LAND RESOURCES OF
The Garden Station

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ACKNOWLEDGEMENTS

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SUMMARY

This report documents the land resources of The Garden Station, occupying an area of 2134km$^2$, approximately 117km north east of Alice Springs. Thirty six land units have been identified and mapped on the station for the purpose of assisting with land management decision making on the property. Each land unit is provided with a detailed description in terms of its landform, soils and vegetation characteristics and includes the pastoral land management implications of these attributes.

The station boasts prime fattening and breeding country consisting of extensive open grassed plains, large ephemeral watercourses and tributaries, foothills, shallow drainage floors and rugged mountain ranges of no pastoral value which are used as natural barriers to stock.

The potential for soil erosion on the property is high with most of the low lying land units susceptible to erosion. Therefore inappropriate siting and construction of graded vehicle tracks, fencelines and reduced vegetation cover from grazing will increase the likelihood of major erosion problems.
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SECTION ONE: INTRODUCTION

A. BACKGROUND TO THIS SURVEY AND HISTORICAL INFORMATION

A detailed knowledge of the different types of country on a station and their reaction to grazing is an essential precursor to good land husbandry, grazing management and property development. Most pastoralists gain a comprehensive first-hand appreciation of the land attributes of their station through living and working in that particular environment, observing the way in which stock use pastures and the response of the country to season.

A land resource inventory can compliment this local knowledge by formally documenting the types of country on the station, accurately mapping their distribution, and indicating the potential productivity and land management hazards associated with each. As such it provides a tangible basis for making property management and development decisions. Besides the station manager, land resource information is especially valuable to Government advisors in the fields of soil conservation, pasture management and livestock husbandry as well as land administrators.

This land resource survey documents the pastorally different land types of The Garden Station, located 117km north east of Alice Springs and occupying an area of 2134km$^2$. The survey was requested by Mr Jamie Turner, the then lessee of the station. To meet his requirements the station was mapped into land units with pastorally different attributes (soil and vegetation type, grazing characteristics, stocking capacity and erosion hazard) at a scale of 1:100,000. This report provides a detailed description of each land unit and its pastoral management features, as well as information on the physical environment.

HISTORICAL INFORMATION

Originally the Turner family came to the Alice Springs District looking for gold at Arltunga in the early 1900's. However, the Turners turned their hand to market gardening and established a garden at the site of the present homestead which supplied produce to the miners.

In 1921 a pastoral lease was granted to James Turner encompassing the market garden and surrounding area to become The Garden Station. The Turner family held the lease until 1996 when the Hayes family who have other pastoral interests in the Centre acquired The Garden.

B. PREVIOUS SURVEYS

Grant (1987) mapped 120km$^2$ of the Hale Plain on The Garden Station into 28 land units at a scale of 1:20,000. This was undertaken to provide detailed land resource data for a three year study carried out by the Northern Territory Conservation Commission on the behaviour of feral horses and their interaction with cattle.

The Garden Station has been previously mapped into seven land systems at a scale of 1:1,000,000 by Perry et al. (1962). These authors identified the following seven land systems on the station.
**Allua Land System** - Ridges and foothills, relief up to 500ft; little soil; spinifex or sparse grass. Strike vales with alluvial plains; shallow stony soils and calcareous earths; gidgee and/or short grass.

**Ambalindum Land System** - Dissected terraces and plains with alluvial basins and sparse low trees, shrubs and Mitchell grass.

**Bond Springs Land System** - Rocky hills and ridges of gneiss and schist with narrow plains supporting sparse low trees and shrubs over grasses and forbs.

**Gillen Land System** - Quartzite and sandstone ridges with spinifex. Vales with alluvial plains and gravel terraces supporting shrubs and low trees, mulga, or witchetty bush over short grass.

**Harts Land System** - Rugged mountain ridges and rounded crests of gneiss and schist, granite domes and tors with foot slopes and drainage floors supporting sparse low trees and shrubs over grasses and forbs.

**Huckitta Land System** - Strike ridges of limestone, with foothills and valleys supporting sparse low trees and shrubs over grasses and forbs.

**Sonder Land System** - Steep quartzite cuestas and ridges with valleys and gorges supporting sparse low trees and shrubs over grasses and forbs.

The land system approach is based on the description of compound map units. Each land system may therefore include several unmapped pasture types with widely differing management characteristics and occurring in varying proportions. The variability within land systems therefore reduces the value of this type of mapping for planning property management. For instance, a particular land system may vary in the proportion of a highly productive pasture type from paddock to paddock. Importantly, land types with specific management requirements may be mapped with other pastures within the one land system.

In this survey, the mapping has been based on the identification of simple units, each of which defines areas of uniform pastoral characteristics within the resolution of the map scale. Consequently the land types within individual management areas (e.g. paddocks, bore areas) are specifically described on the map permitting better planning decisions at this level.
C. SURVEY METHODOLOGY

A land unit is an area of land which has relatively uniform landform, soil and vegetation characteristics. The Garden has been mapped into thirty six land units at a scale of 1:100,000 on the basis of the stereo-interpretation of aerial photographs and extensive ground survey.

The aerial photo coverage consisted of 1:50,000 scale colour contact prints, flown over the station in 1988. Tentative land unit boundaries were mapped on to the photographs prior to the conduct of a ground survey and suitable sites for field examination were identified according to this preliminary classification. Field survey consisted of vehicle traverses between recording sites, which were selected at an average intensity of approximately 1 site per 100 sq km. Access was good throughout the station as well maintained tracks and fencelines occur in most areas.

At each recording site landform, soil and vegetation characteristics were documented according to the criteria of McDonald et al. (1984) and representative areas photographed. Soil profiles were generally described using soil pits excavated by hand to a depth of up to 1m. Exposures in creek banks and gullies were used to describe soil profiles where suitable.
Seasonal conditions up to and including most of the survey period were drier than normal and lacked good summer and winter rains. Although, useful summer rain did fall towards the end of the survey. Therefore areas of the station were less vegetated than in average to good seasons but the ground layer vegetation was suitably represented to gain a thorough inventory of vegetation although some forbs may be missing.

Final amendments to land unit boundaries were made during a comprehensive re-examination of the aerial photography subsequent to the field survey. A base map was produced using global positioning system data and Auslig 1:100,000 digital contour and drainage information and checked against orthophoto maps. Land unit boundaries were then compiled onto the base map. The mapping was scanned and entered into the Departments ARC/INFO GIS system and site information is held on an INFO database.
<table>
<thead>
<tr>
<th>EON</th>
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<th>PERIOD</th>
<th>EPOCH</th>
<th>YEARS BEFORE PRESENT</th>
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<tr>
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<td>Devonian</td>
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<td>Protérozoic</td>
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</tr>
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SECTION TWO: GUIDE TO INTERPRETATION OF SURVEY INFORMATION

This report describes each land unit of The Garden Station in terms of its geology, landform, soils, vegetation and management requirements. The format of each description includes a general outline of the main landscape features, a summary of management issues and a representative photograph on the left-hand page. This level of detail will suit the needs of many report users. A more detailed description of geology, landform, soils and vegetation is provided on the right-hand page for users requiring a greater depth of technical information.

In this section technical aspects of the geology, landform, soils and vegetation descriptions are explained in order to assist non-expert users in interpreting the more detailed information provided.

A. GEOLOGY

The description of the geology of each land unit in this report is based on the interpretation of existing 1:250,000 scale or 1:100,000 scale mapping. This mapping is often generalized in areas lacking rock outcrop and the geology indicated in this report may be inferred from other evidence. A geological time scale is indicated in Table 1.

B. LANDFORMS

The landform classification adopted in this report is based on an interpretation of landform pattern together with a description of land surface attributes such as slope, relief and drainage pattern (see McDonald et al., 1990).

The landform pattern is largely inferred from the stereo-interpretation of aerial photographs and classifies terrain according to its overall morphology and processes of formation. The following landform patterns commonly comprise central Australian landscapes.

- **Hill** - terrain with high relief (90-300m) and gently inclined to precipitous slopes.
- **Low hill** - uplands with low relief (30-90m) and gentle to steep slopes.
- **Rise** - terrain with very low relief (9-30m) and gentle to steep slopes.
- **Plain** - level to undulating terrain with relief of less than 9m.
- **Pediment** - plains with low relief developed on bedrock.
- **Paleoplain** - plains formed over a very long period of geological time on highly weathered rocks.
- **Fan** - outwash areas, usually where a watercourse exits uplands, having gently inclined slopes away from distributary watercourses.
**Floodplain** - alluvial plains characterised by active deposition and erosion by overbank flow from creek or river channels.

**Drainage floor** - depressions carrying concentrated run-off flows, but lacking channel features.

**Floodout** - outwash areas at the terminal end of a stream channel where runoff and sediment accumulates.

**Swamp** - frequently inundated closed depressions that accumulate sediment and runoff flows.

**Sandplain** - level or gently undulating terrain with coarse textural surfaces modified by wind action.

**Dunefield** - terrain with low relief consisting of dunes and interdune flats formed by wind action.

**C. SOILS**

**I) SOIL CHARACTERISTICS**

Soils have certain physical and chemical properties which are governed by the type of parent material from which they formed, the landform on which they occur and the climatic environment under which they developed. In this report, soils are described in terms of texture, colour, reaction trend, the presence of calcium carbonate, structure, fabric, coarse fragments and strength. On the basis of these characteristics, they are classified into their Australian Great Soil Group (Stace *et al.*, 1968), Principle Profile Form (Northcote, 1979) and Australian Soil Classification (Isbell, 1993).

**Horizons**

Change that occurs with increasing depth down a soil profile is described in terms of horizons. A horizon is a soil layer or level parallel to the land surface that has characteristics differing from those above and below. The development of horizons results from biological and sediment transport processes near the soil surface and the movement of clays and soluble substances with moisture at depth. Horizons are mainly defined by soil texture, structure grade and colour.

Horizons are designated according to a long-established and widely used notation. A-horizons include the "topsoil" which may be sandier, less structured and darker in colour than the underlying B-horizon or "subsoil". A C-horizon of partly weathered rock may be present beneath the B-horizon. D-horizons consist of unidentified underlying material, while R-horizons include massive rock. Individual horizons are usually subdivided, the sub-horizons numbered in a consecutive sequence from top downward. Buried soils are identified by a horizon prefix.
**Texture**

Soil texture describes the proportion of sand, silt and clay in the soil. It is indicated in the field by the behaviour of a moistened soil sample. Texture affects soil cohesion, permeability and moisture-holding capacity. It is therefore an important factor in determining the erodibility of a soil. Soil fertility is also influenced by texture as most plant nutrients are bound to clay minerals. In central Australia texture is therefore a major determinant of the type of native pasture that grows on a particular area.

The most common soil textures encountered in central Australia are: loamy sands (5% clay), sandy loams (10-20% clay), sandy clay loams (20-30% clay), clay loams (30-35% clay), light clays (35-40% clay), light medium clays (40-45% clay), medium clays (45-55% clay), medium heavy and heavy clays (more than 50% clay).

**Colour**

The colour of moist and dry soil is assessed in the field using a standard Munsell colour chart. This forms the basis of colour names used in this report which refers to moist soil only. Soil colour assists in the recognition of soil horizons and is useful for comparing soils of different areas. Colour can also indicate soil age and other properties such as drainage and organic matter content.

**Soil Reaction**

The acidity or alkalinity of soil material is indicated by a pH value. A pH value of 7.0 is neutral, while less than 7.0 indicates acidity and greater than 7.0 signifies alkalinity. In general, under alkaline soil conditions (pH 8.0 or greater) phosphorus and most micronutrients become less available to plants and deficiencies may develop. Alkalinity may also result from a high level of sodium (sodicity) which results in poor soil stability. High acidity (pH less than 5.5) also reduces the availability of soil nutrients to plants and consequently affects potential pasture productivity.

**Soil Structure**

Structure is a distinctive property determined by the occurrence of natural soil aggregates (or peds) within the soil profile. Soil structure influences moisture infiltration, drainage and the ease of root penetration. Soils without distinct peds may be massive and cohesive or have single-grain structure (e.g. dune sand). Pedal soils are described in terms of the size, shape and distinctness of the individual peds. Strongly pedal soils have distinct aggregates readily observable in an undisturbed profile while weak pedality may be evident only as a pattern of cracks in dry soil material.

**Fabric**

The characteristic arrangement of particles in the soil material is described in terms of soil fabric. The exposed faces of massive soils have a porous, dusty appearance termed earthy fabric whereas single-grain structure has a sandy fabric. Pedal soils have fabric characterised by either smooth or rough-faced aggregates.
Calcium Carbonate

Nodules and fine particles of calcium carbonate (or lime) are a common component of many arid zone soils. In abundance, calcium carbonate strongly influences the type of plants that can grow on a particular soil as it increases alkalinity and interacts with micronutrients. It also predisposes soils to the formation of bulldust under heavy trafficking by stock or vehicles.

Coarse Fragments

The presence of grit, gravel and larger rocks is recorded as it provides clues to the origin of the soil and influences plant growth by affecting moisture holding capacity and root penetration. Fragments are described in terms of their size, shape and rock type.

Strength

An assessment of soil strength is performed during the field description of soils. This assessment can detect hardpans that affect moisture penetration and plant growth.

(ii) SOIL CLASSIFICATIONS

In this report, soils are classified according to three different classification systems widely used throughout Australia:

(a) Great Soil Groups (Stace et al., 1968) - This classification is now superseded but relatively easy for non-professionals to use. The following Great Soil Groups were recorded on the station.

Red Earths - These are medium-textured soils, red in colour, with a massive structure and earthy fabric. There is a gradual increase in clay content with soil depth.

Alluvial Soils - These are brown sandy soils associated with floodplains, floodouts and range frontage fans.

Lithosols - Shallow gravelly soils such as occur on rocky hillslopes.

Siliceous Sands - These occur as red dune soils with less than 5% clay content, single grain structure and a sandy fabric.

Earthy Sands - These soils are found in sandplain areas. They have deep, uniform profiles with little increase in clay content with depth, massive structure, earthy fabric and are red in colour.

Red Calcareous Soils - These soils are shallow, medium-textured and highly alkaline. They have developed directly from underlying calcareous rocks or calcrete.
Brown and Red Clays - Deep, heavy-textured soils that are strongly structured. These soils may present deep cracking when dry and often display gilgai micro-relief.

Solonized Brown Soils - These soils are characterised by large amounts of calcareous material in the profile, increasing in concentration with depth.

Red-Brown Earths - These soils are characterised by an abrupt boundary between a sandy topsoil and a heavy textured subsoil. They are often highly erodible, saline, and calcareous at depth.

Non-calcic Brown Soils - These soils are very similar to red-brown earths, although generally shallower, and carbonate free.

(b) Principal Profile Form (Northcote, 1979) is a classification based on a key defined by physical characteristics. The main divisions and sub-divisions are as follows.

**Uniform** - Profiles with uniform texture throughout  
Uc - coarse textures  
Um - medium textures  
Uf - fine textures, non cracking  
Ug - fine textures, cracking

**Gradational** - Profiles increase in clay content with depth  
Gc - calcareous throughout  
Gn - non calcareous throughout

**Duplex** - Profiles have an abrupt texture boundary between the topsoil and the subsoil  
Dr - red clay subsoil  
Db - brown clay subsoil  
Dy - yellow-grey subsoil  
Dd - dark clay subsoil  
Dg - grey clay subsoil

**Organic** - These soils are not found in central Australia

This classification is accompanied by a numerical code that specifies diagnostic characteristics of the individual profiles, as defined in Northcote (1979).

The Australian Soil Classification System - 3rd Approximation (Isbell, 1993) is a key based on both soil characteristics and laboratory data. It includes thirteen main soil orders. Each order has a series of keys that are used to classify the suborder, great group, subgroup and family classes. The main soil orders found in central Australia are as follows.

**Calcarosols (CA)** - soils are normally calcareous throughout the profile (often highly calcareous).
Chromosols (CH) - these soils have a strong texture contrast between the A and B horizons, are weakly acid and are non-sodic.

Dermosols (DE) - soils lacking strong texture contrast between the A horizon and the structured B horizon. This order is diverse.

Ferrosols (FE) - The structured B horizons of these soils are high in free iron oxide, and lack strong texture contrast between the A and B horizons.

Kandosols (KA) - These soils lack strong texture contrast, B horizons are massive or weakly structured and the profile is not calcareous throughout. These soils are a widespread group in central Australia, and occur locally in large areas.

Rudosols (RU) - Soils in this order have little if any pedological organisation. They are usually young soils that vary widely in terms of texture and depth. These soils may be stratified and some may be highly saline.

Tenosols (TE) - This order is made up of a diverse range of soils, with generally weak pedological organisation, apart from the A horizons.

Vertosols (VE) - These are clay soils that exhibit strong cracking tendencies when dry due to swell-shrink properties. Slickensides and/or lenticular peds appear at depth.

(iii) SOIL ERODIBILITY

Erodibility is the potential of the soil to erode. This is influenced by inherent soil factors, the nature of the parent material and the landform on which it occurs. Inherent soil factors include texture, salinity, ease of dispersion (sodicity) and the presence or absence of surface crusts or gravels.

Generally, soils with sandy loam or lighter are likely to experience wind erosion. Water erosion is unlikely to affect very light-textured porous soils or clays and sandy loam or sandy clay loam surfaces will be affected. Saline or sodic soil materials (the latter having high levels of sodium) are susceptible to the formation of strong surface crusts (scalding) and shallow gully ing.

When sheet runoff flows are concentrated into a channel by linear surface features, eg. grader windrow or stock pad, gully ing can be initiated. Deep gully ing generally occurs only on alluvial landforms, while sheet erosion and rilling occur mainly on pediment or peneplain surfaces. Soils that have developed from partially striped deeply-weathered rocks (the pallid zone of laterite profiles) are particularly susceptible to shallow gully ing or scalding, possibly the result of slightly saline conditions.
D. VEGETATION

The vegetation community (or pasture type) is the principal aspect of the land resource affecting pastoral activities. The land units described in this report, although also defined in terms of landforms and soils, are most easily recognized as pasture types.

