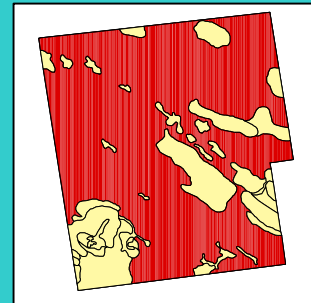


Land Resources of the Singleton Station Application Area and A Reconnaissance Land Capability Survey Identifying Potential Areas for Horticultural Development in the Singleton–Murray Downs Study Area



By

Mark Sugars and Diana Whitehouse

March 2001

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Distribution List

- Department of Primary Industries and Fisheries - Alice Springs
- Tennant Creek
- Department of Lands, Planning and Environment - Alice Springs
- Darwin
- Owner of Singleton Station - Australian Land and Cattle Company : Group MD : Allan Gallagher
- Manager of Singleton Station – Mr. Vidler

Summary

This report contains two study areas. Study Area One is a land resource survey of Singleton Station Application Area and Study Area Two is a reconnaissance survey of an area on Singleton and Murray Downs Stations that has been identified as having good quality groundwater suitable for irrigation.

Study area 1

Singleton Station Application Area is a 25 km² block of land located between Wycliffe Well and Wauchope, Northern Territory. The land use potential has changed over time due to industry diversification and there is now a push to look at other possible land uses such as horticulture. This report aims to describe the resources of the Application Area so that suitability for horticulture can be determined.

Describing the resources involves identifying areas with similar landform, soils and vegetation. These areas are called land units. Table 1.0 summarises the land units found in the Singleton Application Area. The Application Area is a uniform block dominated by sandplains that are dissected by drainage depressions and slightly elevated narrow plains. The soils on the sandplains tend to be well drained and gradational with subsoil textures of sandy loam, whereas the soils in the drainage depressions tend to be slightly heavier with some areas having textures of light clays in the subsoil. The vegetation reflects this with an increase in mulga and decrease in spinifex on the heavier soils. Swamps and rocky rises also form a minor component of the Application Area.

The Department of Primary Industries and Fisheries will build on the land capability map created from information in this report and come up with levels of suitability for particular horticultural crops within the Singleton Application Area.

Study area 2

The area of good quality water (less than 1000mg/L of total dissolved solids) extends south-easterly through Singleton and into Murray Downs Stations (Singleton-Murray Downs Study Area). A broad reconnaissance survey was therefore conducted on this area to assess land capability for horticulture. It was found that 35 % of the Singleton-Murray Downs Study Area was capable with only minor to moderate limitations and 13% capable with severe limitations. The remainder was deemed unsuitable for horticulture. This information will prove useful to identify other blocks for detailed land resource surveys.

Table 1 Summary of the soil and vegetation attributes for each land unit

Land Unit	Land and Soil Features	ASC	Vegetation	Area
SOILS OVERLYING FOLDED SEDIMENTARY ROCK AND ALTERED BASALT				
1. Gently Undulating to undulating low rises				
1.1	Very gently inclined, gravelly and cobbly hillcrest adjacent to deep, sandy hillslopes. Elevation is approximately 10m above the surrounding sandplain. Shallow, moderately gravelly and cobbly, reddish brown fine sandy loams.	Clastic Rudosol	A tall sparse shrubland dominated by hill turpentine with holly grevillea and colony wattle over an open hummock grassland of feathertop spinifex with annual grasses and forbs.	0.2%
1.2	Very gently inclined (1.5-2.5%) waning hillslope. Thick, dark red sandy surface over a red sandy loam (light) subsoil.	Orthic Tenosol	Very tall sparse shrubland of scrub wattle with emergent bloodwood and ghost gum over a rejuvenating sparse shrubland, dominated by scrub wattle with desert cassia over a hummock grassland of hard spinifex with annual grasses and forbs.	1.2%
1.3	Very gently inclined (1.5-2.5%) waning hillslope. Thick, dark red sandy surface over a red sandy subsoil.	Orthic Tenosol	Isolated emergent ghost gums over a tall sparse shrubland dominated by scrub wattle with desert fringe myrtle, quinine bush, chocolate bush, native fuchsia and torulosa wattle over an open hummock grassland of hard spinifex with annual grasses and forbs.	0.4%
1.4	Broad, very gently inclined (1-2%) hillslope. Moderately thick to thick dark red loamy sand surface over a red sandy loam (light) subsoil.	Orthic Tenosol	Very tall sparse shrubland dominated by Fitzroy wattle with witchetty bush and Sturt Creek mallee over a tall sparse shrubland of <i>Stylobasium spathulatum</i> with a mixture of shrubs over a hummock grassland of predominantly hard spinifex with annual forbs and grasses.	0.2%

SOILS OVERLYING QUATERNARY ALLUVIUM

2. Undulating rises

2.1	Sand ridge with hillslopes ranging from 4-12% and narrow very gently inclined hillcrests.	Arenic Rudosol	A very tall sparse shrubland dominated by scrub wattle over a tall shrubland of sandhill wattle with native fuchsia over an open hummock grassland dominated by hard spinifex.	2.5%
	Deep, dark red sandy soil occasionally increasing to loamy sand.			

3. Level to gently undulating sandplains

3.1	Level plains (<1.0%) dissected by drainage depressions or slight undulations.	Red Kandosol	A sparse tall shrubland of witchetty bush with a mixture of shrubs over a hummock grassland of hard spinifex. Emergent bloodwood and Sturt Creek mallee are also present on some sites.	75.6%
	Deep, dark reddish brown loamy sand surface grading into a massive dark red sandy loam subsoil.			
3.2	Slightly elevated (2-4 m relief) level to gently undulating plains (1-2.5%) forming part of the surrounding sandplain.	Orthic Tenosol	A tall sparse shrubland of scrub wattle and Fitzroy wattle over a low sparse shrubland of <i>Senna</i> species with native fuchsia over a hummock grassland of hard spinifex.	8.1%
	Deep, dark reddish brown sandy surface over a massive dark red loamy sand subsoil.			
3.3	Slightly elevated (2-4 m relief) level to gently undulating plains (1-2.5%) forming part of the surrounding sandplain.	Red Kandosol	A tall sparse shrubland of Fitzroy wattle, desert grevillea and sandhill wattle over hummock grassland of hard spinifex	5.2%
	Deep, dark reddish brown sandy surface over a massive dark red sandy loam subsoil.			

4.0 Drainage depressions dissecting level to gently undulating sandplains

4.1	Shallow weakly forming drainage depression with a slope of less than 1.0% and channels between 100 and 200m wide. Reddish brown loamy sand surface over a massive dark red sandy loam subsoil.	Red Kandosol	A Low open woodland of long-leaved corkwood over a tall sparse shrubland of native fuchsia with <i>Senna</i> species over a sparse hummock grassland of hard spinifex.	1.5%
4.2	Shallow, moderately distinct drainage depressions. Channel width ranges between 100 and 200m and slope is less than 1.0%. Deep dark reddish brown loamy sand surface grading into a massive red sand clay loam subsoil.	Red Kandosol	A tall sparse shrubland of mulga and witchetty bush with various shrubs and emergent bloodwoods over a hummock grassland of hard spinifex with grasses and forbs. This particular example is a variant in that it has a tall open woodland of mulga with bloodwood, beefwood and Sturt Creek mallee in the upper stratum.	0.7%
4.3	Shallow, moderately distinct drainage depressions. The channels do not exceed 100m and slope is less than 1%. Deep dark reddish brown loamy sand surface grading into a massive red sandy clay loam subsoil; manganese segregations occasionally present.	Red Kandosol	Low woodland of mulga with witchetty bush over a tall shrubland of witchetty bush with mulga over a hummock grassland of hard spinifex. Variant: some sites may have perennial grasses more dominant in the lower stratum.	0.9%
4.4	Shallow, moderately distinct drainage depressions Deep, dark reddish brown sandy surface grading into a massive red light clay (sandy) subsoil; manganese segregations present.	Red Kandosol	Tall open woodland of mulga with colony wattle and bloodwood over a tall sparse shrubland of blunt-leaf cassia, with mulga and witchetty bush and a mixture of shrubs over an open hummock grassland dominated by hard spinifex with annual grasses and forbs.	0.6%
4.5	Broad, distinct drainage depressions (approximately 350m wide) adjacent to the lower slopes of low rises. Slope of this unit is < 1.0%. Deep dark reddish brown sandy loam surface, grading into massive clay loam fine sandy and light clay (sandy) with depth; manganese segregations present.	Red Kandosol	Low open woodland of mulga with witchetty bush over a tall sparse shrubland of witchetty bush with native fuchsia, native currant and mulga over an open tussock grassland of three-awn wanderrie with hard spinifex and other grasses and forbs.	1.0%

5.0 Swamps and flood plains

5.1	<p>Seasonally flooded swamps influenced by Wycliffe Creek in the south</p> <p>Deep, dark greyish brown light clay surface overlying a weakly to moderately structured, mottled, dark greyish brown light medium clay subsoil; expect manganese segregations with depth.</p>	Grey Dermosol	<p>A very tall to tall open mallee shrubland of inland tea-tree with coolibah over a mid-dense fernland of common nardoo. The perimeter of the depressions in the lower stratum tends to be dominated by a variety of sedges, forbs and grasses.</p>	0.2%
5.2	<p>Swamp and plain interface which is gently undulating (1-2.5%) and slightly elevated above adjacent swamps.</p> <p>Moderately deep, brown loamy sand surface grading to a massive red sandy clay loam subsoil; calcium carbonate segregations occur in the lower subsoil.</p>	Brown Kandosol	<p>A mid high open to isolated woodland of coolibah over an open mallee shrubland of inland tea-tree with oval leaf cassia over an open fernland of common nardoo with woollybutt and a mixture of forbs and grasses</p>	1.4%
5.3	<p>The peripheral areas of the sandplain adjacent to the swamp or the swamp-plain interface. These areas are quite small and gently undulating (1-2%).</p> <p>Moderately deep, loamy sand surface grading into a massive sandy loam and sandy clay loam subsoil. Calcium carbonate segregations occur in the lower subsoil.</p>	Red Kandosol	<p>Low open woodland of coolibah over a sparse shrubland of inland tea-tree with native fuchsia and desert cassia over an open hummock grassland of hard spinifex.</p>	0.3%

1.0 Introduction

The owners of Singleton Station intend to establish a horticultural industry on a portion of the property. This area of land is referred to as the Application Area and comprises of 25km² immediately south of Singleton Homestead. An additional 907 km² has been identified as containing good quality groundwater located partly on Singleton Station and Murray Downs Station. These two areas were examined separately as different levels of information were required from each.

The first area (**Singleton Application Area**) required a low intensity land resource survey (Gunn *et al*, 1988). Within this survey, a suite of descriptions including soils, vegetation, landform and geology were recorded. These attributes were used to define land units and mapped at a scale of 1:25,000 with a site intensity of 1 site per 0.5km². The Department of Primary Industries and Fisheries Horticultural Division, Alice Springs, will comment on the land suitability for horticulture in a separate report.

Area two (**Singleton-Murray Downs Study Area**) was a broad reconnaissance survey using largely desktop processes. Previous mapping (where present), satellite imagery and land systems information was utilised with some ground truthing via vehicle traverses. The aim of the reconnaissance survey was to identify areas where it would be appropriate to conduct detailed assessment for horticulture. More detailed resource assessment will be required on particular areas prior to development.

2.0 Existing land resource information

Prior to this report, the land resource information was limited to a broad reconnaissance survey (Perry *et al*, 1962) which identified three Land Systems on Singleton Station. The entire Application Area comprises the Singleton land system and is described as spinifex sandplains. In addition to the land systems mapping, is the 1:100,000 scale land unit mapping of Murray Downs Station (Grant, 1989) which borders Singleton Station to the south.

Water resources have been identified in the Singleton–Murray Downs Study Area as described by 13 drill sites. Each drill site has a descriptive geological log to a depth of up to 100 m as well as information on the quality of the groundwater (Gilbert *et al*, 1990).

Geology has been mapped at 1:250,000 scale on the Bonney Well map sheet and is described in detail in the interpretation notes (Wyche, 1987). Aerial photographs flown in 1982 at 1:25,000 scale over Singleton Station and recent (June 2000) satellite imagery (30 m pixel size) over both Singleton and Murray Downs Stations were used. Topographic maps were used for navigation and identifying contours.

3.0 Description of the Study Areas

3.1 Area and location

Singleton Station is located between Wauchope and Wycliffe Well on the eastern side of the Stuart Highway in the Northern Territory (Figure 1.0). The Singleton Station Application Area is located south of the homestead and occupies 26 km² (Figure 2.0). Access to the property can be obtained via the Stuart Highway or through Ali-Curung (Warrabri) Aboriginal Community.

A network of tracks and fence lines traverse the property ensuring relatively easy access to the majority of the property.

Murray Downs Station lies south of Singleton and east of Neutral Junction Station and Warrabri. The Singleton-Murray Downs Study Area (Figure 2.0) consists of two polygons that have been identified as having high quality ground water. Together they comprise of an area of 933km². The northern polygon crosses both Singleton and Murray Downs Station and the southern is contained within Murray Downs Station.

