REPORT

On contract research for

Pioneer Minerals (Pty) LTD

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SOIL SURVEY FOR THE PROPOSED PROSPECTING ON THE REMAINING PORTIONS OF THE FARM REMHOOGTE 152

By

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1. TERMS OF REFERENCE

Jasper Dreyer was contracted by Pioneer Minerals to undertake a soil investigation on the remaining portions of the farm Remhoogte 152, 30km east of north-east of Prieska in the Northern Cape province. The purpose of the investigation is to contribute to the environmental management programme for the proposed prospecting on the farm. The objectives of the study are to do a reconnaissance soil survey and;

- To classify the soils and to produce a soil map of the specified area,
- To state the soil properties namely fertility, dry land crop production potential and irrigation potential of each map unit.
- To assessed the Land Capability of each map unit.

2. SITE CHARACTERISTICS

2.1 Location

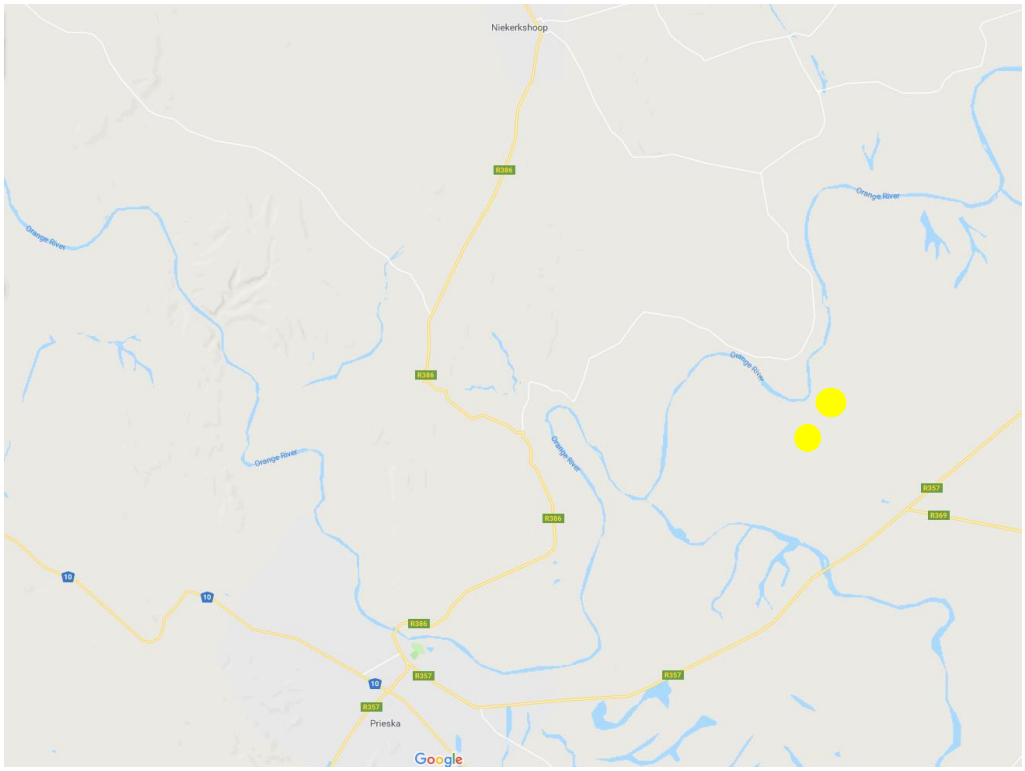


Figure 1: Locality map with the surveyed area in yellow.

The area that was investigated covers 2 491.8 ha on the farm as mentioned above, lying ±30km east of north-east of Prieska in the Northern Cape province. The location of the surveyed area can be seen in Figure 1, with the coordinates lying between 29°30’53”S to 29°36’22”S and 22°57’45”E to 23°04’35”E.

2.2 Terrain

The terrain morphological class of the area can described as plains with low relief, with a distinct escarpment going into closed hills with moderate and high relief, lying at an altitude of around 1 000 meters above sea level (Kruger, 1983). The current agricultural use of the surveyed area is that of grazing and a pecan orchard.

