

Soil Mapping and Advisory Services
Botswana

SOILS AND LAND SUITABILITY
OF THE LOBATSE AREA



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Of The Lobatse Area

by

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The conclusions given in this report are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of this project.

The definitions employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal or constitutional status of any country, territory or sea area or concerning the delimitation of frontiers.

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INTRODUCTION

The Soil Survey, at a scale of 1:250 000 of this area known as the Lobatse sheet was produced as part of an ongoing FAO/UNDP/Govt of Botswana Soil Mapping and Advisory Services Project. The project started in 1981 with a program of systematic soil mapping at a scale of 1:250 000 followed by a 1:1000 000 soil map of the whole country.

The report is in two parts, the soils chapter and the land evaluation chapter. Land evaluation was carried out for sorghum, maize and millet under improved traditional dryland farming using the FAO framework for land evaluation as a base, with modifications to suit Botswana conditions (Rhebergen, 1988).

Summary of Conclusions and Recommendations

Conclusions

The surveyed area can be divided into two distinct regions, the hardveld in the east and the sandveld in the west.

Hardveld

Areas with potential for arable farming are found in this region. High yields can be obtained with proper water management, erosion control and high fertilizer inputs.

A large area with marginally to moderately suitable soils with moisture availability as the main limiting factor lies between Mmathethe in the north and Phitsane Molopo in the south, the Sandveld-Hardveld boundary in the west and the eastern frontier.

Marginally suitable soils with a similar limiting moisture factor also occur to a small extent in the south east district between Otse and Lobatse. In the Pelotshetlha area there are marginally suitable soils, but here erosion is the main limiting factor.

The remaining soils have no potential for arable farming due to:

- 1) Shallow to very shallow soils with little or no foothold for roots
- 2) Soils with a high phosphorus fixation due to calcium toxicity. These soils are formed on highly calcareous parent material around Segwagwa.
- 3) Soils along drainage channels which are likely to be flooded.
- 4) The complex area between Otse and Lobatse with very shallow soils on pediments and poorly structured soils on shales.

Sandveld

The soils of the sandveld are light textured, they have a low water holding capacity, a low natural fertility and a very low cation exchange capacity. All these combined with an arid climate makes these soils unsuitable for arable farming since the limitations are too severe to be corrected economically.

Recommendations

- Any future mapping at a detailed scale should be restricted to the hardveld since this is where there is potential for arable farming.

- High fertilizer inputs are going to be a must in years of good rainfall if high yields are to be expected from areas with arable farming potential.

- Since these soils have moisture availability as the main limiting factor, good water management should be practiced. Care should be taken in the use of nitrate fertilizers : these should not be recommended in years with a high probability of drought occurrence.

- All soils with no agricultural potential like those in the sandveld, those with a high calcium toxicity, those which are too shallow and those along drainage channels should not be used nor allocated for arable farming since inputs will by far exceed outputs.

- Good management practices should be undertaken against soil erosion on soils formed on fine-grained sedimentary rocks especially those around Dipot-sane and Pelotshetlha.

1 GENERAL DESCRIPTION OF THE AREA

1.1 Location, Population and Communications

1.1.1 Location

The area surveyed is located in south eastern part of the country. It is bounded in the north by latitude 25°00'00" south in the west by longitude 24°00'00" east and south by the international boundary with the Republic of South Africa.

1.1.2 Population

Botswana has a population of approximately 1.2 million when considering a growth rate of 3.7% from 941 000 of the 1981 census. The surveyed area has a population of 114 000.

Population density decreases from the hardveld towards the sandveld in the west. Most of the large villages and towns are located in the east.

The population density pattern is mainly attributed to soil types which also determine the land use system of the area. The sandveld, being mainly a live-stock rearing area, is thinly populated, whereas the hardveld is mainly an arable area with permanent households and is thus more densely populated. On the hardveld the soils vary, the rainfall is higher and ground water is more easily accessible through shallow hand-dug wells (H.J. Cooke 1985) and pans.

1.1.3 Communications

The hardveld is well covered by rail and road transport which is not only part of the north-south link of the country, but also provides a very important link through a fairly dense network of secondary roads and tracks to both major and smaller inland villages.

In the sandveld the situation is somewhat different in that there are a few secondary roads and motorable tracks linking similarly few and scattered major villages, small settlements and cattle posts.

Air transport is available to a very small extent with landing facilities for light aircrafts only at major villages and the Lobatse township.

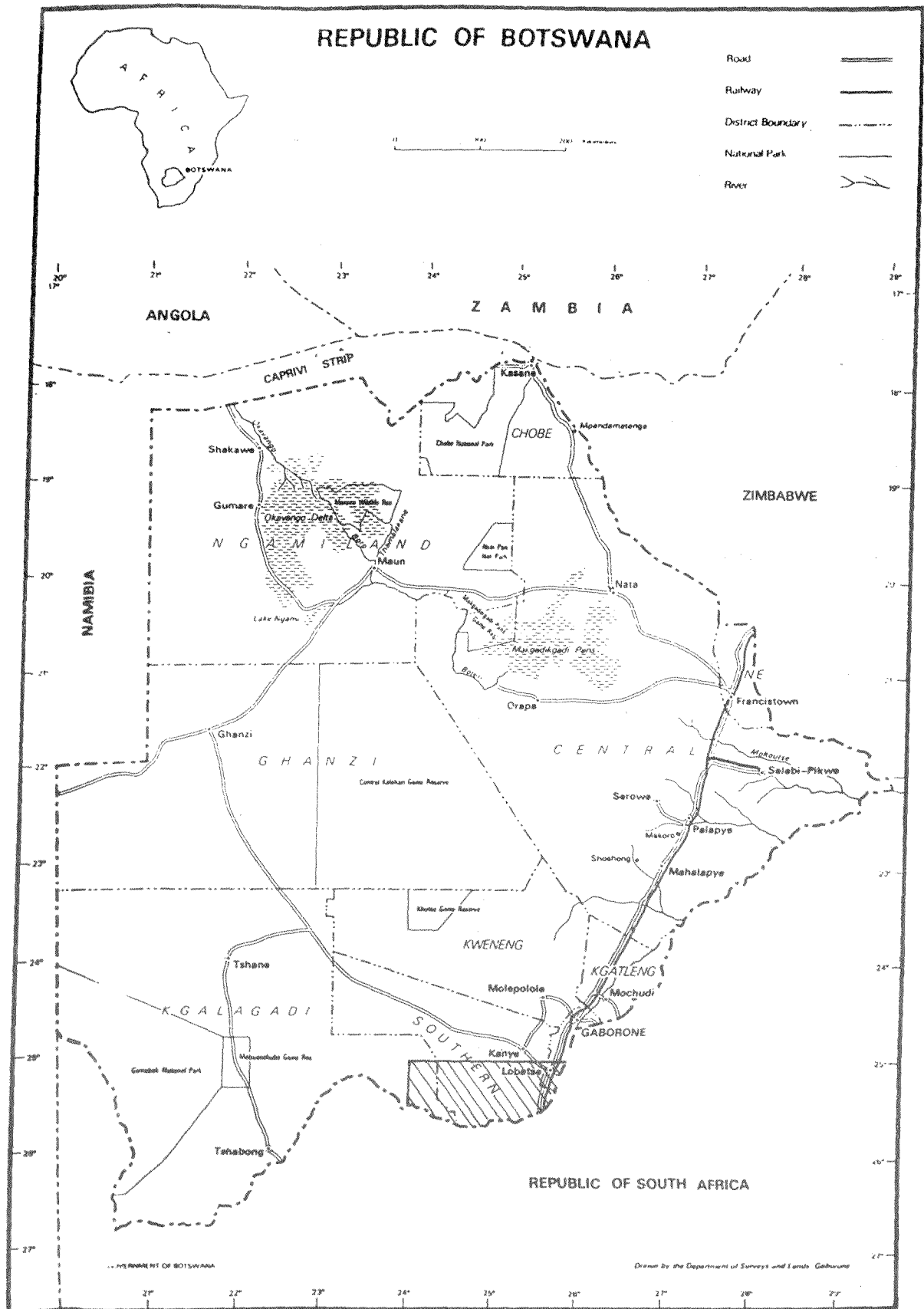


Figure 1 : Location of Survey Area

1.2 Climate

The climate of Botswana is considered to be semi-arid with summer rainfall and high evapotranspiration.

As rainfall in Botswana is very erratic and highly variable, a frequency analysis of the growing period was done which resulted in the country being divided into climatic zones (Figure 2; Dambe 1987).

The growing period is defined as the length in days during a year when precipitation exceeds half evapotranspiration, plus a period required to evapotranspire an assumed 100mm of water from excess precipitation stored in the soil profile, or less if not available.

The surveyed area falls within three of these climatic zones:

1e3 101-120 days length of growing season with a frequency of 75-100%; 41-50 dry days within the growing season; 20-40 days length of humid period with a frequency occurrence of 25-40%. The nearest representative meteorological synoptic station with complete data is Gaborone.

Climatic data for this station is presented in Table 1 and the monthly moisture balance for this station is illustrated in Figure 3.

- mean annual rainfall is 538mm
- mean maximum annual temperature is 28.3°C and mean minimum annual temperature is 12.9°C

Only one growing period occurs, which, on average starts, in mid November and ends in April. In most years no humid period occurs.

2d3 81-100 days length of growing season with a frequency of 75-100%; 31-40 dry days with the growing season; 20-40 days length of humid period with a frequency occurrence of 25-49 %.

3b3 61-80 days length of growing season with a frequency of 75-100%; 11-20 dry days within the growing season; 20-40 days length of humid period with a frequency of 25-40%.

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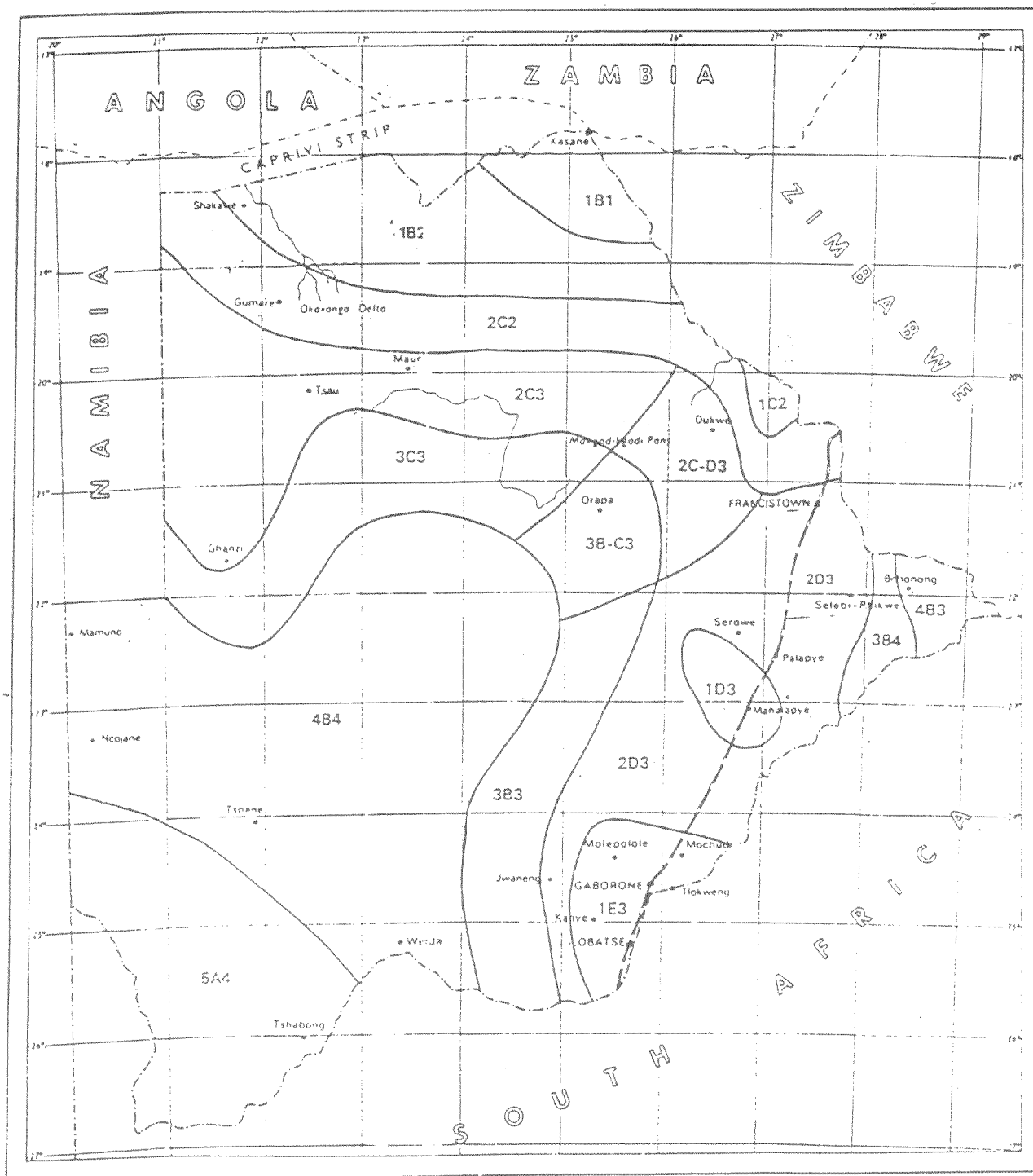


Figure 2 : AGRO-CLIMATIC ZONES OF BOTSWANA (Dambe, 1987)

Length of Season		Number of Dry Days within the Season		Length of Humid Period	
Duration (days)	Frequency (%)			Duration (days)	Frequency (%)
1 101-120	75-100	A	0-10	1 41-60	75-100
2 81-100	75-100	B	11-20	2 20-40	50-74
3 61-80	75-100	C	21-30	3 20-40	25-49
4 41-60	75-100	D	31-40	4 20-40	25
5 41-60	50-74				

Table 1

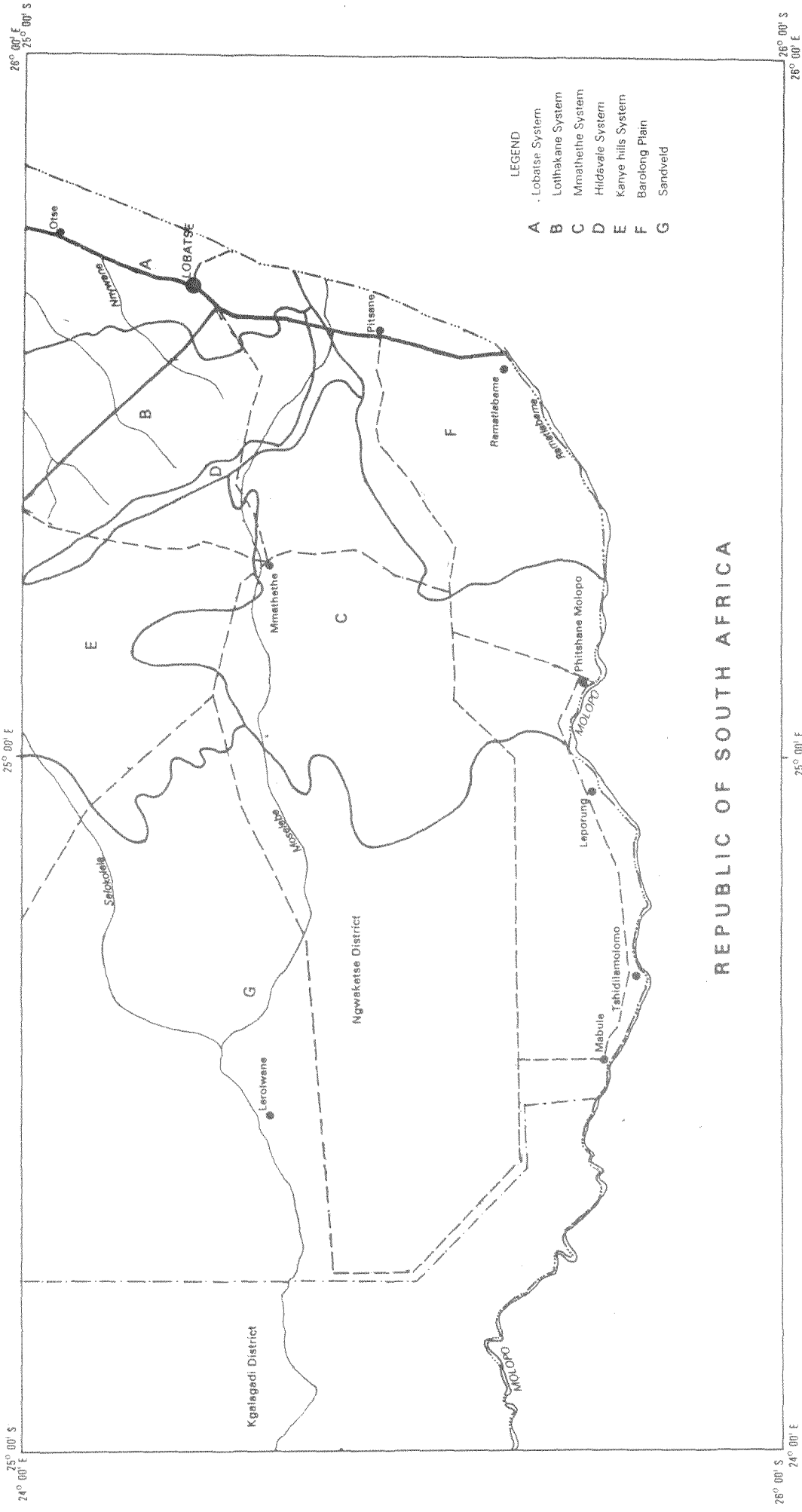
SUMMARY OF CLIMATIC DATA GABORONE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Pmean													
(mm)	97.4	84.4	72.7	43.7	13.7	4.6	3.5	4.6	14.9	42.8	64.2	91.6	528.1
T mean													
(°C)	26.2	25.1	25.0	20.2	16.1	13.1	13.0	16.0	20.5	23.1	24.4	25.3	20.6
T mean													
max (°C)	32.6	31.2	31.1	27.2	24.6	22.2	22.3	25.5	29.2	30.7	31.2	21.1	28.3
T mean													
min (°C)	19.7	19.0	18.0	13.1	7.6	4.0	3.6	6.5	11.9	15.5	17.5	18.4	12.9
RH mean													
(%)	54.0	56.5	56.5	57.5	54.0	52.5	49.0	42.5	38.0	42.0	47.0	49.5	
Wind													
speed													
(m/sec)	6.9	5.9	5.0	4.8	5.1	4.8	5.0	6.4	7.8	9.1	8.2	7.2	6.4
PET													
penman													
(mm)	161	132	124	85	63	44	48	80	122	155	156	166	1336

Table 2

RAINFALL DATA FROM OTHER STATIONS IN THE SURVEY AREA WITH LONG RECORDS (mm)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
LOBATSE	101.1	86.8	69.4	46.7	14.0	6.6	4.2	3.3	16.8	43.8	72.1	92.4	552.2
MOEDING	110.1	85.8	79.3	56.9	12.0	1.6	0.4	3.8	23.9	40.5	71.2	90.2	578.2
HILDA-													
VALE	107.4	73.8	67.3	81.7	15.9	8.4	1.9	4.3	10.4	39.0	69.7	66.3	504.9
GOODHOPE	97.3	79.9	71.9	47.1	9.8	8.4	1.9	4.4	20.7	45.1	51.1	79.9	514.6
KANYE	99.8	84.9	71.2	38.5	13.5	6.7	3.5	3.5	14.5	41.2	65.9	82.7	527.2
RAHATLA-													
BAKA	97.5	75.5	64.0	53.3	9.0	4.4	0.9	4.3	16.3	34.4	61.7	75.2	494.1



1.3 Geology

With reference to the Geological Survey Department (BSI Marengwa 1978) and the 1:1000 000 geological map of Botswana, the surveyed area comprises the following:

- Intrusions of the Basement Complex : In the form of thin strips of felsites in between the Gaborone granite, the Mmathethe granite- gneiss and those of the Waterberg Supergroup in the form of syenites and dolerites around Segwagwa (North of Mmathethe)

- Sedimentary Rocks : between Otse and Lobatse and those around Pelotshetlha, comprising:

a) The Ventersdorp Supergroup system which is divided into three litho-stratigraphic units namely:

i) the lower stratigraphic assemblage composed of felsic tuffs, ignimbrites and agglomerates

ii) the Mogobane or Dipotsane assemblage composed of argillaceous metasedimentary rocks and

iii) the upper volcanic assemblage composed of andesite lavas

b) The Transvaal Supergroup composed mainly of shales and quartzites with subordinate limestone, banded ironstone, conglomerates and volcanics.

