

# Data on significant wilderness areas in the Alinytjara Wilurara and South Australian Arid Lands NRM Regions

**Wilderness Advisory Committee**  
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Left and right image: Nullabor Plains, South Australia

# 1. Purpose of the report

South Australia's most significant lands of high wilderness value are located in the State's arid regions. An analysis of the wilderness potential of this area has been undertaken by the Wilderness Advisory Committee using data from a number of sources. It is hoped this data will be of use to

those working on Regional Natural Resource Management Plans, particularly in relation to Goal 3 of the State NRM Plan 2012 -2017 with which is 'Improved condition and resilience of natural systems'.

# 2. The significance of wilderness areas

The concept of wilderness has been part of modern Australian culture for over a hundred years. While the concept has evolved, it still retains the essential themes of remoteness and minimal disturbance by modern technological society. This is reflected in the *Wilderness Protection Act 1992* which uses the following criteria for determining whether or not land should be regarded as wilderness:

- a) the land and its ecosystems must not have been affected, or must have been affected to only a minor extent, by modern technology;
- b) the land and its ecosystems must not have been seriously affected by exotic animals or plants or other exotic organisms.

Initially applied in the context of the forests and ranges of Tasmania and the east coast of Australia, the concept of wilderness in arid and semi-arid regions is now well established.

Collectively, Australia's wilderness areas are of international importance and rank with the Sahara, the Amazon and Antarctica. (McCloskey and Spalding 1989). Australia has the largest area of arid wilderness of any developed country and it is of high quality. A large part of Australia's arid wilderness is located in South Australia, extending across tenure and land use.



## Biological significance

Wilderness areas provide the best possible circumstances for species to persist. Ecosystems in wilderness areas have a greater capacity to cope with large-scale disturbances, such as bush fires and human forced climate change. The protection of intact natural ecosystems helps ensure not only species survival but also the maintenance of ecosystem services, such as climate regulation and water resources, on which humans depend.

## Scientific significance

Wilderness areas provide us with a genetic 'library' which can contribute to improvements in medicine and agriculture. They are of value for research into ecological and physical processes, evolutionary development, and long term climatic trends. Such areas provide a scientific benchmark with which modified environments can be compared, and from which appropriate management and rehabilitation strategies for modified environments can be derived.

## Cultural significance

Wilderness areas provide indigenous people with the opportunity to maintain traditional cultural practices and linkages with the land. Wilderness areas are also of historical interest as they provide close approximations of South Australia's landscape in the age before agriculture, industry and urbanisation. They are increasingly being used for eco-tourism and are an important resource for the regional tourism.

## Natural Resources Management significance

Wilderness areas are a vital part of the mosaic of land and water resources. Their protection, coupled with projects which better conserve the land between protected areas, is integral to whole-of-landscape management and is consistent with Goal 3 of the State Natural Resources Management Plan 'Improved condition and resilience of the environment'. Furthermore, the cost of protection of intact wilderness areas is very much lower than the cost of rehabilitation of modified landscapes



### 3. Wilderness surveys

Two wilderness surveys have been completed for the Australian Government. The National Wilderness Inventory (NWI) (Appendix 3, Map 5) was produced by the Australian Heritage Commission (Lesslie et al.) in 1999. The NWI uses the criteria of remoteness and naturalness and four indicators (remoteness from access, remoteness from settlement, apparent naturalness and biophysical naturalness) to measure wilderness quality. The inventory represents wilderness as a variable quality. Land on which native vegetation has been removed is un-surveyed.

The boundaries of wilderness areas of potential national significance (See Appendix 3 Maps 1,2,3,4 and 6) were established by the Australian and World Heritage Group of Environment Australia in 1998 and 1999. (Environmental

Research and Assessment Pty Ltd, 2000). Boundaries were determined by applying a threshold to NWI estimates consisting of an index value of 12 and a minimum size criterion. (See Appendix 1 for descriptions).

In the west of the State the scale of the wilderness areas is noteworthy in an international context, with the Great Victoria wilderness having an area two and a half times greater than the size of Tasmania.

Both wilderness surveys are indicative and require additional work, particularly in relation to recently established water points, to verify present conditions.

### 4. Adequacy of formal protection

Map 7 (Appendix 3) shows the bioregional distribution of IUCN Category Ia, Ib, II & III reserves. In these reserves mining and pastoralism are not permitted. The Wilderness Advisory Committee considers four bioregions have adequate, or near adequate, formal protection in Category Ia, Ib II& III reserves and five bioregions should be made a priority for protection.

*\* The Broken Hill Complex bioregion has been omitted as it contains no wilderness areas of potential national significance.*

*\*\*The Eyre Yorke Block and Murray Darling Depression bioregions have been omitted as they are largely outside the study area.*

Bioregions with adequate protection	Percentage in Category 1a, Ib, II and III reserves %
Nullarbor	11.7
Great Victoria Desert	11.2
Flinders Lofty Block	6.2
Simpson Strzelecki Dunefields	5.8

Bioregions with priority protection	Percentage in Category 1a, Ib, II and III reserves %
Channel Country	0.5
Gawler	0.2
Stony Plains	0.2
Finke	0
Central Ranges	0

# 5. Management principles for the arid environment

The extensive areas of relatively intact natural and semi-natural vegetation remaining in the arid lands of South Australia provide scope for implementing a whole of landscape approach to conservation planning and management.

Some of the factors that challenge the implementation of conservation measures in the arid lands are noted by Stafford Smith and McAllister (2008).

- c) Some organisms operate over very large scales including those that track resources, e.g. waterbirds that follow episodic rainfall or flooding events, honeyeaters that follow flowering. Many sedentary species have life history strategies that require habitat heterogeneity over very large areas to accommodate large-scale variability in drivers such as climate, water distribution and fire.
- d) The spatial distribution of the condition of vegetation may be especially important to conservation outcomes. If the degree and longevity of impact is sufficient, key processes may be absent long enough for diversity to be lost.

Stafford Smith and Allister maintain that two types of conservation management are required:- Management in specific localities or **focal areas** e.g. locations with species or communities which are rare or threatened species or have restricted distribution; also locations with structural and functional characteristics such as complexity of assemblages and relative intactness;

Management of **diffuse ecosystem processes** across large areas. Examples include recruitment and migration processes– particularly at very large scales (e.g. waterbirds, rock wallabies); the promotion of patchy processes (e.g. fire, grazing) and connectivity (e.g. processes associated with river systems) at large scales to maintain species and genetic diversity.

Both types of management must be linked. For example biologically significant sites such as Coongie Lakes cannot be effectively conserved unless the lakes have focal area protection, along with the protection of the broader hydrological processes associated with the Cooper Creek system.

Stafford Smith and McAllister (2008) identify the following principles in conservation management in the arid zone.

- 1) Protect focal area values for key species and communities dependent on these values.
- 2) Maintain connectivity between focal areas.
- 3) Protect diffuse processes based on landscape structure and spatial and temporal diversity in rainfall, herbivory and predation.
- 4) Protect threshold conditions for key processes before critical thresholds are crossed. As degradation increases there will be increasing parallels with fragmented agricultural landscapes and focal areas become more important.

The concept of protecting both focal areas and diffuse ecosystem processes is reflected in the State Government's NatureLinks program and the Trans Australia Ecolink. These principles also align strongly with those identified by Dunlop M. and Brown P.R. in their report Implications of climate change for Australia's National Reserve System.

(See Appendix 2 for this report's list of climate change priority actions.)

## 6. Conclusion

In the north of the State, the CSIRO and the Bureau of Meteorology are predicting a 2.5 to 3°C temperature increase by the year 2070, based on a medium emissions scenario (See Appendix 3, Map 8). Rainfall decreases have been predicted of between 5% and 10% in some areas and 10% to 20% in others. It is probable the biological impacts of climate change of this magnitude will be extensive, with CO<sub>2</sub> impacts, changes in the timing of lifecycle events, species distribution shifts and abundance changes (Dunlop M. and Brown P.R. 2008)

As international climate change negotiations continue, the time available to create an effective whole of landscape conservation system in South Australia's arid and semi-arid lands is becoming limited. It is hoped data on wilderness areas in this report will be of use to those working on Regional Natural Resource Management Plans and Integrated Climate Change Vulnerability Assessments, and help speed this process.



*Lake Gairdner, South Australia*



# Appendix 1

## Wilderness Areas of Potential National Significance: Description

The following descriptions of wilderness areas of potential national significance are from the reports *Wilderness in Western South Australia* and *Wilderness in Eastern South Australia*, Environmental Research and Assessment Pty Ltd, 1998. See Map 5 for area locations. These wilderness surveys are indicative and require additional work to verify present conditions. The areas have grouped two categories by the Wilderness Advisory Committee:-

1. Wilderness areas of potential national significance with adequate protection.
2. Other wilderness areas of potential national significance.

## Wilderness areas of potential national significance with adequate protection

### Freeling

The Northern Flinders Ranges have prominence in the minds of South Australians as a remote region of great beauty and of special scientific interest, both in biological and geological terms. The ranges were occupied quite early in the sequence of arid and semi-arid land development in South Australia, following the Explorations of Eyre and Frome in the early 1840's. Initially there was strong interest in the grazing and mining potential of the region, but despite efforts over many years the perceived potential was never fulfilled. A central feature of the identified area is the Mawson Plateau, an inaccessible area which has never been used for grazing or mining, is widely recognised in SA for its 'wilderness' values. The identified area extends more widely, encompassing adjacent areas on Arkaroola and Mount Freeling leases. Mount Freeling currently operates as a pastoral lease, but Arkaroola is managed as a wildlife sanctuary and tourist facility.

The identified area includes a number of access tracks connected with mineral exploration and also some minor mine workings. These are however not active and are

of small scale. The area also includes access and some infrastructure associated with pastoral occupation (Mt Freeling lease), but again these are not sufficiently significant to warrant rejection of the area as wilderness. For example, Valley Bore and Valley Well on the Mount Freeling lease are not used for stock, and essentially support goat numbers in the area. Feral goats have historically caused the most severe biophysical impact in the identified area. Some parts such as the Mawson Plateau, have largely escaped their effects, and many years of sustained active control measures have been carried out on the Arkaroola lease, to excellent effect. In other parts goats remain a cause of continuing impact. Feral donkeys are also present in the more remote parts of the MacDonnell Creek catchment.

While there is considerable recreational value in the area, present patterns of use appear to pose little threat to wilderness quality. The managers strictly control public access on Arkaroola and relatively small numbers presently visit areas on Freeling Heights and Mawson Plateau, which is the foci of bushwalker interest.

### Gammon

The second wilderness area of the Northern Flinders Ranges is Gammon, the great majority of which is included within the 122,875ha Gammon Ranges NP which was established in 1970. A very small section is also included within Nepabunna Aboriginal Lands. The area is almost wholly within the Gammon environmental association (Laut et al. 1977), characterised as a high plateau and ridges of quartzite which are covered by Melaleuca scrub, low woodland and Spinifex which have not been severely affected by grazing.

The present management regime for the area within the NP is guided by management objectives and principles set down in the plan of management (SA Department of Environment and Planning 1985). There is explicit recognition within the management plan of the area's wilderness quality and the need to protect this within the context of wider park management responsibilities. This is formalised in the zoning plan, which designates a 'wilderness zone' over most of the identified area. Of the remaining part of the identified area, most is included within a 'primitive zone' which restricts activities to those which are substantially consistent with the protection of

wilderness quality, including prohibition of public access by vehicle. Park management also takes account of the traditional links which the Adnyamathanha aboriginal people have with the landscape and establishes mechanisms for maintaining traditional links and land use practices as well as wider involvement in park management.

There are few management issues relating to the part of the identified wilderness on Nepabunna Aboriginal Land. The area involved is small and is also a rugged and inaccessible part of the ranges.

Historically, the area was predominantly within the Balcanoona pastoral lease which was formed from a number of pastoral runs taken up in during the 1850s. The lease is one which was well developed, and regarded as an excellent example of an outback sheep station. However, the part of the lease which is included in the identified area remained essentially undeveloped throughout its pastoral history. Sheep grazing on Balcanoona was very much restricted to hills and plains country which surround the Gammon Plateau and the very rugged ranges and gorges associated with it. Similarly, while there were a number of mines established on the present park area (of minor scale and duration), none occur within the identified area.

Current management issues relate primarily to visitor use and the control and eradication of feral animals. Visitor use of the Gammon Ranges NP is fostered by the management plan, directed primarily around more accessible areas of historic interest. However there is considerable interest among bushwalkers in more remote parts including the identified area. Bushwalker access is possible throughout, although the plateau and surrounding gorges are very inaccessible. However, the aridity of the area means bushwalker impact is concentrated around camping sites at permanent water sources. The area around Loch Ness Well receives highest levels of use. Feral animals and introduced pest plants are both major issues concerning conservation management in the North Flinders Ranges. Rabbits, goats and cats are vertebrate species of particular concern, particularly in the hills and ridges with dolomitic soils in the wider Gammon Ranges region. However, the landscapes of the Gammon environment association, which typify the identified area, have suffered very little impact in this regard.

## Great Victoria (& Great Victoria North)

Situated in the Officer Basin, within the Western Sandplains Environmental Region (Laut et al. 1977), this area includes much of western SA and is the largest area of high quality wilderness in SA. When adjoining areas in WA are taken into

account the extent and quality of these lands is of international significance. The area is comprised, for the most part, by east-west trending longitudinal sand dune system. The system is one of the largest in Australia. It contains, in the north, the Deering Hills, Birksgate Ranges, Mt Lindsay and other isolated inselbergs that decrease in incidence to the south. Also included are large playa lakes associated with paleodrainage systems such as the Serpentine Lakes, Wyola Lake, Lake Dey Dey, Lake Maurice, and the Wilkinson Lakes. The southern limits of the area include northern parts of the karst Nullarbor Plain and the northern edge of the Eucla Basin where limestone is replaced calcareous sandstone buried beneath the sand dunes of the desert proper.

The area is semi-arid at its southern and northern limits. (200–299mm pa) and arid in the central area (< 200mm pa). Rainfall is not particularly seasonal (Scott 1982). Dominant vegetation is low open woodland, including mallee, tall shrubland, low shrubland and hummock grasslands. The Nullarbor component is primarily low chenopod shrubland. Detailed environmental descriptions are provided by Laut et. al. (1986); SA Department of Environment and Land Management (1993); Greenslade et al. (1986) Copley and Kemper (1993); SA Dept. of Environment and Natural Resources (1996).

The western boundary of the identified area is defined by the WA border, although wilderness extends well into Western Australia. The southern boundary is defined by the Transcontinental Railway line, railway settlements such as Cook and Barton with associated tracks and other infrastructure. This boundary is also defined by the Maralinga defence (atomic bomb facility) including the atomic test sites, and associated infrastructure and access features; also the Oak Valley Aboriginal Community and access to it. To the east the Victoria Desert is bounded by pastoral lands associated with the Stony Plains and the western limits of the Great Artesian Basin. In the north the area is limited by access and settlements associated with Aboriginal occupation in the Pitjantjatjara lands.

The area comprises The Unnamed Conservation Park, the Tallaringa Conservation Park, lands held by the *Maralinga Tjarutja under the Maralinga Tjarutja Land Rights Act 1984* and lands held by the Anangu Pitjantjatjaraku under the *Pitjantjatjara Land Rights Act 1981*. Access and use of aboriginal land is subject to the legislation which confers rights over the land. Also included are areas North Out of Hundred Hundred Section 400 Commonwealth Prohibited Area (associated with Maralinga) and Section 1486 (Emu field). A substantial part of the area also falls within the Woomera Prohibited Area.



Comments and notes relating to the area are based on cited documentary sources, discussions with individuals with local knowledge (R. Allen, National Parks and Wildlife SA; N. Gill, Dept. of Geography ADFA), and field inspections of the Ann Beadell Highway from Tallaringa to the Serpentine Lakes, and Oak Valley-Vokes Hill access conducted in July 1990 and May 1995. The Unnamed Conservation Park, northern Nullarbor and Oak Valley areas were also aerially inspected at these times.

