AG : BOT/85/011
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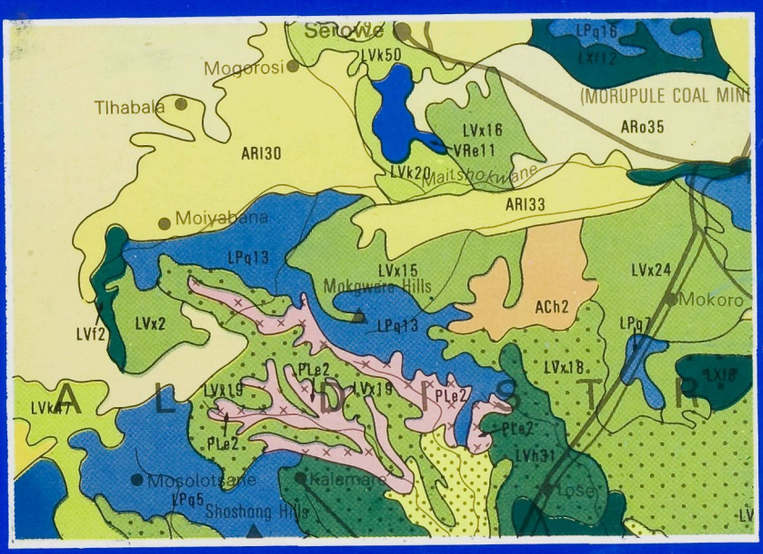
SOIL MAPPING AND ADVISORY SERVICES
BOTSWANA

EXPLANATORY NOTE ON THE SOIL MAP OF THE REPUBLIC OF BOTSWANA



FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

REPUBLIC OF BOTSWANA

UNITED NATIONS DEVELOPMENT PROGRAMME

GABORONE, DECEMBER 1990

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EXPLANATORY NOTE ON THE SOIL MAP OF THE REPUBLIC OF BOTSWANA

by

P. V. DE WIT

and

F.O. NACHTERGAELE

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by

A.O. MACHERINGAYE

and

P. A. DE WIT

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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.

De Wit, P.V., Nachtergaele, F.O., 1990. Explanatory note on the National Soil Map of Botswana at scale 1:1 000 000. FAO/UNDP/ Government of Botswana. Soil Mapping and Advisory Services AG : BOT/85/011, Field Document 30. 48 pp.*

* Typifying Pedons and Soil Analytical Data are available as a separate Annex of 167 pp.

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Those who have particularly helped the realization of the soil map are listed below:

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1 INTRODUCTION

Within the overall Government development objective that the Soil Mapping and Advisory Services Project (BOT/85/011) should help improve the basis for medium and long term planning of agriculture and rural development, the production of a National Soil Map of Botswana takes particular importance. Indeed national planning units require soil resources information on a national scale in a sufficiently condensed form to fit in the larger concepts of land evaluation and land use planning.

The production of a national soil map at 1:1000 000 scale is also part of an effort of all SADCC countries to facilitate transfer of technology within the area, and fits in the larger concept to produce a 1:1 million scale soils map of the whole continent. In addition to this soil map it proved necessary to produce a separate map, with physiographic units that contains additional information on landforms, topography, vegetation and soils. The combination of both maps provides an ideal basis for the inventory of physical resources in Botswana and their eventual inclusion in a Geographical Information System.

Last but not least the soil and land systems maps serve an educational purpose as their scale and summarized information is well adapted for a quick overview of the land resources in Botswana.

2 THE SOILS OF BOTSWANA

2.1 Previous Investigations

The first soil map of Botswana, at that time the Bechuanaland Protectorate, was prepared by Van Straten and De Beer (1959), using an early version of the Inter-African Pedological Service Classification, at a scale of 1:6 000 000. Seven main groups were distinguished, with a subdivision based on geology and some soil characteristics: Lithosols, Desert Soils, Sub-Desert soils, Young soils on fairly recent material, Calcimorphic non-alluvial Soils, Ferruginous Tropical Soils and Halomorphic Soils.

Bawden and Stobbs (1963) carried out a land resources survey of Eastern Bechuanaland which included soil information based on the concepts of Van Straten and De Beer. These investigations and maps served as a basis for the country's coverage in the Soil Map of the World at 1:5 000 000 scale (FAO/UNESCO,1974).

A detailed soil classification system was developed during the surveys of Mitchell (1964-1967) in Eastern Botswana, where it was applied to selected areas along the main rivers (Mitchell, 1976). Mitchell distinguished three soil orders, subdivided in five soil groups: Weakly developed soils (Regosols and Lithosols), Calcimorphic soils (Vertisols and Siallitic soils), and Kaolinitic soils (Fersiallitic soils). These groups were further subdivided into families and series.

Siderius (1970) introduced a soil identification system identical to the Binominal System for South Africa (Mac Vicar et al, 1977). This system recognizes two levels of classification: soil forms and soil series, and showed similarities to the USDA Soil Taxonomy (Soil Survey Staff, 1975). In his later work (1972, 1973) Siderius used the Seventh Approximation (USDA, 1960) and also correlated the soils with the FAO/UNESCO legend of the Soil Map of the World (FAO/UNESCO, 1974). Most of Siderius' soil investigations were carried out in the Mahalapye-Shoshong area.

Eldridge (1978) proposed a classification system designed specifically as an aid to land use planning. His five soil groups were: alluvial soils, very shallow soils, cracking clays, red brown and gray soils, desert and subdesert soils. The subgroups were defined using as differentiae texture, drainage, calcareousness and topography. Series within subgroups were defined according to parent material while a variety of criteria were used at phase level: erosion risk, stoniness, depth, alkalinity, salinity and surface crusting.

The Ministry of Agriculture began a systematic survey, mapping and classification of the country's soils in 1977, concentrating first on the Limpopo catchment (Venema, 1980) and the lower Boteti area (Breyer, 1983, 1986) at detailed scale, and the Okavango delta at reconnaissance scale (Staring, 1978). The FAO/UNESCO legend of the soil map of the world was adapted by the Ministry as a general basis for soil classification in Botswana. The Soil Taxonomy (Soil Survey Staff, 1975, 1987) was used as a reference classification, while, since very recently, soils were also correlated with the Revised Legend of the Soil Map of the world (FAO/UNESCO/ISRIC, 1988).

Between 1981 and 1990 the FAO/UNDP soil mapping projects (BOT/80/003 and BOT/85/011), in cooperation with the Soil Survey Unit in the Ministry of Agriculture has covered about 60 percent of the country at reconnaissance scale (1:250 000) and reports on soil surveys in specific areas have been published or are in preparation: South East Central District (Remmelzwaal, 1988) North Eastern Botswana (Radcliffe, Venema and De Wit, 1990), Chobe District (Remmelzwaal and Van Waveren, 1989), Gaborone (Moganane, 1989), Lobatse (Mafoko, 1990), Jwaneng (Huesken, 1989), Southeast Ngamiland (Verbeek, 1989), Northwest Ngamiland (Jamagne, 1990), Linyanti (Bekker, 1990), Letiahau (Tersteeg, 1990), Nxai Pan (Verbeek, 1990), Ghanzi (Kopelo, 1990), Tsau (Mafoko, 1990), Northern Central District (Moganane, 1990).

In addition several detailed soil surveys were carried out in recent years in support of specific agronomic development plans: Chobe enclave (Baert, 1989; University of Utrecht, 1989), Boro Shorobe (Rhebergen, 1988), Pandamatenga (Van Waveren and Moganane, 1989), South East District (Huesken et al, 1989), Maunatlala (De Wit and Moganane, 1990), Mmadinare-Bobonong area (De Wit and Cavaliere-Parzaneze, 1990).
Map 1 shows the sources of soil information and the degree of their reliability in Botswana. A separation is made between the areas compiled from semi-detailed and detailed surveys , soil reconnaissance , and exploratory surveys. About 5 percent of Botswana is now covered by large and medium scale surveys, a further 60 percent is covered by reconnaissance soil maps. The thinly populated and/or semi-inaccessible areas in the southwest of the country were covered by less intensive surveys. However, satellite imagery and aerial photograph interpretation have complemented the several field surveys to these regions, and the information gathered corresponds with the level of detail of the final map.