- Metamorphic Rocks of the Basement Complex : occurring in the larger area in both the west and south of the sheet.

-Calcrete: occurs on related rocks which are high in calcium carbonates. They also occur due to favourable topography. It is found at shallow depth around Segwagwa and at a deeper depth in depressions and along drainage lines.

1.4 Geomorphology and Hydrography

Geomorphology

The surveyed area shows a clearly different soil mapping unit pattern between two major geomorphological units, namely the hardveld with a denser mapping pattern and the sandveld with larger mapping units.

The geomorphology has been described following M.G. Bawden and A.R. Stobbs, 1963.

1.4.1 Hardveld

There are six geomorphological sub units occurring within the hardveld:

- A Lobatse system:- this is a complex area in which water erosion has left rugged steep sided hills adjacent to gently undulating valleys with small hills and pediments.
- B Lotlhakane Plain:- on undulating Gaborone granite plain which displays a relatively denser drainage system with occasional kopjes. The scarp retreat zone is characterized by a pedimentary plain with frequent kopjes.
- C Mmathethe system:- An almost flat to gently undulating plain on the Mmathethe granite-gneiss with flat fossil valleys.
- D Hildavale plateau:- Gently undulating with many pediments stretching from Kanye hills through Gathwane to Hildavale.
- E Kanye hills :- part of an undulating basin due to stream erosion of the Kanye hills
- F Barolong Plain:- Almost flat to gently undulating with broad flat valleys which gradually fade away north east towards Hildavale

1.4.2 Sandveld

The sandveld belongs to the Kalahari basin. The main geomorphological activity in the area is wind erosion and deposition.

There is little relief variation except for a north-south transition from flat to gently undulating to undulating plains. Depressions, which may hold water after rainfall, occur.

Across the sandveld one finds a few infilled valleys from windblown sands. Valleys sides are gently sloping

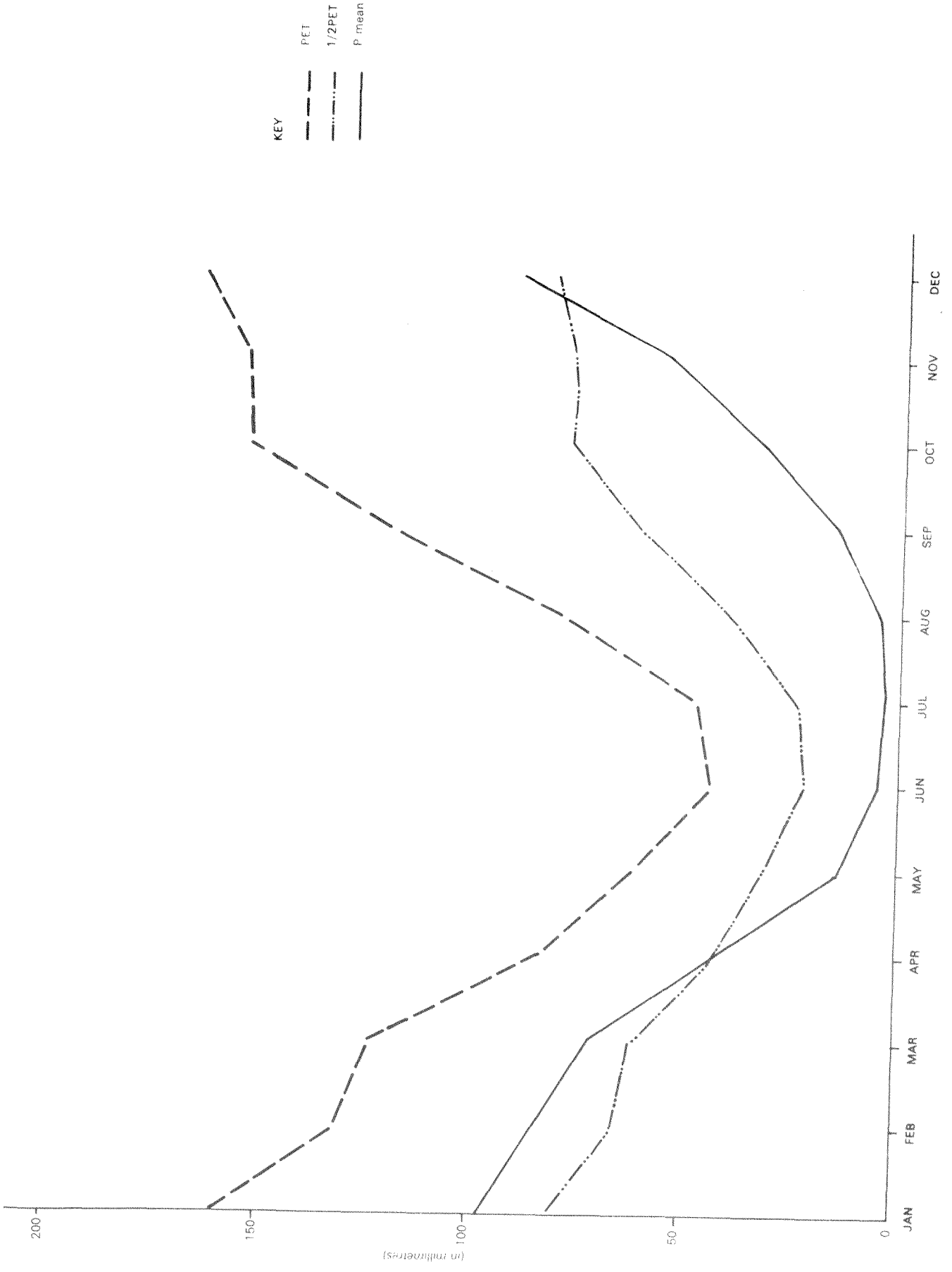


FIG. 3: MONTHLY MOISTURE BALANCE FOR GABORONE

1.4.3 Hydrography

In addition to the fairly dense networks of small rivers in the north eastern part of the surveyed area which provide surface water during the rainy season, there is the dry Molopo river forming the Molopo drainage system flowing westwards along the southern border with the Republic of South Africa.

In the sandveld most rivers are fossil and covered with windblown sand. These are the Moselebe with its main tributaries the Ukhwi, Sekhutlane and Selokolela which run from east to west via Mabuasehube to the Limpopo. Besides the Ngwane dam supplying the Lobatse township, there are smaller hand-dug dams owned by individuals and syndicates to supplement underground water from wells and boreholes during the rainy season.

There are numerous small pans in the Barolong which are normally filled with water during wet years.

1.5 Vegetation

Although a close relationship exists between natural vegetation and soil types it does not apply to all soil units.

From field observations the following general pattern was arrived at:

Sandveld

On higher areas of very deep sands dominant species of Terminalia sericia and Acacia mellifera form a dense tree savanna. On low lying areas which are slightly more clayey, dominant species of Grewia flava and Acacia mellifera form an open dense shrub savanna.

Highly calcareous areas

In these areas, soils have either calcrete outcrops or calcrete at a very shallow to shallow depth. The dominant species in these areas are Acacia mellifera and Grewia flava shrubs. Since the soils are having inadequate foothold for roots and a low moisture holding capacity, in areas which have experienced long drought period, the trees have been uprooted and the tree savanna has given way to a grass savanna.

Floodplains

These areas are normally devoid of vegetation except for a few Acacia tortilis shrubs.

Valley sides

This physiographic unit is characteristic of the hardveld in the mapping area especially in the Lobatse area - Dominant species are Acacia tortilis and Acacia mellifera.

Undulating to gently undulating areas

These are exclusive of the granite area. They are characterized by :

- An open shrub savanna of Acacia erioloba on shallow soils
- A dense tree savanna of Acacia erioloba and Acacia Leuderidzii on deeper soils.
- Peltophorum africanum and Terminalia sericia tend to occur on coarse textured soils.

Disturbed and Overgrazed areas

In these areas mostly around villages and cattleposts you find encroaching species . Around villages Acacia tortilis is the most common and Dichrostachys cinerea is found around cattle posts.

1.6 Land Use

The land use in this area is mainly governed by the land tenure system which in turn is strongly influenced by soil types and socio-economic factors.

The land tenure system practiced in this area is as follows:

- a) Freehold which is privately owned land and used as private farms, with a small part found as residential plots in townships. This type of land is in areas in and around Lobatse and is used as a residential area and as farms practising both crop farming and livestock grazing. Commercial farms under Tribal Grazing Land Policy scheme, used mainly for controlled livestock farming, are found west of the surveyed area.
- b) Tribal Lands : These occupy about 95% of the mapped area. This land is owned by all members of the tribe, under the custody of Land Boards. Land is free to be used exclusively by an individual for arable farming. Grazing land is used communally.

In the hardveld, although arable farming is a dominant activity most people also practice livestock farming. In the sandveld livestock farming is the dominant activity due to the inherent poor sandy soil and an unfavourable climate. Water for livestock is obtained from boreholes.

2 SOILS

2.1 General

For Soil Survey methods, Guidelines for Soil Profile Descriptions and Soil Analytical Methods, reference is made to Appendix 1 of Remmelzwaal and Van Waveren (1988) and to Breitbart (1988).

Mapping was done mainly with the aid of 1:250 000 landsat imagery (enhanced colour composites), the 1:50 000 black and white aerial photographs (13/4/82) and old soil profile descriptions by D.J. Eldridge.

In addition to 107 sampled soil pits, 96 augerings especially on representative areas were used. The pits were sampled for chemical analysis.

The relatively long period it took to map this area affected the quality in mainly two aspects and that is in sampling and omissions.

Changes in the sampling depth e.g. 30-50cm for an argillic horizon were introduced in the later stages of mapping. The introduction of a new more detailed soil profile description after developing a computerized database gave problems in that the new information was required that was not recorded in the old format of soil profile descriptions.

Overview of Soil Patterns: The surveyed area shows a clearly different map - unit pattern between the hardveld and the sandveld, namely a denser mapping pattern in the hardveld and an open one with larger mapping units in the sandveld. Variation in soils is more pronounced in the hardveld due to strong influence of two interacting soil forming factors, namely the parent material and topography. The sandveld shows very little variation in soil due to minor differences in relief and parent material.

Hardveld The area between Otse, Lobatse and west of the Gaborone granite is strongly influenced by the above mentioned soil forming factors. The main soil units are very shallow to shallow sandy loams on fine grained sedimentary rocks, deep to very deep moderately well drained sandy clay loams on colluvial slopes, and deep imperfectly to moderately well drained sandy loams to sandy clays on alluvial pans. The main problem with these soils are steep slopes, poor structure and shallow soils.

Soils on acid igneous rocks mainly in the area north of Ramatlabama the Mmathethe granite and Gaborone granite are formed on almost flat to gently undulating plains due to moderate weathering nature of granites. Soils are moderately well to well drained shallow sandy loams to deep sandy clay loams. On the Mmathethe granite-gneiss, south from Mmathethe to Ramatlabama, one observes shallow to moderately deep sandy loams (C5) due to fluvial influence of the fossil Moselebe river. The calcrete is found deeper as the influence becomes weak to the east (G13a-13). Areas with no fluvial influence have no calcrete and are moderately deep to deep sandy clay loams (G106-6a-4)

On the Gaborone granite, soils on gently undulating to undulating plains are moderately deep to deep moderately well to well drained sandy loams to sandy clays. Undulating and gently undulating plains are dissected by a drainage network of very deep imperfectly drained dark yellowish brown sandy clay loams and imperfectly drained sandy clays.

The other two areas of interest in the hardveld are the dolomites around Segwagwa south east of Kanye and the fine-grained sedimentary parent material in the Pelotshetlha area.

The area around Segwagwa, north west of Mmathethe, forms flat dolomite plains and syenite ridges. Dominant soils are very shallow to shallow with a thin sand cover overlying highly calcareous material. Calcrete surface stones and outcrops can be observed on very shallow soils. Limitations are related to the nature of parent materials and effective rooting depth. The soils are too shallow. The pH is high due to high calcium carbonate content which contributes to a serious nutrient deficiency especially in the form of phosphorous fixation.

In the Pelotshetlha area around Dipotsane the parent material is easily susceptible to weathering. Soils are deep, massive imperfect to moderately well drained dark yellowish brown sandy clay in lower areas whilst in higher areas they are deep to very deep reddish brown. Vertisols (deep cracking black cotton soils) occur in floodplains. Adjacent to these soil units, soils are very shallow sandy loams on parent material which is not so easily susceptible to weathering.

The Sandveld: as indicated above the sandveld is almost flat to gently undulating with vast low lying areas in between higher areas. In the high areas dominant soils are very deep reddish brown to strong brown sands with lamellae of clay accumulation occurring at about 80-100 cm depth or are absent on even higher areas. On low lying areas soils are also very deep but textures are loamy sands with lamellae of clay accumulation occurring at shallower depth. These areas are characterized by low shrub savanna in contrast to the tree savannas of Terminalia sericea on higher areas.

It is on the boundaries with the hardveld that very deep sands occur, with a calcic horizon resulting from the influence of the adjacent dolomitic or calcareous parent material.

2.2 Soil Classification

Soils are classified according to the General Soil Legend of Botswana (Rommelzwaal 1988). This system is based on the legend of the Soil Maps of the World. (FAO/Unesco, 1974) with modification to suit Botswana soils. Reference is made to previous reports and publications for changes introduced to the FAO Legend.

The Soil Taxonomy classification (Soil Survey Staff 1987) is used as a second classification system up to sub-group level.

2.3 Soil Legend

- A1** **FAO:** Pellic Vertisol (1974)
 Pelli-Eutric Vertisol (1988)
ST : Typic Pellustert
- Area :** 7600 ha (0.5%)
Description : Deep to very deep poorly to imperfectly drained
very dark gray to dark grayish brown clay
Topography: Flat to almost flat normal to receiving.
Profile: L80
Characteristics: Have deep cracks. Moderate gilgai relief. Slickensides (pressure faces).
Occurrence: In the floodplains.
Vegetation: Open shrub savanna of Acacia tortilis.
- A4** **FAO:** Calcaric Cambisol (1974)
 Calcaric Cambisol (1988)
ST : Typic Ustrochrept
Area : 4900 ha (0.4%)
Description: Moderately deep to very deep imperfectly to
moderately well drained dark grayish brown to brown
sandy loams to sandy clay
Topography : Flat to gently undulating, normal to receiving
Profile:
Occurrence : Valley bottom west and north of Molapowabojang and
southwest of Sedibeng.
- A7** **FAO:** Gleyic Luvisol (1974)
 Gleyic Luvisol (1988)
ST : Aquic Haplustalf
Area: 4060 ha (0.3%)
Description: Deep to very deep poorly to imperfectly drained dark
gray to grayish brown sandy clayloam to clay
Topography: Flat, (slightly) receiving
Profile: L76
Characteristics: Brown to dark yellowish brown with hydromorphic
properties at 50cm.
Occurrence: East of Lotlhakane and north west of Mogotlhwane.
Vegetation: Dense shrub savanna of Acacia mellifera.
- A9** **FAO:** Calcic Luvisol (1974)
 Calcic Luvisol (1988)
ST : Typic Haplustalf
Area: 4900 ha (0.4%)

Description : Deep to very deep imperfectly to moderately well drained dark grayish brown to yellowish brown sandy clayloam to clay
Topography: Flat to gently undulating, normal to slightly receiving
Profile: L39
Characteristics: Dark yellowish brown with a high sodium content.
Occurrence: In valleys
Vegetation: Open shrub savanna of Acacia mellifera and sometimes of Grewia flava.

A9b **FAO:** Calcic Luvisol/Petrocalcic phase (1974)
Calcic Luvisol (1988)
ST : Petrocalcic Paleustalf
Area : 15800 ha (1.1%)
Description: As A9, with a petrocalcic horizon.
Topography: Flat to gently undulating, normal to slightly receiving.
Profile: KS172
Characteristics: Dark yellowish brown and dark brown with a calcrete pan within one metre.
Occurrence: On low lying areas around Mmathethe.
Vegetation: Dense shrub savanna of Acacia mellifera.

A11 **FAO:** Ferric Luvisol (1974)
Ferric Luvisol (1988)
ST : Oxic Haplustalf
Area: 3800 ha (0.3%)
Description: Moderately deep to very deep moderately well to well drained red to strong brown sandy clayloam to sandy clay
Topography: Flat to gently undulating normal to slightly receiving.
Profile:
Occurrence: Upper slopes south of Otse and on the Gaborone granite.
Vegetation: Open shrub savanna of Acacia karoo.

A11a **FAO:** Ferric Luvisol Petroferric phase (1974)
Ferric Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 6400 ha (0.5%)
Description: Moderately deep to deep moderately well drained red to brown sandy loams to sandy clayloam
Topography: Flat to gently undulating normal.
Profile: L69
Characteristics: Moderately deep. Very weak structure.
Occurrence: Colluvial slopes between Molapowabojang and Lotlhakane and around Lobatse

A13 **FAO:** Chromic Luvisol (1974)
Chromic Luvisol (1988)
ST : Typic Haplustalf
Area: 1100 ha (0.1%)
Description: Moderately deep to deep moderately well to well drained strong brown to dark red sandy loams to sandy clayloam
Topography: Almost flat to gently undulating. Normal to slightly receiving.
Profile: KS163
Characteristics: Moderate very coarse subangular blocky structure. Texture sandy clay loam. Occurs in association with A9.
Occurrence: On colluvial slopes of hills west of Segwagwa pan.
Vegetation: Open tree savanna of Acacia tortilis.

A13a **FAO:** Chromic Luvisols (1974)
Chromic Luvisols (1988)
ST : Typic Haplustalf
Area: 1500 ha (0.1%)
Description: Moderately deep to deep moderately well drained strong brown to dark red massive sandy clayloam to sandy clay
Topography: Flat to gently undulating, normal to slightly receiving.
Profile: KS162
Characteristics: Very deep sandy clayloam.
Occurrence: On colluvial material along hills west of Segwagwa pan.
Vegetation: Dense tree savanna of Acacia erioloba, Acacia mellifera and Acacia tortilis.

A14 **FAO:** Orthic Luvisol (1974)
Haplic Luvisol (1988)
ST : Typic Haplustalf
Area: 4800 ha (0.3%)
Description: Moderately deep to very deep moderately well to well drained dark brown to yellowish brown sandy loam to sandy clay
Topography: Flat to gently undulating. Normal to slightly receiving.
Profile: L50
Characteristics: Moderately deep sandy loam. Weak medium coarse subangular blocky structure.
Occurrence: On alluvial fans.
Vegetation: Open shrub savanna of Acacia mellifera and Acacia tortilis.