2.3 Climate

The climate of the area can be regarded as typical of the Northern Cape, with cold, dry winters and hot, semi-dry summers (ISCW, 2011). The main climatic indicators are given in Table 1.

Table 1. Climate Data

Month	Average Rainfall (mm)	Average Daily Min. Temp (ºC)	Average Daily Max. Temp (ºC)
Jan	26.7	18.9	35.1
Feb	50.5	18.2	33.7
Mar	45.9	15.7	31.2
Apr	31.1	10.8	26.6
May	10.3	5.3	22.6
Jun	6.8	1.5	19.2
Jul	5.1	1.0	19.7
Aug	8.4	3.4	22.0
Sep	5.0	7.7	26.2
Oct	16.8	11.3	28.8
Nov	24.0	15.0	31.9
Dec	20.7	17.5	34.1
Year	**251.3 mm**	**19.0 ºC (Average)**	

The long-term average annual rainfall is 251.3mm, of which 184.6mm, or 73.5%, falls from October to March. Temperatures vary from an average monthly maximum and minimum of 35.1ºC and 18.9ºC for January to 19.7ºC and 1.0ºC for July respectively.

2.4 Geology

The geology of the area consists of aeolian sand, calcrete, terrace gravel and shale of the Dwyka formation of the Ecca Group, Karoo Sequence (Eloff, 1984).

2.5 Vegetation

According to Low & Rebelo (1996), the dominant vegetation type is that of the Orange River Nama Karoo and falls into the Nama Karoo Biome. On the pediments, Spike-flowered Black Thorn *Acacia mellifera,* Threethorn *Rhigozum trichotomum,* Shepherd's Tree *Boscia albitrunca* and Stink Shepherd's Tree *B. foetida* are common trees and shrubs, while Silky Bushman Grass *Stipagrostis uniplumis* often dominates the plains.

3. METHODOLOGY

A hand auger was used to conduct the survey for a reconnaissance soil survey. Observation points where predetermined to represent the different geological units of the area. Soils were augered to a depth of 1.2 m or shallower if a restricting layer such as rock was encountered. The position of the observation and sampling points was determined by GPS.

Seventeen soil observations were made and classified according to the Taxonomic System for South Africa (Soil Classification Working Group, 1991) and areas of different soil types were noted and mapped. Soil samples were taken at three localities and the soils was analysed (Non-Affiliated Soil Analysis Work Committee, 1991) for sand, silt and clay percentage, exchangeable cations, pH (KCl) and P (Olsen). The analytical results are given in Table 4.

The sampling sites are marked on the soil map. The agricultural potential of each soil mapping unit was then assessed. This information is given on the associated Soil and Land Capability maps (Appendix).

4. SOILS and LAND CAPABILITY

With the survey done, four broad soil map units were identified and mapped. A list with all the observation points and the soil form at that specific point is given in Table 2.

The soils of map unit **Cv** consists of structureless (apedal) soils, with dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam, sub soil, underlain by a neocarbonate B horizon. The soils in this unit cover 47.4% of the area and belong mainly to the Clovelly soil form, although soils of the Hutton, Augrabies and Prieska forms were also present in a lesser extent. The Land Capability class of this map unit is arable land and, if it is irrigated it will have a high potential, otherwise the potential is grazing.

The Coega soils of map unit **Cg1** have dark brown to brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete). The effective depth of these soils is 150mm to 200mm. The Land Capability class of this map unit is grazing. This map unit cover 5.0% of the area.

The soils of map unit **Cg2** is dominantly of the Coega soil form, with few soils of the Glenrosa and Prieska soil forms. It consists of dark reddish brown, apedal, loamy sand topsoil on a horizon consisting of a continuous, very hard, massive layer, cemented by carbonates (hardpan carbonate horizon or calcrete). The surface and top soil have 25-30% gravel and stones. This map unit cover 10.3% of the area. The Land Capability class of this map unit is grazing.