Biophysical conditions within the desert dunefield and associated systems are high integrity throughout. The vast majority of the identified area has never been grazed by stock and in dunefield environments there is little evidence of the effect of introduced plant and animal species. Exotic plants are mostly restricted to grasses and forbs along access tracks. Five introduced animals have colonised the area: the camel, house mouse, fox, cat and rabbit. Importantly, rabbit numbers over many parts of the desert proper area have been very low compared with other parts of the state and are confined to particular soil types where rabbit grazing has had a significant impact on regeneration. Lake margins appear to be more susceptible (SA Dept. of the Environment and Natural Resources 1996).

In the southern black oak and mulga areas, however, particularly in sandplain areas, rabbit numbers have been significant. On the Nullarbor treeless plain rabbit numbers have always been high. There is, however, recent anecdotal evidence that the Rabbit Calicivirus Disease (RCD) virus has had a major impact in reducing rabbit numbers to near negligible levels (National Parks and Wildlife Service SA 1998). Occasional tracks of cats and foxes have been found and their numbers are presumed to be low. Small groups of camels are seen regularly along the Anne Beadell Highway but their biophysical impact is considered negligible.

Settlement influences on the area relate primarily to the Aboriginal communities and homelands established within the desert region on Aboriginal land (e.g. Oak Valley, Iltur, Aralya, Kunytjanu, Makiri, Fregon, Mimili). Impacts associated with these settlements is largely localised, although they are centres from which hunting and visits to traditional sites take place. Settlement influences on the identified area also include the Maralinga test centre, railway communities (the largest of which are Cook and Barton) and the Mintabie mining area.

Access within the identified area is very limited, consisting of tracks which are all suitable only to access by 4WD vehicles. Many access routes were established as a part of the 1950s

and 60s atomic testing program centred on Maralinga and Emu. Recent use of these tracks is primarily for communication between Aboriginal communities. (There is however very little communication between the Maralinga and Pitjantjatjara communities). A recently established track which is not marked on map sheets, links Oak Valley with the Tjuntjuntjara community in Western Australia for use only by these Aboriginal communities.

Between 1953 and 1963 the British conducted a program of nuclear weapons development trials at Maralinga and Emu (excluded). Nine major trials involving nuclear explosions were carried out along with several hundred smaller scale experiments which dispersed radioactive materials over small areas at these two locations. Once the Maralinga and Emu testing ranges were closed, a final cleanup of all sites was undertaken by the British in 1967. Relics of the settlement and airstrip at Emu still remain (field inspected during 7/1990). More recently, concerns over radiation hazards has led to further cleanup operations.

Seismic exploration has occurred in the area. Most seismic lines that were established during the 1960s and early 1970s are difficult to discern, even from the air. Recent seismic investigation (1993) around the eastern and northern perimeter of the Unnamed CP is still evident, particularly through dune crests; rehabilitation is only partial (pers. comm. N. Gill ADFA)

Benchmarks and survey markers which were included and analysed within the current NWI model do not significantly impact on wilderness quality (and should be removed from the primary database)

The Unnamed CP is currently managed in accordance with the reserve Management Plan (Department of Environment and Land Management 1993). The management plan was developed jointly with the Maralinga Tjarutja, giving due consideration to wilderness values of the area. Joint management arrangements provide a basis for management for wilderness protection, at the same time providing for hunting and foraging for native plants and animals in accordance with the *National Parks and Wildlife Act*. The park is a 'single proclamation' park and for this reason exploration activity is excluded. In addition, public access to the Woomera Prohibited Area also requires a permit.

Those parts of the identified area within Aboriginal land are managed under the terms of *Land Rights Acts* under which this land is held. Public entry to these lands is restricted

and by permit only. Agreements have been established with mining companies and government agencies for the purpose of undertaking exploration activity. The area of primary exploration interest is the Officer Basin on Pitjantjatjara Aboriginal Land. The Far West Working Group is a key forum through which Aboriginal landowners have developed arrangements for dealing with exploration and mining issues on these lands.

## Nullarbor West

The Nullarbor West area comprises a substantial section of the Nullarbor Plain in SA that extends south from the Transcontinental Railway, and north from the old Eyre Highway. The area continues west into WA. The treeless plain is a remarkable landscape, being one of the largest continuous karst landscapes in the world. It is elevated plain rising to 240m, sloping gently southwards and eastwards. The coastal area has a winter-rainfall semi-arid climate while, towards the interior, it becomes more arid with uniform rainfall distribution.

The area contains two reserves, the first being the Nullarbor NP which was created in 1979 and which includes, in this area, what was the Koonalda pastoral property. The second reserve is the Nullarbor RR established in 1989 from unallocated Crown lands in the north. These areas are presently under Aboriginal land claim. The land use history is essentially pastoral, with the main limitation to development being the lack water, which prevented occupation in the more northern parts. However, as discussed in Part 3, areas of a more intensive pastoral development south of the old Eyre Highway are excluded from the identified area.

In terms of biophysical impact it is the rabbit that has been the most significant factor in pasture degradation. The effects of rabbits on Nullarbor vegetation is discussed by Beard (1975). Rabbit shooting has been a significant economic activity in certain parts of the plain with complex networks of vehicle tracks associated with this pursuit visible from the air. Recent evidence indicates that RCD has had a major impact on rabbit populations (National Parks and Wildlife SA, 1998). There is some visitor access to the area, most notably to the pastoral station ruins, various karst features (caves, sinkholes, dolines), and north-south access through the area between the Eyre Highway and railway settlements.

## Nullarbor East

The Nullarbor East area extends eastward from Nullarbor West, interrupted only by the road from the Eyre Highway to Cook. The eastern boundary is, again, almost solely defined by a road - the road from Colona to Ooldea - which is the only feature separating this area from the Yellabinna area to the east. Like Nullarbor West, the northern boundary of this eastern area is defined by the Transcontinental Railway line, while the south is bounded largely by the old Eyre Highway and dog fence. Yalata Aboriginal land lies to the south of the boundary.

The physical environment, biota, land management and conservation considerations that apply to this area largely mirror those of its western counterpart. The area lies entirely within reserve: the Nullarbor NP and RR. The area is subject to Aboriginal land claim. European landuse history, where it exists, is again essentially pastoral, the two old pastoral properties which are partly included in the area being Nullarbor and Yalata (the latter being established in 1858). Most of the pastoral infrastructure associated with both stations is, however, excluded from the identified area.

The impacts which pastoralism and, more particularly rabbits are believed to have had on native vegetation in the area has already been alluded to in discussion of the Western Nullarbor area; the impact being severe. The extent of the change which the country has undergone since European settlement is hinted at when the character of the largely low chenopod shrub land which typifies present conditions is compared with the scene which met early European visitors

Giles traversed the region in 1875, traveling from Colona outstation (on Yalata station) to Ooldea soak; in effect a transect through the eastern edge of the identified area. He made the following observations on the country:

at twenty miles north of Colona we reached the edge of the plain that stretched away to the north and being evidently of very great extent .... Although this plain is covered with vegetation there was no grass whatever upon it but a growth of broom, two to three feet high waving in the heated breezes as far as the eye could reach, which gave it a billowy and extraordinary appearance.  
(Giles 1889, p.72)

The broom that Giles refers to is believed to be *Eremophila scoparia*, now no longer abundant on these plains and occurring only sporadically on rises and dunes (McKenzie and Robinson 1987)



## Yellabinna

Yellabinna is a key wilderness in SA with strong biophysical affiliations with the Great Victoria Desert. The western limit of the area also includes part of the Nullarbor Plain. The area is separated from Great Victoria only by the Transcontinental Railway, and its associated settlements and access tracks. The great majority of the area is included in the within the Yellabinna RR (2,501,551ha, established in 1990) and Yumbarra CP (321,127ha, established in 1968). Other parts of the area are included within Nullarbor RR, Pureba CP, Lake Gairdner NP, Koolgera CR, Nunnah CR, the Chundaria pastoral lease, and the Euria miscellaneous lease and also parts of Lake Everard and Wilgena pastoral leases.

The northern boundary is principally defined by the Transcontinental Railway line and associated settlements and access tracks. Eastwards, the boundary leaves the railway line following the dog fence south then continuing in an easterly direction, crossing inside the dog fence into Wilgena lease until meeting the access road to Yerda homestead. The eastern boundary is also defined by stock fencing and the Lake Everard shore-line. Southern boundaries of the area include the dog fence and the northern limits of native vegetation clearance for agriculture on Eyre Peninsular. The south-western limit of the area is defined by the unsealed road linking Yantanabie and Hitiba Station while further west the boundary is defined by the dog fence and the road from Colona to Ooldea. This road separates Yellabinna from Nullarbor East.

Biophysical descriptions of the area are provided by Copley and Kemper (1993) and Owens et al. (1995); also outlined in SA Dept. of Environment and Natural Resources (1996). The dunefield consists of south-east trending dunes, comprised mainly of red quartzitic sand derived from the western Australian Shield, with whiter sand appearing in the southern portions. The dunefield overlays an erosional plain, with occasional granite tors or inselburgs from the Gawler Craton. Vegetation consists of open mallee scrub with either a chenopod shrub or grass understory (see also Laut et al, 1977). There is an abrupt transition from dune environments to the Nullarbor Plain. Salt lakes are also present in the eastern part of the area, together with scattered low volcanic hills. The region is a key component of a biological corridor connecting mallee areas in western and eastern Australia.

The lack of reliable water resource means the area has had minimal pastoral use. Light grazing has occurred in limited areas north of the dog fence in more open country

transitional between the Nullarbor and Barton Sandhill system (Chundaria and Euria leases) but assessments of these areas by the Native Vegetation Conservation Section and Pastoral Management Branch indicate that there has been little disturbance. There is also little evidence of improvements or recent use (A.Macdonald pers com.) Limited grazing also occurs on the Lake Everard and Wilgena leases.

Management issues are comprehensively discussed in SA Dept. of Environment and Natural Resources (1996). There are, as yet, no adopted management plans for nature conservation reserves within the area, but one is under preparation at present.

Reserved areas are popular for recreational and 4WD enthusiasts, with most interest from regional population centres. Before 1975, apart from a track which crossed the western corner of the area between Bookabie and Ooldea, there were few 4WD tracks. Since, then there has been a proliferation of tracks, most notably a north-south track (Goog's Track) which crosses Yumbarra CP and Yellabinna RR. Other tracks have been constructed to access bore sites for mineral exploration purposes, creating a network which has been kept open largely by recreational use. It is estimated that there are up to 3,000 visitors per year within the area. Popular sites include various rock holes and salt lakes.

The majority of reserved area have been, and continue to be, explored for minerals. Of the total reserved area, only the core of Yubarra CP (less than 5% of land reserved) is unavailable for mineral lease. The main target of exploration has been minerals as opposed to oil or gas (basement crystalline rock), and there have been numerous bore-holes drilled for analysis. In some areas, such as Pureba CP, the drilling program has been intense, and access for drilling rigs has created a dense network of cleared tracks. Mines and Energy SA actively monitors rehabilitation of these tracks. The majority of these tracks are annotated to maps.

Few introduced plant and animal species are present within the area. Most introduced plants are exotic grasses found along tracks, rarely occurring elsewhere. Seven introduced vertebrates have been recorded in the area: the rabbit, fox, wild dog, cat, house mouse, camel, and goat (Copley and Kemper 1993; Owens et al. 1995). None of these are considered to pose a significant biophysical threat at present.

## Other wilderness areas of potential national significance.

### **Acraman**

Acraman includes salt lake surface of Lake Acraman and adjacent dunefields associated with the Gawler Ranges. A large part of the identified area is defined either by the Lake Acraman shoreline or the nearest adjacent fencing. Other parts of area are bounded by paddock fencing associated with ungrazed (or irregularly grazed) sections of the Lake Everard and Moonaree pastoral leases (Gawler Ranges Soil Conservation District). Limited lengths of fence line exist within the identified area.

Pastoralism is the key management issue in the area. Apart from the lake surface itself, and islands within the lake, all areas are within pastoral lease. For the most part identified areas are subject to minimal grazing, however. This is confirmed by the up-to-date pastoral infrastructure database and watered area analysis completed by the Pastoral Management Branch (DEHAA). The area is of some interest because of evidence suggesting that Lake Acraman may be a landscape feature that is associated with ancient comet impact; one of the largest recorded on earth. The lake is, however, inaccessible and there is presently negligible visitor access to the area.

### **Arckaringa**

Of smaller size, Arckaringa is one of the more distinctive areas identified in this study. Although not under a conservation tenure, the area has for some time been recognised for its nature conservation values which include wilderness, but which most particularly relate to its spectacular breakaway landscapes. Breakaways are mainly confined to the south of the area. This area is located on the Arckaringa, Todmorden, and Allendale pastoral leases. The boundary is defined mainly by tracks which provide access to pastoral infrastructure, mostly artificial and natural water points. In the north the area is bounded by the South Branch of the Neales and a station track which follows this watercourse. In the south it is bounded by a station track adjacent Arckaringa Creek and the Cadney-Oodnadatta road which passes by good examples of breakaway country.

The north side of the breakaway complex extends into a stony tableland which, for the most part, is little grazed by stock, despite having grazing potential with significant Mitchell grass cover. Minor grazing occurs around Wurley Hole. Grazing increases in intensity where there is greater

proximity to permanent and semi-permanent water. This is particularly the case near the Neales and Arckaringa Creek. The area includes fencing on all lease areas.

Accessible areas of breakaway along sections of the Cadney-Oodnadatta road receive a high level of visitation from tourists, but usage is mostly restricted to the main road, and does not extend far into the area. Extensive exploration drilling (for coal) has been completed around the Arckaringa homestead, but this does not extend into the area.

### **Bagot**

A comparatively small area centred on the Bagot Range and part of the Hamilton pastoral lease. The area is marginal given the given the criteria used to identify wilderness in this study, particularly in terms of size and influence of grazing. Bagot is bounded by roads, station tracks and fence-lines. Sustained grazing is most likely to be concentrated in proximity to permanent/semi-permanent water points and major water courses that border most parts of the identified area.

There is little recreational interest in the area, nor apparent mineral or petroleum prospectivity.

### **Davenport**

Davenport is an area, which, in terms of the criteria adopted in this study, is marginal as wilderness on the basis of both size and condition. The identified area is located on Nilpinna, The Peake and Anna Creek pastoral leases and is centred around Mt Margaret and Davenport Range. The area is also located in a part of the state where early pastoral runs were established (1860s) and which would have been subject to heavy levels of use associated with the over-optimistic expectations of sustainable carrying capacities. Although permanent artificial waters are excluded from the area, significant parts are still accessible to stock and will have been subject to significant grazing pressure over many years. Feral donkeys which have recently been subject to culling also occupy the ranges. There has been little scientific investigation of the nature conservation significance of the area, although the area is known to maintain a population of Black-footed rock wallabies.

There is presently very little recreational interest in the area, although the western side of the area is exposed to the Oodnadatta Track and is relatively accessible. There is also little apparent prospectivity for minerals or petroleum.



## Eyre South

Separated by a relatively minor strip of land with pastoral infrastructure and access, Eyre South is, in effect, an outlier of the Simpson/Eyre area. The identified area is comprised entirely by the surface of the Lake Eyre South Salina. Some mound springs are present on the lake surface. The area is included in the Lake Eyre NP. An assessment of the World Heritage significance of parts of the SA Lake Eyre basin includes Lake Eyre South as a place of significant natural heritage value (Morton, Doherty and Barker 1996)

Management issues are few and far between. There is some recreational interest in the south of the area, where the Oodnadatta track meets the lake shore. Minor impacts from vehicle use and camping occur in the immediate vicinity

## Frome

Frome is comprised of two landscape types common to north-eastern SA; the salina of Lake Frome, and the adjoining Strzelecki Desert dunefield-playa lake complex. Lake Frome is included within the 259,000ha Lake Frome RR, established in 1991. An even larger area is included in parts of the Strzelecki Desert dunefield under pastoralism (cattle) within the Lakeside, Frome Downs and Quinyambie pastoral leases.