A16 **FAO:** Eutric Nitosol (1974)
Pale-chromic Luvisol (1988)
ST : Typic Paleustalf
Area: 2700 ha (0.2%)
Description: Very deep moderately well to well drained strong brown to dark red sandy loams to sandy clayloam

- Topography :** Almost flat to gently undulating, normal to slightly receiving
- Profile:** L8
- Occurrence:** Valley bottom east of Molapwabojang
- Vegetation:** Open Savanna of Pelthophorum africanum Papea capensis and Terminalia comphoranthus.
- A19** **FAO:** Ferralic Arenosol (1974)
 Ferralic Arenosol (1988)
ST : Typic Ustipsamment
Area: 6500 ha (0.5%)
Description: Deep to very deep well to somewhat excessively drained yellowish brown to dark red sands to loamy sands
Topography: Flat to gently undulating, normal
Profile: KS166
Characteristics: Moderately deep loamy sand strongly calcareous with a calcic horizon at 60cm.
Occurrence: Infilled alluvial plain.
Vegetation: Open shrub savanna of Grewia flava.
- A21** **FAO:** Calcic Arenosol (1974)
 Haplic Calcisol (1988)
ST : Typic Ustochrept
Area: 6100 ha (0.4%)
Description: Moderately deep to very deep moderately well to well drained dark grayish brown to yellowish brown sands to loamy sands
Topography: Flat
Profile : PM 121
Occurrence: Along the Moslebe Fossil river
Vegetaton: Open shrub savanna of Acacia erioloba and Grewia flava.
- A21a** **FAO:** Petrocalcic Arenosol (1974)
 Areni-Petric Calcisol (1988)
ST : Typic Torripsamments
Area: 25700 ha (1.8%)
Description: As A21, with a petrocalcic horizon.
Topography: Flat to gently undulating normal site.
Profile: PM103.
Occurrence: Infilled fossil rivers.
Vegetation: Grass savanna.
- B3** **FAO:** Chromic Luvisols (1974)
 Chromic Luvisol (1988)
ST : Typic Rhodustalf

Area: 3900 ha (0.3%)

Description: Deep moderately well to well drained red to strong brown sandy loams to clayloam

Topography: Almost flat to undulating normal to slightly shedding.

Profile: PM113.

Characteristics: Deep sandy clayloam, moderately coarse to very coarse angular blocky structure.

Occurrence: On the Phitshane Molopo basic rocks.

- C1** **FAO:** Lithosol (1974)
 Calci-Lithic Leptosol (1988)
ST : Petrocalcic Ustochrept
Area: 18000 ha (1.3%)
Description: Very shallow (less than 10cm) moderately well to well drained dark grayish brown to brown loamy sands to clayloam
Topography: Flat to gently undulating, normal to shedding.
Profile: KS111
Characteristics: Very shall loamy sands overlying calcrete.
Occurrence: On dolomite west of Mmathethe, sometimes occurring in association with C3.
Vegetation: Dense shrub savanna of Acacia mellifera. In some areas open grass savanna.
- C2** **FAO:** Calcaric Regosol shallow Petrocalcic (1974)
 Petrocalci-Eutric Leptosol (1988)
ST : Typic Ustorthent
Area: 3000 ha (0.2%)
Description: Very shallow to shallow imperfectly to well drained very dark gray to brown sandy loam to clayloam
Topography: Flat to gently undulating normal to shedding.
Profile: KS149.
Characteristics: Shallow sandy loam overlying calcrete.
Occurrence: On dolomite north of Mmathethe. Also occurs as an association with C5 on the hardveld sandveld boundary.
Vegetation: Open shrub savanna of Acacia mellifera.
- C3** **FAO:** Petrocalcic Arenosol Shallow Petrocalcic (1974)
 Epi - Petrocalcic Leptosol (1988)
ST : Typic Ustochrept
Area: 43 800 ha (3.1%)
Description: Very shallow to shallow imperfectly to moderately well drained dark grayish brown to reddish brown sands to loamy sands
Topography: Flat to gently undulating normal to slightly receiving.
Profile: KS148.
Characteristics: Very shallow loamy overlying strongly cemented calcrete layer.

- Occurrence:** On shallow calcrete around Segwagwa.
Vegetation: Open shrub savanna of Acacia tortilis, Zyzyphus mucronata and Acacia erioloba.
- C3b** **FAO:** Calcaric Arenosols (1974)
 Areni-haplic Calcisols (1988)
ST : Typic Ustochrept
Area: 4900 ha (0.4%)
Description: Moderately deep moderately well to well drained light grayish brown to dark yellowish brown sands to loamy sands
Topography: Flat to gently undulating normal.
Profile: PM137
Characteristics: Moderately deep loamy sand. Strongly calcareous from 15cm.
Occurrence: On the sandveld - hardveld boundary.
Vegetation: Open shrub savanna of Grewia flava and Acacia mellifera.
- C5** **FAO:** Calcic Luvisol (1974)
 Hypercalci - Luvic Calcisols (1988)
ST : Typic Haplustalf
Area: 8500 ha (0.6%)
Description: Shallow to moderately deep moderately well to well drained dark yellowish brown to yellowish red sandy loams to clayloams
Topography: Flat to gently undulating, normal to slightly receiving.
Profile: PM138.
Characteristics: Deep clay loam with a strongly cemented calcrete layer at one metre.
Occurrence: On fossil alluvial plain. Also occurs in association with C2 and the hardveld - sandveld boundary.
Vegetation: Open shrub savanna of Grewia flava and Zyzyphus mucronata with scattered trees of Acacia erioloba.
- D1** **FAO:** Dystric Regosol shallow petric (1974)
 Dystric Regosol (1988)
ST : Lithic Ustorthent
Area: 1700 ha (0.1%)
Description: Very shallow to moderately deep well drained yellowish brown to reddish brown sandy loam to clayloam
Topography: Undulating to hilly, shedding.
Profile: L22.
Characteristics: Very shallow sandy loam.
Occurrence: On pediments north of Lobatse.
Vegetation: Open to dense tree savanna of Acacia mellifera, Dichro-
 tachys cinera and Acacia tortilis.

- D1a** **FAO:** Eutric Regosol shallow petric (1974)
Eutric Leptosol (1988)
ST: Lithic Ustorthent
Area: 12 000 ha (0.9%)
Description: As D1
Topography: undulating to hilly, shedding.
Profile: L19
Characteristics: Very shallow sandy loam.
Occurrence: On shallow shales south of Kanye. Also in association with D10.
Vegetation: Open tree savanna of Peltophorum africanum, Acacia karroo and Acacia mellifera.
- D1b** **FAO:** Calcaric Regosol (1974)
Calcaric Regosol (1988)
ST : Lithic Ustorthent
Area: 3000 ha (0.2%)
Description: As D1
Topography: Almost flat.
Profile: KS 164
Occurrence: North west of Mmathethe
Vegetation: Open savanna of Acacia tortilis, Acacia mellifera and Grewia flava.
- D1c** **FAO:** Eutric Regosol (1974)
Eutric Leptosol (1988)
Typic Ustorthent
Area: 1200 ha (0.1%)
Description: Very shallow to moderately deep well to moderately well drained yellowish brown to reddish brown sandy clay to clay
Topography: Almost flat to undulating, normal to shedding.
Characteristics: Shallow to massive clay.
Occurrence: On pediments north of Lobatse and south of Pelotshetlha.
Vegetation: Open shrub savanna of Tarchonanthus comphoranthus, Acacia tortilis and Zyzyphus mucronata.
- D2** **FAO:** Ferric Luvisol petroferric phase (1974)
Haplic Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 1900 ha (0.1%)
Description: Moderately deep well drained yellowish red to brown sandy loams
Topography: Flat to undulating, normal to slightly shedding.
Profile: L11
Occurrence: On argillaceous sedimentary rock west of Otse.

Vegetation: Dense shrub savanna of Acacia mellifera, Tarchonanthus comphoranthus and Acacia tortilis.

- D5** **FAO:** Ferric Luvisol (1974)
 Ferric Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 4000 ha (0.3%)
Description: Moderately deep to deep moderately well to well drained reddish brown to strong brown sandy loams to partly petric sandy clayloam
Topography: Flat to gently undulating, normal to slightly shedding.
Profile: KS214
Occurrence: In the Pelotshetlha area.
Vegetation: Open shrub savanna of Grewia flava and Acacia tortilis.
- D5a** **FAO:** Chromic Luvisol (1974)
 Chromic Luvisol (1988)
ST : Kanhaplic Haplustalf
Area: 2100 ha (0.2%)
Description: Deep to very deep moderately well to well drained reddish yellow to yellowish red sandy loams to sandy clayloam
Topography: Flat to gently undulating, normal to slightly shedding.
Profile: KS118.
Characteristics: Deep sandy clayloam. Very weak, coarse angular blocky structure.
Occurrence: In the Pelotshetlha area.
Vegetation: Open to dense tree savanna.
- D7** **FAO:** Ferric Luvisol (1974)
 Ferric Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 4300 ha (0.3%)
Description: Massive moderately deep to very deep moderately well drained dark brown to yellowish red sandy clay loam to sandy clay
Topography: Flat to gently undulating, normal.
Profile: L901.
Occurrence: North of Lobatse. Also occurs in association with D7a.
Vegetation: Open tree savanna of Combretum hereroense and Burkea africana. In some areas its and open tree savanna of Acacia tortilis, Acacia mellifera and Zizyphus mucronata.
- D7a** **FAO:** Orthic Luvisol (1974)
 Haplic Luvisol (1988)

ST : Typic Haplustalf
Area: 7900 ha (0.6%)
Description: Massive deep imperfectly to moderately well drained dark brown to yellowish brown clayloam to sandy clay
Topography: Flat to almost flat, normal.
Profile: KS22
Characteristics: Massive sandy clay to clay.
Occurrence: North of Lobatse and Pelotshetlha.

D10 **FAO:** Eutric Nitosol (1974)
Rhodi-chromic Luvisol (1988)
ST : Rhodic Paleustalf
Area: 1100 ha (0.1%)
Description: Very deep moderately well to well drained red sandy loams to sandy clayloam
Topography: Gently undulating, normal to slightly shedding
Profile: L19
Occurrence: East of Lobatse
Vegetation: Open tree savanna of Pelthophorum africanum, Acacia karoo and Acacia mellifera.

G1a **FAO:** Eutric Regosol shallow petric/lithic (1974)
Eutric Regosol (1988)
ST : Typic Ustorthent
Area: 38 300 ha (2.8%)
Description: Very shallow to shallow moderately well to somewhat excessively drained grayish brown to yellowish red coarse sands to coarse sandy loams
Topography: Undulating to hilly, shedding.
Profile: L18.
Occurrence: On shallow rock also in association with R on hills.
Vegetation: Dense shrub savanna of Acacia tortilis and Acacia erioloba.

G1b **FAO:** Dystric Regosol (1974)
Dystric Regosol (1988)
ST : Typic Ustorthent
Area: 6000 ha (0.4%)
Description: Moderately deep moderately well to well drained dark grayish brown to reddish brown coarse sands to coarse shallow petric loamy sands
Topography: Almost flat to rolling, (slightly) shedding.
Profile: L54
Characteristics: Sandy loams.
Occurrences: On pediments
Vegetation: Open tree savanna of Acacia mellifera, Peltophorum africanum and Acacia tortilis.

- G1c** **FAO:** Eutric Regosol Petric Phase (1974)
Eutric Regosol (1988)
ST : Typic Ustorthent
Area: 9800 ha (0.7%)
Description: As G1b
Topography: Flat
Profile: KS132
Occurrence: West of Kanye
Vegetation: Open savanna of Acacia erioloba and Grewia flava.
- G2a** **FAO:** Eutric Regosol (1974)
Eutric Regosol (1988)
ST : Typic Ustorthent
Area: 10200 ha (0.7%)
Description: Moderately deep to deep moderately well to well drained dark grayish brown to reddish brown coarse loamy sands. Petric within 75cm
Topography: Almost flat to undulating, shedding to normal.
Profile: PM126.
Occurrence: North west of Mmathethe.
Vegetation: Open shrub savanna of Acacia tortilis.
- G2c** **FAO:** Chromic Luvisol petric phase (1974)
Chromic Luvisol (1988)
ST : Typic Haplustalf
Area: 6300 ha (0.4%)
Description: Moderately deep moderately well to well drained strong brown to red coarse sandy loams to sandy shallow clayloam. Petric within 75cm
Topography: Almost flat to undulating shedding to normal.
Profile: L86
Characteristics: moderately deep sandy clayloam to sandy clay.
Occurrence: On the Mmathethe granite.
Vegetation: Open tree savanna of Peltophorum africanum and Acacia erioloba.
- G2d** **FAO:** Ferric Luvisol (1974)
Ferric Luvisol (1988)
ST : Kanhaplic Haplustalf
Area: 15 100 ha (1.1%)
Description: As G2c but greyish brown to red. Petric within 75 cm.
Topography: Almost flat to undulating. Shedding to normal.
Profile:
Occurrence: East of Kanye

- G4** **FAO:** Ferralic Arenosol (1974)
 Ferralic Arenosol (1988)
ST : Typic Ustipsamment
Area: 56 600 ha (4.1%)
Description: Moderately deep to very deep well to somewhat
 excessively drained strong brown to yellowish red coarse
 sands to loamy coarse sands.
Topography: Almost flat to gently undulating, normal to shedding.
Profile: L65.
Characteristics: Very deep loamy sands.
Occurrence: On the Mmathethe granite and to a small extent on the
 Gaborone granite.
Vegetation: Dense shrub savanna of Acacia tortilis. In some areas open
 tree savanna of Terminalia sericea.
- G5** **FAO:** Ferric Acrisol petroferric phase (1974)
 Ferric Acrisol (1988)
ST : Kanhaplic Haplustult
Area: 12 000 ha (0.9%)
Description: Moderately deep to deep moderately well to well
 drained yellowish red to dark yellowish brown coarse sandy loams
 to sandy clay
Topography: Almost flat to undulating, normal to shedding.
Profile: L48.
Characteristics: Massive sandy loam to sandy clayloam.
Occurrence: Undulating Gaborone granite plain.
Vegetation: Dense shrub savanna of Acacia caffra.
- G6** **FAO:** Ferric Luvisol Petroferric Phase (1974)
 Haplic Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 18 100 ha (1.3%)
Description: Moderately deep to deep moderately well to well
 drained reddish yellow to red loamy coarse sands to
 coarse sandy loams. Petric/petroferric not within 75cm
Topography: Flat, normal.
Profile: KS177
Occurrence: On the Mmathethe granite
- G6a** **FAO:** Ferric Luvisol Petroferric Phase (1974)
 Haplic Lixisol (1988)
ST : Kanhaplic Haplustalf
Area: 29 200 ha (2.1%)
Description: Moderately deep to deep moderately well drained
 yellowish red to red sandy clayloam to clay
 Petric/petroferric not within 75cm

Topography: Almost flat to undulating, normal to slightly shedding.
Profile: L89.
Occurrence: On the Mmathethe granite.
Vegetation: Open shrub savanna of Acacia tortilis.

- G8** **FAO:** Chromic Luvisol
Chromic Luvisol
ST : Typic Haplustalf
Area: 4700 ha (0.3%)
Description: Moderately deep to deep moderately well to well drained yellowish red to red coarse sandy loams to sandy clayloam. Petric not within 75cm
Topography: Almost flat to undulating, normal to slightly shedding.
Profile: L95
Characteristics: Moderately deep sandy clay loam.
Occurrence: Upper slopes of the Moselebe floodplains.
Vegetation: Open shrub savanna of Acacia tortilis.
- G9** **FAO:** Chromic Luvisol (1974)
Chromic Luvisol (1988)
ST : Typic Haplustalf
Area: 4400 ha (0.3%)
Description: Deep to very deep moderately well to well drained yellowish red to dark red sandy clayloam to sandy clay
Topography: Almost flat to undulating.
Profile: L96.
Characteristics: Very deep sandy clay loam.
Vegetation: Open shrub savanna of Acacia tortilis and Acacia erioloba.
- G10b** **FAO:** Ferric Luvisol (1974)
Ferric Luvisol (1988)
ST : Kanhaplic Haplustalf
Area: 65200 ha (4.7%)
Description: Deep to very deep moderately well drained yellowish red to strong brown sandy clayloam to clay
Topography: Almost flat, normal to receiving.
Profile: L85.
Characteristics: Very deep sandy loam to sandy clay loam.
Occurrence: On the Mmathethe granite. Also occurs in association with G6.

G13 **FAO:** Calcic Luvisol (1974)
Luvic Calcisol (1988)
ST : Typic Haplustalf
Area: 18 300 ha (1.3%)
Description: Moderately deep to deep imperfectly to well drained dark grayish brown to dark reddish brown coarse sandy loams to sandy clay
Topography: Flat to undulating, normal to (slightly) receiving.
Profile: KS190
Characteristics: Deep sandy clay loam with soft powdery lime within 125cm.
Occurrence: On the Mmathethe granite.
Vegetation: Open tree savanna of Acacia erioloba and Acacia leuderidzii.

G13a **FAO:** Calcic Luvisol Petrocalcic Phase (1974)
Petric Calcisol (1988)
ST : Petrocalcic Paleustalf
Area: 28 000 ha (2%)
Description: As G13, with a petrocalcic horizon.
Topography: Flat to undulating, normal to (slightly) receiving.
Profile: KS 134.
Characteristics: Moderately deep sandy loam with a petrocalcic.
Occurrence: On the Mmathethe granite in association with C3 or G13 and G2d.
Vegetation: Open tree savanna of Acacia erioloba.

S3/KS3 **FAO:** Ferralic Arenosol (1974)
Ferralic Arenosol (1988)
ST : Typic Torripsamment
Area: 55 600 ha (4.0%)
Description: Deep to very deep well to somewhat excessively drained yellowish brown (with chroma of 5 or more) to yellowish red fine and fine-medium sand
Topography: Flat to undulating normal.
Profile: PM124.
Characteristics: Have chroma of 6.
Occurrence: Found in association with KS5 in the sandveld.
Vegetation: Dense tree savanna of Terminalia sericea, Acacia erioloba and Acacia mellifera. In some area it is an open low shrub savanna of Dichrostachys cinerea and Grewia flava probably as a result of veld fires.

S5/KS5 **FAO:** Ferralic Arenosol (1974)
Luvic Arenosol (1988)
ST : Typic Ustipsamment
Area: 139 400 (10.0%)

Description: Deep to very deep well to somewhat excessively drained yellowish brown to red fine and fine-medium sand to loamy fine sand

Topography: Flat to undulating, normal.

Profile: PM 123

Occurrences: In low lying areas in the sandveld. Also occurs in association with KS5a.

Vegetation: Open low shrub savanna of Grewia flava and Acacia mellifera.

S5a/KS5a FAO: Luvic Arenosol (1974)

Luvic Arenosol (1988)

ST : Typic Ustipsamment

Area: 594 200 ha (42.5%)

Description: As S5, showing lamellae of clay accumulation.

Topography: Flat to undulating, normal

Profile : PM 106

Characteristics: Very deep sands with common clay bands (lamellae of clay) 2mm thick starting from 55cm. Distance between clay bands is 10cm.

Occurrence: Widespread on the sandveld.

Vegetation: As S5

S12 FAO: Arenic Calcic Luvisol (1974)

Areni - Luvic Calcisol(1988)

Typic Paleustalf

Area: 4900 ha (0.4%)

Description: Deep to very deep well to somewhat excessively drained dark grayish brown to yellowish red sandy loams

Topography: Flat to undulating, normal.

Profile: KS179

Characteristics: Have soft powdery lime and moderate to strongly calcareous.

Occurrence: On the Hardveld - Sandveld boundary.

Vegetation: Open shrub savanna of Grewia flava and Tarchonanthus comphoranthus or with Acacia mellifera. In some areas it is an open tree savanna.

R Rock outcrops and associated very shallow soils.

Area: 53 000 ha (3.8%)

Soil Units A3, A13b, D9, G1e and G14 occur to a very minor extent (<1000 ha) in the survey area.

3 SOIL MAPPING UNIT ASSOCIATIONS

3.1 Hardveld

Some typical associations of soil mapping units on granitic rocks of the hardveld are illustrated in Figure 5.

- i) Alla occurs on colluvial or alluvial slopes. These soils are yellowish red to red sandy loams. On undulating granite plains moderately deep to very deep, yellowish brown to red sandy loams to sandy clayloams (G5) occur.
- ii) G4, moderately deep to very deep well to somewhat excessively drained strong brown to dark yellowish brown sandy loams, occurs on undulating plains both on the Gaborone granite and the Mmathethe granite.
- iii) Most the R unit area occurs in association with very shallow somewhat excessively drained sandy loams. Further down the slopes soil development increases in depth even though the soils are still gravelly.

