm‘s spinifex	1 3
**Poa annua*	winter grass, annual meadow-grass	1
Poa fordeana	Forde’s poa	3
**Polypogon monspeliensis*	annual beard-grass	1 2 3
**Rostraria pumila*	tiny bristle-grass	1 3
**Schismus barbatus*	Arabian grass, mulga grass	1 3
Setaria dielsii	Diel‘s pigeon-grass	1 2 3
**Setaria verticillata*	whorled pigeon-grass, sticky grass	1
Sporobolus actinocladus	ray grass, katoora	1 2 3
Sporobolus blakei		1
Sporobolus caroli	yakka grass	2 3
Sporobolus mitchellii	rat-tail couch	2 3
Sporobolus virginicus	salt couch	1 2 3
Stipa eremophila	rusty spear-grass	3
Stipa nitida	Balcarra spear-grass, Balcarra grass	1 3
Stipa nodosa	tall spear-grass, knotty spear-grass	1
Stipa scabra ssp. *scabra*	rough spear-grass	3
Stipa trichophylla		3
Themeda avenacea	tall oat-grass	1 3
Themeda triandra	kangaroo grass	1 2 3
Thyridolepis mitchelliana	window mulga-grass, mulga-grass	1 3
Thyridolepis multiculmis		3
Thyridolepis xerophila		1
Tragus australianus	small burr-grass, burr grass	1 2 3
Triodia basedowii	hard spinifex, lobed spinifex	1 2 3
Triodia irritans	spinifex, porcupine grass	1 2 3
Triodia pungens var. *pungens – R*	gummy spinifex, soft spinifex	1
Tripogon loliiformis	five-minute grass, rye beetle-grass	1 2 3
Triraphis mollis	purple plume grass, purple needle-grass	1 2 3
**Triticum aestivum*	wheat	1
Uranthoecium truncatum	flat-stem grass	1 3
Urochloa gilesii ssp. *gilesii*	hairy-edged arm-grass	1 (2) 3
Urochloa piligera	hairy arm-grass	2 3
Urochloa praetervisa	large arm-grass	1 2 3
Yakirra australiensis var. *australiensis*	bunch panic	1 2 3

Family/Scientific Name	Common Name	Source
GRAMINEAE		
Zygochloa paradoxa	sandhill cane-grass	1 2 3
GUTTERIFERAE		
Hypericum gramineum	small St John's wort	3
GYROSTEMONACEAE		
Codonocarpus cotinifolius	desert poplar, poplar bell-fruit	1 3
Gyrostemon ramulosus	bushy wheel-fruit, Chinese bush	1 2 3
HALORAGACEAE		
Haloragis aspera	rough raspwort	1 2 3
Haloragis glauca forma *glauca*	grey raspwort, grey raspweed	3
Haloragis glauca forma *sclopetifera*	grey raspwort, grey raspweed	1 3
Haloragis gossei	Gosse's raspwort	1 2 3
Haloragis odontocarpa forma *pterocarpa*	mulga nettle	3
Haloragis odontocarpa forma *rugosa*	mulga nettle	3
Haloragis uncatipila	shrubby raspwort	1 3
Myriophyllum verrucosum	red milfoil, red water-milfoil	1 3
JUNCACEAE		
Juncus bufonius	toad rush	1
**Juncus capitatus*	dwarf rush, capitate rush	1
Juncus kraussii	sea rush	1 2 3
JUNCAGINACEAE		
Triglochin calcitrapum	spurred arrowgrass	1 2 3
Triglochin centrocarpum	dwarf arrowgrass	1 3
Triglochin hexagonum	six-point arrowgrass	1
LABIATAE		
Mentha australis	river mint	1 3
Prostanthera althoferi ssp. *longifolia*		1 3
Prostanthera striatiflora	striated mintbush, jockey's cap	1 3
Teucrium albicaule	scurfy germander	2
Teucrium corymbosum	rock germander, forest germander	1
Teucrium racemosum	grey germander	1 3
LAURACEAE		
Cassytha sp.	dodder laurel	3
LEGUMINOSAE		
Acacia ammobia – R		3
Acacia aneura var. *aneura*	mulga, narrow-leaf mulga	1 (2) 3
Acacia aneura var. *aneura* x 'silver falcate'		3
Acacia aneura var. 'silver falcate'		3
Acacia ayersiana var. *ayersiana*	blue mulga	1
Acacia ayersiana var. *latifolia*	broad-leaf mulga	1 3
Acacia burkittii	pin-bush wattle, Burkitt's wattle	1 3
Acacia calcicola	northern myall, limestone wattle	1 3
Acacia cambagei	gidgee, stinking wattle	1 2 3
Acacia cibaria	turpentine mulga, umbrella mulga	1 2 3
Acacia coriacea	wirewood, wiry wattle	1 3
Acacia cyperophylla	red mulga, mineritchie	1 2 3
Acacia dictyophleba	net-veined wattle, waxy wattle	1 2 3
Acacia estrophiolata	ironwood	1 3
Acacia farnesiana	sweet acacia bush, mimosa bush	1 2 3
Acacia georginae – R	Georgina gidgee, Georgina gidgea	1 2
Acacia kempeana	witchetty bush	1 3

Family/Scientific Name	Common Name	Source
LEGUMINOSAE		
Acacia ligulata	umbrella bush, dune wattle	1 2 3
Acacia minyura	desert mulga, resin mulga	1 3
Acacia murrayana	colony wattle, Murray‘s wattle	1 2 3
Acacia nyssophylla	spine bush, wait-a-while	1 3
Acacia olgana	Mount Olga wattle	3
Acacia oswaldii	umbrella wattle, Oswald‘s wattle	1 2 3
Acacia papyrocarpa	western myall	1 3
Acacia paraneura	weeping mulga	1 3
Acacia ramulosa	horse mulga, sand dune mulga	1 2 3
Acacia salicina	willow wattle, Broughton willow	1 2 3
Acacia stenophylla	river cooba, eumong	1 3
Acacia stowardii	bastard mulga	1 3
Acacia tetragonophylla	dead finish, kurara	1 2 3
Acacia victoriae ssp. *arida*	downy elegant wattle, downy bramble wattle	1 3
Acacia victoriae ssp. *victoriae*	elegant wattle, bramble wattle	1 (2) 3
Aeschynomene indica	budda pea	1 3
Crotalaria cunninghamii	bird-flower rattle-pod, green bird-flower	1 2 3
Crotalaria eremaea ssp. *eremaea*	downy loose-flowered rattle-pod	2 3
Crotalaria eremaea ssp. *strehlowii*	smooth loose-flowered rattle-pod, bluebush pea	1 3
Crotalaria medicaginea	trefoil rattle-pod	1
Crotalaria novae-hollandiae ssp. *lasiophylla*	woolly rattle-pod, woolly bird-flower	1 2 3
Crotalaria smithiana	low rattle-pod, yellow rattle-pod	1 2 3
Cullen australasicum	tall scurf-pea, verbine scurf-pea	1 2 3
Cullen cinereum	annual scurf-pea, hoary scurf-pea	1 2 3
Cullen discolor	prostrate scurf-pea, white-flower scurf-pea	2 3
Cullen graveolens	native lucerne	1 3
Cullen pallidum	white scurf-pea, woolly scurf-pea	1 2 3
Cullen patens	spreading scurf-pea, native verbine	1 2 3
Glycine canescens	silky glycine	1 2 3
Glycine clandestina var. *sericea*	twining glycine	1 (3)
Indigofera basedowii	showy indigo, Basedow‘s indigo	1
Indigofera colutea	sticky indigo, rusty indigo	1 2 3
Indigofera georgei	George’s indigo	2 3
Indigofera helmsii		2
Indigofera linifolia	flax-leaf indigo	3
Indigofera leucotricha	silver indigo	3
Indigofera linnaei	Birdsville indigo	1 3
Indigofera longibractea		1
Indigofera psammophila	sand indigo, desert indigo	1 3
Isotropis wheeleri	Wheeler‘s lamb-poison	1 2
Lotus cruentus	red-flower lotus, red bird’s-foot trefoil	1 2 3
**Medicago orbicularis*	button medic	1
**Medicago polymorpha* var. *polymorpha*	burr-medic, toothed medic	1 3
**Melilotus indica*	King Island melilot, sweet melilot	1
Muelleranthus stipularis	sand pea	3
Neptunia dimorphantha		1 2 3
Petalostylis labicheoides	butterfly bush, slender petalostylis	1
Senna artemisioides nothossp. *artemisioides*	silver senna, silver cassia	1 3
Senna artemisioides nothossp. *coriacea*	broad-leaf desert senna, broad-leaf desert cassia	1 2 3
Senna artemisioides nothossp. *sturtii*	grey senna, dense senna	1 3
Senna artemisioides ssp. *alicia*	desert senna, desert cassia	1 3

Family/Scientific Name	Common Name	Source
LEGUMINOSAE		
Senna artemisioides ssp. *filifolia*	fine-leaf desert senna, fine-leaf desert cassia	1 2
Senna artemisioides ssp. *helmsii*	blunt-leaf senna, crinkled senna	1 2 3
Senna artemisioides ssp. *oligophylla*	limestone senna, blunt-leaf senna	1 2 3
Senna artemisioides ssp. *petiolaris*	flat-stalk senna, phyllodinous desert cassia	1 2 3
Senna artemisioides ssp. *quadrifolia*	four-leaf desert senna	1 2 3
Senna artemisioides ssp. *zygophylla*	twin-leaf desert senna	2 3
Senna cardiosperma ssp. *gawlerensis*	Gawler Ranges senna	1 3
Senna cardiosperma ssp. *microphylla*	curved-leaf senna	1 3
Senna glutinosa ssp. *pruinosa*	white senna	(1) 2 (3)
Senna phyllodinea	woody cassia	3
Senna pleurocarpa var. *pleurocarpa*	stripe-pod senna, firebush	1 2 3
Swainsona acuticarinata	Burke‘s swainson-pea, limestone swainson-pea	1
Swainsona adenophylla	violet swainson-pea, wild violet	1
Swainsona affinis	small-leaf Swainson-pea, common poison pea	1 2 3
Swainsona burkittii	woolly Darling pea	1
Swainsona campylantha		1 2 3
Swainsona canescens	grey swainson-pea	3
Swainsona eremaea		1
Swainsona flavicarinata	yellow-keel swainson-pea	1 2 3
Swainsona formosa	Sturt pea, Sturt‘s desert-pea	1 3
Swainsona laxa		3
Swainsona microcalyx – R	wild violet	1
Swainsona microphylla	small-leaf swainson-pea	1 2
Swainsona minutiflora – V	small-flower swainson-pea	1 3
Swainsona oligophylla – R		1 2 3
Swainsona oliveri		1 3
Swainsona oroboides	variable swainson-pea, kneed Darling pea	1 2 3
Swainsona phacoides	dwarf swainson-pea, lilac Darling pea	1 2 3
Swainsona procumbens – V	Broughton pea, Tatiara pea	1 2
Swainsona purpurea	purple swainson-pea	1 3
Swainsona stipularis	orange swainson-pea, orange Darling pea	1 3
Swainsona tenuis		3
Swainsona tephrotricha	ashy-haired swainson-pea	1 3
Swainsona unifoliolata		3
Swainsona villosa	villous swainson-pea	1 3
Swainsona viridis – V	creeping Darling pea	1
Templetonia egena	broombush templetonia, desert broombush	1 3
Tephrosia sphaerospora	mulga trefoil	1 2 3
Trigonella suavissima	sweet fenugreek, Cooper clover	1 2 3
Vigna lanceolata var. *latifolia*	maloga bean, native bean	1 (2) 3
LEMNACEAE		
Lemna disperma	common duckweed	1 2 3
LILIACEAE		
Bulbine alata	winged bulbine-lily, winged leek-lily	1 3
Bulbine semibarbata	annual leek-lily	2 3
Corynotheca micrantha var. *divaricata*	small-flower sand lily	1
Lomandra leucocephala ssp. *robusta*	woolly mat-rush, woolly-head mat-rush	1 3

Family/Scientific Name	Common Name	Source
LILIACEAE		
Thysanotus exiliflorus	inland fringe-lily	1 3
Wurmbea dioica ssp. *citrina*	green-flower Nancy, green-flower star-lily	1 (2) 3
Wurmbea stellata	star Nancy	3
LORANTHACEAE		
Amyema gibberulum var. *gibberulum*	twin-flower mistletoe	3
Amyema maidenii ssp. *maidenii*	pale-leaf mistletoe	1 2 3
Amyema miquelii	box mistletoe	1 3
Amyema miraculosum ssp. *boormanii*	fleshy mistletoe	1 3
Amyema preissii	wire-leaf mistletoe	1 2 3
Amyema quandang var. *quandang*	grey mistletoe	1 (2) 3
Diplatia grandibractea	coolibah mistletoe	1 2 3
Lysiana exocarpi ssp. *exocarpi*	harlequin mistletoe	1 (2) 3
Lysiana murrayi	mulga mistletoe	1 3
Lysiana subfalcata	northern mistletoe	1 2 3
LYTHRACEAE		
Ammannia multiflora	jerry-jerry	1 2 3
Lythrum hyssopifolia	lesser loosestrife, small loosestrife	1
Lythrum wilsonii	Wilson‘s loosestrife	1
MALVACEAE		
Abutilon cryptopetalum	hill lantern-bush	1 3
Abutilon fraseri		1 2 3
Abutilon halophilum	plains lantern-bush	1 2 3
Abutilon leucopetalum	desert lantern-bush, desert Chinese-lantern	1 3
Abutilon macrum	slender lantern-bush	1 3
Abutilon malvaefolium	scrambling lantern-bush	1 2 3
Abutilon otocarpum	desert lantern-bush, desert Chinese-lantern	1 2 3
Abutilon oxycarpum var. *oxycarpum*	straggly lantern-bush, flannel weed	1 3
Gossypium sturtianum var. *sturtianum*	Sturt‘s desert rose	1
Hibiscus brachysiphonius	low hibiscus	1 3
Hibiscus burtonii		3
Hibiscus krichauffianus	velvet-leaf hibiscus	1 2 3
Hibiscus sturtii var. *grandiflorus*	Sturt‘s hibiscus, hill hibiscus	1 3
Hibiscus trionum var. *vesicarius*	bladder ketmia	1 3
Lavatera plebeia	Australian hollyhock, native hollyhock	1 2 3
Lawrencia glomerata	clustered lawrencia, small golden-spike	1 2 3
Lawrencia squamata	thorny lawrencia, thorny fan-leaf	1 2 3
**Malva parviflora*	small-flower marshmallow, marshmallow	1 3
Malvastrum americanum	malvastrum, spiked malvastrum	1 3
Sida ammophila	sand sida	1 2 3
Sida argillacea		3
Sida calyxhymenia	tall sida	3
Sida corrugata	corrugated sida, variable sida	1 2 3
Sida cunninghamii	ridge sida	1 2 3
Sida fibulifera	pin sida, low sida	1 2 3
Sida filiformis	fine sida	1 3
Sida intricata	twiggy sida	1 3
Sida petrophila	rock sida	1 3
Sida phaeotricha	hill sida	1 3
Sida rohlenae	shrub sida	2