Technical descriptions of vegetation usually define the community structure as well as listing the species present or floristics (see McDonald et al., 1990).

Structure

Vegetation communities usually consist of distinct layers or strata of various growth forms (e.g. trees, shrubs, grasses) having different heights. Communities are usually named according to the structure of the tallest stratum present, but there may also be a mid-stratum (understorey) and lower stratum (ground layer). Very sparse individuals taller than the upper stratum are termed emergent.

The structure of a stratum is defined in terms of the height (e.g. tall, mid-high, low), spacing (e.g. open, sparse) and growth form (e.g. woodland, shrubland, grassland) of the plants present. For example, the structural formation of thick mulga country may be a mid-high woodland, whereas open flats may support a low open woodland. The criteria used to define height and spacing are indicated in Tables 3-5 (from McDonald et al., 1990). Note that tree and shrub spacing is defined in terms of canopy size relative to the separation of canopies (crown separation ratio).

Floristics

In this report, vegetation descriptions indicate the characteristic or ‘indicator’ tree, shrub and pasture species present within a land unit. It should be noted that the species composition of pastures can vary considerably in response to seasonal conditions, grazing history and the incidence of fire. Fire also influences tree and shrub cover on most land types. The vegetation descriptions provided are based on the plants recorded at the time of survey. However, poor seasonal conditions during the conduct of field work may hamper the assessment of pasture composition. Therefore, where possible the principal pasture species likely to be present following adequate summer rains on areas in good condition and unaffected by recent fires has been indicated as well as species actually present.

The common names used in this report generally follow the nomenclature compiled by Strong (1987) and are listed with their botanical names in the Appendix.
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<th>D: Closed or Dense</th>
<th>M: Mid-dense</th>
<th>S: Sparse</th>
<th>V: Very sparse</th>
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<th>L: Isolated Clumps</th>
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<td>Touching-slight separation</td>
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<tr>
<td>M Tree mallee</td>
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<td>S Shrub</td>
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<td>Closed mallee shrubland</td>
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<tr>
<td>Z Heath shrub</td>
<td>Closed heathland</td>
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<td>C Chenopod shrub</td>
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*Tables from McDonald et al. (1990)
### TABLE 3
FORMATION CLASSES FOR GROUND COVERS*

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<th>Crown Class</th>
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<th>M</th>
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<td>Sparse</td>
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<td>Isolated Clumps</td>
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<td>&gt;70</td>
<td>30-70</td>
<td>10-30</td>
<td>&lt;10</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

#### Growth Form

<table>
<thead>
<tr>
<th>Structural formation classes</th>
</tr>
</thead>
</table>

| G Tussock grass | Closed grassland | Grassland | Open grassland | Sparse grassland | Isolated grasses | Isolated clump of tussock grasses |
| H Hummock grass | Closed hummock grassland | Hummock grassland | Open hummock grassland | Sparse hummock grassland | Isolated hummock grasses | Isolated clump of hummock grasses |
| D Sod grass | Closed sod grassland | Sod grassland | Open sod grassland | Sparse sod grassland | Isolated sod grasses | Isolated clump of sod grasses |
| V Sedge | Closed sedgeland | Sedgeland | Open sedgeland | Sparse sedgeland | Isolated sedges | Isolated clump of sedges |
| R Rush | Closed rushland | Rushland | Open rushland | Sparse rushland | Isolated rushes | Isolated clump of rushes |
| F Forb | Closed forbland | Forbland | Open forbland | Sparse forbland | Isolated forbs | Isolated clump of forbs |
| E Fern | Closed fernland | Fernland | Open fernland | Sparse fernland | Isolated ferns | Isolated clump of ferns |
| O Moss | Closed mossland | Mossland | Open mossland | Sparse mossland | Isolated mosses | Isolated clump of mosses |
| L Vine | Closed vineland | Vineland | Open vineland | Sparse vineland | Isolated vines | Isolated clump of vines |

* Tables from McDonald et al. (1990)
### TABLE 4
HEIGHT CLASSES FOR VARIOUS GROWTH FORMS*

<table>
<thead>
<tr>
<th>Class</th>
<th>Height (m)</th>
<th>Trees, vines, palms</th>
<th>Shrubs, heath shrubs, chenopod shrubs, mallee (tree or shrub form), cycads</th>
<th>Tussock and hummock grasses, forbs, rushes, sedges, ferns, <em>Xanthorrhoea</em></th>
<th>Sod grasses, mosses, lichens, liverworts</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>&gt;36.01</td>
<td>Extremely tall</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>20.01-35</td>
<td>Very tall</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>12.01-20</td>
<td>Tall</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>6.01-12</td>
<td>Mid-high</td>
<td>Extremely tall</td>
<td>Very tall</td>
<td>NA</td>
</tr>
<tr>
<td>5</td>
<td>3.01-6</td>
<td>Low</td>
<td>Tall</td>
<td>Mid-high</td>
<td>Tall</td>
</tr>
<tr>
<td>4</td>
<td>1.01-3</td>
<td>Dwarf</td>
<td>Low</td>
<td>Low</td>
<td>Mid-high</td>
</tr>
<tr>
<td>3</td>
<td>0.51-1</td>
<td>NA</td>
<td>Tall</td>
<td>Extremely tall</td>
<td>Tall</td>
</tr>
<tr>
<td>2</td>
<td>0.26-.5</td>
<td>NA</td>
<td>Low</td>
<td>Tall</td>
<td>Low</td>
</tr>
<tr>
<td>1</td>
<td>&lt;.25</td>
<td>NA</td>
<td>Dwarf</td>
<td>NA</td>
<td>Low</td>
</tr>
</tbody>
</table>

* *Table and Figure from McDonald *et al.* (1990).

### FIGURE B SHOWING UPPER, MID AND LOWER STRATUMS*

* Table and Figure from McDonald *et al.* (1990).
SECTION THREE: THE LAND RESOURCES OF THE GARDEN STATION

A. GEOLOGY AND LANDFORMS

The geology of The Garden Station has been mapped at 1:100,000 by Shaw and Langworthy (1984) and at 1:250,000 scale by Wells (1969).

The region comprises mainly early to late Proterozoic metamorphic and igneous rocks of the Arunta Block. In the south of the station these outcrop as low hills and ranges of the Heavitree Quartzite and Bitter Springs Formation (late Proterozoic) as part of the Amadeus Basin sequence. The middle of the station mainly comprises low hills and plains of the Randall Peak Metamorphics (gneiss and schist) of early Proterozoic age and Jennings Granitic Gneiss of mid Proterozoic age. The north of the station predominantly comprises uplands and plains of Cadney metamorphics (gneiss, quartzite and granulite).

Seven broad categories of geology and landform comprise the basis of land classification used in this report. Each category encompasses several related units.

1-3) Mountains and Hills:

This includes terrain ranging from low hills to Mt Laughlen, the highest mountain on The Garden. These uplands have developed on Proterozoic metamorphic and igneous rocks of the Arunta complex, mainly granulites and quartzite. They were formed from sedimentation in the Amadeus Basin in the late Proterozoic (2000 million years ago) with the deposition of sand and gravel in marine lacustrine and fluvial environments. The sediments were subsequently compressed during intermittent periods of distortion (uplifting and down warping) of the earths crust when metamorphism and intrusion of igneous rock took place resulting in the formation of ranges and hills.

4) Rises:

These are elevated surfaces with very low relief (9-30m). Many of these surfaces are the result of erosional processes dating over 2000 million years with the weathering down of higher terrain. The geology of this terrain varies with calcrete, gneiss, granite, sandstone and silcrete predominating. Most being remnants of earlier mountain building. The exception being the calcareous rises which have formed by the deposition of calcrete in areas with a shallow water-table during the Holocene or latest Pleistocene period.

5) Colluvial Fans and Terraces:

These are masses of weathered material transported by gravity and deposited down slope. Colluvial fans are prominent in the south of the station and occur at the base of the Georgina Range as rounded cobbles of Heavitree Quartzite or in the north of the station as plains with gravelly soils. These were formed by the weathering and erosion of parent material over millions of years.
6) Pediment Plains:

Plains of eroded rock covered by a thin veneer of alluvium. The Quaternary alluvium was deposited when the environment was less arid and extensive erosion and dissection occurred. These plains are scattered throughout most of the station and usually support grasslands with isolated trees.

7) Alluvial plains and Floodouts:

This group of units are associated with major creek floodouts. The surface features of central Australian floodplains have largely developed as the result of one or more extremely large flood events during the late Pleistocene to Holocene period (10,000 years ago) when large erosional channels formed and deposition of alluvium occurred.

B. DESCRIPTION OF LAND UNITS

Most of the land units covering the Hale Plain have been selected and copied directly from Grant (1987) following stereoscopic interpretation using 1:50,000 aerial photography. This was undertaken to avoid duplication of work in areas already covered in Russel Grants previous survey.
DESCRIPTION - Quartzite ridges covered in rock and supporting an open woodland community of mulga and red mallee over weeping spinifex.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because erosion only occurs as minor rills or is absent. There is also not likely to be any type of development or stock grazing on this land unit which would accelerate erosion. Therefore this unit currently does not require soil management.

Pasture Management - This land unit has no pastoral value. Steep slopes (reducing stock accessibility), abundant rock outcrop (95%) and predominantly unpalatable plants make this a robust, but pastorally unproductive land unit. Therefore presently no pasture management is required.

The ridges act as natural barriers to stock movement in certain situations.
DESCRIPTION - Quartzite ridges with abundant outcrop; lithosols; low open woodland of emergent mulga and red mallee over a hummock grassland of weeping spinifex.

GEOLOGY - Heavitree quartzite of Upper Proterozoic age.

LANDFORM - Quartzite strike ridges with relief to 80m and slopes of up to 20%. This land unit drains well because runoff is rapid due to low infiltration and steep slopes.

SOIL -

Example: Site 35 (5.3km west of Patsy Bore).

Classification: Lithosols, shallow poorly developed soils derived from weathered parent material.

Surface: 1% angular quartzite stones 20-50mm in size; surface flake; cryptogam crust; hard setting.

A1 Horizon: dark reddish brown (5.0YR3/3); sandy loam; pH 4.5; massive structure and earthy fabric; weak and non-sticky consistence.

VEGETATION - A low open woodland of emergent mulga and red mallee over a hummock grassland of weeping spinifex.

Example: Site 35 (5.3km west of Patsy Bore).

UPPER STRATUM  A low open woodland of sparse emergent mulga, red mallee, Thozet’s box and ghost gum.

MID STRATUM  A tall open shrubland of sparse dead finish and witchetty bush.

LOWER STRATUM  A low sparse hummock grassland of weeping spinifex with scattered woolly cloak fern.
GENERAL

LAND UNIT 1.2

DESCRIPTION - Sandstone ridges covered in stones and supporting an open woodland of mulga and whitewood over rock fuchsia bush, mountain wanderrie, kerosene grasses, woollyoat grass and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because of abundant stone cover. However, new roads should be planned on aerial photographs to follow the crests or contour, be properly formed and avoid low-lying areas on adjacent land units where runoff flows will be greatest.

Pasture Management - This land unit has low pastoral value. Steep slopes and stony ground deter stock use and palatable plants are sparse and have low bulk. Therefore this unit is not likely to be heavily utilised by stock and does not require specific management.
TECHNICAL LAND UNIT 1.2

DESCRIPTION - Sandstone ridges with abundant stone cover; lithosols; tall open shrubland of mulga and whitewood over rock fuchsia bush, mountain wanderrie, kerosene grasses, woollyoat grass and forbs.

GEOLOGY - Sandstone of late Proterozoic age.

LANDFORM - Sandstone ridges with abundant stone cover, having slopes of less than 30%, relief to 70m and colluvial deposits on lower slopes. Runoff is moderately rapid, draining by sheet flow into shallow drainage channels which disperse water rapidly down slope.

SOIL -
Example: Site 80 (4km north east of Acacia Bore).

Classification: Lithosols, shallow poorly developed skeletal soils derived from weathered parent material.
Surface: 60% subangular sandstone stones 10-20mm in size; sandy veneer; hard setting.
0.0 - 0.1m: A1 Horizon: dark reddish brown (5.0YR3/4); loamy sand; pH 7.0; massive structure and earthy fabric; weak and non-sticky consistence.

VEGETATION - A tall open shrubland of mulga over sparse grasses and forbs.
Example: Site 80 (4km north east of Acacia Bore).

UPPER STRATUM A tall open shrubland of sparse mulga and whitewood.

MID STRATUM A mid-high sparse shrubland of rock fuchsia bush, dead finish, Rhagodia eremaea, mulga, blunt-leaf cassia and young ironwood.

LOWER STRATUM An annual grassland of very sparse woollyoat grass, button grass, small-burr grass, mulga grass and erect kerosene grass. The perennial grass mountain wanderrie is also present. Forbs include very sparse tickweed, large green pussytail, tropical speedwell, Heliotropium tenuifolium, munyeroo, caltrop and ruby saltbush.
GENERAL LAND UNIT 2.1

DESCRIPTION - Granulite ridges with rock outcrops supporting mulga and witchetty bush over mountain wanderrie, cotton panic grass, woollyoat grass and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because it is protected from erosion by dense stone cover and rock outcrop. However, when clearing fencelines or access tracks, disturbance to surfaces should be minimised to limit channelling run-off onto neighbouring erodible units. If possible new roads should be planned on aerial photographs to follow the crests or contour and be properly formed.

Pasture Management - This land unit has no pastoral value and requires no pasture management because of steep slopes, rocky ground and the low bulk of palatable plants. Therefore presently no pasture management is required.
DESCRIPTION - Granulite ridges with abundant outcrop; lithosols; tall open shrubland of mulga and witchetty bush over mountain wanderrie, kangaroo grass, cotton panic grass, woollyoat grass and forbs.

GEOLOGY - Granulites of early Proterozoic age.

LANDFORM - Granulite ridges with abundant outcrop, slopes to 12% and relief of up to 60m. Infiltration is very slow because it is limited by rock with runoff draining by sheet flow into shallow drainage depressions where it is distributed down slope.

SOIL -

Example: Site 10 (700m north west of Southern Cross Bore).

Classification: Lithosols, shallow poorly developed skeletal soils derived from weathered parent material.

Surface: 20-30% angular granulite stones 5-30mm in size; hard setting; sandy veneer.

0.0 - 0.1m A1 Horizon: dark reddish brown (2.5YR3/3); loamy sand; pH 6.0; massive structure and earthy fabric; weak and non-sticky consistence.

VEGETATION - A tall open shrubland of mulga and witchetty bush over a very sparse grassland of annual and perennial grasses.

Example: Site 10 (700m north west of Southern Cross Bore).

UPPER STRATUM A tall open shrubland of sparse mulga, whitewood and long-leaf corkwood.

MID STRATUM A mid-high shrubland of sparse witchetty bush, long-leaf corkwood, blunt-leaf cassia, dead finish, rock fuchsia bush and Rhagodia eremaea.

LOWER STRATUM A very sparse grassland of mulga grass, five-minute grass, green summer grass, mountain wanderrie, woollyoat grass and finger panic grass. Forbs include very sparse orange spade flower, caltrop, silver tails, bush banana, caustic weed, tickweed, buckbush and munyeroo.
GENERAL LAND UNIT 2.2

DESCRIPTION - Calcareous hills with abundant outcrop and supporting an open shrubland of witchetty bush and whitewood over oval-leaf cassia, rough threeawn, oatgrass, finger panic grass and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because of sparse stone cover, although disturbed areas are susceptible to water sheeting. Therefore, new roads should be planned on aerial photographs to follow the crests or contour.

Pasture Management - This land unit has low pastoral value. Palatable and nutritious plants are sparse and have low bulk although, witchetty bush does provide limited topfeed.

At this time pasture management is not required, however the pasture could be monitored for increased grazing impact.
TECHNICAL LAND UNIT 2.2

DESCRIPTION - Calcareous pyramidal hills with abundant outcrop; lithosols; tall open shrubland of witchetty bush and whitewood over oval-leaf cassia, finger panic grass, rough threeawn, oatgrass, woollyoat grass and forbs.

GEOLOGY - Quartzite, calcareous silicate rock, biotite gneiss and felsic granulite of early Proterozoic age.

LANDFORM - Calcareous hills with sparse stone cover, slopes to 10% and relief of up to 25m. Drainage is by sheet flow into a tributary network of shallow drainage depressions which disperse water down slope.

SOIL –

Example: Site 13 (3km north east of Southern Cross Bore).

Classification: Lithosols, shallow poorly developed soils derived from weathered parent rock.

Surface: 25% 8mm angular tabular and 40mm angular quartzite stones; sandy veneer; hard setting; surface crust.

0.0 - 0.1m A1 Horizon: dark brown (10.0YR3/3); loamy sand; pH 8.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 4% calcareous nodules 4-10mm in size.

VEGETATION - A tall open shrubland of witchetty bush and whitewood over very sparse grasses and forbs.

Example: Site 13 (3km north east of Southern Cross Bore).

UPPER STRATUM A tall open shrubland of sparse witchetty bush and whitewood.

MID STRATUM A mid-high open shrubland of very sparse oval-leaf cassia and whitewood.

LOWER STRATUM A very sparse grassland of oatgrass, rough threeawn, finger panic grass, rough threeawn and woollyoat grass. Forbs include silver sida, white paper daisy, buckbush, Hybanthus aurantiacus, showy indigo, crimson foxtail and caustic weed.
**GENERAL**

**LAND UNIT 2.3**

**DESCRIPTION** - Granite hills supporting a woodland community of mulga over witchetty bush, annual grasses and forbs.

**LAND MANAGEMENT IMPLICATIONS**

**Soil Management** - The erosion hazard of this unit is low because of abundant rock outcrop, although, disturbed soils may scour with storm runoff.