Figure 6 shows a typical association of soil mapping units on fine grained sedimentary rocks.

On slopes of fine-grained sedimentary rocks, very shallow to moderately deep sandy loams to clays occur. Further down slope, at steeper gradients, well drained reddish brown sandy clay loams (D7) are found, whilst the imperfectly drained yellowish brown soils occur on lower gently undulating plains.

3.2 Sandveld

In the sandveld there is a relationship between KS5 and KS5a (Figure 7). KS5a occurs in low lying areas, characterized by open low shrub savanna. Clay bands commonly, occur at a depth of 55cm or more. On higher areas unit S5 or KS5 with no clay occurs. In the north where the topography is almost flat, dominant soil units are KS5a - 3.

FIG. 5 : SOIL MAPPING UNIT ASSOCIATIONS ON GRANITE ROCKS OF THE HARDVELD

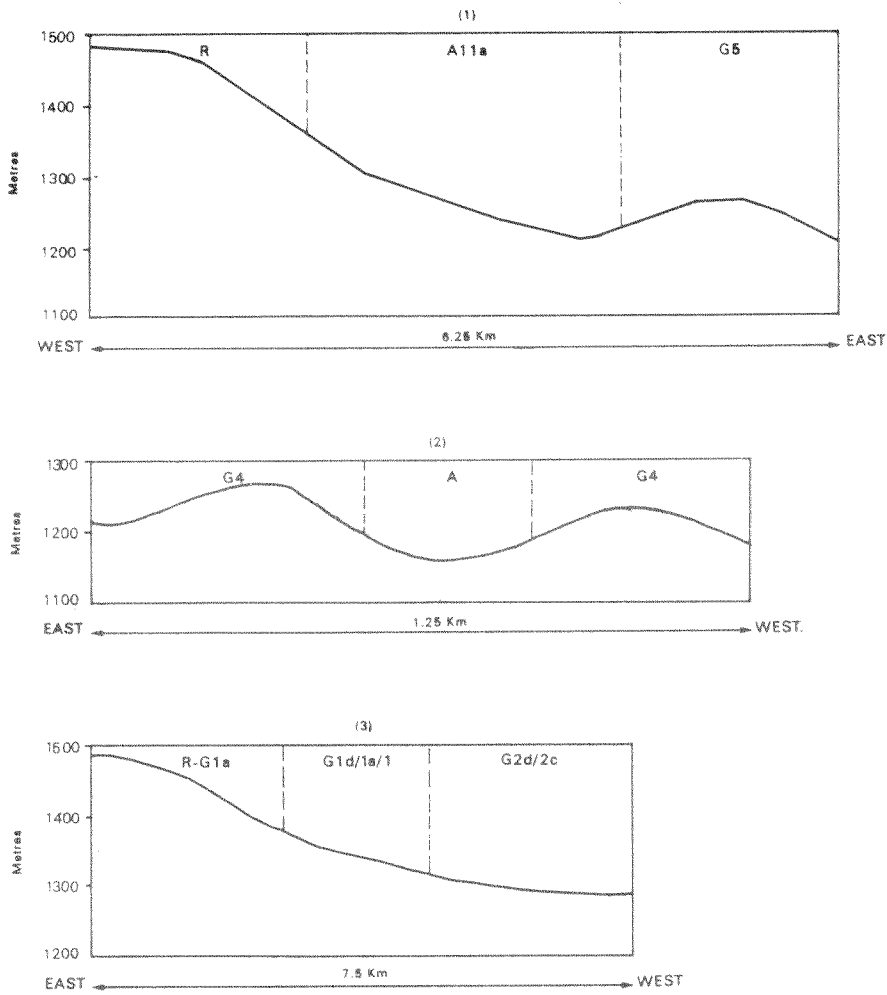


FIG. 6 : SOIL MAPPING UNIT ASSOCIATIONS ON FINE-GRAINED SEDIMENTARY ROCKS OF THE HARDVELD

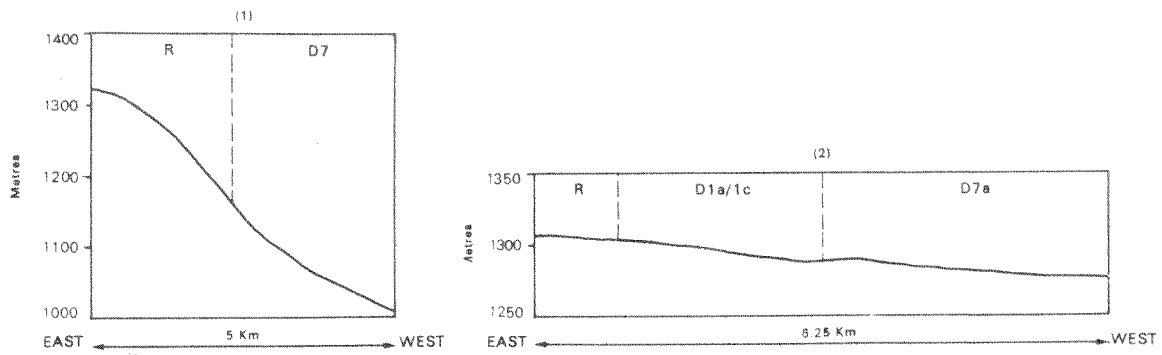
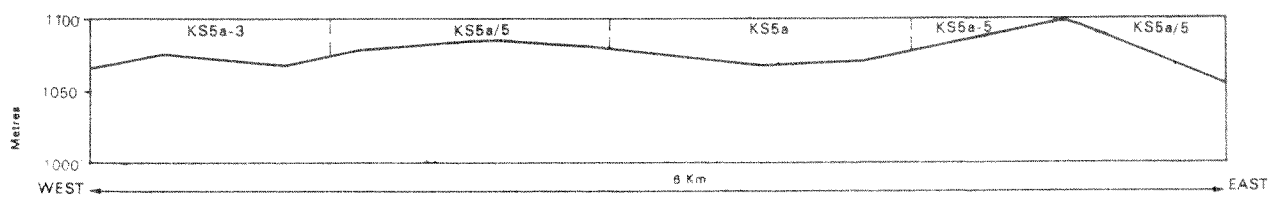


FIG. 7 : SOIL MAPPING UNIT ASSOCIATIONS OF THE SANDVELD



4 LAND EVALUATION

4.1 Introduction

In carrying out our land evaluation 4 main activities have to take place as follows:

- i) Describe land use type to be considered and establish its requirements.
- ii) Description of land mapping units and derivation of land qualities.
- iii) Comparison of land use type with types of land units.
- iv) Land suitability classification.

In Botswana four land use types are recognized under dryland farming and these are as follows:

Traditional
Improved traditional
Partly mechanized traditional
Mechanized commercial

To make a distinction between land use types use is made of the following

- produce
- yields
- market orientation
- size of holding
- capital intensity
- farm power
- technical knowledge
- infrastructural requirements and
- land tenure

For the surveyed area, land suitability has been assessed for improved traditional dryland farming. This assessment covers three crops; sorghum, maize and millet. The definition for improved traditional dryland farming is on Table 3.

4.2 Matching Land with Land Use Requirements

To compare requirements of specific crops grown under specific land use types with land units to give a prediction of crop performance, land characteristics are used. These are properties of land that can be measured or estimated eg soil texture, slope, rainfall, nutrient status etc.

In most cases there are interactions between land characteristics e.g. moisture availability is determined by climate (rainfall and evapotranspiration) modified by topography (water shedding sites versus water receiving sites) and soil characteristics (infiltration, permeability, available water holding capacity). Because of this, land characteristics are brought together to derive land qualities which are in fact complex properties of land, quantified by a number of land characteristics. The following land qualities were used to assess the suitability of land units:

Table 3

Land use type: **Improved Traditional Dryland Farming**

Produce:	Sorghum, maize, millet, groundnuts, peas, beans, sunflower
Yields:	500 - 600 kg/ha (grain)
Market orientation:	Firstly subsistence; sale of surplus
Size of holding:	10 ha; total area planted depends on amount and distribution of rainfall
Capital intensity:	Moderate
Labour intensity:	Moderate
Credit facilities:	Government controlled institutions
Farm power:	Oxen, donkeys, mules
Technical knowledge:	Good knowledge of modern farming practices related to non-mechanized dryland farming
Management practices:	Winter ploughing, early planting, row planting, improved seeds, modest use fertilizer/manure, insecticides, use of planter and inter-row cultivator, contour ploughing, adequate crop protection against pests, proper storage of harvest.
Infrastructure requirements:	Advisory services; depots for sale of supplies (fertilizer, seeds) and storage of produce.
Land tenure system:	Communal

edaphic and agro-climatic qualities

- (c) correct temperature regime
- (f) absence of damaging floods
- (g) adequacy of conditions for germination
- (m) moisture availability
- (n) nutrient availability
- (o) oxygen availability
- (r) adequacy of foothold for roots
- (t) absence of toxic substances

management and conservation

- (a) accessibility
- (e) resistance to soil erosion
- (w) workability

The requirements of a specific land use type are matched with precise information on land qualities of each land unit. The outcome of this exercise is the overall land suitability.

4.3 Land Suitability Structure

The Land suitability structure distinguishes 2 orders suitable(S) and non suitable(N). Within the S order there are 4 classes as follows:

S1 highly suitable ; Land which is expected to be highly productive. High returns amply justify inputs. No significant limitations.

S2 moderately suitable ; Land which is expected to be moderately productive. Moderate returns justify required inputs. Limitations reduce crop yield 20 -40 % and/or increase recurrent costs for production and conservation.

S3 marginally suitable; Land which is expected to have a low productivity. Yield benefits are just high enough to justify required inputs. Limitations reduce crop yield to 40-60% and/or considerably increase costs for production and conservation.

S4 very marginally suitable ; Land which is expected to have a very low productivity. It is doubtful whether yield benefits alone justify required inputs. Severe limitations reduce crop yields with 60-80% and/or considerably increase costs for production and conservation.

Within the N(non suitable), no subdivisions have been made. this order refers to land with very severe limitations, which at present cannot be corrected economically.

Subclasses

Classes have subclasses indicated by arabic letters e.g. S2e. The letter indicates the type of limitation which restricts a land unit from qualifying to a higher suitability class.

Mapping

In the map three letter types of S are used as follows:

- 1 A bold **S** implies that the suitability rating represents 60-80% of mapping units.
- 2 A normal capital S represents 40-60% of the mapping unit.
- 3 A lower case s represents 20-40% of the mapping unit.

The remaining 20% or lower is considered minor and it is not mentioned in the association or complex.

4.4 Comments and Assumption

- Only physical attributes which have been recorded in the field and laboratory analysis of samples profiles have been used in this evaluation exercise.
- In this assessment sorghum has been used as a standard crop and as a guideline, ratings for maize are always a class lower and those for millet a class higher.
- Data for nutrient and moisture assessment is not available for soil units which were not analyzed.
- Land qualities such as drainability, availability of water (for irrigation), adequacy of topography etc were not assessed because they are not applicable to dryland farming.
- Limiting factors given on the map symbols only refer to the most limiting land quality.
- Adjacent soil mapping units which have a similar suitability have been combined to form one unit.

4.5 Observations

- Moisture availability is the main limiting factor.
- Sands on the sandveld are all not suitable for dryland arable farming.
- On soil with fine-grained sedimentary rocks especially shales, the erosion risks are high and therefore care should be taken through proper management techniques to avoid this negating effect.

- Soils on highly calcareous material suffer from calcium carbonate toxicity and the result is a very high pH which contributes to phosphorous fixation (phosphorus not being available to plants). Application of amendments on these soils to reduce pH is not justified.
- Most of the soil units which are not suitable in the hardveld with the exception of those on highly calcareous material, are too shallow for any form of cultivation.
- Caution should be exercised in interpreting the evaluation results because there may be by differences in observations between the field and the results of interpretations of soils data.

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**Appendix 1 : Selected Soil Profile Descriptions
and Analytical Data**

A - Soils on Alluvial Deposits

Unit	Profile	FAO classification (1974)
A1	L80	Pellic vertisol
A7	L76	Gleyic luvisol
A11	L137	Ferric luvisol
A11a	L69	Ferric luvisol Petroferric phase
A13	KS163	Chromic luvisol
A13a	KS162	Chromic luvisol
A14	L50	Orthic luvisol
A19	KS166	Ferralic Arenosol
*A21a	PM103	Petrocalcic Arenosol

B - Soils on Basic Igneous and Metamorphic Phase

*B3	PM113	Chromic Luvisol
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C - Soils on Highly Calcareous Material

C2	KS149	Calcaric Regosol Shallow Petrocalcic
C3	KS148	Petrocalcic Arenosol shallow petrocalcic

D - Soils on Fine grained Sedimentary Rocks

D1	L22	Dystric Regosol shallow petric
*D1c	L31	Eutric Regosol
*D2	L11	Ferric Luvisol Petroferric phase
*D5a	KS118	Chromic Luvisol
D7	L901	Ferric Luvisol

G - Soils on Acid Igneous and Metamorphic Rocks

G1b	L54	Dystric Regosol
G2d	L82	Ferric Luvisol
G4	L65	Ferralic Arenosol
G5	L48	Ferric Acrisol petroferric phase
G6	KS177	Ferric Luvisol petroferric phase
G6a	L89	Ferric Luvisol petroferric phase
G8	L95	Chromic Luvisol
G9	L96	Chromic Luvisol
G10b	L85	Ferric Luvisol
G13	KS190	Calcic Luvisol
G13a	KS134	Calcic Luvisol petrocalcic phase

(S - or KS) - Soils on Coarse grained Sedimentary Rocks

KS5a	JW011	Luvic Arenosol
KS12	KS179	Arenic Calcic Luvisol

* Not sampled

The following codes for profiles are used:

L - Lobatse
GH - Goodhope
KS - Kanye South
JW - Jwaneng
PM - Phitshane Molopo

SOIL PROFILE DESCRIPTION

Profile: L 0080 Unit: A01 Status: 2

SHEET : 2525A4
LOCATION : 4km North of Garlhwane.
AUTHOR(S): T.D.Mafoko K.Kgatlwane
CLASSIFICATION FAO: (1988) Pellic Vertisol (1974) sodic phase
ST : Typic Pellustert

GRID : LB-490-948
COORD: 25-21-30-S 25-29-55-E
DATE : 14/08/84

AGRO CLIM.ZONE: 1E3
ELEVATION : 1265 m
SMR: ustic

LANDFORM : plain
TOPOGRAPHY: gently undulating
SURF. CHAR: slight sealing, no cracks,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heterocantha (dom.) Acacia hebeclada
: Grasses/forbs-

LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: low gilgai
VEGETATION: open shrub savanna

POSITION: upper slope
SLOPE : - 3 % convex

GRASSCOVER:

PARENT MATERIAL: alluvium
MOIST. COND: dry 0 - 10 , slightly moist 10 - 100 cm
SURE.STONES: none
EROSION : nil

ROCK TYPE: granite

ROCK OUTCROP: none

GEOLOGICAL UNIT: Intrusives
DRAINAGE : imperfectly drained
HUMAN INF: nil

REMARKS: There is 2cm of granular layer on the surface

SAMPLES: A: 0 - 15 B: 40 - 60 C: 80 - 100

Ap 0 - 15 cm 10YR 3/1 (moist) and 10YR 3/1 (dry), clay, moderate fine and medium subangular blocky structure, very hard, common fine pores, non calcareous, many fine roots, clear wavy boundary.

B 15 - 100 cm 10YR 3/1- (moist), clay, strong very coarse angular blocky structure, very hard, continuous thick slickensides on horizontal pedfaces, few fine pores, few fine rounded rock fragments, very few fine spherical hard calcareous white nodules, non calcareous, common fine roots,

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0080

SAMPLE DEPTH	pH	H2O CaCL2	EC m	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)					CECclay	METH	PRETR				
															weight %	vcS	cS	mS	fS				vFS	cSi	fSi	Clay
A	0 15	6.8	6.3	0.0	1	0.8	0.00	37.9	25.7	8.8	0.9	0.6	0.0	95	0.0	1	4	5	14	13	7	9	46	75	H	0
B	40 60	7.9	7.2	0.0	1	0.6	0.00	42.4	29.5	4.8	0.6	2.4	0.0	88	0.0	3	4	4	9	8	15	0	57	71	H	0
C	80 100	7.9	7.3	0.0	1	0.5	0.00	43.8	32.3	5.3	0.8	2.6	0.0	94	0.0	2	4	3	8	8	7	9	60	70	H	0

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: L 0076 Unit: A07 Status: Z

SHEET : 2525B1
 LOCATION : 7.5km E of Letlhakane.
 AUTHOR(S): T.D.Mafoko K.Kgatlwane
 CLASSIFICATION FAO: Gleyic Luvisol (1974)
 ST : Aquic Haplustalf

GRID : LC-512-246
 COORD: 25-05-20-S 25-30-30-E
 DATE : 12/07/84

AGRO CLIM.ZONE: IE3
 ELEVATION : 1189 m
 SMR: ustic

LANDFORM : alluvial plain
 TOPOGRAPHY: gently undulating
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE:

LAND ELEMENT : flood plain
 MICRO TOPOGRAPHY: low hummocks
 VEGETATION: dense shrub savanna

POSITION:
 SLOPE : - 3 %
 GRASSCOVER:

SPECIES : Trees -
 : Shrubs - Acacia mellifera (dom.) Euclea undulata Acacia tortilis subs. heterocantha
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 85 cm
 SURF.STONES: none
 EROSION : strong sheet erosion and moderate gully erosion

ROCK TYPE: granite
 ROCK OUTCROP: none

GEOLOG. UNIT: Gaborone granite
 DRAINAGE : imperfectly drained
 HUMAN INF: nil

REMARKS:

SAMPLES: A: 0 - 20 B: 20 - 40 C: 80 - 100

A 0 - 20 cm 10YR 4/3 (moist) and 10YR 5/3 (dry), loamy sand to sandy loam, very weak coarse subangular blocky structure, hard, few fine pores, non calcareous, few fine roots, diffuse smooth boundary.

Bt1 20 - 50 cm 10YR 4/3 (moist) and 10YR 5/3 (dry), sandy loam, very weak coarse subangular blocky structure, hard, few fine pores, non calcareous, few fine roots, clear smooth boundary.