2.2 Soil classification system

2.2.1 Introduction

As one of the major objectives of the National Soil Map is to facilitate the transfer of technology within the SADCC region, common terms for all countries should be used, and it has been agreed that the FAO/UNESCO/ISRIC (1988) soil classification should be followed (Samki, 1988). However, the introduction of some new soil units and diagnostic horizons in the FAO 1988 classification system makes the correlation sometimes difficult, whilst research and experience in Botswana has shown that gaps and inaccuracies remain in this soil classification system (Remmelzwaal, 1988).

In order to avoid misunderstanding, all exceptions to the Revised Legend of the Soil Map of the World as applied in the National Soil Map of Botswana are discussed below.

2.2.2 Diagnostic Horizons and Properties

Mollic Horizon : an A Horizon which has a very hard consistency and coarse blocky structure is excluded from the mollic horizon, considering the general concept as given in Soil Taxonomy (Soil Survey Staff, 1975).

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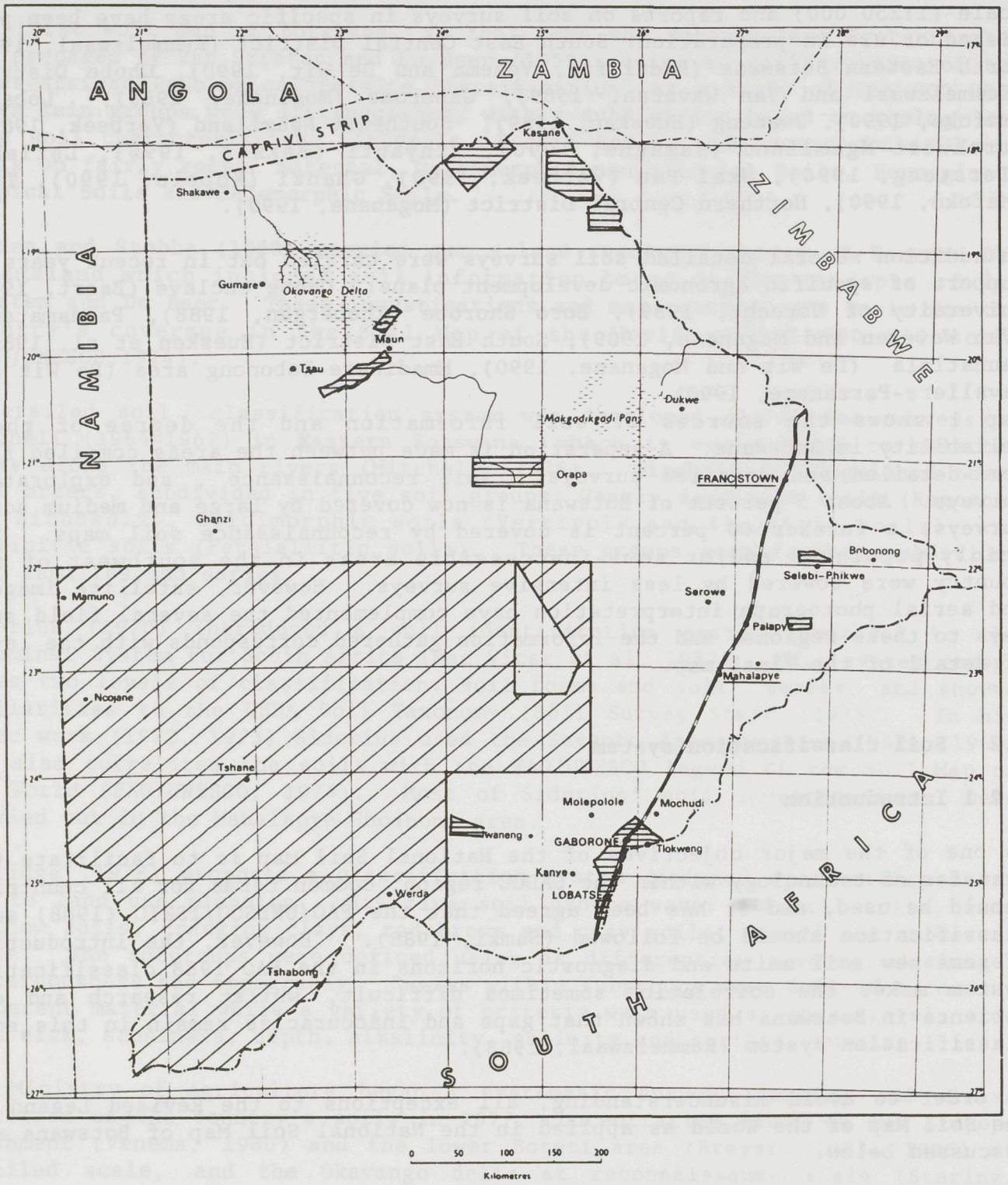

Semi - Detailed and Detailed Soil Maps (1:100000)

Reconnaissance Soil Maps (1:250 000)

Exploratory Soil Maps (1:1 000 000)

Map 1: Status of Soil Mapping in Botswana

Cambic horizon : the Soil Taxonomy definition is used.

Soft powdery lime : significant is quantified as follows: at least few (5 to 15 percent) by volume, or covering at least 50 percent of the ped faces.

Albic horizon : the complete Soil Taxonomy definition is used.

Ferralic properties : the cation exchange capacity used in the calculation of the CEC/100g clay is corrected for organic matter content (400meq/100g organic carbon). Note that for Arenosols in Botswana ferralic properties alone are not sufficient to qualify for Ferralic Arenosols.

Hydromorphic properties : The Soil Taxonomy definition is used. Differentiation between "Stagnic" and "Gleyic", although relevant in some areas of Botswana, is not made (all soils with hydromorphic properties are considered Gleysols or gleyic subgroups).

Vertic properties : the Soil Taxonomy definition as used for subgroups: "having cracks at some period in most years, that are 1cm or more wide at 50cm; that are at least 30cm long in some part and that extended upwards to the surface or to the basis of an Ap (A) horizon, "if not irrigated" is considered.

Colouring : to distinguish between grayish, relative recent, beach sand and other, more weathered, coarse materials, Remmelzwaal (1988a) suggested that coloured B horizons should have a hue of 10YR with chroma of 5 or more, or have hues redder than 10YR .

2.2.3 Soil Units

Taking into account the remarks made in section 2.2.2 some additional clarifications are required for the definition of the soil units. It has been agreed upon to use the FAO/UNESCO/ISRIC Revised Legend as it stands, including the amendments to the system made in annex 1. Basic differences with the General Soil Legend of Botswana (Remmelzwaal 1988a), or with the proposals of P. De Wit and F. Nachtergaele (1989) are discussed in this section.

Leptosols

This soil unit permits a calcic and petrocalcic horizon, provided they contain more than 40% $CaCO_3$ equivalent (Purnell, personal communication, 1989; Remmelzwaal, 1988a). This is indicated at the third level respectively: Calci-Eutric Leptosols (LPeka) and Petrocalci-Eutric Leptosols (LPepe).
Calcic Leptosols and Calcaric Leptosols (De Wit, Nachtergaele, 1989) are not retained.

Vertisols

The Pellic and Chromic Vertisols, as defined in the FAO/UNESCO classification of 1974, are not retained at the second level. Although soil scientists of the SADCC countries are not convinced by the arguments put forward in support of

the changes in the Revised Legend (Samki, personal communication, 1989), the latter is used for correlation purposes. Note that most Vertisols in Botswana were Pellic Vertisols and are now renamed Pelli-Eutric Vertisols, or sometimes Pelli-Calcic Vertisols. The few Chromic Vertisols occurring in Botswana become Eutric Vertisols.

Fluvisols

The key of the Revised Legend is followed. This implies that Calcaric Fluvisols key out before Salic Fluvisols. This coincides with the General Soil Legend of Botswana, where the salinity of Calcaric Fluvisols is expressed as a phase. It should be mentioned that with the introduction of fluvic properties in the Revised Legend, most white sand deposits in Northern Botswana, previously classified as Arenic Eutric Fluvisols, become Gleyic Arenosols. No clear stratification can be observed and the organic carbon content does not decrease irregularly with depth and is very low.