**Pasture Management** - A land unit of low pastoral value. Palatable plants are very sparse and steep slopes reduce stock access. Therefore the pasture does not require management other than monitoring for increased stock impact.
TECHNICAL LAND UNIT 2.3

DESCRIPTION - Large granite hills; lithosols; tall open shrubland of isolated mulga and witchetty bush over annual grasses and forbs.

GEOLOGY - Jennings granitic gneiss of mid Proterozoic age.

LANDFORM - Large granite hills with slopes of up to 2% and relief to 40m. Drainage is well with the majority of water running off by sheet flow.

SOIL -

Example: Site 56 (5km east of Wallaces Soak).

Classification: Lithosols, shallow skeletal soils derived from weathered parent material.

Surface: 70% subrounded quartzite stones 20-70mm in size; firm; sandy veneer.

0.0-0.1m: A1 Horizon: dark reddish brown (5YR3/3); sandy loam; pH 4.5; massive structure and earthy fabric; loose and non-sticky consistence.

VEGETATION - A low open woodland of mulga and witchetty bush over sparse grasses.

Example: Site 56 (5km east of Wallaces Soak).

UPPER STRATUM  A tall open shrubland of isolated sparse mallee red gum, bloodwood and mallee bloodwood.

MID STRATUM  A mid-high shrubland of isolated Hakea grammatophylla and Maitland's wattle.

LOWER STRATUM  A grassland of sparse woollybutt wanderrie and weeping spinifex. Potato bush was the only forb recorded.
GENERAL

LAND UNIT 2.4

DESCRIPTION - Limestone hills supporting an open shrubland of rock fuchsia bush and witchetty bush over giant grey spinifex.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this unit is low because of abundant rock outcrop, although disturbed soils may scour with storm runoff.

Pasture Management - A land unit of low pastoral value. Palatable plants are very sparse and steep slopes reduce stock access. Therefore the pasture does not require management other than monitoring for increased stock impact. Periodic patch burning may reduce the likelihood of wildfires.
DESCRIPTION - Gravelly pyramidal limestone hills; lithosols; tall open shrubland of witchetty bush over rock fuchsia bush and giant grey spinifex.

GEOLOGY - Limestone of late Proterozoic age (Gillen Member).

LANDFORM - Pyramidal limestone hills with upper and lower slopes of up to 17% and relief to 20m. Infiltration is slow with most drainage occurring as runoff along shallow poorly defined drainage channels.

SOIL -

Example: Site 79 (3.6km north east of Goat Camp Dam).

Classification: Lithosols, shallow skeletal soils derived from weathered parent material.
Surface: 60% subangular limestone stones 10-20mm in size; sandy veneer; hard setting.
0.0 - 0.1m: A1 Horizon: dark brown (7.5YR4/4); sandy clay loam; pH 8.5; massive structure and earthy fabric; weak and non-sticky consistence.

VEGETATION - A tall open shrubland of witchetty bush and rock fuchsia bush over giant grey spinifex.

Example: Site 79 (3.6km north east of Goat Camp Dam).

UPPER STRATUM A low open woodland of ghost gum and whitewood.

MID STRATUM A tall open shrubland of *Eucalyptus* spp., witchetty bush, rock fuchsia bush, *Eremophila* sp., *Senna* sp. and blunt-leaf cassia.

LOWER STRATUM A mid-high open hummock grassland of giant grey spinifex.
GENERAL

LAND UNIT 2.5

DESCRIPTION - Ridge lines with rock outcrop and supporting an open woodland community of mulga, witchetty bush and dead finish over cotton panic grass, mountain wanderrie and kangaroo grass.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because of the high percentage of rock outcrop. Although, new roads should be properly formed to reduce the likelihood of water concentrating and eroding nearby units.

Pasture Management - This land unit has low pastoral value. Palatable and nutritious plants are sparse and steep slopes deter stock access. However, the pasture should be monitored for increased stock impact.
TECHNICAL LAND UNIT 2.5

DESCRIPTION - Linear ridge crests with abundant outcrop; lithosols; low open woodland of mulga, witchetty bush and dead finish over cotton panic grass, mountain wanderrie and kangaroo grass.

GEOLOGY - Southern Cross Schist of Proterozoic to Palaeozoic age.

LANDFORM - Linear ridge crests with abundant outcrop, relief of up to 20m and slopes to 15%. Steep slopes and abundant rock outcrop generate rapid runoff dispersing as sheet flow in open areas and via shallow drainage depressions between rock outcrops.

SOIL -

| Example: Site 30 (1.5km east of Boundary Dam). |
| Classification: Lithosols: highly acidic soils with poor profile development derived from weathered parent material. |
| Surface: 15% subangular gravel 15-70mm in size; sandy veneer; hard setting. |
| 0.0 - 0.1m: A1 Horizon: dark reddish brown (5YR3/3); sandy loam; pH 4.5; massive structure and earthy fabric; weak and non-sticky consistence. |

VEGETATION - A low open woodland of mulga and witchetty bush over a mid-high shrubland of native fuchsia and dead finish.

| Example: Site 30 (1.5km east of Boundary Dam). |
| UPPER STRATUM | A low open woodland of very sparse mulga, long-leaf corkwood, bloodwood, whitewood and supplejack. |
| MID STRATUM | A mid-high sparse shrubland of dead finish, showy indigo, native fuchsia, witchetty bush, blunt-leaf cassia, whitewood, wild orange, Rhagodia eremaea and desert cassia. |
| LOWER STRATUM | A low very sparse tussock grassland of cotton panic grass, mountain wanderrie and kangaroo grass. Forbs include buckbush, silver tails and desert spurge. |
GENERAL LAND UNIT 3.1

DESCRIPTION - Low calcareous hills with sparse stone cover and supporting an open woodland of witchetty bush and whitewood over sparse forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because of shallow soil and abundant stone cover (40%) which maintains soil stability. Roads built on this land unit should follow the crest or contour and be graded without windrows to reduce the likelihood of channelling water onto more erodible neighbouring land units.

Pasture Management - This land unit has low pastoral value. Palatable species are sparse and have low bulk although, witchetty bush does provide some topfeed.

Rabbits may exert severe grazing pressure on the vegetation and may be controlled in the more productive areas.

Good range condition is apparent when witchetty bush has not been grazed heavily and palatable grasses are present within grazing reach.
TECHNICAL LAND UNIT 3.1

DESCRIPTION - Calcareous low hills with sparse stone cover; calcareous red earths; mid-high open woodland of whitewood, long leaf corkwood, bloodwood, ironwood and beefwood over witchetty bush and very sparse woollybutt wanderrie and forbs.

GEOLOGY - Granulite of early Proterozoic age.

LANDFORM - Calcareous low hills with sparse stone cover, having slopes of up to 5% and relief to 15m. Infiltration is impeded by rock with the majority of water lost to runoff by sheet flow which drains into widely spaced (625-1000m) incipient stream channels at the base of this unit.

SOIL –

Example: Site 67 (500m west of Porter Bore).

Classification: Calcareous red earths (Db3.53) Calcarosol - CA,BD,BQ,CP,HLMV. Medium textured highly calcareous soils, increasing in clay content with depth.

Surface: 80% angular tabular quartzite and granulite stones 5-20 mm in size; sandy veneer; hard setting.

0.0 - 0.1m: A1 Horizon: dark reddish brown (5.0YR3/2); sandy loam; pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 30% angular tabular granulite coarse fragments 6-20mm in size; 2% calcareous nodules 3mm in size.

0.1 - 0.2m: B2 Horizon: dark brown (7.5YR3/2); sandy clay loam; pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 15% subangular to subangular tabular granulite coarse fragments 8-18mm in size; 2% calcareous nodules 3mm in size.

0.2 - 0.3m: B21 Horizon: dark brown (7.5YR3/3); sandy clay loam; pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 20% subangular coarse fragments 8-15mm in size.

0.5 - 0.6m: B21 Horizon: dark brown (7.5YR3/3); sandy clay loam; pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 30% 8-15mm subangular to angular tabular gneiss coarse fragments.

VEGETATION - A mid-high open woodland of witchetty bush over very sparse forbs.

Example: Site 67 (500m west of Porter Bore).

UPPER STRATUM A tall open shrubland of sparse witchetty bush, isolated long-leaf corkwood, bloodwood, ironwood and whitewood.

MID STRATUM A mid-high open shrubland of sparse witchetty bush and dead finish.

LOWER STRATUM A forbland of very sparse caltrop, caustic weed, desert spurge, silvertails, hairy goodenia, munyeroo, bush banana, buckbush, potato bush, sticky indigo and ruby saltbush. Grasses include limestone oatgrass, woollybutt wanderrie, rough threeawn, five-minute grass and purple plumegrass.
GENERAL LAND UNIT 3.2

DESCRIPTION - Stony quartzite foot slopes supporting an open shrubland of blunt-leaf cassia and rock fuchsia bush with minor occurrence of whitewood, desert cassia and mulga.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low. Quartzite gravels protect the soil from erosion although minor rilling can occur where surface gravel has been disturbed. Therefore when clearing fencelines or access tracks, disturbance of surfaces should be minimised to limit channelling run-off onto neighbouring erodible units.

Pasture Management - This land unit has low pastoral value. Unpalatable shrubs dominate the pasture and palatable understorey vegetation is sparse with low bulk. Mulga does however provide limited topfeed.

Poor range condition is apparent when mulga has been substantially grazed and there is only minor regeneration and also palatable grasses are predominantly confined to places out of grazing reach e.g. under trees and shrubs.
**TECHNICAL LAND UNIT 3.2**

**DESCRIPTION** - Stony foot slopes; lithosols; tall open shrubland of blunt-leaf cassia and rock fuchsia bush with minor occurrence of whitewood, desert cassia and mulga.

**GEOLOGY** - Ankala gneiss, of early Proterozoic age.

**LANDFORM** - Stony foot slopes with relief of up to 4m and slopes to 10%. Infiltration is slow with the majority of water lost to runoff by sheet flow.

**SOIL** -

<table>
<thead>
<tr>
<th>Example:</th>
<th>Site 36 (5km north west of Patsy Bore on the road to Pinnacles)</th>
</tr>
</thead>
</table>

**Classification**: Lithosols, shallow skeletal soils derived from weathered parent material.

**Surface**:  
- 30% angular quartzite stones 6-20mm in size; cryptogam crust; surface crust; hard setting.

**0.0 - 0.1m: A1 Horizon**: dark reddish brown (2.5YR3/4); sandy loam (heavy); pH 6.0; massive structure and earthy fabric; loose and non-sticky consistence.

**VEGETATION** - A tall open shrubland of blunt-leaf cassia over very sparse forbs.

<table>
<thead>
<tr>
<th>Example:</th>
<th>Site 36 (5km north west of Patsy Bore on the road to Pinnacles)</th>
</tr>
</thead>
</table>

**UPPER STRATUM**  
A tall open shrubland of sparse whitewood and mulga.

**MID STRATUM**  
A mid-high sparse shrubland of blunt-leaf cassia and rock fuchsia bush.

**LOWER STRATUM**  
A very sparse forbland of woolly cloak fern and *Sclerolaena* sp. Eight day grass was also recorded.
GENERAL LAND UNIT 3.3

DESCRIPTION - Low hills with rock outcrop supporting an open woodland of mulga and witchetty bush over very sparse woolly oat grass, rough threeawn and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because it is protected from erosion by rock outcrop (70%) and gravel. However, roads should be built to follow the contour and be properly formed to avoid channelling water onto neighbouring more erodible units.

Pasture Management - This land unit has low pastoral value. Plants are generally of low to moderate palatability and have low bulk. Topfeed species such as mulga and witchetty bush are present and provide predominantly drought topfeed.

Poor range condition is apparent when mature mulga is heavily grazed with little or no recruitment of juvenile plants.

Rabbits have been noted but do not appear to constitute a major problem.
DESCRIPTION - Low pyramidal hills with abundant outcrop; red calcareous soils; low open woodland of mulga and witchetty bush over very sparse woollyoat grass and rough threeawn.

GEOLOGY - Gneiss of early Proterozoic age.

LANDFORM - Low pyramidal hills with slopes of up to 11% and relief to 20m. Infiltration is limited by the abundance of rock with the majority of water lost to runoff by sheet flow.

SOIL -

<table>
<thead>
<tr>
<th>Example:</th>
<th>Site 44 (5km east of Patsy Bore).</th>
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</table>

**Classification:** Red calcareous soils (Uc1.23) Calcarosol - CA, CY, DU, CD, HMMV. Shallow, medium-textured and highly calcareous soils.

**Surface:** 85% 10mm subangular and 15mm subangular platy gneiss stones; hard setting; sandy veneer.

**0.0 - 0.1m:** A1 Horizon: dark reddish brown (5.0YR3/4); sandy clay loam; pH 7.0; massive structure and earthy fabric; firm and slightly sticky consistence; 50% subangular platy gneiss coarse fragments 5-20mm in size.

**0.1 - 0.2m:** B1 Horizon: dark reddish brown (5.0YR3/3); clay loam; pH 8.5; massive structure and earthy fabric; loose and slightly sticky consistence; 50% subangular tabular gneiss coarse fragments 5-20mm in size.

**0.2 - 0.3m:** B21 Horizon: dark reddish brown (5.0YR3/3); clay loam; pH 9.0; massive structure and earthy fabric; loose and slightly sticky consistence; 15% subangular gneiss coarse fragments 5-25mm in size; 50% calcareous nodules 20-35mm in size.

**0.5 - 0.6m:** B22 Horizon: dark reddish brown (5.0YR3/3); clay loam; pH 9.0; massive structure and earthy fabric; loose and slightly sticky consistence; 20% subangular gneiss coarse fragments 5-25mm in size; 40% calcareous nodules 25-40mm in size.

VEGETATION - A low open woodland of mulga and witchetty bush over very sparse annual grasses and forbs.

**Example:** Site 44 (5km east of Patsy Bore).

**UPPER STRATUM** A low open woodland of sparse mulga with sub-dominance by bloodwood, witchetty bush and long-leaf corkwood.

**MID STRATUM** A mid-high sparse shrubland of dead finish, blunt leaf cassia, rock fuchsia bush, witchetty bush, *Rhagodia eremaea* and juvenile mulga.

**LOWER STRATUM** A low sparse forbland of caustic weed, caltrop, tar vine, munyeroo and ruby saltbush. Other plants include rough threeawn, five-minute grass, woollyoat grass and button grass.
GENERAL

LAND UNIT 3.4

DESCRIPTION - Low hills with rock outcrops supporting an open shrubland of mulga and witchetty bush over native millet, cotton panic grass, five minute grass, woollyoat grass and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low. When clearing fencelines or access tracks, disturbance of surfaces should be minimised to limit channelling run-off onto neighbouring erodible units.

Pasture Management - This land unit has moderate pastoral value. During dry seasons witchetty bush and mulga provide good topfeed and following rain palatable and nutritious perennial (native millet, cotton panic grass) and annual grasses and forbs grow.

Good range condition is apparent when there is good cover of palatable grasses e.g. native millet, cotton panic grass and woollyoat grass. The woodland remains open without an increase in density of witchetty bush and or Cassia spp. and mulga has not been heavily grazed.
DESCRIPTION - Low hills with rounded crests and abundant outcrop; lithosols; tall open shrubland of mulga and witchetty bush over native millet, cotton panic grass, five minute grass, woollyoat grass and forbs.

GEOLOGY - Gneiss of early Proterozoic age.

LANDFORM - Low rounded hills with slopes of up to 17% and relief to 7m. Infiltration is slow with the majority of water being lost to runoff by sheet flow.

SOIL -

Example: Site 62 (3km south west of 9 Mile Yard).

Classification: Lithosols, shallow skeletal soils derived from weathered parent material.
Surface: 70% 5-65mm subangular gneiss; sandy veneer; hard setting.
0.0 - 0.1m: A1 Horizon: dark reddish brown (5.0YR3/4); sandy loam; pH 7.0; massive structure and earthy fabric; loose and non-sticky consistence.

VEGETATION - A tall open shrubland of mulga and witchetty bush over sparse annual grasses and forbs.

Example: Site 62 (3km south west of 9 Mile Yard).

UPPER STRATUM A tall open shrubland of emergent mulga, ironwood and whitewood.

MID STRATUM A mid-high shrubland of sparse witchetty bush, white cassia, weeping emu bush, blunt-leaf cassia and silver cassia.

LOWER STRATUM A forbland of sparse caltrop, desert spurge, tropical speedwell, sticky indigo, boggabri, snake vine, caustic weed, munyeroo, buckbush, large green pussytail, silver tails and tickweed. Grasses include five-minute grass, purple plumegrass, native millet, cotton panic grass, mulga grass and woollyoat grass.
This land unit description is from Grant (1987).

**DESCRIPTION** - Gently undulating low hills with shallow stony soils supporting scattered ironwood, mulga and witchetty bush over annual grasses.

**LAND MANAGEMENT IMPLICATIONS** - This unit has a moderate water erosion hazard. Storm runoff is likely to scour graded tracks, well-worn stock pads and alluvial soils are subject to gullying. Rough wiregrass is reputed to increase in response to prolonged grazing pressure.
**DESCRIPTION** - Gently undulating low hills; lithosols; low open woodland of sparse mulga and ironwood over annual grasses.

**GEOLOGY** - Early Proterozoic metamorphic rocks, mainly gneiss (Cadney Metamorphics).

**LANDFORM** - Stony hills with low relief and gentle slopes (less than 10%), drained by a widely-spaced network of depressions tributary to the main creek channels. Quartz reef outcrop occasionally present.

**SOIL** - Lithosols (Um5.51) predominate. These are gravelly medium textured soils, dark reddish brown and usually slightly alkaline and calcareous. Coarse-textured brown alluvial soils (Uc1.23) are present along drainage depressions.