Family/Scientific Name	Common Name	Source
MALVACEAE		
Sida sp. B (C.Dunlop 1739)		3
Sida sp. F (Latz 7459)		3
Sida sp. L (A.M.Ashby 4202)		3
Sida spodochroma		1 3
Sida trichopoda	high sida, narrow-leaf sida	1 2 3
MARSILEACEAE		
Marsilea costulifera	narrow-leaf nardoo	1
Marsilea drummondii	common nardoo	1 2 3
Marsilea exarata	swayback nardoo	1 2 3
Marsilea hirsuta	short-fruit nardoo	1 3
MORACEAE		
Ficus platypoda var. *minor*	native fig	1
MYOPORACEAE		
Eremophila alternifolia	narrow-leaf emubush, scented emubush	1 3
Eremophila battii		1 3
Eremophila bignoniiflora	bignonia emubush	3
Eremophila deserti	turkey-bush	1 3
Eremophila duttonii	harlequin emubush, Dutton‘s emubush	1 2 3
Eremophila freelingii	rock emubush, limestone fuchsia-bush	1 2 3
Eremophila gilesii	hairy-fruit emubush, Giles’’ emubush	1 3
Eremophila glabra	tar bush, common emubush	1 3
Eremophila latrobei ssp. *glabra*	crimson emubush, Latrobe‘s emubush	1 2 3
Eremophila latrobei ssp. *latrobei*	grey-leaf crimson emubush, grey fuchsia-bush	1 3
Eremophila longifolia	weeping emubush, long-leaf emubush	1 2 3
Eremophila macdonnellii	Macdonnell‘s emubush	1 2 3
Eremophila maculata var. *maculata*	spotted emubush, fuchsia bush	1 2 3
Eremophila neglecta		1 3
Eremophila obovata var. *obovata*		1 2
Eremophila oppositifolia var. *oppositifolia*	opposite-leaved emubush, showy-sepal emubush	1 3
Eremophila paisleyi ssp. *glandulosa*		1 (3)
Eremophila paisleyi ssp. *paisleyi*		1
Eremophila pentaptera – R		2 3
Eremophila rotundifolia	round-leaf emubush	1 2 3
Eremophila scoparia	broom emubush, silvery emubush	1 2 3
Eremophila serrulata	green emubush, toothed emubush	1 3
Eremophila sturtii	turpentine bush, narrow-leaf emubush	1 3
Eremophila verrucosa ssp. *verrucosa*	warty emubush	1 3
Eremophila willsii	Wills’’ emubush, Wills’’ desert-fuchsia	1 2 3
Myoporum brevipes	warty boobialla, pale myoporum	1
Myoporum montanum	native myrtle, water-bush	1 2 3

Family/Scientific Name	Common Name	Source
MYRTACEAE		
Baeckea tuberculata		3
Corymbia eremaea ssp. *eremaea*	hills bloodwood	1 3
Eucalyptus camaldulensis var. *camaldulensis*	river red gum	3
Eucalyptus camaldulensis var. *obtusa*	northern river red gum	1 2 3
Eucalyptus coolabah ssp. *arida*	coolibah	1 (2) 3
Eucalyptus eucentrica		1
Eucalyptus intertexta	gum-barked coolibah, smooth-barked coolibah	1 3
Eucalyptus mannensis ssp. *mannensis*	Mann Ranges mallee	3
Eucalyptus oleosa	red mallee	3
Eucalyptus socialis	beaked red mallee, summer red mallee	1 3
Eucalyptus youngiana	Ooldea mallee	3
Melaleuca glomerata	inland paper-bark, white tea-tree	1 2 3
Melaleuca pauperiflora ssp. *mutica*	boree	1 3
Melaleuca uncinata	Broombush, broom honey-myrtle	1 3
Melaleuca xerophila	boree	1
Micromyrtus flaviflora	yellow heath-myrtle	3
Thryptomene longifolia		3
Thryptomene maisonneuvei	desert thryptomene	3
NYCTAGINACEAE		
Boerhavia coccinea	tar-vine	1 3
Boerhavia dominii	tar-vine, tah-vine	1 2 3
Boerhavia schomburgkiana	Schomburgk‘s tar-vine	1 2 3
Commicarpus australis	pink gum-fruit	1
ONAGRACEAE		
**Oenothera stricta* ssp. *stricta*	common evening primrose	3
OPHIOGLOSSACEAE		
Ophioglossum polyphyllum – R	large Adder’s tongue	3
OROBANCHACEAE		
Orobanche cernua var. *australiana – V*	Australian broomrape	1
OXALIDACEAE		
Oxalis perennans	native sorrel, native oxalis	1 3
PALMAE		
**Phoenix dactylifera*	date palm	1 2 3
PAPAVERACEAE		
**Papaver hybridum*	rough poppy	1
PEDALIACEAE		
Josephinia eugeniae	Josephinia burr	2 3
PITTOSPORACEAE		
Pittosporum phylliraeoides var. *microcarpa*	native apricot, weeping pittosporum	1 2 3
PLANTAGINACEAE		
**Plantago coronopus* ssp. *commutata*	bucks-horn plantain	1
Plantago cunninghamii	clay plantain	3
Plantago drummondii	dark plantain, dark sago-weed	1 2 3
Plantago sp. B	little plantain, annual plantain	1 3
Plantago turrifera	crowned plantain, small sago-weed	1
Plantago varia complex	native plantain	1 2 3

Family/Scientific Name	Common Name	Source
POLYGALACEAE		
Polygala isingii	Central Australian milkwort, Ising's milkwort	1
POLYGONACEAE		
**Acetosa vesicaria*	rosy dock, wild hops	1 3
Muehlenbeckia florulenta	lignum, tangled lignum	1 2 3
Persicaria decipiens	slender knotweed	3
**Polygonum aviculare*	Wireweed, prostrate knotweed	1
Polygonum plebeium	small knotweed	1 2 3
Rumex crystallinus	glistening dock, bristly dock	1 2
PORTULACACEAE		
Anacampseros australiana	Australian anacampseros	3
Calandrinia balonensis	broad-leaf parakeelya	1 2 3
Calandrinia disperma	two-seed purslane	2
Calandrinia eremaea	dryland purslane, small purslane	1 3
Calandrinia polyandra var. *polyandra*	parakeelya	1 (2)
Calandrinia ptychosperma	creeping parakeelya	1 2 3
Calandrinia pumila	tiny purslane	1 2 3
Calandrinia remota	round-leaf parakeelya	1 2 3
Calandrinia reticulata		1 3
Calandrinia volubilis	twining purslane	1
Portulaca filifolia	slender purslane	3
Portulaca intraterranea	buttercup purslane, inland purslane	1 2 3
Portulaca oleracea	common purslane, munyeroo	1 2 3
POTAMOGETONACEAE		
**Potamogeton pectinatus*	fennel pondweed, sago pondweed	1 3
Ruppia maritima	sea tassel, water tassel	1
PRIMULACEAE		
Samolus repens	creeping brookweed, creeping samolus	1 2 3
PROTEACEAE		
Grevillea juncifolia	honeysuckle grevillea	1 2 3
Grevillea nematophylla	water bush	1 2 3
Grevillea stenobotrya	rattle-pod grevillea, sandhill grevillea	1 2 3
Grevillea striata	beefwood	1 2
Hakea divaricata	corkbark, corkbark tree	1 2 3
Hakea eyreana	fork-leaf corkwood, straggly corkbark	1 2
Hakea leucoptera ssp. *leucoptera*	silver needlewood, needle bush	1 (2) 3
Hakea suberea	long-leaf corkwood, corkbark	1 3
RANUNCULACEAE		
Myosurus minimus var. *australis*	mousetail	1 3
Ranunculus pentandrus var. *pentandrus*	smooth buttercup, inland buttercup	1
Ranunculus pentandrus var. *platycarpus*	smooth buttercup, inland buttercup	1 3
Ranunculus pumilio var. *pumilio*	ferny buttercup, small-flower buttercup	1

Family/Scientific Name	Common Name	Source
RUBIACEAE		
Canthium attenuatum		3
Canthium latifolium	broad-leaf native currant, wild currant	1 3
Canthium lineare	narrow-leaf native currant	3
Dentella pulvinata		1 2
Pomax umbellata	pomax	2
Synaptantha tillaeacea		1 2 3
SANTALACEAE		
Exocarpos aphyllus	leafless cherry, leafless ballart	1
Santalum acuminatum	quandong, native peach	1 3
Santalum lanceolatum	Plumbush, northern sandalwood	1 2 3
SAPINDACEAE		
Alectryon oleifolius ssp. *canescens*	bullock bush, cattle bush	1 2 3
Atalaya hemiglauca	whitewood	1 2 3
Dodonaea microzyga var. *microzyga*	brilliant hop-bush	1 (2) 3
Dodonaea viscosa ssp. *angustissima*	narrow-leaf hop-bush, slender hop-bush	1 2 3
Dodonaea viscosa ssp. *mucronata*	northern hop-bush	1 2 3
Dodonaea viscosa ssp. *spatulata*	sticky hop-bush	2 3
SCROPHULARIACEAE		
Glossostigma cleistanthum	spoon mud-mat	1
Glossostigma diandrum	two-anther mud-mat	1 2
Glossostigma drummondii	desert mud-mat	1
**Kickxia elatine* ssp. *crinita*	twining toadflax, sharp-leaf fluellen	1
Limosella curdieana var. “curdieana”	large mudwort	1
Mimulus gracilis	slender monkey-flower	2
Mimulus repens	creeping monkey-flower	1 3
Peplidium “Marla” (W.R.Barker 3535)		3
Peplidium aithocheilum		1 2 3
Peplidium foecundum	dwarf peplidium	1 2 3
Stemodia "haegii"(J.Z.Weber 9055) E R	Haegi's stemodia	1 3
Stemodia florulenta	bluerod	1 2 3
Stemodia glabella	smooth bluerod, bluerod	1 2 3
SOLANACEAE		
**Datura leichhardtii*	native thorn-apple	1 2 3
Duboisia hopwoodii	pituri, pitcheri	1 3
Lycium australe	Australian boxthorn	1 3
**Lycium ferocissimum*	African boxthorn	1
**Lycopersicon esculentum*	tomato	1
Nicotiana burbidgei - R		1 2 3
Nicotiana occidentalis ssp. *obliqua*	western tobacco	1 (2)
Nicotiana rosulata		3
Nicotiana simulans	native tobacco, wild tobacco	1 2 3
Nicotiana truncata - R		3
Nicotiana velutina	velvet tobacco	1 2 3
Solanum centrale	desert raisin	1 2 3
Solanum chenopodinum	goosefoot potato-bush	1 2 3
Solanum cleistogamum	shy nightshade	3
Solanum coactiliferum	tomato-bush, western nightshade	1 2 3
**Solanum elaeagnifolium*		3
Solanum ellipticum	velvet potato-bush, potato-bush	1 2 3
Solanum esuriale	quena	1 2 3
Solanum lacunarium	lagoon nightshade	1 3
Solanum lasiophyllum	flannel bush	1 3

Family/Scientific Name	Common Name	Source
SOLANACEAE		
**Solanum nigrum*	black nightshade, black-berry nightshade	1 3
Solanum oligacanthum	desert nightshade	1 2 3
Solanum petrophilum	rock nightshade	1
Solanum quadriloculatum	plains nightshade, tomato bush	1 3
Solanum sturtianum	Sturt's nightshade, Thargomindah nightshade	1 3
STACKHOUSIACEAE		
Stackhousia clementii	limestone candles	3
Stackhousia muricata ssp. "Annual" (W.R.Barker 2172)	yellow candles	3
STERCULIACEAE		
Gilesia biniflora - R	western tar-vine	1 2 3
Melhania oblongifolia	velvet hibiscus	1 2 3
TAMARICACEAE		
**Tamarix aphylla*	athel pine, tamarisk	1 3
THYMELAEACEAE		
Pimelea microcephala ssp. *microcephala*	shrubby riceflower, mallee riceflower	1 (2) 3
Pimelea penicillaris - R	sandhill riceflower	1 2 3
Pimelea simplex ssp. *continua*	desert riceflower	1 2 3
Pimelea simplex ssp. *simplex*	desert riceflower	1 3
Pimelea trichostachya	spiked riceflower, annual riceflower	1 2 3
TYPHACEAE		
Typha domingensis	narrow-leaf bulrush, narrow-leaf cumbungi	1 2 3
UMBELLIFERAE		
Daucus glochidiatus	native carrot, Australian carrot	1 2 3
Eryngium plantagineum	long eryngium, eryngo	1
Eryngium supinum	little devil	3
Eryngium vesiculosum - R	prostrate blue devil, prickfoot	1
Hydrocotyle trachycarpa	wild parsley	1 3
Hydrocotyle verticillata	shield pennywort	1 2 3
Trachymene glaucifolia	blue parsnip, wild parsnip	1 2 3
Trachymene pilosa	dwarf trachymene	3
URTICACEAE		
Parietaria cardiostegia	mallee smooth-nettle, mallee pellitory	1
Parietaria debilis	smooth-nettle, shade pellitory	1
**Urtica urens*	small nettle, stinging nettle	1
VERBENACEAE		
**Verbena officinalis*	common verbena	2
**Verbena supina*	trailing verbena	1
ZANNICHELLIACEAE		
Lepilaena preissii	slender water-mat	1

Family/Scientific Name	Common Name	Source
ZYGOPHYLLACEAE		
Nitraria billardierei	nitre-bush, Dillon bush	1 2 3
Tribulus astrocarpus	star-fruit caltrop	1 3
Tribulus eichlerianus	Eichler's caltrop, bull-head	1 2 3
Tribulus hystrix	spiky caltrop	1 2 3
Tribulus macrocarpus		1
**Tribulus terrestris*	caltrop, cat-head	1 2 3
Tribulus terrestris (long style)		3
Zygophyllum ammophilum	sand twinleaf	2 3
Zygophyllum apiculatum	pointed twinleaf, gallweed	1
Zygophyllum aurantiacum ssp. *aurantiacum*	shrubby twinleaf	1 (2) 3
Zygophyllum aurantiacum ssp. *verticillatum*	shrubby twinleaf	1
Zygophyllum compressum	rabbit-ears twinleaf	1 2 3
Zygophyllum crassissimum - R	thick twinleaf	1 2 3
Zygophyllum eichleri		3
Zygophyllum emarginatum	notched twinleaf	1 2 3
Zygophyllum eremaeum	pale-flower twinleaf, climbing twinleaf	1 3
Zygophyllum glaucum	pale twinleaf	1
Zygophyllum howittii	clasping twinleaf	1 2 3
Zygophyllum humillimum - R	small-fruit twinleaf	1 2
Zygophyllum hybridum - R		1 3
Zygophyllum iodocarpum	violet twinleaf	1 2 3
Zygophyllum marliesiae	twinleaf	1
Zygophyllum prismatothecum	square-fruit twinleaf	1 2 3
Zygophyllum rowelliae	twinleaf	1
Zygophyllum simile	white twinleaf	1 2 3
Zygophyllum kochii		3

APPENDIX H: List of Animals Recorded from the Marla-Oodnadatta SCD

Nomenclature follows Robinson et al. (2000).
* Indicates introduced taxa.