In map unit **Gs1** the soil is dominantly of the Glenrosa soil form. These soils have dark grey, weakly structured, sandy clay loam topsoil with free lime in it. The topsoil is underlain by a stony or gravelly subsoil, grading into weathered rock. Other soil forms found in this map units was of the Brandvlei and Augrabies soil forms. The Land Capability is classified as wilderness because of the steep slopes and have 30-50% stones and gravel on the surface. It covers 37.3% of the area.

Table 2. Observation point and soil form.

Observation point	Soil form	Latitude	Longitude
1.	Augrabies 1110	S29.57505	E22.99133
2.	Coega 2000	S29.58446	E22.98962
3.	Coega 2000	S29.58660	E22.98681
4.	Clovelly 3100	S29.59217	E22.98658
5.	Clovelly 3100	S29.59596	E22.96631
6.	Glenrosa 2112	S29.58554	E22.97025
7.	Hutton 3100	S29.54109	E22.99900
8.	Prieska 1110	S29.53656	E23.00724
9.	Augrabies 2110	S29.54186	E23.02270
10.	Augrabies 2110	S29.54157	E23.04275
11.	Brandvlei 1000	S29.54293	E23.06075
12.	Coega 2000	S29.54981	E23.06779
13.	Coega 1000	S29.53182	E23.05748
14.	Prieska 1110	S29.52098	E23.04333
15.	Coega 2000	S29.52905	E23.04190
16.	Clovelly 3100	S29.53412	E23.03562
17.	Glenrosa 2112	S29.52723	E23.03459

The map units are shown on the soil map in the appendix according to the following example: **Cv**

797.5 ha

where **Cv** represents the soil unit and **797.5 ha** represents the area of the unit.

A summary of the main soil characteristics is given in Table 3.

Table 3. Soil mapping units

Map Unit	Dominant Soil Form	Sub Dominant Soil Form	Effective Depth (mm)	Description of mapping unit	Agricultural Potential	Area (ha)
Structureless (apedal) soils						
Cv	Clovelly 3100	Hutton 3100 Augrabies 2110 Prieska 1110	1000-1200	Dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam subsoil.	High to moderate	1 182.1
Calcareous soils						
Cg1	Coega 2000		150 - 200	Dark brown to brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	124.5

Map Unit	Dominant Soil Form	Sub Dominant Soil Form	Effective Depth (mm)	Description of mapping unit	Agricultural Potential	Area (ha)
Cg2	Coega 2000	Glenrosa 2112 Prieska 1110	150 – 200	Dark reddish brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	257.1
Shalllow soils						
Gs1	Glenrosa 2112	Augrabies 2110 Brandvlei 1000	150 - 200	Dark grey, weakly structured, sandy clay loam topsoil on a stony/gravelly, subsoil, grading into weathered rock.	Low	928.1
					Total	**2 491.8**

5. SOIL FERTILITY

No abnormal or unexpected values or limitations could be observed from the analysis values in Table 3.

Table 4. Soil analysis results

Sample site		**3**		**9**		**11**	
Co-ordinates (Lat/Long)		S 29.58660° E 22.98681°		S 29.54186° E 23.02270°		S 29.54293° E 23.06075°	
Soil Form		Coega 2000		Augrabies 2110		Brandvlei 1000	
Horizon		A	C	A	B	A	B
Depth (mm)		0 - 150		0 - 200	200 - 500	0 - 150	150 - 550
Sand	**%**	84		76	61	96	96
Silt		11		17	28	2	2
Clay		5		8	11	2	2
Na	**cmol kg^{-1}**	0.026		0.024	0.111	0.018	0.026
K		0.511		0.460	0.336	0.736	0.386
Ca		10.056		8.391	7.347	5.211	6.582
Mg		1.167		1.216	2.124	0.936	1.231
P (mg/kg)		3		5	2	6	5
pH (KCl)		7.6		7.8	7.9	7.6	7.8

The analysis results show that the soil reaction (pH) is mildly to moderately alkaline. The phosphorus (P) content of 2 to 6 mg/kg soil is low, but it is normal for natural soils. The cations, Na, K, Ca, and Mg is at normal levels for these dry conditions (MVSA, 1994).

6. AGRICULTURAL POTENTIAL

The map units, their areas, percentages and soil potential classes are given in Table 5.