**VEGETATION** - Scattered ironwood, mulga and witchetty bush, with occasional bloodwood, long leaved corkwood and ghost gum, in association with annual grasses, mainly woollyoat, oat and mulga grasses. Herbage species including common sida, silver tails and potato bush occasionally present. Dense stands of curly windmill grass, desert bluegrass and kangaroo grass occur on the alluvial soils.
GENERAL LAND UNIT 4.1

DESCRIPTION - Granite rises with rock outcrops supporting an open woodland of long-leaf corkwood, bloodwood and witchetty bush over woollyoat grass, mountain wanderrie, katoora and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - Parts of this land unit have a low erosion hazard because they are protected from erosion by granite boulders. In exposed areas where grazing has been heavy, rill, scalding, windsheeting and stream bank erosion may occur. In these areas erosion can be reduced by maintaining vegetation cover.

If possible tracks should be planned from aerial photographs to follow ridge crests or the contour, be properly formed and avoid low-lying areas where runoff flows will be greatest.

Pasture Management - This land unit when in good condition has a moderate to high pastoral value. Following rain a variety of palatable and nutritious annual grasses grow e.g. woollyoat grass, button grass and green summer grass. Witchetty bush and mulga also provide valuable topfeed during dry seasons.

This pasture is sensitive to the effects of heavy stocking and is in good condition when there is an open cover of shrubs over oatgrasses in good seasons. In poor condition desert bluegrass and other palatable perennial grasses will decline and ephemeral species will dominate in favourable seasons.

Rabbits are often present and may be controlled in more productive areas.
TECHNICAL LAND UNIT 4.1

DESCRIPTION - Granitic rises with abundant outcrop; lithosols; low open woodland of long-leaf corkwood, bloodwood and witchetty bush over woolly oat grass, mountain wanderrie, katoora and forbs.

GEOLOGY - Trephina Granitic Gneiss of middle Proterozoic age.

LANDFORM - Undulating granitic rises with abundant outcrop, slopes of up to 9% and relief to 4m. Infiltration is moderate with excess water running off by sheet flow into incipient and closely spaced (250-400m) stream channels 2m wide and 0.7m deep.

SOIL –

Example: Site 57 (16km north of Whistleduck Bore along the road to Georgina Gap Dam).

Classification: Lithosols (Dy4.53) Calcarosol - CA,CY,DN,CDFLMV. Shallow medium textured soils developed directly from underlying calcrete.

Surface: 65% subangular quartz stones; hard setting; sandy veneer.

0.0 - 0.1m: A1 Horizon: dark brown (7.5YR3/3); sandy loam (heavy); pH 9.5; massive structure and earthy fabric; weak and non-sticky consistence; 10% subangular granite coarse fragments 4-15mm in size.

0.1 - 0.2m: A3 Horizon: dark brown (7.5YR3/2); sandy clay loam; pH 9.5; massive structure and earthy fabric; weak and slightly sticky consistence; 50% subangular tabular granite coarse fragments 4-15mm in size.

0.2 - 0.3m: B21 Horizon: dark greyish brown (10.0YR4/2); sandy clay loam (light); pH 8.5; massive structure and earthy fabric; weak and non-sticky consistence; 50% subangular tabular coarse fragments 5-15mm in size.

0.3 - 0.45m: B22 Horizon: dark greyish brown (10.0YR4/2); clay loam (sandy); pH 8.5; massive structure and earthy fabric; weak and slightly sticky consistence; 44% subangular tabular granite coarse fragments 7-20mm in size.

VEGETATION - A low open woodland of mulga over sparse forbs and grasses.

Example: Site 57 (16km north of Whistleduck Bore along the road to Georgina Gap Dam).

UPPER STRATUM A low open woodland of sparse mulga, long-leaf corkwood, river red gum, white cypress pine and bloodwood.

MID STRATUM A mid-high sparse shrubland of witchetty bush, dead finish, inland teatree, Acacia bush, silver cassia and Senna artemisioides ssp. filifolia.

LOWER STRATUM A mid-high sparse grassland of woolly oatgrass, five-minute grass, button grass, limestone oatgrass, desert bluegrass, rough threeawn, mountain wanderrie, eight day grass, green summer grass, woollyoat grass, creek windmill grass and katoora. Forbs include caltrop, tickweed, desert spurge, caustic weed, silvertails, orange spade flower and potato bush.
DESCRIPTION - Calcareous rises with sparse stone cover and supporting an open woodland of mulga and or witchetty bush over oval-leaf cassia, grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because it is protected from erosion by abundant rock outcrop and sparse stone cover, although, tracks and fences may promote erosion on neighbouring more erodible units by channelling water flow. Therefore, roads should be planned on aerial photographs to follow the crests or contour, be properly formed and avoid low lying areas where runoff flows will be greatest.

Pasture Management - This land unit has low pastoral value due to the sparseness and low bulk of palatable plants. Following rain a range of palatable ephemeral species grow which provide feed for a short time.

Good range condition is apparent when the palatable plants e.g. cotton panic grass, *Rhagodia eremaea*, climbing saltbush and bush banana are not heavily grazed within the reach of stock. There is regeneration of mulga and trees have not been heavily grazed.

Rabbits are often present and seasonally exert heavy grazing pressure. Therefore, rabbit control might be undertaken to reduce rabbit impact on more productive neighbouring land units.
TECHNICAL LAND UNIT 4.2

DESCRIPTION - Calcareous rises with sparse stone cover; red calcareous soils; low open woodland of mulga, witchetty bush and or whitewood over oval-leaf cassia, silver cassia, cotton panic grass, rough three awn, erect kerosene grass and forbs.

GEOLOGY - Quaternary calcrete.

LANDFORM - Undulating calcareous rises with sparse stone cover, relief to 9m and slopes of up to 7%. The rises are well drained with the majority of water running off by sheet flow into incipient stream channels 2m wide and 0.6m deep.

SOIL –

Example: Site 20 (5km north of 10 Mile Dam along the road to Sixteen Mile Tank).

Classification: Red calcareous soils (Db1.53) Calcarosol - CA,DA,DK,CP,GKAMW. Shallow medium textured soils which are usually calcareous throughout the profile.

Surface: 50% subrounded 10-40mm calcrete stones; hard setting; surface crust.

0.0 - 0.1m: A1 Horizon: dark brown (10.0YR4/3); loamy sand; pH 9.5; very highly calcareous; massive structure and earthy fabric; weak and slightly sticky consistency; 50% 20mm subangular and 10mm subrounded calcrete coarse fragments; 50% calcareous nodules 10-40mm in size.

0.1 - 0.2m: B1 Horizon: dark brown (10.0YR4/3); sandy clay loam; pH 9.5; very highly calcareous; massive structure and earthy fabric; weak and slightly sticky consistency; 50% 20mm subangular and 10mm subrounded calcrete coarse fragments 10-20mm in size; 50% calcareous nodules 10-20mm in size.

0.2 - 0.3m: B11 Horizon: dark brown (10.0YR4/3); sandy clay loam; pH 9.5; very highly calcareous; massive structure and earthy fabric; firm and slightly sticky consistency; 60% subrounded calcrete coarse fragments 10-20mm in size; calcareous nodules 10-20mm in size.

0.3 - 0.5m: B21 Horizon: brown (10.0YR5/3); clay loam (sandy); pH 9.5; very highly calcareous; massive structure and earthy fabric; firm and slightly sticky consistency; 25% subrounded calcrete coarse fragments 7-12mm in size; 25% calcareous nodules 7-12mm in size.

0.6 - 0.7m: B2 Horizon: brown (10.0YR5/3); clay loam (sandy); pH 9.5; very highly calcareous; massive structure and earthy fabric; weak and slightly sticky consistency; 20% subangular calcrete coarse fragments 8-15mm in size; 20% calcareous nodules 8-15mm in size.

0.8-0.9m: B2 Horizon: brown (10.0YR5/3); clay loam (sandy); pH 9.5; very highly calcareous; massive structure and earthy fabric; weak and slightly sticky consistency; 20% subangular calcrete coarse fragments 6-10mm in size; 20% calcareous nodules 6-10mm in size.

VEGETATION - A low open woodland of mulga and witchetty bush over sparse forbs and isolated grasses.

Example: Site 20 (5km north of 10 Mile Dam along the road to Sixteen Mile Tank)

UPPER STRATUM Mid STRATUM LOWER STRATUM
A low open woodland of emergent mulga with ironwood and supplejack. A mid-high sparse shrubland of mulga, witchetty bush, oval-leaf cassia and silver cassia. A low sparse forbland of woolly cloak fern, bush banana, buckbush, silver sida, showy indigo and silver tails. Grasses include cotton panic grass, rough threeawn and erect kerosene grass. Rhagodia eremaea was also recorded.
GENERAL LAND UNIT 4.3

DESCRIPTION - Calcareous rises with dense stone cover and supporting a spinifex grassland of giant grey spinifex and red mallee.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low, although disturbance of the stone cover may result in scouring following rain. When clearing fencelines or access tracks, disturbance of surfaces should be minimised to limit the channelling of run-off onto more erodible units.

Pasture Management - This land unit has no real pastoral value. Giant grey spinifex is not palatable and the few fodder plants which grow between the tussocks are too sparse to be of pastoral value.

Periodic patch burning may be worthwhile to reduce the possibility of wildfires caused by lightning strikes advancing onto more productive areas.
**TECHNICAL LAND UNIT 4.3**

**DESCRIPTION** - Calcareous rises with dense stone cover, low hills and ridges; red calcareous soils; open hummock grassland of buck spinifex with very sparse red mallee and Thozet’s box.

**GEOLOGY** - Cadney Metamorphic Gneiss of early Proterozoic age.

**LANDFORM** - Calcareous rises with dense stone cover and low hills and ridges with slopes to 3% and relief of up to 5m. This land unit drains well because runoff is moderately rapid by sheet flow due to low infiltration and gently inclined slopes.

**SOIL** –

<table>
<thead>
<tr>
<th>Example:</th>
<th>Site 27 (5km west of Southern Cross Bore on the road to Boundary Dam).</th>
</tr>
</thead>
</table>

Classification: Lithosols, shallow skeletal soils derived from weathering of the parent material.

Surface: 70% subangular schist coarse fragments 10-30mm in size; firm; sandy veneer.

0.0 - 0.1m: **A1 Horizon**: dark reddish brown (5YR3/2); loam; pH 9.5; moderately calcareous; massive structure and earthy fabric; loose and non-sticky consistence.

**VEGETATION** - A mid-high open hummock grassland with emergent red mallee.

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<tr>
<th>Example:</th>
<th>Site 27 (5km west of Southern Cross Bore on the road to Boundary Dam).</th>
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**UPPER STRATUM**
Very sparse emergent red mallee and Thozet’s box.

**MID STRATUM**
A mid-high very sparse shrubland of Acacia bush.

**LOWER STRATUM**
A mid-high open hummock grassland of giant grey spinifex with very sparse buckbush and oatgrass.
GENERAL LAND UNIT 4.4

DESCRIPTION - Gently undulating rises with sparse gravel and supporting an open shrubland of bloodwood and mulga over witchetty bush and sparse grasses.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is moderate. Where soil has been disturbed water sheeting may occur and develop into gullies. Hence, roads would be better situated on less erodible units or they should be graded without windrows and follow the crest or contour.

Pasture Management - This land unit has moderate pastoral value. In good seasons oatgrass provides good feed when green but decreases in value as it dries off. However, in dry seasons the pastoral value of this unit decreases dramatically with sparse mulga and witchetty bush providing the only real source of feed.

Palatable perennial grasses are susceptible to repeated heavy grazing and should be periodically spelled from grazing to allow them to set seed and recover. Woody weeds may also increase if heavy grazing is prolonged.

Poor range condition is evident when there is a decline in oatgrass following favourable summer rain and the pasture is dominated by limestone oatgrass and bindyis. Mulga has also been heavily grazed with branches broken down within the reach of stock.
TECHNICAL LAND UNIT 4.4

**DESCRIPTION** - Gently undulating rises with sparse gravel; red earths; tall open shrubland of emergent bloodwood and mulga over witchetty bush, finger panic grass, curly windmill grass, wire grasses and forbs.

**GEOLOGY** - Georgina Gap Granitic Gneiss of mid Proterozoic age.

**LANDFORM** - Gently undulating rises with sparse gravel, slopes of up to 4% and relief to 2m. Soils have moderate infiltration with excess water running off by sheet flow into small rills to be dispersed down slope.

**SOIL** -

| Example: | Site 46 (4.5km north of Georgina Gap Dam on the road to Delaney Dam). |

**Classification**: Red earth (Dd1.53) Calcarosol - CA, CY, DU, CD, HLMU. Medium textured soils increasing in clay content with depth and usually calcareous throughout the profile.

**Surface**: 2% gneiss gravel 2-5mm in size; sandy veneer; hard setting.

| 0.0 - 0.1m: | A1 Horizon: | dark brown (7.5YR3/2); sandy loam; pH 7.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 35% subangular gneiss coarse fragments 5-10mm in size. |
| 0.1 - 0.2m: | A3 Horizon: | dark brown (7.5YR3/2); sandy clay loam (sandy); pH 9.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 25% subrounded gneiss coarse fragments 6-10mm in size; 2% calcareous nodules 4mm in size. |
| 0.2 - 0.3m: | B1 Horizon: | dark brown (7.5YR3/2); sandy clay loam (sandy); pH 9.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 40% subrounded gneiss coarse fragments 4-12mm in size; 2% calcareous nodules 4mm in size. |
| 0.5 - 0.6m: | B2 Horizon: | dark yellowish brown (10.0YR3/4); sandy clay loam; pH 9.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 20% subrounded gneiss coarse fragments 4-8mm in size; 5% calcareous nodules 5mm in size. |

**VEGETATION** - A tall open shrubland of witchetty bush and dead finish over sparse grasses.

| Example: | Site 46 (4.5km north of Georgina Gap Dam on the road to Delaney Dam). |

**UPPER STRATUM** Sparse emergent bloodwood.

**MID STRATUM** A tall open shrubland of sparse dead finish, Acacia bush, witchetty bush, whitewood, weeping emu bush, silver cassia, long-leaf corkwood and turpentine bush.

**LOWER STRATUM** A low tussock grassland of very sparse finger panic grass, five-minute grass, rough threeawn, mountain wanderrie, woollyoat grass, erect kerosene grass, button grass and curly windmill grass. Forbs include potato bush, silver tails, bush banana and orange spade plant.
DESCRIPTION - Gravelly quartz rises with an open woodland of mulga over sparse witchetty bush, Acacia bush, whitewood, grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is moderate. Sparse stone cover provides valuable protection from water sheeting although, where the surface has been disturbed by road building or cattle pads, rills and gullies may form. Roads should therefore be built without windrows to avoid channelling water or they should be situated on more resilient units.

Pasture Management - This land unit has low pastoral value because the majority of plants are of low palatability and have low bulk. However witchetty bush and mulga do provide limited topfeed in dry conditions.

Poor range condition is evident when there is a browse line evident on mulga and branches are broken down within grazing reach of stock. Perennial grasses are absent or only occur in places unaccessible to stock and the pasture is dominated by bindyis in favourable seasons.
DESCRIPTION - Gravelly quartz rises; red earths; low open woodland of mulga over sparse witchetty bush, perennial grasses (cotton panic grass, rough threeawn) five minute grass and forbs.

GEOLOGY - Calc-silicate marble, sillimanite and biotite gneiss of early Proterozoic age.

LANDFORM - Gravelly rises with relief to 3m and slopes of up to 2% in the direction of flow. Infiltration is moderate with excess water running off by sheet flow into shallow stream channels (up to 1m in depth and 8m wide), spaced between 400-625m apart.

SOIL -

Example: Site 31 (2.7km north of Pinnacles Bore on the road to Boundary Dam).

Classification: Red earth (Dr2.13) Kandosol - KA,AA,DZ,CD,BGMOV. These soils have an abrupt texture boundary between the topsoil and the subsoil.

Surface: 42% 15-40mm angular quartzite stones; sandy veneer; hard setting; surface crust.

0.0 - 0.1m: A1 Horizon: dark reddish brown (2.5YR2.5/4); sandy clay loam; pH 7.5; massive structure and earthy fabric; weak and slightly sticky consistence; 20% subangular quartz coarse fragments 5-12mm in size.

0.1 - 0.2m: B21 Horizon: dark reddish brown (2.5YR2.5/4); light clay (medium sandy); pH 7.5; weak 3mm primary and 10mm secondary subangular blocky rough faced peds; weak and slightly sticky consistence; 25% angular quartzite coarse fragments 5-12mm in size.

0.2 - 0.3m: B21 Horizon: dark red (2.5YR3/6); light clay (medium sandy); pH 8.0; weak 3mm primary and 10mm secondary subangular blocky rough faced peds; weak and slightly sticky consistence; 5% subangular quartz coarse fragments 5-15mm in size.

03 - 0.4m: B22 Horizon: dark reddish brown (2.5YR2.5/4); clay loam (heavy, medium sandy); pH 8.0; massive structure and earthy fabric; weak and slightly sticky consistence; 45% subangular platy quartz coarse fragments 10-30mm in size; 30% calcareous nodules 5-20mm in size.

0.4 - 0.5m: B22 Horizon: red (2.5YR4/6); clay loam (heavy, medium sandy); pH 9.5; moderately calcareous; massive structure and earthy fabric; weak and slightly sticky consistence; 5% subangular quartz coarse fragments 8mm in size.

VEGETATION - A low open woodland of mulga over sparse witchetty bush and forbs.

Example: Site 31 (2.7km north of Pinnacles Bore on the road to Boundary Dam).

UPPER STRATUM A low open woodland of sparse mulga with very sparse long-leaf corkwood and ironwood. Creek lines are dominated by bastard coolibah and the calcareous breakaways by sparse red mallee.

MID STRATUM A mid-high open shrubland of sparse witchetty bush, Acacia sessiliceps, Acacia bush, whitewood, turpentine bush and weeping emu bush.