Bt2 50 - 85 cm 10YR 4/4 (moist) and 10YR 5.5/4 (dry), common fine faint diffuse yellow mottles, sandy clay loam, very weak coarse subangular blocky structure, hard, patchy thick cutans, common fine pores, non calcareous, few fine roots,

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0076

SAMPLE DEPTH	pH	H2O CaCl2	EC	mS/cm	ppm	P	m	C	N	weight %	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	CECclay	METH	PRETR								
										meq/100gr soil							%	%	meq/100gr										
A	0	20	5.7	4.9	0.0	2	0.3	0.00	4.3	0.4	0.6	0.3	0.0	0.0	0.0	0.0	30	0.0	5	14	13	30	17	9	3	9	33	H	O
B	20	40	5.5	5.0	0.0	1	0.2	0.00	4.8	0.4	0.7	1.1	0.0	0.0	0.0	0.0	46	0.0	2	11	16	25	16	7	4	20	20	H	O
C	80	100	5.7	4.7	0.0	1	0.0	0.00	7.9	0.7	1.5	1.7	0.0	0.0	0.0	0.0	49	0.0	4	11	12	20	13	8	4	28	29	H	O

Soil Survey of Botswana FAO/ROT/85/011

Last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

SHEET : 2525B1
 LOCATION : South of Ngwane dam.
 AUTHOR(S) : E. Van Waveren T.D. Mafoko
 CLASSIFICATION FAO: Ferric Luvisol (1974)
 ST : Oxic Paleustalf

LANDFORM : alluvial fan
 TOPOGRAPHY: undulating
 SURF. CHAR: no sealing, no cracks, nil evidence of salt,
 LAND USE: commercial dryland farming
 SPECIES : Trees - Acacia Karroo (dom.) Acacia tortilis subs. heterocantha
 : Shrubs - Acacia tortilis subs. heterocantha (dom.) Acacia Karroo
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 80 , slightly moist 80 - 170 cm
 SURF. STONES: few gravel
 EROSION : nil

GRID : LC-690-206
 COORD: 25-08-15-S 25-41-50-E
 DATE : 13/01/88

AGRO CLIM. ZONE: 1E3
 ELEVATION : 1156 m
 SMR: ustic

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 VEGETATION: dense savanna
 Ziziphus mucronata
 Ziziphus mucronata

POSITION: lower slope
 SLOPE : 1.5 - 2 % convex
 GRASSCOVER: > 70 %

ROCK TYPE:
 ROCK OUTCROP: none

GEOLOG. UNIT: Ventersdorp supergroup
 DRAINAGE : moderately well drained
 HUMAN INF: nil

REMARKS:

SAMPLES: A: 0 - 15 B: 20 - 40 C: 50 - 70 D: 80 - 100 E: 110 - 130 F: 140 - 160

- A 0 - 15 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), sandy loam, weak medium to very coarse subangular blocky structure, slightly hard, common very fine and fine pores, non calcareous, many fine and medium roots, clear wavy boundary.
- Bt1 15 - 45 cm 7.5YR 4/6 (moist) and 7.5YR 4.5/6 (dry), sandy clay loam, very weak medium to very coarse angular blocky structure, slightly hard, common very fine and fine pores, non calcareous, common fine and medium roots, gradual wavy boundary.
- Bt2 45 - 80 cm 7.5YR 4/6 (moist) and 7.5YR 5/6 (dry), sandy clay loam, very weak medium and coarse angular blocky structure, very friable, patchy thin clay and sesquioxides cutans on pedfaces, common very fine and fine pores, very few medium spherical hard iron-manganese black nodules, non calcareous, few burrows, few fine roots, clear irregular boundary.
- Bt3 80 - 100 cm 10YR 4/6 (moist) and 10YR 5/8 (dry), sandy clay, very weak medium and coarse angular blocky structure, very friable, broken thin clay and sesquioxides cutans on pedfaces, common very fine and fine pores, frequent fine irregular soft iron-manganese reddish nodules, non calcareous, few burrows, few fine roots, clear irregular boundary.
- Bt4 100 - 140 cm 10YR 4/6 (moist) and 10YR 4.5/6 (dry), sandy clay, very weak medium and coarse angular blocky structure, friable, broken thin clay and sesquioxides cutans on pedfaces, common very fine and fine pores, frequent coarse irregular hard manganese black nodules and frequent medium irregular hard ferruginous reddish nodules, non calcareous, very few fine roots, clear wavy boundary.
- 2Bt5 140 - 160 cm 10YR 4.5/6 (moist), sandy clay, very weak medium and coarse subangular blocky structure, friable, broken thin clay and sesquioxides cutans on pedfaces, common very fine and fine pores, frequent fine rounded weathered quartzite rock fragments, few coarse irregular hard manganese black nodules and few medium irregular hard ferruginous reddish nodules, non calcareous, very few fine roots, clear wavy boundary.
- 2Bt6 160 - 280 cm 10YR 3.5/6 (moist), sandy clay, massive structure, broken thin clay and sesquioxides cutans random, common very fine and fine pores, very few coarse irregular hard manganese black nodules and few medium irregular hard ferruginous reddish nodules, non calcareous, very few fine roots, clear wavy boundary.

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0137

SAMPLE DEPTH	pH	EC m	CaCL2	ms/cm	EC m	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR		
																	weight %	ms/cm	ppm	weight %	meq/100gr soil	meq/100gr soil				meq/100gr soil	meq/100gr soil
A	0	15	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	9	10	9	17	19	9	9	18	H	N
B	20	40	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	4	10	9	16	19	12	8	22	H	N
C	50	70	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	4	9	8	15	17	8	12	27	H	N
D	80	100	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	5	9	8	15	16	8	12	26	H	N
E	110	130	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	8	9	7	12	14	9	13	29	H	N
F	140	160	0.0	0	0.0	0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	8	7	6	13	16	9	13	29	H	N

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION Profile: L 0069 Unit: Alla Status: 2

SHEET : 2525B1
LOCATION : 7km NE of Lotlhakane.
AUTHOR(S) : T.D.Mafoko K.Kgalwane
CLASSIFICATION FAO : Ferric Lixisol(1988) Ferric Luvisol (1974) petroferric phase
ST : Kanhaplic Haplustalf
LANDFORM : plain
TOPOGRAPHY : flat
SURE CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees - Terminalia sericea (dom.) Combretum heteroense
: Shrubs - Acacia tortilis subs. heteroantha (dom.) Acacia karroo Acacia caifra
: Grasses/forbs-
PARENT MATERIAL: alluvium
MOLST. COND: dry 0 - 60 cm
SURF.STONES: none
EROSION : nil

REMARKS:

SAMPLES: A: 0 - 15 B: 40 - 60

A 0 - 15 cm 7.5YR 3.5/4 (moist) and 10YR 4/6 (dry), loamy sand, weak medium subangular blocky structure, slightly hard, few fine pores, non calcareous, common fine roots, gradual smooth boundary.
Bt 15 - 60 cm 4YR 4/6 (moist) and 4YR 5/6 (dry), sandy loam, very weak coarse subangular blocky structure, slightly hard, common fine pores, non calcareous, few fine roots, abrupt smooth boundary.
Cmo 60 cm + extremely hard, patchy thin clay cutans on pedfaces, cemented, dominant ferruginous concretions, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0069

SAMPLE DEPTH	pH	H2O	CaCl2	EC mS/cm	P ppm	m C	N weight %	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR			
																vcS	cS	mS	fs	vfs	cSi				fSi	Clay	meq/100gr
A	0	15	6.0	5.2	0.0	2	0.0	0.00	3.0	0.5	0.6	0.4	0.0	0.0	50	0.0	7	12	13	31	17	7	3	9	34	H	O
B	40	60	6.0	5.4	0.0	1	0.0	0.00	4.0	0.6	1.1	1.0	0.0	0.0	68	0.0	6	11	16	25	14	8	4	16	25	H	O

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

Print date: 12/03/90

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P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SHEET : 2525A1
 LOCATION : 3km South West of Segwagwa.
 AUTHOR(S) : T.D.Mafoko
 CLASSIFICATION FAO: Chromic Luvisol (1974)
 ST : Typic Haplustalf
 LANDFORM : alluvial fan
 TOPOGRAPHY: undulating
 SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
 LAND USE:
 SPECIES : Trees - Acacia tortilis subs. heterocantha (dom.)
 : Shrubs - Ziziphus mucronata (dom.) Grewia flava
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 70 cm
 SURF. STONES: none
 EROSION : nil

REMARKS:
 VEGETATION: dense tree savanna
 LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 SMR: ustic
 POSITION: upper slope
 SLOPE : - 4 %
 GRASSCOVER:
 GEOL. UNIT: Intrusives
 DRAINAGE : well drained
 HUMAN INF: nil

GRID : LC-141-111
 COORD: 25-12-45-S 25-02-15-E
 DATE : 07/03/85

A 0 - 10 cm 7.5YR 4/6 (moist) and 7.5YR 4/6 (dry), loamy sand, moderate to strong very coarse angular blocky structure, hard, non calcareous, many roots, clear wavy boundary.

Bt 10 - 70 cm 5YR 3/4 (moist) and 5YR 4/6 (dry), sandy clay loam, moderate very coarse subangular blocky structure, very hard, patchy thin cutans, non calcareous, few fine roots, abrupt wavy boundary.

C 70 cm + very frequent coarse and very coarse angular strongly weathered rock fragments, non calcareous,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0163

SAMPLE DEPTH	pH	EC m	P	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)					CECclay	METH	PRETR	
						weight %	µ	µ	µ	µ	µ	µ	%	%	vcS	cS	mS	fS	vfs	cSi	fSi	Clay	meq/100gr

A	0	10	5.8	4.7	0.0	2	0.3	0.00	6.2	1.7	0.6	0.4	0.1	0.0	45	0.0	1	8	37	19	5	2	11	44	H	0
B	40	60	6.2	5.3	0.0	1	0.2	0.00	12.4	4.1	1.8	0.3	0.1	0.0	51	0.0	1	8	30	15	4	3	22	52	H	0

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: KS 0162 Unit: A13a Status: 3

SHEET : 2525A1
 LOCATION : 1km SE of Gatsopane dam.
 AUTHOR(S) : T.D.Mafoko
 CLASSIFICATION FAO: Chromic Luvisol (1974)
 ST : Typic Haplustalf

LANDFORM : plain
 TOPOGRAPHY: gently undulating
 SURF. CHAR: strong sealing, no cracks, nil evidence of salt,
 LAND USE: traditional grazing
 SPECIES : Trees - Acacia erioloba (dom.) Acacia mellifera
 : Shrubs - Ziziphus mucronata (dom.) Grewia bicolor
 : Grasses/forbs-

PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 145 cm
 SURF. STONES: none
 EROSION :

REMARKS: Pit and augering at 100cm

SAMPLES: A: 0 - 20 B: 40 - 60 C: 80 - 100

A 0 - 1 cm 10YR 3/4 (moist) and 5YR 4/4 (dry), sandy clay loam, moderate medium subangular blocky structure, very hard, common fine pores, non calcareous, many fine roots, clear smooth boundary.
 Bt 15 - 100 cm 5YR 3/4 (moist), sandy loam, moderate medium subangular blocky structure, very hard, common fine pores, non calcareous, many fine roots, clear smooth boundary.
 Bt2 100 - 145 cm 7.5YR 4/6 (moist) and 7.5YR 5/6 (dry), sandy clay loam, non calcareous,
 R 145 cm +

GRID : LC-126-086
 COORD: 25-13-40-S 25-08-20-E
 DATE : 06/03/85

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 VEGETATION: dense tree savanna
 Acacia tortilis subs. heterocantha

ROCK TYPE: acid igneous/metamorphic
 ROCK OUTCROP: none

AGRO CLIM.ZONE: 2D3
 ELEVATION : 1234 m
 SMR: ustic
 POSITION: middle slope
 SLOPE : - 3 %
 GRASSCOVER:

GEOLOG. UNIT: Intrusives
 DRAINAGE : moderately well drained
 HUMAN INF: nil

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0162

SAMPLE DEPTH	pH	H2O CaCl2	EC mS/cm	P ppm	m C	N weight %	CEC	Ca	Mg	K	Na	EXAC	PBS %	CARBO %	Particle size (weight %)					CECclay meq/100gr	METH	PRETR				
															vcS	cS	mS	fS	vfs				cSi	fSi	Clay	
A	0	20	6.5	5.8	0.0	2	0.4	0.00	4.9	2.2	0.4	0.0	0.0	53	0.0	2	8	15	35	17	6	3	14	23	H	O
B	40	60	6.8	6.1	0.0	1	0.2	0.00	9.6	4.6	1.1	0.7	0.1	68	0.0	2	7	13	28	15	5	3	28	32	H	O
C	80	100	7.1	6.3	0.0	0	0.1	0.00	10.1	5.5	1.1	0.6	0.1	72	0.0	3	7	13	27	14	5	5	27	36	H	O

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SHEET : 2525B1
 LOCATION : 9km North of Molapowabejang.
 AUTHOR(S) : T.D.Mafoko K.Kgatlwane
 CLASSIFICATION FAO: Haplic Luvisol(1988) Orthic Luvisol (1974)
 ST : Udic Haplustalf
 LANDFORM : plain
 TOPOGRAPHY: undulating
 SURF. CHAR: moderate sealing, no cracks,
 LAND USE: traditional grazing
 SPECIES : Trees -
 : Shrubs - Acacia mellifera (dom.) Acacia tortilis subs. heterocantha Acacia caffra
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 95 cm
 SURF. STONES: none
 EROSION : moderate rill erosion

GRID : LC-535-273
 COORD : 25-07-05-S 25-33-15-E
 DATE : 03/05/84
 LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: low hummocks
 VEGETATION:
 ROCK TYPE: granite
 ROCK OUTCROP: none

AGRO CLIM.ZONE: 1E3
 ELEVATION : 1091 m
 SMR: ustic
 POSITION:
 SLOPE : - 5 % convex
 GRASSCOVER:
 GEOL.UNIT: Gaborone granite
 DRAINAGE : moderately well drained
 HUMAN INF: nil

REMARKS:
 SAMPLES: A: 0 - 15 B: 20 - 40 C: 50 - 70
 A 0 - 15 cm 10YR 4/4 (moist) and 10YR 5/4 (dry), loamy sand, weak fine and medium subangular blocky structure, slightly hard, non calcareous, many fine roots, clear smooth boundary.
 Bt1 15 - 45 cm 10YR 4/6 (moist) and 10YR 5/4 (dry), loamy sand, weak medium and coarse subangular blocky structure, soft, patchy thin clay cutans, slightly calcareous, many fine roots, clear smooth boundary.
 Bt2 45 - 75 cm 10YR 5/8 (moist) and 10YR 6/8 (dry), common coarse prominent clear reddish mottles, sandy loam, soft, patchy thin clay cutans, frequent angular quartz rock fragments, slightly calcareous, common fine roots, clear smooth boundary.
 Cm 75 - 95 cm slightly calcareous,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0050

SAMPLE DEPTH	pH	H2O CaCl2	EC mS/cm	ppm	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)										CECclay	METH	PRETR
																weight %	meq/100gr soil	%	%	vcS	cS	mS	fS	vFS	cSi			
A	0 15	5.4	4.7	0.0	2	0.3	0.00	3.1	1.2	0.2	0.2	0.0	0.0	52	0.0	0.0	6	13	17	30	16	9	3	7	26	H	0	
B	20 40	5.5	4.8	0.0	1	0.3	0.00	3.4	8.5	0.3	0.3	0.0	0.0	100	0.0	0.0	8	13	17	27	15	8	3	9	24	H	0	
C	50 70	5.0	4.0	0.0	1	0.2	0.00	5.2	7.5	0.5	0.2	0.0	0.0	100	0.0	0.0	8	13	18	20	11	8	5	17	25	H	0	

Soil Survey of Botswana FAO/BOT/85/011

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EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PREFRETTMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: KS 0166 Unit: A19 Status: 2

SHEET : 2525A1
 LOCATION : 1.5km North Gatsapana.
 AUTHOR(S) : T.D.Mafoko
 CLASSIFICATION FAO: Rhodi-Ferralic Arenosol(1988) Ferralic Arenosol (1974)
 ST : Typic Ustipsamment
 LANDFORM : plain
 TOPOGRAPHY: undulating
 SURF. CHAR: no sealing, no cracks, nil evidence of salt,
 LAND USE:
 SPECIES : Trees - Terminalia sericea (dom.) Acacia erubescens Peltophorum africanum
 : Shrubs - Grewia flava (dom.)
 : Grasses/forbs-
 PARENT MATERIAL: alluvium
 MOIST. COND: dry 0 - 200 cm
 SURF. STONES: none
 EROSION : nil

GRID : LC-112-103
 COORD: 25-12-50-S 25-07-35-E
 DATE : 07/03/85

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 VEGETATION: dense tree savanna

AGRO CLIM.ZONE: 2D3
 ELEVATION : 1234 m
 SMR: ustic to aridic

POSITION: slope
 SLOPE : 0 - 5 % convex
 GRASSCOVER:

ROCK TYPE: quartzite
 ROCK OUTCROP: none

GEOLOGICAL UNIT: Transvaal supergroup
 DRAINAGE : somewhat excessively drained
 HUMAN INT: nil

REMARKS:

SAMPLES: A: 0 - 15 B: 40 - 60 C: 80 - 100

A 0 - 15 cm 7.5YR 3/4 (moist) and 7.5YR 4/6 (dry), sand, single grain structure, loose, common fine pores, non calcareous, many fine roots, clear smooth boundary.
 B 15 - 200 cm 4YR 3/4 (moist) and 4YR 4/6 (dry), sand, very weak coarse angular blocky structure, hard, common fine pores, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0166

SAMPLE DEPTH	pH	H2O	CaCl2	EC	mS/cm	N	C	P	m	ppm	weight %	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR	
																				vcS	cS	mS	fS	vFS	cSi				fSi
A	0	15	6.6	5.3	0.0	3	0.3	0.00	2.2	2.0	0.3	0.2	0.1	0.0	0.0	100	0.0	0.0	1	20	25	31	14	3	1	6	18	H	O
B	40	60	6.5	5.4	0.0	1	0.2	0.00	2.3	2.0	0.3	0.2	0.1	0.0	0.0	100	0.0	0.0	2	26	27	26	11	2	1	6	23	H	O
C	80	100	6.1	4.9	0.0	1	0.2	0.00	3.8	1.7	0.1	0.1	0.1	0.0	0.0	53	0.0	0.0	3	21	23	29	13	3	1	7	43	H	O

Soil Survey of Botswana RAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water
P : Available Phosphorus determination m : method ... O = Olsen B = Bray
C : Organic Carbon determination Walkley-Black method
N : Total Nitrogen determination Kjeldahl method
CEC and bases : Ammonium acetate method
EXAC : Exchangeable acidity extracted with KCl
CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: PM 0103 Unit: A 2 | a Status: 3

SHEET : 2525A3
LOCATION : 5km SE Kaditkau.
AUTHOR(S): T.D.Mafoko E. Van Waveren C.I.Ketlogetswe J.Huesken
CLASSIFICATION FAO: Eutric Regosol (1974) lithic phase

GRID : LC-162-040
COORD: 25-16-20-S 25-10-30-E
DATE : 10/09/87

ST :
LANDFORM : plain
TOPOGRAPHY: gently undulating
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: no apparent management system
SPECIES : Trees - Terminalia sericea (dom.) Combretum hereroense
: Shrubs -

AGRO CLIM.ZONE:
ELEVATION :
SMR:
POSITION: higher part
SLOPE : 1 - 2 % straight
GRASSCOVER: < 10 %

LAND ELEMENT :
MICRO TOPOGRAPHY: even
VEGETATION: open savanna

PARENT MATERIAL: aeolian sand
MOIST. COND: moist 0 - 2.5 cm
SURF.STONES: very few gravel
EROSION : slight sheet erosion

ROCK TYPE:
ROCK OUTCROP: very few rocky
GEOL.UNIT:
DRAINAGE : somewhat excessively drained
HUMAN INF: nil

REMARKS:
SAMPLES:

A 0 - 25 cm 7.5YR 3/4 (moist), sand, very weak very coarse subangular blocky structure, very friable, common very fine and fine pores, non calcareous, common very fine and fine roots, abrupt boundary.