Arenosols

The key used in the Revised Legend deviates in several respects from the one used in the General Soil Legend of Botswana. An extensive discussion on the reasons for these changes is made in Nachtergaele (1989) and Remmelzwaal (1988a,b).
Three major issues are highlighted here :

a/ In the General Soil Legend of Botswana, the Arenosol soil unit definition is made in such a way that it corresponds closely with the "Psamment" definition in Soil Taxonomy (no high content of coarse fragments are permitted, soils can be less deep than 100cm in case of a lithic contact but should always be deeper than 30cm). The depth criteria is stricter for the National Soil Legend, and the definition as it stands in the Revised Legend is maintained. This implies that sandy soils with a depth of less than 100cm are not considered as Arenosols, but become Regosols. The sandy texture is indicated at the third level (example: Areni-Eutric Regosol, RGear)

b/ The colouring requirement for Ferralic Arenosols is introduced to distinguish them from recent beach sand that are greyish rather than reddish brown. Without this criteria nearly all Haplic Arenosols in Botswana would become Ferralic Arenosols as the CEC of these soils is nearly always less than 4meq/100g. This change is introduced recently in the amendments of the Revised FAO/UNESCO/ISRIC Legend.

c/ Calcium carbonate redistributions are considered definite pedogenetic processes and as such calcic and petrocalcic horizons can not occur in Arenosols. Consequently Calcic Arenosols and Petrocalcic Arenosols defined in the General Soil Legend of Botswana become respectively Haplic Calcisols and Petric Calcisols in the National Soil Map.
The sandy texture is indicated at the third level. The new unit, Arenic Calcisols, introduced by De Wit and Nachtergaele (1989) is not considered here.

Nitisols

The definition of Nitosols in the General Soil Legend of Botswana is based on clay distribution, and not on nitic properties. It has been observed that most soils previously classified as Nitosols do not meet the requirements of nitic properties. As such the Eutric Nitosols are classified as Luvisols.

Conclusions

An attempt has been made in Botswana to use the FAO/UNESCO/ISRIC Revised Legend as it is presented in World Soil Resources Report 60, taking into account the amendments in Annex 1. Discrepancies with proposals of Remmelzwaal (1989a,b), Nachtergaele (1989) and De Wit, Nachtergaele (1989), especially for Leptosols, Arenosols, Calcisols and Vertisols, are ironed out using the third level subdivisions.
An overview of the soil units that occur in the Legend of the National Soil Map of Botswana (Appendix 2) is given in Table 1.

Table 1

SOIL UNITS IN BOTSWANA

FL FLUVISOLS	AR ARENOSOLS	SN SOLONETZ
Fle Eutric Fluvisols	ARh Haplic Arenosols	SNh Haplic Solonetz
FLc Calcaric Fluvisols	ARl Luvic Arenosols	
	ARa Albic Arenosols	CH CHERNOZEMS
GL GLEYSOLS	ARo Ferralic Arenosols	CHk Calcic Chernozems
GLe Eutric Gleysols	ARg Gleyic Arenosols	CHl Luvic Chernozems
GLm Mollic Gleysols	ARc Calcaric Arenosols	
GLk Calcic Gleysols		PH PHAEOZEMS
GLd Dystric Gleysols	CM CAMBISOLS	
	CMc Calcaric Cambisols	PHg Gleyic Phaeozems
RG REGOSOLS	CMe Eutric Cambisols	PHl Luvic Phaeozems
RGe Eutric Regosols	CMv Vertic Cambisols	
RGc Calcaric Regosols	CMo Ferralic Cambisols	LV LUVISOLS
RGd Dystric Regosols	CMx Chromic Cambisols	LVh Haplic Luvisols
		LVf Ferric Luvisols
LP LEPTOSOLS	CL CALCISOLS	LVx Chromic Luvisols
LPk Rendzic Leptosols	CLl Luvic Calcisols	LVg Gleyic Luvisols
LPe Eutric Leptosols	CLp Petric Calcisols	LVa Albic Luvisols
LPq Lithic Leptosols	CLh Haplic Calcisols	LVk Calcic Luvisols
VR VERTISOLS	SC SOLONCHAKS	LX LIXISOLS
VRe Eutric Vertisols	SCk Calcic Solonchaks	LXh Haplic Lixisols
VRk Calcic Vertisols	SCg Gleyic Solonchaks	LXf Ferric Lixisols
	SCh Haplic Solonchaks	
AC ACRISOLS		
ACh Haplic Acrisols	PL PLANOSOLS	
	PLe Eutric Planosols	

2.2.4 Third Level Subdivisions

The third level soil classification was introduced to indicate intergrades between major soil groups at the first and second level, or to further characterize or specify the second level groups. Definitions of soil subunits connotatives as used in Botswana were given by Remmelzwaal (1988a), with rules for priority. The symbols and definition retained in the Legend of the National Soil Map are as follows:

Symbol	Third Level abbreviation	Definition
ar	areni-	Having a texture of loamy fine sand or coarse in the upper 50cm of the soil.
ag	argi-	Arenosol only : having a B horizon that meets clay increase and other requirements of an argillic horizon.
hy	hypercalci-	Having a calcic horizon with 40% or more $CaCO_3$- equivalent.
ka	calci-	Having a calcic horizon or soft powdery lime within 125cm of the surface.
la	lamelli-	Having clay illuviation lamellae within 125cm of the surface.
lu	luvi-	Having an argic B horizon.
pe	petrocalci-	Having a petrocalcic horizon within 125cm of the surface.
pl	pelli-	Vertisols only: having a moist value of 3.5 or less and a chroma of 1.5 or less in the upper 30cm of the soil matrix.
rh	rhodi-	Having an argic horizon with a hue redder than 5YR in all parts and a colour value moist of less than 3.5 and a color value dry no more than one unit higher than the value moist
ve	verti-	Having vertic properties within 50cm of the surface.

2.2.5 Soil Phases

Seven phases are presented on the National Soil Map of Botswana. The phase of the dominant unit is given in full in the Legend (Appendix 2) and presented by an overprint on the map.
Phases of associated or included soils are presented in the Legend by a two letter symbol that follows the second (or third) level symbol: salic (sa), sodic (so), duripan (du), petric (pt), petroferric (pf), skeletic (sk), lithic (li).

Duripan phase

A duripan is a subsurface horizon that is cemented by silica so that dry fragments do not slake during prolonged soaking in water or in hydrochloric acid. Duripans occur in Botswana in a variety of form and thickness, and at various depths. Often they are found associated with calcrete, silica replacing calcium carbonate.
The duripan phase marks soils in which the upper level of a duripan occurs within 100cm of the surface.

Lithic phase

The lithic phase is used when continuous hard rock occurs within 50cm of the surface.

Petric phase

The petric phase marks soils which show a layer consisting of 40 percent or more, by volume, of oxidic concretions, hardened plinthite nodules, ironstone or other coarse fragments like weathred and fragmented rock, with a thickness of at least 25cm, the upper part of which occurs within 100cm of the surface.

Skeletic phase

Coincides with the definition of a petric phase, but the upper part occurs within 50cm of the suface.

Petroferric phase

The petroferric phase refers to the occurence of a continuous layer of indurated material, in which iron is an important cement and in which organic matter is absent, or present only in traces. The indurated layer must either be continuous or, when it is fractured, the average lateral distance between fractures must be 10cm or more.
The petroferric phase marks soils in which the upper part of the indurated layer occurs within 100cm of the surface.

Salic phase

The salic phase marks soils which, in some horizon within 100cm of the surface, show electric conductivity values of the saturation extract higher than 4 dS m^{-1} at 25 ^{o}C. The salic phase is not shown for Solonchaks because their

definition implies a high salt content.

Sodic phase

The sodic phase marks soils which have more than 6 percent saturation with exchangeable sodium at least in some horizon within 100cm of the surface. The sodic phase is not shown for Solonetz since a high percentage of sodium saturation is already implied in their definition.