Birds

Conservation status codes are shown following the scientific name. The first code is the Australian status according to the Commonwealth Environment Protection and Biodiversity Conservation Act 1999; the second is the State status according to the South Australian National Parks and Wildlife Act 1972 schedules.

V Vulnerable - rare and at risk from potential threats or long-term threats which could cause the species to become endangered in the future.

R Rare - having a low overall frequency of occurrence, confined to a restricted range or scattered sparsely over a wider area. Not currently exposed to significant threats but warranting monitoring and protective measures to prevent reduction of populations.

E Endangered – in danger of extinction if the causal factors continue to operate.

The last column indicates the source of bird species records as follows:

1. People, Land, Plants and Animals - Witjira National Park SA. DRAFT June 2001 (NPWSA 2001). (As modified by NPWSA Biodiversity Survey and Monitoring; Roger Playfair (RMP Environmental); and Jenny Bourne (NPWSA Outback Region.)
2. Biological Survey and Monitoring, DEH, Database records, November 2001
3. F.J. Badman published and unpublished data.
4. Robinson et al. (2000).

Records marked (?) are regarded as doubtful for the District.
* denotes introduced species.

Family	Scientific Name	Common Name	Source
ACANTHIZIDAE	*Acanthiza apicalis*	Inland Thornbill	1 2 4
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	3 4
	Acanthiza iredalei	Slender-billed Thornbill	4
	Acanthiza pusilla	Brown Thornbill	2
	Acanthiza robustirostris -,R	Slaty-backed Thornbill	1 2 3 4
	Acanthiza uropygialis	Chestnut-rumped Thornbill	1 2 3 4
	Aphelocephala leucopsis	Southern Whiteface	1 3 4
	Aphelocephala nigricincta	Banded Whiteface	1 2 3 4
	Aphelocephala pectoralis - R	Chestnut-breasted Whiteface	2 4
	Calamanthus campestris	Rufous Field-wren	1 3 4
	Gerygone fusca	Western Gerygone (Western Warbler)	2
	Pyrrholaemus brunneus -,R	Redthroat	1 2 3 4
	Smicrornis brevirostris	Weebill	1 2 3 4
ACCIPITRIDAE	*Accipiter cirrhocephalus*	Collared Sparrowhawk	1 3 4
	Accipiter fasciatus	Brown Goshawk	1 3 4
	Aquila audax	Wedge-Tailed Eagle	1 3 4
	Circus approximans	Swamp (Marsh) Harrier	1 2 3 4
	Circus assimilis	Spotted Harrier	1 3 4
	Elanus axillaris	Black-shouldered Kite	1 3 4
	Elanus scriptus	Letter-winged Kite	1 2 3
	Haliastur sphenurus	Whistling Kite	1 2 3 4
ACCIPITRIDAE	*Hamirostra melanosternon -,R*	Black-breasted Buzzard	1 2 3 4
	Hieraaetus morphnoides	Little Eagle	1 3 4
	Lophoictinia isura - V	Square-tailed Kite	2 4
	Milvus migrans	Black Kite	1 2 3 4
AEGOTHELIDAE	*Aegotheles cristatus*	Australian Owlet-Nightjar	1 2 3 4

Family	Scientific Name	Common Name	Source
ALCEDINIDAE	*Todiramphus pyrrhopygia*	Red-backed Kingfisher	1 3 4
	Todiramphus sancta	Sacred Kingfisher	1 3 4
ANATIDAE	*Anas castanea*	Chestnut Teal	1 2 34
	Anas gracilis	(Australasian) Grey Teal	1 3 4
	Anas rhynchotis -,R	Australian Shoveler	1 3 4
	Anas superciliosa	Pacific Black Duck	1 3 4
	Aythya australis	Hardhead (White-eyed Duck)	1 3 4
	Biziura lobata -,R	Musk Duck	1 3
	Chenonetta jubata	Australian Wood Duck	1 3 4
	Cygnus atratus	Black Swan	1 3 4
	Dendrocygna eytoni	Plumed Whistling-Duck	1 (?)
	Malacorhynchus membranaceus	Pink-eared Duck	1 3 4
	Oxyura australis -,R	Blue-billed Duck	1 3 4
	Stictonetta naevosa -,V	Freckled Duck	1 3 4
	Tadorna rajah	Radjah Shelduck	4
	Tadorna tadornoides	Australian Shelduck (Mountain Duck)	1 3 4
ANHINGIDAE	*Anhinga melanogaster*	Darter	1 2 3 4
APODIDAE	*Apus pacificus*	Fork-tailed Swift	1 3
ARDEIDAE	*Ardea alba*	Great (White) Egret	1 3 4
	Ardea ibis	Cattle Egret	3
	Ardea pacifica	White-necked (Pacific) Heron	1 2 3 4
	Egretta garzetta	Little Egret	1 4
	Egretta novaehollandiae	White-faced Heron	1 3 4
	Nycticorax caledonicus	Nankeen Night Heron	1 3 4
ARTAMIDAE	*Artamus cinereus*	Black-faced Woodswallow	1 3 4
	Artamus leucorhynchus	White-breasted Woodswallow	1 3 4
	Artamus minor	Little Woodswallow	4
	Artamus personatus	Masked Woodswallow	1 3 4
	Artamus superciliosus	White-browed Woodswallow	1 3 4
	Cracticus nigrogularis	Pied Butcherbird	1 3 4
	Cracticus torquatus	Grey Butcherbird	1 3 4
	Gymnorhina tibicen	Australian Magpie	1 3 4
BURHINIDAE	*Burhinus grallarius -,V*	Bush Stone-curlew	1 4
CACATUIDAE	*Cacatua leadbeateri*	Major Mitchell's Cockatoo (Pink Cockatoo)	1 4
	Cacatua roseicapilla	Galah	1 3 4
	Cacatua sanguinea	Little Corella	1 3 4
	Calyptorhynchus banksii samuelli ,R	Red-tailed Black-Cockatoo	1 3
	Nymphicus hollandicus	Cockatiel	1 3 4
CAMPEPHAGIDAE	*Coracina maxima*	Ground Cuckoo-shrike	1 3 4
	Coracina novaehollandiae	Black-faced Cuckoo-shrike	1 3 4
	Lalage tricolor	White-winged Triller	1 3 4
CAPRIMULGIDAE	*Eurostopodus argus*	Spotted Nightjar	1 3 4
CASUARIIDAE	*Dromaius novaehollandiae*	Emu	1 3 4

Family	Scientific Name	Common Name	Source
CHARADRIIDAE	*Charadrius australis*	Inland Dotterel	1 3 4
	Charadrius mongolus	Lesser Sand Plover	1 (?)
	Charadrius ruficapillus	Red-capped Plover (Red-capped Dotterel)	1 2 3 4
	Elseyornis melanops	Black-fronted Dotterel	1 3 4
	Erythrogonys cinctus	Red-kneed Dotterel	1 2 3 4
	Pluvialis squatarola	Grey Plover	3 4
	Vanellus miles	Masked Lapwing (Spur-winged Plover)	1 3 4
	Vanellus tricolor	Banded Lapwing (Banded Plover)	1 3 4
CLIMACTERIDAE	*Climacteris affinis*	White-browed Treecreeper	4 (?)
COLUMBIDAE	**Columba livia*	Rock Dove (Feral Pigeon)	3 4
	Geopelia cuneata	Diamond Dove	1 3 4
	Geopelia placida	Peaceful Dove	1 3 4
	Geophaps plumifera -,R	Spinifex (Plumed) Pigeon	1 4
	Ocyphaps lophotes	Crested Pigeon	1 3 4
	Phaps chalcoptera	Common Bronzewing	1 3 4
	Phaps histrionica -,V	Flock Bronzewing (Pigeon)	1 3 4
CORVIDAE	*Corvus bennetti*	Little Crow	1 2 3 4
	Corvus coronoides	Australian Raven	1 3 4
	Corvus orru	Torresian Crow (Australian Crow)	1 3 4
CUCULIDAE	*Chrysococcyx basalis*	Horsfield's Bronze-Cuckoo	1 3 4
	Chrysococcyx osculans	Black-eared Cuckoo	1 3 4
	Cuculus pallidus	Pallid Cuckoo	1 3 4
DICAEIDAE	*Dicaeum hirundinaceum*	Mistletoe Bird	1 3 4
DICRURIDAE	*Grallina cyanoleuca*	Magpie-Lark	1 3 4
	Myiagra cyanoleuca	Satin Flycatcher	3
	Myiagra inquieta	Restless Flycatcher	3 4
	Rhipidura albiscapa	Grey Fantail	1 3 4
	Rhipidura leucophrys	Willie Wagtail	1 3 4
ESTRILDIDAE	*Emblema pictum*	Painted Finch	4
	Taeniopygia guttata	Zebra Finch	1 3 4
EUPETIDAE	*Cinclosoma castanotus -,R*	Chestnut Quail-thrush	1 (?)
	Cinclosoma cinnamomeum	Cinnamon Quail-thrush	1 3 4
	Psophodes cristatus	Chirruping Wedgebill	1 3 4
	Psophodes occidentalis	Chiming Wedgebill	1 3 4
FALCONIDAE	*Falco berigora*	Brown Falcon	1 3 4
	Falco cenchroides	Nankeen (Australian) Kestrel	1 3 4
	Falco hypoleucus -,R	Grey Falcon	1 3 4
FALCONIDAE	*Falco longipennis*	Australian Hobby	1 2 3 4
	Falco peregrinus -,R	Peregrine Falcon	1 2 3 4
	Falco subniger	Black Falcon	1 3 4

Family	Scientific Name	Common Name	Source
GLAREOLIDAE	*Glareola maldivarum*	Oriental Pratincole	1 (?)
	Stiltia isabella	Australian Pratincole	1 2 3 4
GRUIDAE	*Grus rubicunda -,V*	Brolga	1 2 3 4
HIRUNDINIDAE	*Cheramoeca leucosternus*	White-backed Swallow	1 3 4
	Hirundo neoxena	Welcome Swallow	1 2 3 4
	Petrochelidon ariel	Fairy Martin	1 3 4
	Petrochelidon nigricans	Tree Martin	1 3 4
LARIDAE	*Chlidonias hybridus*	Whiskered (Marsh) Tern	1 3 4
	Hydroprogne caspia	Caspian Tern	1 3 4
	Larus novaehollandiae	Silver Gull	1 3 4
	Sterna nilotica	Gull-Billed Tern	1 3 4
MALURIDAE	*Amytornis barbatus -,R*	Grey Grasswren	1 (?)
	Amytornis goyderi	Eyrean Grasswren	1 2 4
	Amytornis textiles -,R	Thick-billed Grasswren	1 3 4
	Malurus lamberti	Variegated Fairy-wren	1 3 4
	Malurus leucopterus	White-winged Fairy-wren	1 2 3 4
	Malurus splendens	Splendid Fairy-wren	1 3 4
	Stipiturus ruficeps -,R	Rufous-Crowned Emu-wren	1 4
MELIPHAGIDAE	*Acanthagenys rufogularis*	Spiny-Cheeked Honeyeater	1 3 4
	Ashbyia lovensis	Gibberbird	1 3 4
	Certhionyx niger	Black Honeyeater	1
	Certhionyx variegatus	Pied Honeyeater	1 2 3 4
	Epthianura albifrons	White-fronted Chat	1 3
	Epthianura aurifrons	Orange Chat	1 3 4
	Epthianura tricolor	Crimson Chat	1 3 4
	Lichenostomus keartlandi	Grey-headed Honeyeater	4
	Lichenostomus penicillatus	White-plumed Honeyeater	1 3 4
	Lichenostomus plumulus	Grey-fronted Honeyeater	1 4
	Lichenostomus virescens	Singing Honeyeater	1 3 4
	Lichmera indistincta -,R	Brown Honeyeater	1 3 4
	Manorina flavigula	Yellow-throated Miner	1 3 4
	Phylidonyris albifrons	White-Fronted Honeyeater	1 3 4
MEROPIDAE	*Merops ornatus*	Rainbow Bee-Eater	1 2 3 4
MOTACILLIDAE	*Anthus novaeseelandiae*	Richard's Pipit	1 3 4
NEOSITTIDAE	*Daphoenositta chrysoptera*	Varied Sittella	1 4
OTIDIDAE	*Ardeotis australis -,V*	Australian Bustard	1 2 3 4
PACHYCEPHALIDAE	*Colluricincla harmonica*	Grey Shrike-thrush	1 3 4
	Oreoica gutturalis	Crested Bellbird	1 3 4
	Pachycephala rufiventris	Rufous Whistler	1 3 4
PARDALOTIDAE	*Pardalotus rubricatus*	Red-browed Pardalote	1 3 4
	Pardalotus striatus	Striated Pardalote	1 3 4
PASSERIDAE	**Passer domesticus*	House Sparrow	3 4
PELECANIDAE	*Pelecanus conspicillatus*	Australian Pelican	1 2 3 4