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SHEET : 2525C1
LOCATION : 4.5km West of Pitsane Molopo.
AUTHOR(S): T.D.Mafoko
CLASSIFICATION FAO: Chromic Luvisol (1974)
ST : Typic Rhodustult
LANDFORM : plain
TOPOGRAPHY: almost flat
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees - Acacia mellifera (dom.)
: Shrubs - Grewia sp. (dom.)
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 120 cm
SURF. STONES: none
EROSION : slight sheet erosion

GRID : LB-063-546
COORD: 25-42-00-S 25-04-00-E
DATE : 06/02/86
AGRO CLIM.ZONE: 2D3
ELEVATION : 1167 m
SMR: ustic to aridic
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: dense tree savanna
POSITION: middle slope
SLOPE : - 5 % convex
GRASSCOVER: 30 - 70 %
ROCK TYPE: basic igneous/metamorphic
ROCK OUTCROP: none
GEOLOGICAL UNIT: Basement complex
DRAINAGE : well drained
HUMAN INF: nil

REMARKS:

SAMPLES:

- A 0 - 15 cm 5YR 5/8 (moist) and 2.5YR 3/6 (dry), sandy loam, moderate fine and medium subangular blocky structure, slightly hard, non calcareous, many very fine and fine roots, clear smooth boundary.
- Bt 15 - 120 cm 2.5YR 3/6 (moist) and 2.5YR 4/6 (dry), sandy clay loam, moderate coarse and very coarse angular blocky structure, hard, patchy thin clay cutans on pedfaces, non calcareous, common fine and medium roots,

SOIL PROFILE DESCRIPTION Profile: KS 0149 Unit: C02 Status: 2

SHEET : 2525a1 GRID : LC-183-208 AGRO CLIM.ZONE: 1E3
LOCATION : 1.5km North of Diponyane. COORD: 25-07-10-S 25-12-05-E ELEVATION : 1295 m
AUTHOR(S): T.D.Mafoko DATE : 31/01/85

CLASSIFICATION FAO: Calcaric Regosol (1974) shallow petrocalcic phase
ST : Typic Ustorthent
LANDFORM : plain
TOPOGRAPHY: flat
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: improved trad. dryland farming
SMR: ustic

SPECIES : Trees -
: Shrubs - Acacia mellifera (dom.)
: Grasses/forbs -

PARENT MATERIAL: calcrete
MOIST. COND: slightly moist 0 - 35 cm
SURF.STONES: none
EROSION : nil

POSITION: intermediate part
SLOPE : - 1 % straight
GRASSCOVER:

ROCK TYPE: dolomite
ROCK OUTCROP: none
GEOL.UNIT: Transvaal supergroup
DRAINAGE : well drained
HUMAN INF: clearing

REMARKS:
SAMPLES: A: 0 - 20

A 0 - 35 cm 7.5YR 3/4 (moist), loamy sand, weak coarse angular blocky structure, friable, common fine pores, many fine roots, clear broken boundary.
Ck 35 cm + weakly cemented, frequent very coarse angular limestone rock fragments,

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STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0149

SAMPLE DEPTH	PH	EC m	P	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	CECclay	METH	PRETR
	H2O	CaCl2	ms/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	%	%	%	%	%	%	%	%	meq/100gr			
A 0 20	6.3	5.4	0.0	1	0.4	0.00	7.3	2.8	1.5	0.4	0.0	0.0	64	0.0	3	7	14	40	17	4	2	12	47	H	0	

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EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION Profile: KS 0148 Unit: C03 Status: 2

SHEET : 2525A1
LOCATION : 1km South of Morweisana.
AUTHOR(S): T.D.Mafoko
CLASSIFICATION FAO: Petrocalcic Arenosol (1974) shallow petrocalcic phase
ST : Typic Ustochrept
LANDFORM : plain
TOPOGRAPHY: undulating
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortillis subs. heterocantha (dom.)
: Grasses/forbs-
PARENT MATERIAL: calcrete
MOIST. COND: slightly moist 0 - 15 cm
SURF.STONES: none
EROSION : nil

GRID : LC-194-220
COORD: 25-06-35-S 25-12-40-E
DATE : 31/01/85

LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: open shrub savanna

AGRO CLIM.ZONE: 1E3
ELEVATION : 1295 m
SMR: ustic
POSITION: upper slope
SLOPE : 0 - 4 % convex

GRASSCOVER:

GEOLOGICAL UNIT: Transvaal supergroup
DRAINAGE : well drained
HUMAN INF: nil

REMARKS:

SAMPLES: A: 0 - 15

A 0 - 15 cm 10YR 3/2.5 (moist), loamy sand, moderate medium angular blocky structure, firm, common fine pores, many roots, abrupt wavy boundary.

Cmk 15 cm + extremely hard, cemented,

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Last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0148

SAMPLE DEPTH	pH	EC	mS/cm	CaCL2	EC	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)	vcS	cS	mS	fs	vfS	cSi	fSi	Clay	meq/100gr	CEC	Clay	METH	PRETR
A	0	15	8.1	7.6	0.0	2	0.6	0.00	16.4	5.0	12.3	0.6	0.1	0.0	100	0.0	0	6	11	33	19	7	4	20	70			H	O	

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, . = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: L 0022 Unit: D01 Status: 3

SOIL PROFILE DESCRIPTION

SHEET : 2525B1
LOCATION : 3km East of Pitsane halt.
AUTHOR(S) : T.D.Mafoko K.Kgatlwane
CLASSIFICATION FAO: Dystric Regosol (1974) petric (skeletal) phase

ST : Lithic Ustorthent

LANDFORM : plain
TOPOGRAPHY: undulating
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: commercial grazing

SPECIES : Trees -
: Shrubs -
: Grasses/forbs-

PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 25 cm
SURF. STONES: very few
EROSION : nil

REMARKS:

SAMPLES: A: 0 - 15

A 0 - 25 cm 7.5YR 3/4 (moist) and 7.5YR 4/5 (dry), sandy loam, weak medium and coarse subangular blocky structure, hard, non calcareous, no roots, abrupt smooth boundary.

Cr 25 cm + dominant medium and coarse rock fragments, non calcareous, no roots,

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

GRID : LC-722-195
COORD: 25-08-30-S 25-43-55-E
DATE : 08/10/84
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: dense tree savanna
ROCK TYPE: shale
ROCK OUTCROP: none
AGRO CLIM.ZONE: 1E3
ELEVATION : 1189 m
SMR: ustic
POSITION: slope
SLOPE : 4 - % straight
GRASSCOVER: < 10 %
GEOLOGICAL UNIT: Transvaal supergroup
DRAINAGE : well drained
HUMAN INF: nil

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0022

SAMPLE DEPTH	pH	EC m	P ppm	C ppm	N weight %	CEC meq/100gr soil	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)	CECclay	METH	PRETR
A	0 15	4.7 4.3	0.0 3	0.5 0.00	9.5 0.7	0.2 0.4	0.3 0.0	0.0 17	0.0 0.0	0.0 0.0	0.0 0.0	0.0 17	0.0 0.0	5 9 10 24 21 9 5 17	45	H	0
Soil Survey of Botswana PAO/BOT/85/011																	
last changed : 28/09/89																	
Print date: 12/03/90																	

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profiles: L 0031 Unit: D01c Status:

SHEET : 2525B1
 LOCATION : Lobatse.
 AUTHOR(S) : T.D.Mafoko K.Kgalwane
 CLASSIFICATION FAO: Eutric Regosol (1974)
 ST : Typic Ustorthent
 LANDFORM : plain
 TOPOGRAPHY: almost flat
 SURF. CHAR: strong sealing, no cracks, nil evidence of salt,
 LAND USE: improved trad. dryland farming, crops: sorghum, maize
 SPECIES : Trees -
 : Shrubs - Acacia tortillis subs. heterocantha (dom.) Acacia tortillis subs. heterocantha Ziziphus mucronata
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 30 cm
 SURF. STONES: none
 EROSION :

GRID : LC-706-107
 COORD: 25-13-00-S 25-42-45-E
 DATE : 14/02/84
 LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: termite mounds
 VEGETATION: open shrub savanna

AGRO CLIM.ZONE: IE3
 ELEVATION : 1181 m
 SMR: ustic
 POSITION:
 SLOPE : 2 %
 GRASSCOVER:

CFOL.UNIT: Transvaal supergroup
 DRAINAGE : moderately well drained
 HUMAN INF: nil

REMARKS:

SAMPLES:

- A 0 - 6 cm 10YR 3.5/4 (moist) and 10YR 5/4 (dry), coarse sand, massive structure, hard, non calcareous, common fine and medium roots,
- B 6 - 30 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), coarse sand, massive structure, very hard, patchy thin clay cutans on pedfaces, slightly calcareous, gradual smooth boundary.
- Cn 30 - 30 cm

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last changed : 28/09/89

print date: 12/03/90

SOIL PROFILE DESCRIPTION ----- Profile: L 0011 Unit: D02 Status: 4 -----

SHEET : 2525B1
LOCATION : Otse.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Haplic Lixisol (1988) Ferric Luvisol (1974) petroferric phase
ST : Kanhaplic Haplustalf
LANDFORM : pediment
TOPOGRAPHY: gently undulating
SURF. CHAR: no cracks,
LAND USE: traditional grazing
SPECIES : Trees -
: Shrubs - Acacia mellifera (dom.) Acacia tortilis subs. heterocantha Euclea divinorum
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 55 cm
SURF. STONES: none
EROSION : slight gully erosion and strong rill erosion

REMARKS:

SAMPLES:

A 0 - 25 cm 10YR 4/4 (moist) and 10YR 5/4 (dry), sand, very weak medium subangular blocky structure, slightly hard, non calcareous, common fine and medium roots, gradual smooth boundary.
Bt 25 - 55 cm 10YR 4/6 (moist) and 10YR 5/6 (dry), sandy loam, weak medium subangular blocky structure, hard, broken thin clay cutans, non calcareous, common fine and medium roots, abrupt smooth boundary.
Cmo 55 cm + cemented,

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SHEET : 2525A2
 LOCATION : Mabadisa.
 AUTHOR(S) : T.D.Mafoko
 CLASSIFICATION FAO: Chromic Luvisol (1974) petroferric phase
 ST : Typic Haplustalf

GRID : LC-237-199
 COORD: 25-07-35-S 25-15-10-E
 DATE : 15/11/84

AGRO CLIM.ZONE: IE3
 ELEVATION : 1311 m
 SMR: ustic

LANDFORM : plain
 TOPOGRAPHY: flat
 SURF. CHAR: no cracks, nil evidence of salt,
 LAND USE: improved trad. dryland farming
 SPECIES : Trees -
 : Shrubs -
 : Grasses/forbs-

LAND ELEMENT : not applicable
 MICRO TOPOGRAPHY: even
 VEGETATION:
 POSITION: intermediate part
 SLOPE : - 1 %
 GRASSCOVER:

PARENT MATERIAL: in situ weathered
 MOIST. COND: slightly moist 0 - 100 cm
 SURF.STONES: none
 EROSION :

ROCK TYPE: shale
 ROCK OUTCROP: none
 GEOL.UNIT: Transvaal supergroup
 DRAINAGE : well drained
 HUMAN INF: clearing

REMARKS:
 SAMPLES:

- Ap 0 - 20 cm 5YR 3/4 (moist) and 5YR 4/6 (dry), sandy loam, weak medium subangular blocky structure, slightly hard, non calcareous, many fine roots, gradual smooth boundary.
- Bt 20 - 100 cm 5YR 3/4 (moist) and 5YR 4/6 (dry), sandy clay loam, very weak very coarse subangular blocky structure, hard, cemented, abrupt smooth boundary.
- R 100 cm + patchy thin clay cutans on pedfaces, cemented, common fine roots,

SOIL PROFILE DESCRIPTION Profile: L 0901 Unit: D07 Status: 1

SHEET : 2525B2 GRID : LC-760-325 AGRO CLIM.ZONE: 1E3
LOCATION : 2.1km North North East of Otse. COORD: 25-00-30-S 25-47-15-E ELEVATION : 1087 m
AUTHOR(S) : A.B.Price M.D.Mays A.Rommelzwaal DATE : 12/04/86
CLASSIFICATION FAO: Pale-Ferric Lixisol(1988) Ferric Luvisol (1974) SMR: ustic

LANDFORM : pediment LAND ELEMENT : not applicable POSITION: middle slope
TOPOGRAPHY: almost flat MICRO TOPOGRAPHY: termite mounds SLOPE : 2 % straight
SURF. CHAR: slight sealing, no cracks, nil evidence of salt, bleached sand on surface VEGETATION: open savanna
LAND USE: improved trad. dryland farming

SPECIES : Trees -
: Shrubs -
: Grasses/forbs-
PARENT MATERIAL: colluvium ROCK TYPE: feldspatic sandstone
MOIST. COND: dry 0 - 150 cm ROCK OUTCROP: none
SURF. STONES: few gravel
EROSION : moderate sheet erosion

REMARKS: USDA Pedon no.14. Excursion site FAO EASC meeting 1-4-87. Structure almost massive.

SAMPLES: A: 0 - 0 B: 0 - 0 C: 0 - 0 D: 0 - 0 E: 0 - 0

A 0 - 24 cm 7.5YR 4/3 (moist) and 7.5YR 5/3 (dry), sandy loam, weak coarse subangular blocky structure, slightly hard very friable, non sticky non plastic, few very fine pores, non calcareous, common very fine and fine and common medium roots, gradual smooth boundary.

Bt1 24 - 51 cm 7.5YR 4/3 (moist) and 7.5YR 5/3 (dry), many medium prominent brown mottles, sandy clay loam, very weak medium subangular blocky structure, slightly hard very friable, non sticky non plastic, patchy thin clay and sesquioxides cutans on pedfaces, few fine and medium pores, few medium spherical hard iron-manganese nodules, non calcareous, few very fine and fine roots, diffuse irregular boundary.

Bt2 51 - 80 cm 7.5YR 4/4 (moist) and 7.5YR 5/4 (dry), many medium prominent red mottles, sandy clay loam, very weak coarse subangular blocky structure, very hard friable, sticky slightly plastic, patchy thin clay and sesquioxides cutans on pedfaces, few fine and medium pores, few medium spherical hard iron-manganese nodules, non calcareous, few very fine and fine roots, diffuse irregular boundary.

Bt3 80 - 107 cm 7.5YR 4/4 (moist) and 7.5YR 5/4 (dry), many coarse prominent red mottles, sandy clay, very weak coarse subangular blocky structure, very hard friable, sticky plastic, patchy thin clay and sesquioxides cutans on pedfaces, few very fine and fine pores, few medium spherical hard iron-manganese nodules, non calcareous, few very fine and fine roots, diffuse irregular boundary.

Bt4 107 - 150 cm 7.5YR 5/4 (moist) and 7.5YR 6/4 (dry), many coarse prominent red mottles, sandy clay, very weak coarse subangular blocky structure, very hard firm, sticky plastic, patchy thin clay and sesquioxides cutans on pedfaces, few fine and medium pores, few medium spherical hard iron-manganese nodules, non calcareous, few very fine and fine roots,

Soil Survey of Botswana IAO/BOT/85/011 last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0901

SAMPLE DEPTH	pH	EC mS/cm	EC m	P	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)				CECclay	METH	PRETR							
H2O	CaCl2	ms/cm	ppm	weight %	ù	ù	ù	ù	ù	ù	ù	ù	%	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr					
A	0	0	6.2	4.9	0.0	B	3	0.4	0.00	2.0	0.8	0.3	0.2	0.0	0.0	65	0.0	1	15	32	22	11	4	5	10	4		N
B	0	0	6.0	4.8	0.0	B	2	0.3	0.00	3.7	1.2	1.0	0.3	0.0	0.0	68	0.0	1	19	30	14	7	3	6	20	13		N
C	0	0	6.0	4.7	0.0	B	2	0.3	0.00	4.7	1.6	1.4	0.2	0.0	0.0	68	0.0	2	16	26	13	7	4	5	28	13		N
D	0	0	6.1	4.9	0.0	B	1	0.2	0.00	6.9	2.2	2.1	0.2	0.0	0.0	65	0.0	1	10	18	12	7	4	5	42	15		N
E	0	0	6.3	5.2	0.0	B	1	0.2	0.00	8.1	2.8	2.7	0.3	0.0	0.0	72	0.0	4	11	15	9	7	4	6	45	16		N

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

S O I L P H Y S I C A L P R O P E R T I E S

PROFILE: L 0901 UNIT: D07

Location : 2.1km North North East of Otse
 drainage : well
 parent material : colluvium
 Classification : Ferric Luvisol

Horizons: A 0 - 24 SL Bt1 24 - 51 SCL Bt2 51 - 80 SCL Bt3 80 - 107 SC Bt4 107 - 150 SC

INFILTRATION

No.	Basic (cm/hr)	a	n
1	17.0	0.42	0.92
2	15.5	0.73	0.82
3	20.9	1.06	0.81
4	15.8	0.57	0.86
5	13.5	0.52	0.85

METHODS. Infiltration: double ring infiltrometer for cumulative time of 4 hrs 'a' and 'n' are constants in equation $F=at$ where
 F = cumulative infiltration (cm) and t = elapsed time (min)
 Bulk Density: oven dry, mean of 5 measurements - CL = clod; CO = core
 Moisture Retention: Tension \leq 1bar on core or clods; Tension $>$ 1bar on $<$ 2mm crushed samples
 Structural Stability Index: on sieved samples (1-2 mm fraction) of surface soil, relative collapse of larger pores on slow & fast wetting
 values : between 0 (completely unstable) and 1 (completely stable, for well structured soils (no single grains))

SURFACE STRUCTURE STABILITY INDEX: 0.40

	DEPTH (cm)	BULK DENSITY (g/cc)	WATER CONTENT (weight %)								
			0.03bar	0.05bar	0.1bar	0.3bar	1.0bar	3.0bar	5.0bar	15.0bar	
A	0 24	1.50	CO	12.80	10.40	8.62	7.97	6.5	5.3	5.2	4.2
B	24 80	1.64	CO	13.44	13.01	11.67	11.13	9.8	8.4	8.2	6.9
C	80 107	1.62	CO	16.85	14.96	14.53	12.82	12.5	10.2	10.2	8.7

REMARKS:infiltration runs 1 and 4 done after removing surface soil. A very friable surface crust.

Soil Survey of Botswana FAO/BOT/85/011

last change : 22/11/89

Print date: 19/03/90

SOIL PROFILE DESCRIPTION

Profile: L 0054 Unit: G01b Status: 3

SHEET : 2525B1
 LOCATION : 2km South of Kgomokasitwa.
 AUTHOR(S): T.D.Mafoko K.Kgatlwane
 CLASSIFICATION FAO: Dystric Regosol (1988) Dystric Regosol (1974) petroferric phase
 ST : Typic Ustorthent

LANDFORM : pediment
 TOPOGRAPHY: gently undulating
 SURF. CHAR: no sealing, no cracks, nil evidence of salt,
 LAND USE: commercial grazing
 SPECIES : Trees - Acacia mellifera (dom.) Peitophorum africanum Combretum apiculatum
 : Shrubs - Dichrostachys cinerea Acacia tortillis subs. heterocantha
 : Grasses/forbs-
 PARENT MATERIAL: in situ weathered
 MOIST. COND: dry 0 - 20 , slightly moist 20 - 50 cm
 SURF. STONES: few gravel
 EROSION : moderate sheet erosion and moderate rill erosion

REMARKS: Composition rock fragments predominantly quartz

SAMPLES: A: 0 - 10 B: 30 - 50

A 0 - 10 cm 10YR 4/4 and 10YR 6/4 (dry), sandy loam, moderate medium and coarse subangular blocky structure, slightly hard, non calcareous, many fine roots, clear smooth boundary.

C 10 - 50 cm 7.5YR 4/6 (moist), sandy loam, single grain structure, loose, very frequent fine rounded rock fragments, non calcareous, many fine roots, abrupt wavy boundary.