Remarks

Three phases are foreseen in the Revised Legend that do occur in Botswana, but that have not been retained, not in the legend nor on the map:

a/ The Inundic phase: occurs in and around the Okavango delta, however no precise data are available to permit its mapping.

b/ The Phreatic phase: does certainly occur in Botswana but groundwater studies are incomplete as no systematic survey of the whole country has been undertaken.

c/ The Yermic phase: is probably of large extent in the Kalahari area, however no special attention has been paid to it during previous more detailed surveys, and it has not been retained on the National Soil Map. Arid conditions are thought to be better presented by climatic rather than by soil parameters, a principle put forward by the Revised Legend itself.

2.3 General Soil Descriptions and correlations with other Classifications

Appendix 1 gives the symbol and soil classification up to phase level of all occurring units and their correlation with the General Soil Legend in use for reconnaissance surveys of Botswana and also with the Soil Taxonomy (Soil Survey Staff, 1987).

In addition a brief description is given of additional characteristics not evident from the soil classification: depth, drainage, colour and texture.

The meaning of the terms used are briefly discussed below:

- **Soil depth**. The range is indicated using soil depth classes:

  0 - 25cm : very shallow
  25 - 50cm : shallow
  50 - 100cm: moderately deep
  100- 150cm: deep
  > 150cm: very deep.

The lower limit indicated is the depth to which roots of grasses and annual crops can penetrate. The depth is normally limited by the occurence of slightly weathered or unweathered hard rock or cemented layers.

- **Drainage**. The classes follow the standard FAO/SSM classification. Normally the range is one or two classes, occasionally three.

- **Colour**. The colours are described according to the Munsell Soil Color Charts (Munsell, 1975). The range is indicated from one value/chroma to limit diagonally over one or more hues to the other value/chroma limit. The colours refer to the colours of the B horizon (or C horizon if there is no B horizon) in the moist state.

- **Texture**. The texture generally refers to the texture at a depth of 100 cm (or immediately above a lithic or paralithic contact or cemented horizon) and occasionally to a depth of 125-150 cm if this influences the soil classification, as for some sandy soils. Normally the textural range is restricted to two or three classes.

The textural triangle used is presented in Figure 1, and the revised subdivision of sand classes as defined by Remmelzwaal and Van Waveren (1988) follows:

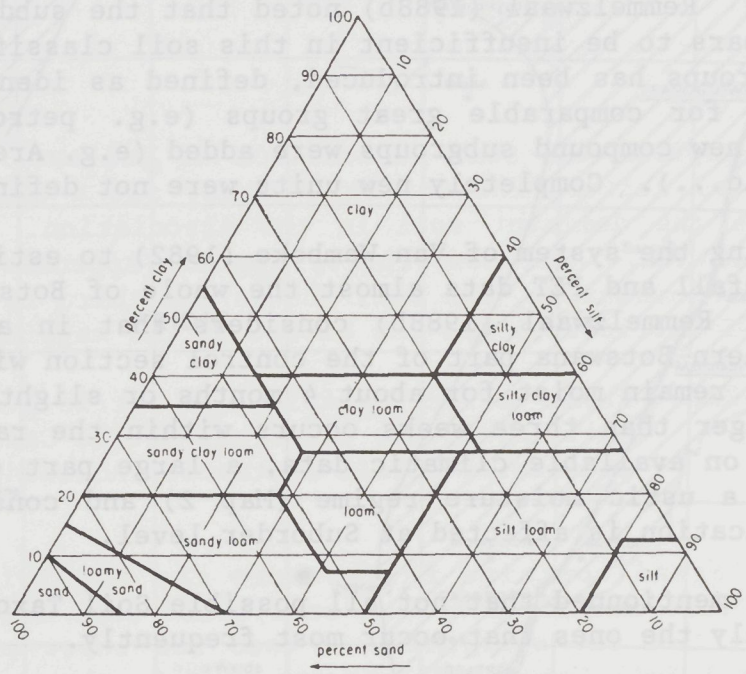

Figure 1 : Textural Triangle

Sands, loamy sands and sandy loams are subdivided according to the proportions of very coarse/coarse, medium, fine and very fine sand in the sand fraction. The proportions are calculated from the particle size distribution, taking the total of the sand fraction as 100%.

Reading as a key, the definitions are as follows:

Very fine sand	-	50% or more very fine sand.
Fine sand	-	50% or more very fine sand, and less than 25% coarse sand.
Fine-medium sand	-	35% or more very fine and fine sand, and less than 15% of coarse/very coarse sand.
Coarse sand	-	25% or more very coarse and coarse sand, and less than 50% medium sand.
Sand	-	other

Soil Taxonomy : Remmelzwaal (1988b) noted that the subdivision of certain great groups appears to be insufficient in this soil classification, therefore a number of subgroups has been introduced, defined as idential subgroups already identified for comparable great groups (e.g. petrocalcic, ustalfic, arenic ...) Some new compound subgroups were added (e.g. Arenic Kandic Rhodic, Arenic Petrocalcic...). Completely new units were not defined.

Note that following the system of Van Wambeke (1982) to estimate soil moisture regimes from rainfall and PET data almost the whole of Botswana would be considered aridic. Remmelzwaal (1988b) considers that in an average year in eastern and northern Botswana part of the control section will be moistened in November and will remain moist for about 4 months or slightly longer unless a dry spell of longer than three weeks occurs within the rainy season. This means that based on available climatic data, a large part of Botswna is considered to have a ustic moisture regime (Map 2) and consequently the Soil Taxonomy classification is affected at Suborder level.

It should also be mentionned that not all possible Soil Taxonomy subgroups are indicated, but only the ones that occur most frequently.

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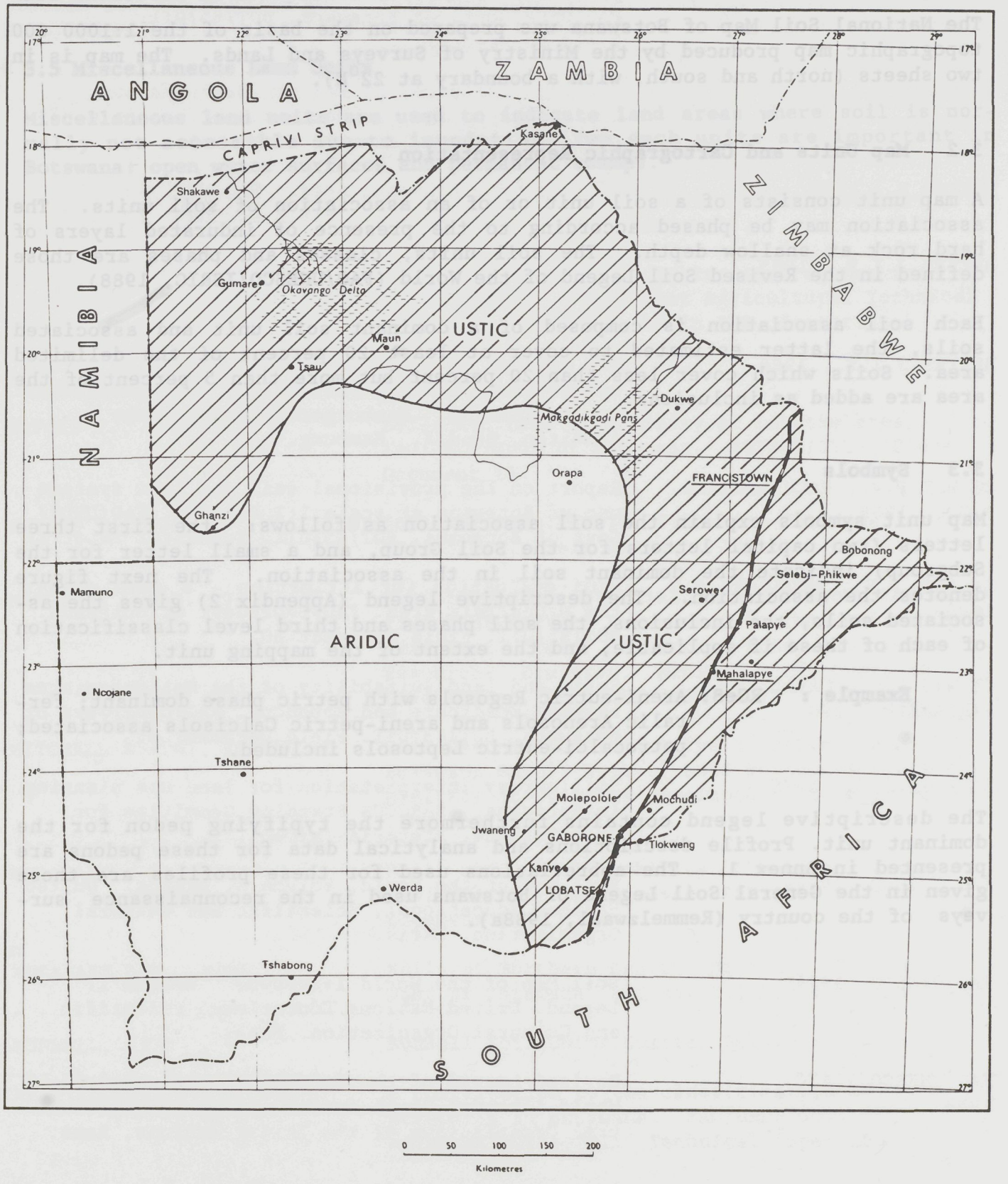