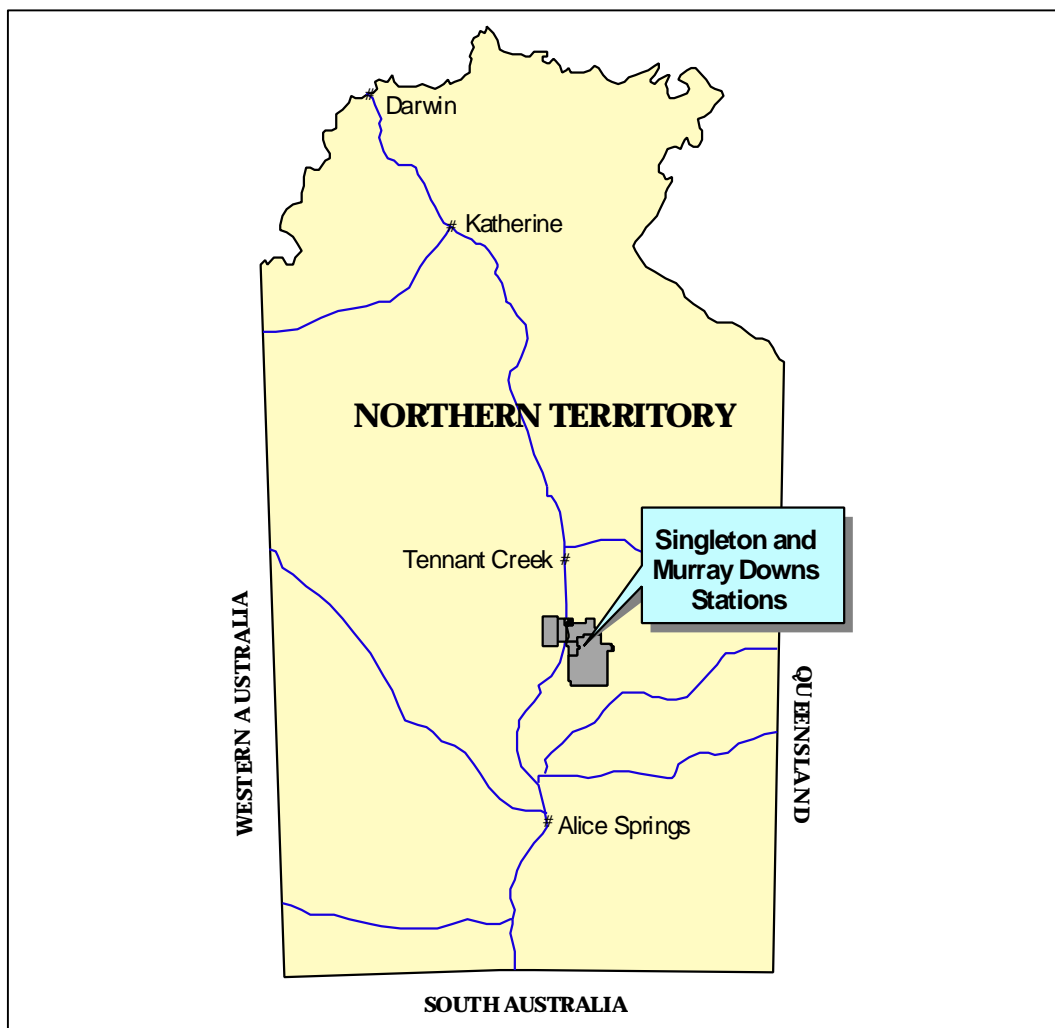


Figure 1.0 Locality diagram of Singleton and Murray Downs Stations

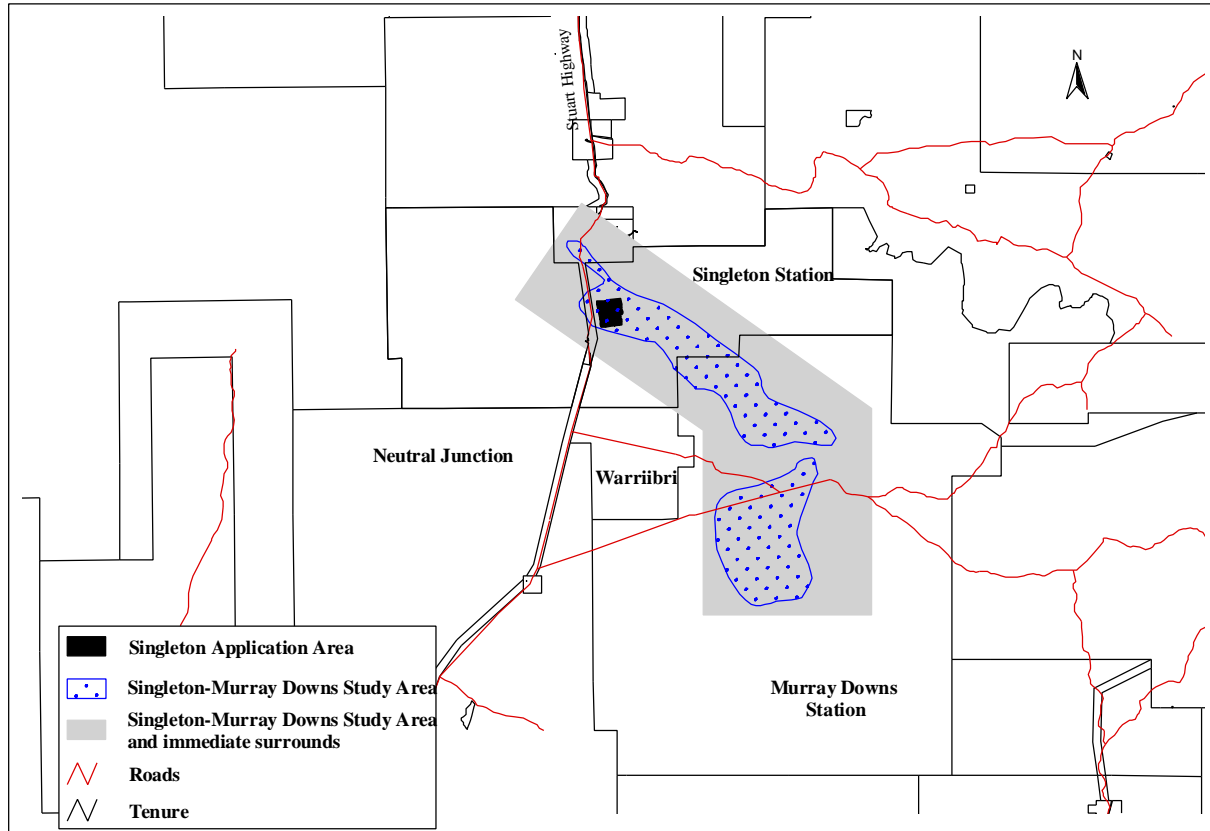


Figure 2.0 Locality diagram of the Singleton Application Area and the Singleton-Murray Downs Study Area

3.2 Climate

Singleton and Murray Downs Stations are located in the semi-arid region of Australia and experience long, hot summers and short, mild winters. Eighty-four percent of the average annual rainfall occurs between the months of October and March (Figure 3.0). The median rainfall (decile 5) in each month indicates that the mean rainfall is variable.

High evaporation rate (Figure 3.0) is due to high temperatures and low humidity (Bureau of Meteorology, 2000). Evaporation rate compared with rainfall (Figure 3.0) creates a moisture deficit highlighting the necessity for crop irrigation.

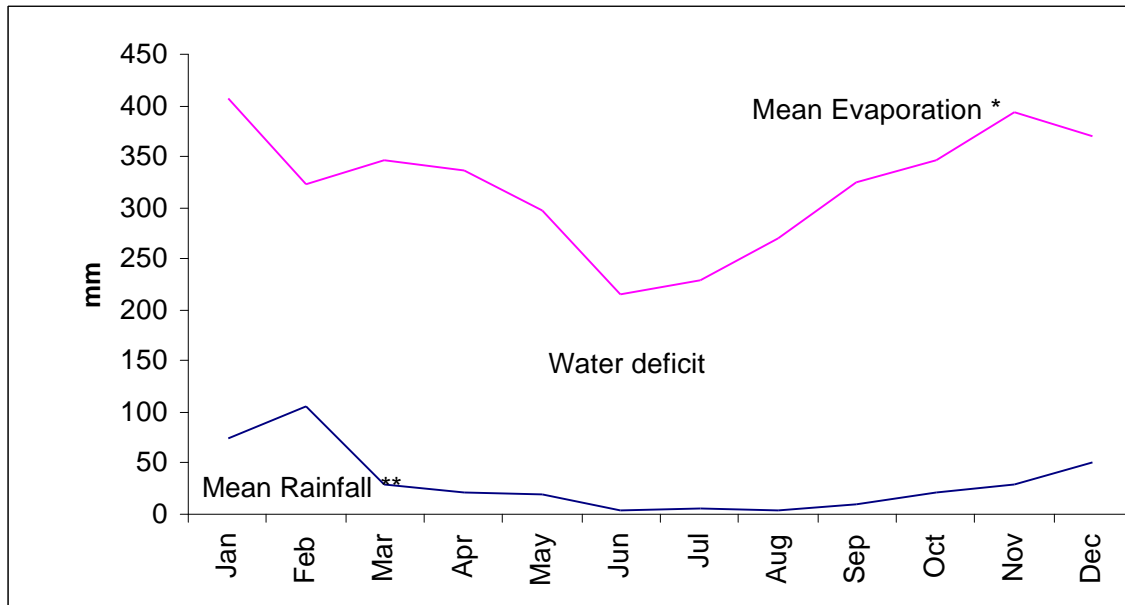


Figure 3.0. Mean evaporation and rainfall showing water deficit because of the high evaporation.

* Mean evaporation for Tennant Creek (Bureau of Meteorology, 2000)

** Mean rainfall for Ali Curung (Bureau of Meteorology, 2000)

The temperature at Ali Curung according to the Bureau of Meteorology (2000) is highest in January and lowest in July (Table 2.0). Temperatures are quite variable, reaching maximums of 45°C in January and minimums of as low as -1.0°C in August. Mean relative humidity rarely exceeds 50% in the morning and 30% in the afternoon throughout the year (Bureau of Meteorology, 2000).

Table 2.0 Mean daily temperatures at Ali Curung (Bureau of Meteorology, 2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Aver.
Mean Daily Max Temp	38.4	36.9	35.6	31.6	27.4	24.5	24.4	27.3	32.4	35.2	36.8	37.8	32.5
Min Daily Max Temp	24.1	23.4	20.9	16.9	21.1	8.9	7.5	9.7	14.8	18.9	21.4	23.1	17.0

Frosts occur occasionally in July at Barrow Creek (approximately 100km south of Singleton) with the frequency increasing southwards (Perry *et al*, 1962).

4.0 Singleton Application Area

4.1 Attributes of the Singleton Application Area

4.1.1 Landform and geology

The geology underlying the Application Area on Singleton Station is Cainozoic and is only briefly documented in the available literature. The majority of the Application Area consists of Quaternary aeolian deposits (Qs) which comprises of sand, silt and clay lithology. This is in the form of residual and aeolian sand and silt (Qs), forming sand sheets and dunes on aeolian plains (Wyche *et al*, 1987). These plains represent areas of Recent formation (less than one million years old) and comprise thick blankets of sand, silt and clay overlying older rocks. A band of Coulter's Sandstone with a southeasterly strike protrudes the sandplain and consists of quartz arenite,

lithic/feldspathic arenite, minor siltstone and possibly altered basalt lava lithology plains (Wyche *et al*, 1987).

This area consists of level plains dissected by broad slightly elevated plains and narrow drainage depressions. The broad slightly elevated plains have a southeasterly strike and stand no higher than four metres above the surrounding landscape with an approximate slope of 1%. The drainage depressions are weakly formed and also lie in a south-easterly direction. The southern portion of the Application Area contains floodouts, ephemeral swamps and sand ridges formed by recent (Holocene) fluvial actions imparted by the Wycliffe Well Creek system.

4.1.2 Soils

Sixteen land units based on landform, soil and vegetation were identified in the Singleton Application Area (Table 1.0). The most variable soil attribute across all land units is the texture of the topsoil and subsoil. This attribute affects soil classification according to Isbell (1996) and influences the physical properties of the site including surface condition, drainage and permeability.

The soils occurring in the Application Area are predominantly massive gradational soils (Kandosols) and uniform sands (Tenosols) occurring on sandplains. Red Kandosols are the most dominant soils, making up 82% of the Application Area. These soils feature a sandy or loamy sand surface grading into a sandy loam subsoil. The soils in the drainage lines contain more clay, particularly in the subsoil.

All of the soils described within the Application Area are non-saline (electrical conductivity readings of < 0.1 dS/m through out the profile). The soils are moderate to highly permeable and moderately well to well drained. They also have a neutral soil reaction trend. It is also suspected all soils have low cation exchange capacity and low exchangeable sodium percentage supported by the chemistry analysis (Appendix 2). This remains consistent with the low clay content found in these soils.

4.1.3 Vegetation

The vegetation communities on the Singleton Application Area seem to reflect some association with the five major landforms identified in this study. Soil differences in arid environments are often clearly expressed by vegetation association (Grant and Whittard, 1990). However, the soils over the Application Area have relatively uniform characteristics and vegetation was of limited value in aiding field identification and mapping of soil distribution.

Undulating low rises

The gently undulating to undulating low rises on Singleton Application Area commonly support tall sparse shrublands of a mixture of shrubs such as scrub wattle, Fitzroy wattle and witchetty bush over grasslands of hard spinifex with forbs and grasses. The gravelly and cobbly hillcrest of Land Unit 1.1 is significantly different due the presence of feathertop spinifex in the lower stratum.

Undulating rises – sand ridges

The sandy ridges or undulating rises tend to support tall sparse shrublands largely dominated by scrub wattle and sandhill wattle over hummock grasslands of hard spinifex.