Chc 50 cm + common distinct reddish mottles, cemented, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0054

SAMPLE DEPTH	pH	EC	CaCl2	mS/cm	EC	N	C	P	m	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)				CEC	METH	PRETR				
					meq/100gr soil	meq/100gr soil									%	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr		
A	0	10	5.3	4.6	0.0	4	0.5	0.00	4.0	1.0	0.2	0.3	0.0	0.0	38	0.0	8	15	14	19	17	11	4	13	15	H	0
B	30	50	5.3	4.7	0.0	1	0.1	0.00	2.8	0.4	0.3	0.1	0.0	0.0	29	0.0	2	18	27	17	11	7	4	14	17	H	0

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: L 0082 Unit: G02d Status: 2

SOIL PROFILE DESCRIPTION

SHEET : 2525A4
LOCATION : 2km West of Gatlhwane.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Ferric Luvisol (1974) petroferric phase
ST : Kanhapic Haplustalf
LANDFORM : plain
TOPOGRAPHY : almost flat
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: commercial dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heterocantha (dom.)
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 70 cm
SURE.STONES: none
EROSION : strong rill erosion

REMARKS:

SAMPLES: A: 0 - 15 B: 40 - 60

A 0 - 15 cm 10YR 3/4 (moist) and 10YR 4/4 (dry), sandy loam, very weak fine and medium subangular blocky structure, slightly hard, common fine pores, non calcareous, many fine roots, clear smooth boundary.
Bt 15 - 70 cm 7.5YR 3/4 (moist) and 7.5YR 4/4 (dry), sandy clay loam, very weak coarse angular blocky structure, hard, patchy thin cutans, non calcareous, many fine roots, abrupt smooth boundary.
Cmo 70 cm + cemented, dominant rock fragments, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0082

SAMPLE DEPTH	pH	H2O	CaCl2	EC	m	P	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR			
																		ms/cm	ppm	weight %	%	meq/100gr soil	%				%	vcS	cS
A	0	15	5.9	5.1	0.0	2	0.5	0.00	6.2	6.8	2.2	0.6	0.0	0.0	0.0	100	0.0	0.0	3	4	4	8	9	4	16	53	8	H	O
B	40	60	5.6	4.9	0.0	1	0.5	0.00	9.6	2.6	1.5	0.5	0.0	0.0	0.0	48	0.0	0.0	3	3	3	8	9	6	13	56	14	H	O

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: L 0065 Unit: G04 Status: 1

SHEET : 2525B1
LOCATION : 7.5km SW of Magotlhwane.
AUTHOR(S): T.D.Mafoko
CLASSIFICATION FAO: Ferralic Arenosol (1988) Ferralic Arenosol (1974)

SF : Typic Ustipsamment

LANDFORM : plain
TOPOGRAPHY: gently undulating
SURF. CHAR: no sealing, no cracks,
LAND USE: improved trad. dryland farming
SPECIES: Trees - Terminalia sericea (dom.) Peltophorum africanum
: Shrubs -

: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 200 cm
SURF. STONES: none
EROSION : nil

REMARKS:

SAMPLES: A: 0 - 20 B: 40 - 60 C: 80 - 100 D: 150 - 160

GRID : LC-526-295
COORD: 25-02-45-S 25-32-25-E
DATE : 10/07/84

LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even

VEGETATION:

ROCK TYPE: granite
ROCK OUTCROP: none

AGRO CLIM. ZONE: 1E3
ELEVATION : 1128 m
SMR: ustic

POSITION: middle slope
SLOPE : - 2% convex

GRASSCOVER:

GEOLOG. UNIT: Gaborone granite
DRAINAGE : somewhat excessively drained
HUMAN INF: clearing

- A 0 - 20 cm 10YR 4/4 (moist) and 10YR 5.5/4 (dry), sand to loamy sand, very weak fine subangular blocky structure, soft, few fine pores, non calcareous, many fine roots, gradual smooth boundary.
- B 20 - 200 cm 7.5YR 4.5/6 (moist) and 10YR 5/6 (dry), loamy sand, very weak medium and coarse subangular blocky structure, slightly hard, few fine pores, non calcareous, few fine roots,

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0065

SAMPLE DEPTH	pH	H2O	CaCl2	EC	mS/cm	P	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)										CECclay	METH	PRETR
																		vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr				
A	0	20	5.6	4.8	0.0	2	0.0	0.00	3.0	0.0	0.3	0.3	0.0	0.0	0.0	20	0.0	0.0	5	16	26	30	11	3	2	8	36	H	0	
B	40	60	5.5	4.8	0.0	1	0.0	0.00	3.2	0.0	0.5	0.2	0.0	0.0	0.0	22	0.0	0.0	4	15	26	29	11	4	2	9	35	H	0	
C	80	100	5.6	4.6	0.0	1	0.0	0.00	3.1	0.0	0.6	0.2	0.0	0.0	0.0	26	0.0	0.0	4	15	27	30	11	4	2	9	36	H	0	
D	150	160	5.7	4.7	0.0	1	0.0	0.00	3.1	0.0	0.6	0.2	0.1	0.0	0.0	29	0.0	0.0	5	16	25	28	11	5	2	9	34	H	0	

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water
P : Available Phosphorus determination m : method ... O = Olsen B = Bray
C : Organic Carbon determination Walkley-Black method
N : Total Nitrogen determination Kjeldahl method
CEC and bases : Ammonium acetate method
EXAC : Exchangeable acidity extracted with KCl
CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: L 0048 Unit: G05 Status: 2

SOIL PROFILE DESCRIPTION

SHEET : 2525R1
LOCATION : 5km NE of Molapowabojang.
AUTHOR(S) : T.D.Mafoko K.Keatlwane
CLASSIFICATION FAO : Haplic Acrisol(1988) Ferric Acrisol (1974)
ST : Kanhaplic Haplustult

LANDFORM : plain
TOPOGRAPHY: undulating
SURF. CHAR: no sealing, no cracks,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heteroantha (dom.) Acacia caffra Euclea undulata
: Grasses/forbs -
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 20 , slightly moist 20 - 75 cm
SURF. STONES: none
EROSION : nil

REMARKS:

SAMPLES: A: 0 - 20 B: 40 - 60

A 0 - 20 cm 10YR 4/4 (moist) and 10YR 5/4 (dry), loamy sand, moderate medium subangular blocky structure, slightly hard, common fine roots, clear wavy boundary.
Bc 20 - 75 cm 10YR 5/6 (moist) and 10YR 6/6 (dry), sandy clay loam, massive structure, slightly hard, patchy thin clay cutans, very few fine quartz rock fragments, slightly calcareous, few fine roots, abrupt wavy boundary.
Cmo 75 cm + extremely hard, abrupt wavy boundary.

GRID : LC-519-166
COORD: 25-09-15-S 25-30-45-E
DATE : 03/05/84

SMR: ustic

LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
SLOPE : - 3 %

VEGETATION: dense shrub savanna
GRASSCOVER:

ROCK TYPE: granite
ROCK OUTCROP: none
GEOLOGICAL UNIT: Gaborone granite
DRAINAGE : moderately well drained
HUMAN INF: nil

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0048

SAMPLE DEPTH	pH	H2O CaCl2	EC mS/cm	EC m	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)				CECclay	METH	PRETR					
																weight %	u	meq/100gr soil	%				vcS	cS	mS	fS	vfs
A	0	20	5.6	4.9	0.0	1	0.5	0.00	4.0	0.5	0.0	0.4	0.3	0.0	0.0	0.0	9	18	15	23	15	8	4	8	24	H	O
B	40	60	5.8	5.0	0.0	1	0.3	0.00	3.8	0.4	0.8	0.3	0.0	0.0	0.0	0.0	14	20	16	18	9	7	4	13	21	H	O

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, ° = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: XS 0177 Unit: G06 Status:

SHEET : 2525A3
LOCATION : Just South of Thihe Pan.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Arenic Ferric Luvisol (1974)
ST : Typic Haplustalf

GRID : LB-216-913
COORD: 25-23-10-S 25-13-40-E
DATE : 08/05/85

ACRO CLIM.ZONE: 2D3
ELEVATION : 1234 m
SMR: ustic to aridic

LAND ELEMENT :
MICRO TOPOGRAPHY: low hummocks

VEGETATION: dense savanna

POSITION:
SLOPE : - %

VEGETATION: dense savanna
Acacia mellifera Boscia albitrunca

Acacia mellifera Boscia albitrunca

GRASSCOVER:

ROCK TYPE: granite
ROCK OUTCROP: none

GEOL.UNIT: Basement complex
DRAINAGE : well drained

HUMAN INF: nil

REMARKS:

SAMPLES: A: 0 - 0 B: 0 - 0 C: 0 - 0 D: 0 - 0

A 0 - 20 cm 10YR 4/6 (moist) and 10YR 5/6 (dry), sand, single grain structure, loose, non calcareous, common fine roots, gradual smooth boundary.
Bt1 20 - 45 cm 10YR 4/6 (moist) and 10YR 5/6 (dry), sand, very weak coarse angular blocky structure, slightly hard, non calcareous, few fine roots, clear smooth boundary.
Bt2 45 - 130 cm 7.5YR 4/6 (moist) and 7.5YR 5/6 (dry), loamy sand, massive structure, extremely hard, patchy thin clay cutans on pedfaces,

Soil Survey of Botswana FAO/BCT/85/011 last changed : 28/09/89 print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0177

SAMPLE DEPTH	pH	H2O CaCl2	EC m	P ppm	m C	N weight %	CBC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR				
															vcS	cS	fs	vfS	cSi	fSi				Clay	meq/100gr		
A	0	0	6.7	5.7	0.0	3	0.1	0.00	3.6	1.4	0.3	0.2	0.2	0.0	58	0.0	0	11	34	31	15	3	1	4	80	H	0
B	0	0	6.7	5.7	0.0	1	0.0	0.00	3.9	1.8	0.7	0.2	0.1	0.0	72	0.0	0	7	30	36	17	1	0	9	44	H	0
C	0	0	6.7	5.6	0.0	1	0.0	0.00	3.6	1.3	0.6	0.2	0.3	0.0	67	0.0	0	10	32	30	15	3	3	9	41	H	0
D	0	0	6.9	5.7	0.0	1	0.1	0.00	5.7	1.9	0.6	0.1	0.2	0.0	49	0.0	0	9	30	30	16	3	3	9	60	H	0

Soil Survey of Botswana FAO/BCT/85/011

Last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: L 0089 Unit: G06a Status: 2

SOIL PROFILE DESCRIPTION

SHEET : 2525B3
LOCATION : 3km South of Digawana.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO : Ferric Luvisol(1988) Ferric Luvisol (1974) petroferric phase
ST : Kanhaplic Haplustalf
LANDFORM : plain
TOPOGRAPHY : almost flat
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heterocantha (dom.)
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 90 cm
SURF.STONES: none
EROSION : nil

GRID : LB-548-928
COORD: 25-23-30-S 25-33-30-E
DATE : 15/08/84
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: open shrub savanna
ROCK TYPE: granite
ROCK OUTCROP: none

AGRO CLIM.ZONE: IE3
ELEVATION : 1295 m
SMR: ustic
POSITION: intermediate part
SLOPE : - 2 % straight
GRASSCOVER:
GEOLOG.UNIT: Basement complex
DRAINAGE : well drained
HUMAN INF: nil

SAMPLES: A: 0 - 15 B: 30 - 50 C: 70 - 90

A 0 - 15 cm 10YR 4/4 (moist) and 10YR 5/6 (dry), sandy clay loam, very weak coarse subangular blocky structure, hard, common fine pores, non calcareous, common fine roots, gradual smooth boundary.

Bc 15 - 90 cm 5YR 3/4 (moist) and 5YR 4/4 (dry), sandy clay loam to sandy clay, very weak coarse subangular blocky structure, hard, patchy thin clay cutans on pedfaces, common fine pores, frequent fine angular rock fragments, non calcareous, few fine roots, abrupt smooth boundary.

Cmo 90 cm + extremely hard, cemented,

REMARKS:
last changed : 28/09/89 print date: 12/03/90

Soil Survey of Botswana FAO/BOT/85/011

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0089

SAMPLE DEPTH	pH	EC m	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weightt %)	CECclay	METH	PRETR												
	H2O	CaCL2	mS/cm	ppm	weight %	µ	µ	µ	µ	µ	µ	%	%	vcS	cS	mS	fS	vFS	cSI	fSI	Clay	meq/100gr							
A	0	15	5.3	4.6	0.0	0.4	0.00	7.4	3.8	1.4	0.8	0.0	0.0	81	0.0	0.0	0.0	0.0	7	13	13	21	16	7	3	20	29	H	O
B	30	50	6.4	5.8	0.0	1	0.3	0.00	12.0	7.1	1.8	0.3	0.1	78	0.0	0.0	0.0	0.0	8	12	10	14	11	6	4	35	31	H	O
C	70	90	7.0	6.5	0.0	1	0.2	0.00	15.2	9.5	3.0	0.1	0.1	84	0.0	0.0	0.0	0.0	9	9	8	13	11	8	4	38	38	H	O

Soil Survey of Botswana FAO/BGT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION Profile: L 0095 Unit: G08 Status: 2

SHEET : 2525B3
LOCATION : 2km North of Gatlwane.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Chromic Luvisol (1974) petric (skeletal) phase
ST : Typic Haplustalf

LANDFORM : plain
TOPOGRAPHY: flat
SURF. CHAR: strong sealing, no cracks,
LAND USE:

SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heterocantha (dom.)
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 85 cm
SURF.STONES: none
EROSION : nil

REMARKS:

SAMPLES: A: 0 - 15 B: 40 - 60

A 0 - 15 cm 7.5YR 3/6 (moist) and 7.5YR 4/ 6 (dry), sandy loam, very weak coarse subangular blocky structure, hard, common fine pores, very frequent fine angular rock fragments, non calcareous, common fine roots, diffuse smooth boundary.
Bt 15 - 85 cm 5YR 3/4 (moist) and 5YR 4/4 (dry), sandy clay loam, very weak coarse subangular blocky structure, hard, patchy thin cutans, common fine pores, very frequent fine angular rock fragments, non calcareous, few fine roots, abrupt smooth boundary.
Cr 85 cm + extremely hard,

GRID : LB-503-927
COORD: 25-22-35-S 25-30-40-E
DATE : 16/08/84
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: open shrub savanna

AGRO CLIM.ZONE: IE3
ELEVATION : 1280 m
SMR: ustic
POSITION: lower part
SLOPE : 0 - 1 % straight
GRASSCOVER:

ROCK TYPE: gneiss
ROCK OUTCROP: none
GEOLOGICAL UNIT: Basement complex
DRAINAGE : well drained
HUMAN INF: nil

Soil Survey of Botswana FAO/BOT/85/011 last changed : 28/09/89 print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0095

SAMPLE DEPTH	pH	EC m	P m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)					CECclay	METH	PRETR							
		H2O CaCl2 mS/cm	ppm	weight %	µ	µ	µ	µ	µ	µ	µ	%	%	vcS	cS	mS	fS	vfS	cSi	fSi	Clay	meq/100gr						
A	0 15	5.8	5.1	0.0	3	0.4	0.00	6.5	3.6	1.2	0.2	0.1	0.0	0.0	78	0.0	0.0	7	16	15	23	13	5	3	18	28	H	0
B	40 60	6.4	5.7	0.0	1	0.3	0.00	11.0	5.4	1.9	0.3	0.0	0.0	69	0.0	0.0	5	15	12	17	10	5	4	32	31	H	0	

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water
P : Available Phosphorus determination m : method ... O = Olsen B = Bray
C : Organic Carbon determination Walkley-Black method
N : Total Nitrogen determination Kjeldahl method
CEC and bases : Ammonium acetate method
EXAC : Exchangeable acidity extracted with KCl
CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION

Profile: L 0096 Unit: G09 Status:

SHEET : 2525B3
LOCATION : 3km NNE of Gathwane.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Chromic Luvisol (1974)
ST : Typic Haplustalf
LANDFORM : plain
TOPOGRAPHY: flat
SURF. CHAR: moderate sealing, no cracks, nil evidence of salt,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortillis subs. heterocantha Acacia erioloba
: Grasses/forbs -
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 130 cm
SURF. STONES: none
EROSION : strong rill erosion

REMARKS:

SAMPLES: A: 0 - 15 B: 40 - 60 C: 80 - 100

A 0 - 15 cm 7.5YR 3/ 4 and 7.5YR 5/ 6 (dry), sandy loam, very weak medium subangular blocky structure, hard, common fine pores, non calcareous, common fine roots, gradual smooth boundary.

Bt 15 - 130 cm 5YR 3/4 (moist) and 5YR 5/6 (dry), sandy clay loam, weak very coarse angular blocky structure, hard, patchy thin cutans, common fine pores, very frequent fine rounded rock fragments, non calcareous, common fine roots, gradual smooth boundary.

C 130 cm +

Soil Survey of Botswana FAO/BOT/85/011

Last changed : 28/09/89 print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0096

SAMPLE DEPTH	pH	EC	mS/cm	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR							
											vcS	cS	mS	fS	vFS	cSI				fSI	Clay	meq/100gr				
A	0 15	6.2	5.5	0.0	1	0.5	0.00	6.7	3.1	0.9	0.8	0.0	0.0	72	0.0	7	18	17	22	13	5	3	16	29	H	O
B	40 60	6.0	5.3	0.0	1	0.4	0.00	10.3	4.9	1.7	0.2	0.0	0.0	66	0.0	6	13	12	18	12	5	1	32	27	H	O
C	80 100	6.5	5.8	0.0	0	0.3	0.00	11.6	6.6	2.0	0.0	0.1	0.0	75	0.0	5	11	12	19	12	6	3	33	32	H	O

Soil Survey of Botswana FAC/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: L 0085 Unit: G10b Status: 2

SOIL PROFILE DESCRIPTION

SHEET : 2525A4
LOCATION : 4km South of Gathwane.
AUTHOR(S) : T.D.Mafoko A.Remmelzwaal K.Kgatlwane
CLASSIFICATION : FAO: Ferric Luvisol (1974)
ST : Kanhaplic Haplustalf
LANDFORM : plain
TOPOGRAPHY : undulating
SURF. CHAR: no sealing, no cracks, nil evidence of salt,
LAND USE: improved trad. dryland farming
SPECIES : Trees -
: Shrubs - Acacia tortilis subs. heterocantha (dom.)
: Grasses/forbs -
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 130 cm
SURF. STONES: none
EROSION : nil
REMARKS:
SAMPLES: A: 0 - 15 B: 40 - 60 C: 80 - 100

GRID : LB-470-872
COORD: 25-25-35-S 25-25-50-E
DATE : 14/08/84
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION:
ROCK TYPE: granite
ROCK OUTCROP: none

AGRO CLIM.ZONE: 1E3
ELEVATION : 1280 m
SMR: ustic
POSITION: intermediate part
SLOPE : - 6 % convex
GRASSCOVER:
GEOLOG. UNIT: Gaborone granite
DRAINAGE : well drained
HUMAN INF: nil

A 0 - 15 cm loamy sand, very weak fine and medium subangular blocky structure, slightly hard, common fine pores, non calcareous, common fine roots, gradual smooth boundary.
Bt 15 - 130 cm 5YR 3/4 (moist) and 5YR 4/6 (dry), sandy loam to sandy clay loam, very weak coarse angular blocky structure, hard, patchy thin cutans, common fine pores, non calcareous, few fine roots, abrupt smooth boundary.
Cmo 130 cm + extremely hard, dominant iron-manganese nodules, non calcareous,

Soil Survey of Botswana FAO/BOT/85/011
Last changed : 28/09/89
print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: L 0085

SAMPLE DEPTH	pH	H2O	CaCl2	EC	m	P	m	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)							CECclay	METH	PRETR		
																		weight %	meq/100gr soil	%	%	vcS	cS	mS				fS	vfS
A	0	15	5.8	4.8	0.0	4	0.4	0.00	4.8	1.7	0.8	0.4	0.0	0.0	0.0	60	0.0	0.0	2	11	22	31	16	6	2	12	27	H	0
B	40	60	6.0	5.1	0.0	1	0.2	0.00	6.8	3.0	1.0	0.2	0.0	0.0	62	0.0	0.0	1	12	21	26	15	7	2	18	34	H	0	
C	80	100	5.9	5.0	0.0	1	0.2	0.00	7.8	3.4	1.5	0.1	0.1	0.0	65	0.0	0.0	4	11	11	29	24	7	2	11	64	H	0	

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART. SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known

PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SOIL PROFILE DESCRIPTION Profile: KS 0134 Unit: G13a Status: 2

SHEET : 2525A1 GRID : LC-148-211
LOCATION : 2km North East of Mogapiyana. COORD: 25-07-00-S 25-10-00-E
AUTHOR(S): T.D.Mafoko DATE : 30/01/85

CLASSIFICATION FAO: Petri-Ferric Lixisol(1988) Calcic Luvisol (1974) petrocalcic phase
ST : Petrocalcic Paleustalf

LANDFORM : plain LAND ELEMENT : not applicable
TOPOGRAPHY: flat MICRO TOPOGRAPHY: even