LOWER STRATUM A low sparse tussock grassland of cotton panic grass, five-minute grass and rough threeawn. Forbs include ruby saltbush, cartwheel burr and buckbush.
GENERAL

This land unit description is from Grant (1987).

DESCRIPTION - Stony plains and mesa crests with red earth soils carrying open mulga over fuchsia bush and mainly wire grass.

LAND MANAGEMENT IMPLICATIONS - This unit has a minor water erosion hazard. Storm runoff may initiate minor rilling when ground cover is poor. Pastures are unattractive to stock and only lightly grazed.
TECHNICAL LAND UNIT 4.6

DESCRIPTION - Terrace surfaces (mesas and plains); stony red earths; tall open shrubland of mulga over rock fuchsia bush and wire grass.

GEOLOGY - Early Tertiary quartzose sandstone, with some silcrete (Hale Formation).

LANDFORM - Terrace surfaces with low relief and very gentle slopes (1% or less), featuring an open network of narrow tributary drainage depressions. Occasional sandstone outcrop. This unit embraces the remnants of a previous land surface of Tertiary age, now dissected and partially buried. It includes mesa tops (areas of the terrace surface now isolated by geologic erosion) as well as plains were the surface merges with surrounding landscapes.

SOIL - Red earths or Kandosols (Gn 2.13), with textures graduating from a sandy clay loam at the surface to a light clay at about 0.5m. Profiles are neutral or slightly acid throughout the profile, and ironstone or quartz gravel is occasionally present. Soil colour is typically dark red or reddish brown.

VEGETATION - An open shrubland of mulga and occasionally witchetty bush with rock fuchsia bush, spiny saltbush and blunt leaf cassia, over mainly wiregrass. Woollyoat grass together with tussocks of brush wire grass, blunt leaf cassia and native panic is often present beneath the shrub canopy.

In several areas the mulga cover is sparse and degenerate, possibly as a result of past wildfire damage and poor seedling recruitment. Thozet's box is present on this unit near the upper reaches of Delaney Creek.
GENERAL LAND UNIT 4.7

This land unit description is from Grant (1987).

DESCRIPTION - Breakaways and wash areas with fragile sandy soils over a hardpan supporting annual grasses and bladder saltbush with scattered Thozet’s box.

LAND MANAGEMENT IMPLICATIONS
The texture-contrast soils of the alluvial tracts have severe erosion hazard and are subject to extensive scalding, gullyng and minor salination. The bladder saltbush community is usually degenerate, supporting only scattered saltbush and ephemeral or unpalatable grasses.
DESCRIPTION - Dissected breakaways and wash areas; texture-contrast soils with occasional Thozet’s box over bladder saltbush.

GEOLOGY - Early Tertiary sandstones (Hale Formation) and Quaternary alluvium.

LANDFORM - Dissected scarp faces with variable slopes and relief up to 30m, draining into narrow channels that feed small alluvial tracts usually about 500m in length.

SOIL - The scarp faces are comprised of bare, white sandstone out-crop, with only small pockets of soils. Texture contrast soils or Dermosols (Dr 4.53) occur along the alluvium tracts, and consist of a brown sandy loam surface horizon 0.1m deep overlying a reddish brown sandy clay. Soil reaction trend is neutral or slightly alkaline. These soils are often badly scalded and gullied.

VEGETATION - Isolated specimens of Thozet’s box are often present on the scarp faces. The alluvial tracts support sparse bladder saltbush in association with a ground cover that includes woollyoat and eight-day grasses, winged chloris, katoora, fairy grass, various copper burrs and scattered tussocks of curly windmill grass. Thozet’s box is occasionally present on these areas. Main creek lines (i.e. Delaney Ck) are fringed by inland tea-tree and rarely northern myall.
This land unit description is from Grant (1987).

**DESCRIPTION** - Ironstone rises with sparse dead mulga and localised patches of fuchsia bush.

**LAND MANAGEMENT IMPLICATIONS**
This unit has negligible erosion hazard and very little grazing potential.
DESCRIPTION - Ironstone residuals; stony soils, bare or with sparse mulga.

GEOLOGY - Ferricrete associated with early Tertiary sandstone.

LANDFORM - Terrace residuals, including gently sloping terrace surfaces fringed by steep scarps, and low rises with smooth rounded crests.

SOIL - Virtually absent. Surfaces are comprised of ironstone gravel and cobbles.

VEGETATION - Absent, otherwise a sparse cover of annual grasses. Mulga (often dead), Thozet’s box and rock fuchsia bush are associated with small outcrops of sandstone and southern bluebush is present in conjunction with colluvial deposits.
DESCRIPTION - Level to gently undulating plains with sparse gravel cover. These areas support sparse grasses and isolated trees.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is high. Once vegetation cover has been removed by grazing the top soil is susceptible to wind and water sheeting with scalds forming where the clay sub-soil is exposed. The options for reclaiming such areas are to remove stock and allow the scald to be reclaimed naturally or build ponding banks which pond shallow expanses of water across the scald thereby promoting vegetation growth.

Pasture Management - This land unit would normally be moderately to highly productive. However, rabbits and cattle have removed most vegetation and there is very little regeneration. In good seasons annual and ephemeral species would probably grow in sufficient bulk to be of value for a short period before dying off.

Some areas have abundant dead timber, mainly mulga. This death may have been the result of wildfire with regeneration suppressed by rabbit and grazing impact.

It may be desirable on similar land units with more vegetation to implement rabbit control measures to help revegetation.
DESCRIPTION - Colluvial fans with granulite gravels; lithosols; a sparse tussock grassland of curly windmill grass and erect kerosene grass with isolated mulga.

GEOLOGY - Granulite of early Proterozoic age.

LANDFORM - Very gently undulating colluvial fans with slopes of up to 1% and relief to 1m. Infiltration is moderate with excess water running off by sheet flow into narrow dissecting drainage channels.

SOIL -

Example: Site 16 (3.5km north of 10 Mile Dam on the road to Sixteen Mile Tank).

**Classification:** Lithosols (Dr2.52) Chromosols - CH,AA,BD,CD,BGLOW. These soils have a strong texture contrast between the A and B horizons and are non-sodic. Surface: 20% subangular 80mm granulite and 7mm quartzite stones; cryptogam surface; sandy veneer; hard setting; surface crust.

- **0.0-0.1m:** **A1 Horizon:** yellowish red (5.0YR4/6); sandy loam; pH 7.0; massive structure and earthy fabric; very weak and slightly sticky consistency; 15% subangular quartz coarse fragments 7-15mm in size.

- **0.1-0.2m:** **A1 Horizon:** yellowish red (5.0YR4/6); sandy loam; pH 7.0; massive structure and earthy fabric; very weak and slightly sticky consistency; 20% 7mm granulite and 20mm quartz subangular coarse fragments.

- **0.2-0.3m:** **B21 Horizon:** dark red (2.5YR3/6); light clay (medium sandy); pH 7.0; massive structure and earthy fabric; weak and slightly sticky consistency; 50% 25mm granulite and 7mm quartz subangular coarse fragments 7-25mm in size.

- **0.3-0.5m:** **B21 Horizon:** dark red (2.5YR3/6); light clay (medium sandy); pH 7.0; massive structure and earthy fabric; weak and slightly sticky consistency; 30% 17mm subrounded and 4mm subangular granulite coarse fragments.

- **0.5-0.6m:** **B22K Horizon:** yellowish red (5.0YR4/6); light clay (medium sandy); pH 8.0; massive structure and earthy fabric; very weak and slightly sticky consistency; 10% subangular granulite coarse fragments 10mm in size.

- **0.5-0.6m:** **B22K Horizon:** yellowish red (5.0YR4/6); light clay (medium sandy); pH 8.0; massive structure and earthy fabric; very weak and slightly sticky consistency; 10% subangular granulite coarse fragments 10mm in size.

VEGETATION - A low sparse tussock grassland with isolated mulga.

Example: Site 16 (3.5km north of 10 Mile Dam on the road to Sixteen Mile Tank).

**UPPER STRATUM** Emergent isolated mulga.

**MID STRATUM** A mid-high sparse shrubland of very sparse caper bush, bloodwood and long-leaf corkwood.

**LOWER STRATUM** A low sparse tussock grassland of very sparse eight day grass, erect kerosene grass, silver sida, rough threeawn and curly windmill grass. After rain most of the annual grasses would be in far greater numbers than recorded here.
DESCRIPTION - Level to gently undulating plains with sparse gravel. These areas support a very open community of isolated mulga over sparse grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - This land unit has a low to moderate erosion hazard, the gravel cover providing some protection to the soil from wind. However, scalding and rilling may occur where the gravel has been removed.

Rabbits may exert severe grazing pressure on the pasture and it may be worth implementing rabbit control in the most productive areas.

Pasture Management - A land unit of moderate to high pastoral value depending on rainfall. After summer rain palatable and nutritious annual and perennial grasses grow. However, in dry seasons perennial grasses may be heavily grazed. When neverfail is being grazed this is an indication grazing pressure is too high.
DESCRIPTION - Level to gently undulating plains with sparse gravel; red calcareous soils; isolated mulga and red mallee over sparse *Eremophila* spp., sparse perennial grasses and caustic weed.

GEOLOGY - Undivided deeply weathered metamorphic rock of Tertiary age or older.

LANDFORM - Gently undulating colluvial fans with relief of up to 1m and slopes to 2.5%. Infiltration is slow to moderate with excess water running off by sheet flow into closely spaced incipient stream channels at the unit margins with widths of about 2m and depths of 30cm.

SOIL -

**Classification:** Red calcareous soils (Db1.13) Kandosol - KA,AA,AH,CD,BFMDW. These soils lack strong texture contrast and are usually calcareous throughout much of the solum. On the Hale Plain non-calcareous red earths may dominate.

**Surface:** 40% 9mm subangular and 3mm subrounded quartzite gravel; hard setting; sandy veneer; saline.

**0.0 - 0.1m:** **A1 Horizon:** yellowish red (5.0YR4/6); sandy clay loam; pH 9.0; very weak and slightly sticky consistence; strong rough faced subangular blocky primary 6mm and secondary 12mm peds; 5% subangular quartz coarse fragments; 1% calcareous nodules 7mm in size.

**0.1 - 0.2m:** **B1 Horizon:** yellowish red (5.0YR4/6); light clay; pH 9.0; slightly calcareous; very weak and slightly sticky consistence; strong smooth faced lenticular primary 3mm and secondary 8mm peds; 5% 9mm quartz and 4mm quartzite subangular coarse fragments.

**0.2 - 0.3m:** **B2 Horizon:** yellowish red (5.0YR4/6); light clay; pH 8.5; slightly calcareous; weak and slightly sticky consistence; strong rough faced subangular blocky primary 3mm and 8mm secondary peds; 1% subangular quartz coarse fragments 4mm in size; 1% calcareous nodules 4mm in size.

**0.4-0.5m:** **B21 Horizon:** yellowish red (5.0YR4/6); light clay; pH 8.5; slightly calcareous; weak and slightly sticky consistence; weak rough faced lenticular primary 3mm and 8mm secondary peds; 2% subangular quartz coarse fragments 4mm in size; 1% calcareous nodules 4mm in size.

**0.6-0.65m:** **B22 Horizon:** yellowish red (5.0YR4/6); light clay; pH 9.0; slightly calcareous; weak and slightly sticky; very weak rough faced subangular blocky primary 3mm and secondary 6mm peds; 2% subangular quartz coarse fragments 4mm in size; 1% calcareous nodules 4mm in size.

VEGETATION - Isolated mulga and red mallee over rough threeawn and narrow-leaf neverfail.

**Example:** Site 17 (1.5km east of Granite Bore).

**UPPER STRATUM** Isolated mulga and red mallee.

**MID STRATUM** A mid-high shrubland of isolated turpentine bush and caper bush.

**LOWER STRATUM** A grassland of isolated rough threeawn, narrow-leaf neverfail and caustic weed.
GENERAL LAND UNIT 5.3

DESCRIPTION - Gently undulating plains covered with sparse gravel and supporting an open woodland of red mallee, bastard coolibah and mulga over turpentine bush, witchetty bush, cotton panic grass, rough three awn and woollybutt.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The soils of this land unit have a moderate erosion hazard with scouring and water sheeting forming shallow drainage channels where stone cover has been disturbed. This erosion can be accelerated by cattle pads and roads which concentrate water flow. Therefore roads and fences should ideally be situated on less erodible land units or roads should be graded without windrows to avoid channelling water.

Pasture Management - This land unit has low pastoral value because there is normally only a sparse cover of palatable perennial grasses such as cotton panic grass, narrow-leaf neverfail and woollybutt. Mulga and witchetty bush do however provide limited topfeed during dry seasons.

The pasture is fairly robust under grazing but there will be a decrease in cotton panic grass, narrow-leaf neverfail and woollybutt following prolonged heavy grazing.
**TECHNICAL LAND UNIT 5.3**

**DESCRIPTION** - Gently undulating plains with sparse gravel; red calcareous soils; open woodland of red mallee, bastard coolibah and mulga over turpentine bush, witchetty bush, cotton panic grass, rough threeawn and woollybutt.

**GEOLOGY** - Southern Cross Schist of Proterozoic to Palaeozoic age.

**LANDFORM** - Gently undulating colluvial fans with sparse gravel, slopes of up to 2% and relief to 1m. Infiltration is slow with excess water running off by sheet flow into shallow rills which disperse water down slope.

**SOIL** –

<table>
<thead>
<tr>
<th>Example: Site 26 (2km west of Boundary Dam).</th>
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</thead>
</table>

**Classification:** Red calcareous soils (Uf 6.12) Kandosol-KA,AA,AH,CD,BFOOX. These soils have uniform fine textures throughout and are non-cracking.

**Surface:** 65% angular schist gravel; hard setting; surface crust; sandy veneer.

*0.0-0.1m: A1 Horizon:* dark red (2.5YR3/6); light clay; pH 9.0; firm and non-sticky consistence; weak subangular blocky rough faced primary 3mm and secondary 8mm peds; 2% subangular schist coarse fragments 4-7mm in size.

*0.1-0.2m: B21 Horizon:* dark red (2.5YR3/6); light clay; pH 9.0; firm and non-sticky consistence; weak subangular blocky rough faced primary 4mm -and 8mm secondary peds; 10% subangular schist coarse fragments 5-11mm in size.

*0.2-0.3m: B22 Horizon:* dark red (2.5YR3/6); light clay; pH 9.0; very firm and non-sticky consistence; weak subangular blocky rough-faced primary 5mm and secondary 9mm peds; 2% calcareous nodules 4mm in size.

*0.4-0.5m: B22 Horizon:* dark red (2.5YR3/6); light clay; pH 9.0; very firm and non-sticky consistence; weak subangular blocky rough-faced primary 4mm and secondary 8mm peds; 2% calcareous nodules 4mm in size.

*0.6-0.65m: B22k Horizon:* dark reddish brown (5.0YR3/4); light clay; pH 9.0; massive structure and earthy fabric; very firm and non-sticky consistence.

**VEGETATION** - A low open woodland of red mallee and mulga over very sparse grasses.

<table>
<thead>
<tr>
<th>Example: Site 26 (2km west of Boundary Dam).</th>
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</table>

**UPPER STRATUM** A low open woodland of sparse red mallee, bastard coolibah and mulga.

**MID STRATUM** A mid-high shrubland of sparse turpentine bush with very sparse witchetty bush, mulga and ruby saltbush.

**LOWER STRATUM** A grassland of very sparse, cotton panic grass, rough threeawn, narrow-leaf neverfail and woollybutt.
GENERAL

LAND UNIT 5.4

DESCRIPTION - Gently sloping rises with quartzite gravels. These areas support a woodland of mulga and whitewood over witchetty bush, rock fuchsia bush, turpentine bush, mulga grass and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because of dense stone cover. However, when clearing fencelines or access tracks, disturbance of surfaces should be minimised to limit the channelling of run-off onto more erodible units.

Pasture Management - This unit has low pastoral value because of palatable species although mulga and witchetty bush do provide limited topfeed in dry seasons.

Poor range condition is apparent when witchetty bush and mulga have been heavily grazed and palatable perennial grasses are generally confined to areas out of stock reach.
TECHNICAL LAND UNIT 5.4

DESCRIPTION - Gently sloping colluvial fans with abundant quartzite cobbles; lithosols; low open woodland of scattered mulga and whitewood over witchetty bush, rock fuchsia bush, turpentine bush, mulga grass and a variety of forbs.

GEOLOGY - Fanglomerate, dissected alluvium and colluvium of Quaternary age.

LANDFORM - Gently sloping fans with colluvial cobbles and gravels, lying at the base of mountain slopes (see Land Unit 1.1). Fan surfaces are extremely gravelly and have slopes of at least 3%. Infiltration is slow with runoff flowing down slope into narrow watercourses and channels which traverse the unit.

SOIL -

Example: Site 48 (2.5km north of Georgina Gap Dam on the road to Delaney Dam).

Classification: Lithosols, soils with little profile development derived from weathering of parent material.

Surface: 90% subangular tabular cobbles and gravel; sandy veneer.
0.0-0.1m: A1 Horizon: dark red (2.5YR3/6); sandy clay loam; pH 7.0; massive structure and earthy fabric; weak and slightly sticky consistence.

VEGETATION - A low open woodland of mulga and whitewood over sparse shrubs and grasses.

Example: Site 48 (2.5km north of Georgina Gap Dam on the road to Delaney Dam).

UPPER STRATUM  A low open woodland of sparse mulga, whitewood and bloodwood.

MID STRATUM  A mid-high sparse shrubland of witchetty bush, rock fuchsia bush, turpentine bush, mulga and long-leaf corkwood.