Table 5. Agricultural Potential

Potential Class	Map Unit(s)	Main limiting factor(s)	Area (ha) (+ % of study area)
High (for irrigation)	Cv	Few limitations; favourably textured soil and good soil depth.	1 182.1 ha (47.4%)
Low	Cg1 Cg2	Shallow soils with calcrete.	381.6 ha (15.3%)
Low	Gs1	Shallow soils with gravel and stones.	928.1 ha (37.3%)
		Total	**2 491.8 ha (100%)**

A large portion (52.6%) of the surveyed area (map units **Cg1**, **Cg2**, and **Gs1**) is considered to be of low agricultural potential, due to the shallow soil depth and high amount of stones and gravel in these soils. These soils is only suited for grazing and not for dryland or irrigation crop production.

According to the criteria by Schoeman (2004), land in the Northern Cape Province is only considered to be of high potential if it is under permanent irrigation. The soils of map unit **Cv** is between 1 000 to 1 200mm deep, with a high agricultural potential for crop production under irrigation. The annual rainfall of 251mm is too low for dry land crop production.

7. SUITABILITY FOR REHABILITATION

The soils of map unit **Cv** would be the best suitable for rehabilitation because of its more favourable soil texture and structure.

The soils of map unit **Cg1**, **Cg2**, and **Gs1** would be far less suitable for rehabilitation than those of map unit **Cv**. The reason for the low suitability for rehabilitation of these soils is their shallow depth (150-250mm) and high content of stones and gravel, which results in a low volume of soil to work with for effective rehabilitation.

9. REFERENCES

Department: Water Affairs and Forestry. A practical field procedure for identification and delineation of wetlands and riparian areas. Department of Water Affairs and Forestry. Pretoria.

Eloff, J.F. 1984. Geology. In *Land types of the maps 2922 Prieska*. (ed MacVicar, C.N.) *Mem. Agric. nat. Resour. S. Afr*. Department of Agriculture, Pretoria.

ISCW. 2011. Prieska long term climate data 1960-1989. Agro-Climatology. Institute for Soil Climate and Water. Pretoria.

Kruger, G.P. 1983. Terrain Morphological Map of Southern Africa. Department of Agriculture. Pretoria.

Low, A.B. & Rebelo, A.T., 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

MVSA. 1994. Bemestingshandleiding. Die Misstofvereniging van Suid-Afrika. Lynnwoodrif.

Non-Affiliated Soil Analysis Working Committee, 1991. Methods of soil analysis. SSSSA, Pretoria.

Schoeman, J.L. 2004. Criteria for high potential agricultural land in South Africa. Institute for Soil, Climate and Water, Pretoria.