Information regarding the history and management of the area is scanty, but can be broadly considered in terms of pastoralism, mineral and petroleum exploration and nature conservation. Cattle graze the majority of areas under pastoral tenure when conditions are suitable. However the availability of water is a key limitation to the distribution of stock. The area includes substantial areas where permanent water for stock is absent and which therefore will not be grazed during dry times when ephemeral surface water is not available. Some places adjacent to the area boundary are permanently watered and hence accessible to stock. The presence of yards and tanks in fairly central parts of the dunefield, also suggests there may be affects of sustained grazing by cattle within the core area. Dunefield areas have historically suffered damage from rabbits. There is some conservation interest in islands in the southern part of Lake Frome which have not been domestically grazed and are likely to be little impacted from rabbits.

The area has been subject to some mineral and petroleum exploration. Most notable is a seismic survey conducted in the south-western corner of Lake Frome during the late 1980's. The area is fairly inaccessible and receives little tourist visitation. There is some visitation to the Lake Frome shore-line via the 'plains' block of Gammon Ranges NP.

## Gairdner

Gairdner is one of the larger areas of high wilderness quality in semi-arid SA. It is environmentally and scenically diverse, including environments which are, in other parts, well developed for pastoralism and agriculture. The area is dominated by the huge salt lake of Lake Gairdner along with a number of other major salt lakes including Island Lagoon, Lake McFarlane, Lake Harris and Lake Everard. In addition to the salt lakes, the area is characterised by rounded porphyritic hills with long footslopes, separated by plains supporting a mixed cover of low open woodland, with open shrub understory and low mixed chenopod shrublands on valley loams. Salt marshes, sand dune communities and extensive ephemeral herbland/grassland communities also occur in area. There is a rainfall gradient across the area from 300mm per annum in the south-west to 150mm in the north. Places around the southern shores of Lake Gairdner (Kolendo, Unalla, Mount Ive) have been identified as part of a key biological area (Robinson et al. 1988).

The salt lakes themselves are largely unused, Lakes Gairdner, Harris and Everard included within Lake Gairdner NP (548,143ha, established in 1991) with Island Lagoon and Lake McFarlane being unallocated Crown land. Permits for conducting speed trials on a southern section of Lake Gairdner have been granted, although the area is irregularly used. Other areas, mostly adjacent to the lakes, are under pastoral tenure with a small part also included in the Woomera Prohibited Area. Early pastoral development, which took place during the 1850s, was restricted by the limited availability of surface water and suffered also from increasing dingo and rabbit numbers. However, after 1905, the dog fence and improvements in the distribution of permanent water through dam construction meant that the area of land under pastoral use considerably expanded.

The identified area is defined primarily by apparent limits to grazing. In this regard the current pastoral infrastructure database and watered areas analysis maintained by the Pastoral Management Branch (DEHAA) has been particularly useful. Boundary definition for this large and complex area is detailed in Part 3 of this report under individual map units. Boundaries are generally defined by a combination of fence-lines, roads and tracks, and the lake shores. Boundary definition problems apply in two areas; both in dunefield corridors linking Lake Gairdner and Island Lagoon and Lakes Gairdner and McFarlane. In the northern corridor (on Wirraminna pastoral lease) there is uncertainty regarding the extent of recent poly-pipe waterpoint development in the area,

but no recent extension of watered areas is evident from field inspection. Some doubt also exists regarding the identified area on Wirraminna South due to the availability of water for stock. Further south, similar issues apply in the second area of doubt on Mahanewo pastoral lease. Included areas in both places contain fence lines.

The identified area also includes minor parts of pastoral leases adjoining Island Lagoon (Oakden Hills, Yalymboo, Arcoona, and Wirraminna South). Advice from the Pastoral Management Branch indicates that the Yalymboo lease area has been very lightly grazed. Parts may therefore have potential for inclusion within the identified area. On the west side of the lake conditions may also be appropriate for inclusion within the identified area.

At present there is only minor recreational interest in the Gairdner area although the scenic and nature conservation qualities of the area means that there is considerable potential for increased levels of interest. Access to the area is currently limited because of surrounding pastoral tenures and terrain. The lake can be reached at only two points near the Yardea/Kingoonya road as well as through Mt. Ive station. Tourist facilities at Mt. Ive station (adjacent the southern limit of Gairdner) represent a base for recreation and tourism in the region. Adventure/eco tourism operators also work in the area.

## **Gilles**

Gilles mainly includes the surface of Lake Gilles together with adjacent lands that comprise Lake Gilles CP and CR. The boundaries are defined, for the most part, by fence lines surrounding the lake surface, including some adjacent lands. The eastern and southern boundaries of the areas follow the park boundary. The area contains relics of pastoralism including dams, fence lines and vehicle tracks. There is some continuing recreational use of these tracks.

## **Mann, Woodroffe and Mt Davies**

In the far north-east of South Australia are several mountain ranges which are the centre-piece of three identified areas; Mann, Woodroffe and Mt Davies. All three are located within Pitjantjatjara Lands (freehold aboriginal lands granted under the *Pitjantjatjara Land Rights Act 1981*). In each case, area boundaries are defined by road access and settlements associated with aboriginal settlement and landuse. For Mann and Woodroffe wilderness quality extends across the border from SA into NT.

Landscapes are characterised by steep, rugged ranges fringed by fans that merge into broad alluvial plains with some dunes and isolated hills and ridges. There is a mixed cover of low woodland, open hummock grassland, low open woodland or open shrubland. Extending further from the ranges are undulating sand plains with occasional low inselbergs and the south-easterly trending dunes of the Great Victoria Desert proper. The area is arid with an annual mean rainfall of 200mm and evaporation of 3600mm (Laut et al. 1977)

These areas have almost no history of pastoral use. Mineral exploration and mining activity have occurred in the vicinity of Mt Davies. Access and use is administered through the Pitjantjatjara Land Council. There is no right of public access to these lands. Permits for entry must be obtained from the Land Council.

The major focus of land development in the Pitjantjatjara lands over the last 20 years has been the establishment of homelands. A number of aboriginal communities and homelands have been established in the vicinity of the ranges, but none intrude into the identified areas. Control over the establishment of communities and homelands (and the necessary infrastructure for their support) along with other aspects of landuse and development is exercised by the Pitjantjatjara Land Council. More recently agreements (joint ventures) have been developed with mining and petroleum interests to facilitate the resources exploration and development of Pitjantjatjara lands.

Nature conservation is an emerging land management objective. In the last 5 years a number of biological surveys have been undertaken on Pitjantjatjara lands, coordinated by National Parks and Wildlife SA (DEHAA) collaborating with the Anangu Pitjantjatjaraku. Nature and culture-oriented tourism is also developing in the wider area. There is evidence of the impact of the regular burning on plains surrounding the ranges, along with localised grazing by stock.

## **Moon Plain (East & West)**

Moon Plain mostly comprises a featureless dry clay plain which, during dry periods, carries very little vegetation beyond drainage lines. It is a stark landscape of particular interest to tourists, although there are few accessible points. Other landscapes in the identified area include breakaways (north-west) and stony plains (north-east). The area is unreserved, mostly under pastoral tenure within the Mount Barry, Mount Willoughby, Nipinna and Anna Creek pastoral

leases. It is also partly in the Coober Pedy Precious Stone Field and the Woomera Prohibited Area, where public access without permit is prohibited. The identified area (east and west) is bisected by the main road from Coober Pedy to Oodnadatta.

The area is bounded in the south-west by the dog fence which receives high levels of visitation by tourists based in Coober Pedy. Northern boundaries are mainly defined by station tracks which link artificial water points on Mount Barry and Mount Willoughby. The north-eastern boundary is defined by a fence-line which delimits a well-watered part of the mount Barry lease, and station tracks which link artificial water points on Nipinna and Anna Creek leases. Pastoral infrastructure evident around Mary Bore and Yard is a particular case in point. The south-eastern boundary is defined by what is assumed to be the approximate limit of grazing. This is delimited by the Coober Pedy-William Creek road and a section of Egenina Creek, the shoreline of Lake Cadibarravirracanna, a direct line from the lake Cooyurooparie Hill, then to an artificial water point.

The majority of the identified area, comprising the Moon Plains landscape is not grazed despite being on pastoral lease. There is a broad transition from the Moon Plains landscape in the east to stony plains in the north and east. Parts of other landscapes within the area generally sustain grazing where there is proximity to water. This includes boundary locations particularly areas along north-east, east, and south-east boundaries. The identified area also includes some fences and tracks (e.g. to Giidi Giddinna Springs)

There is presently very limited visitor interest in the area beyond a few accessible places. Views into the area are obtained at the breakaway reserve near Coober Pedy and also along the Coober Pedy-Oodnadatta road.

## **Murloocoppie**

Murloocoppie is mainly characterised by breakaway landscapes located on the Evelyn Downs and Mount Willoughby pastoral leases. The western limit of the area follows the Stuart Highway (and related access).

The eastern and southern limits are defined mostly by station tracks which link artificial water points. One section of the boundary follows the alignment of the breakaway escarpment.

The area is marginal as wilderness (in terms of the selection criteria used in this study). It is relatively small, particularly

when fences and tracks and permanently/semi-permanently watered areas (artificial) within the area are considered. The area is nevertheless included because of reports of relatively low-levels of stocking in these parts of the lease areas, and its adjacency with the Moon Plains area. There is little recreational interest in the area, nor apparent mineral or petroleum prospectivity.

## **Oodnadatta (North & South)**

The Oodnadatta wilderness consists of two parts (north and south) which can be characterised as a stony plains/gilgae landscape complex, with breakaway elements. The area is one which has been subject to pastoral use over a long period, in a region that includes some of the earliest pastoral runs in SA. Today the area is still under pastoral occupation, being located on parts of several pastoral leases; mostly Allendale, a northern part of The Peake, and a western part of Mucumba. The northern and southern parts of the identified area are separated by drainage lines and access along which stock and station infrastructure is concentrated. The area is identified as significant in terms of wilderness on the basis that it contains places which are remote from permanent surface water and which are therefore only grazed intermittently in periods following rain.

Having stated this, the identified area does contain a number of permanent and semi-permanent watering points (both artificial and streamline waterholes) and therefore includes places that are grazed on a continuing basis. However, studies by the Pastoral Management Branch (DEHAA) indicate that the measurable biophysical impact of stock in the stony plains/gilgae complex is limited to 2 to 3 km from these waters. Some pastoral infrastructure (station tracks and fencing) is also present within the identified area, but again it is sparsely distributed. There is little mineral or petroleum interest in the area. Visitor interest in the area is also negligible at present. However, the eastern limit of the area (north and south) is adjacent to the Oodnadatta Track, and to this extent there is public access to the area.

## **Pedirka**

Pedirka contains a large part of the Pedirka Desert dunefield. The area is located on the Todmorden, Lambina and Hamilton pastoral leases (within the Marla-Oodnadatta Soil Conservation District). It is bounded in the north by access tracks linking water point infrastructure on Lambina and Hamilton. In the south-west, the area is limited by fence-lines bordering Todmorden and Hamilton. A part



of the Pedirka Desert within Todmorden has been fairly well developed with pastoral infrastructure, with few areas not accessible to stock. For this reason most of the Pedirka Desert on Todmorden has been excluded from the identified area, despite the fact the dunefield, in general, is not attractive to stock and is not often grazed. In the west, the area is limited by the Alberga River, track access and Curralulla Creek. The area excludes all permanent artificial water points; an included bore on Hamilton is not functioning.

While the dunefield is generally not attractive to cattle, areas in proximity to permanent water are accessible to stock. Such areas are located mostly along the margins of the identified area. This includes both artificial water points and waterholes within Hamilton Creek which flows through the desert. Fencing infrastructure is also in the area. Limited seismic exploration has occurred, mostly between 1984-1989. There is no recreational interest in the area.

## **Piniewirie**

Piniewirie is a small area of wilderness of significance located on pastoral country (the Cordillo Downs pastoral lease) in far north-east of SA. It comprises undulating stony plain with isolated low silcrete-capped hills vegetated with mixed cover chenopod shrubland, tall open shrubland with chenopod understory and low fringing woodland (Laut 1977). The western boundary of Piniewirie is defined by the road linking Cordillo Downs homestead to the Cadelga Outstation ruin, and pastoral infrastructure in the vicinity of the Cadelga ruin. The southern boundary is defined by Providence Creek and associated pastoral infrastructure. The eastern boundary of the area is defined by access tracks, water points and other pastoral infrastructure on Cordillo Downs. Comparable wilderness quality extends across the SA/Qld border.

Piniewirie has been subject to both oil and gas exploration and cattle grazing, although not at great intensity. Seismic exploration has been, for the most part, very limited although several relatively intensive seismic survey arrays were established between 1970 and 1989 in a southern part of the area. Aerial inspection suggests that there is relatively little long-term impact from exploration activity. Very few water points suggest there is only light, intermittent grazing pressure over much of the area. Grazing appears to be more concentrated in marginal parts of the area where there is greater proximity to permanent/semi-permanent water. Despite being located in the popular north-east of SA, there is little recreational interest in the area.

## **Scrubby Peak, Mt Sturt and Pinkawillinie**

Scrubby Peak, Mt Sturt and Pinkawillinie are a series of areas which lie in a north-west to south-east trending transitional zone between the Gawler Ranges in the north, the Barton Sandhills and Yellabinna region in the west and the mallee environments of northern Eyre Peninsular. These areas are significant not only because of their transitional situation but also because they include examples of environments which have been developed for pastoralism and agriculture in the Gawler Ranges and northern Eyre Peninsular.

Pinkawillinie primarily comprises mallee dunefield affiliated with northern Eyre Peninsular. The majority of the area is included within Pinkawillinie CP (127,164ha, established in 1970), Corrobinnie Hill CP (211ha, established 1983), and an ungrazed part of Paney pastoral lease, and additional areas under miscellaneous lease and annual licence. The area is bounded on the north-west by the Paney road, and in the east and west limits of land clearance and fencing. The northern limit is defined by the dog fence. Management issues in the area relate mainly to the impact of mineral exploration activity. Areas subject to exploration drilling, as identified in the accompanying map sheets, were identified from the Geoscientific Geographic Information database (Mines and Energy South Australia 1997). Pastoralism is also a relevant issue, with fence-lines and other pastoral infrastructure located in parts. There is presently little recreation in the identified area, the main focal point of interest in the vicinity being Corrobinnie Hill adjacent to the area's south-west boundary.

Scrubby Peak includes a diverse and scenically spectacular area of the Gawler Ranges which receives the highest rainfall of the Gawler Ranges and possibly the highest plant species diversity and concentration of important plants in the region. It supports two of the four remaining populations of Yellow-footed Rock Wallabies in the Gawler Ranges (Robinson et al. 1988). The identified area includes parts of Pine Lodge, Scrubby Peak pastoral leases, a number of areas under miscellaneous lease and annual license and part of Koolgera CR (44,720ha, established in 1993) It includes the playa lake system adjacent to the Yantanabie-Hiltiba Station road together with the sand ridge and porphyritic range complex that extends in a south-east direction towards the Minnipa-Yardea road.

The boundary is defined primarily by fence lines for the control of stock. The southern and eastern boundaries are defined by access tracks bordering watered and grazed

areas associated with the Narlabby lease, track access to the Locke Claypans and the Minnipa-Yardea road. The north-western boundary of the areas is defined by the road linking Yantanabie and Hiltiba Station. The identified area contains fence lines and other pastoral infrastructure. The Yandinga Gorge to Pine Lodge areas are the only areas with significant tourist visitation at present, although the scenic quality and natural interests of the area means that it is of greater potential in this regard. Limited exploration drilling has occurred on an internal access track.