LOWER STRATUM  A low very sparse tussock grassland of five-minute grass and mulga grass. Forbs include desert spurge, caltrop, hairy goodenia, ruby saltbush and crimson foxtail.
GENERAL LAND UNIT 5.5

DESCRIPTION - Stony rises supporting southern bluebush and annual grasses.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is low because the surface is covered by stones. However, where the surface has been disturbed rilling and windsheeting may occur.

Pasture Management - This land unit has low to moderate pastoral value. In good seasons, highly palatable oatgrasses grow but usually don’t constitute much bulk. At other times southern bluebush provides good drought feed. As bluebush and oatgrass are sensitive to heavy grazing this unit is in good condition when there is a good cover of bluebush and oatgrass in favourable seasons.

Rabbits are often common and can significantly reduce feed. However, during long dry periods rabbits usually experience major decline, increasing again in good seasons. Therefore warren ripping in dry seasons may be an option to prevent rabbits grazing more productive neighbouring units.
TECHNICAL LAND UNIT 5.5

DESCRIPTION - Breakaway slopes and residuals; stony lithosols; low open shrubland of southern bluebush and sparse annual grasses.

GEOLOGY - Quaternary colluvium derived from late Proterozoic quartzites.

LANDFORM - Breakaway slopes and residuals with relief to 2m and slopes of up to 2%. Drainage is rapid as infiltration is low with excess water running down slope by sheet flow.

Example: Site 76 (2.5 km east of Hill Soakage Dam).

SOIL -

Classification: Lithosols (Dr2.53) Chromosols - CH,AB,AH,CD,BFLOU. These are shallow soil which have a strong texture contrast between the A and B horizons.

Surface: 50% 5-25mm angular quartzite gravel; sandy veneer; hard setting

0.0-0.1m: A1 Horizon: reddish brown (5.0YR4/4); sandy loam; pH 6.5; non-calcareous; massive structure and earthy fabric; weak and non-sticky consistence; 5% 5-25mm angular quartzite coarse fragments.

0.1-0.2m: B1 Horizon: yellowish red (5.0YR4/6); light medium clay; pH 8.0; non-calcareous; massive structure and earthy fabric; firm and slightly sticky consistence.

0.2-0.3m: B12 Horizon: dark brown (7.5YR4/4); light medium clay; pH 8.0; non-calcareous; massive structure and earthy fabric; firm and slightly sticky consistence.

0.3-0.4m: C Horizon: dark brown (7.5YR4/4); light medium clay; pH 8.5; non-calcareous; massive structure and earthy fabric; firm and slightly sticky consistence; 5% 2-5mm subangular weathered quartz coarse fragments.

VEGETATION - A low sparse chenopod shrubland of southern bluebush over an annual grassland.

Example: Site 76 (2.5 km east of Hill Soakage Dam).

UPPER STRATUM Isolated mulga and witchetty bush.

MID STRATUM A mid-high very sparse shrubland of turpentine bush, *Rhagodia eremaea*, cottonbush and witchetty bush.

LOWER STRATUM A low sparse chenopod shrubland of southern bluebush with isolated bladder saltbush over annual grasses of button grass, five-minute grass, woollyoat grass, oatgrass, limestone oatgrass, small-burr grass and bunched kerosene grass. Forbs include munyeroo, caustic weed, copper-burr, hairy goodenia and *Ptilotus parvifolius*. 
GENERAL LAND UNIT 6.1

DESCRIPTION - Bedrock plains supporting an open woodland of mulga and witchetty bush over curly windmill grass, cotton panic grass, annual grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is moderate to high. The sandy topsoil is susceptible to wind and water erosion especially after periods of low rainfall when intense storms may promote rill, scald and gully erosion.

Graded lines or tracks across this unit may divert sheet flow and scour out. To minimise erosion potential, tracks and watering points should be located on adjacent, more stable land types and conservative stocking rates should be implemented to retain vegetation cover. On this unit tracks should be located on crests or upper slopes and constructed without developing windrows.

Pasture Management - This land unit has moderate to high pastoral value. During dry seasons witchetty bush and mulga provide useful topfeed and after rain annual and ephemeral plants grow which are suitable for fattening cattle.

Prolonged heavy grazing will lead to a decrease in palatable annual and perennial grasses and an increase in buckbush and bindyis which do not provide soil cover during dry seasons.
TECHNICAL

TECHNICAL LAND UNIT 6.1

DESCRIPTION - Level to gently undulating plains on granite; red earths; low open woodland of mulga and witchetty bush over curly windmill grass, cotton panic grass, annual grasses and forbs.

GEOLOGY - Gneissic granites of Proterozoic age and Quaternary alluvium.

LANDFORM - Level to gently undulating plains with slopes of less than 1% and relief to 1m. Drainage is predominantly by sheet flow into widely spaced (625-1000m) stream channels.

SOIL -
Example: Site 49 (0.3km north of Georgina Gap Dam).

Classification: Red earth (Dr1.22) Kandosol - KA, AA,AG,AT,BFLOU. Medium textured poorly structured soils increasing in clay content with depth.

Surface:
- **A1 Horizon**: dark reddish brown (5.0YR3/4); sandy loam; pH 6.0; massive structure and earthy fabric; firm and non-sticky consistence; 2% subangular quartz coarse fragments 4-6mm in size.
- **A2 Horizon**: yellowish red (5.0YR4/6); sandy loam; pH 6.5; massive structure and earthy fabric; firm and non-sticky consistence; 2% subangular quartzite coarse fragments 4-8mm in size.
- **B1 Horizon**: yellowish red (5.0YR4/6); sandy clay loam; pH 6.5; massive structure and earthy fabric; 1% subrounded quartzite coarse fragments 4mm in size.
- **B21 Horizon**: yellowish red (5.0YR4/6); light clay; pH 6.5; weak rough faced subangular blocky primary 5mm and secondary 15mm peds; weak and slightly sticky consistence; 1% subangular gneiss coarse fragments 5mm in size.
- **C Horizon**: red (2.5YR4/6); light clay; pH 7.0; weak rough faced subangular blocky primary 5mm and secondary 15mm peds; weak and slightly sticky consistence; 40% subrounded gneiss coarse fragments 4-10mm in size.

VEGETATION - A low open woodland of mulga and witchetty bush over sparse grasses.

Example: Site 49 (0.3km north of Georgina Gap Dam).

UPPER STRATUM A low open woodland of sparse mulga and witchetty bush with very sparse whitewood, bloodwood and long-leaf corkwood.

MID STRATUM A mid-high sparse shrubland of mulga, dead finish, witchetty bush, Acacia bush, *Rhogodia eremaeae*, whitewood, weeping emu bush and weeping pittosporum.

LOWER STRATUM A low sparse tussock grassland of button grass, five-minute grass, mountain wanderrie, eight day grass, curly windmill grass, kangaroo grass, erect kerosene grass, cotton panic grass, woollyoat grass and green summer grass. Forbs include caltrop, caustic weed, munyeroo, potato bush, sticky indigo, *Sclerolaena costata*, buckbush and bush banana. Climbing saltbush was also recorded.
GENERAL

LAND UNIT 6.2

DESCRIPTION - Level to gently undulating calcareous plains. These areas support an open woodland of ironwood and Acacia bush over sparse grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of this land unit is high because it is susceptible to both wind and water erosion, especially during dry periods when vegetation is sparse and intense storms promote rilling, scouring of stream channels and scalding. Thus this land unit should be spelled or only low numbers of stock should be grazed to maintain vegetation cover during dry seasons.

Graded lines or tracks with windrows across the unit may divert sheet flood flows and scour out. To maximise traffic ability and minimise erosion potential, tracks should be located on adjacent, more stable land types or constructed with adequate drainage. Watering points are also ideally located elsewhere.

Pasture Management - This land unit is of moderate to high pastoral value. Normally there is a range of palatable perennial grasses and after rain annual and ephemeral species. However, as the photograph shows this unit is susceptible to heavy grazing by rabbits and stock. The palatable perennial grasses have been removed and the pasture is dominated by ephemeral species. There is also very little regeneration of trees and shrubs.

Conservative stocking rates should be implemented and rabbit control measures might be used to reduce rabbit numbers.
TECHNICAL LAND UNIT 6.2

DESCRIPTION - Level to gently undulating plains on calcareous rock; red calcareous soils; low very open woodland of ironwood over Acacia bush, witchetty bush, turpentine bush, perennial grasses (curly windmill grass, wire grass) annual grasses (oatgrass, and five minute grass) and a variety of forbs.

GEOLOGY - Calcareous Arunta Block granulites of Proterozoic age.

LANDFORM - Level to gently undulating pediment plains with sparse surface gravel, slopes of up to 1% and relief to 1m. Infiltration is slow with surface water running off by sheet flow into moderately spaced stream channels 1.5m wide and 0.6m deep.

SOIL –

Example: Site 22 (6.5km north of 10 Mile Dam).

Classification: Red calcareous soils (Uf 6.71) Calcarosol - CA,CQ,BM,CD,HOOOW.

Surface: Hard setting; surface crust; sandy veneer.

0.0-0.1m: A11 Horizon: reddish brown (5.0YR4/4); light clay; pH 9.5; massive structure and earthy fabric; firm and non-sticky consistence; 27% granulite subangular coarse fragments 6-10mm in size.

0.1-0.2m: A12 Horizon: yellowish red (5.0YR4/6); light clay; pH 9.5; massive structure and earthy fabric; firm and non-sticky consistence; 5% granulite subangular coarse fragments 6-10mm in size.

0.2-0.3m: A3 Horizon: yellowish red (5.0YR4/6); light clay; pH 9.5; massive structure and earthy fabric; firm and non-sticky consistence; 20% granulite subangular coarse fragments 7-15mm in size.

0.4-0.5m: A3 Horizon: yellowish red (5.0YR4/6); light clay (medium sandy); pH 9.5; massive structure and earthy fabric; weak and non-sticky consistence; 60% granulite subangular coarse fragments 7-20mm in size.

0.5-0.6m: B1 Horizon: strong brown (7.5YR4/6); light clay (medium sandy); pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 15% granulite subangular coarse fragments 7-10mm in size.

0.7-0.8m: B12 Horizon: dark brown (7.5YR4/4); light clay (medium sandy); pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 10% granulite subangular coarse fragments 6-15mm in size.

1.00-1.10m: B2 Horizon: yellowish red (5.0YR4/6); light clay (medium sandy); pH 9.5; massive structure and earthy fabric; very weak and non-sticky consistence; 20% granulite subangular coarse fragments 5-15mm in size; 7% calcareous nodules 3-10mm in size.

VEGETATION - Isolated ironwood over very sparse grasses and forbs.

Example: Site 22 (6.5km north of 10 Mile Dam).

UPPER STRATUM Isolated ironwood.

MID STRATUM Isolated Acacia bush, witchetty bush and turpentine bush.

LOWER STRATUM A low sparse tussock grassland of curly windmill grass, rough threeawn, five-minute grass, woolly oat grass, silky browntop and desert bluegrass. Forbs include bush banana, climbing saltbush and buckbush.
GENERAL LAND UNIT 6.3

DESCRIPTION - Level to gently undulating plains with rock outcrop. These areas support grasslands of mulga grass, curly windmill grass, annual grasses and forbs. There is also isolated mulga and long-leaf corkwood.

LAND MANAGEMENT IMPLICATIONS

Soil Management - This unit has a moderate to high erosion hazard because the soil is susceptible to both wind and water sheeting. When soil is disturbed storm runoff may initiate rills which develop into gullies where surface flows are concentrated. Thus new roads should be planned on aerial photographs to follow the crests or contour and avoid low lying areas where runoff flows will be greatest. Roads should also be graded without windrows and constructed with adequate drainage.

Pasture Management - This land unit has high pastoral value. Following rain a variety of palatable annual and ephemeral plants grow and in dry seasons perennial grasses and topfeed species such as mulga and witchetty bush provide drought feed.

Conservative stocking rates should be used to maintain pasture condition by not allowing palatable grasses to decrease in abundance and be replaced by buckbush and bindyis which do not provide drought feed.
TECHNICAL LAND UNIT 6.3

DESCRIPTION - Open plains on gneiss with sparse outcrop; red earths; tussock grassland of mulga grass, curly windmill grass, annual grasses and forbs. Isolated long-leaf corkwood and mulga also grow.

GEOLOGY - Randall Peak Metamorphics of early Proterozoic age.

LANDFORM - Level to undulating pediment plains with sparse outcrop with slopes of up to 1% and relief of less than 1m. Surface water runs off as sheet flow into widely spaced (625-1000m) stream channels.

SOIL -

Example: Site 71 (4.5km north of Bulltrap Bore).

**Classification**: Red earth (Uc1.23) Kandosol - KA,AB,DO,CD,BHKLV. Medium textured soils usually with a coarse sandy surface.

**Surface**: Sandy veneer; hard setting.

<table>
<thead>
<tr>
<th>Depth</th>
<th>Horizon</th>
<th>Color</th>
<th>Texture</th>
<th>pH</th>
<th>Structure</th>
<th>Consistence</th>
<th>Fragments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0.01m</td>
<td>A1 Horizon</td>
<td>dark brown (7.5YR 3/4); loamy sand; pH 7.0; massive structure and earthy fabric; moderately weak and non-sticky consistence; 20% subangular gneiss coarse fragments 5-10mm in size.</td>
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<tr>
<td>0.1-0.2m</td>
<td>A3 Horizon</td>
<td>dark reddish brown (5.0YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; weak and non-sticky consistence; 20% angular 10mm to subangular 6mm gneiss coarse fragments.</td>
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<tr>
<td>0.2-0.3m</td>
<td>B1 Horizon</td>
<td>dark brown (5.0YR3/4); loamy sand; pH 7.0; massive structure and earthy fabric; weak and non-sticky consistence; 50% subangular gneiss coarse fragments 6-10mm in size.</td>
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<tr>
<td>0.4-0.5m</td>
<td>B12 Horizon</td>
<td>dark brown (7.5YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; weak and non-sticky consistence; 30% gneiss subrounded tabular coarse fragments 4-12mm in size.</td>
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<tr>
<td>0.6-0.7m</td>
<td>B2 Horizon</td>
<td>dark yellowish brown (10.0YR3/4); sand; pH 7.0; massive structure and earthy fabric; weak and non-sticky consistence; 30% 10mm subangular to 5mm subrounded tabular gneiss coarse fragments.</td>
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</tbody>
</table>

VEGETATION - A low sparse tussock grassland of sparse annual grasses with an over storey of isolated long-leaf corkwood and mulga.

Example: Site 71 (4.5km north of Bulltrap Bore).

**UPPER STRATUM**

Isolated emergent long-leaf corkwood, witchetty bush, bloodwood, mulga and whitewood.

**MID STRATUM**

Not-present

**LOWER STRATUM**

A low sparse tussock grassland of five-minute grass, eight-day grass, rough threeawn, mulga grass, curly windmill grass, green summer grass and button grass. Forbs include colocynth, sticky indigo, potato bush, caustic weed, munyeroo, caltrop and buckbush.
GENERAL  LAND UNIT 6.4

This land unit description is from Grant (1987).

DESCRIPTION - Open bedrock plains with shallow red earth soils supporting scattered mulga over annual grass pasture.

LAND MANAGEMENT IMPLICATIONS
This landscape has a slight water erosion hazard. Storm runoff is likely to initiate rilling where surface flows are concentrated along tracks or stock pads. Prolonged overgrazing is likely to result in an increase in the proportion of mulga grass and herbage species in the pasture. Rabbits favour the calcareous soils of this unit.
TECHNICAL LAND UNIT 6.4

DESCRIPTION - Plains; shallow red earths; low open woodland of sparse mulga over annual grasses.

GEOLOGY - Weathered early Proterozoic rocks, mainly granites and gneisses.

LANDFORM - Very gently-sloping pediment surfaces, with some small areas of bare rock or limestone gravel. These plains drain by sheet flow.

SOIL - Red earths (Gn 2.13), consisting of gritty, dark reddish brown sandy clay loams at the surface, graduating to slightly calcareous, red light clays at about 0.5m. They are slightly alkaline throughout the profile, and nodules of carbonate occur at depth, overlying granite.

VEGETATION - Scattered mulga or fork-leaved corkwood in association with an annual grassland of woollybutt, oat and mulga grasses. Wire grass and herbage species including common sida, munyeroo and potato bush are sometimes present.
This land unit description is from Grant (1987).

**DESCRIPTION** - Gently sloping gilgaied plains with Mitchell grass and narrow-leaf neverfail grasses.

**LAND MANAGEMENT IMPLICATIONS** This unit has slight erosion hazard. Storm runoff may initiate rilling where surface flows are concentrated along graded tracks. Prolonged overgrazing is likely to result in an increase in the proportion of limestone oatgrass.
DESCRIPTION - Gilgaid plains; stony calcareous soils with mitchell and annual grasses.

GEOLOGY - Mid-Tertiary limestones and siltstone (Waite Formation), and some Quaternary colluvium.

LANDFORM - Pediment surfaces (erosional surfaces formed by scarp retreat), partly mantled by Quaternary colluvium, comprising gently-sloping plains with low relief having crabhole and linear gilgai micro-relief.

SOIL - Stony, highly calcareous and alkaline soils. Brown gradational soils (Gc1.22) occur between the gilgai depressions. Soil texture graduates from a sandy clay loam at the surface to a medium clay at 0.5m. Yellowish red clay soils (Ug5.3) light to medium clay in texture, occupy the gilgai depressions. Calcrete gravel is abundant on surfaces near areas of outcrop, but diminishes with distance down slope, where the surface mantle consists mainly of quartzite gravel and cobbles.

VEGETATION - An annual grassland of oat and limestone oatgrasses, with neverfail and curly Mitchell grasses within the gilgai depressions. Sparse Acacia bush or needlewood is present on some down slope areas.
DESCRIPTION - Floodplains with ironwood and river red gum over wire grasses, buffel grass and forbs or river red gum and fork-leaved corkwood over mulga grass, button grass, woollyoat grass, five-minute grass and forbs. Two distinctive land units occur (Unit 7.1a and 7.1b) along the major river channels. These both have similar landform but can be separated on vegetation type.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion hazard of these land units is low provided vegetation cover is maintained. However, if stock are allowed to concentrate on these units then erosion of banks and scouring of floodouts may occur. Windsheeting may also occur when the ground surface is bare.