SURF. CHAR: no sealing, no cracks, nil evidence of salt, VEGETATION:

LAND USE: improved trad. dryland farming
SPECIES : Trees - Acacia mellifera (dom.) Acacia tortilis subs. heterocantha
: Shrubs - Grewia flava (dom.)
: Grasses/forbs-

PARENT MATERIAL: in situ weathered
MOIST. COND: moist 0 - 60 cm
SURF.STONES: none
EROSION : nil

REMARKS:
A 0 - 30 cm 10YR 3/3.5 (moist), loamy sand, very weak fine subangular blocky structure, friable, common fine pores, common fine roots, diffuse smooth boundary.
Bt 30 - 60 cm 10YR 3/4 (moist), sandy loam, very weak medium subangular blocky structure, friable, few fine pores, few fine irregular soft calcareous white soft segregations, few fine roots, abrupt wavy boundary.
Cmk 60 cm + extremely hard, cemented, extremely calcareous,

AGRO CLIM.ZONE: 1E3
ELEVATION : 1280 m
SMR: ustic
POSITION: intermediate part
SLOPE : - 1 %
GEOL.UNIT: Transvaal supergroup
DRAINAGE : well drained
HUMAN INF: nil

ROCK TYPE: acid igneous/metamorphic
ROCK OUTCROP: none

SAMPLES: A: 0 - 20 B: 40 - 60

Soil Survey of Botswana HAO/BOT/85/011

last changed : 28/09/89

print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0134

SAMPLE DEPTH	pH	EC	mS/cm	CaCL2	ms/cm	EC	N	C	P	m	K	Mg	Na	EXAC	PBS	CARBO	Particle size (weight %)					CECclay	MEIH	PRETR				
																	weight %	meq/100gr soil	%	%	vcS				cS	mS	fS	vFS
A	0	20	7.8	7.2	0.0	3	0.2	0.00	9.4	10.8	1.0	0.5	0.1	0.0	100	0.0	0.0	3	12	21	34	14	3	2	11	79	H	0
B	40	60	7.8	7.3	0.0	1	0.2	0.00	10.2	30.5	1.0	0.3	0.1	0.0	100	0.0	0.0	1	14	20	33	14	4	1	14	67	H	0

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

- EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water
- P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray
- C : Organic Carbon determination Walkley-Black method
- N : Total Nitrogen determination Kjeldahl method
- CEC and bases : Ammonium acetate method
- EXAC : Exchangeable acidity extracted with KCl
- CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

SHEET : 2424A3
 LOCATION : 14 km SSE of Dikobwane Pan.
 AUTHOR(S) : J.Huesken K.Kgatlwane A.Markus
 CLASSIFICATION FAO: Luvic Arenosol(1988) Luvic Arenosol (1974)
 ST : Alfic Ustipsamment
 LANDFORM : sand plain
 TOPOGRAPHY: flat
 SURF. CHAR: slight sealing, no cracks, nil evidence of salt, bleached sand on surface
 LAND USE: traditional grazing
 SPECIES : Trees - Acacia luederitzii var.luederitzii (dom.) Boscia albitrunca
 : Shrubs - Dichrostachys cinerea (dom.) Boscia albitrunca Acacia haematoxylon
 : Grasses/forbs- Aristida congesta Eragrostis lehmanniana
 PARENT MATERIAL: aeolian sand
 MOIST. COND: dry 0 - 70 , slightly moist 70 - 120 cm
 SURF.STONES: none
 EROSION : moderate wind erosion/deposition

REMARKS: 5 cm of loose sand on top, clay illuviation in bands. Also the grasses Eragrostis pallens and Stipagrostis uniplumus.
 SAMPLES: A: 0 - 15 B: 30 - 50 C: 60 - 80 D: 90 - 110

- A 0 - 15 cm 9YR 4/5 (moist) and 9YR 6/7 (dry), sand (3% clay), weak to moderate medium and coarse subangular blocky structure, slightly hard, non calcareous, common very fine and fine and few medium roots, clear wavy boundary.
- Bt1 15 - 80 cm 7.5YR 4/6 (moist) and 7.5YR 6/6 (dry), sand (4% clay), very weak fine to coarse angular and subangular blocky structure, very friable, common very fine and fine pores, non calcareous, common infilled burrows, common fine and few medium roots, gradual smooth boundary.
- Bt2 80 - 120 cm 7.5YR 5/6 (moist) and 7.5YR 6/7 (dry), sand (7% clay), very weak fine to coarse subangular and angular blocky structure, slightly hard, patchy thin clay cutans on pedfaces and patchy thin lamellae, common very fine and fine pores, non calcareous, few infilled burrows, few fine roots,

STANDARD SOIL ANALYSIS RESULTS

PROFILE: JW 0011

SAMPLE DEPTH	pH	H2O CaCl2	EC mS/cm	EC m	P ppm	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)						CECclay	METH	PRETR				
																vcS	cS	mS	fS	vFS	cSi				fSi	Clay	meq/100gr	
A	0	15	5.6	4.5	0.0	B	3	0.2	0.00	2.0	0.9	0.2	0.2	0.1	0.0	66	0.0	0	1	21	55	17	1	1	5	26	H	N
B	30	50	5.8	4.5	0.0	B	1	0.1	0.00	2.5	0.5	0.4	0.2	0.0	0.0	44	0.0	0	1	18	55	20	1	2	4	52	H	N
C	60	80	6.1	4.9	0.0	B	1	0.2	0.00	2.5	0.4	0.4	0.2	0.0	0.0	40	0.0	0	1	20	55	18	1	1	5	34	H	N
D	90	110	6.3	5.3	0.0	B	1	0.1	0.00	3.8	0.9	0.8	0.2	0.0	0.0	50	0.0	0	1	20	56	17	1	1	6	55	H	N

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 19/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... O = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Profile: KS 0179 Unit: S12 Status: 2

SOIL PROFILE DESCRIPTION

SHEET : 2525A3
LOCATION : 6km West of Ditojana.
AUTHOR(S) : T.D.Mafoko
CLASSIFICATION FAO: Arenic Calcic Luvisol (1974)
ST : Typic Paleustalf
LANDFORM : plain
TOPOGRAPHY: almost flat
SURF. CHAR: slight sealing, no cracks, nil evidence of salt,
LAND USE: traditional grazing
SPECIES : Trees -
: Shrubs - Tarchonanthus camphoratus (dom.) Grewia flava Boscia albitrunca
: Grasses/forbs-
PARENT MATERIAL: in situ weathered
MOIST. COND: dry 0 - 150 cm
SURF. STONES: none
EROSION : nil

GRID : LC-051-941
COORD: 25-00-40-S 25-08-00-E
DATE : 09/05/85
LAND ELEMENT : not applicable
MICRO TOPOGRAPHY: even
VEGETATION: dense shrub savanna
ROCK TYPE: gneiss
ROCK OUTCROP: none
HUMAN INF: nil

AGRO CLIM.ZONE: IE3
ELEVATION : 1219 m
SMR: ustic
POSITION: intermediate part
SLOPE : - 2 % straight
GRASSCOVER:

GEOL.UNIT: Basement complex
DRAINAGE : well drained
HUMAN INF: nil

SAMPLES: A: 0 - 20 B: 40 - 60 C: 80 - 100 D: 130 - 145
A 0 - 30 cm 10YR 3/3 (moist) and 10YR 4/3 (dry), sand, moderate medium subangular blocky structure, very hard, few fine irregular soft calcareous white soft segregations, non calcareous, clear smooth boundary.
Btk1 30 - 60 cm 10YR 3/4 (moist) and 10YR 4/4 (dry), sandy loam, massive structure, very hard, few fine irregular soft calcareous white soft segregations, slightly calcareous, diffuse smooth boundary.
Btk2 60 - 120 cm 10YR 3/4 (moist) and 10YR 4/4 (dry), sandy loam, massive structure, very hard, frequent fine irregular soft calcareous white soft segregations, moderately calcareous, abrupt boundary.
Btk3 120 - 150 cm clay loam, very hard, strongly calcareous, abrupt boundary.
Cmk 150 cm + cemented,

Soil Survey of Botswana FAO/BOT/85/011
last changed : 28/09/89
print date: 12/03/90

STANDARD SOIL ANALYSIS RESULTS

PROFILE: KS 0179

SAMPLE DEPTH	pH	EC m	P ppm	C	N	CEC	Ca	Mg	K	Na	EXAC	PBS	CARBO	Particle size (weight %)				CECclay	METH	PRETR							
	H2O	CaCL2	mS/cm	ppm	weight %	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	meq/100gr soil	%	%	vcS	cS	mS	fS	vfs	cSi	fSi	Clay	meq/100gr					
A	0	20	7.7	7.0	0.0	0	0.3	0.00	8.1	6.0	0.7	0.5	0.1	0.0	90	0.0	0	6	26	39	16	3	2	9	78	H	0
B	40	60	8.3	7.6	0.0	1	0.1	0.00	9.6	3.5	1.0	0.4	0.2	0.0	53	0.0	3	27	16	36	15	0	0	2	383	H	0
C	80	100	8.7	7.9	0.0	2	0.0	0.00	9.0	10.3	0.9	0.2	0.1	0.0	100	0.0	1	6	23	38	18	3	2	11	86	H	0
D	130	145	8.9	8.2	0.0	0	0.1	0.00	9.2	47.7	2.1	0.2	0.1	0.0	100	0.0	**	**	22	35	15	5	2	16	57	H	0

Soil Survey of Botswana FAO/BOT/85/011

last changed : 28/09/89

Print date: 12/03/90

EC : Electrical Conductivity m : method ... * = saturated paste not marked = 1:5 in water

P : Available Phosphorus determination m : method ... 0 = Olsen B = Bray

C : Organic Carbon determination Walkley-Black method

N : Total Nitrogen determination Kjeldahl method

CEC and bases : Ammonium acetate method

EXAC : Exchangeable acidity extracted with KCl

CARBO : Free Carbonates by destruction with HCl

PART-SIZE DETERMINATION METHOD: H = Hydrometer Method, P = Pipette Method, * = Not Known
 PRETREATMENT: O = Organic Matter, F = Free Iron Oxides, C = Carbonates, S = Soluble Salts N = None

Appendix 2

Land Suitability Classification

Author <i>T.D. MAFOKO</i>	Date <i>06/12/89</i>	Map Sheet Code <i>LOBATSE</i>
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Land Suitability Classes

Soil Unit			<i>A1</i>	<i>A7</i>	<i>A9</i>	<i>A9b</i>	<i>A11</i>	<i>A11a</i>	<i>A13</i>	<i>A13a</i>	<i>A14</i>	<i>A16</i>
Agro Climatic Zone			<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>2d3</i>	<i>2d3</i>	<i>1e3</i>	<i>1e3</i>
L	Temperature Regime	c	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Soil Drainability	d	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
N	Floods	f	<i>S2</i>	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
D	Germination	g	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S2</i>	<i>S1</i>
	Moisture Availability	m	<i>S1</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S3</i>	<i>N2</i>	<i>S4</i>	<i>N2</i>	<i>N2</i>	<i>S3</i>
Q	Nutrient Availability	n	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S2</i>
U	Oxygen Availability	o	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Water Availability	q	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
L	Foothold for Roots	r	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
I T I	Absence of Toxic Substances	salinity	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		sodicity	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		CaCO3	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
E	Accessibility	a	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
S	Soil Erosion	e	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>	<i>S4</i>	<i>S3</i>	<i>S3</i>	<i>S4</i>	<i>S2</i>
	Pests	p	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
	Work-ability	Trad.	<i>S2</i>	<i>S1</i>	<i>S3</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		Mechanized	w	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Adequacy of Topography	Molapo	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
		Cravity	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
		Sprinkler	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Adequacy of Flooding	y	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Land Drainability	z	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
OVERALL SUITABILITY			<i>S3o</i>	<i>S3o</i>	<i>S3/9e</i>	<i>S3ge</i>	<i>S3ge</i>	<i>N2</i>	<i>S4m</i>	<i>N2</i>	<i>N2</i>	<i>S3m</i>

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			Land Suitability Classes									
Soil Unit			<i>D1a</i>	<i>D1b</i>	<i>D1c</i>	<i>D2</i>	<i>D5</i>	<i>D5a</i>	<i>D7</i>	<i>D7a</i>	<i>G1a</i>	<i>G1b</i>
Agro Climatic Zone			<i>1e3</i>	<i>2d3</i>	<i>1e3</i>	<i>1e3</i>	<i>2d3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>
			-									
L	Temperature Regime	c	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Soil Drainability	d	-	-	-	-	-	-	-	-	-	-
N	Floods	f	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
D	Germination	g	<i>S2</i>	<i>S1</i>	<i>S3</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S3</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>
	Moisture Availability	m	<i>N2</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S4</i>	<i>S3</i>	<i>S2</i>	<i>N2</i>	<i>N2</i>
Q	Nutrient Availability	n	<i>S2</i>	<i>NA</i>	<i>NA</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>
U	Oxygen Availability	o	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S3</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Water Availability	q	-	-	-	-	-	-	-	-	-	-
L	Foothold for Roots	r	<i>S3</i>	<i>S2</i>	<i>S2</i>	<i>S3</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S2</i>
I	Absence of Toxic Substances	salinity	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		sodicity	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
I		CaCO3	<i>N2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
E	Accessibility	a	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
S	Soil Erosion	e	<i>S2</i>	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S1</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>S2</i>
	Pests	p	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
Work-ability	Trad.		<i>N2</i>	<i>S2</i>	<i>S3</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>N2</i>	<i>S1</i>
	Mechanized	w	-	-	-	-	-	-	-	-	-	-
Adequacy of Topography	Molapo	x	-	-	-	-	-	-	-	-	-	-
	Cravity	x	-	-	-	-	-	-	-	-	-	-
	Sprinkler	x	-	-	-	-	-	-	-	-	-	-
Adequacy of Flooding		y	-	-	-	-	-	-	-	-	-	-
Land Drainability		z	-	-	-	-	-	-	-	-	-	-
OVERALL SUITABILITY			<i>N2</i>	<i>S3m</i>	<i>S3gm</i>	<i>S3mo</i>	<i>S2mn</i>	<i>S4m</i>	<i>S3mg</i>	<i>S3e</i>	<i>N2</i>	<i>N2</i>

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			Land Suitability Classes									
Soil Unit			<i>G1c</i>	<i>G2a</i>	<i>G2c</i>	<i>G2d</i>	<i>G4</i>	<i>G5</i>	<i>G6</i>	<i>G6a</i>	<i>G8</i>	<i>G9</i>
Agro Climatic Zone			<i>2d3</i>	<i>2d3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>1e3</i>
L	Temperature Regime	c	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Soil Drainability	d	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
N	Floods	f	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
D	Germination	g	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S3</i>	<i>S2</i>
	Moisture Availability	m	<i>N2</i>	<i>S3</i>	<i>S4</i>	<i>S3</i>	<i>S4</i>	<i>N2</i>	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S4</i>
Q	Nutrient Availability	n	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
U	Oxygen Availability	o	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Water Availability	q	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
L	Foothold for Roots	r	<i>S3</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
I T I	Absence of Toxic Substances	salinity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		sodicity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		CaCO3	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
E	Accessability	a	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
S	Soil Erosion	e	<i>S2</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>-</i>
	Pests	p	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
	Work-ability	Trad.		<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>
		Mechanized	w	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Adequacy of Topography	Molapo	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
		Cravity	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
		Sprinkler	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Adequacy of Flooding	y	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	
	Land Drainability	z	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	
OVERALL SUITABILITY			<i>N2</i>	<i>S3m</i>	<i>S4m</i>	<i>S3m</i>	<i>S4m</i>	<i>S4m</i>	<i>S2mn</i>	<i>S3m</i>	<i>S3m</i>	<i>S4m</i>

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		Land Suitability Classes									
Soil Unit		<i>G10b</i>	<i>G13</i>	<i>G13a</i>	<i>K53</i>	<i>K55</i>	<i>K55a</i>	<i>K512</i>			
Agro Climatic Zone		<i>1e3</i>	<i>1e3</i>	<i>1e3</i>	<i>2d3</i>	<i>3b3</i>	<i>3b3</i>	<i>3b3</i>			
L	Temperature Regime	c	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
A	Soil Drainability	d	-	-	-	-	-	-	-		
N	Floods	f	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
D	Germination	g	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
	Moisture Availability	m	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>N2</i>	<i>N2</i>	<i>N2</i>	<i>S4</i>		
Q	Nutrient Availability	n	<i>S2</i>	<i>S2</i>	<i>S1</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>		
U	Oxygen Availability	o	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
A	Water Availability	q	-	-	-	-	-	-	-		
L	Foothold for Roots	r	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
I	Absence of Toxic Substances	salinity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
T		sodicity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
I		CaCO3	t	<i>S1</i>	<i>S1</i>	<i>N2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	
E	Accessibility	a	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S1</i>		
S	Soil Erosion	e	<i>S2</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>	<i>S3</i>		
	Pests	p	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>		
	Work-ability	Trad.		<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>		
		Mechanized	w	-	-	-	-	-	-	-	
	Adequacy of Topography	Molapo	x	-	-	-	-	-	-		
		Cravity	x	-	-	-	-	-	-		
		Sprinkler	x	-	-	-	-	-	-	-	
	Adequacy of Flooding	y	-	-	-	-	-	-	-		
	Land Drainability	z	-	-	-	-	-	-	-		
OVERALL SUITABILITY			<i>S2me</i>	<i>S2mn</i>	<i>N2</i>	<i>N2</i>	<i>N2</i>	<i>N2</i>	<i>S4m</i>		

Author <i>T.D. MAFOKO</i>	Date <i>06/12/89</i>	Map Sheet Code <i>LOBATSE</i>
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		Land Suitability Classes									
Soil Unit		<i>A19</i>	<i>A21</i>	<i>A21a</i>	<i>B3</i>	<i>C1</i>	<i>C2</i>	<i>C3</i>	<i>C3b</i>	<i>C5</i>	<i>D1</i>
Agro Climatic Zone		<i>2d3</i>	<i>2d3</i>	<i>2d3</i>	<i>2d3</i>	<i>1e3</i>	<i>2d3</i>	<i>1e3</i>	<i>2d3</i>	<i>2d3</i>	<i>1e3</i>
L	Temperature Regime	c	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Soil Drainability	d	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
N	Floods	f	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>
D	Germination	g	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
	Moisture Availability	m	<i>N2</i>	<i>NA</i>	<i>S4</i>	<i>S4</i>	<i>S4</i>	<i>S4</i>	<i>S1</i>	<i>S3</i>	<i>S2</i>
Q	Nutrient Availability	n	<i>S2</i>	<i>NA</i>	<i>S2</i>	<i>NA</i>	<i>S3</i>	<i>S3</i>	<i>S2</i>	<i>NA</i>	<i>S1</i>
U	Oxygen Availability	o	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
A	Water Availability	q	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
L	Foothold for Roots	r	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>N2</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S3</i>
I T I	Absence of Toxic Substances	salinity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		sodicity	t	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
		CaCO3	t	<i>S1</i>	<i>N2</i>	<i>S4</i>	<i>S1</i>	<i>N2</i>	<i>S4</i>	<i>S4</i>	<i>S4</i>
E	Accessibility	a	<i>S1</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>	<i>S1</i>
S	Soil Erosion	e	<i>S2</i>	<i>S1</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>	<i>S2</i>
	Pests	p	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
Work-ability	Trad.		<i>S1</i>	<i>N2</i>	<i>S1</i>	<i>S1</i>	<i>N2</i>	<i>S4</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>
	Mechanized	w	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
Adequacy of Topography	Molapo	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Cravity	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Sprinkler	x	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Adequacy of Flooding	y	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Land Drainability	z	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>
OVERALL SUITABILITY			<i>N2</i>	<i>N2</i>	<i>S4m</i>	<i>S4m</i>	<i>N2</i>	<i>S4mt</i>	<i>S4t</i>	<i>S4t</i>	<i>S4t</i>

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