Level to gently undulating sandplains

The most common vegetation structure found on the level to gently undulating red sandplains is mixed tall sparse shrublands over grasslands of hard spinifex. A mixture of shrubs such as scrub wattle, sandhill wattle, native fuchsia, Fitzroy wattle and cassias may be found at these sites. Hard spinifex as found in these units, commonly grow on red sandplains. Bloodwoods and Sturt mallee may also occur within these landscapes.

Drainage depressions dissecting level to gently undulating sandplains

The vegetation within the drainage depressions are largely composed of open woodlands of mulga and witchetty bush with a mixture of shrubs over hummock grasslands of hard spinifex. In some sites, grasses such as three-awn wanderrie are equally or more dominant than the spinifex.

Swamps and flooded plains

The swamps and flood plains support open woodlands of coolibah and inland tea-tree over common nardoo. The floodplains tend to support more forbs, sedges and tussock grasses than the dominant common nardoo found in the swamp area of Land Unit 5.1.

4.2 Singleton Application Area Study Methodology

The resource survey methodology for the Singleton Application Area was designed to provide land resource information at a scale appropriate for a horticultural capability assessment. This assessment is to be conducted by Department of Primary Industries and Fisheries in the future. Prior to any horticultural development more intensive field investigation (1:10 000 scale) will be required to identify variability across selected parts of the study area.

The Application Area was investigated using 1:25,000 scale colour aerial photographs (Table 3.0).

Table 3.0 Aerial photographs used for the Singleton Station Land Resource Survey

Print name	Print Number	Year	Photo run number	Photo frame number	Scale
Wauchope	NTC709	1982	5	123-125	1 : 25,000
Wauchope	NTC709	1982	6	97-99	1 : 25,000
Wauchope	NTC709	1982	7	172-174	1 : 25,000

Existing land unit and land systems mapping formed the basis for the pre-field aerial photography interpretation on the Singleton–Murray Downs Study Area. The aerial photograph interpretation involved delineating areas of similar characteristics in terms of geology, landform, soil and vegetation.

The fieldwork involved soil and vegetation surveys, which were conducted according to the Australian Soil and Land Survey Field Book (McDonald *et al*, 1990). The uniformity of the Application Area made it possible to perform a free survey. To help locate representative areas and potential survey sites, the aerial photographs were examined under a stereoscope. Interpretation was ground truthed with fieldwork.

The soil sites were augured to 1.7 m or to a depth where restrictions were encountered. At each site the attributes of the soil profile were described including colour, texture, structure, presence of coarse fragments and segregations, pH, and electrical conductivity. A soil profile from the largest land unit was sampled for analysis in the laboratory. This confirmed measurements taken in the field and identified other chemical attributes of the soil such as cation exchange capacity and base status.

The vegetation data recorded was species type, height and abundance recorded within a 100 m radius of each soil site and was used to define the community structure based on McDonald *et.al*, (1990). Where necessary, specimens were collected and identification verified.

After completion of the fieldwork the land unit boundaries were finalised on the aerial photographs using the geomorphic approach. Geology and landform were considered first followed by the soil type and the representative vegetation community. Sixteen land units were identified which fit into five major landforms. A map drawn from the finalised land unit boundaries was digitised on screen using Arcview 3.2. All editing, corrections, legend and map layouts were done with Arcview and Arc/Info.

4.3 Land Resources

4.3.1 Land units of the Singleton Application Area

Land units were described using a series of attributes including geology, landform, soil and vegetation.

The scale of this survey allows subtle differences in landforms and soils to be described and represented as land units. The two main attributes that vary between Land Units (LU) within each major grouping (1 to 5) are soil texture (particularly at depth) and landform (differences in elevation and slope).

LU grouping 1 comprises of four LU's. LU 1.1 is a gravelly hillcrest. The other three LU's are described as hillslopes with slight differences in soil texture, landform morphological type and slope. LU 1.2 (lower hillslope) is different to LU 1.3 (upper hillslope) because it has a sandy loam subsoil rather than a sandy subsoil. The vegetation is also slightly different. LU 1.4 describes the northern hillslope of the rise. The surface texture of sandy loam is slightly heavier than LU 1.2 and 1.3 and significant differences in vegetation are also apparent.

LU 2.1 is a sand ridge. Because of the small area this LU occupies the different landform elements within the landform pattern have been mapped as one. The soil and vegetation differences across the landform elements were not significant.

LU 3.1 (Sandplain) is the most dominant LU in the study area. Slightly elevated plains of LU 3.2 and 3.3 divide the level plains of this LU. The main subtle difference between LU 3.2 and 3.3 is the heavier sandy loam subsoil in LU 3.3 compared with loamy sand subsoil in LU 3.2. Vegetation was very similar.

The heavier textured soils are commonly found in drainage depressions (open and closed). LU 4.1 is unique to all other drainage depressions because of the lighter soil textures and absence of mulga. LU 4.2 and 4.3 are also similar, and can be separated by three main attributes. The first separating attribute is the presence of manganese segregation in LU 4.3. Secondly, LU 4.3 has a distinctive narrow channel (100m wide) compared with LU 4.2 (100-200m wide). The units can also be divided by vegetation community structure with LU 4.3 supporting a mulga woodland compared with LU 4.2 consisting of a sparse shrubland of mulga and witchetty. LU 4.4 and 4.5 both have clay subsoils with LU 4.4 having a lighter sandy surface and a more abrupt increase in texture into the clay subsoil. Furthermore, the drainage area of LU 4.5 is more distinct and broad than LU 4.4

The swamp and flood plains incorporating land units 5.1 to 5.3 vary significantly. LU 5.1 consists of swamps and has clay soils. LU 5.2 describes the swamp and plain interface. This unit is influenced by periodic flooding and has much lighter textured soils than LU 5.1. LU 5.3 is slightly elevated, less frequently inundated and has a clay loam subsoil with calcium carbonate segregations.

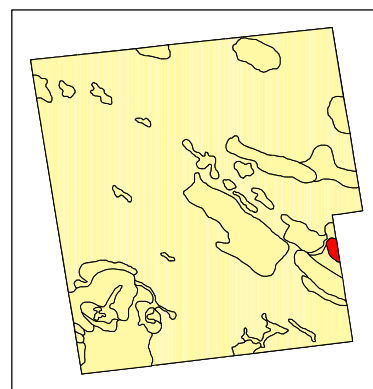
Gently Undulating to Undulating Low Rises

LAND UNIT 1.1

General Description: Very gently inclined, gravelly and cobbly hillcrest adjacent to deep, sandy hillslopes. The soils are shallow with a moderately gravelly and cobbly reddish brown fine sandy loam surface. Gravels decrease with depth.



Distribution of Land Unit



Area: 5.4ha, 0.2% of Application Area

Geology : Coulters sandstone in the Wauchope Subgroup and Hatches Creek Group. The lithology consist of dominantly quartz arenite, lithic / feldspathic arenite and minor siltstone.

Landform: Very gently inclined (1%) hillcrest forming part of a gently undulating rise.

Soil Surface Condition: soft

Site drainage: moderate to well

Runoff : slow

Soil permeability: moderately well

SOIL (Sites 12 and 4)

Salinity: Nil (< 0.1 dS/m field measurement on the surface)

Soil classification: Clastic Rudosol (RUHHHJAR ECU), Uc5.31

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.0 – 0.20	Reddish brown (5YR4/4); sandy loam; massive with earthy fabric; 20% 30mm subrounded quartzite coarse fragments; non calcareous. Field pH 6.5

NB: The soil description includes the top 0.20m of the soil profile because of the difficulty in penetrating the gravel layer. Suspect that with depth the gravels and cobbles decrease but the texture remains a fine sandy loam until the substrate is reached.

VEGETATION

General description: A tall sparse shrubland dominated by hill turpentine with holly grevillea and colony wattle over an open hummock grassland of feathertop spinifex with annual grasses and forbs.

Example site 12

UPPER STRATUM – Tall sparse shrubland	
Dominant species	Hill turpentine
Other species	Holly grevillea, desert grevillea, <i>Grevillea juncifolia</i> and red-bud mallee
MID STRATUM – Tall sparse shrubland	
Dominant species	Hill turpentine
Other species	Colony wattle, witchetty bush, desert cassia and native fuchsia
LOWER STRATUM – Tall open hummock grassland	
Species recorded	Feathertop spinifex, curry wattle, fairy grass, <i>Goodenia ramelii</i> , slender wanderrie, desert Flinders grass, <i>Ptilotus schwartzii</i> , mamukata, <i>Stakhousia</i> A90542, desert spurge, short-leaved rush, <i>Polycarpaea corymbosa</i> , fruit-salad bush and <i>Sida</i> sp.

LAND USE IMPLICATIONS

- Land unit is small and irregular.
- Soils have abundant coarse fragments on surface and the soil depth is shallow (less than 1.0m).
- Soils have a low erosion potential.

This land unit is small and irregular thereby imposing a different management regime to that of the surrounding hillslopes and sandplains.

The moderate coarse fragments (approximately 35%) occurring in the top 0.2m of the soil (and deeper) lowers the soil water holding capacity. This combined with the inherent low water holding capacity of the soil (low organic matter and clay content) requires that the soil be irrigated more frequently thereby decreasing the efficiency and viability of any horticultural operation on this land unit.

The land unit may be a problem for road or pipe placement because of the surface gravels and outcrop. The adjacent land units (hillslopes) have low to moderate erosion potential because of the slopes. Wind erosion may occur when large areas are left bare by fire or when vegetation is cleared.

Gently Undulating to Undulating Low Rises

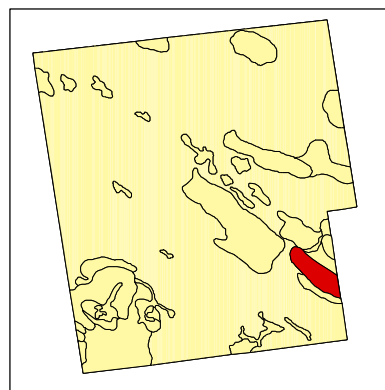
LAND UNIT 1.2

General Description: Very gently inclined waning hillslope forming part of a gently undulating rise. The soils occurring in this landform element have a dark red sandy surface overlying a massive dark red sandy loam subsoil.



Photo: Site 11

Distribution of Land Unit



Area: 29.6ha, 1.2% of Application Area

Geology : Coulters Sandstone in the Wauchope Subgroup and Hatches Creek Group. The lithology consist of dominantly quartz arenite, lithic / feldspathic arenite and minor siltstone. The surface 1.7m shows no indication of this geology but with depth it may become apparent. The surface 1.7m and deeper is deposited aeolian Quaternary Alluvium blown in from the surrounding sandplains.

Landform: Very gently inclined (1.5-2.5%) waning lower hillslope forming part of a gently undulating rise.

Soil Surface Condition: loose / soft

Site drainage: well

Runoff : very slow

Soil permeability: high

SOIL (site 11)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Orthic Tenosol (TEDSGFAR CEKLX), Uc1.23

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00 - 0.40	Dark red (2.5YR3/6); sand; massive and earthy fabric; loose consistence with no coarse fragments; non-calcareous; Field pH 6.0
B ₁	0.04 - 1.20	Dark red (10YR3/6); loamy sand (light); massive and earthy; very weak consistence with no coarse fragments; non-calcareous; Field pH 6.5-7.0
B ₂	1.20 - 1.70	Dark red (10YR3/6); sandy loam (light); massive and earthy, very weak consistence with no coarse fragments; non-calcareous; Field pH 6.0 –6.5

VEGETATION

General description: Very tall sparse shrubland of scrub wattle with emergent bloodwood and ghost gum over a tall sparse shrubland dominated by scrub wattle with desert cassia over a tall hummock grassland of hard spinifex with annual grasses and forbs.

Example site 11

UPPER STRATUM – Very tall sparse shrubland	
Dominant species	Scrub wattle
Other species	Bloodwood and ghost gum
MID STRATUM – Tall sparse shrubland	
Dominant species	Scrub wattle
Other species	Desert cassia, witchetty bush, grey cassia, Fitzroy wattle and <i>Stylobasium spathulatum</i>
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass, wild tomato bush, silver tails, velvet hibiscus, caustic weed and <i>Walthera indica</i>

LAND USE IMPLICATIONS

- Soil surface is loose which may create problems for mechanical equipment traversing the unit.
- Low to moderate water erosion potential on cleared areas – especially along tracks if windrows are present.

The soil surface is loose which can cause access problems for harvesting equipment, vehicles and other machinery. With continuous traffic the soil surface may become susceptible to erosion creating rills where water can concentrate. Wind erosion may occur when large areas are left bare by fire or when vegetation is cleared.

Gently Undulating to Undulating Low Rises

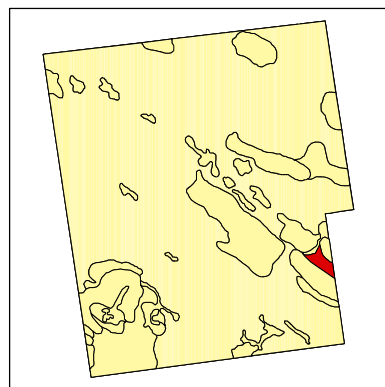
LAND UNIT 1.3

General Description: Very gently inclined upperslope of a hillslope forming part of a gently undulating rise. The soils are deep massive, red sands.