Map 2: Soil Moisture regimes in Botswana

3 THE SOIL MAP

3.1 Topographic Base

The National Soil Map of Botswana was prepared on the basis of the 1:1000 000 topographic map produced by the Ministry of Surveys and Lands. The map is in two sheets (north and south, with a boundary at 22^{o}N).

3.2 Map Units and Cartographic Representation

A map unit consists of a soil unit or of an association of soil units. The association may be phased according to the presence of indurated layers of hard rock at shallow depth. The soil units, classes and phases are those defined in the Revised Soil Legend of the World (FAO/UNESCO/ISRIC, 1988).

Each soil association is composed of a dominant soil unit and associated soils, the latter estimated to cover at least 20 percent of the delimited area. Soils which cover less than 20 percent but more than 5 percent of the area are added as inclusions.

3.3 Symbols

Map unit symbols explain the soil association as follows: the first three letters (two capital letters for the Soil Group, and a small letter for the Subgroup) indicate the dominant soil in the association. The next figure denotes the association. The descriptive legend (Appendix 2) gives the associated soils, the inclusions, the soil phases and third level classification of each of these if applicable, and the extent of the mapping unit.

Example : **RGe8:** Areni-eutric Regosols with petric phase dominant; ferralic Arenosols and areni-petric Calcisols associated; petrocalci-eutric Leptosols included.

The descriptive legend contains furthermore the typifying pedon for the dominant unit. Profile descriptions and analytical data for these pedons are presented in Annex 1. The abbreviations used for these profiles are those given in the General Soil Legend of Botswana used in the reconnaissance surveys of the country (Remmelzwaal, 1988a).

3.4 Phases

Seven phases are indicated on the National Soil Map of Botswana. These phases are indicated as overprints if they occur in the dominant unit.

3.5 Miscellaneous Land Units

Miscellaneous land units are used to indicate land areas where soil is normally not accessible due to inundation. Two such units are important in Botswana: open water surfaces and permanent swamps.

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APPENDIX A

General Soil Descriptions and Correlations with other Soil Classification Systems

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
ACh	Haplic Acrisols	Ferric Acrisols	Kanhaplic Haplustalfs Kandic Paleustults /Paleustalfs Kandic Rhodustults Kanhaplic Haplustults/ Paleustults	D7c, G5	Moderately deep to very deep, moderately well to well drained, dark yellowish brown to red, coarse sandy loams to sandy clays.
ARh	Haplic Arenosols	Eutric Arenosols Dystric Arenosols	Ustic Quartzipsamments Typic Ustipsamments Ustic/Typic Torripsamment	A40, A40b L16 (L) (K)S17(d)	Deep to very deep, moderately well somewhat excessively drained, dark gray to white,sands to loamy sands.
ARg	Gleyic Arenosols	Arenic Eutric Fluvisol	Typic Psammaquents	A24a	Very deep, very poorly drained, white to dark grayish brown, sands to loamy sands.
ARa	Albic Arenosols	Albic Arenosols	Typic Quartzipsamments	G3	Moderately deep to deep, moderately well drained, brown to light gray, massive, coarse sands to loamy coarse sands.
ARc	Calcaric Arenosols	Calcaric Arenosols	Ustic Quartzipsamments Ustic/Typic Torripsamments	L10	Deep to very deep, moderately well to well drained, dark gray to pale brown fine sands to loamy sands.
ARl	Luvic Arenosols	Ferralic/Luvic Arenosols	Ustic Quartzipsamments Typic Ustipsamments Ustic/Typic Torripsamments	(K)S5	Deep to very deep, well to somewhat excessively drained, yellowish brown to red,fine and fine-medium sands to loamy fine sands.
ARlag	Argi-Luvic Arenosols	Arenic Ferric Luvisols Arenic Ferric Acrisols	Psammentic kandic Paleustalfs Psammentic kandic Paleustults	S7, S9	Deep to very deep, well to somewhat excessively drained, strong brown to red, loamy sands to loamy fine and fine-medium sands.
ARlla	Lamelli-Luvic Arenosols	Luvic Arenosols	Alfic Torripsamments Alfic Quartzipsamments	A41, L40, (K)S5a (K)5b, (K)S6a	Deep to very deep, moderately well to excessively drained, grayish brown to red, fine sands to loamy sands, lamellae of clay illuviation.
ARo	Ferralic Arenosols	Ferralic Arenosols	Ustic Quartzipsamments Typic Ustipsamments Ustic/Typic Torripsamments	A19, (K)S3, KS3a (K)S6, S4, G4 L44	Deep to very deep, well to excessively drained, yellowish brown to dark red, coarse sands to loamy fine sands.
ARorh	Rhodi-Ferralic Arenosols	Ferralic Arenosols	Ustic Quartzipsamments Typic Ustipsamments Ustic/Typic Torripsamments	(K)S3a	Deep to very deep, well to somewhat excessively drained, red, fine and fine-medium sands.

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
CHk	Calcic Chernozems	Calcic Chernozems	Typic Calciaquolls Typic Calciustolls	L36	Deep to very deep, poorly to imperfectly drained, very dark gray to grayish brown, sandy clay loams to clays.
CHlhy	Hypercalci-Luvic Chernozems	Gleyic Luvic Chernozems	Typic/Petrocalcic Argiaquolls Typic/Petrocalcic Argiustolls	(L)C8	Shallow to moderately deep, poorly to imperfectly drained, very dark gray to gray, sandy clays to clays.
CHlkaso	Calcic-Luvic Chernozems sodic phase	Luvic Chernozems sodic and petric phase	Typic Argiustolls	L35b	Moderately deep to deep, imperfectly to moderately well drained, grayish brown to pale brown, sandy loams to clays.
CLh	Haplic Calcisols	Calcic Cambisols Calcic Xerosols	Typic/Ustollic Calciorthids Typic Ustochrepts	A4a, A4b, L14	Moderately deep to very deep, imperfectly to well drained, gray to brown, sandy loams to clays.
CLhar	Areni-Haplic Calcisols	Calcic Arenosols	Grossarenic Calciorthids Grossarenic Ustochrepts	A21, L11, L11a S13	Moderately deep to very deep, moderately well to well drained, dark gray to yellowish red, sands to loamy sands.
CLhhy	Hypercalci-Haplic Calcisols	Calcic Cambisols Calcic Xerosols	Typic Ustochrepts Ustollic Calciorthids	C4, C4a	Shallow to moderately deep, imperfectly to well drained, very dark gray to reddish brown, sandy loams to clay loams.
CLlhy	Hypercalci-Luvic Calcisols	Calcic Luvisols Calcic Luvic Xerosols	Typic Haplustalfs Ustollic/Ustalfic Haplargids Petrocalcic Paleustalfs	C5, C5c	Shallow to moderately deep, imperfectly to well drained, dark grayish brown to yellowish red, sandy loams to clay loams.
CLp	Petric Calcisols	Calcic Xerosols petrocalcic phase	Ustollic Paleorthids	L15a	Moderately deep, moderately well to well drained, grayish brown to pale brown, fine sandy loams to silt loams
CLpar	Areni-Petric Calcisols	Petrocalcic Arenosols	(Gross) Arenic (Ustollic) Paleorthids (Gross) Arenic Petrocalcic Ustochrepts	A21a, L12, L12a L12b (K)S13a	Moderately deep to very deep, moderately well to somewhat excessively drained, very dark grayish brown to very pale brown, sands to loamy sands.
CLplu	Luvi-Petric Calcisols	Calcic Luvisols petrocalcic phase	Petrocalcic Paleustalfs	A9b, L24b G13a	Moderately deep to deep, imperfectly to well drained, very dark grayish brown to dark reddish brown, coarse sandy loams to sandy clays.