Family	Scientific Name	Common Name	Source
PETROICIDAE	*Melanodryas cucullata*	Hooded Robin	1 3 4
	Microeca fascinans	Jacky Winter	1 4 (?)
	Petroica goodenovii	Red-Capped Robin	1 3 4
PHALACROCORACIDAE	*Phalacrocorax carbo*	Great (Black) Cormorant	1 2 3 4
	Phalacrocorax melanoleucos	Little Pied Cormorant	1 3 4
PHALACROCORACIDAE	*Phalacrocorax sulcirostris*	Little Black Cormorant	1 2 3 4
	Phalacrocorax varius	Pied Cormorant	1 3 4
PHASIANIDAE	*Coturnix pectoralis*	Stubble Quail	1 3 4
PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth	1 2 3 4
PODICIPEDIDAE	*Poliocephalus poliocephalus*	Hoary-headed Grebe	1 3 4
	Tachybaptus novaehollandiae	Australasian (Little) Grebe	1 2 3 4
POMATOSTOMIDAE	*Pomatostomus superciliosus*	White-browed Babbler	1 3 4
	Pomatostomus temporalis -,R	Grey-crowned Babbler	1 3 4
PROCELLARIIDAE	*Puffinus gavia*	Fluttering Shearwater	1 (?)
PSITTACIDAE	*Aprosmictus erythropterus -,R*	Red-Winged Parrot	1 (?)
	Barnardius zonarius	Australian Ringneck (Ring-necked Parrot)	1 3 4
	Melopsittacus undulatus	Budgerigar	1 3 4
	Neophema chrysostoma -,V	Blue-Winged Parrot	1 3
	Neophema splendida	Scarlet-chested Parrot	1 3 4
	Neopsephotus bourkii	Bourke's Parrot	1 3 4
	Northiella haematogaster	Blue Bonnet	1 3 4
	Pezoporus occidentalis E,E	Night Parrot	1
	Polytelis alexandrae	Princess Parrot	4
	Psephotus varius	Mulga Parrot	1 3 4
RALLIDAE	*Fulica atra*	Eurasian Coot	1 2 3 4
	Gallinula tenebrosa	Dusky Moorhen	1 2 3 4
	Gallinula ventralis	Black-tailed Native-hen	1 3 4
	Porphyrio porphyrio	Purple Swamphen	1 2 3 4
	Porzana fluminea	Australian Spotted Crake	1 3 4
	Porzana pusilla	Baillon's Crake	3
	Porzana tabuensis	Spotless Crake	1 2 3 4
	Gallirallus philippensis	Buff-Banded Rail	1 3 4
RECURVIROSTRIDAE	*Cladorhynchus leucocephalus*	Banded Stilt	1 3 4
	Himantopus himantopus	Black-winged Stilt (White-headed Stilt)	1 3 4
	Recurvirostra novaehollandiae	Red-necked Avocet	1 2 3 4
SCOLOPACIDAE	*Actitis hypoleucos*	Common Sandpiper	1 3 4
	Arenaria interpres	Ruddy Turnstone	3
	Calidris acuminata	Sharp-tailed Sandpiper	1 2 3 4
	Calidris ferruginea	Curlew Sandpiper	1 2 3 4
	Calidris melanotus	Pectoral Sandpiper	3 4
	Calidris ruficollis	Red-necked Stint	1 2 3 4
SCOLOPACIDAE	*Numenius minutus*	Little Curlew	3 4
	Tringa glareola	Wood Sandpiper	1 2 3 4
	Tringa nebularia	Common Greenshank	1 2 3 4
	Tringa stagnatilis	Marsh Sandpiper	1 2 3 4

Family	Scientific Name	Common Name	Source
STRIGIDAE	*Ninox novaeseelandiae*	Southern Boobook	1 2 3 4
STURNIDAE	**Sturnus vulgaris*	Common Starling	3
SYLVIIDAE	*Acrocephalus stentoreus*	Australian (Clamorous) Reed-Warbler	1 3 4
	Cinclorhamphus cruralis	Brown Songlark	1 3 4
	Cinclorhamphus mathewsi	Rufous Songlark	1 3 4
	Megalurus gramineus	Little Grassbird	1 2 3 4
THRESKIORNITHIDAE	*Platalea flavipes*	Yellow-billed Spoonbill	1 3 4
	Platalea regia	Royal Spoonbill	1 3 4
	Plegadis falcinellus -,R	Glossy Ibis	1 3 4
	Threskiornis molucca	Australian White Ibis (Sacred Ibis)	1 3
	Threskiornis spinicollis	Straw-necked Ibis	1 3 4
TURNICIDAE	*Turnix velox*	Little Button-quail	1 2 3 4
TYTONIDAE	*Tyto alba*	Barn Owl	1 2 3 4
	Tyto capensis -,R	Grass Owl	1 4

Reptiles and Amphibians

Species are listed by scientific name in taxonomic family order.
The columns indicate the source of reptile and amphibian species records:
1. People, Land, Plants and Animals - Witjira National Park SA. DRAFT June 2001 (NPWSA 2001). (As modified by NPWSA Biodiversity Survey and Monitoring; Roger Playfair (RMP Environmental); and Jenny Bourne (NPWSA Outback Region.)
2. Biological Survey and Monitoring (DEH)_ database, November 2001.
3. A List of the Vertebrates of South Australia (Robinson et al. 2000).

Family Name	Scientific Name	Common name	Source
REPTILES			
AGAMIDAE	*Amphibolurus longirostris*	Long-nosed Dragon	1 2 3
	Ctenophorus cristatus	Crested Dragon	2 3
	Ctenophorus gibba	Gibber Dragon	2 3
	Ctenophorus isolepis	Military Dragon	1 2 3
	Ctenophorus maculosus	Lake Eyre Dragon	3
	Ctenophorus nuchalis	Central Netted Dragon	1 2 3
	Ctenophorus pictus	Painted Dragon	1 2 3
	Ctenophorus reticulatus	Western Netted Dragon	2 3
	Ctenophorus tjantjalka	Ochre Dragon	1 3
	Ctenophorus vadnappa	Red-barred Dragon	2 2
	Diporiphora winneckei	Canegrass Dragon	1 3
	Moloch horridus	Thorny Devil	2 3
	Pogona minor	Dwarf Bearded Dragon	2 3
	Pogona nullarbor - R	Nullarbor Bearded Dragon	2
	Pogona vitticeps	Central Bearded Dragon	1 2 3
	Tympanocryptis centralis	Centralian Earless Dragon	3
	Tympanocryptis cephalus	Pebble Dragon	2 3
	Tympanocryptis intima	Smooth-snouted Earless Dragon	1 2 3
	Tympanocryptis lineata	Five-lined Earless Dragon	1 2 3
	Tympanocryptis tetraporophora	Eyrean Earless Dragon	1 3
BOIDAE	*Antaresia stimsoni*	Stimson's Python	3
	Aspidites ramsayi	Woma	1 3
ELAPIDAE	*Demansia reticulata*	Desert Whipsnake	3
	Furina ornata	Moon Snake	2 3
	Oxyuranus microlepidotus	Inland Taipan	1 3
	Pseudechis australis	Mulga Snake	1 3
	Pseudonaja modesta	Five-ringed Snake	1 3
	Pseudonaja nuchalis	Western Brown Snake	1 2 3
	Simoselaps bertholdi	Desert Banded Snake	3
	Simoselaps fasciolatus	Narrow-banded Snake	3
	Simoselaps semifasciatus	Half-girdled Snake	3
	Suta monachus	Hooded Snake	3
	Suta suta	Curl Snake	1 3
GEKKONIDAE	*Delma australis*	Barred Snake-lizard	1 2
	Delma nasuta	Centralian Snake-lizard	1 2
	Delma tincta	Black-necked Snake-lizard	1 2 3
	Diplodactylus byrnei	Pink-blotched Gecko	1 3
	Diplodactylus conspicillatus	Fat-tailed Gecko	1 3
	Diplodactylus damaeus	Beaded Gecko	1 3
	Diplodactylus galeatus	Mesa Gecko	2 3
	Diplodactylus stenodactylus	Sandplain Gecko	1 2 3
	Diplodactylus tessellatus	Tessellated Gecko	1 2 3

Family Name	Scientific Name	Common name	Source
GEKKONIDAE	*Gehyra purpurascens*	Purple Dtella	1 3
	Gehyra variegata	Tree Dtella	1 3
	Heteronotia binoei	Bynoe's Gecko	1 3
	Lialis burtonis	Burton's Legless Lizard	1 2 3
	Nephrurus laevissimus	Pale Knob-tailed Gecko	2 3
	Nephrurus levis	Smooth Knob-tailed Gecko	1 2 3
	Nephrurus milii	Barking Gecko	3
	Notoscincus ornatus	Desert Glossy Skink	2
	Ophidiocephalus taeniatus	Bronzeback Legless Lizard	3
	Pygopus nigriceps	Black-headed Scaly-foot	2 3
	Pygopus schraderi	Hooded Scaly-foot	3
	Rhynchoedura ornata	Beaked Gecko	1 2 3
	Strophurus ciliaris	Northern Spiny-tailed Gecko	1 3
	Strophurus intermedius	Southern Spiny-tailed Gecko	3
SCINCIDAE	*Cryptoblepharus plagiocephalus*	Desert Wall Skink	1 3
	Ctenotus ariadne	Pin-striped Ctenotus	1
	Ctenotus brooksi	Sandhill Ctenotus	1 2 3
	Ctenotus joanae	Blacksoil Ctenotus	1
	Ctenotus leae	Centralian Coppertail	1 2 3
	Ctenotus leonhardii	Common Desert Ctenotus	2 3
	Ctenotus olympicus	Saltbush Ctenotus	1 3
	Ctenotus orientalis	Spotted Ctenotus	2 3
	Ctenotus pantherinus	Leopard Skink	1 2 3
	Ctenotus quattuordecimlineatus	Many-lined Ctenotus	2 3
	Ctenotus regius	Eastern Desert Ctenotus	1 2 3
	Ctenotus robustus	Eastern Striped Skink	2 3
	Ctenotus saxatilis	Centralian Striped Skink	1 2 3
	Ctenotus schomburgkii	Sandplain Ctenotus	1 2 3
	Ctenotus septenarius	Gibber Ctenotus	1 3
	Ctenotus strauchii	Short-legged Ctenotus	1 2 3
	Cyclodomorphus venustus	Saltbush Slender Bluetongue	1 3
	Egernia inornata	Desert Skink	1 2 3
	Egernia slateri - E	Black-striped Desert Skink	2 3
	Egernia stokesii	Gidgee Skink	2 3
	Eremiascincus fasciolatus	Narrow-banded Sandswimmer	1 2 3
	Eremiascincus richardsonii	Broad-banded Sandswimmer	1 2 3
	Lerista bipes	Western Two-toed Slider	2
	Lerista desertorum	Great Desert Slider	2 3
	Lerista dorsalis	Southern Four-toed Slider	2
	Lerista elongata	Woomera Slider	3
	Lerista labialis	Eastern Two-toed Slider	1 2 3
	Lerista muelleri	Dwarf Three-toed Slider	1 2 3
	Lerista terdigitata	Southern Three-toed Slider	2
	Lerista xanthura	Yellow-tailed Slider	1 2
	Menetia greyii	Dwarf Skink	1 2 3
	Morethia adelaidensis	Adelaide Snake-eye	1 2 3
	Morethia boulengeri	Common Snake-eye	1 2 3
	Morethia ruficauda	Fire-tailed Skink	3
	Notoscincus ornatus -,R	Desert Glossy Skink	1
	Tiliqua multifasciata	Centralian Bluetongue	1 2 3
	Tiliqua occipitalis	Western Bluetongue	2 3
	Tiliqua rugosa	Sleepy Lizard	2 3

Family Name	Scientific Name	Common name	Source
TYPHLOPIDAE	*Ramphotyphlops australis*	Southern Blind Snake	3
	Ramphotyphlops bituberculatus	Rough-nosed Blind Snake	2 3
	Ramphotyphlops endoterus	Centralian Blind Snake	1 2 3
VARANIDAE	*Varanus eremius*	Desert Pygmy Goanna	1 3
	Varanus giganteus	Perentie	1 2 3
	Varanus gilleni	Pygmy Mulga Goanna	1 3
	Varanus gouldii	Sand Goanna	1 2 3
AMPHIBIANS			
HYLIDAE	*Cyclorana maini*	Main's Frog	2 3
	Cyclorana platycephala	Water-holding Frog	1 3
	Litoria rubella	Red Tree Frog	1 2 3
MYOBACHTRACHIDAE	*Limnodynastes spenceri*	Spencer's Burrowing Frog	3
	Limnodynastes tasmaniensis	Marbled Frog	3
	Neobatrachus centralis	Trilling Frog	1 3

Mammals

Conservation status codes are shown following the scientific name. The first code is the National status according to the Environment Protection and Biodiversity Conservation Act 1999. The second is the South Australian status from the National Parks and Wildlife Act 1972 schedules.

Status code definitions

E Endangered – taxa in danger of extinction if causal factors continue.

V Vulnerable – taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

R Rare – taxa with small populations in South Australia that are not at present endangered or vulnerable, but are at risk.

The last column indicate the source of mammal species records as follows:

1 People, Land, Plants and Animals – Witjira National Park SA. DRAFT June 2001 (NPWSA 2001). (As modified by NPWSA Biodiversity Survey and Monitoring; Roger Playfair (RMP Environmental); and Jenny Bourne (NPWSA Outback Region.)

2 Biological Survey and Monitoring (DEH)_ database, November 2001.

3 A List of the Vertebrates of South Australia (Robinson et al. 2000).

* indicates introduced species.