Mt Stuart adjacent to the Paney pastoral lease, comprises a number of areas under miscellaneous lease and annual licence. A small part is also contained within the Pinkawillinie CP. The area is delimited primarily by fencing associated with these tenures. The north-west boundary is defined by the Minnipa- Yardea road; the south-east boundary by the Paney road. The identified area contains fence lines and other pastoral infrastructure.

## **Simpson/ Eyre**

Simpson/ Eyre is the second largest contiguous area of wilderness identified in SA, extending beyond SA, from the border into NT and Qld. It contains examples of most major landscape types which characterise the Lake Eyre drainage basin, one of the largest internal drainage basins in the world. These landscapes include the southern Simpson Desert dunefield; Lake Eyre North; the stony downs and tablelands of Witjira NP; the Tirari Desert dunefield; and parts of a number of major watercourses and floodplains such as the Warburton, Kallakoopa, Cooper, Macumba and Eyre Creek (Mulligan River). A recent assessment of World Heritage significance of the SA part of the Lake Eyre basin suggests that, among other places, the Cooper and Warburton Creek drainages and Lake Eyre North have significant natural heritage values (Morton, Doherty and Barker, 1996). Most landscapes/ land systems associated with the area are described by Purdie (1984). The area is centred in the driest part of Australia; much of the area within the 100mm isohyet. However, because many of the water courses associated with the area originate in more northerly locations with higher rainfall, floods in these watercourses contribute to a moisture regime more complex than would occur from rainfall alone.

The size and environmental diversity of the region also means that its history, since European occupation, is more complex than other areas identified in this study, a complexity which is reflected in present landscape use

patterns and land management regimes. The area can, in a sense, be regarded as a remote, inhospitable core around which pastoral occupation, communications and settlement in northern SA developed. In the east the first European to enter the area was Sturt, who in 1845 eventually reached a point in the Simpson Desert dunefield near the NT/Qld border. From 1858, after A.C. Gregory followed the Cooper and Strzelecki to Lake Blanche, pastoral runs were steadily established northwards up to the eastern margins of the area (Litchfield 1983). The western and southern margins of the area were essentially defined during the 1860s as pastoral runs were taken up in this part of SA. By 1872 western pastoral runs extended to the Dalhousie Springs area (Witjira NP), by which time the Overland Telegraph had been established.

While pastoralism drove early development around the identified area, exploration for hydrocarbons represented a major new phase of interest and development in the area and a shift of focus from the margins of the area to its core. The potential of the Simpson/Lake Eyre area as a possible source of petroleum was first emphasised by Sprigg in 1958 who pointed the petroleum bearing potential of the Permian and pre-Permian sediments under the Simpson Desert (Pedirka Basin). Petroleum exploration commenced in 1959 with the granting of exploration licenses to Delhi Australia Pty Ltd. and SANTOS Ltd. While initial efforts focused mostly on the Cooper Basin and north-east of SA, between 1963 and 1966 French Petroleum undertook a series of seismic surveys, the two lasting effects of which are the free-flowing Purnie Bore in the western Simpson Desert and the 'French Track' which crosses the Desert on an east-west alignment. Petroleum exploration activity in the desert has been sporadic, with seismic work concentrating in the 1970s and 19980s. More than 4,500km of seismic tracks have been established in the SA part of the Simpson Desert. Seismic line clearance has mostly occurred within the Simpson dunefield proper, with other isolated surveys on the stony downs and tablelands of Witjira NP, and in the Kallakoopa and lower Warburton Creek area.

The environmental impact of seismic lines is dependent on the landscape within which lines are cut and methods used for line clearance. Many of the lines cut in the Simpson Desert were established during the 1970s and early 1980s; a period when clearance methods were at their most destructive. However evidence suggests that, in dune environments which typify the desert, damage is largely ameliorated over 10-20 years by natural rehabilitative

processes, providing there is no subsequent use. It is a different story in stony downs and tableland environments, where erosion prone duplex soils often means that damage is effectively permanent. There has been substantial damage caused in these in the north-western parts (Witjira) of the identified area.

Exploration drilling has been limited to a handful of wells within the Simpson Desert dunefield, none of which are commercial, although significant oil showings were recorded at Poolawanna. The drilling of Purnie Bore (excluded from the wilderness) with its free-flowing waters has led to the establishment of a local wetland which not only supports wildlife, but also feral vertebrates including cattle, camels, donkeys and rabbits. The bore has been rehabilitated, its flow reduced, and more recently has been developed with shower, toilet and interpretive facilities for visitors.

Although the impact of most drilling operations has been mostly localised, drilling operations have required the construction of access routes (for heavy drilling equipment and supplies) which are partly clay surfaced, mainly over dune crests. A legacy of these operations is the 'Rig Road' which, like the French Track, provides east-west vehicle access across the desert.

The opening of the Simpson Desert to petroleum exploration, coupled with the emergence of 4WD-based adventure tourism in the 1970s, set the scene for the next wave of interest in the Simpson Desert by vehicle-based recreationists. Visitors who cross the Simpson Desert annually now number in the several thousand. Access is concentrated along the French Track and the Rig Road. Other key points of visitor access to the identified area include two routes to Lake Eyre through Muloorina and Anna Creek stations and access to the Simpson Desert through Dalhousie Springs/Mount Dare.

The majority of the identified area is presently contained within various classes of nature conservation reserve. This includes parts of Witjira NP (771,100ha established in 1985) and all of the Simpson Desert CP (692,680ha established in 1967); Simpson Desert RR (2,964,200ha established in 1988); Lake Eyre NP (1,394,250ha established in 1985), and Elliot Price CP (64,570ha established in 1967). Importantly, all reserves, except Elliot Price CP, are constituted in such a way, which provides for the continuation of mineral and petroleum exploration activities and subsequent development. There are, however, mechanisms through which measures can be taken to minimise deleterious environmental effects resulting from these activities and these have been progressively implemented and tightened

through the 1980s and 1990s. These mechanisms have are of the greatest significance in the Simpson CP and RR where exploration is highest (SA Department for Environment, Heritage and Aboriginal Affairs 1998b).

All reserves have mechanisms for the management and control of recreational activity. One important aspect of visitor management, which applies to all reserved parts of Simpson/Eyre is the Desert Parks Pass. This is a permit for recreational access and use to desert reserves in accordance with specified regulation. A handbook, which accompanies the pass, provides detailed information of permitted activities, safety information, access, camping sites and minimum impact visitation code. Recreational use is also managed in accordance with park management plans which presently exist for the Simpson Desert CP (SA Department of Environment and Planning 1984) and Witjira NP (SA Department of Environment and Natural Resources 1995).

A minor but still substantial part of Simpson/Eyre is located on pastoral leases. Lease holding include Macumba, The Peak, Stuarts Creek, Lake Eyre, Muloorina, Peachawarrina, Mulka, Mungeranie, Kalamurina, Cowarie, Clifton Hills and Alton Downs. Pastoral activity is very limited within the identified area. Lake Eyre North represents a barrier to stock and dunefields associated with the Simpson Desert are not grazed to any significant extent while most other parts are remote and inaccessible and grazed only during periods when ephemeral surface water is present. Floodouts from along the major water courses do, however, have the capacity to support stock, particularly following periodic floods. This is especially the case where permanent and semi-permanent exist, although most of these places are quite inaccessible with little or no pastoral infrastructure. Relevant areas include sections of the Kallakoopah, Warburton, Cooper, and Macumba (on the Kalamurina and Cowarie leases). The area is included with the Marla-Oodnadatta and Maree Soil Conservation Districts and lease holdings are monitored and assessed Pastoral Management Branch of DEHAA.

Vertebrate pest are a management concern through most of the area. Historically, rabbits have been most evident and abundant and have caused considerable concern because of their damage to vegetation and habitat in dunefield environments, although their numbers are known to have fluctuated markedly. It appears that recent hold of rabbits to these environments has been loosened by RCD. The House Mouse has also been abundant. Camels also roam freely across desert environments although their wider ecological impacts are considered minimal. Feral cats and



foxes are also found across the area, but little is known of their abundance. Donkeys, horses and, of course, cattle are present in the margins of the area but do not penetrate far into desert areas.

## Strzelecki/Cooper

Strzelecki/Cooper is the second largest wilderness area identified in Eastern SA. It extends on a north-south alignment through much of far north-east SA, from Lake Blanche and the lower reaches of Strzelecki Creek in the south through to dunefield/playa lake complex north of the Coongie Lakes. The identified area is identified in the south primarily by pastoral development on Murnpeowie station well as the shorelines of Lake Blanche and Gregory. In the east of the Strzelecki Track, the Gidgealpa-Adelaide natural gas pipeline road, and oil and gas exploration and production activity in the Cooper Basin define its limits. Much of the western boundary of the area is defined by the interface between stony desert environments which have been well developed for pastoral use and the more inaccessible and less favored dunefield environments. In the north, the boundaries of the identified area are mainly associated with floodouts, which again distinguish less accessible and lightly used areas from more accessible, well established grazing areas along the Cooper, where there is also an increasing occurrence of seismic exploration lines, production and exploration wells, and access tracks.

Much of the area is located on pastoral lease part of the area also included in the 1,381,800ha Innamincka RR (established in 1988) and the Strzelecki RR (1,165,350 ha, established in 1991) Relevant pastoral leases include Cordillo Downs, Pandie Pandie, Clifton Hills, Kalamurina, Cowarie, Murnpowie, Etadunna, Mulka, Dulkaninna and Mungeranie, as well as a lease for grazing within the Innamincka RR (for the Innamincka Pastoral Co. issued under the *National Parks and Wildlife Act 1972*) The identified area is within the Marree Soil Conservation District. Oil and gas exploration and production tenements also cover a significant part of the area.

The identified area is environmentally diverse and significant. Although dominated by the Strzelecki Desert dunefield, it contains stony plains and tablelands as well as a complex of floodouts, channels, wetlands, swamps and lakes associated the Cooper Creek. Elements of the Cooper Creek system, including freshwater lakes associated with Coongie Lakes are of national and international conservation significance (with part of the area listed as national estate as well as a wetland of international significance under the Ramsar Convention).

Located in one of the most arid parts of Australia (a long-term annual average precipitation of 172mm at Innamincka) the Cooper derives most of its water from the flow events associated with summer monsoonal rainfall in central Queensland. Local runoff from the stony plains also supplies water to waterholes and swamps but on a less frequent and more erratic basis.

The land use and management issues relating to the Cooper system are among the most complex in SA. The grazing potential of the Cooper system with its seasonal flooding cycles was recognized early in the sequence of European occupation of outback SA, with the first runs in the area taken up in the 1870's. Permanent waterholes and creek frontage areas were the focus both of grazing and droving (until the 1960's). On a number of occasions the absence of permanent water along the Strzelecki Track trapped cattle herds in the area. Such instances caused substantial degradation. The various ecological impacts of grazing in environments typical of the area are discussed in SA Department for Environment, Heritage and Aboriginal Affairs (1998a) and SA Department of Lands (1986). Grazed places associated with the Cooper system are included in the identified area where evidence suggests grazing to be relatively extensive and low impact, and where the areas concerned are relatively inaccessible.

The area is also located in a region where, since the 1950's there has been substantial interest in gas and oil exploration and production. The largest and most prolific hydrocarbon province on onshore Australia underlies the area.

Innamincka RR for example, is estimated to cover approximately 27% of the known Cooper Basin gas reserves within SA. Prior to 1989, 288 wells drilled within the RR (54 exploratory wells, 34 appraisal wells and 37 development wells). Strzelecki/Cooper does not contain any appraisal wells or development wells, although several exploratory wells are included. The identified area also includes a number of otherwise remote places where there has been extensive seismic exploration with little evidence of long-term biophysical impact. The environmental effects and rehabilitation impacts associated with seismic exploration activities is discussed in detail by Fatchen and Woodburn (1997) and Fatchen and Woodburn (1998).

Landscape elements associated with the Cooper system, in particular the Coongie Lakes, are a focus of recreation and tourism interest. Studies in the trends in patterns of use in areas within the Innamincka RR indicate generally increasing

visitor numbers that fluctuate with seasonal conditions. In 1986 the number of visitors to the Innamincka township was estimated at approx. 15,000. In 1987 the number of visitors was estimated at approx. 25,000 (SA Department for Environment, Heritage and Aboriginal Affairs 1998a). The near doubling of visitor interest during that short period has been attributed to media coverage relating to ecological research in the area, however levels of visitor use continue to grow. (SA Department for Environment, Heritage and Aboriginal Affairs 1998a). The most common locations for camping lie outside the identified area, but camping at Coogie Lakes is popular (estimated at about 12% of visitors in the Innamincka RR using campsites) (SA Department for Environment, Heritage and Aboriginal Affairs 1998a). Before 1989 recreational activity in the area (including shooting, fishing and camping) was largely unregulated. Since that time visitors have required a Desert Pass or camping permit. Low line fencing on major access routes and well defined windrows have reduced the amount of track proliferation. Low line fencing has been established at Coongie Lakes. Toilets have also been established at Coongie (excluded from identified area).

The range of land use pressures on the Coongie System has meant the development of a fairly complex management regime for the Innamincka RR. Conservation objectives are addressed primarily through the *National Parks and Wildlife Act 1972*, with management plans prepared pursuant to the Act approved in 1993 (SA Department for Environment and Land Management 1993). Also relevant is *Aboriginal Heritage Act 1988* and the *Heritage Act 1993*. The management of petroleum activity is primarily managed through the *Petroleum Act 1940*, the *Cooper Basin (Ratification Act) 1975*, the *National Parks and Wildlife Act 1972* and an Agreement between the Petroleum Exploration License Holders (Delhi Petroleum and Santos) and the Government established under the *National Parks and Wildlife Act*. Pastoral land use is constrained by lease issued under the *National Parks and Wildlife Act* (with the Innamincka Pastoral Co.)

The 1988 Agreement between the Petroleum Exploration Licence holders and the Government recognised the Coongie lakes Control Zone as an area of particular environmental significance within the RR, and an agreed methodology was established for exploration and extraction activities (see also Santos Ltd. 1996).

Agreements have also been reached with the Innamincka Pastoral Co, regarding nature conservation and cattle management in key areas of the Innamincka RR. For example,

Coongie paddock had not been stocked for appropriately seven years during the 1980s due to the BTEC campaign. The paddock was re-stocked in the early 1990s and de-stocked in 1994. Restocking occurred again in the period up to 1997. But in 1994 an agreement was established to fence and exclude stock from several lakes, wetland and associated land types at Coongie, amounting to 32,000ha (including the identified area). The fenced area comprises the geographic centre of the Coongie Lakes Control Zone and the Coongie Wetland of International Importance (Ramsar). The area includes Coongie Lake, Lakes Marroocoolcannie and Marroocutchanie, Nawnewauroatawanie Lagoon and parts of Lake Apachirie. This conservation enclosure has been classified as Special Interest Area under the Innamincka Plan of Management.

Other management issues concerning wilderness quality in the area include feral animals. Rabbits, feral pigs, feral horses and donkeys have been significant pests in the area. The impact of rabbits has historically been particularly substantial in dunefield environments and environments associated with the Cooper floodplain. It is widely accepted that rabbits contributed significantly to total grazing pressure in region over the last century. At present rabbit numbers are generally low due to RCD outbreaks in 1995. Significant rabbit populations are surviving in areas adjacent to permanent fresh water in the Coongie delta area and have recolonised dunes in the area (SA Department for Environment, Heritage and Aboriginal Affairs 1998a)

Upstream water extraction and landuse presents a potential threat to nature conservation values in the Cooper system. There has been particular concern regarding the Qld Govt. Draft Cooper Creek Water Management Plan which involves a strategy for water allocation for Cooper Creek catchment in response to a proposal for water extraction for cotton growing in Currareva near Windorah in south-west Qld. (Qld. Department of Natural Resources 1998).