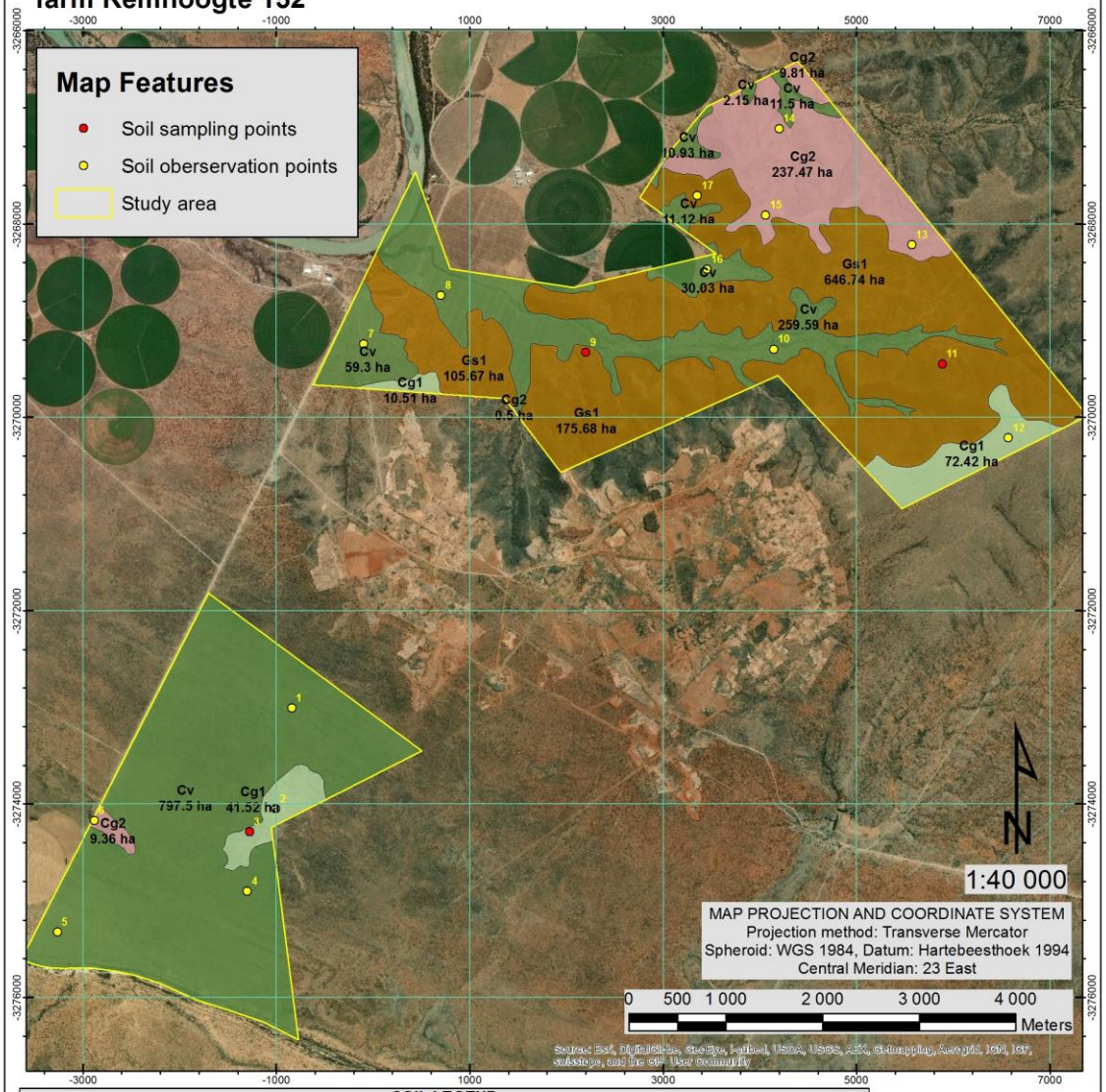
Soil Classification Working Group, 1991. Soil classification. A taxonomic system for South Africa. Institute for Soil, Climate and Water, Pretoria.

APPENDIX 1:

SOIL MAP

Map 1

Broad soil map for the proposed prospecting on the remaining portions of the farm Remhoogte 152