Where possible roads should cross this unit at right angles to the direction of low. Adequate drainage must be provided at entry points to creek crossings. Tracks located parallel to creek lines tend to get scoured during major floods, especially if they are graded with prominent windrows.

Pasture Management - These land units have high pastoral value. Following rain, annual and ephemeral plants grow which are actively sought by stock. Green perennial grasses are also very palatable, becoming less palatable as they hay off and digestibility and nutritional value declines but they still provide moderate drought fodder.

These land units are in good condition when there is a high proportion of desirable perennial grasses e.g. creek windmill grass and in poor condition the perennial and annual grasses will have decreased to be replaced by ephemeral species such as wire grasses.
TECHNICAL LAND UNIT 7.1 a

DESCRIPTION - Level floodplains; red alluvial soils; low open woodland of ironwood and river red gum over wire grasses and forbs or river red gum and fork-leaved corkwood over mulga grass, button grass, woollyoat grass, five-minute grass and forbs.

GEOLOGY - Holocene alluvium.

LANDFORM - Floodplains along river channels and larger creeks (Hale River and Winnecke Creek). The floodplains are approximately 30m wide and have slopes of about 0.5% in the direction of flow.

SOIL -

<table>
<thead>
<tr>
<th>Classification</th>
<th>Example: Site 14 (1km south west of Granite Bore).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Sandy veneer; cryptogam crust; loose.</td>
</tr>
<tr>
<td>0.0-0.1m: A1 Horizon</td>
<td>dark brown (7.5YR3/4); sandy loam; pH 8.0; massive structure and earthy fabric; very weak and slightly sticky consistence; 6% subangular to subrounded gneiss coarse fragments 4-8mm in size.</td>
</tr>
<tr>
<td>0.1-0.2m: A3 Horizon</td>
<td>dark brown (7.5YR3/2); coarse sandy loam; pH 8.5; massive structure and earthy fabric; very weak and slightly sticky consistence; 40% subangular gneiss coarse fragments 5-10mm in size.</td>
</tr>
<tr>
<td>0.2-0.3m: A3 Horizon</td>
<td>very dark brown (10.0YR2/2); loamy sand (coarse); pH 8.5; single grained and sandy; loose and slightly sticky consistence; 50% subangular gneiss coarse fragments 5-10mm in size.</td>
</tr>
<tr>
<td>0.4-0.50m: A3 Horizon</td>
<td>dark brown (7.5YR3/4); clayey sand (coarse sandy); pH 9.0; single grained and sandy; very weak and slightly sticky consistence; 50% subangular gneiss coarse fragments 5-10mm in size.</td>
</tr>
<tr>
<td>0.65-0.75m: 2A1 Horizon</td>
<td>dark brown (7.5YR3/4); sandy loam (medium sandy); pH 9.0; massive structure and earthy fabric; very weak and slightly sticky consistence; 5% subangular gneiss coarse fragments 5mm in size.</td>
</tr>
<tr>
<td>0.95-1.10m: 2A1 Horizon</td>
<td>dark brown (7.5YR3/4); sandy loam; pH 9.0; massive structure and earthy fabric; very weak and slightly sticky consistence; 2% subangular gneiss coarse fragments 5mm in size.</td>
</tr>
</tbody>
</table>

VEGETATION - Emergent ironwood and river red gum over kerosene grasses and forbs.

| Example: Site 14 (1km south west of Granite Bore). |
| UPPER STRATUM | Emergent ironwood with river red gum lining the river channels. |
| MID STRATUM    | A mid-high very sparse shrubland of inland teatree, black teatree, turpentine bush and caper bush. |
| LOWER STRATUM  | A mid-high sparse tussock grassland of creek windmill grass, two gland threeawn and rough threeawn with sparse ground cover of woolly glyicine, potato bush, buffel grass, silver sida, tall yellow top and Phylanthus spp. |
GENERAL LAND UNIT 7.1b

DESCRIPTION - Floodplains with river red gum and fork-leaved corkwood over mulga grass, button grass and forbs.

LAND MANAGEMENT IMPLICATIONS

See Land Unit 7.1a.
DESCRIPTION - Level floodplains; red alluvial soils; low open woodland of river red gum and fork-leaved corkwood over mulga grass, button grass, woollyoat grass, five minute grass and forbs.

GEOLOGY - Halocene alluvium.

LANDFORM - Floodplains along river channels and larger creeks. The floodplains are approximately 30m wide and have slopes of about 0.5%.

SOIL –

Example: Site 73 (1.7km south of Bulltrap Bore).

Classification: Red alluvial soils (Uc1.24) Rudosols - RU, AR, FA,GFIKV. Poorly developed young soils deposited by overbank flows.

Surface: Hard setting, sandy veneer.

0.0 - 0.1m: A1 Horizon: dark brown (7.5YR3/3); loamy sand; pH 7.0; single grained sand; loose consistence; 3% subangular and angular quartzite course fragments 2-5mm in size.

0.1 - 0.2m: A3 Horizon: dark brown (7.5YR3/3); loamy sand; pH 7.0; single grained sand; loose consistence; 3% subangular quartzite course fragments 2-5mm in size.

0.2 - 0.3m: A3 Horizon: dark brown (7.5YR3/3); loamy sand; pH 7.0; single grained sand; loose consistence; 3% subangular quartzite course fragments 2-5mm in size.

0.4 - 0.5m: A3 Horizon: dark brown (7.5YR3/3); loamy sand; pH 8.0; single grained sand; loose consistence; 5% subangular quartzite course fragments 2-7mm in size.

0.6 - 0.7m: A3 Horizon: dark brown (7.5YR3/3); loamy sand; pH 8.5; single grained sand; loose consistence; 10% subangular and angular quartzite course fragments 3-7mm in size.

VEGETATION - A low open woodland of river red gum and fork-leaved corkwood over a grassland of predominantly annual grasses and forbs.

Example: Site 73 (1.7km south of Bulltrap Bore).

UPPER STRATUM A low open woodland of sparse fork-leaf corkwood, native orange, Acacia bush and ironwood.

MID STRATUM A low sparse shrubland of dead finish and fork-leaf corkwood.

LOWER STRATUM A sparse grassland of button grass, small-burr grass, pitted lovegrass, woollyoat grass, purple plumegrass, mulga grass, five-minute grass and feathertop wiregrass. Forbs include colocynth, tickweed, fairy bells, potato bush, munyeroo, boggabri, caustic weed and snake vine.
DESCRIPTION - Level floodplains with oldman saltbush over grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - This land unit has a high erosion hazard. Saltbush is an important soil stabiliser but can be weakened by grazing or removed by the construction of roads which may lead to rilling and large gullies forming.

Roads across this unit may divert sheet flow and scour out. To minimise erosion potential, tracks and watering points should be located on adjacent, more stable and less productive land types.

Pasture Management - This land unit has moderate pastoral value as oldman saltbushes are moderately palatable and nutritious and withstand grazing well. Although, they may be selectively grazed during dry periods when more palatable plants are not available. At these times saltbushes should be monitored and stocking rates varied with bush condition.

Poor range condition is evident when saltbushes show a browse line within grazing height of stock and palatable grasses are replaced by ephemeral species in good seasons.

Rabbits exert severe grazing pressure from warrens situated under the saltbushes. However, control is difficult due to the inaccessibility of warrens and abundance of surface dwelling rabbits.
TECHNICAL LAND UNIT 7.2

DESCRIPTION - Level floodplains; alluvial soils; tall open chenopod shrubland of oldman saltbush and scattered river red gum over sparse creek windmill grass, buffel grass, desert bluegrass and forbs.

GEOLOGY - Holocene alluvium.

LANDFORM - Level floodplains with slopes of less than 1% and relief to 0.3m. This unit is drained by well defined tributary channels about 2m wide which dissect this unit.

SOIL –

Example: Site 60 (3.7km south of Bulltrap Bore).

Classification: Alluvial soils (Uc1.23) Rudosol - RU,AO,FA,EJW. Brown sandy soils with weak pedological structure.

Surface: Hard setting; sandy veneer.

0.0-0.1m: A1 Horizon: dark reddish brown (5.0YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; loose and non-sticky consistence.

0.1-0.2m: A3 Horizon dark reddish brown (5.0YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; loose and non-sticky consistence.

0.2-0.3m: A3 Horizon dark reddish brown (5.0YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; loose and non-sticky consistence.

0.4-0.5m: A3 Horizon dark reddish brown (5.0YR3/3); loamy sand; pH 7.0; massive structure and earthy fabric; loose and non-sticky consistence.

0.6-0.7m: A3 Horizon dark reddish brown (5.0YR3/3); loamy sand; pH 7.5; massive structure and earthy fabric; loose and non-sticky consistence.

0.90-0.100m: A3 Horizon dark reddish brown (5.0YR3/3); loamy sand; pH 7.5; massive structure and earthy fabric; loose and non-sticky consistence.

VEGETATION - A tall open chenopod shrubland of oldman saltbush over sparse forbs.

Example: Site 60 (3.7km south of Bulltrap Bore).

UPPER STRATUM Emergent scattered river red gum.

MID STRATUM A tall open chenopod shrubland of old man saltbush.

LOWER STRATUM A low sparse forblend of caltrop, caustic weed, tall yellow top, wild melon and munyeroo. Grasses include buffel grass, purple plumegrass, desert bluegrass, rough threeawn, creek windmill grass and erect kerosene grass.
GENERAL LAND UNIT 7.3

DESCRIPTION - Level to gently undulating plains supporting an open shrubland of cottonbush and turpentine bush over grasses and forbs.

LAND MANAGEMENT IMPLICATIONS

Soil Management - The erosion risk of this land unit is high, especially after periods of low rainfall when intense storms may promote serious rill, scald and minor gully erosion. Therefore, fences, tracks and watering points should be located elsewhere. Where tracks must be located on this unit they need to be carefully planned and constructed without windrows to avoid channelling run-off.

Pasture Management - This land unit has high pastoral value, especially following rain when a large range of highly palatable and nutritious plants grow. Drought feed is also prevalent and consists of a variety of perennial grasses, the most important being woollybutt and curly windmill grass. These grasses may decline following periods of heavy grazing.

These areas attract heavy grazing by stock and should be periodically spelled to allow plants to recover and set seed. Otherwise there will be a decline in palatable grasses and an increase in unpalatable bindyis and buckbush which will not provide dry season forage.

Rabbits were noted and may exert moderate grazing pressure. Therefore, management may wish to implement control measures to reduce rabbit impact on the pasture.
TECHNICAL LAND UNIT 7.3

DESCRIPTION - Level to gently undulating plains; red earths; tall open chenopod shrubland of cottonbush, turpentine bush and ironwood over curly windmill grass, buffel grass, golden beard grass, woollybutt, annual grasses and forbs.

GEOLOGY - Quaternary alluvium.

LANDFORM - Level to gently undulating alluvial plains with slopes of up to 1% and relief to 1m. Infiltration is moderate with surface water running off by sheet flow into a series of rills and small gullies.

Example: Site 43 (500m along the track to Granite Bore from the main road to the Alice Springs turnoff).

SOIL -

Classification: Red brown earth (Dr2.13) Dermosol - DE,AA,AG,CD,AEKOV. These soils have a distinct texture contrast and commonly scald.

Surface: Loose; sandy veneer; hard setting.

0.0-0.01m: A1 Horizon: dark reddish brown (2.5YR3/4); loamy sand; pH 6.5; massive structure and earthy fabric; weak and slightly sticky consistence.

0.01-0.02m: A3 Horizon: dark reddish brown (2.5YR3/4); loamy sand; pH 6.0; massive structure and earthy fabric; weak and moderately sticky consistence; 0.5% subangular quartzite coarse fragments 0.2mm in size.

0.02-0.03m: B1 Horizon: red (2.5YR4/6); light clay (sandy); pH 6.0; weak rough faced primary 4mm and secondary 15mm peds; weak and moderately sticky consistence; 4% subangular quartzite coarse fragments 1mm in size.

0.03-0.04m: B21 Horizon: red (2.5YR4/6); light medium clay; pH 6.5; strong smooth faced primary 15mm and secondary 30mm peds; very firm and moderately sticky consistence.

0.05-0.06m: B22 Horizon: red (2.5YR4/6); medium clay; pH 8.5; strong rough faced primary 5mm and secondary 25mm peds; firm and moderately sticky consistence.

VEGETATION - A mid-high open shrubland of isolated turpentine bush and witchetty bush over cottonbush, grasses and forbs.

Example: Site 43 (500m along the track to Granite Bore from the main road to the Alice Springs turnoff).

UPPER STRATUM Isolated turpentine bush, ironwood and witchetty bush.

MID STRATUM Isolated cottonbush.

LOWER STRATUM A low sparse tussock grassland of curly windmill grass, buffel grass, rough threeawn, golden beard grass, eight day grass, woollybutt, katoora, button grass, fairy grass, creek windmill grass, winged chloris, umbrella grass and mallee lovegrass. Other plants include climbing saltbush, grey copper burr, Sclerolaena divaricata, hairy goodenia, tar vine, caltrop, munyeroo and potato bush.
This land unit description is from Grant (1987).

DESCRIPTION - Floodplains country with sandy alluvial soils supporting scattered corkwoods with kerosene grass pastures.

LAND MANAGEMENT IMPLICATIONS
This unit has a moderate wind erosion hazard and is subject to drift if denuded. The kerosene grass pastures are relatively resilient to grazing pressure. Prolonged overgrazing will probably result in a decline in the abundance of woollyoat and blunt leaf cassia and an increase in the growth of wire grass and herbage. Rabbits were noted in localised areas on this landscape.
DESCRIPTION - Floodplains and floodouts; sandy alluvial soils; sparse corkwood over kerosene grass.

GEOLOGY - Holocene alluvium.

LANDFORM - Broad sandy floodplains and floodouts along the Hale River and its major tributaries, up to 800m in width. Levee banks and other surface relief are generally absent.

SOIL - Dark reddish brown alluvial soils (Uc 1.23) exhibiting little profile development. They are usually sandy loam in texture to a depth of 0.4m, often graduating to a coarse sandy clay loam beneath this depth. They are non-calcareous with a neutral reaction trend.

VEGETATION - Sparse fork-leaved corkwood and occasionally ironwood or prickly wattle over mainly kerosene grass. Woollyoat grass comprises only a minor component of pasture growth, together with tussock grasses including curly windmill grass and blunt leaf cassia which are present beneath the tree canopy, and herbage species such as potato bush and munyeroo.
This land unit description is from Grant (1987).

**DESCRIPTION** - Floodout areas with sandy soils supporting perennial grasses with localized dense thickets of red gum saplings.

**LAND MANAGEMENT IMPLICATIONS**
Pastures grow rank and are generally ignored by stock except when new growth is available. Soil erosion is unlikely unless the drainage flow is channelled by earthworks or gullying on an adjacent landform.
**TECHNICAL LAND UNIT 7.5**

**DESCRIPTION** - Drainage floors; alluvial soils with occasional red gum over dense curly windmill grass.

**GEOLOGY** - Holocene alluvium.

**LANDFORM** - Shallow drainage tracts, including flood channels on floodplains, depressions adjacent to floodout areas and tributary valley floors in low hill country. Narrow watercourse channels are sometimes present.

**SOIL** - Medium textured alluvial soils (Um1.43). Typical profiles consist of a dark brown sandy clay loam horizon overlying a dark reddish brown light clay at 0.5m. Soils are slightly alkaline at depth but non-calcareous.

**VEGETATION** - Scattered red gum, ghost gum or ironwood over a dense tussock grassland of curly windmill grass, silky browntop, kangaroo grass and Queensland bluegrass.
This land unit description is from Grant (1987).

**DESCRIPTION** - Drainage depressions with loamy soils supporting dense perennial grasses and scattered red gum.

**LAND MANAGEMENT IMPLICATIONS**
Stock may use these areas as harbour during mustering operations. The unit is small in extent and presents no erosion problems. The density of red gum regeneration has increased spectacularly since the early 1970's (ref.1971 1:80,000 black and white aerial photos) in response to favourable seasonal conditions.
DESCRIPTION - Drainage floors; alluvial soils with dense red gum over curly windmill grass.

GEOLOGY - Holocene alluvium.

LANDFORM - Terminal lobes of floodouts where flood deposition is presently active.

SOIL - Coarse-textured brown alluvial soils with bed load sand and gravels.

VEGETATION - A closed forest formation of red gum saplings. Ground-cover is generally absent, but perennial tussock grasses such as curly windmill grass may be present.
REFERENCES


*Munsell Soil Colour Charts* (Munsell Colour Co. Inc. Baltimore 18, Maryland 21218, U.S.A.)


APPENDIX

PLANTS RECORDED DURING THE GARDEN SURVEY

This appendix is arranged in two sections, the first contains plants indexed alphabetically by botanical name and the second section shows the same plants alphabetically indexed by common name.