Photo: Site 35

Distribution of Land Unit



Area: 10.0ha, 0.4% of Application Area

Geology : Coulters Sandstone in the Wauchope Subgroup and Hatches Creek Group. The lithology consist of dominantly quartz arenite, lithic / feldspathic arenite and minor siltstone. The surface 1.7m shows no indication of this geology but with depth this geology may become apparent. The surface 1.7m and deeper is in situ modified aeolian Quaternary Alluvium from the surrounding sandplains.

Landform: Very gently inclined (1.5-2.5%) upperslope, adjacent to Land Unit 1.1, which forms parts of a gently undulating rise.

Soil Surface Condition: loose / soft

Site drainage: well

Runoff : very slow

Soil permeability: high

SOIL (Site 35)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Orthic Tenosol (TEDSGFAR BEKKW), Uc1.23

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00 – 0.10	Dark red (2.5YR3/6); sand; massive and earthy; weak consistence with no coarse fragments; non-calcareous; Field pH 5.5
B ₂	0.10 – 1.20	Dark red (10YR3/6); sand; massive and earthy, weak consistence with no coarse fragments; non-calcareous; Field pH 6.0.

VEGETATION

General description: Isolated emergent ghost gums over a tall sparse shrubland dominated by scrub wattle with desert fringe myrtle, quinine bush, chocolate bush, native fuchsia and torulosa wattle over an tall open hummock grassland of hard spinifex with annual grasses and forbs.

Example site 35

UPPER STRATUM – Emergent	
Dominant species	Emergent ghost gum
Other species	
MID STRATUM – Tall sparse shrubland	
Dominant species	Scrub wattle
Other species	Butterfly bush, quinine bush, chocolate bush, native fuchsia and torulosa wattle
LOWER STRATUM- Tall open hummock grassland	
Species recorded	Hard spinifex, butterfly bush, small red-leaf, <i>Sida</i> spp., <i>Ptilotus</i> spp., woollybutt, erect kerosene grass, soft spinifex and <i>Spermacoce scabra</i>

Land Use implication

- Soil surface is loose which may create problems for mechanical equipment traversing the unit.
- Low to moderate water erosion potential on cleared areas – especially along tracks if windrows are present.

The soil surface is loose which can cause access problems for harvesting equipment, vehicles and other machinery. With continuous use the soil surface may become susceptible to erosion creating gullies where water can concentrate. Wind erosion may occur when large areas are left bare by fire or when vegetation is cleared.

Gently Undulating to Undulating Low Rises

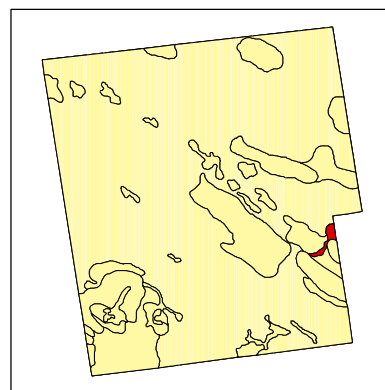
LAND UNIT 1.4

General Description: Level to very gently inclined hillslope forming part of a gently undulating rise. The soils occurring in this land unit consist of dark red loamy sand surfaces which grade into massive, red sandy loam subsoils.



Photo: Site 9

Distribution of Land Unit



Area: 5.9ha, 0.2% of Application Area

Geology : Coulters sandstone in the Wauchope Subgroup and Hatches Creek Group. The lithology consist of dominantly quartz arenite, lithic / feldspathic arenite and minor siltstone. The surface 1.7m shows no indication of this geology but with depth this geology may become apparent. The surface 1.7m and deeper is modified aeolian Quaternary Alluvium from the surrounding sandplains

Landscape: Very gently inclined (1-2%) hillslope forming part of a gently undulating rise

Soil Surface Condition: Hard setting with sandy veneer

Site drainage: moderately well to well **Runoff :** slow **Soil permeability:** moderate to high

SOIL (Site 9)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Orthic Tenosol (TEDSGFAR CEKLX), Uc1.23

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00 – 0.30	Dark red (2.5YR3/6); loamy sand; massive and earthy fabric; No coarse fragments; non-calcareous; Field pH 6.0 – 6.5
A ₃	0.30 – 1.20	Red (2.5YR4/6); loamy sand; massive and earthy fabric; No coarse fragments; non-calcareous; Field pH 6.5
B ₂	1.20 – 1.50	Red (2.5YR4/6); sandy loam (light); massive and earthy fabric; No coarse fragments; non-calcareous; Field pH 7.0

VEGETATION

General description: Very tall sparse shrubland dominated by Fitzroy wattle with witchetty bush and Sturt creek mallee over a tall sparse shrubland of *Stylobasium spathulatum* with a mixture of shrubs over a hummock grassland of predominantly hard spinifex with annual forbs and grasses.

Example site 9

UPPER STRATUM – Very tall sparse shrubland	
Dominant species	Fitzroy wattle
Other species	Witchetty bush and Sturt Creek mallee
MID STRATUM – Tall sparse shrubland	
Dominant species	<i>Stylobasium spathulatum</i>
Other species	Native fuchsia, oval-leaf cassia, Fitzroy wattle, desert fringe myrtle and <i>Senna artemisioides</i> spp.
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, long tails, hairy mulla mulla, erect kerosene grass, short-leaved rush, Three-awn wanderrie, caustic weed, butterfly bush, tropical speedwell, <i>Sida cardiophylla</i> , fairy grass and desert Flinders grass.

LAND USE IMPLICATIONS

- Low to moderate water erosion potential on cleared areas.

With continuous use, the soil surface may become susceptible to erosion creating gullies where water can concentrate. This is already evident along the track and fence line. Wind erosion may occur when large areas are left bare by fire or when vegetation is cleared.

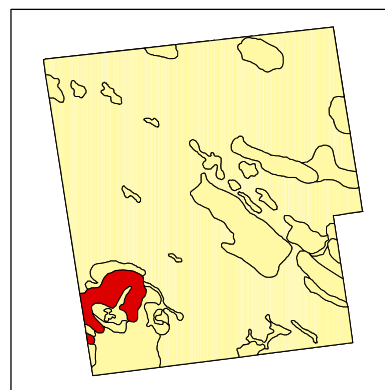
Undulating Rises LAND UNIT 2.1

General Description: Sand ridge with hillslopes ranging from 4-7% and narrow gently inclined hillcrests. Soils are deep and have a dark red sandy surface occasionally increasing in texture to a loamy sand.



Photo: Site 16

Distribution of Land Unit



Area: 61.1ha, 2.5% of Application Area

Geology : The geology of this land unit is Quaternary Alluvium (Qs). Lithology of this unit comprises dominantly of sand. This unit is believed to be the result of past fluvial activity followed by aeolian processes.

Landform: Narrow hillcrests (4-12%) and gently inclined hillslopes forming undulating rises

Soil Surface Condition: loose / soft

Site drainage: well

Runoff : very slow

Soil permeability: high

SOIL (Sites 6 and 16)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Litic Rudosol (RUGVAR EKKX), Uc1.23

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00 – 0.10	Dark red (2.5YR 3/6); sand; massive and earthy fabric; weak consistence with no coarse fragments; non-calcareous. Field pH 6.0
A ₃	0.10 – 1.50	Dark red (2.5YR 3/6); loamy sand; massive and earthy fabric; weak consistence with no coarse fragments; non-calcareous. Field pH 6.0

VEGETATION

General description: A very tall sparse shrubland dominated by scrub wattle over a tall shrubland of sandhill wattle with native fuchsia over an open hummock grassland dominated by hard spinifex.

Example site 16

UPPER STRATUM – Very tall sparse shrubland	
Dominant species	Scrub wattle
Other species	Fitzroy wattle and Halls creek wattle
MID STRATUM – Tall sparse shrubland	
Dominant species	Sandhill wattle
Other species	Native fuchsia, <i>Stylobasium spathulatum</i> , desert grevillea, double seeded emu-bush, desert fringe myrtle and Croton A77290 Lake Surprise
LOWER STRATUM – Tall open hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass, sandhill sage, desert fringe myrtle and slender pigweed.

LAND USE IMPLICATION

- The steepness of the slopes (4-12%) and softness of the soil surface may be unsafe for machinery access.
- The shape of the sand ridge is irregular.
- Low water erosion potential on cleared areas.

The irregular shape and slopes of the sand ridge will lead to difficulty in effectively establishing and maintaining agricultural crops. Clearing for crops may lead to instability of slopes with subsequent erosion by wind and water.

This land unit is small and irregular thereby imposing a different management regime to that of the surrounding sandplains if development was to occur.

Level to Gently Undulating Sandplains

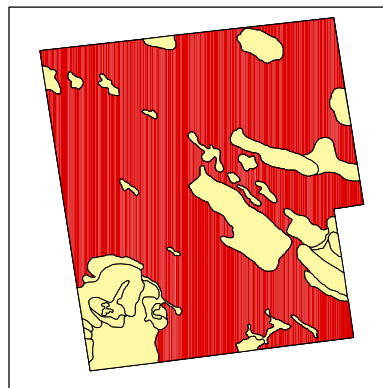
LAND UNIT 3.1

General Description: Level sandplains with slight undulations and minor dissections by drainage depressions. Soils are deep and consists of a dark red loamy sand surface grading into a massive dark red sandy loam subsoil.



Photo: Site 14

Distribution of Land Unit



Area: 1865.5ha, 75.6% of Application

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology.

Landform: Level sandplains with slope rarely exceeding 1.0%. Drainage by sheet flow into weakly defined drainage depressions.

Soil Surface Condition: Hard setting with a sandy veneer

Site drainage: well

Runoff : very slow

Soil permeability: high

SOIL (sites 1,2,5,8,14,15,20,23,24,30,31 and 34)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD CEKLX), Gn2.12

Soil Profile Morphology *Example Site 14*

Horizon	Depth (m)	Description
A ₁	0.00 – 0.30	Dark red (2.5YR3/6); loamy sand; massive and earthy fabric; no coarse fragments. Non-calcareous. Field pH 5.5 – 6.0
B ₁	0.30 – 1.10	Dark red (2.5YR3/6); heavy loamy sand; massive and earthy fabric; no coarse fragments; non-calcareous. Field pH 6.0
B ₂	1.10 – 1.70	Dark red (2.5YR3/6);sandy loam; massive and earthy fabric; no coarse fragments; non-calcareous. Field pH 6.0

VEGETATION

General description: A tall sparse shrubland of witchetty bush with Sturt Creek mallee and Fitzroy wattle over a tall sparse shrubland of scrub wattle with native fuchsia and butterfly bush over a tall hummock grassland of hard spinifex. Some sites will have bloodwood and mulga over a mixture of shrubs.

Example site 14

UPPER STRATUM – Very tall sparse shrubland	
Dominant species	Witchetty bush
Other species	Sturt Creek mallee, Fitzroy wattle, mulga and desert grevillea
MID STRATUM – Tall sparse shrubland	
Dominant species	Scrub wattle
Other species	Native fuchsia, butterfly bush, native currant and <i>Stylobasium spathulatum</i>
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex

LAND USE IMPLICATIONS

- Soils have a low water erosion potential and low to moderate wind erosion potential.

These soils are well drained reducing the risk of water erosion. Sheet flow of water occurs during intense rainfall so roads should be constructed to allow cross flow of water. Windrows along road verges must be minimised to decrease channeled water and thus erosion. Wind erosion may occur when large areas are left bare by clearing. Vegetation clearing should be minimised and carried out as close as possible prior to any development. If the soil requires ripping then it should follow the contour or be ripped in a double “s” pattern. Native vegetation buffer may also help reduce wind exposure and therefore erosion. Advice should be sought from the Resource Management Branch of Lands, Planning and Environment.

Level to Gently Undulating Sandplains

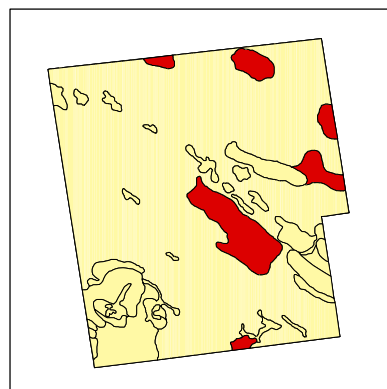
LAND UNIT 3.2

General Description: Slightly elevated, level to gently undulating plains forming part of the surrounding sandplain. The soils are deep with a dark red sandy surface over a massive dark red loamy sand subsoil.



Photo: Site 13

Distribution of Land Unit



Area: 199ha, 8.1% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Slightly elevated (2-4 m relief) level to gently undulating plains (1-2.5%) forming part of the surrounding sandplain.

Soil Surface Condition: Firm to hard with sandy veneer

Site drainage: well

Runoff : very slow

Soil permeability: high

SOIL (sites 13,28 and 29)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Orthic Tenosol (TEDSGFAR BEKKX), Uc1.23

Soil Profile Morphology *Example site 13*

Horizon	Depth (m)	Description
A ₁	0.00 – 0.20	Dark red (2.5 YR 3/5); sand; massive and earthy fabric; loose consistence with no coarse fragments; non-calcareous. Field pH 6.0
B _{21W}	0.20 – 1.70	Dark red (2.5 YR 3/6); loamy sand (light); massive and earthy fabric; very weak with no coarse fragments; non-calcareous. Field pH 6.0

VEGETATION

General description: A tall sparse shrubland of scrub wattle and Fitzroy wattle over a low sparse shrubland of senna species with native fuchsia over a tall hummock grassland of hard spinifex.