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
CLhpt	Haplic Calcisols petric phase	Calcic Xerosols petric phase	Typic Calciorthids Typic Camborthids	B6d	Shallow to moderately deep, well drained, dark brown to reddish brown, clay loams to clays.
CMc	Calcaric Cambisols	Calcaric Cambisols	Typic Ustochrepts	A4	Moderately deep to very deep, imperfectly to moderately well drained, dark grayish brown to brown, sandy loams to sandy clays.
CMopt	Ferralic Cambisols petric phase	Ferralic Cambisols petric phase	Typic Ustochrepts	G2b	Moderately deep to deep, moderately well to well drained, brown to yellowish red, coarse sandy loams.
CMv	Vertic Cambisols	Vertic Cambisols	Vertic Ustochrepts	A3	Deep to very deep, imperfectly drained dark grayish brown, sandy clay loams to clays.
CMxpt	Chromic Cambisols petric phase	Chromic Cambisols petric phase	Typic Ustochrepts	B5b	Shallow to moderately deep, well drained, reddish brown to strong brown, sandy clay loams to sandy clays
CMe	Eutric Cambisols	Eutric Cambisols	Typic Ustochrepts Typic Camborthids	A33	Very deep, well drained, dark brown to brown, sandy loams.
FLc	Calcaric Fluvisols	Calcaric Fluvisols	Typic Fluvaquents Typic Haplaquents	L8	Very deep, very poorly to poorly drained, olive gray to light yellowish brown, stratified complexes of coarse sands to silty to clays.
FLcsa	Calcaric Fluvisols salic phase	Calcaric Fluvisols highly saline	Typic Salorthids	L8a	Very deep, very poorly to poorly drained, olive gray to light yellowish brown, stratified complexes of coarse sands to silty to clays.
FLe	Eutric Fluvisols	Eutric Fluvisols	Mollic/Aeric Fluvaquents Mollic/Aeric Haplaquents	A24d	Very deep, poorly to imperfectly drained, black to dark grayish brown, silty loams to silty clays, often overlying sands to loamy sands.
FLear	Areni-Eutric Fluvisols	Arenic-Eutric Fluvisols	Arenic Mollic/Aeric Fluvaquents Typic/ Mollic Psammaquents	A24b,A24e	Very deep, very poorly to imperfectly drained, black to dark grayish brown, sands to loamy sands.
GLe	Eutric Gleysols	Eutric Gleysols	Typic/Aeric/Mollic Haplaquepts	A31a, A31b	Deep to very deep, poorly to imperfectly drained, dark grayish brown to black, sandy loams to clays.

Symbol	FAO Legend 1988	Soil Legend Botswana	Soil Taxonomy	Typifying pedons	General Soil Description
GLeso	Eutric Gleysols sodic phase	Eutric Gleysols sodic phase	Typic /Aeric/Mollic Haplaquepts	A31	Deep to very deep, poorly to imperfectly drained, very dark gray, sandy clays to clays.
GLd	Dystric Gleysols	Dystric Gleysols	Humic Haplaquepts	L38	Very deep, poorly to imperfectly drained, black to very dark gray, loams to clays.
GLk	Calcic Gleysols	Calcic Gleysols partly sodic	Mollic/Typic Haplaquepts Typic Halaquepts	A30, L6, L6a L6b	Deep to very deep, poorly to imperfectly drained, very dark gray to gray, loams to clays.
GLkve	Verti-Calcic Gleysols	Vertic-Calcic Gleysols	Vertic Haplaquepts	L26	Moderately deep to deep, poorly to imperfectly drained, very dark gray to dark gray, clays.
GLmka	Calci-Mollic Gleysols	Calcic-Mollic Gleysols	Aeric/Typic Calciaquolls Fluvaquentic Humaquepts	L37b	Very deep, poorly to imperfectly drained, black to very dark gray, loams to clays.
GLm	Verti-Mollic Gleysols	Vertic-Mollic Gleysols	Typic Haplaquolls	(L)A42	Deep to very deep, poorly to imperfectly drained, black to gray, loams to clays.
LPepe	Petrocalci-Eutric Leptosols	Calcaric Regosols shallow petricalcic Petrocalcic Arenosol shallow petrocalcic	Petrocalcic Ustochrepts Ustochreptic/Typic Paleorthids	C2, C3	Very shallow to shallow, imperfectly to well drained, very dark gray to reddish brown, sands to clay loams.
LPedu	Eutric Leptosols duripan phase	Eutric Arenosol shallow duripan	Ustic Durochrepts	L16d	Very shallow to shallow, well to somewhat excessively drained, dark gray to pale brown, fine sands to loamy fine sands.
LPq	Lithic Lepotosols	Non-soils (Rocks)	Lithic Ustorthents	R	Very shallow soils.
LPqhy	Hypercalci-Lithic Leptosols	Lithosols	Petrocalcic Ustochrepts	C1	Very shallow (<10cm), moderately well to well drained, dark grayish brown to brown, loamy sands to clay loams.
LPkpe	Petrocalci-Rendzic Leptosols	Rendzina shallow petrocalcic	Petrocalcic Calciustolls	C1a	Very shallow, imperfectly to well drained, dark gray to dark brown, loamy sands to clay loams.
LVf	Ferric Luvisols	Ferric Luvisols	Typic/Ultic Haplustalfs	D5	Moderately deep to deep, moderately well to well drained, reddish brown to strong brown, sandy loams to sandy clay loams.

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
LVfpt	Ferric Luvisols petric phase	Ferric Luvisols petric phase	Typic/Ultic Haplustalfs	D6	Moderately deep, moderately well to well drained, reddish brown to yellowish red, sandy loams to sandy clay loams.
LVfar	Areni-Ferric Luvisols	Arenic-Ferric Luvisols	Arenic Haplustalfs Arenic Paleustalfs	A12, L32, (K)S10	Moderately deep to very deep, moderately well to slightly excessively drained, brown to red, loamy sands to sandy clay loams.
LVg	Gleyic Luvisols	Gleyic Luvisols	Aeric/Typic/Mollic Ochraqualfs	A7, L23	Deep to very deep, poorly to imperfectly drained, dark gray to grayish brown, sandy clay loams to clays.
LVgka	Calci-Gleyic Luvisols	Calcic-Gleyic Luvisols	Aeric/Typic/Mollic Ochraqualfs	A7b, L28	Deep to very deep, poorly to imperfectly drained, dark gray to grayish brown, sandy loams to clays.
LVa	Albic Luvisols	Albic Luvisols	Arenic/Typic Haplustalfs	L43	Deep to very deep, imperfectly to moderately well drained, gray to light brownish gray, fine sands abruptly overlying massive loamy sands to sandy loams.
LVaar	Areni-Albic Luvisols	Albic Luvisols	Arenic Haplustalfs	A44	Deep to very deep, imperfectly to moderately well drained, dark grayish brown to pale brown, massive loamy sands to sandy loams.
LVaka	Calci-Albic Luvisols	Calcic-Albic Luvisols	Arenic Haplustalfs	L43a	Deep to very deep, imperfectly to moderately well drained, gray to light brownish gray, fine sands, abruptly overlying massive loamy sands to sandy loams, having a calcic horizon or soft powdery lime.
LVgve	Verti-Gleyic Luvisols	Vertic-Gleyic Luvisols	Vertic Ochraqualfs	L29	Moderately deep, imperfectly drained, dark gray to grayish brown, sandy clays to clays.
LVh	Haplic Luvisols	Orthic Luvisols Luvic Xerosols	Typic/Ultic Haplustalf Typic/Ustalfic Haplargids	A14, A14a, A36 D7a, G10a, L22	Moderately deep to very deep, imperfectly to well drained, very dark gray to yellowish red, sandy loams to clays.
LVhar	Areni-Haplic Luvisols	Arenic-Orthic Luvisols Arenic Luvic Xerosols	Arenic Haplustalfs Arenic Haplargids	A15a, L22a, L22c	Moderately deep to very deep, imperfectly to moderately well drained, very dark gray to brown, loamy sands