Family Name	Scientific Name	Common Name	Source
BOVIDAE	**Bos taurus*	Cattle	1 3
	**Ovis aries*	Sheep	3
CAMELIDAE	**Camelus dromedarius*	One-humped Camel (Dromedary)	1 2 3
CANIDAE	*Canis lupus dingo*	Dingo	1 3
	**Vulpes vulpes*	Fox	1 3
DASYURIDAE	*Antechinomys laniger*	Kultarr	1 3
	Dasycercus byrnie E,V	Kowari	1
	Dasycercus cristicauda V,E	Mulgara	1 3
	Dasycercus cristicauda hillieri V,R	Ampurta	1
	Ningaui ridei	Wongai Ningaui	1 2 3
	Planigale gilesi	Giles' Planigale	1 2 3
	Planigale tenuirostris	Narrow-nosed Planigale	1 2 3
	Pseudantechinus macdonnellensis	Fat-tailed Pseudantechinus	1 3
	Sminthopsis crassicaudata	Fat-tailed Dunnart	1 3
	Sminthopsis hirtipes -,R	Hairy-footed Dunnart	1
	Sminthopsis macroura	Stripe-Faced Dunnart	1 3
	Sminthopsis ooldea	Ooldea Dunnart	1 3
EMBALLONURIDAE	*Saccolaimus flaviventris -,R*	Yellow-bellied Sheathtail Bat	1 3
	Taphozus hillii – R	Hill's Sheathtail Bat	2 3
EQUIDAE	**Equus asinus*	Donkey	1 3
	**Equus caballus*	Horse	1 3
FELIDAE	**Felis catus*	Cat	1 2 3
LEPORIDAE	**Oryctolagus cuniculus*	Rabbit	1 2 3
MACROPODIDAE	*Lagorchestes hirsutus*	Rufous Hare-wallaby	3

Family Name	Scientific Name	Common Name	Source
	Macropus robustus	Euro	1 3
	Macropus rufus	Red Kangaroo	1 2 3
	Petrogale lateralis[8]	Black-footed Rock Wallaby	3
MOLLOSSIDAE	*Chalinolobus gouldii*	Gould's Wattled Bat	1 3
	Chalinolobus morio	Chocolate Wattled Bat	2 3
	Mormopterus planiceps	Little Mastiff Bat	1
	Mormopterus sp.	Hairy Rostrum Freetail-bat	1
	Mormopterus spp.	Southern Freetail-bats	3
	Nyctophilus geoffroyi	Lesser Long-eared Bat	1 2 3
	Nyctophilus timoriensis -,V	Greater Long-eared Bat	1
	Scotorepens balstoni	Inland Broad-nosed Bat	3
	Scotorepens greyii	Little Broad-nosed Bat	3
	Tadarida australis	White-Striped Freetail-bat	1 3
	Vespadelus baverstocki	Inland Forest Bat	3
	Vespadelus finlaysoni	Finlayson's Cave Bat	3
MURIDAE	*Leggadina forresti*	Forrest's Mouse	1 2 3
	Leporillus conditor E V	Greater Stick-nest Rat	2 3
	**Mus musculus*	House Mouse	1 3
MURIDAE	*Notomys alexis*	Spinifex Hopping-Mouse	1 2 3
	Notomys cervinus -,E	Fawn Hopping-Mouse	1 3
	Notomys fuscus E,V	Dusky Hopping-Mouse	1 3
	Notomys mitchellii	Mitchell's Hopping-Mouse	1
	Pseudomys australis V,V	Plains Rat	1 2 3
	Pseudomys desertor	Desert Mouse	1 3
	Pseudomys hermannsburgensis	Sandy Inland Mouse	1 2 3
	Rattus villosissimus	Long-haired Rat	1 2 3
NOTORYCTIDAE	*Notoryctes typhlops*	Marsupial Mole	2 3
PODOROIDAE	*Bettongia lesueur*	Burrowing Bettong	3
TACHYGLOSSIDAE	*Tachyglossus aculeatus*	Short-beaked Echidna	3

[8] A population of this species was discovered in the District in comparatively recent times. It has not been seen since the advent of RCD, possibly due to prey-switching by foxes.

Fish and Invertebrates

The source of all data (except for some fish) is "People, Land, Plants and Animals - Witjira National Park SA. DRAFT June 2001 (NPWSA 2001). (As modified by NPWSA Biodiversity Survey and Monitoring; Roger Playfair (RMP Environmental); and Jenny Bourne (NPWSA Outback Region.) Some additional data for fish are taken from Tyler et al. (1990).
* indicates introduced taxa.

Class/Order/Family	Scientific Name	Common Name
Fish		
Atherinidae	*Craterocephalus dalhousiensis R (endemic)*	Dalhousie hardyhead
	Craterocephalus eyresii	Lake Eyre hardyhead
	Craterocephalus gloveri (endemic)	Glover's hardyhead
Poeciliidae	**Gambusia holbrooki*	eastern gambusia
Clupeidae	*Nematolosa erebi*	Bony bream
Eleotridae	*Mogurnda mogurnda*	Dalhousie purple-spotted gudgeon
Gobiidae	*Chlamydogobius eremius*	desert gobi
	Chlamydogobius gloveri (endemic)	Dalhousie goby
Terapontidae	*Amniataba percoids*	barred grunter
	Leiopotherapon unicolor	spangled perch
Retropinnidae	*Retropinna semoni*	Australian smelt
Plotosidae	*Neosilurus gloveri (endemic)*	Glover's catfish
Aquatic Invertebrates		
Mollusca		
Hydrobiidae	*sp1 (endemic)*	
	sp2 (endemic)	
	sp3 (endemic)	
	sp4 (endemic)	
	sp5 (endemic)	
	sp6 (endemic)	
Crustacea		
Cladocera		
Daphniidae	*Ceriodaphnia cornuta*	
	Daphnia carinata	
	Bosminia meridionalis	
Ostracoda		
Canonidae	*Candonopsis sp.*	
Cyprididae	*Cypretta sp1*	
	Cypretta sp2	
Cyprididae	*Heterocypris tatei*	
	Sarscyridopsis aculeata	
Cytheridae	*Cyprideis sp. (endemic)?*	
Darwinulidaae	*Darwinula sp. (endemic)?*	
Entocytheridae	*sp1 (endemic)?*	
Ilyocyprididae	*Ilocypris (?) australiensis*	
Limnocytheridae	*Limnocythere sp.*	
	Limnocythere mowbrayensis	

Copepoda - Calanoida		
Centropagiidae	*Boeckella symmetrica*	
	Calamoecia ampulla	
Copepoda - Cyclopoida		
Cyclopidae	*Eucyclops medius*	
	Halicyclops sp. (endemic)?	
	Mesocyclops albicans	
	Microcyclops varicans	
	Paracyclops chiltoni	
Copepoda - Harpacticoida		
Ameiridae	*Nitocra lacustris*	
Cletodidae	*Cletocamptus sp.*	
Darcythompsoniidae	*sp1 (endemic)?*	
Ectinosomatidae	*sp1 (endemic)?*	
Laophontidae	*Onychocamptus bengalensis*	
Amphipoda		
Ceinidae	*Austrochiltonia sp1 (endemic)*	
Ceinidae	*Austrochiltonia sp2 (endemic)*	
Decopoda		
	Cherax sp. (endemic)?	yabby

APPENDIX I: A Plain English Guide to the Native Title Act 1993

The following is a short guide to the main features of the Native Title Act 1993 (the Act). It is not legal advice, only a lawyer can give you a legal opinion about the Act.

The Native Title Act 1993 became law on 1 January 1994.

It is important to remember that the Act is only a beginning. Native title will be explored and developed by courts, tribunals, governments and legislatures across Australia.

Summary of the Act

The Native Title Act:

- Recognises native title rights.
- Contains some basic principles about native title in Australia.
- Allows governments ways in which they can:
    - 'validate' or make legal past acts such as leases which native title might have made invalid;
    - do things in the future and still protect native title rights;
    - lets people get 'compensation' or something in return for loss of native title (generally money) if this happens because past acts have been made legal, or because of future acts;
    - puts conditions on future acts which affect native title land and waters; and
    - contains a process for:
        - § finding out about who has native title rights;
        - § finding out which people might get compensation;
        - § making decisions about whether governments can make future grants, such as grants of mining leases, or do acts over native title land and waters;
        - § creates a Land Fund with money to help Aboriginal and Torres Strait Islander peoples acquire and manage land.

The Aboriginal and Torres Strait Islander Commission (ATSIC) has other booklets which help understand the National Native Title Tribunal and Federal Court processes.

Main Features of the Act

This part of the guide goes through the main sections of the Act and explains what they mean.

The Commonwealth approach to native title

Recognition of native title

The main purpose of the Act is to recognise and protect native title (see sections 3 and 10).

Native title is the rights and interests in land and waters that Aboriginal and Torres Strait Islander peoples have under their traditional laws and customs and that are recognised by the common law (section 223).

Determination of native title

The Act contains a process for 'determining' or deciding about whether or not native title exists and what rights and interests native title holders have (see sections 13 and 61).

A determination of native title under the Act will decide whether the people who have title have 'exclusive possession'. Exclusive possession means they are the only people who have any rights to the land. If they do not have exclusive possession the person who makes the determination may say what kind of rights the titleholders have (section 225).

The traditions of Aboriginal and Torres Strait Islander peoples can change with time and sometimes people stop following a tradition. Therefore, the Act says that native title rights can change or even finish. The Act gives a way to change determinations where circumstances have changed (sections 13 and 61).

Section 12 says that what the common law of Australia says about native title is now Commonwealth law. Native title is subject to the general laws of Australia such as State or Territory laws. Those laws can apply to native title land or waters unless the Act says they cannot (section 8).

However, people may be able to hunt, fish and do other things that are part of their native title rights without a licence or permit when other people need a licence or permit to do those things (section 211).

Some people who have land might want to find out if anyone has native title rights to that land. These people are 'non-claimants', they do not want to claim native title for themselves. The Act allows non-claimants with an interest in land to ask for a determination about native title (sections 61 and 67). If no one opposes a non-claimant application, future acts over the land or waters are valid (section 24).

The Act also says that there will be two public registers: The Register of Native Title Claims where people can register a claim for native title (Part 7) and The National Native Title Register for native title determinations.

(Part 8) Protection of native title

The Act gives a lot of protection to native title.

The Act says that native title is only 'extinguished' or wiped out in a few cases where it is necessary to make past acts legal.

Some future acts of governments can affect native title. The 'non-extinguishment principle' will apply to most future acts (section 238). This means that those acts will not extinguish native title. If there is a conflict between the rights and interests under native title and those granted by a government, the act or grant will win. But once the interests are finished native title can again have full effect. The non-extinguishment principle will not apply when people choose to give up their native title (section 21) or a government compulsorily acquires native title land (section 23(3)b)) and pays compensation. In those cases native title is 'extinguished' or lost forever.

Bodies Corporate

The Act recognises that native title rights are mainly group or community rights. It is likely that a number of people will be able to show that they have native title rights to a particular area. The people who have title will change over time.

To take this into account the Act says there are two ways to organise control of native title:

1. Native title can be held in trust by a company controlled by those who are the native title holders from time to time (see sections 56 and 57).

2. A company can represent the native title holders and act as their agent (sections 57 and 58).

In both cases, the native titleholders get the full benefit of their native title rights.

The companies will provide a practical and legal point of contact for people who want to deal with native titleholders.

Representative Aboriginal and Torres Strait Islander bodies

The Act says that some Aboriginal and Torres Strait Islander organizations may be named as representative Aboriginal and Torres Strait Islander bodies (Representative Bodies) to help people make native title claims (section 202). They will help with applications to determine native title and compensation; and negotiations and proceedings.

The Representative Bodies may be able to get financial help from the Commonwealth or ATSIC (section 203).

The Minister for Aboriginal and Torres Strait Islander Affairs made a Determination that came into effect from 1 January 1994 that named some existing organizations as Representative Bodies. People claiming native title or compensation do not have to use a representative body.

Special measure under the Racial Discrimination Convention

The Act is a special measure under Article 1(4) of the Racial Discrimination Convention and section 8 of the Racial Discrimination Act (RDA). It gives important benefits to Aboriginal and Torres Strait Islander peoples. The Act does not affect the operation of the RDA (section 7), but all past acts made valid by the Native Title Act are made certain by section 7(2).

The Land Acquisition Fund

The Act recognises that many Aboriginal and Torres Strait Islander peoples will not be able to secure native title and to benefit directly from the High Court decision in the Mabo case. So that those people can get some benefit from the High Court decision in the Mabo case the Act establishes a 'National Aboriginal and Torres Strait Islander Land Fund' (section 201). The fund began operation on 1 July 1994.

The purpose of the Fund (section 201(2)) is to help Aboriginal and Torres Strait Islander peoples:

1. To acquire land.

2. To manage the acquired land in a way that provides economic, environmental, social or cultural benefits to them.

Existing rights

The Act does not affect rights held under Commonwealth land rights legislation such as the Aboriginal Land Rights (Northern Territory) Act 1976 (section 210).

Governments can confirm (section 212(2)): existing ownership of natural resources; existing rights to water; that existing fishing rights override native title rights; and existing access to beaches and public places.

However, the confirmation will not affect the ability of native titleholders to continue to exercise any rights they might still have (section 212(3)).

Validation of past acts

Section 14 of the Act validates past Commonwealth acts and section 19 lets States and Territories validate their past acts on the same terms.

The Act does not stop States and Territories from attempting to validate their past acts on their own terms. However, they would do so at their own risk and they might find that their actions are not legal.

Effect of validation on native title

Past acts which are or can be validated include the making of legislation, the grant of a lease, licence or permit and the exercise of executive power by governments, in relation to native title land or waters.

When a past act or grant is validated it will only extinguish native title where there has been what the Act calls a Category A past act (sections 15 (1)(a) and (b) and 229). A Category A past act is a grant of freehold or of a commercial, agricultural, pastoral or residential lease (defined in sections 246 to 249) or the construction of a public work (defined in section 253).

A Category B past act is a grant of a leasehold interest, which is not covered by Category A and is not a mining lease. When a Category B past act is validated it will only extinguish native title rights that cannot co-exist with the rights and interests granted under that act (sections 15(1)(c) and 230).

The Act does not extinguish native title in cases where: a freehold or leasehold grant ended before 1 January 1994; the grant which is validated was made under legislation for the benefit of Aboriginal or Torres Strait Islander peoples; or a validated leasehold grant was held on 1 January 1994 under land rights legislation (sections 229(2), (3) and 230).

Category C past acts are mining leases and Category D past acts are all other grants including licences and permits. Commonwealth validation of Categories C and D past acts (sections 15(1)(d), 231 and 232) will not extinguish native title and the non-extinguishment principle (defined in section 238) will apply to the native title.

In particular, mining leases validated by the Act and those validated by States and Territories under the Act will not extinguish native title.

The only acts that can be validated are: legislation passed before 1 July 1993; other acts and grants made before 1 January 1994; and some acts that will take place in the future where those acts are linked to acts done in the past. These include the exercise of options and legally enforceable rights or the extension or renewal of grants made in the past (see the definition of 'past act' in section 228).

Protection of reservations

The validation exercise will not affect: Any reservations or conditions for the benefit of Aboriginal or Torres Strait Islander peoples contained in any past grant or legislation. Any other right or interest Aboriginal or Torres Strait Islander peoples may hold arising under law or by usage (section 16).

Any extinguishment of native title that happens where a pastoral lease is validated does not give anyone the right to remove Aboriginal peoples from that land (section 15(2)).