Example site 13

UPPER STRATUM –Very tall sparse shrubland	
Dominant species	Scrub wattle and rattlepod grevillea
Other species	Fitzroy wattle and bloodwood
MID STRATUM – Tall sparse shrubland	
Dominant species	Scrub wattle and rattlepod grevillea
Other species	Long-leafed hakea, <i>Stylobasium spathulatum</i> , oval-leaf cassia; desert cassia, quinine bush and <i>Croton</i> A77290 Lake Surprise
LOWER STRATUM – Sparse hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass, woollybutt, desert fringe myrtle, <i>Keraudrenia nephrosperma</i> and long tails.

LAND USE IMPLICATIONS

- Soils have a low to moderate erosion potential.

These soils are well drained reducing the risk of water erosion. Given that the slopes are slightly higher (1-2.5%), linear developments such as roads and pipelines must be well drained, using appropriate soil conservation techniques. Wind erosion may occur when large areas are left bare by clearing. Vegetation clearing should be minimised and carried out as close as possible prior to any development. If the soil requires ripping then it should follow the contour or be ripped in a double “s” pattern. Native vegetation buffer may also help reduce wind exposure and therefore erosion. Advice should be sought from the Resource Management Branch of Lands, Planning and Environment.

Level to Gently Undulating Rises

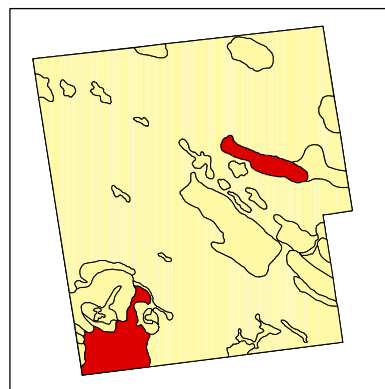
LAND UNIT 3.3

General Description: Slightly elevated, level to gently undulating plains forming part of the surrounding sandplain. The soil is deep with a dark reddish brown sandy surface over a massive dark red sandy loam subsoil



Photo: Site 3

Distribution of Land Unit



Area: 127.8 ha, 5.2% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Slightly elevated (2-4 m relief) level to gently undulating plains (1-2.5%) forming part of the surrounding sandplain.

Soil Surface Condition: Firm with sandy veneer

Site drainage: well

Runoff : very slow

Soil permeability: moderate to high

SOIL (sites 3)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BEKLX), Gn2.12

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00 – 0.15	Dark reddish brown (2.5YR 2.5/4); sandy loam; massive and earthy; very weak consistence with no fragments; non-calcareous. Field pH 6.0
B ₁	0.15 – 0.50	Dark red (2.5YR 3/6); heavy loamy sand; massive and earthy; weak consistence with no fragments; non-calcareous. Field pH .6.0
B ₂₂	0.50 – 1.50	Dark red (2.5YR 3/6); sandy loam; massive and earthy; weak consistence with no fragments; non-calcareous. Field pH 6.5

VEGETATION

General description: Tall sparse shrubland of Fitzroy wattle, desert grevillea and colony wattle with a mixture of shrubs over a tall hummock grassland of hard spinifex.

Example site 3

UPPER STRATUM – Tall sparse shrubland	
Dominant species	Fitzroy wattle, desert grevillea and colony wattle
Other species	Scrub wattle, long-leaved corkwood, native currant, <i>Sylobasium spathulatum</i> , witchetty bush, native fuchsia and <i>Eucalypt</i> spp.
MID STRATUM – Absent	
Dominant species	
Other species	
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass and desert fringe myrtle.

LAND USE IMPLICATIONS

- Soils have a low to moderate erosion potential.

These soils are well drained reducing the risk of water erosion. Sheet flow of water occurs during intense rainfall so roads should be constructed by pushing aside surface vegetation and minimising windrow development. Wind erosion may occur when large areas are left bare by clearing. Vegetation clearing should be minimised and carried out as close as possible prior to any development. If the soil requires ripping then it should follow the contour or be ripped in a double “s” pattern. Native vegetation buffer may also help reduce wind exposure and therefore erosion. Advice should be sought from the Resource Management Branch of Lands, Planning and Environment.

Given that the slopes are slightly higher (1-2.5%), linear developments such as roads and pipelines must be well drained, using appropriate soil conservation techniques.

Drainage Depression Dissecting Level to Gently Undulating Sandplains

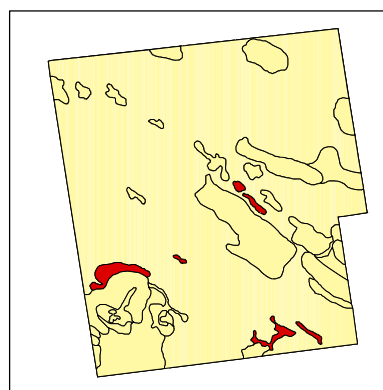
LAND UNIT 4.1

General Description: Shallow and narrow drainage depression. The soil is dominantly a red, massive gradational soil with a loamy sand surface and sandy clay loam subsoil.



Photo site 26

Distribution of Land Unit



Area: 38.1ha, 1.5% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Weakly defined and active drainage depressions that dissect the sandplains. These areas are generally 100 to 200m wide and have a slope no greater than 1%. They form part of a chain of depression which run in a southeasterly direction.

Soil Surface Condition: Hard setting with sandy veneer and surface flake. Cryptogamic crust also present on part of the surface.

Site drainage: moderately well

Runoff: very slow

Soil permeability: moderate

SOIL (Sites 26 and 27)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BEKLX), Gn2.12

Soil Profile Morphology *Example Site 27*

Horizon	Depth (m)	Description
A ₁	0.00 – 0.20	Reddish brown (2.5YR 5/4); loamy sand; massive and earthy fabric; very weak consistence with no coarse fragments; non-calcareous. Field pH 6.5
A ₃	0.20 – 0.90	Dark red (2.5YR 3/6); loamy sand to clayey sand; massive and earthy fabric; very weak consistence with no coarse fragments; non-calcareous. Field pH 6.5
B ₂	0.90 – 1.70	Dark red (2.5YR 3/6); sandy loam; massive and earthy fabric; very weak consistence with no fragments; non-calcareous. Field pH 6.5 – 6.7

VEGETATION

General description: A low open woodland of long-leafed corkwood, with bloodwood and sometimes beefwood over a tall sparse shrubland dominated by native fuchsia with *Senna artemisioides* spp. over a tall hummock grassland dominated by hard spinifex with annual grasses and forbs.

Example site 26

UPPER STRATUM –Low open woodland	
Dominant species	Long-leafed corkwood
Other species	Bloodwood, Fitzroy wattle, scrub wattle and ghost gum
MID STRATUM – Tall spare shrubland	
Dominant species	Native fuchsia
Other species	Blunt leaf cassia, <i>Sylobasium spathulatum</i> , and quinine bush
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass, curly wiregrass, woollybutt wanderrie, fairy grass, short-leaved rush, long tails, <i>Sida</i> spp., slender pigweed, desert Flinders grass, silky blue bush, silky brown top, <i>Bergia diacheiron</i> , <i>Spermacoce scarba</i> , and <i>Trianthema pilosa</i>

LAND USE IMPLICATIONS

- Soils have low erosion potential.
- Soils suffer from minor drainage problems

These soils are moderately well drained with a potential risk of water erosion. This unit receives a moderate amount of runoff which may present an erosion hazard if the soil is left bare of vegetation. Crops may suffer from prolonged water exposure and potential undermining by sheet flow.

Drainage Depressions Dissecting Level to Gently Undulating Sandplains

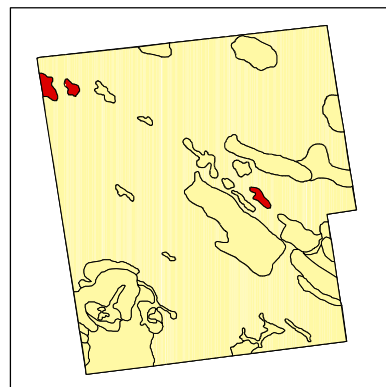
LAND UNIT 4.2

General Description: Shallow, moderately distinct drainage depressions. The soils are gradational with a dark reddish brown loamy sand surface grading into a massive red sandy clay loam subsoil.



Photo: Site 19

Distribution of Land Unit



Area: 18.0ha, 0.7% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Shallow, moderately distinct active drainage depressions that dissect the surrounding sandplains. Slope of less than 1% and have a width of between 100 and 200m.

Soil Surface Condition: Hard setting with sandy veneer and surface flake

Site drainage: Moderately well

Runoff: very slow

Soil permeability: moderate

SOIL (site 19, 33 and 36)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BEKMX), Gn2.12

Soil Profile Morphology *Example site 19*

Horizon	Depth (m)	Description
A ₁	0.00 –0.20	Dark reddish brown (2.5YR 3/4); loamy sand; massive and earthy fabric; weak consistence with no coarse fragments; non-calcareous. Field pH 6.5
B ₁	0.20 –1.20	Dark reddish brown (2.5YR 3/6); loamy sand; massive and earthy fabric; weak consistence with no coarse fragments; non-calcareous. Field pH 6.5
B ₂	1.20 – 1.70	Dark reddish brown (2.5YR 4/6); sandy clay loam; massive and earthy fabric; weak consistence with no coarse fragments; non-calcareous. Field pH 6.5

VEGETATION

General description. A tall sparse shrubland of mulga and witchetty bush with various shrubs and emergent bloodwoods over a tall hummock grassland of hard spinifex with grasses and forbs. This particular example is a variant in that it has a tall open woodland of mulga with bloodwood, beefwood and Sturt creek mallee in the upper stratum.

Example site 19

UPPER STRATUM – Tall open woodland	
Dominant species	Mulga
Other species	Bloodwood, beefwood and Sturt creek mallee
MID STRATUM – Tall sparse shrubland	
Dominant species	Mulga and Witchetty bush
Other species	Oval-leaf cassia, desert cassia, blunt-leaf cassia, native fuchsia, dogwood, butterfly bush and beefwood.
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, five minute grass, woollybutt, wild tomato, erect kerosene grass, poison sage, unequal three-awn, <i>Sida cardiophylla</i> , jointed nine-awn, spinifex everlasting, northern mulga grass, tropical speedwell, blue pincushion and short-leaved rush

LAND USE IMPLICATIONS

- Land unit is subject to high moisture conditions after high intensity rainfall or prolonged rainfall.
- Soils have low erosion potential.
- Units are small and discrete with different management issues.

This land unit is not suitable for roads, pipelines and other infrastructure due to infrequent water inundation. Because areas are small they should be easily avoidable.

These soils are moderately well drained with a moderate risk of water erosion. This unit receives a moderate amount of runoff which may present an erosion hazard if the soil is left bare of vegetation. Crops may suffer from excessive moisture and potential undermining by sheet flow.

This land unit is small and irregular thereby imposing a different management regime to that of the surrounding sandplains if development was to occur.

Drainage Depressions Dissecting Level to Gently Undulating Sandplains

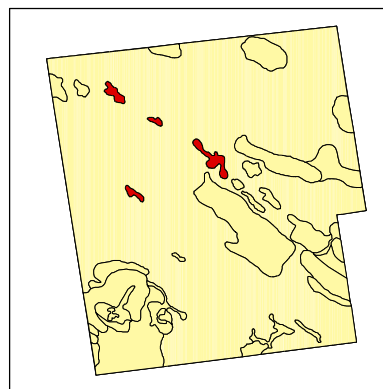
LAND UNIT 4.3

General Description: Moderately distinct narrow depressions with obvious mulga growth in the channels. The soil is gradational with a dark reddish brown loamy sand surface and a massive red sandy clay loam subsoil (rarely reaching light clay; sandy with depth); manganese segregation may be present.



Photo: Site 22

Distribution of Land Unit



Area: 21.5 ha, 0.9% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Moderately distinct active drainage depressions that dissect the surrounding sandplains. The channels are narrow with a width of 100m. Slopes are less than 1.0%.

Soil Surface Condition: Hard setting with sandy veneer

Site drainage: moderately well

Runoff: very slow

Soil permeability: moderate

SOIL (Sites 21,22, and 25)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BEKMX), Gn2.12

Soil Profile Morphology *Example 21*

Horizon	Depth (m)	Description
A ₁	0.00-0.10	Dark reddish brown (2.5YR2.5/4); loamy sand; massive and earthy fabric; very weak consistence and no coarse fragments; non-calcareous; Field pH 6.0
A ₃	0.10-0.90	Dark red (2.5YR 3/6); loamy sand; heavy; massive and earthy fabric; very weak consistence and no coarse fragments; Field pH 6.0
B ₁	0.90-1.10	Red (10R 3/6); sandy loam; massive and earthy fabric, very weak consistence and no coarse fragments, Field pH 6.5
B ₂	1.10-1.65	Red (10YR 4/6); sandy clay loam; massive and earthy fabric; weak consistence with no coarse fragments, Field pH 6.0

VEGETATION

General description: A low to mid-high woodland of mulga with witchetty bush over a tall shrubland of witchetty bush with mulga over an open hummock grassland dominated by hard spinifex. Variant: Some sites may have grasses in the lower stratum more dominant than hard spinifex associated with heavier textures.

Example site 22

UPPER STRATUM – Mid-high open woodland	
Dominant species	Mulga
Other species	Witchetty bush, bloodwood and native currant
MID STRATUM – Tall spare shrubland	
Dominant species	Witchetty bush
Other species	Native fuchsia, desert poplar and native currant
LOWER STRATUM – Tall hummock grassland	
Species recorded	Hard spinifex, <i>Polycarpaea corymbosa</i> , erect kerosene grass, woolly butt, firegrass, three-awn wanderie, cotton panic grass, wild tomato, fairy grass, short-leaved rush, Burtons Hibiscus

LAND USE IMPLICATIONS

- Land unit is subject to water accumulation after high intensity or prolonged rainfall. This may bring about access restrictions.
- Soils have low sheet erosion potential.
- Units are small and discrete with different management issues.