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	to sandy clay loams. General Soil Description
LVhpt	Haplic Luvisols petric phase	Orthic Luvisols petric phase Luvic Xerosols petric phase	Typic/Ultic Haplustalfs Typic/Ustalfic Haplargids	G2e, G7	Moderately deep to deep, imperfectly to well drained, dark grayish brown to red, coarse sandy loams to sandy clay loams.
LVhdu	Haplic Luvisols duripan phase	Orthic Luvisols duripan phase	Typic Durustalfs	L22e	Very shallow to moderately deep, imperfectly to moderately well drained, dark grayish brown to brown, loamy sands to sandy clay loams.
LVk	Calcic Luvisols	Calcic Luvisols Calcic-Luvic Xerosols	Typic Haplustalfs Ustalfic Haplargids Typic/Calciorthidic Paleustalfs	A9, A10, A37, B4, B6, D9 L24	Moderately deep to very deep, imperfectly to well drained, dark grayish brown to red, sandy clay loams to clays.
LVkar	Areni-Calcic Luvisols	Arenic-Calcic Luvisols Arenic Calcic Luvic Xerosols	Arenic Haplustalfs Arenic Ustollic Haplustalfs	A9a, L24c, L24d (K)S12a	Moderately deep to very deep, imperfectly to somewhat excessively drained, dark grayish brown to yellowish red,sandy loams to sandy clay loams.
LVkso	Calcic Luvisols sodic phase	Calcic Luvisols sodic phase	Typic Haplustalfs	A9c	Deep to very deep, imperfectly drained, dark grayish brown, sandy clay loams to clays.
LVkpt	Calcic Luvisols petric phase	Calcic Luvisols petric phase Calcic Luvic Xerosols petric phase	Typic/Lithic Haplustalfs Typic/Lithic Haplargids	B6a, B6c	Shallow to moderately deep, well drained, dark brown to reddish brown, clay loams to clays.
LVkpe	Petrocalci-Calcic Luvisols	Calcic Luvisols petrocalcic phase Calcic Luvic Xerosols petrocalcic phase	Petrocalcic Paleustalfs Petrocalcic (Ustollic) Paleargids	A9b, G13a L24e	Moderately deep to deep, imperfectly to well drained, very dark grayish brown to dark reddish brown, coarse sandy loams to clays.
LVx	Chromic Luvisols	Chromic Luvisols Eutric Nitosols Luvic Xerosols	Typic/Ultic Haplustalfs Typic Rhodustalfs Typic/Rhodic/Ultic Paleustalfs Ustalfic/Typic Haplargids	A13, A16, B3, B7 D5a, D8, D10, G8a G9	Moderately deep to very deep, moderately well to slightly excessively drained, strong brown to dark red, sandy loams to clay loams.
LVxar	Areni-Chromic Luvisols	Arenic Eutric Nitosols	(Gross)arenic (Rhodic) Paleustalfs	S11	Very deep, well somewhat excessively drained, brown to red, fine and fine-medium sandy loams.
LVxpt	Chromic Luvisols petric phase	Chromic Luvisols petric phase Luvic Xerosols petric phase	Typic/Ultic Haplustalfs Typic Rhodustalfs Ustalfic/Typic Haplargids	A13b, B2, B5c G2c, G2e, G8	Shallow to deep, moderately well to well drained, strong brown to red, coarse sandy loams to clay loams.

Symbol	FAO Legend 1988	Soil Legend Botswana	Soil Taxonomy	Typifying pedons	General Soil Description
LXh	Haplic Lixisols	Ferric Luvisols	Kanhaplic Haplustalfs Kandic Rhodustalfs Kandic Paleustalfs	D7, G6a, G10b	Moderately deep to very deep, imperfectly to moderately well drained, dark brown to red, sandy clay loams to clays.
LXhar	Areni-Haplic Lixisols	Arenic Ferric Luvisols	Arenic Kanhaplic Haplustalfs (Gross)arenic Kandic Paleustalfs	G6,(K)S10	Moderately deep to very deep, moderately well to somewhat excessively drained, reddish yellow to red, loamy coarse sands to fine sandy loams.
LXhpt	Haplic Lixisols petric phase	Ferric Luvisols partly petric phase	Kanhaplic Haplustalfs Kandic Rhodustalfs	G6a	Moderately deep to deep, moderately well drained, yellowish red to red, sandy clay loams to clays.
LXfrh	Rhodi-Ferric Lixisols	Ferric Luvisols	Kandic Rhodustalfs Kandic rhodic Paleustalfs	A11	Moderately deep to very deep, moderately well to well drained, strong brown to red, sandy clay loams to sandy clays.
LXfpf	Ferric Lixisols petroferric phase	Ferric Luvisols petroferric phase	Kanhaplic Haplustalfs Kandic Rhodustalfs	A11a, G2d	Moderately deep to deep, moderately well to well drained, grayish brown to red, coarse sandy loams to sandy clay loams.
PHg	Gleyic Phaeozems	Gleyic Phaeozems	Typic Argiaquolls	A47	Deep to very deep, poorly to imperfectly drained, black to grayish brown, clay loams to clays over sands to loamy sands.
PHl	Luvic Phaeozems	Luvic Phaeozems	Aquic Argiustolls	A45a	Moderately deep to very deep, imperfectly drained, very dark grayish brown, sandy loams to clays, overlying sands to loamy sands.
PLe	Eutric Planosols	Eutric Planosols	Typic Paleustalfs Aeric/Arenic/Typic Albaqualfs	L41, A49	Deep to very deep, poorly to imperfectly drained, very dark gray to brown sandy clay loams to clays.
PLeso	Eutric Planosols sodic phase	Solodic Planosols	Albic Natraqualfs Aeric/Arenic Albaqualfs Typic Natrustalfs	G15	Deep to very deep, imperfectly drained, yellowish brown to strong brown, sandy clays to clays.
RGc	Calcaric Regosols	Calcaric Regosols	Typic Ustorthents Typic Torriorthents	L13	Deep to very deep, moderately well to well drained, grayish brown, fine sandy loams to silty clay loams.

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
RGcdu	Calcaric Regosols duripan phase	Calcaric Regosols duripan phase	Typic Durochrepts	L13a	Deep to very deep, moderately well to well drained, grayish brown, fine sandy loams to silty clay loams, with a duripan.
RGcsk	Calcaric Regosols skeletic phase	Calcaric Regosols shallow-petric phase	Typic/Lithic Ustorthents	D1b, G1d	Very shallow to moderately deep, moderately well to well drained, dark grayish brown to reddish brown, coarse sands to clay loams.
RGcli	Calcaric Regosols lithic phase	Calcaric Regosols lithic phase	Lithic Ustorthents	B1b	Very shallow to shallow, well to somewhat excessively drained, dark brown to reddish brown, sandy loams to clay loams.
RGdsk	Dystric Regosols skeletic phase	Dystric Regosols shallow petric phase	Typic/Lithic Ustorthents	G1b	Moderately deep, moderately well to well drained, dark grayish brown to reddish brown, coarse sands to coarse loamy sands.
RGear	Areni-Eutric Regosols	Ferralic Arenosols	Typic/Ustic Torripsamments Ustic Quartzipsamments Typic Ustipsamments	S1a	Moderately deep, somewhat excessively drained, yellowish to yellowish red or dark reddish brown, sands to loamy sands.
RGeardu	Areni-Eutric Regosols duripan phase	Eutric Arenosols duripan phase	Arenic Durochrepts	L16c	Moderately deep, well to somewhat excessively drained, dark gray to pale brown,fine sands to loamy fine sands, with duripan.
RGearpt	Areni-Eutric Regosols petric phase	Arenic Eutric Regosols petric phase Eutric Regosols petric phase	Arenic Ustorthents Arenic Torriorthents	S1b, S1c, G2a	Shallow to moderately deep, moderately well to somewhat excessively drained, dark grayish brown to yellowish red, sands to loamy sands.
RGeli	Eutric Regosols lithic phase	Eutric Regosols lithic phase Ferralic Arenosols lithic phase	Lithic Ustorthents Lithic Torriorthents	B1, B1a, G1a S1	Very shallow to shallow, moderately well to excessively drained, grayish brown to yellowish red, coarse sands to clay loams.
RGesk	Eutric Regosols skeletic phase	Eutric Regosols shallow petric phase	Typic/Lithic Ustorthents Typic/Lithic Torriorthents	D1a, G1c	Very shallow to moderately deep, moderately well to well drained, dark grayish brown to reddish brown, coarse sands to clay loams.