## **Strzelecki (North-east and South-east)**

The Strzelecki Desert contains a number of identified areas. These two areas, in the eastern part of the desert are separated by the Merty Merty-Cameron Corner road. Strzelecki South-east consists of two major landscape types; the salina of Lake Callabonna, and the adjoining Strzelecki Desert dunefield complex (described by Wasson 1986). This area is partly reserved, and partly under pastoral occupation. Reserved areas are included in the Strzelecki RR (1,165,350ha, established 1991) and Lake Callabonna Fossil Reserve. The

area under pastoralism is included in Quinyambie, Linton and Bollards Lagoon pastoral leases. The smaller Strzelecki North-east is solely dunefield and is almost entirely located within the Bollards Lagoon and Merty Merty pastoral leases. Minor areas are included within the Strzelecki RR.

As for Frome, there is little readily available information concerning the history and management of the area. Both historical and current use and interests in these areas can be considered in terms of pastoralism, petroleum exploration and nature conservation.

All areas under pastoral tenure are subject to grazing cattle, however the availability of permanent water effectively restricts stock distributions. A significant part of Strzelecki South-east appears to be subject to grazing on a sustained basis, especially along the southern boundary (which is adjacent to Tilcha Creek) and in the east where there are a series of permanent/semi-permanent artificial water points. The presence of yards and tanks in a central parts of the dunefield suggests there may be some sustained grazing there. Similarly the configuration of permanent or semi-permanent water points in Strzelecki North-east shows that there may be sustained grazing within this area, in this case mainly along the northern boundary. Both areas are included within the Marree Soil Conservation Board District, and grazing is subject to review and assessment of the Pastoral Management Branch (DEHAA)

Both areas are also under petroleum exploration license, by relatively little exploration has been included within either.

In the far north-west of Strzelecki South-east a series of seismic explorations were conducted between 1970 and 1990, but there is evidently little interest in the area at present. Similarly, in Strzelecki North-east there was limited seismic exploration between 1970-1990. However, immediately to the north of the identified area, there has been recent and intensive exploration. A number of gas wells have also been established.

At present there is little recreational/tourist interest in either area, although both are accessible via public access routes at certain points. RR designation (which applies to part of the Strzelecki South-east) provides mechanisms for managing visitor use of these areas if required. Lake Callabonna (within a Fossil Reserve) is of conservation significance because of the presence of fossils and also mound springs. Management plans have not been developed for either reserve. Dune-field areas have historically suffered from damage by rabbits, but RCD appears to be controlling this threat at present.

## Stuart Range South

Stuart Range South is dominated by breakaway and tableland landscapes associated with the southern part of the Stuart Range and plains and tablelands extending to the south-west. The majority of the area is situated on pastoral lease; the southern part within the Balta Balta and Millers Creek pastoral leases (sheep), and the northern part of the Anna Creek property (cattle). The majority of the area also lies within the Woomera Prohibited Area, an area within which public access without permit is prohibited. A minor part of the identified area is also included within the Coober Pedy Precious Stones Field and not grazed by stock.

The area is bordered in the west by the Stuart Highway and opal mining and exploration activity on the Stuart Range adjacent to the highway, and further south by station track and fence infrastructure, the Stuart Range itself and permanent water points. Further west, the boundary is defined watercourses with the Margaret River (Wantamarran and North Creeks), station access tracks, water points and related pastoral infrastructure. In the north-west the boundary is defined by the Dog Fence and also the Coober Pedy-William Creek road.

The northern part of the area is within the Marla-Oodnadatta Soil Conservation District, while the southern part is within the Kingoonya Soil Conservation District. Pastoral management on the lease areas is monitored by the Pastoral Management Branch (DEHAA), with the involvement of the relevant District Soil Conservation Boards. Rangeland evaluation and monitoring, including a watered area analysis, has been completed by the Pastoral Management Branch for the Kingoonya Soil Conservation District. This has assisted in the evaluation of the area. Indications are that much of the southern part of the area (Balta Balta and Millers Creek) is not grazed on a regular basis. Pastoral Management Branch Assessments of key parts of these areas leases attest to the 'pristine' nature of unwatered areas. Sustained grazing occurs in several isolated places where there is permanent water, also in areas adjacent to the identified boundary.

On Anna Creek (the Marla-Oodnadatta Soil Conservation District) the distribution of grazed areas is less clear because of the lack of up-to-date information on pastoral infrastructure, but because key northern water points are all excluded, sustained grazing is likely only in areas adjacent to boundaries.

There is at present little recreational interest in the area. Public



access in the Woomera Prohibited Areas is prohibited without permit. Camping is not permitted. There is also little mineral or petroleum interest at present beyond areas in the Coober Pedy Precious Stones Field.

## Toondina

Toondina comprises a part of the tableland/gilgai landscape complex that characterises much of the Stony Plains region in SA (also Oodnadatta). The area is under pastoral tenure; Allendale, Arckaringa, Nilpinna and Mount Barry leases (Marla-Oodnadatta Soil Conservation District). The area is bordered in the west by the Coober Pedy-Oodnadatta road and in the north by the Neales River. The eastern boundary is formed by the Oodnadatta Track, and the southern boundary by Coober Pedy-Oodnadatta road and Arckaringa Creek.

Many of the comments made regarding pastoral activity within Oodnadatta also apply to Toondina. Pastoral infrastructure (station tracks and fencing) within the area is sparsely distributed, but the area contains several permanent and semi-permanent watering points (both artificial and streamline waterholes) which support sustained grazing. The Pastoral Management Branch (DEHAA) suggests that the measurable biophysical impact of stock in stony plains/gilgae complex are limited to 2/3 km from these waters. The area with greatest proximity to water is adjacent to the southern boundary

Toondina includes areas which are evidently prospective for oil and gas. This is apparent by arrays of seismic clearance lines (approx. 1970 to 1990) and several exploration drill holes. The state of rehabilitation of seismic arrays is not fully known, although old lines were clearly visible from the air during field inspections. There is presently little recreational interest in the area, although there is public access to the margins of the area from the Coober Pedy-Oodnadatta road and the Oodnadatta Track.

## Torrens

Lake Torrens, which is included within the 570,000 ha Lake Torrens NP make up the majority of this area. Also included are substantial areas adjoining the lake on the Witchelina, Mulgaria, Andamooka, Bosworth, South Gap, Pernatty Yadlamulka, Lake Torrens, Beltana, Nilpena, and Wintabatinyana pastoral leases. These adjacent lands are included where the distribution of permanent water points and other pastoral infrastructure suggests that there has been little or no sustained domestic grazing. The major landscape types typical of Torrens include the salina of Lake Torrens,

dunefield, and stony tableland.

Apart from the lake itself, the influences and impacts of pastoralism are the primary controls over wilderness quality in this area. In this regard, a watered areas analysis completed by the Pastoral Management Branch (DEHAA), which takes into account both the foraging limits of stock (sheep), watering points, and paddock fence lines, is a key factor in determining the limits of wilderness on the western side of Lake Torrens. This analysis resulted in the inclusion of several places where there is no evidence of a history of sustained grazing, including a substantial area of dunefield adjacent the northern end of the lake, and several areas of stony tablelands (a large part of Andamooka Island and a section of the Andamooka Ranges). On the eastern side of Lake Torrens boundary of the identified area is defined by a 5km setback that extends

## Wahgunyah

Wahgunyah lies between the coast (between the Head of the Bight and Cape Adieu) and the Eyre Highway. It is located partly within the Yalata Aboriginal land and partly within Wahgunyah CR (38,280ha, established in 1993). The northern boundary is defined by track access and water points (relics of early pastoralism) south of the Highway and further to the east, by the Highway itself. In the west the area is bounded by mobile dunefields at the Head of the Bight. The Southern Ocean is the southern boundary (notwithstanding marine wilderness possibilities). The eastern boundary is less clear-cut. It is defined by a combination of fence lines and tracks associated with earlier pastoral occupation. The status of adjacent lands to the east is unclear as several parcels under annual or miscellaneous lease have recently been acquired for conservation purposes (not yet in reserve). Other freehold lands are protected under Heritage Agreement. Places where there is more widespread evidence of pastoral activity are excluded from the area.

Wahgunyah includes a number of relics of past pastoral use (water points and fences). It is also traversed by a number of 4WD tracks which link these features and provide beach access to local fishers. The beach is a highly regarded location for fishing and access tracks through the identified area regularly used for the purpose. Beach access and recreational fishing is probably the main management issue of the area under CR. A range of aboriginal land management issues relate to that part of Wahgunyah which is aboriginal land. The CR is currently under two native title claims.

<sup>1</sup> Note the Wahgunyah CR (now the Wahguyah CP) is outside the study area of Measures for Improving Wilderness Protection in South Australia's Arid Lands



*Simpson Desert, South Australia*

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# Appendix 2

## Climate change priority actions

### **From Implications of climate change for Australia's National Reserve System, Dunlop, M., & Brown, P.R.**

1. Understand how biodiversity will respond to climate change and the implications for conservation. To effectively address climate change, the management, policy, research and general communities need a good and broad understanding of the possible changes to species and ecosystems, and the implications of those changes for conservation and the National Reserve System (NRS). One immediate implication is the need to revise the core objective of conservation to accommodate changes in biodiversity - "manage the change to minimise the loss". Implementation of this objective will require community debate (to inform trade-offs) and better information about change. Coordinated observation and formal monitoring programs can identify what types of change are actually occurring; further research (including improved methods) is needed for assessing likely future changes on a bioregional basis. Key uncertainties include the importance of changes in the distributions and abundances, interactions between species, changes in ecosystem processes, the dynamics of changes, changing threats (especially new species, altered fire regimes, land use change and altered hydrology) and the role of habitat and landscape diversity in mediating changes.
2. Protect more habitat and more diverse habitat. Protecting habitat is probably the best way to conserve species under climate change. While the species and ecosystems in any one area will change over time, the greater the total area of habitat available, and the more diverse the habitat, the greater the number of ecosystems and species will be able to survive. The bioregional framework used in the NRS is therefore very well suited for building a robust reserve system, and it will be much more effective under climate change than systems that mainly target endangered species and communities. However, at present the effectiveness of the NRS is limited as habitat in many regions is very poorly represented. Further habitat protection through the NRS and other conservation programs is a priority in these regions and in regions that are identified as likely to experience the most significant ecological changes. Protection of additional habitat may also be required for some species that are particularly vulnerable.
3. Manage habitat to reduce threats. Management of protected areas and other areas of native habitat will be required to reduce the impact of known and anticipated threats to biodiversity. In addition, active management will be required in some situations to facilitate natural adaptation processes, and in other situations to maintain habitat that is suitable for species that have been identified as particularly vulnerable to climate changes. Policies and guidelines about managing protected areas may need to be revised to accommodate changing conservation objectives under climate change.
4. Manage landscape-scale issues. Many important ecological processes occur at scales larger than that of individual of individual protected areas. Additional protection may be warranted for areas that act as fire or climate refuges for species within a broader region. Connectivity of habitat at various scales can be important for facilitating the movement of different species, which may increase their viability and ability to respond to climate variability and change. Connectivity may also facilitate the spread of fire and movement of species that might have negative impacts on other species; hence it may be beneficial to protect isolated as well as well-connected habitat areas, and to assess the risks and benefits before increasing the connectivity of habitat. Some threats, including new species, land use change and altered landscape hydrology, may be best addressed at broad-scales via the coordinated efforts of a variety of conservation programs

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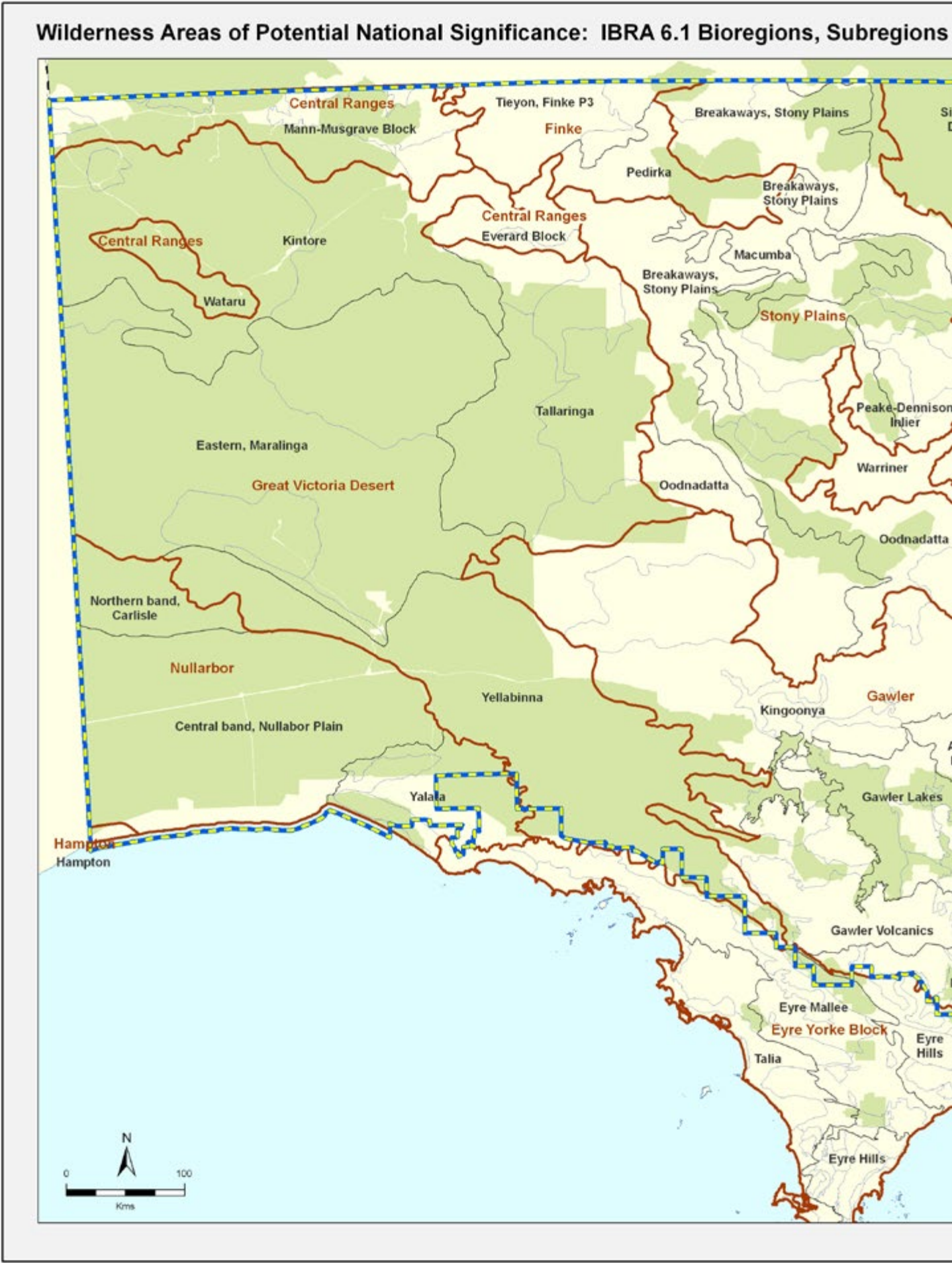
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*Lake Gairdner, South Australia*

## Appendix 3 maps





## MAP 1 Bioregions



### Legend

- Wilderness Areas of Potential National Significance
- Arid Lands of South Australia
- IBRA 6.1 Bioregions
- IBRA 6.1 Subregions
- IBRA 6.1 Environmental Associations
- Murray River
- State Borders