This land unit is not suitable for roads, pipelines and other infrastructure due to the inundation. Because areas are small they should be easily avoidable.

These soils are moderately well drained with a moderate risk of water erosion. This unit receives a moderate amount of runoff which may present an erosion hazard if the soil is left bare of vegetation. Crops may suffer from waterlogging and potential undermining by sheet flow. This land unit is small and irregular thereby imposing a different management regime to that of the surrounding sandplains if development was to occur.

Drainage Depressions Dissecting Level to Gently Undulating Sandplains

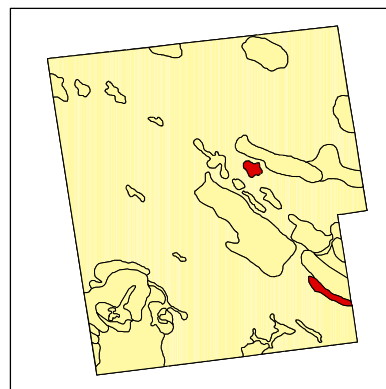
LAND UNIT 4.4

General Description: Shallow, moderately distinct drainage depressions. The soils are gradational with a dark reddish brown sandy surface grading into a massive red light clay sandy subsoil which is mottled and contains manganese segregation in the lower subsoil.



Photo: Site 32

Distribution of Land Unit



Area: 14.9 ha, 0.6 % of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Shallow, moderately distinct drainage depressions that dissect the surrounding sandplains. Slopes less than 1.0% and width between 100 and 200m.

Soil Surface Condition: Firm to hard setting

Site drainage: imperfect

Runoff: very slow

Soil permeability: moderate

SOIL (Sites 32)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BEKOX)

Soil Profile Morphology *Example site 32*

Horizon	Depth (m)	Description
A ₁	0.00-0.10	Dark reddish brown; (2.5YR 2.5/4); sand; massive and earthy fabric, weak consistence with no coarse fragments; Field pH 6.5
A ₂	0.10-0.50	Dark red (2.5YR 3/6); loamy sand; massive and earthy fabric, weak consistence with no coarse fragments; Field pH 6.5
A ₃	0.50-0.90	Dark red (2.5YR 3/6); sandy loam; massive and earthy fabric, weak consistence with no coarse fragments; Field pH 6.5
B ₁	0.90-1.20	Dark red (2.5YR 3/6); sandy clay loam; massive and earthy fabric, weak consistence with no coarse fragments; Field pH 6.5-6.7
B ₂₁	1.20-1.45	Dark red (2.5.YR 3/6); light clay; sandy; massive and earthy fabric, weak consistence with no coarse fragments; Field pH 6.7
B _{22c}	1.45-1.70	Yellowish red (5.0YR 5/6); 2% distinct red mottling and 2% faint pale mottling; light clay; sandy; massive and earthy fabric, firm consistence with no coarse fragments; 10% 2mm manganese soft segregations, Field pH 6.7

VEGETATION

General description A tall open woodland of mulga with colony wattle and bloodwood over a tall sparse shrubland of blunt-leaf cassia, with mulga and witchetty bush and a mixture of shrubs over a tall open hummock grassland dominated by hard spinifex with annual grasses and forbs.

Example site 32

UPPER STRATUM – Tall open woodland	
Dominant species	Mulga
Other species	Bloodwood and colony wattle
MID STRATUM – Tall sparse shrubland	
Dominant species	Blunt-leaf cassia
Other species	Mulga, witchetty bush, colony wattle, silver cassia, native fuchsia, broom wattle, long-leaved corkwood, Halls Creek wattle, and sandhill wattle
LOWER STRATUM – Tall open hummock grassland	
Species recorded	Hard spinifex, erect kerosene grass, northern wanderrie, northern mulga grass, bunched kerosene grass, <i>Keraudrenia nephrosperma</i> , <i>Sida</i> spp., desert poplar, butterfly bush, poison sage, silky browntop, <i>Zornia</i> spp., woollybutt, <i>Ptilotus shcwartzii</i> , woolly oat grass, <i>Polycarpaea corymbosa</i> , wild tomato bush, <i>Stylobasium spathulatum</i>

LAND USE IMPLICATIONS

- Land unit is subject to waterlogging after high intensity rainfall or prolonged rainfall.
- Soils have low erosion potential.
- Units are small and discrete with different management issues.

This land unit is not suitable for roads, pipelines and other infrastructure due to the inundation. Because areas are small they should be easily avoidable.

These soils are moderately well drained with a moderate risk of water erosion. This unit receives a moderate amount of runoff which may present an erosion hazard if the soil is left bare of vegetation. Crops may suffer from waterlogging and potential undermining by sheet flow. This land unit is small and irregular thereby imposing a different management regime to that of the surrounding sandplains if development was to occur.

Drainage Depressions Dissecting Level to Gently Undulating Sandplains

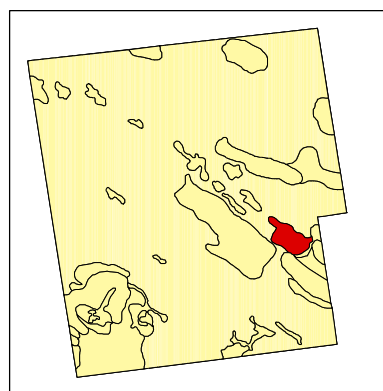
LAND UNIT 4.5

General Description: Broad, distinct drainage depression adjacent to the lower slope of gently undulating rises. The soil has a dark reddish brown fine sandy loam surface grading into a massive clay loam fine sandy subsoil increasing to a light clay fine sandy with depth. Manganese segregations are present in the upper subsoil.



Photo site 10

Distribution of Land Unit



Area: 23.6ha, 1.0% of Application Area

Geology : Quaternary Alluvium (Qs) comprising of sand, silt and clay lithology

Landform: Broad, distinct drainage depressions adjacent to the lower slopes of gently undulating rises. Slope less than 1.0% and width approximately 350m.

Soil Surface Condition: Hard setting

Site drainage: imperfect

Runoff: very slow

Soil permeability: moderate

SOIL (Sites 10)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAAAGCD BELOX), Gn2.12

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00-0.20	Dark reddish brown; (2.5YR 2.5/4); fine sandy loam; massive and earthy fabric, very weak consistence with no coarse fragments; Field pH 5.0
A ₃	0.20-0.50	Dark red (2.5YR 3/6); fine sandy clay loam; massive and earthy fabric; very weak consistence with no coarse fragments; Field pH 5.7
B _{1c}	0.50-0.70	Dark red (2.5YR 3/6); clay loam fine sandy; massive and earthy fabric; very weak consistence with no coarse fragments; 10% 4mm manganese nodules; Field pH 6.5
B ₂₁	0.70-1.50	Dark reddish brown (2.5YR 4/6); light clay fine sandy; massive and earthy fabric; weak consistence with no coarse fragments; Field pH 6.5

VEGETATION

General description: Low open woodland of mulga with witchetty bush over a tall sparse shrubland of witchetty bush with native fuchsia, native currant and mulga over an mid-high open tussock grassland of three-awn wanderrie with hard spinifex and other grasses and forbs.

Example site 10

UPPER STRATUM –Low open woodland	
Dominant species	Mulga
Other species	Witchetty bush
MID STRATUM – Tall spare shrubland	
Dominant species	Witchetty bush
Other species	Native fuchsia, native currant and mulga
LOWER STRATUM – Mid-high open tussock grassland	
Species recorded	Three-awn wanderrie, hard spinifex, unequal three-awn, desert Chinese lantern, spinifex everlasting, <i>Polycarpaea corymbosa</i> , Sturts Hibiscus and small red-leaf

LAND USE IMPLICATIONS

- Land unit is subject to high moisture retention after high intensity or prolonged rainfall.
- Soils have low to moderate erosion potential.
- Units are small and discrete with different management issues.

This land unit is not suitable for roads, pipelines and other infrastructure due to the inundation. Because areas are small they should be easily avoidable.

These soils are moderately well drained with a moderate risk of water erosion. This unit receives a moderate amount of runoff which may present an erosion hazard if the soil is left bare of vegetation. Crops may suffer from excess water and potential undermining by sheet flow. This land unit is small and irregular thereby imposing a different management regime to that of the surrounding sandplains if development was to occur. Boggy conditions may arise after excessive quantities of rainfall.

Swamps and Flood Plains

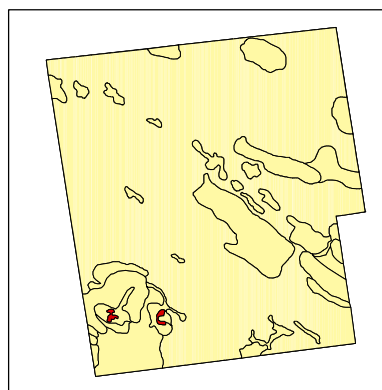
LAND UNIT 5.1

General Description: Seasonally flooded swamps influenced by Wycliffe Creek to the south. The soil is a uniform non-cracking clay with a dark greyish brown light clay surface overlying a weakly to moderately structured, mottled, dark greyish brown light medium clay subsoil.



Photo site 17

Distribution of Land Unit



Area: 4.0ha, 0.2 % of Application Area

Geology: Quaternary Alluvium (Qp) comprising of sand, silt and clay, lacustrine lithology

Landform: Seasonally flooded closed depressions consisting of small swamps. The surface relief is level within the swamp with a few small channel dissecting the edges where vegetation is present. Sandplains and adjacent sand ridges provide for the majority of the run-on.

Soil Surface Condition: Hard setting when dry and soft when wet

Site drainage: very poor

Runoff: very slow

Soil permeability: very slow

SOIL (Site 17)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Grey Dermosol (DEADAGCD BEOO-), Uf6.41

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00-0.10	Dark greyish brown (10YR 4/2); light clay, heavy; massive, moist; firm consistence with no coarse fragments; non-calcareous; Field pH 7.0
B ₂₁	0.10-0.30	Dark greyish brown (2.5Y 4/2); light medium clay; weak to moderate subangular blocky structure; wet; weak consistence; 5% 3mm rounded silcrete coarse fragments; Field pH 6.5
B ₂₂	0.30-0.70	Dark greyish brown (10YR 4/2); 20% grey mottling; light medium clay; moderate subangular blocky; wet; weak consistence; no coarse fragments; Field pH 7.0

VEGETATION

General description: A very tall to tall open mallee woodland of Inland tea-tree with coolibah over a mid-dense fernland of common nardoo. The perimeter of the depressions in the lower stratum tends to be dominated by a variety of sedges, forbs and grasses.

Example site 17

UPPER STRATUM –Very tall open mallee woodland	
Dominant species	Inland tea-tree
Other species	Coolibah
MID STRATUM – Tall open mallee woodland	
Dominant species	Inland tea-tree
Other species	
LOWER STRATUM - Mid-dense fernland	
Species recorded	Common nardoo, sticky indigo, small poached egg daisy, <i>Isotoma luticola</i> , eight-day grass, small water-fire; <i>Polycarpaea corymbosa</i> , fairy grass, spreading nut heads, <i>Cyperus nervulosus</i> , budda pea and pale spike-rush

LAND USE IMPLICATIONS

- Areas are subject to flooding and would remain waterlogged for a considerable time after high intensity or prolonged rainfall.
- Units tend to be small and discrete with different management issues to the surrounding land units thus interrupting broad scale management systems

This land unit is not suitable for roads, pipelines and other infrastructure due to water inundation. The size and location of these land units should not interrupt development of other more suitable areas. These soils are poorly drained with moderate risk of infrequent flooding. The soil properties and landform are not suitable for horticulture due to moisture characteristics.

Swamps and Flooded Plains

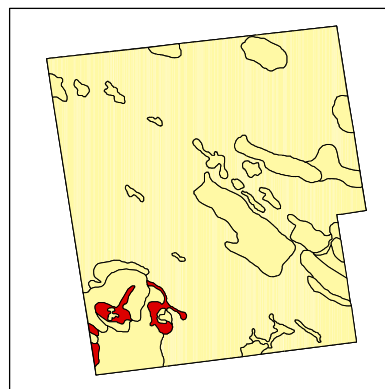
LAND UNIT 5.2

General Description: Swamp and plain interface, which is gently undulating and slightly elevated above adjacent swamps. Soil has a clayey sand surface that is very hard and compacted due to the fine sand component.



Photo site 18

Distribution of Land Unit



Area: 35.3ha, 1.4% of Application Area

Geology : Quaternary Alluvium (Qp) comprising of sand, silt and clay, lacustrine lithology

Landform: Swamp and sandplain interface that is gently undulating and slightly elevated above the adjacent swamps.

Soil Surface Condition: Hard setting

Site drainage: poor

Runoff: slow

Soil permeability: slow

SOIL (Site 18)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Brown Kandosol (KAABAHCD)

Soil Profile Morphology

Horizon	Depth (m)	Description
A ₁	0.00-0.10	Dark greyish brown (7.5YR 3/3); clayey sand; massive, dry; strong with no coarse fragments; Field pH 5.50
A ₂	0.10-0.45	Dark greyish brown (7.5YR 3/3); fine sand; dry; massive, strong with no coarse fragments; Field pH 6.5

VEGETATION

General description A mid high open–isolated woodland of coolibah over an open mallee woodland of Inland tea-tree with oval leaf cassia over an open fernland of common nardoo with woollybutt and a mixture of forbs and grasses.