Entitlement to compensation for validation

In the small number of cases where it is necessary to make acts legal by validating, native titleholders are entitled to compensation for the loss of native title.

Native titleholders are entitled to compensation for the effect of the validation of past acts on their rights when the Act extinguishes native title, for example, by the validation of a freehold grant:

- Compensation to native title holders will be on just terms (sections 17, 20 and 51); 'impairs' or takes away some rights of native title but does not extinguish it on onshore land, for example by the validation of a mining lease over land.
- Compensation will be paid to native title holders where freeholders would have received compensation and this will be assessed in the same way as it is for freeholders (sections 17, 20 and 51(3), and the definition of the 'similar compensable interest test' in section 240); or impairs native title and the grant or act could not have been done over freehold land, or where the grant or act was over an offshore place.
- Compensation to native title holders will be on just terms (sections 17, 20 and 51).

The Act gives Commonwealth rights to compensation, even for the effect of State and Territory validations. These Commonwealth rights can be followed up in the National Native Title Tribunal (NNTT) and the Federal Court. States and Territories may also provide rights to compensation and a process for following up those rights (section 20(4)).

When a court or tribunal makes a decision about giving people compensation under this Act they must take into account any compensation already given by a State or Territory under their own laws (section 49(b)). In practice, this means that people will not get double compensation.

Compensation is payable to native titleholders by: the Commonwealth Government for acts it has validated (section 17(4)), or a State or Territory government if it validates an act (section 20(3)).

Native titleholders also have a right to compensation for the effect of invalid acts where a State or Territory has not acted to validate those acts (Section 20(2)).

If the RDA gives native titleholders a right to compensation, instead of making a grant or act invalid, they can claim compensation under the Native Title Act.

Non-monetary compensation

Native title holders can negotiate non-monetary compensation for the loss of their native title. This could include other property or goods and services (sections 51(6) and 79).

In special circumstances, the Commonwealth Minister may tell the NNTT to consider the effects of validation of particular past acts on Aboriginal and Torres Strait Islander peoples. The Minister can also tell the NNTT to consider the different kinds of compensation (section 137).

The Future Act regime

The Commonwealth also knows that it is very important to have a process that will allow future grants and actions over lands and waters that are or might be affected by native title. Therefore, native title is recognised and made part of the national land management system.

Future acts that can be done

The Act says that future acts that affect native title can be done legally if they are 'permissible future acts' (defined in section 235).

It is important to recognise that the Act makes a distinction between 'offshore' and 'onshore' places. These terms are defined in section 253. An 'onshore place' is land or waters located within the limits of a State or Territory. The waters off the coast of a State or a Territory (known as the coastal waters) are not included in this definition. They are 'offshore' places, which also includes any land (for example, reefs and islands) or waters to which the Act extends that are not within the limits of a State or Territory.

All future acts in offshore places are 'permissible' and can be done even if that place is subject to native title (section 235(8)(a)).

In the case of onshore places, the Act says that where an act can be done over ordinary title land then that act is also permitted over native title land (section 235(5)). 'Ordinary title land' means either freehold or, in the Australian Capital Territory and Jervis Bay, leasehold (section 253).

There is also a test for where an act is proposed over onshore native title waters such as lakes, rivers and harbours. An act can be done to those waters if it could be done to the waters if the land beside or surrounding them was ordinary title land (section 235(5)).

New legislation will only be permissible if it affects native title holders in the same way that it affects ordinary title holders or if it does not put native title holders in a worse position than ordinary title holders (section 235(2)).

Commencement of 'permissible future act' test

From 1 July 1993, new legislation must satisfy the 'permissible future act' test. Other acts and grants must satisfy the test from 1 January 1994.

However, the Act will validate some acts and grants that will take place after these dates as part of the process for validating 'past acts'. Those acts and grants will not need to satisfy the permissible future act test (sections 228(3), (4) and (9), and 233(1)(b)).

Exceptions to 'permissible future act' test

When a non-claimant application is made over a piece of land and no native title claim is made to that land then any act over that land before a court or tribunal makes any determination of native title is valid (section 24).

Renewals of existing interests flowing from a legally enforceable right can occur without negotiation even if the renewals are over native title land or waters (section 25).

Other renewals or extensions of valid existing commercial, agricultural, pastoral or residential leases are permissible future acts (section 235(7)).

Grant of mining interest permitted

An example of a permissible future act is the grant of a mining interest. A mining interest means the right to do something to do with mining either exploring or actually mining. Where a government can grant a mining interest over freehold land it can also make the same grant over native title land.

Other permissible future acts are those made under general Compulsory Acquisition Acts (see definition in section 253).

Future extinguishment

In the future governments can only extinguish native title: if the native titleholders agree (section 21); or by using land for a purpose which it was acquired under a Compulsory Acquisition Act (section 23(3) and section 11).

Compensation for future acts

Native titleholders will be entitled to 'just terms compensation' for any future extinguishment of their rights and interests. Just terms means something that is fair given the circumstances of a particular case. Each different case will have different just terms compensation.

Where an act only impairs the native title rights: onshore, native title holders can get compensation in the same way that ordinary title holders could (sections 23(4) and 51(3)); or offshore, the native title holders can get just terms compensation (sections 23(4) and 51(1)).

The Act provides a Commonwealth right to compensation for extinguishment of native title where it occurs because of a Compulsory Acquisition Act or for onshore impairment. However, this is only when native titleholders do not have a right to compensation given by a State or Territory law (section 23(3)(c), (4)(b)(ii)(c)).

Procedural rights for future acts

In the case of all future acts other than 'low impact future acts', native title holders are entitled to the same procedural rights as holders of ordinary title, such as the right to be notified and to object (sections 23(6) and 253).

Right to negotiate

The Act recognises the special attachment that Aboriginal and Torres Strait Islander peoples have to their land.

It makes sure that registered native title holders and registered native title claimants have a right to negotiate before certain 'permissible future acts' happen (see Subdivision B of Division 3 of Part 2 for more detail about this). The right to

negotiate applies to acts to do with mining, the compulsory acquisition of native title to make a grant to a third party and any other acts approved by the Commonwealth Minister (see section 26).

The right to negotiate does not apply if there are no registered native title holders or registered native title claimants within two months of notification of the proposed act (sections 28(1)(a) and 30). In this case, the act can go ahead in the normal way.

Certain types of grants, which have minimal effect on native title, can be excluded from the right to negotiate (sections 26(3) and (6)). Also, if a particular act will not involve major disturbance to native title land, the right to negotiate may not apply (sections 32 and 237).

The right to negotiate is not a 'veto' or right to reject. If the parties cannot come to an agreement after negotiation then any party can apply for a decision to the NNTT or the recognised State or Territory body, called the 'arbitral' or decision making body (section 27). The arbitral body will make a decision about whether or not the act may go ahead and if so on what conditions (section 35).

When it makes its the decision the arbitral body must take into account a number of things, such as the way in which the proposed act might affect the way of life, culture and traditions of the native title holders. It must also consider how important the act is to the economy of Australia and the relevant State or Territory (section 39).

Where there is a State or Territory arbitral body, a State or Territory Minister may override the determination in the interest of the State or Territory (section 42(1), (3)). If the NNTT is the arbitral body, the Commonwealth Minister may override the decision in the national or State or Territory interest (section 42(2), (3)). The relevant Minister may set conditions on which the act may go ahead.

State and Territory bodies and processes for right to negotiate

Where a State or Territory body complies with the relevant criteria and the Commonwealth Minister has recognised it, that body will be the arbitral body for the State or Territory (sections 27 and 251). The Act also has a way in which a State or Territory system, which has an equivalent right to negotiate, can be approved (section 43). Where there are such State or Territory systems then the Commonwealth system for determining whether acts may go ahead will not operate.

Low impact future act

Certain future acts are defined as 'low impact future acts' (section 234). These include the grant of minor licences and permits (such as for beekeeping). Those acts can go ahead before native title is determined. However, they do not extinguish native title and there is no need to pay compensation. The acts may not continue if native title is later determined to exist (sections 23 and 235(8)(b)) unless the native titleholders agree that they can continue.

Surrender of native title

Land which was held traditionally could not be bought and sold. Therefore, native titleholders cannot 'alienate' or give up their title except to governments. They can give up their title to the relevant government in exchange for 'statutory' title such as freehold or leasehold (section 21(1)(a)). Native titleholders can also agree to any acts taking place over their land (section 21(1)(b)). Negotiations of agreements on a local or regional basis can happen if appropriate (Preamble and section 21(4)).

Pastoral leases held by native titleholders

The Act says that Aboriginal and Torres Strait Islander people who have a pastoral lease over an area of land may also be able to claim native title over that land, where they have maintained traditional links with it. Any determination that native title exists is on the basis that the pastoral lease remains valid and operative but the native title holders receive the benefit of the protection given by the Act (section 47).

Future acts where native title is not known

A government can do an act in an area where it has applied to the NNTT for a determination of whether native title exists and no claims to native title are lodged within a specified time (sections 24 and 67). If the NNTT finds that native title does exist the act is not invalidated. However, the native titleholders would be able to get compensation.

The Tribunal and Court process

The Act establishes a new body called the National Native Title Tribunal and gives the Federal Court jurisdiction in native title matters (see Part 6 of the Act). This is to provide the most effective means of dealing with native title issues.

PLAIN ENGLISH GLOSSARY AND ABBREVIATIONS

Act: with a capital 'A' means the Native Title Act 1993, with a lower case 'a' means 'an act'

acts: means acts done by governments, people or organizations, such as the granting of a mining lease, or the making of legislation

Representative Aboriginal and Torres Strait Islander Bodies (Representative Bodies): Aboriginal and Torres Strait Islander organizations which can help Aboriginal and Torres Strait Islander people making native title claims. They are determined by the Minister for Aboriginal and Torres Strait Islander Affairs under the Act

arbitral body: a body which can decide whether acts may go ahead over native title land, for example, the NNTT

ATSIC: the Aboriginal and Torres Strait Islander Commission

common law: laws which are made by courts; not legislation

compensation: something you get in return when something you own is lost, taken or given away

compulsorily acquire: to take without giving anyone a choice. Only governments can take land by compulsory acquisition and only with a good reason

determine: to make a decision. A determination is a final decision. However, a person can appeal against a determination of a tribunal or court made under the Native Title Act

extinguish: to take away forever

freehold: the highest form of land title granted by governments

grants: a legal right to a piece of land which is given by governments

impair: to take away some rights

interest in land: any legal right to have or use a piece of land

just terms compensation: compensation that is fair based on each different case. Courts and tribunals will decide this if parties cannot agree

leasehold: temporary land title, generally giving a right to exclude others, that may be for a long or short period of time

legislation: laws which are made by Commonwealth or State parliaments or Territory legislatures

mining interest: the right to do things such as explore, prospect or mine

National Aboriginal and Torres Strait Islander Land Fund: a fund which began operation on 1 July 1994 and will assist Aboriginal and Torres Strait Islander peoples to purchase and manage land

National Native Title Register: a public list of native title determinations

NNTT: the National Native Title Tribunal. The tribunal which may hear native title claims from all over Australia

non-claimants: people or organizations who have an interest in land and do not want to or cannot make a native title claim but want to ask for a determination about native title for the land in which they have an interest

non-extinguishment principle: a principle in the Act. Where this applies to acts and grants they do not extinguish native title. The act or grant can have effect but when its period of operation has ended, native title may again have full effect

permissible future acts: acts which the Act allows people or organizations to do over native title land

public work: something which is built by a government, for example, a school, a road or a dam

RDA: the Racial Discrimination Act 1975

Register of Native Title Claims: a public list of native title claims

statutory: something that is done under legislation

title to land: a legal right to some kind of ownership or use of a piece of land

title holders: the people or group of people which has title to an area of land

traditions: the customs and laws etc. of people which have been passed down through generations. Traditions can change over time or be given up

validate: to make legal

***DISCLAIMER**: The material in this paper is provided for general information only and should not be relied upon as legal advice for the purpose of a particular matter.*

Source: Native Title and Land Rights Branch ATSIC January 1997

APPENDIX J: A Plain English Guide to the Wik Case

What is the Wik Case?

On 30 June 1993 (before the Native Title Act became law in December 1993) the Wik Peoples made a claim for native title in the Federal Court of Australia to land on Cape York Peninsula in Queensland.

The Thayorre People joined the action, claiming native title rights to an area partly overlapping the Wik Peoples' claim. The land claimed by the Wik Peoples and the Thayorre People included land where two pastoral leases were granted by the Queensland Government.

One pastoral lease of 1,119 square miles (2,830 km2), originally granted in 1945, continues to be a pastoral lease. The current lease was granted in 1975 and expires in the year 2004. It has never been permanently occupied or fenced. In 1988 it was reported that it carried only 100 unbranded cattle.

The other pastoral lease was 535 square miles (1,385 square km). It was first granted in 1915. It was forfeited and replaced by another pastoral lease in 1919 and forfeited again in 1920. In fact, it was never occupied as a pastoral lease. Aboriginal people, however, have been in continuous occupation of the area. About 300 were recorded as being present in 1919. In 1922 the area became an Aboriginal Reserve and remains so today.

The Wik Peoples and the Thayorre People argued that native title co-existed with the pastoral leases.

On 29 January 1996, Justice Drummond in the Federal Court made a decision that the claim of the Wik and Thayorre Peoples could not succeed over the areas as they were subject to pastoral leases. The Judge’s reason was that he considered that the grant of pastoral leases under Queensland law extinguished any native title rights.

The Wik People went to the High Court to appeal that decision. The Appeal was against answers which Justice Drummond had given to several legal questions.

The most important of those questions related to the two pastoral leases. The question asked in the case of each pastoral lease was:

"Does the pastoral lease confer rights to exclusive possession on the grantee (i.e. the pastoralist)?"

What did the High Court say?

The High Court said that:

Native title can only be extinguished by a written law or an act of the Government which shows a clear and plain intention to extinguish native title. The Statute creating pastoral leases in Queensland did not show an intention to extinguish native title. Pastoral leases come from Australian Statute Law, not from English common law. Pastoral leases were created in Australia to meet the special needs of the emerging Australian pastoral industry in circumstances unknown in England. The pastoral leases did not give exclusive possession to the pastoralists. (Exclusive possession means not having to share the land with others.) The grant of a pastoral lease does not necessarily extinguish all native title rights. Native title rights could continue at the same time that the land was subject to a pastoral lease. Where there is conflict in the

exercise of those rights, native title rights were subordinate to those of the pastoral lease holder.

What the High Court did not say

The High Court did not make a decision in the Wik Case about what native title rights the Wik Peoples or the Thayorre People have.