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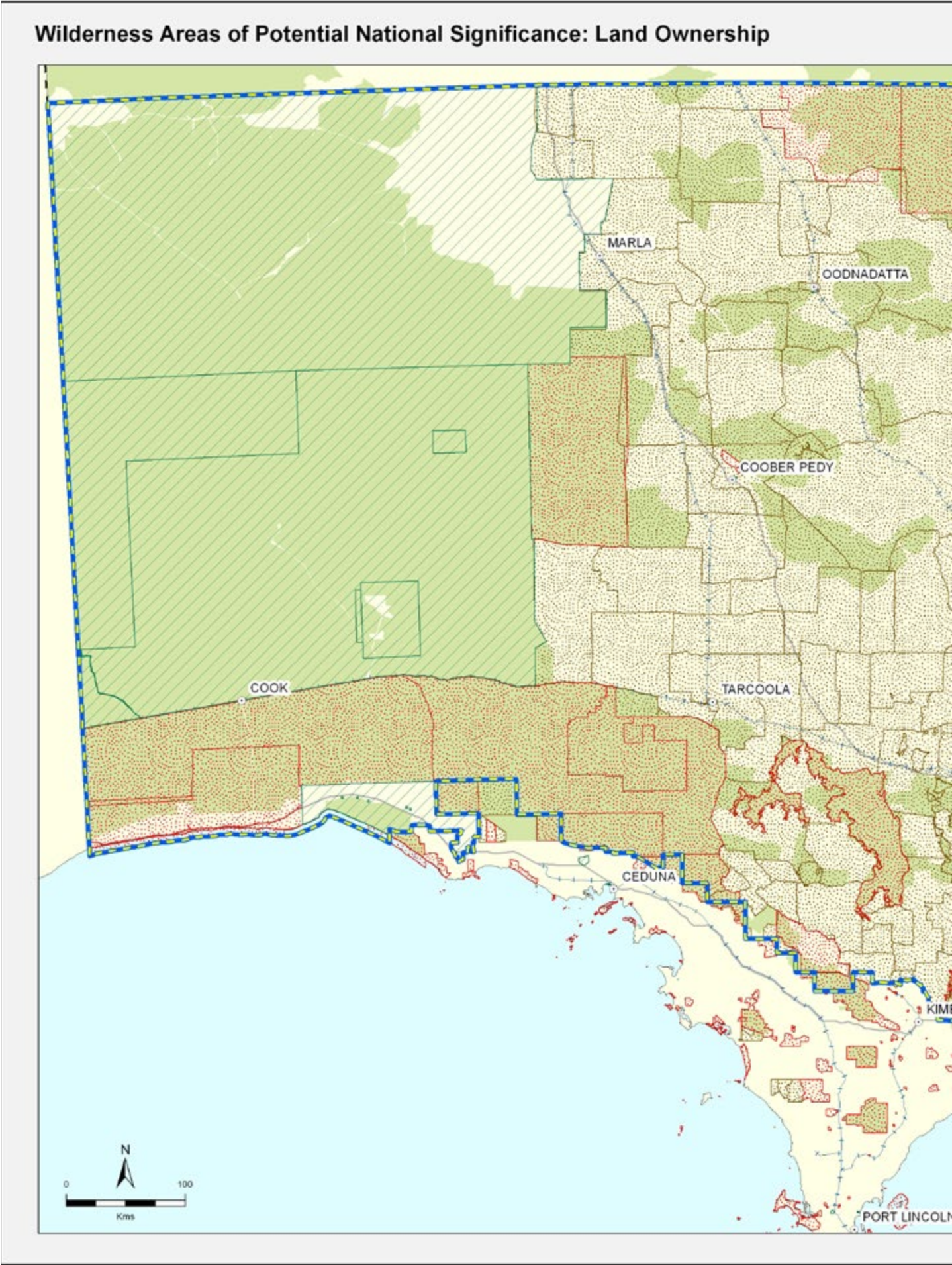
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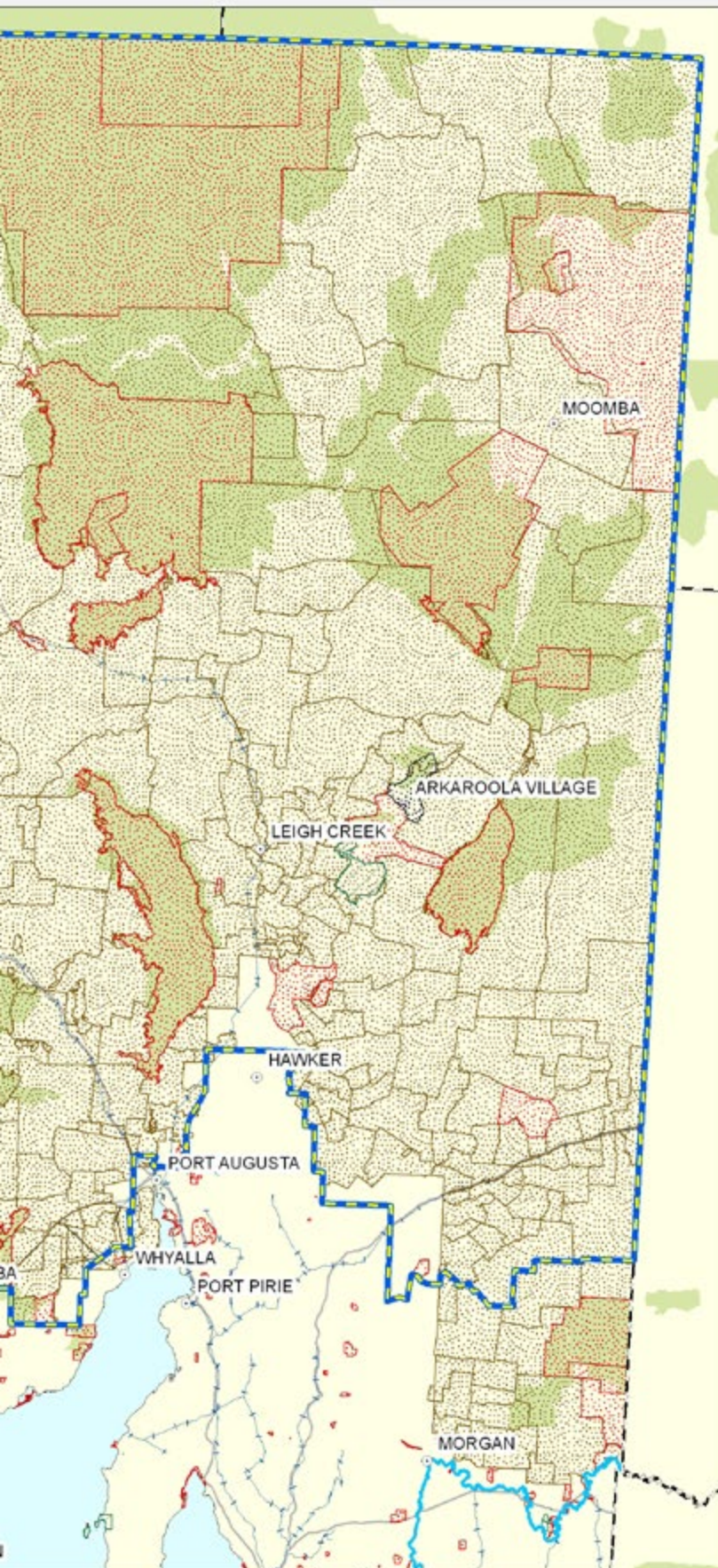
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## MAP 2 Land Ownership



### Legend

- Wilderness Areas of Potential National Significance
- Aboriginal Lands
- State Government Lands
  - Reserves
  - Pastoral Lease
  - Arkaroola Protection Area
- State Border
- Murray River
- Railway
- Townships



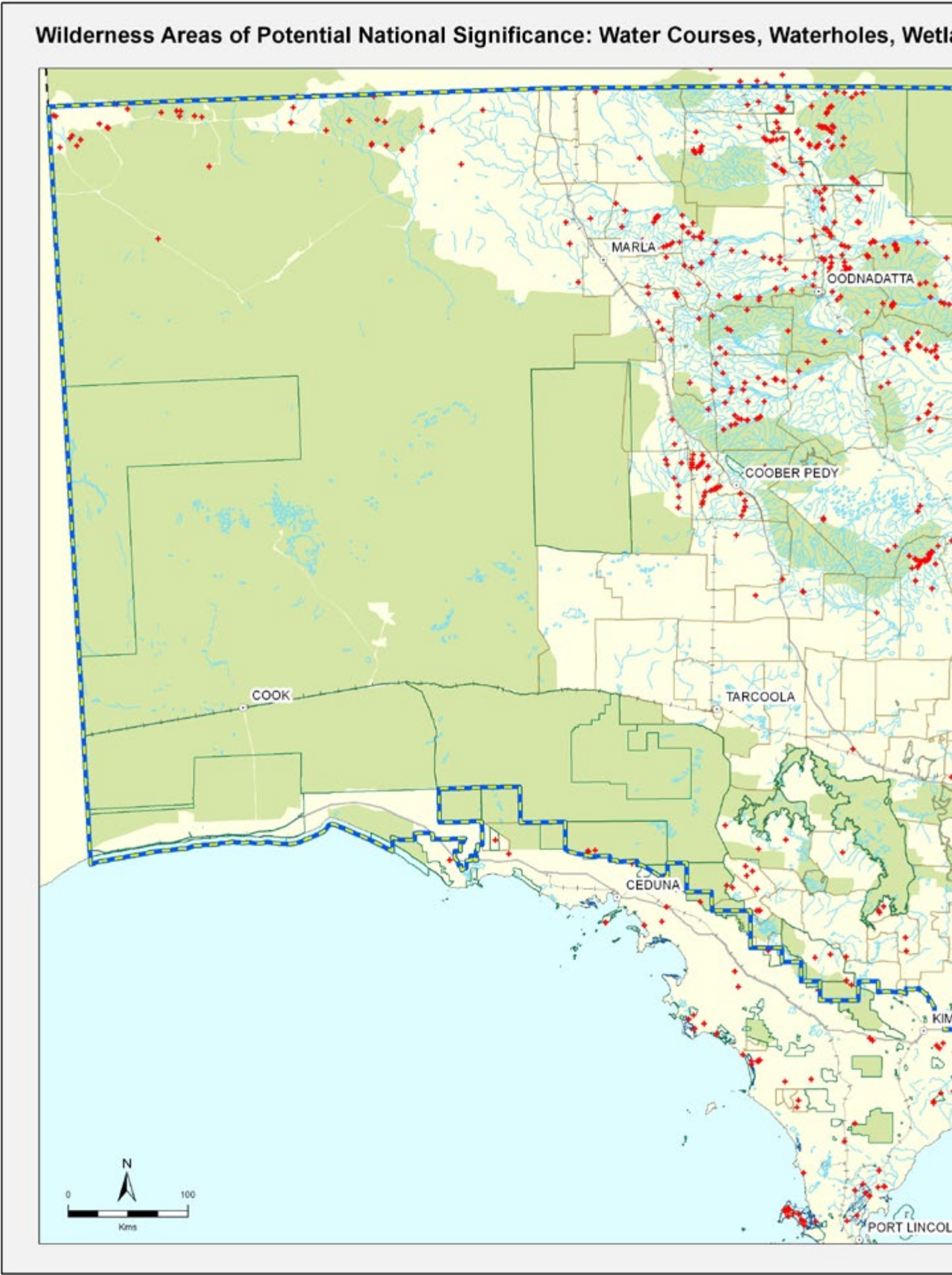
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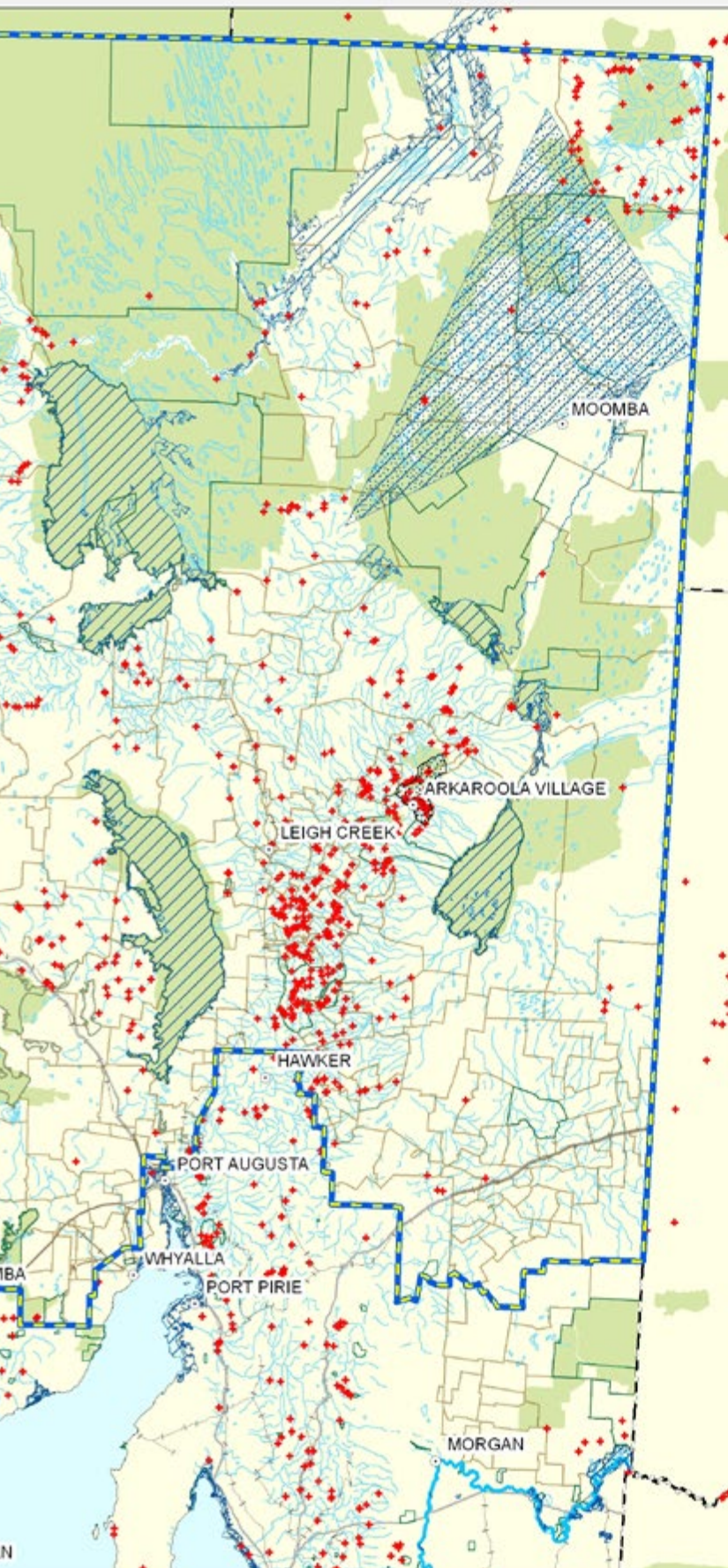
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## MAP 3 Water Courses and Wetlands



### Legend

- Wilderness Areas of Potential National Significance
- Arid Lands of South Australia
- Government Reserves
- Pastoral Lease
- Wetlands of National Importance
- Ramsar Areas
- Arkaroola Protection Area
- + Natural Water Points
- State Border
- Murray River
- Major Water Courses
- +— Railway
- Townships