Example site 18

UPPER STRATUM –Mid high open woodland	
Dominant species	Coolibah
Other species	
MID STRATUM – Tall open mallee woodland	
Dominant species	Inland tea-tree
Other species	Oval leaf cassia
LOWER STRATUM – Mid-high open fernland	
Species recorded	Common nardoo, woollybutt, delicate lovegrass, <i>Bergia diacheiron</i> , spreading nut heads, narrow-leaf joyweed, eight-day grass, golden beard grass and northern wanderrie grass.

LAND USE IMPLICATIONS

- Area would be subject to flooding thus would remain waterlogged for a considerable time after high intensity rainfall or prolonged rainfall.
- Units tend to be small and discrete with different management issues to the surrounding land units, thus interrupting broad scale management systems

This land unit is not suitable for roads, pipelines and other infrastructure due to water inundation. The size and location of these land units should not interrupt development of other more suitable areas. These soils are poorly drained with moderate risk of infrequent flooding. The soil properties and landform are not suitable for horticulture.

Swamps and Flooded Plains

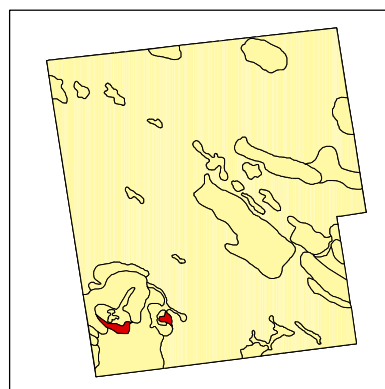
LAND UNIT 5.3

General Description: The peripheral areas of the sandplain adjacent to the swamp or the swamp plain interface are subject to flooding. The areas are quite small and gently undulating. The soils have a loamy sand surface that grades into a sandy loam and sandy clay loam subsoil. Calcium carbonate segregations occur in the lower subsoil.



Site 7

Distribution of Land Unit



Area: 8.6ha, 0.3% of Application Area

Geology : Quaternary Alluvium (Qp) comprising of sand, silt and clay, lacustrine lithology

Landform: Gently undulating alluvial plain

Soil Surface Condition: Hard setting

Site drainage: imperfect

Runoff: slow

Soil permeability: moderate

SOIL (Site 7)

Salinity: Nil (< 0.1 dS/m field measurement throughout the soil profile)

Soil classification: Red Kandosol (KAAABDCD BEKMW), Gn2.12

Soil Profile Morphology (limited information)

Horizon	Depth (m)	Description
A ₁	0.00-0.10	Red; clayey sand; massive and earthy, dry; weak consistence with no coarse fragments; non-calcareous; Field pH 6.5
A ₃	0.10-0.25	Red; loamy sand; dry; massive and earthy, weak consistence with no coarse fragments; non-calcareous; Field pH 6.5
B ₁	0.25-1.10	Red; sandy loam; dry; massive and earthy, firm consistence with no coarse fragments; non-calcareous; Field pH 7.0
B _{21k}	1.10-1.20	Red; sandy clay loam; moist; massive and earthy, firm consistence with no coarse fragments; 20% 5-10mm carbonate concretions; moderately calcareous; Field pH 8.0

VEGETATION

General description Low open woodland of coolibah over a sparse shrubland of inland tea-tree with native fuchsia and desert cassia over and tall open hummock grassland of hard spinifex.

Example site 7

UPPER STRATUM –Mid high open woodland	
Dominant species	Coolibah
Other species	
MID STRATUM – Tall open mallee woodland	
Dominant species	Inland tea-tree
Other species	Native fuchsia and desert cassia
LOWER STRATUM – Tall open hummock grassland	
Species recorded	Hard spinifex with a mixture of forbs and annual grasses.

LAND USE IMPLICATIONS

- Area would be subject to minor flooding compared with Land Unit 5.1 and 5.2. Moisture content in the soil after high intensity rainfall would create access problems.
- Units tend to be small and discrete with different management issues to the surrounding land units, thus interrupting broad scale management systems

This land unit is not suitable for roads, pipelines and other infrastructure due to water inundation. The size and location of these land units should not interrupt development of other more suitable areas. These soils are poorly drained with moderate risk of infrequent flooding. The soil properties and landform are not suitable for horticulture.

5.0 Reconnaissance survey of Singleton-Murray Downs Study Area

5.1 Study methodology

The Singleton-Murray Downs Study Area entailed a much broader look at potential suitable areas for horticulture. The area assessed was identified by hydrogeologists as having groundwater with less than 1000 mg/L of total dissolved solids (TDS) (Gilbert and Jolly, 1990). Previous mapping on Murray Downs (Grant, 1989) was used and verified by spot-checking along tracks. Spot-checking involved inspecting site drainage, presence of coarse fragments or outcropping, landform type and attributes, erosion potential, soil uniformity and the susceptibility to flooding. No detailed soil or vegetation recording was conducted. The assessment of the Singleton station component of the study area required greater extrapolation from the available information due to the lack of land resource information on this station. This is reflected by the reliability diagram on Map 2.

The Singleton-Murray Downs Study Area and the immediate surroundings (Figure 2.0) were divided into three levels of capability. These were then mapped (Map 2) at 1:200,000 scale by direct digitising onto a rectified satellite image in the GIS. Land unit line work already established over Murray Downs Station was used and altered where appropriate to comply with the capability boundaries.

5.2 Capability for horticultural development in the Singleton-Murray Downs Study Area and its immediate surroundings

The land capability for particular land uses varies depending on the requirements of the crop and limitations of the land. The land deemed capable for horticulture in the Singleton-Murray Downs Study Area (including the Singleton Application Area – Maps 1 and 3), are those which have uniform areas of deep, well drained soils with little impedance due to abundant coarse fragments and calcrete pans, and/or rock outcrop close to the surface. The soils are also required to have low salinity and exchangeable sodium percentage both of which played no part of the evaluation process due to limited information. The landforms most desirable are those which have a level to slightly inclined, uniform gradient which will have similar management requirements over the entire area as well as easy access for machinery and other equipment.

Many factors determine land capability of a soil landscape. For the purpose of this reconnaissance survey, seven factors were taken into account for the assessment. They are:

Wetness – Wetness poses a problem for two main reasons. The first is the detrimental effects of excessive moisture content for plant growth and the second the difficulty in gaining access to waterlogged soils. The factors used to assess wetness of a site are permeability of the soil, drainage and runoff.

Flooding – Areas prone to flooding are usually centred on drainage depressions. This limitation takes into account more than wetness as it includes the destructive forces of flooding on infrastructure and the crop. Areas, which appear to be flooded regularly (as visible on satellite imagery), are deemed unsuitable.

Slope – Slope influences suitability for cropping by restricting safe machinery access to steep country. Slopes of greater than 10-15% were generally deemed unsuitable. Slope also affects the susceptibility of land to erosion.

Water erosion hazard – Water erosion hazard is assessed by looking at the features of the landscape (eg. shape and gradient) that influence water runoff. Other features such as climatic factors (eg. rainfall intensity and distribution), edaphic factors (eg. infiltration rate and soil erosivity), vegetation cover and management also affect the severity of erosion.

Rockiness – The abundance and size of coarse fragments in the surface soil and on the surface can interfere with agricultural machinery. They can also reduce the ability of the soil to hold moisture thereby lowering the plant available water. Scattered areas of abundant coarse fragment and rock outcrop can break up the continuity of an agricultural block altering the management regime.

Soils depth – Depth of soil refers to the depth which the roots can penetrate and which in turn can affect plant available water. This barrier may be in the form of rock or any other impermeable layer.

Soil complexity – Soil is generally required to be of an adequate size and suitable shape to be viable for irrigation. As soil uniformity changes across an area so does the management of the soil.

Due to the broadness of this assessment three classes of capability have been identified in the study area (Map 2). They are:

Class 1 – Capable with minor to moderate limitations

Class 2 – Capable with severe limitations

Class 3 – Unsuitable

5.3 Results

5.3.1 : Singleton Murray Downs Study Area

It was found that the Singleton-Murray Downs Study Area (total dissolved solids <1000 mg/L) has approximately 449km² of land with minor to severe limitations and 484km² of unsuitable land (Table 4.0).

Figure 4.0 Areas of land capability in the Singleton-Murray Downs Study Area (< 1000 mg/L of TDS) and the immediate surroundings.

Capability Class	Singleton-Murray Downs Study Area and immediate surrounds*	Singleton-Murray Downs Study Area	% area of Singleton-Murray-Downs Study Area
1. Capable with minor to Moderate Limitations	767 km ²	330 km ²	35.4%
2. Capable with severe Limitations	410 km ²	119 km ²	12.7%
2. Unsuitable	1564 km ²	484 km ²	51.9%
Total Land studied	2741 km ²	933 km ²	100.0%

* Singleton-Murray Downs Study Area and immediate surrounds as shown in figure 2.0

5.3.2 Singleton Application Area

Three capability classes have been allotted to the land units within the Singleton Application Area (Table 5.0).

Eighty-nine percent of Singleton Application Area was assessed as class one capability (slight to moderate limitations). The land resource survey described most of these land units (Land Unit 3.1, 3.2, 3.3) as being well drained, level to gently sloping, non-saline and having nil coarse fragment, nil rock outcrop and no identifiable impedance to water drainage within the upper 2-3m of soil profile.

The minor depressions (LU 4.1, 4.2, 4.3, .4.4) and sandy hillslopes (LU 1.2, 1.3) fall into capability class two (5.3 %). The small areas and reduced drainage are the most notable features causing the severe limitations whereas with the hillslopes, the loose surface condition limits trafficability and machinery access. Wind erosion may occur when large areas are left bare by fire or when vegetation is cleared.

Capability class three (unsuitable) includes the land units that are unsuitable for horticulture. The land units which make up this class are the swamps (LU 5.1) and the associated peripherals areas (LU 5.2, 5.3), sand ridges (LU 2.1) and small, gravelly hillcrest. These are unsuitable for one or more of the following limitations; flooding, wetness, excessive slope gradient, water erosion hazard and soil complexity.

Figure 5.0 Areas of land capability in the Singleton-Application Area

Capability Class	Singleton Application Area*	% area of Singleton-Application Area
3. Capable with minor to Moderate Limitations	22.0 km ²	89.0%
4. Capable with severe limitations	1.3 km ²	5.3%
3. Unsuitable	1.4 km ²	5.6%
Total Land	24.7 km ²	100.00

* Singleton Application Area as shown in figure 2.0

6.0 Conclusions

Singleton Application Area

The Singleton Application Area is a generally uniform area encompassing several landforms and soils. Five landscapes comprising 16 land units in the 25 km² Application Area were identified.

The level to gently undulating sandplains are the most dominant landscape (88.9%) in which three land units were identified (LU 3). The most dominant soil are those with red sandy surfaces grading into a red sandy loams subsoil. Drainage depressions dissect the study area and tend to have sandy loam surfaces overlying clay loam to clayey subsoils (LU 4). Swamps located in the south-western region of the study area have poorly drained non-cracking clays (LU 5). Adjacent to these swamps are undulating rises with deep sandy soils (LU 2). Rocky rises found on the eastern central boundary have a sandy loam surface. The very gently inclined to gently inclined hillslopes have a sandy surface with a sandy to sandy loam subsoil (LU 1).

The landscapes recommended for further investigation for specific crop suitability in the Singleton Application Area are the level to gently undulating sandplains (LU 3) due to the potential they hold for horticultural development. The attributes most desirable on these plains are the gently inclined slopes, freely draining soils and the soil textures of the surface and subsoils.

The rock free slopes on the rises also require attention. These areas have many desirable attributes for development but the slope gradient and the soft to loose surface condition may hinder access for heavy machinery.

The swamps, rocky hillcrests and drainage depressions have attributes less desirable for horticulture. These may include rockiness, poor drainage or heavier soil textures.

Overall the Singleton Application Area has considerable potential for horticultural development. Land capability study suggests that 89% of the Application area is capable with only slight to moderate limitations. Careful planning is required and this will necessitate further evaluation of the more favourable areas identified.

Singleton-Murray Downs Study Area

The Singleton-Murray Downs Study Area is an area that has been identified as having good quality groundwater suitable for horticultural purposes.

A broad reconnaissance survey identified areas that are capable for horticulture with a view that more detailed assessment will be carried out in the future.

Three capability classes were defined which include capable with minor to moderate limitations, capable with severe limitations, and unsuitable. The percentage of capable land with minor to moderate limitations is 35%, while 65% of the study area has severe limitations or is unsuitable. The main criteria used to assess the levels of capability are wetness, flooding, slope, water erosion potential, rockiness, soil depth and soil

complexity. In many cases not all criteria could be applied due to limited available information.

This survey highlights that parts of Singleton-Murray Downs Study Area have the potential for horticultural development. Prior to any development more intensive land resource survey is required.

7.0 References

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- DPIF – Berrimah Agricultural Research Centre for laboratory analysis of soil samples.
- Dave Albrecht and Hilary Colson, Herbarium Parks and Wildlife Commission of the Northern Territory for aid in identification of plants.

Appendix 1 Plant species recorded in the Singleton Application Area

LISTED BY COMMON NAME

Trees

Bloodwood
Coolibah
Desert poplar
Ghost gum
Long-leafed corkwood
Rough-leaved bloodwood
Red bud mallee
Sturt Creek mallee
-

Corymbia opaca
Eucalyptus coolibah subsp. *arida*
Codonocarpus cotinifolius
Corymbia apparrerinja
Hakea lorea ssp. *lorea*
Corymbia setosa
Eucalyptus pachyophylla
Eucalyptus ondotoarpa
Eucalyptus spp.