The High Court did not decide on the actual native title rights of the Wik and Thayorre Peoples because of the way in which the case got to the High Court. It was an appeal from a decision of Justice Drummond who had made his decision before hearing any of the evidence of the Wik Peoples' claim to native title.

What Native Title Rights may co-exist with Pastoral Leases?

The only native title rights that can co-exist with the rights of a pastoralist holding a lease are those that are not inconsistent with the rights of the pastoralist. If an agreement cannot be reached between the relevant parties the Federal Court can make a final determination on native title and compare the native title rights with the rights under the pastoral lease. It may be, for example, that rights to visit sacred sites, hold ceremonies and collect native foods will not be seen as inconsistent with the pastoralists' rights.

What Native Title Rights may not co-exist with Pastoral Leases?

A native title holder could not exclude the holder of a pastoral lease from the area of the pastoral lease or restrict pastoralists from using the lease area for pastoral purposes. A native title holder could not, therefore, have full beneficial ownership of the land at the same time as it is the subject of a pastoral lease. A native title holder would not be able to do anything which interfered with:

- the ability of the pastoralist's livestock to take advantage of the pasture and water sources on the land
- the pastoralist's privacy on the homestead
- the pastoralist's right to build fences, gates, windmills and other improvements to the land

Are Pastoral Leases Affected ?

The High Court made it very clear that none of the rights of the pastoral leases are taken away by co-existing native title rights. Where there is any inconsistency with a pastoralist's rights, the pastoralist's rights override native title.

The High Court in the Wik Case confirmed its view in the Mabo Case that Governments have power to grant valid pastoral leases. Indeed, the Native Title Act 1993 validated any grants of pastoral leases which might have been invalid because of native title.

What rights do Pastoralists have?

The High Court confirmed that a pastoral lease gives the pastoralist the right to use the land for pastoral purposes. The Court said that pastoral purposes would include:

- raising livestock
- establishing fences, yards, bores, mills and accommodation.

The Court said that a pastoral lessee's rights are defined by the relevant State Statute.

An example of a relevant State Statute is the Land Act of WA. It gives a pastoral lessee the natural surface of the land for pastoral purposes. It does not give general rights to soil or timber but gives specific rights to:

- take soil and timber for domestic purposes,
- take soil and timber for the construction of airstrips, roads, buildings, fences, stockyards or other improvements on the land
- sow and cultivate non-indigenous pasture species with the approval of the State Minister.

The High Court points out that pastoral leases in Queensland are subject to statutory provisions which define the right of a pastoralist, (as they are in the other parts of Australia) including conditions:

- requiring that the land be developed, improved or enclosed by fencing,
- requiring the destruction of noxious plants and the control of vermin,
- prohibiting the destruction of trees,
- making leases subject to rights granted under mining legislation, petroleum legislation and forestry legislation,
- keeping for the Government the power to allow other persons to enter the land to take soil or timber or for "any purpose"
- giving drovers and others the right to pass through pastoral leases and use pastures while passing through.

These provisions are generally limited by the Statute to protect the privacy of the homestead and gardens and paddocks under cultivation.

In other States such as Western Australia, South Australia and the Northern Territory, Statutes provide that Aboriginal people have a right to enter pastoral leases in order to live off the land in their traditional manner. Those provisions also have limitations which protect improved parts of properties.

What about where the Government has to approve certain acts on pastoral leases?

Some statutory provisions stop pastoralists carrying out certain activities on pastoral leases except with State Government approval. The native title implications of carrying out these “future acts” are discussed in Appendix K.

Are there any economic consequences for pastoralists?

Pastoralists’ perceptions of their rights under their leases may have changed as a result of the Wik decision, but they retain the same legal interest as was their legal entitlement prior to the decision. Accordingly, there is no legal impact on:

- the value of the pastoral lease
- the value of the security which the pastoral lease may provide for borrowing money.

Moreover, as restated by the industry recently, financial institutions base their valuations of pastoral leases for security for a loan on its capacity to carry stock (and hence its ability to generate income), the equipment owned by the pastoralist and improvements (houses, fences, dams, yards etc). All these things are unaffected by

the Wik decision. Typically, a pastoralist would use the livestock on the land as security for a loan. This is known as a stock mortgage. Again, these arrangements are unaffected by the Wik decision.

There are also no compensation obligations on pastoralists flowing from the Wik decision. Pastoralists are entitled, in the exercise of their rights to use the land for pastoral purposes, to progressively develop areas of the pastoral property for use for pastoral purposes by building fences, cultivating pastures, creating dams or building houses for workers etc. If the pastoralists' acts have the effect of extinguishing or impairing the exercise of co-existing native title rights, those acts are validated by the Native Title Act because they are authorised by statute law. Any compensation payable because of that extinguishment or impairment would be payable by the Government which made that law.

How are miners affected?

Since the commencement of the Native Title Act on 1 January 1994 the grant of mining tenements over land where native title may still exist has to go through a right to negotiate process. This involves governments notifying native title holders of its intention to grant the mining tenement, allowing the native title holders a short time to register their claim and, if it is registered, negotiations between the native title holders, the mining company and the Government. If no agreement can be reached, then the National Native Title Tribunal or a similar State body decides if exploration or mining can go ahead and on what conditions.

There are also mechanisms in the Native Title Act 1993 to avoid or fast track the right to negotiate process in some circumstances.

All grants of mining tenements on pastoral leases since 1 January 1994 should have gone through the right to negotiate process as the question of the continued existence of native title on pastoral leases was not resolved by the Mabo case or the Native Title Act. In finding that some native title rights may coexist with pastoral leases the Wik case confirms the need for governments to use the right to negotiate process.

If native title claims are made over pastoral leases upon which mining tenements existed prior to the Native Title Act, the native title rights are subject to the rights of miners to continue mining. In those instances, the right to negotiate process under the Act will not apply.

However, if a government granted mining tenements on pastoral leases after the Native Title Act without going through the right to negotiate process, those mining tenements could prove to be invalid.

> ***DISCLAIMER**: The material in this paper is provided for general information only and should not be relied upon as legal advice for the purpose of a particular matter.*

Source: Native Title and Land Rights Branch ATSIC January 1997.

APPENDIX K: Native Title Act: Diversification on Pastoral Leases

This short pamphlet[9] is aimed at pastoral lessees and others with an interest in the management of lands covered by Pastoral Leases in South Australia. It gives a brief summary of the effect of the Commonwealth *Native Title Act* on proposals by pastoral lessees or others to diversify activities on land covered by the lease - that is, where they are considering whether to undertake new types of activities, or to expand the scale or scope of existing activities.

It does not claim to be a full explanation of the applicable law but is a guide only. Anyone wanting more information should seek their own legal advice on their specific proposal.

This pamphlet summarises legal aspects of the *Native Title Act* as they relate to diversification on Pastoral Leases. It does not cover:

- other approvals, permits, licences or the like that may be required under the South Australian *Pastoral Land Management and Conservation Act*, *Development Act, Native Vegetation Act, Aboriginal Heritage Act* or other laws; or
- technical or economic information and advice about the activities being considered.

What is the role of the Pastoral Board?

The Pastoral Board is established and operates under the South Australian *Pastoral Land Management and Conservation Act*. A prime legal duty under the Act is to make sure that land held under Pastoral Leases is well managed and prudently used so that the land's renewable resources are maintained and its yield is sustained.

Pastoral Leases have conditions governing what may be done on the land under the lease. Generally, this means the pasturing of sheep and cattle and ancillary activities. Pastoral lessees may not carry out any other activity on the land unless the lease permits it. The Pastoral Board may permit the conditions to be changed, but only if it would still achieve the objects of the Act.

Therefore, any pastoral lessee who wants to introduce activities that are not already approved under the lease, or wants to go beyond limits placed on existing uses, may only do so if the Board permits it. Other authorisations may also be required under law.

The *Native Title Act* **does not change this role of the Board**. In particular, whatever the *Native Title Act* provides about diversification, **the pastoral lessee must still get permission from the Board before proceeding**, if the activity falls outside what may already be done under the lease.

In general terms, the Board would need to be satisfied that the new development is consistent with the principle of ecologically sustainable development.

What does the Native Title Act do?

The *Native Title Act* attempts to define when certain activities - including diversification - can and cannot be lawfully carried out and how they affect, or are affected by, native title.

These provisions are **in addition to** any other legal requirements that might apply.

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[9] This section is reproduced with permission from a pamphlet produced the State Indigenous Land Use Agreement Negotiation Team (Attached to the South Australian Attorney-General's Department).

Definitions

The provisions of the *Native Title Act* mainly flow from the definition in the Act of **primary production**. In the Act, this means:

- cultivating land (that is, preparing and using land for crops);
- maintaining, breeding or agisting animals (which includes reptiles, birds and insects, whether they are natural or introduced);
- fishing (including shell-fish and crustacea);
- forest operations (that is, planting and tending groups of trees for felling);
- horticulture (that is, plant cultivation - vegetables, seeds, bulbs, flowers, mushrooms etc);
- aquaculture (breeding or cultivating animals or plants in water);
- any other activity that is ordinarily understood to be primary production.

For this purpose, **mining is not included** as primary production.

In several places the Act refers to **activities that are incidental to or associated with primary production**. These would include:

- housing/recreational activities for people who live or work on the leased land;
- construction/use of airstrips, power supply, water supply, fencing, roads, dams etc connected with running a pastoral operation;
- sale and transport of livestock;
- storage of materials for use in the pastoral operation;
- repair shops for machines used in the pastoral operation;
- pasture management;
- culling of wild-life, and feral animal control.

What about existing activities?

The *Native Title Act* provides that some activities under Pastoral Leases are not affected by native title, as long:

- the activity was permitted by the terms of the Pastoral Lease (including any changes to the Pastoral Lease conditions approved by the Pastoral Board) and other laws **at some time before 31 March 1998**; and
- the activity is carried out by the lessee; and
- where the lease covers more than 5,000 ha, most of it is still used for pastoral purposes.

The activities that fall in this category are:

- **primary production** (as defined above); or
- **any activity associated with or incidental to primary production** (as defined above), as long as most of the lease area is still used for primary production itself.

If the pastoral lessee was already permitted to carry out these defined activities before 31 March 1998:

⇒ the pastoral lessee may still carry out that activity at any time (subject to any other law that applies);

⇒ the activity prevails over any native title rights that might exist, but does not extinguish them;

⇒ no compensation is payable to the native title holders; and

⇒ neither the pastoral lessee nor the Pastoral Board has to notify native title claimants if the pastoral lessee wants to carry out the activity.

What about other activities?

The *Native Title Act* refers to two main classes of proposed activity that have a native title impact.

The **first class** is where the activity is not permitted at present and the Pastoral Board agrees to alter the conditions of the Pastoral Lease to permit:

- a new type of **primary production** (as defined above); or
- any **activity associated with or incidental to primary production** (as defined above), as long as most of the lease area is still used for primary production itself; or
- **farm tourism** (except if it involves observing Aboriginal activities or cultural works).

In this case, the *Native Title Act* provides that:

⇒ the permission granted by the Board is valid;

⇒ it does not extinguish any native title that might exist;

⇒ if the pastoral lessee carries out the activity, it prevails over any native title rights that might exist;

⇒ the pastoral lessee is not liable to compensate the native title holders; and

⇒ in most cases, before granting permission the Board must notify the relevant native title claimants and the Aboriginal Legal Rights Movement, and must give them an opportunity to comment on the proposal.

However, before proceeding the pastoral lessee must still obtain any other approvals, permits, licences or the like that are required under any other law.

The **second class** is where a person (either the pastoral lessee or someone else) lawfully permits a third party to:

- cut and remove **timber** from the land; or
- take **sand, gravel, rocks, soil or other resources** from the land, as long as it does not constitute "mining",

provided that the grant of permission does not amount to a lease of the land.

The circumstances in which pastoral lessee may by themselves permit someone else to carry out these activities on Pastoral Lease land are very limited, if they exist at all. Therefore, this class is most probably only applicable to permission granted to a third party by someone else, such as the Pastoral Board.

An example of an activity that did not amount to mining would be the removal of sand or gravel for construction or landscaping purposes.

In the case of activities in this second class, the *Native Title Act* provides that:

⇒ the granting of permission is valid;

⇒ it does not extinguish any native title that might exist;

⇒ the pastoral lessee or other person is not liable to compensate the native title holders; and

⇒ before granting permission, the person must notify the relevant native title claimants and the Aboriginal Legal Rights Movement, and must give them an opportunity to comment on the proposal.

What if the proposed activity is not allowed under any of the above?