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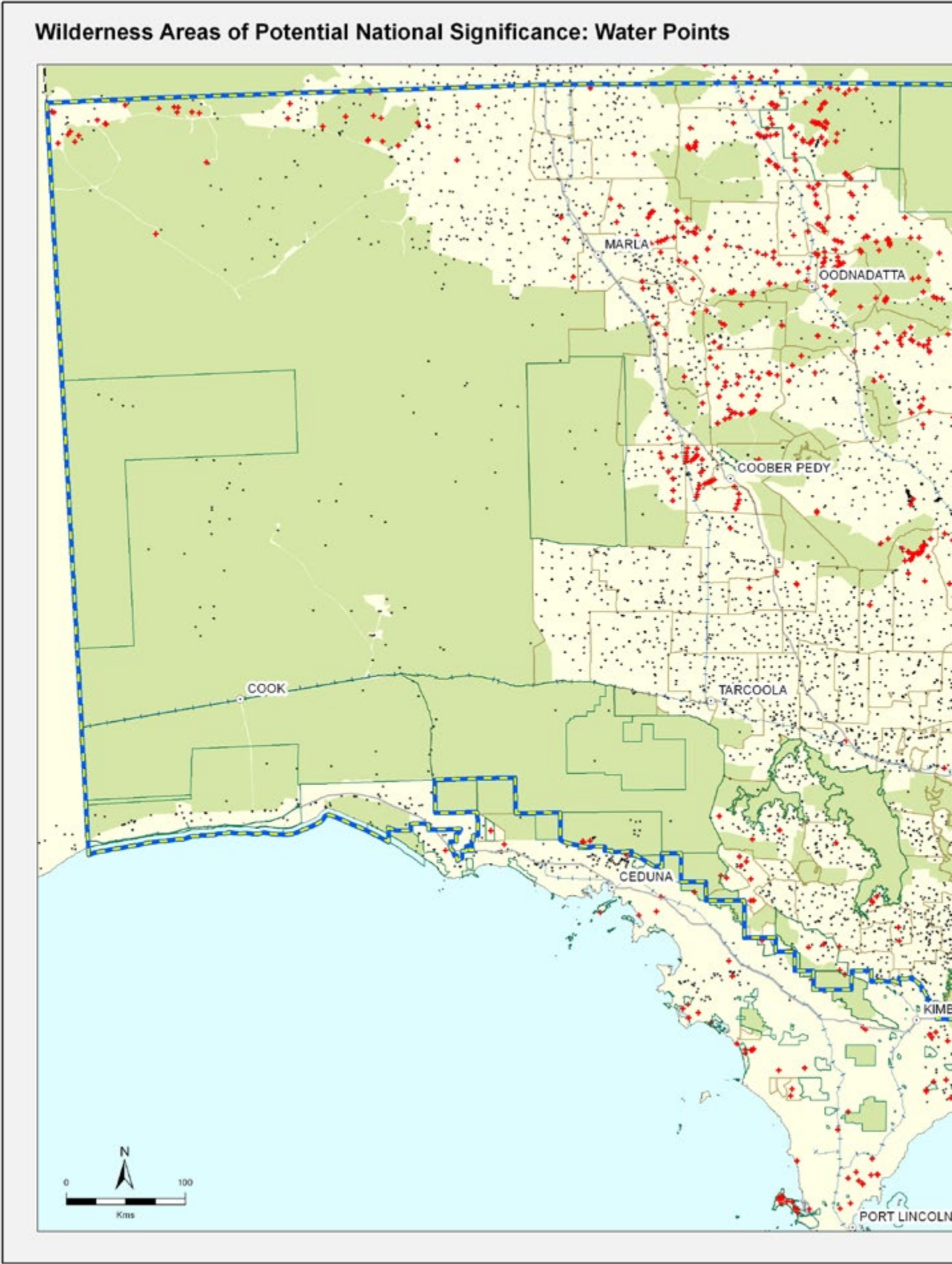
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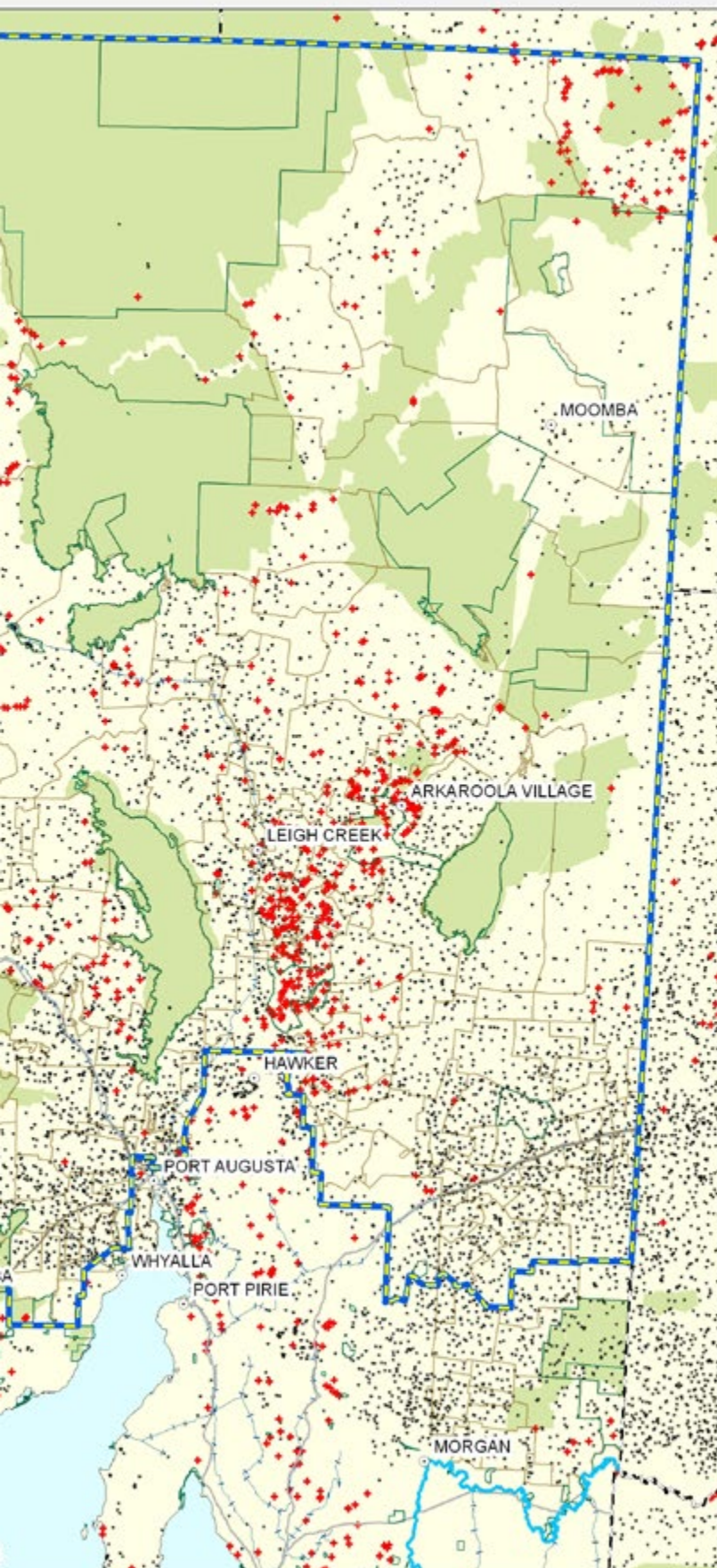




## MAP 4 Water Points

### Legend

-  Wilderness Areas of Potential National Significance
-  Government Reserves
-  Pastoral Lease
-  Arid Lands of South Australia
-  Natural Water Points
-  Bores and Wells
-  State Border
-  Murray River
-  Railway



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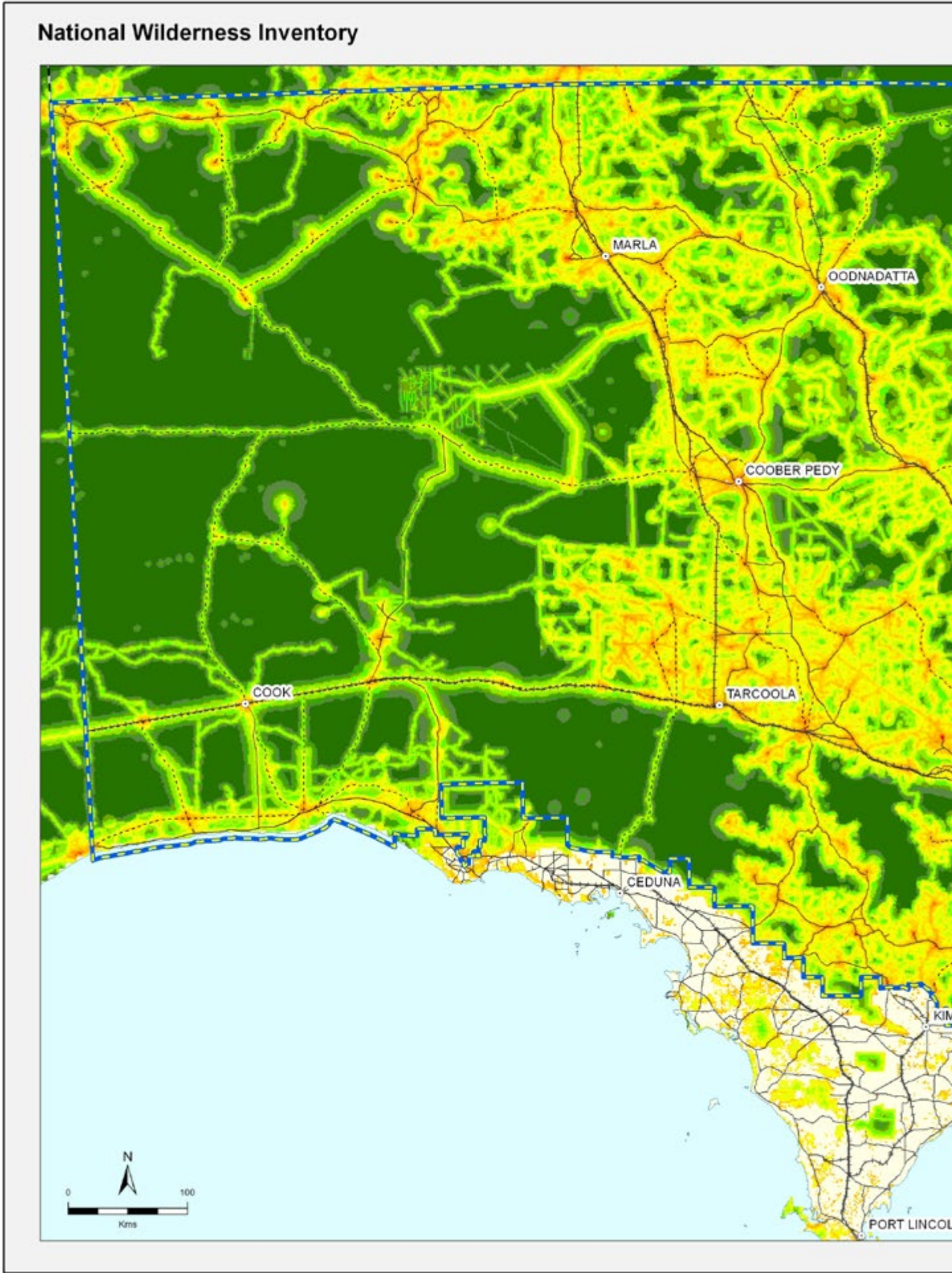
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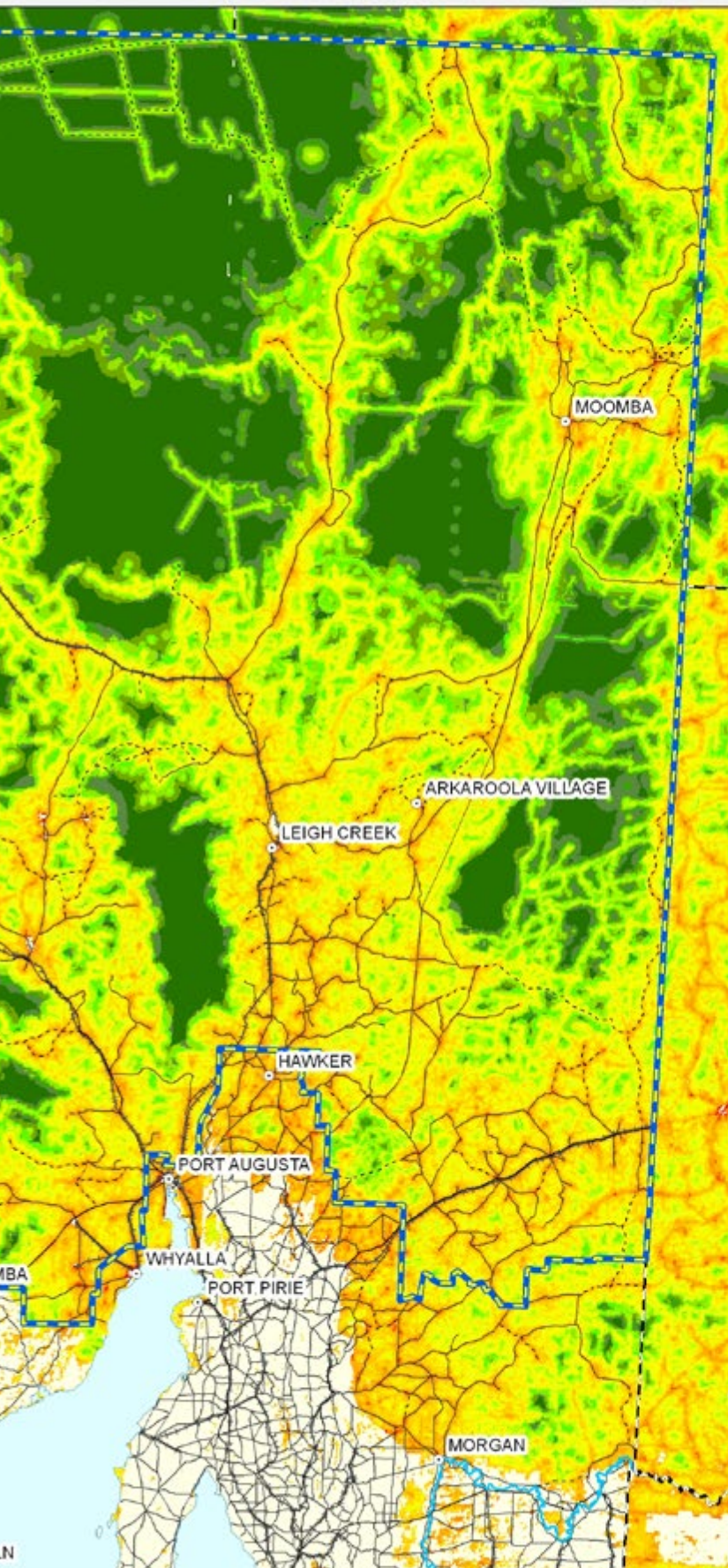
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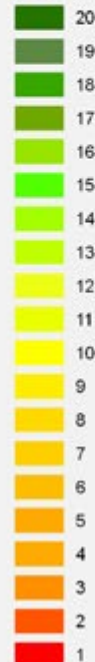
# MAP 5 National Wilderness Inventory