Shrubs

Beefwood
Blunt-leaf cassia
Broom wattle, Minyana
Burtons hibiscus
Butterfly bush
Chocolate bush
Colony wattle, Murrays wattle
Curry Wattle, Spineleaf wattle
Desert cassia
Desert fringe myrtle
Desert grevillea
Dogwood
Double-seeded emu bush
Fitzroy wattle
Grey cassia
Halls creek wattle
Hill turpentine
Holly grevillea
Inland tea-tree
Mulga
Native currant
Native fuchsia
Oval-leaf cassia
Qunine bush
Rattlepod grevillea
Sandhill Wattle, Feather-veined wattle
Scrub wattle
Sturts hibiscus
Supplejack
Torulosa wattle, Deep-gold wattle
Waxy wattle
Whipstick Wattle, Sugar brother
Witchetty bush
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-

Grevillea striata
Senna artemisoides subsp. *helmsii*
Acacia tenuissima
Hibiscus burtonii
Petalostylis cassioides
Senna pleurocarpa
Acacia murrayana
Acacia spondyophylla
Senna artemisoides subsp. *filifolia*
Calytrix longiflora
Grevillea juncifolia
Acacia coriacea
Gyrostemon tepperi
Acacia ancistrocarpa
Senna artemisoides subsp. *desolata*
Acacia cowleana
Acacia monticola
Grevillea wickhamii
Melaleuca glomerata
Acacia aneura
Canthium latifolium
Eremophila latrobei var. *glabra*
Senna artemisoides subsp. *oligophylla*
Petalostigma nummularium
Grevillea stenobotrya
Acacia dictyophleba
Acacia stipuligera
Hibiscus sturtii
Ventilago viminalis
Acacia torulosa
Acacia melleodora
Acacia adsurgens
Acacia kempeana
Senna artemisoides subsp.
Stylobasium spathulatum

Forbs

Blue pincushion
Budda pea, Kath sola
Bushy fan-flower
Caustic vine
Caustic weed, Caustic creeper, Mat spurge
Climbing salt bush
Desert Fire weed
Desert Chinese lantern
Desert Spurge, Caustic bush
Fruit Salad Plant, Apple bush
Hairy mulla mulla

Brunonia australis
Aeschynomene indica
Scaevola ovalifolia
Sarcostema australe
Euphorbia drummondii
Einadia nutans
Rulingia loxophylla
Abutilon otocarpum
Euphorbia tannensis
Pterocaulon serrulatum
Ptilotus helipteroides

Longtails
 Mamukata, Devils son
 Poison sage
 Sandhill sage
 Silky blue bush
 Silver tails
 Slender pigweed
 Small poached egg daisy
 Small water-fire
 Spinifex everlasting
 Spreading nut heads
 Sticky indigo
 Tropical speedwell
 Velvet hibiscus
 Weeping mulla mulla
 Wild tomato bush
Yellow twin stem, Speedy weed

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Grasses

Brown pigeon grass
 Cotton panic grass
 Delicate lovegrass
 Desert Flinders grass
Erect kerosene grass, White grass, Arrow grass
Fairy grass, Cumings lovegrass
 Feathertop spinifex
Five minute grass, Rye beetle grass
Golden beard grass, Ribbon grass
 Hard Spinifex
Jointed Nine-awn, Limestone oat-grass, Jointed bottlewasher
 Narrow-leaf joyweed
Northern mugla grass, Spinifex couch
Northern wanderrie, Wiregrass
 Silky brown Top
Slender wanderrie, Wiregrass
Small Red-leaf, Red Spathe grass, Firegrass
 Three-awn wanderrie
Unequal Three-awn, Curly wiregrass, Fire grass,
 Woolly butt
Woolly Oat grass, Oat grass, Leaf nine-awn
 Woollybutt wanderrie

Sedges

Eight-day grass, Common fringe rush
 Pale spike-rush
 Short-leaved rush
 -

Ferns

Common nardoo

Ptilotus polystachyus
Heliotropium tenuifolium
Isotropis atropurpurea
Newcastelia spodioptricha
Maireana villosa
Ptilotus obovatus
Portulaca filifolia
Myriocephalus radallii
Bergia trimera
Leucochrysum stipitatum
Sphaeromorphaea australis
Indigofera colutea
Evolvulus alsinoides
Melhanina oblongiflora
Ptilotus calostachyus
Solanum quadrioculatum
Flavaria australasica
Bergia diacheiron
Croton A77290 Lake Surprise
Goodenia ramelii
Isotoma laticola
Keraudrenia nephrosperma
Maireana planifolia
Myriocephalus radallii
Paspalum diffusum
Polycarpaea corymbosa
Ptilotus schwartzii
Sida cardiophylla
Sida sp.
Spermacoce scabra
Trianthema pilosa
Waltheria indica
Zornia sp.

Setaria surgens
Digitaria brownii
Eragrostis tennellula
Yakirra australiensis
Aristida holathera
Eragrostis cumingii
Triodia schinzii
Tripogon loliflorus
Chrysopogon fallax
Triodia basedowii
Enneapogon cylindricus
Alternanthera angustifolia
Paraneurachne muelleri
Eriachne obtusa
Eulalia aurea
Eriachne ciliata
Schizachyrium fragile
Eriachne aristida
Aristida inaequiglumis
Eragrostis eridipoda
Enneapogon polyphyllus
Eriachne helmsii

Fimbristylis dichotoma
Eleocharis pallens
Bulbosytilus barbarta
Cyperus nervulosus

Marsilea exarata

BY SCIENTIFIC NAME

Trees

Corymbia setosa
Corymbia opaca
Corymbia apparrerinja
Codonocarpus cotinifolius
Eucalyptus coolibah subsp. *arida*
Eucalyptus ondotoarpa
Eucalyptus pachyophylla
Eucalyptus sp.
Hakea lorea ssp. *lorea*

Rough-leaved bloodwood
 Bloodwood
 Ghost gum
 Desert popla
 Coolibah
 Sturt Creek mallee
 Red bud mallee
 -
 Long-leaved corkwood

Shrubs

Acacia ancistrocarpa
Acacia adsurgens
Acacia aneura
Acacia coriacea
Acacia cowleana
Acacia dictyophleba
Acacia kempeana
Acacia melleodora
Acacia monticola
Acacia murrayana
Acacia spondyophylla
Acacia stipuligera
Acacia tenuissima
Acacia torulosa
Calytrix longiflora
Canthium latifolium
Eremophila latrobei var. *glabra*
Grevillea juncifolia
Grevillea stenobotrya
Grevillea striata
Grevillea wickhamii
Gyrostemon tepperi
Hibiscus burtonii
Hibiscus sturtii
Melaleuca glomerata
Petalostylis cassioides
Petlostigma nummularium
Senna artemisoides subsp. *desolata*
Senna artemisoides subsp. *filifolia*
Senna artemisoides subsp. *Helmsii*
Senna artemisoides subsp. *Oligophylla*
Senna artemisoides subsp.
Senna pleurocarpa
Stakhousia A90542
Stylobasium spathulatum
Ventilago viminalis

Fitzroy wattle
Whipstick wattle, Sugar brother
 Mulga
 Dogwood
 Halls creek wattle
Sandhill wattle, Feather-veined wattle
 Witchetty bush
 Waxy wattle
 Hill turpentine
Colony wattle, Murray's wattle
Curry Wattle, Spineleaf wattle
 Scrub wattle
Broom wattle, Minyana
Torulosa wattle, Deep-gold wattle
 Desert fringe myrtle
 Native currant
 Native fuchsia
 Desert grevillea
 Rattlepod grevillea
 Beefwood
 Holly grevillea
 Double-seeded emu bush
 Burtons hibiscus
 Sturts hibiscus
 Inland tea-tree
 Butterfly bush
 Quinine bush
 Grey cassia
 Desert cassia
 Blunt-leaf cassia
 Oval-leaf cassia
 -
 Chocolate bush
 -
 -
Supplejack

Forbs

Abutilon otocarpum
Aeschynomene indica
Bergia diacheiron
Bergia trimera
Brunonia australis
Croton A77290 Lake Surprise
Einadia nutans
Euphorbia drummondii
Euphorbia tannensis
Evolvulus alsinoides
Flavaria australasica
Goodenia ramelii
Heliotropium tenuifolium

Desert chinese lantern
Budda pea, Kath sola
 -
 Small water-fire
 Blue pincushion
 -
 Climbing salt bush
Caustic weed, Caustic creeper, Mat spurge
Desert Spurge, Caustic bush
 Tropical Speedwell
Yellow twin stem, Speedy weed
 -
 Mamukata, Devils son

Indigofera colutea
Isotoma luticola
Isotropis atropurpurea
Keraudrenia nephrosperma
Leucochrysum stipitatum
Maireana planifolia
Maireana villosa
Melhaniea oblongifolia
Myriocephalus ruallii
Newcastelia spodiopetala
Polycarpaea corymbosa
Portulaca filifolia
Pterocaulon serrulatum
Ptilotus calostachyus
Ptilotus helipteroides
Ptilotus obovatus
Ptilotus polystachyus
Ptilotus schwartzii
Rulingia loxophylla
Sarcostema australe
Stackhousia A90542
Scaevola ovalifolia
Sida cardiophylla
Sida sp.
Solanum quadriloculatum
Spermacoce scabra
Sphaeromorphaea australis
Trianthema pilosa
Waltheria indica
Zornia sp.

Grasses

Alternanthera angustifolia
Aristida holathera
Aristida inaequiglumis
Chrysopogon fallax
Digitaria brownii
Enneapogon cylindricus

Enneapogon polyphyllus
Eragrostis eridipoda
Eragrostis cumingii
Eragrostis tenellula
Eriachne aristidea
Eriachne ciliata
Eriachne helmsii
Eriachne obtusa
Eulalia aurea
Paraneurachne muelleri
Paspalidium diffusum
Schizachyrium fragile
Setaria surgens
Triodia basedowii
Triodia schinzii
Tripogon loliiformis
Yakirra australiensis

Sedges

Bulbostylus barbata
Cyperus nervulosus
Eleocharis pallens
Fimbristylis dichotoma

Ferns

Marsilea exarata

Sticky indigo
 -
 Poison sage
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 Spinifex everlasting
 Low bluebush
 Silky blue bush
 Velvet hibiscus
 Small poached egg daisy
 Sandhill sage
 -
 Slender pigweed
Fruit salad plant, Apple bush
 Weeping mulla mulla
 Hairy mulla mulla
 Silver tails
 Longtails
 -
 Desert fire weed
 Caustic vine
 -
 Bushy fan-flower
 -
 -
 Wild tomato bush
 -
 Spreading nut heads
 -
 -
 -

Narrow-leaf joyweed
Erect kerosene grass, White grass, Arrow grass
Unequal three-awn, Curly wiregrass, Fire grass,
Golden beard grass, ribbon grass
 Cotton panic grass
Jointed nine-awn, Limestone oat-grass, Jointed
 bottlewasher
Woolly Oat grass, Oat grass, Leaf nine awn
 Woolly butt
Fairy grass, Cumings lovegrass
 Delicate lovegrass
 Three-awn wanderrie
Slender wanderrie, Wiregrass
 Woollybutt wanderrie
Northern wanderrie, Wiregrass
 Silky brown top
Northern mugla grass, Spinifex couch
 -
Small Red-leaf, Red spathe grass, Firegrass
 Brown pigeon grass
 Hard spinifex
 Feather top spinifex
Five minute grass, Rye beetle grass
 Desert Flinders grass

Short-leaved rush
 -
 Pale spike-rush
Eight-day grass, Common fringe rush

Common nardoo

Appendix 2 – Soil chemistry results of sites 31 (full profile) and site 10 (diagnostic sample)

Site 31 - Land Unit 3.1

Depth (m)	1:5 Soil Water			CEC	Exchangeable Cations				ESP*	BS**
	pH	Ec mS/m	Cl Mg/kg		K	Ca Meq/100g	Mg	Na		
0.0-0.1	5.1	0.01	<2.5	0.93	0.1	0.7	0.2	0.1	11.7	22
0.2-0.3	6.0	0.01	<2.5	1.53	0.2	1.0	0.3	0.1	7.1	24
0.5-0.6	6.1	0.01	<2.5	1.6	0.2	1.1	0.3	0.1	6.8	17
0.8-0.9	6.3	0.01	<2.5	1.94	0.2	1.4	0.4	0.1	5.6	17
1.1-1.2	6.5	0.01	<2.5	1.89	0.2	1.3	0.4	0.1	5.8	11
1.4-1.5	6.5	0.01	<2.5	1.96	0.2	1.4	0.4	0.1	5.5	10

- *ESP value is the maximum it could possible be as the detection level of this measurement is 0.1 meq/100g. This means exchangeable sodium values are in the range of 0 to 0.1 meq/100g
- ** BS - Base status – sum of exchangeable basic cations (Ca, Mg, K, Na)

Site 10 - Land Unit 4.5

Depth (m)	1:5 Soil Water			CEC	Exchangeable Cations				ESP*	BS**
	pH	Ec mS/m	Cl Mg/kg		K	Ca Meq/100g	Mg	Na		
0.5-0.7	5.9	0.01	<2.5	0.93	0.4	2.3	1.3	0.1	2.7	18

- ESP value is the maximum it could possible be as the detection level of this measurement is 0.1 meq/100g. This means exchangeable sodium values are in the range of 0 to 0.1 meq/100g
- ** BS - Base status – sum of exchangeable basic cations (Ca, Mg, K, Na)