If the proposed activity falls outside any of the above classes, or was not already permitted before 31 March 1998, it is not legally allowed to be done except under one of the two following methods:

- Indigenous Land Use Agreement (**ILUA**)

  Under the *Native Title Act*, an ILUA is a legally binding agreement between native title claimants and other people with an interest in the land. The terms of that agreement would be up to the parties to agree; or

- Compulsory acquisition

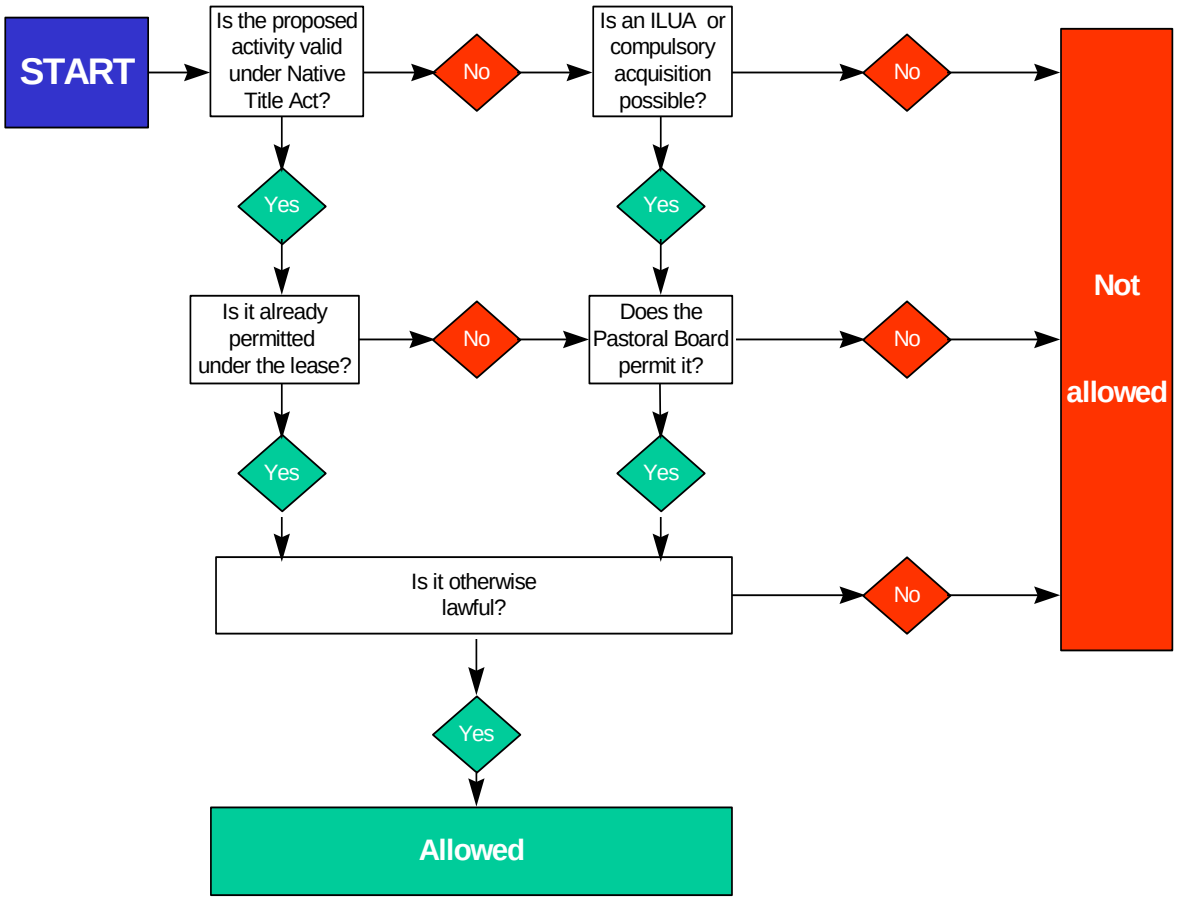
  In theory, the Government could provide the pastoral lessee with an "upgraded" land tenure (eg freehold title) that extinguishes native title. This would be rare because it would involve compulsory acquisition of the native title interest by the Government, probably resulting in compensation being payable by the Government to the native title claimants.

What should pastoral lessees do if they want to diversify?

The diagram overleaf shows the steps that need to be taken to find out if an activity proposed by a pastoral lessee on the leased land can be carried out lawfully.

As shown, even if the activity is within the classes declared to be valid by the *Native Title Act*, the pastoral lessee may still have to obtain Pastoral Board authorisation (or other legal authorisations) before going ahead.

If the activity is not within those declared to be valid by the *Native Title Act*, the pastoral lessee first needs to find out whether an Indigenous Land Use Agreement or compulsory acquisition is possible. Even if it is, authorisations from the Pastoral Board or under other laws may still be necessary.



Source: Indigenous Land Use Agreement Negotiation Team (Attached to the South Australian Attorney-General's Department).

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APPENDIX L: Liaison Guidelines for Landholders and Mineral Explorers in South Australia

A guide to establishing and maintaining good relations between the mining and agricultural industries[10].

INTRODUCTION

Good relations between landholders and those involved in mineral exploration are based on each party understanding the interests of the other.

In South Australia, minerals are the property of the Crown.

Whilst the Mining Act enables mining companies and prospectors to access the land for exploration purposes, it also recognises the rights of landowners.

Official Notice of Entry must be given to the landholder 21 days prior to entry. If applicable, a notice to use 'Declared Equipment', e.g. earthmoving equipment, should also be served to the landholder with 21 days notice.

The Act lays down clear obligations for the explorer to notify and consult with landowners, to repair damage to improvements, to reinstate disturbed areas and to pay compensation for financial loss, hardship or inconvenience.

Fossickers (those who gather minerals as a recreation and do not disturb the land or water with machinery or explosives) are not subject to the Mining Act and can only enter the land with the owner's permission.

These guidelines have been prepared by PIRSA to promote communication to establish good working relationships between landholders who have surface rights, and explorers who are authorised under the Mining Act to enter the land to search for mineral deposits.

The landowner and the explorer are both obliged to care for the land and use its resources in a sustainable way. This can only be achieved if each party knows what the other is doing and can integrate their management practices into a single property plan.

The exploration company should aim to:

- establish and maintain close liaison with the owner and occupier of the land on which exploration is conducted
- avoid damage to improvements (including water supplies) and carefully manage activities in relation to their effects on vegetation and land
- avoid interference with crops, livestock and other economic activities on the property
- avoid disturbance to the owner's house and other amenities from noise, dust and other nuisances
- rectify damage to the property or improvements without delay
- pay compensation promptly

[10] This section is adapted from PIRSA Earth Resources Information Sheet E11.

- ensure that all employees and contractors know of and comply with the company's obligations and commitments.

The landowner's contribution to a good working relationship is to:

- respond with minimum delay to requests for information or to notices issued under the Mining Act
- advise the explorer of any changes to previously agreed stock or management programmes
- respect the confidential nature of exploration and refrain from discussing the results of the work with others.

ESTABLISHING AND MAINTAINING GOOD RELATIONS

Preparations Prior to entry onto land

- Either the Project Officer or an appropriately qualified person should be appointed as a *Liaison Officer* who is responsible for liaison throughout the life of the programme. This person must be given that specific responsibility in their duties and should preferably have knowledge of the agricultural and/or pastoral sector and an affinity for people on the land.
- The Liaison Officer shall be responsible to the company and should be familiar with all aspects and requirements of the project.
- The Liaison Officer should be authorised to make agreements and arrangements on behalf of the company.
- All project personnel, including contractors, should be briefed on company policy and be aware of and comply with the tenement conditions and agreements made with the owner and occupier.
- The Liaison Officer should make direct contact to discuss the exploration programme with the landholder (the person who has an interest in the land by way of freehold title, leasehold interest or holds land under some form of dedicated reservation, i.e. park, road reserve, easement, etc.) before exploration commences.
- If possible, the field programme should be made flexible enough to fit in with the often more rigid timetable of the landholder, e.g. reaping and lambing.
- The landholder should be informed of the Liaison Officer's responsibilities and who the Liaison Officer reports to in the company.
- The company should make the Liaison Officer or other appropriate person available to discuss reasonable requests from the local community for information on the project management plan and commitments.
- The Liaison Officer should ask the landholder about:
    - the location of special features of the property including the location of known Aboriginal or European heritage sites
    - the existence of any Heritage Agreements or management plans approved under the Pastoral Land Management and Conservation Act,

the Soil Conservation and Land Care Act, and any other statutory obligations

- the preference for reinstatement of disturbed areas
- the future use of drill holes which intersect useable groundwater.

- Wherever practical, serve notices required under the Act personally and use the opportunity to explain the programme and establish a working relationship.
- Supply the landholder with the tenement number and conditions attached to it.
- Provide the landholder with the Liaison Officer's business and after hours telephone numbers.
- The explorer should consult with the traditional Aboriginal custodians of the land to avoid disturbance of any significant Aboriginal sites. The Department of State Aboriginal Affairs (DoSAA) can advise on the relevant groups or contact persons.

Do not leave landholder liaison to contractors. Make sure that the contractor knows and abides by the terms of the agreements with the landowner and others with an interest in the land.

ACTIONS UPON FIRST ARRIVING ON THE LAND

- Upon arrival at the property, introductions should be made immediately at the homestead.
- Provide the landholder with comprehensive details of the exploration programme. In particular, the following details should be provided:
  - proposed location of fieldwork (include a map)
  - extent and type of operations to be conducted
  - description of vehicles to be used
  - names of personnel involved, including contractors who will do the work
  - living arrangements, particularly if a campsite is required.
- The explorer should request the following details from the landholder:
  - access
  - suitable campsites
  - landholder's planned work programme
  - updates on the explorer's map, i.e. fences, gates, bores, dams, etc.
  - permission for use of water.
- Agreements between the landholder and explorer should be simple and clearly identify what has been agreed to between the two parties. It is preferable that agreements are in writing, because verbal agreements can lead to misunderstandings. If agreements are made verbally, all parties should have a witness present.

- Regular meetings between the Liaison Officer and landowner should be arranged to discuss progress, performance and agreements.
- The outcome of these discussions should be that the owner, occupier and mining company understand each others needs and how they can be fulfilled.
- Where possible, allow the landholder the opportunity of quoting for any contract work that may become available. Try to employ local people wherever possible but be aware of the need for all contractors to carry adequate public liability and third party insurance.

LANDCARE

- In addition to agreed arrangements with the landholder, the planning and conduct of operations should be based on the *Statement of Environmental Objectives for Mineral Exploration* (Earth Resources Information Sheet E9), issued by PIRSA.
- Reduce any vegetation clearance to the absolute minimum. Unavoidable track clearing and construction should be undertaken in a manner acceptable to the landholder.
- Be mindful of initiating weed infestations and outbreaks of disease. Thoroughly clean vehicles before moving into new areas.
- No pets or firearms should be taken onto the property without the express permission of the landholder.
- If a campsite is required, prior agreement with the landholder on preferred locations should be reached. However, in order to comply with the *Pastoral Land Management and Conservation Act*, the campsite should be positioned at least one kilometre away from any homestead and 500 m away from any stock watering point. It should not be placed near drainage lines or be positioned over stock pads leading to watering points.
- Under no circumstances should chemicals or their containers be dumped where they could enter surface or groundwater systems. All hazardous rubbish should be removed and placed in authorised waste disposal depots. General rubbish should be disposed of, taken to a local tip or buried on written advice from the landholder.
- Fuel stores and vehicle servicing areas should be located and used in a manner which does not permanently contaminate soil or pollute water. Any contaminated areas must be rehabilitated.

PROPERTY INFRASTRUCTURE

- If an explorer needs to cut a fence, consult with the landowner for alternatives. However, if a fence is cut, stock-proof gates must be installed and removed if requested by the landowner on completion of the work. Permanent repairs to cut fences must be effected as soon as practicable.
- Report any damage of gates, fences, roads, crops etc. to the landholder (even if the explorer is not responsible). Where necessary, discuss any arrangement for repairs. Temporary repairs should be completed immediately.

- When the ground is wet, vehicle movements should be curtailed. Any track damage caused by vehicle movements in wet conditions should be repaired as soon as conditions dry out.
- The explorer should ensure that declared equipment is used only under competent supervision. The supervisor should be fully aware of the company's environmental policy and negotiate locational matters with the landholder.

GOOD HOUSEKEEPING

- Have crews carry rubbish containers and avoid littering at all times.
- Where several days are to elapse between the various operational phases of the survey, have any temporary gates checked for stock security.
- Appropriate fire suppression equipment should be carried and accessible at all times.
- Fire risks should be minimised by siting fuel dumps, generators, welders and similar equipment on suitably cleared areas.
- Regulations pursuant to appropriate fire legislation should be adhered to. Talk to the local Country Fire Service officers if in any doubt.
- Have a fire fighting plan or procedures; fire-fighting equipment should be supplied, installed and properly maintained in the camp.
- Personnel should be trained and fire drills carried out.

MANAGEMENT OF EXPLORATION ACTIVITIES

- Keep the landholder fully informed of the progress of the exploration programme.
- The explorer should find out on a regular basis where stock are located to avoid unnecessary disturbance.
- Be mindful of the possibility of discovering sites of scientific or heritage significance. Aboriginal sites should be reported to DoSAA (see the Aboriginal Heritage Act 1988, Sections 20 and 23).
- Reduce speed near homesteads, watering points and grazing stock to reduce dust and disturbance.
- Be aware of hazards to health and safety to stock and people from cables, drill casing, excavations etc. and take actions to prevent potential hazards.
- Advise the landholder if any blasting is to occur.
- When using helicopters or low-flying aircraft, advise the landholder of their proposed use, the area of use and the times of such flights. Discuss with the landholder the planned stock programme, e.g. lambing and mustering and ensure that the pilots are instructed to cause minimal disturbance to stock.

REINSTATEMENT OF DISTURBED AREA

- The company should prepare and implement a programme which complies with tenement conditions, best practice and the reasonable needs of the landholder.
- The Liaison Officer should visit sites of major disturbance with the landholder after reinstatement has been completed and attend to any reasonable requests for further work.
- Where soil compaction has occurred, rehabilitate the site to the landholder's satisfaction.
- Unless otherwise requested by the landholder, all drill holes should be backfilled immediately on completion, cuttings backfilled, raked over or removed and octa-plugs put in place. If drill holes are required to remain open temporarily, install casing to prevent injury to stock and small animals from falling in. Backfill costeans and other excavations as soon as they are no longer required.
- Permanent survey markers should be placed where they will not hinder station management. Temporary markers, pegs, tags and flagging tape should be made from biodegradable materials or removed if requested by the landholder.

ACTIONS TO BE UNDERTAKEN UPON PROGRAM COMPLETION

- The Liaison Officer should invite the landholder to inspect the work area when the project is complete and carry out any reasonable requests for reinstatement of the land.
- Undertake any agreed restoration without undue delay and promptly pay in full any agreed compensation which is due to the landholder under the Mining Act or an agreement between the parties.
- Make a final inspection of all roads, gates, fence lines, campsites, drill sites, trenches, etc. to ensure that all areas are free of rubbish and left in a condition that is safe to stock and free of hazards to people.

OTHER PIRSA INFORMATION SHEETS OF INTEREST TO LANDHOLDERS AND EXPLORERS

Environmental Guidelines for Mineral Exploration in South Australia. (E8)

Statement of Environmental Objectives for Mineral Exploration in South Australia. (E9)

FURTHER INFORMATION

Mineral Resources
Level 4, 101 Grenfell Street
Adelaide, SA, 5000.
Telephone (08) 8463 4154.
Facsimile: (08) 8463 4155.

Petroleum
Level 7, 101 Grenfell Street
Adelaide, SA, 5000.
Telephone: (08) 8463 3204. Facsimile: (08) 8463 3229.

South Australian Chamber of Mines and Energy Inc. 4 Greenhill Road Wayville SA 5034	Phillip Sutherland Chief Executive Officer Ph. (08) 8373 9699
South Australian Farmers Federation 122 Frome St Adelaide SA 5000	Scott Donner Executive Officer Natural Resources Ph. (08) 8232 5555

Further information is also available from the PIRSA website www.pir.sa.gov.au.

These *Liaison guidelines for landholders and mineral explorers in South Australia* have been endorsed by the South Australian Chamber of Mines and Energy and the South Australian Farmers Federation.

Source: PIRSA Earth Resources Information Sheet E11.