SOIL LEGEND

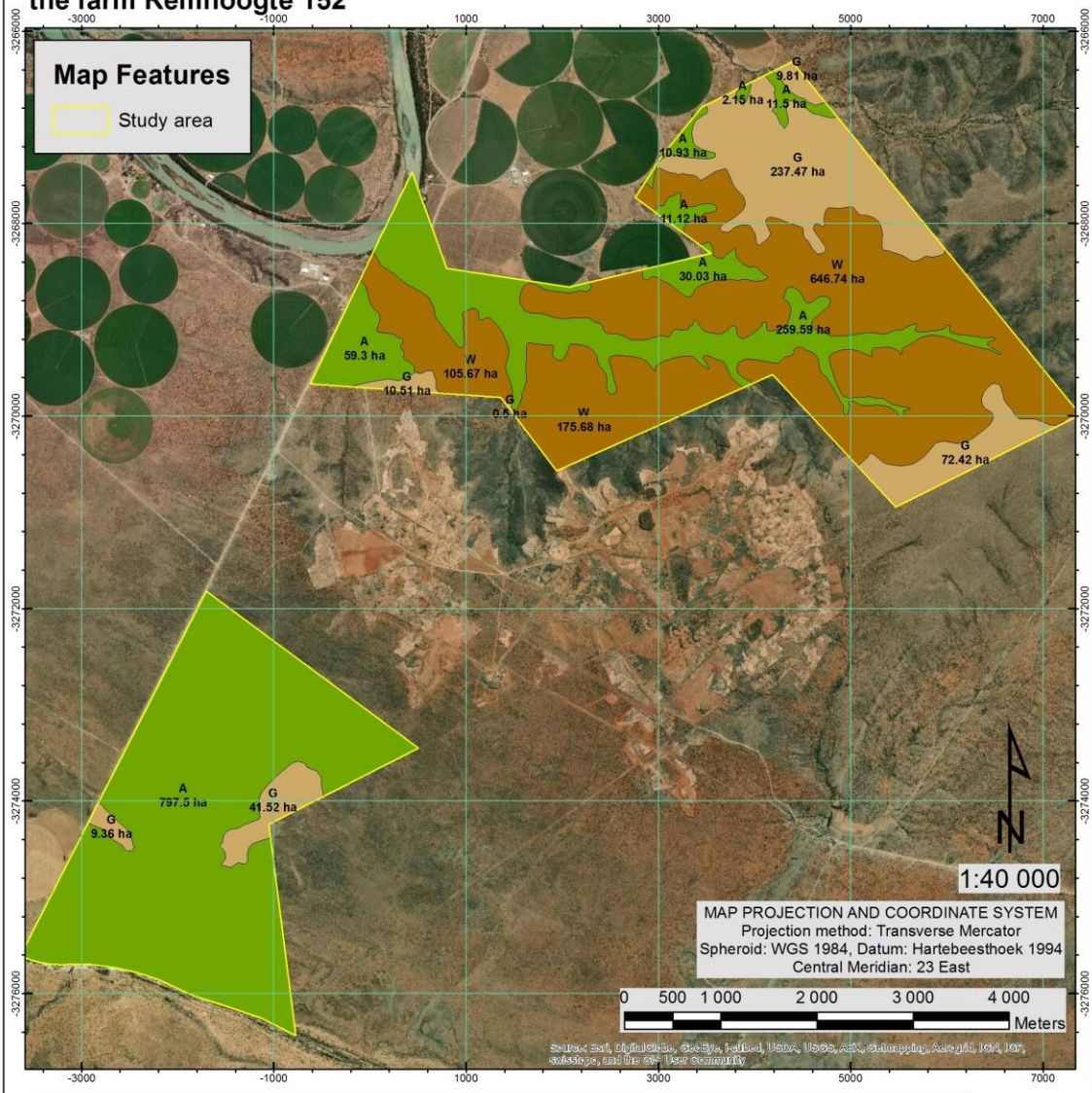
Map Unit	Dominant Soil Form	Other Soil Forms	Effective Depth (mm)	Description of mapping unit	Agricultural potential	Area (ha)	Area (%)
Cv	Clovelly	Augrabies Prieska Hutton	1000-1200	Dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam subsoil.	High to moderate	1182.12	47.44
Cg1	Coega		150 - 200	Dark brown to brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	124.45	4.99
Cg2	Coega	Glenrosa Prieska	150 – 200	Dark reddish brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	257.14	10.32
Gs1	Glenrosa	Brandvlei Augrabies	150 - 200	Dark grey, weakly structured, sandy clay loam topsoil on a stony/gravelly, subsoil, grading into weathered rock.	Low	928.09	37.25
					Total	**2491.8**	**100.0**

APPENDIX 2:

LAND CAPABILITY MAP

Map 2

Land Capability map for the proposed prospecting on the remaining portions of the farm Remhoogte 152



LEGEND: LAND CAPABILITY

Land Capability Code	Land Capability Class	*Map Units	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable (Irrigation)	Cv	Dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam subsoil.	8	1182.12	47.44
G	Grazing	Cg1, Cg2	Dark brown to dark reddish brown, apedal, loamy sand tosandy loam topsoil on calcrete or on a stony subsoil grading into weathered rock.	7	381.59	15.32
W	Wilderness	Gs1	Dark grey, weakly structured, sandy clay loam topsoil on a stony/gravelly, subsoil, grading into weathered rock.	3	928.09	37.24
*See soil map			**Total**	**18**	**2491.8**	**100.0**