## Legend

### National Wilderness Inventory

Rating: 20 high quality, 1 low quality



Arid Lands of South Australia

State Borders

Murray River

Railways

Townships

### Roads

Major Road

Minor Road

Track



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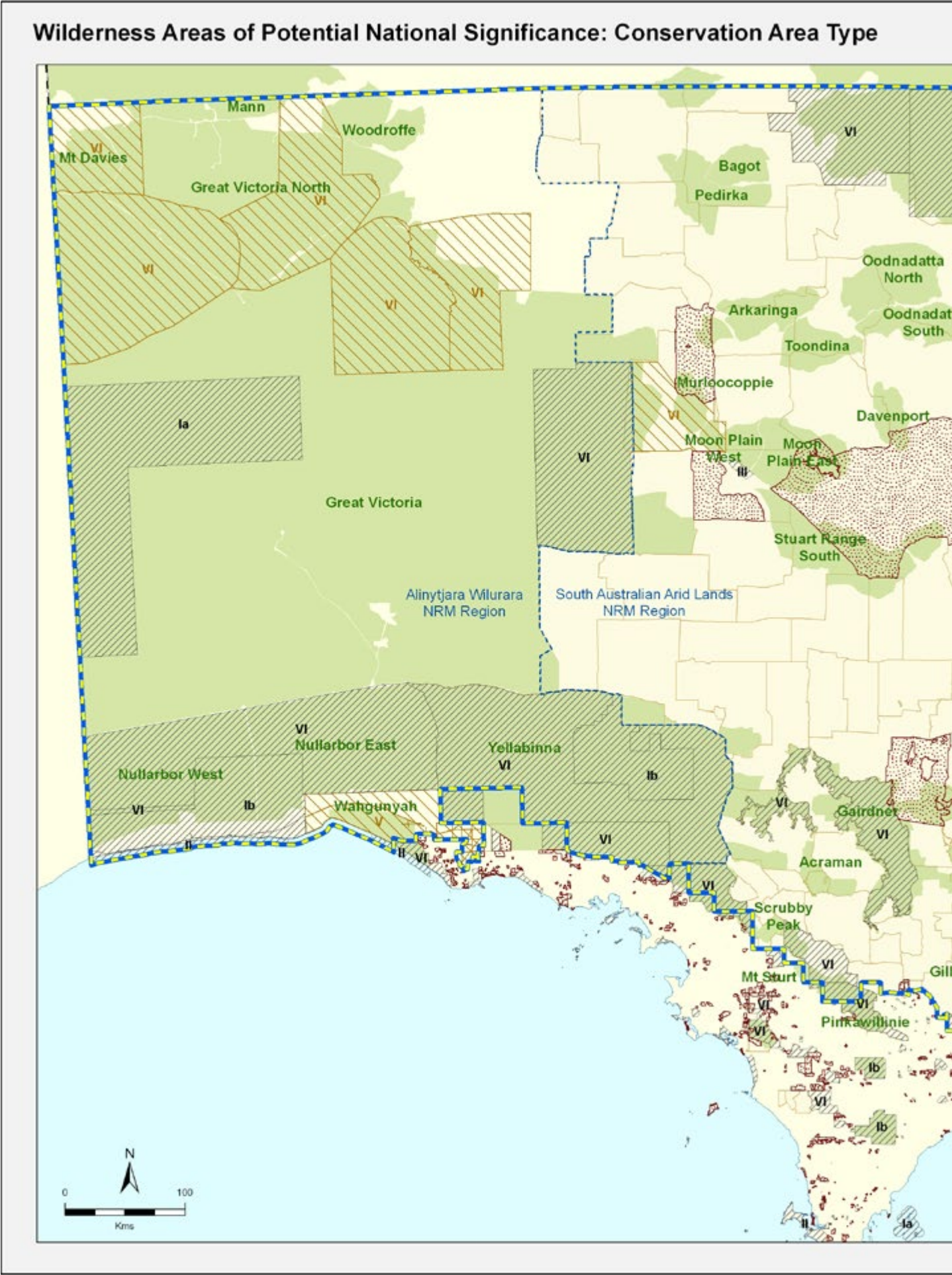
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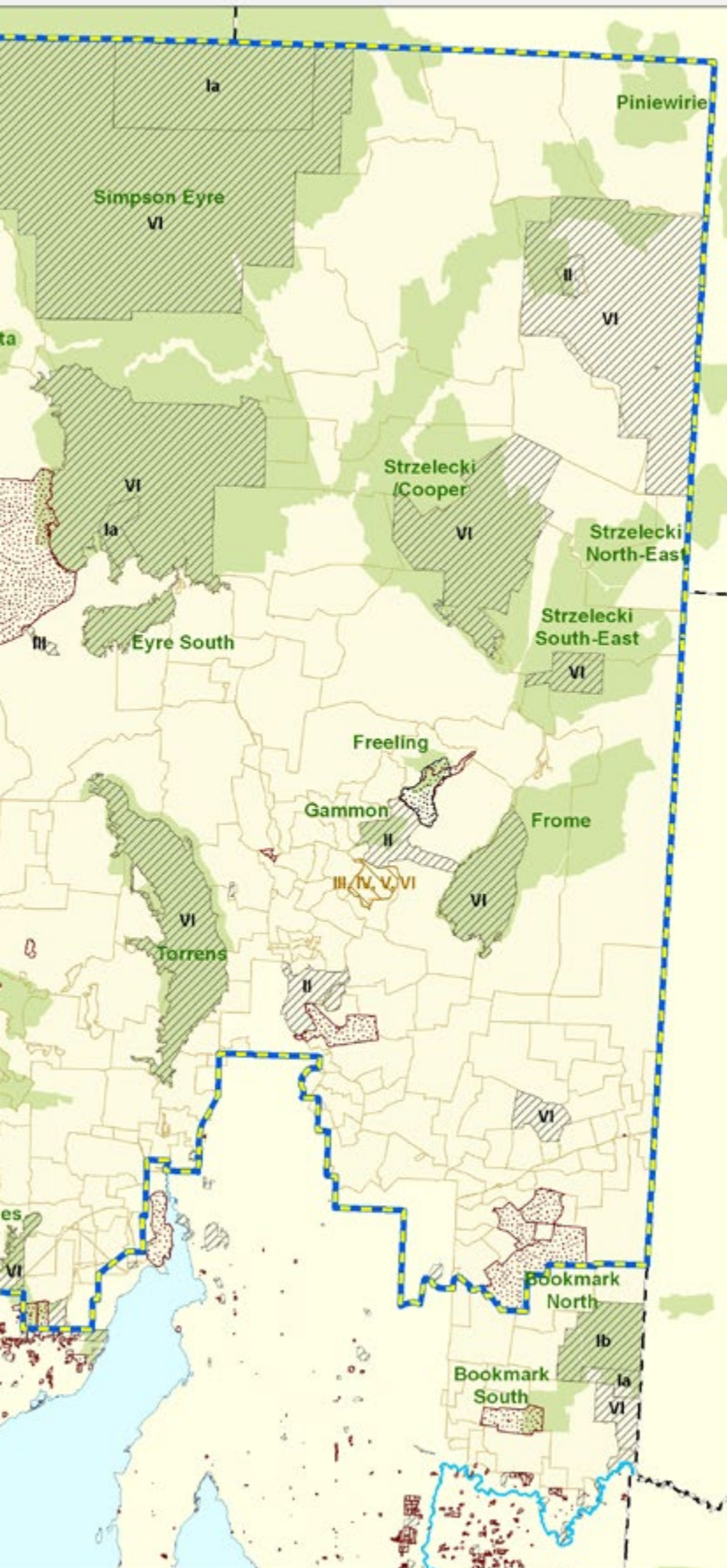






# MAP 6

## Conservation Area Type



### Legend

- Wilderness Areas of Potential National Significance
- Names of Wilderness Areas
- Arid Lands of South Australia
- Pastoral Leases
- AW and SAAL NRM dividing boundary
- State Border
- Murray River

### Reserve Types

- Government Protected Areas
- Arkaroola Protection Area
- Non-Government Conservation Areas
- Indigenous Protected Areas

### IUCN Protected Areas Categories

- Category Ia - Strict nature reserve**
- Category Ib - Wilderness area**
- Category II - National Park**
- Category III - Natural monument or feature**
- Category IV - Habitat/species management area**
- Category V - Protected landscape**
- Category VI - Protected areas with sustainable use of natural resources**

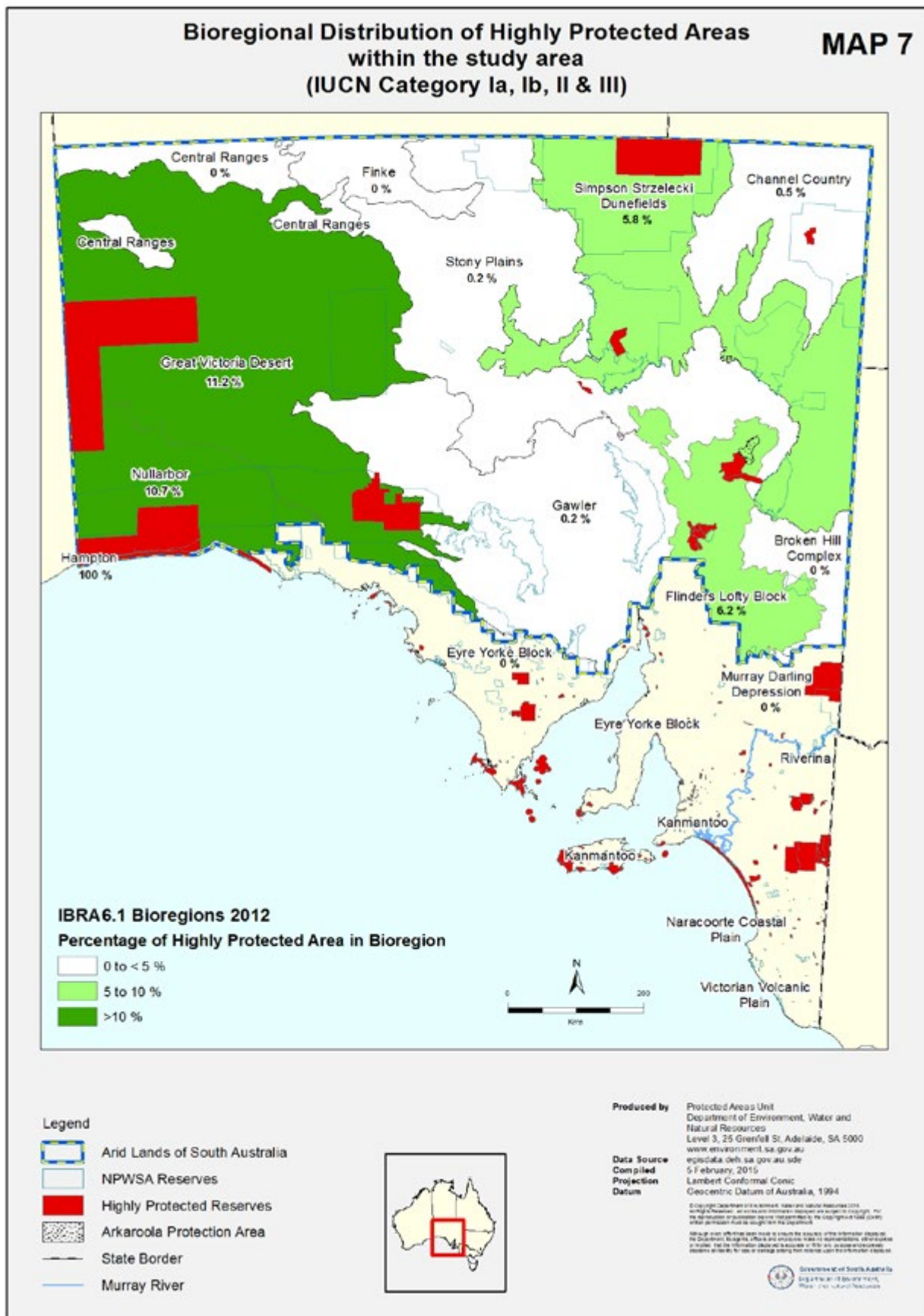


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[egisdata.deh.sa.gov.au/sde](http://egisdata.deh.sa.gov.au/sde)

**Data Source** 31 July 2013  
**Compiled** Lambert Conformal Conic  
**Projection** Geocentric Datum of Australia, 1994  
**Datum**

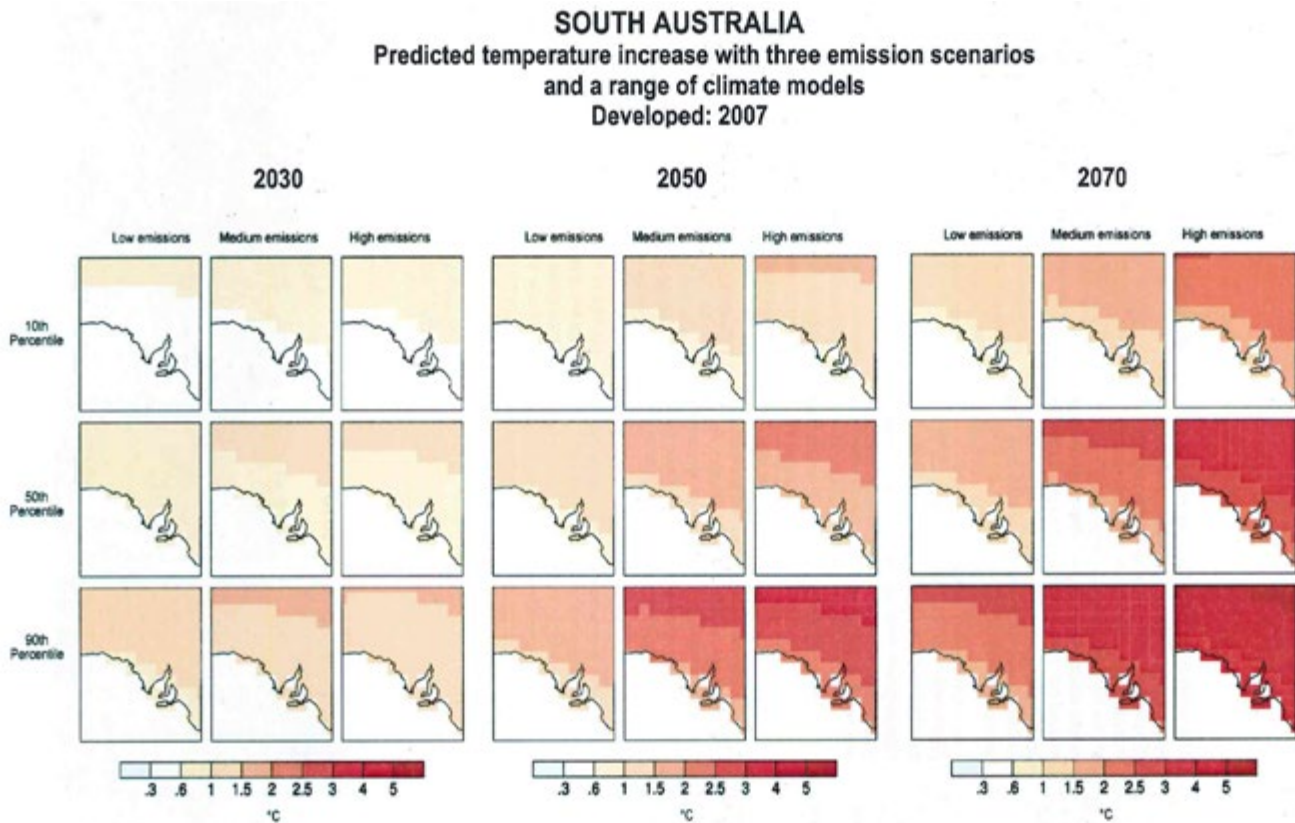
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Map 7 Bioregional Distribution of Highly Protected Areas (IUCN Category Ia, Ib, II and III)





Map 8 Predicted Temperature Increase for South Australia, 2030, 2050 and 2070.



Projections are given relative to the period 1980-1999 (referred to as the 1990 baseline for convenience). The projections give an estimate of the average climate around 2030, 2050 and 2070, taking into account consistency among climate models. Individual years will show variation from this average. The 50th percentile (the mid-point of the spread of model results) provides a best estimate result. The 10th and 90th percentiles (lowest 10% and highest 10% of the spread of model results) provide a range of uncertainty. Emissions scenarios are from the IPCC Special Report on Emission Scenarios. Low emissions is the B1 scenario, medium is A1B and high is A1FI.

<http://climatechangeinaustralia.com.au/satemp5.php>

### For further information please contact

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