SECTION 1: PLANTS INDEXED BY BOTANICAL NAME

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
</tr>
<tr>
<td>Acacia aneura</td>
<td>Mulga</td>
</tr>
<tr>
<td>Acacia calcicola</td>
<td>Northern Myall</td>
</tr>
<tr>
<td>Acacia estrophiolata</td>
<td>Ironwood</td>
</tr>
<tr>
<td>Acacia sessiliceps</td>
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<tr>
<td>Acacia tetragonophylla</td>
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<tr>
<td>Atalaya hemiglaucu</td>
<td>Dead Finish</td>
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<td>Callitris glaucophylla</td>
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<td>Capparis mitchellii</td>
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<td>Eucalyptus camaldulensis</td>
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<td>Eucalyptus eremaea</td>
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<td>Eucalyptus manensis</td>
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<td>Mallee Red Gum</td>
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<td>Eucalyptus thozetiana</td>
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<tr>
<td>Grevillea striata</td>
<td>Bloodwood</td>
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<tr>
<td>Hakea eyreana</td>
<td>Red Mallee</td>
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<td>Hakea macrocarpa</td>
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<td>Thozet's box</td>
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<td>Hakea suberea</td>
<td>Fork-leaved Corkwood</td>
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<td>Ventilago viminalis</td>
<td>Needlewood</td>
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<tr>
<td></td>
<td>Long-leaf corkwood</td>
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<tr>
<td></td>
<td>Supplejack</td>
</tr>
</tbody>
</table>
Shrubs

*Acacia aneura*  
*Acacia basedowii*  
*Acacia dictophlebla*  
*Acacia kempeana*  
*Acacia ligulata*  
*Acacia macdonnelliensis*  
*Acacia maitlandii*  
*Acacia tetragonophylla*  
*Acacia victoriae*

* Atriplex nummularia  
* Callistemon pauciflorus  
* Capparis mitchellii  
* Capparis spinosa var. nummularia  
* Dodonaea viscosa  
* Eremophila christophori  
* Eremophila freelingii  
* Eremophila gilesii  
* Eremophila latrobei  
* Eremophila longifolia  
* Eremophila macdonnellii  
* Eremophila neglecta  
* Eremophila platythomas  
* Eremophila sturtii  
* Grevillea wickhamii  
* Maireana aphylla  
* Melaleuca bracteata  
* Melaleuca glomerata  
* Pandorea doratoxylon  
* Pittosporum phylliraeoides  
* Rhagodia eremaeae  
* Rhagodia parabolica  
* Rhagodia spinescens  
* Santalum lanceolatum  
* Senna artemisioides ssp. artemisioides  
* Senna artemisioides ssp. coriacea  
* Senna artemisioides ssp. filifolia  
* Senna artemisioides ssp. helmsii  
* Senna artemisioides ssp. oligophylla  
* Senna artemisioides ssp. petiolaris  
* Senna glutinosa ssp. pruinosa  

*Mulga*  
*Basedow's Wattle*  
*Sandhill Wattle*  
*Witchetty Bush*  
*Umbrella Bush*  
*Maitland's Wattle*  
*Dead Finish*  
*Acacia Bush (Prickly Wattle, Elegant Wattle)*  
*Old man Saltbush*  
*Desert Bottlebrush*  
*Wild Orange*  
*Caper Bush*  
*Sticky Hopbush*  
*Rock Fuchsia Bush*  
*Desert Fuchsia*  
*Native Fuchsia*  
*Weeping Emu Bush*  
*Turpentine Bush*  
*Holy Grevillea*  
*Cottonbush*  
*Black Teatree*  
*Inland Teatree*  
*Spearwood*  
*Weeping pittosporum*  
*Berry Saltbush*  
*Spiny Saltbush*  
*Plumbush*  
*Silver Cassia*  
*Desert Cassia*  
*Punty Bush*  
*Blunt-leaf Cassia*  
*Oval-leaf Cassia*  
*Grey Cassia*  
*White Cassia*
Sub Shrubs

Atriplex vesicaria  
Crotalaria eremaea  
Crotalaria novae-hollandiae  
Dipteracanthus australasicus  
Einaida nutans  
Frankenia cordata  
Halosarcia spp.  
Indigofera basedowii  
Maireana appressa  
Maireana astrotricha  
Maireana integra  
Maireana scleroptera  
Maireana triptera  
Maireana villosa  

Forbs

Abutilon otocarpum  
Amaranthus glandiflorus  
Amaranthus mitchellii  
Boerhavia coccinea  
Boerhavia schomburgkiana  
Bothriochloa ewartiana  
Citrullus colocynthis  
Citrullus lanatus  
Cheilanthes lasiophylla  
Chrysocephalum eremaeum  
Cleome viscosa  
Enchylaena tomentosa  
Euphorbia drummondii  
Euphorbia sarcostemmoides  
Euphorbia tannensis  
Evolvulus alsinoides  
Exocarpus sparteus  
Glycine canescens  
Goodenia lunata  
Gymnema stenophyllum  
Heliotropium conocarpum  
Heliotropium tenuifolium  
Helipterum floribundum  
Hibiscus sturtii  
Hybanthus aurantiacus  
Hybanthus enneaspermus  
Indigofera basedowii  
Indigofera colutea  
Indigofera leucotricha  
Isotoma petraea  

Bladder saltbush  
Bluebush Pea  
New Holland Rattlepod  
Climbing Saltbush  
Samphire  
Showy Indigo  
Southern Bluebush  
Three-wing Bluebush  
Silky Bluebush  
Desert Chinese Lantern  
Large-flowered Amaranth  
Boggabri  
Tar Vine  
Desert Bluegrass  
Colocynth  
Wild Melon  
Woolly Cloak Fern  
Tickweed  
Ruby Saltbush  
Caustic Weed  
Climbing Caustic  
Desert Spurge  
Tropical Speedwell  
Slender Cherry  
Woolly Glycine  
Hairy Goodenia  
White Heliotrope  
White Paper Daisy  
Orange Spade Flower  
Showy indigo  
Sticky Indigo  
Rock Isotome
Jasminum calcareum  
Leichhardtia australis  
Mollugo cerviana  
Mukia maderaspatana  
Neptunia gracilis  
Paspalidium basicladum  
Paspalidium constrictum  
Paspalidium rarum  
Phylanthus sp.  
Portulaca oleracea  
Ptilotus atriplicifolius var. atriplicifolius  
Ptilotus macrocephalus  
Ptilotus obovatus ssp. obovatus  
Ptilotus parvifolius  
Ptilotus schwartzii  
Rostellaria adscendens  
Salsola kali  

Scaevola amblyanthera var. centralis  
Sclerolaena bicornis  
Sclerolaena birchii  
Sclerolaena convexula  
Sclerolaena cornishiana  
Sclerolaena costata  
Sclerolaena diacantha  
Sclerolaena glabra  
Sclerolaena longicuspis  
Sclerolaena divaricata  
Sclerolaena spp.  
Senecio magnificus  
Sida fibulifera  
Sida rohleñae  
Solanum ellipticum  
Stenopetalum nutans  
Tinospora smilacina  
Tribulus terrestris  
Trichodesma zeylanicum  

Poison Creeper  
Bush Banana  
Fairy Bells  
Sensitive Plant  
Knottybutt Paspalidium  
Rare Paspalidium  
Spurge  
Munyeroo  
Crimson Foxtail  
Large Green Pussytail  
Silver Tails  
Buckbush (Prickly Saltwort)  
Goathead Burr  
Galvinised Burr  
Tall Copper Burr  
Cartwheel Burr  
Grey Copper Burr  
Long-Spinned Poverty Bush  
Copper Burr  
Tall Yellow Top  
Silver Sida  
Common sida  
Potato Bush  
Stinking Thread-Petal  
Snakevine  
Caltrop  
Cattle Bush
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<tr>
<th>Grasses</th>
<th>Long Greybeard Grass</th>
<th>Wire Grass (Two Gland Threawn)</th>
<th>Mulga Grass (Bunched Kerosene Grass)</th>
<th>Erect Kerosene Grass</th>
<th>Unequal Threawn</th>
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<td>Brachiaria gilesii</td>
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<td>Cenchrus ciliaris</td>
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<td>Keraudrenia nephroperma</td>
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<td>Oxychloirs scariosa</td>
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<td>Panicum decompositum</td>
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<td>Perotis rara</td>
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<tr>
<td>Sporobolus actinoladus</td>
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<tr>
<td>Sporobolus caroli</td>
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**Notes:**
- *Eriachne helmsii* is also known as *Narrow-leaf Neverfail*.
- *Sporobolus actinoladus* is also known as *Katoora*.
- *Sporobolus caroli* is also known as *Fairy Grass*.
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
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<tbody>
<tr>
<td><em>Themeda triandra</em></td>
<td>Kangaroo Grass</td>
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<td><em>Tragus australianus</em></td>
<td>Small-burr Grass</td>
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<td><em>Triodia clelandii</em></td>
<td>Weeping Spinifex</td>
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<td><em>Triodia hubbardii</em></td>
<td>Hubbard’s Spinifex</td>
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<tr>
<td><em>Triodia longiceps</em></td>
<td>Giant Grey Spinifex</td>
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<td><em>Triodia spicata</em></td>
<td>Spike-flowered Spinifex</td>
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<tr>
<td><em>Tripogon loliiformis</em></td>
<td>Five-minute Grass</td>
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<tr>
<td><em>Triraphis mollis</em></td>
<td>Purple plumegrass</td>
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</table>
### SECTION 2: PLANTS INDEXED BY COMMON NAME

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>BOTANICAL NAME</th>
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<tbody>
<tr>
<td><strong>Trees</strong></td>
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<tr>
<td>Bastard Coolibah</td>
<td><em>Eucalyptus intertextra</em></td>
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<td>Beefwood</td>
<td><em>Grevillea striata</em></td>
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<tr>
<td>Bloodwood</td>
<td><em>Eucalyptus opaca</em></td>
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<tr>
<td>Fork-leaved Corkwood</td>
<td><em>Hakea eyreana</em></td>
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<td>Ghost Gum</td>
<td><em>Eucalyptus papuana</em></td>
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<td>Ironwood</td>
<td><em>Acacia estrophiolata</em></td>
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<td>Long-leaf corkwood</td>
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<td>Mallee Bloodwood</td>
<td><em>Eucalyptus eremaea</em></td>
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<td>Mallee Red Gum</td>
<td><em>Eucalyptus gillenii</em></td>
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<td>Mulga</td>
<td><em>Acacia aneura</em></td>
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<td>Northern Myall</td>
<td><em>Acacia callicola</em></td>
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<tr>
<td>Native Orange</td>
<td><em>Capparis mitchellii</em></td>
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<tr>
<td>Needlewood</td>
<td><em>Hakea leucoptera</em></td>
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<td>Red Mallee</td>
<td><em>Eucalyptus oxymitra</em></td>
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<td>River Red Gum</td>
<td><em>Eucalyptus camaldulensis</em></td>
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<td>Supplejack</td>
<td><em>Ventilago viminalis</em></td>
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<td>Thozet’s Box</td>
<td><em>Eucalyptus thozetiana</em></td>
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<td>White Cypress Pine</td>
<td><em>Callitris glaucophylla</em></td>
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<tr>
<td><strong>Shrubs</strong></td>
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<td>Acacia Bush (Prickly Wattle, Elegant Wattle)</td>
<td><em>Acacia victoriae</em></td>
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<td>Berry Saltbush</td>
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<td>Black tea tree</td>
<td><em>Melaleuca bracteata</em></td>
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<td>Blunt-leaf Cassia</td>
<td><em>Senna artemisioides ssp. helmsii</em></td>
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<td>Caper Bush</td>
<td><em>Capparis spinosa var. nummularia</em></td>
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<td><em>Senna artemisioides ssp. coriacea</em></td>
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<td><em>Senna artemisioides ssp. petiolaris</em></td>
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<td><em>Grevillea wickhamii</em></td>
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<td><em>Acacia aneura</em></td>
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<td>Old man Saltbush</td>
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Oval-leaf Cassia
Plumbush
Punty Bush
Rock Fuchsia Bush
Sandhill Wattle
Silver Cassia
Spearwood
Spiny Saltbush
Spiked Daisy Bush
Sticky Hopbush
Turpentine Bush
Umbrella Bush
Weeping Emu Bush
Weeping pittosporum
White Cassia
Wild Orange
Witchetty Bush

Sub Shrubs

Bladder saltbush
Bluebush Pea
Climbing Saltbush
New Holland Rattlepod
Samphire
Showy Indigo
Silky Bluebush
Southern Bluebush
Three-wing Bluebush

Forbs

Boggabri
Buckbush (Prickly Saltwort)
Bush Banana
Caltrop
Cartwheel Burr
Cattle Bush
Caustic weed
Climbing Caustic
Colocynth
Common Sida

Senna artemisioides ssp. oligophylla
Santalum lanceolatum
Senna artemisioides ssp. filifolia
Eremophila freelingii
Acacia dictyophleba
Senna artemisioides ssp. artemisioides
Pandorea doratoxyylon
Rhagodia spinescens
Olearia subspicata
Dodonaea
Eremophila sturtii
Acacia ligulata
Eremophila longifolia
Pittosporum
Senna glutinosa ssp. pruinosa
Capparis mitchellii
Acacia kempeana
Atriplex vesicaria
Crotalaria eremaea
Einadia nutans
Crotalaria novae-hollandiae
Halosarcia calyphrata
Indigofera basedowii
Maireana villosa
Maireana astrotricha
Maireana triptera
Amaranthus mitchellii
Salsola kali
Leichhardtia australis
Tribulus terrestris
Sclerolaena cornishiana
Trichodesma zeylanicum
Euphorbia drummondii
Euphorbia
Citrullus colocynthis
Sida rohlenae
Copper Burr  
Crimson Foxtail  

Desert Chinese lantern  
Desert Spurge  
Fairy Bells  
Galvinised Burr  
Goathead Burr  
Grey Copper Burr  
Hairy Goodenia  
Large Flowered Amaranth  
Large Green Pussytail  
Long-spined Poverty Bush  
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Orange Spade Flower  
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Potato Bush  
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Rock Isotome  
Ruby Saltbush  
Sensitive Plant  
Showy Indigo  
Silver Tails  

Silver Sida  
Slender Cherry  
Snake Vine  
Spurge  
Star Vine  
Sticky Indigo  
Stinking Thread-Petal  
Tall Copper Burr  
Tall Yellow Top  
Tar Vine  
Tickweed  
Tropical Speedwell  
White Heliotrope  
White Paper Daisy  
Wild Melon  
Woolly Cloak Fern  
Woolly Glycine  

Sclerolaena spp.  
Ptilotus atriplicifolius var. atriplicifolius  
Abutilon atriplicifolius  
Euphorbia tannensis  
Mollugo cerviana  
Sclerolaena birchii  
Sclerolaena bicornis  
Sclerolaena diacantha  
Goodenia lunata  
Amaranthus glandiflorus  
Ptilotus macrocephalus  
Sclerolaena longicuspis  
Portulaca oleracea  
Hybanthus enneaspermus  
Jasminum calceatum  
Solanum ellipticum  
Paspalidium rurum  
Isotome petraea  
Enchylaena tomentosa  
Neptunia gracilis  
Indigofera basedowii  
Ptilotus obovatus ssp. obovatus  
Sida fibulifera  
Exocarpus sparteus  
Tinospora smilacina  
Phyllanthus sp.  
Boerhavia coccinea  
Indigofera colutea  
Stenopetalum nutans  
Sclerolaena convexula  
Senecio magnificus  
Boerhavia coccinea  
Cleome viscosa  
Evolvulus alsinoides  
Heliotropium conocarpum  
Helipterum floribundum  
Citrullus lanatus  
Cheilanthes lasiophylla  
Glycine canescens
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<td>Eight Day Grass</td>
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<tr>
<td>Long Greybeard Grass</td>
<td>Amphipogon caracinus</td>
</tr>
<tr>
<td>Mallee Lovegrass</td>
<td>Eragrostis dielsii</td>
</tr>
<tr>
<td>Mountain Wanderrie</td>
<td>Eriachne mucronata</td>
</tr>
<tr>
<td>Mulga Grass (Bunched Kerosene Grass)</td>
<td>Aristida contorta</td>
</tr>
<tr>
<td>Narrow-leaf Neverfail</td>
<td>Eragrostis setifolia</td>
</tr>
<tr>
<td>Native Millet</td>
<td>Panicum decompositum</td>
</tr>
<tr>
<td>Oatgrass (Bottle washers)</td>
<td>Enneapogon avenaceus</td>
</tr>
<tr>
<td>Pitted lovegrass</td>
<td>Eragrostis barrelieri</td>
</tr>
<tr>
<td>Queensland Bluegrass</td>
<td>Dichanthium sericeum</td>
</tr>
<tr>
<td>Purple Plumegrass</td>
<td>Triraphis mollis</td>
</tr>
<tr>
<td>Rough Threeawn</td>
<td>Aristida strigosa</td>
</tr>
<tr>
<td>Sickle Lovegrass</td>
<td>Eragrostis falcata</td>
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<tr>
<td>Silky Browntop</td>
<td>Eulalia fulva</td>
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<tr>
<td>Silkyheads</td>
<td>Cymbopogon obtectus</td>
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<tr>
<td>Small-burr Grass</td>
<td>Tragus australianus</td>
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<tr>
<td>Small-flower Lovegrass</td>
<td>Eragrostis kennedyae</td>
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<tr>
<td>Spike-flowered Spinifex</td>
<td>Triodia spicata</td>
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<tr>
<td>Unequal Threeawn</td>
<td>Aristida inaequiglumis</td>
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<tr>
<td>Winged Chloris</td>
<td>Oxychloris scariosa</td>
</tr>
<tr>
<td>Swamp Canegrass</td>
<td>Eragrostis australasica</td>
</tr>
<tr>
<td>Two Gland Threeawn</td>
<td>Aristida biglandulosa</td>
</tr>
<tr>
<td>Weeping Spinifex</td>
<td>Triodia clelandii</td>
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<table>
<thead>
<tr>
<th>English Name</th>
<th>Scientific Name</th>
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<tbody>
<tr>
<td>Winged Chloris</td>
<td><em>Oyychloris scariosa</em></td>
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<tr>
<td>Woollyoat Grass (Leafy Nineawn)</td>
<td><em>Enneapogon polyphyllus</em></td>
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<tr>
<td>Woollybutt grass</td>
<td><em>Eragrostis eriopoda</em></td>
</tr>
<tr>
<td>Woollybutt Wanderrie</td>
<td><em>Eriachne helmsii</em></td>
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</tbody>
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