Symbol	FAO Legend 1988	FAO Legend 1974	Soil Taxonomy	General Soil Legend Botswana	General Soil Description
SCgso	Gleyic Solonchaks sodic phase	Gleyic Solonchaks sodic phase	Typic Salorthids	L1, L2	Very deep, very poorly to poorly drained, very dark grayish brown to greenish gray, silt loams to clays.
SCgdu	Gleyic Solonchaks duripan phase	Gleyic Solonchaks duripan/sodic phase	Aquic Durorthids	L2a	Very deep, very poorly to poorly drained, very dark grayish brown to greenish gray, silt loams to clay, with duripan.
SChso	Haplic Solonchaks sodic phase	Orthic Solonchaks sodic phase	Typic Salorthids	L4	Deep to very deep, poorly drained, light gray to light yellowish brown to dark grayish brown, silt loams to silty clay loams.
SCharso	Areni-Haplic Solonchaks sodic phase	Arenic Orthic Solonchaks sodic phase	Arenic Salorthids	L5	Deep to very deep, poorly to moderately well drained, light olive brown to pale yellow, fine sands to loamy fine sands.
SCkarso	Areni-Calcic Solonchaks sodic phase	Arenic Orthic Solonchaks sodic phase	Ustochreptic Calciorthids	L5	Deep to very deep, poorly to moderately well drained, light olive brown to pale yellow, fine sands to loamy fine sands, highly calcareous.
SNhsa	Haplic Solonetz salic phase	Orthic Solonetz saline phase	Aquic/Salorthidic Natrustalfs	L21	Very deep, poorly to imperfectly drained, pale brown to olive, silty clay loams to clays.
VRepl	Pelli-Eutric Vertisols	Pellic Vertisols	Typic/Entic Pellusterts	A1, B9, L25 L25a, L25b	Moderately deep to very deep, poorly to imperfectly drained, dark grayish brown to black, clays.
VRe	Eutric Vertisols	Chromic Vertisols	Typic/Entic Chromusterts	A2	Deep to very deep, imperfectly drained, dark grayish brown to reddish brown, clay loams to clays.
VRkpl	Pelli-Calcic Vertisols	Pellic Vertisols	Typic/Entic Pellusterts	L25, L25a, L25b	Deep to very deep, poorly to imperfectly drained, very dark gray to dark grayish brown, clays.

APPENDIX B

Legend of the National Soil Map of Botswana

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
ACh1	ARo, LXfpf	CMc, LVxpt, RGept	-	-	G5	560
ACh2	LVh, LVxpt	LVf, LVg, LVx	-	-	D7c	180
ARc1	ARh, CLhar	-	-	-	L10	1370
ARc3	CLhar	-	-	-	L10	720
ARc4	CLhar, CLpar, LPepe	-	-	-	L10	590
ARc5	CLhar, SCh, SChar	CLpar, LPk	-	-	L10	650
ARc6	CLhhy, CLpar	-	-	-	L10	220
ARg1	ARh, CLhar, LVkar	GLe, LVkso	-	-	A24a	510
ARg2	ARh, CLhar, LVkar	LVkso	-	-	A24a	1210
ARg3	ARh, LVk,	LVhar, LVkso	-	-	A24a	100
ARg4	ARh, LVk, LVkar	FLear, LVh	-	-	A24a	270
ARg5	ARh, LVkar	-	-	-	A24a	750
ARg6	FLear, PLe	-	-	-	A24a	530
ARg7	GLm	-	-	-	A24a	270
ARg8	LVkar, PLe	-	-	-	A24a	190
ARh1	-	-	-	-	A40(b)	2220
ARh2	-	-	-	-	L16	5230
ARh3	-	-	-	-	(K)(L)S17(d)	2840
ARh4	-	CLh, LVkar, RGc	-	-	KS17	1110
ARh5	ARc, CLhar	-	-	-	L16	330
ARh6	ARc, CLpar	-	-	-	L16	2010
ARh7	ARc, CLpar, LPepe	-	-	-	A40	760
ARh8	ARc, LVk	-	-	-	KS17	320
ARh9	ARg	CLhar, LVk, LVkar	-	-	A40	595
ARh10	ARg, LVaar	-	-	-	A40	190
ARh11	ARg, LVkar	-	-	-	A40	110
ARh12	ARlag	LVhar	-	-	KS17	240
ARh13	ARl	LVh, LVk	-	-	KS17	260
ARh14	ARlla	-	-	-	A40	3250
ARh15	ARlla	-	-	-	KS17	6670
ARh16	ARlla, ARo	-	-	-	KS17	3730
ARh17	ARlla, CLhar	-	-	-	KS17	810
ARh18	ARlla, CLhar, Clpar	-	-	-	KS17	1855
ARh19	ARlla, CLhar, LVa	CLpar	-	-	L16	90
ARh20	ARlla, CLpar	-	-	-	KS17	990

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
ARh21	ARlla, CLpar, LVhar	CLhar, CLlhy, LVkar	-	-	KS17	2290
ARh22	ARlla, LVaar, LVkar	-	-	-	A40	300
ARh23	ARlla, LVaar	-	-	-	A40	430
ARh24	ARlla, LVhar	-	-	-	A40	1690
ARh25	ARlla, LVhar	-	-	-	KS17	900
ARh26	ARlla, LVhar	CLpar, FLear, LVk	-	-	A40	1060
ARh27	ARlla, LVkar	CLpar	-	-	KS17	1270
ARh28	ARlla, LVkar	LVhar	-	-	KS17d	2200
ARh29	ARo	-	-	-	KS17	3045
ARh30	ARo	GLkve, LVhar, PLe	-	-	S16	340
ARh31	ARo	LVh	-	-	A40	470
ARh32	ARo, CLpar, LVk	-	-	-	S17	350
ARh33	ARo, LVhar	-	-	-	KS17	11220
ARh34	ARo, LVhar, PHh	-	-	-	KS17d	340
ARh35	ARo, LVk	ARlla, CLhar	-	-	L16	690
ARh36	ARo, LVkar	-	-	-	KS17	260
ARh37	ARo, LVkar	LVkso	-	-	KS17	140
ARh38	ARo, LVkar, RGeardu	-	-	-	KS17	120
ARh39	ARo,RGesk	LVkpe	-	-	S17	85
ARh40	CLhar	-	-	-	L16	1090
ARh41	CLhar	-	-	-	A40	240
ARh42	CLhar	-	-	-	KS17	1650
ARh43	CLhar	-	-	-	LS17d	205
ARh44	CLhar, CLhhy	CLpar	-	-	A40	1480
ARh45	CLhar, Clpar	-	-	-	L16	510
ARh46	CLhar, CLpar	-	-	-	A40	100
ARh47	Clhar, CLpar	LPepe	-	-	L16	330
ARh48	CLhar, CMk, LVk	LVkar	-	-	A40	2570
ARh49	CLhar, FLear	-	-	-	A40b	80
ARh50	CLhar, LVhar	ARlla, LVa, LVkpe	-	-	A40	1000
ARh51	CLhar, LVk	-	-	-	L16	270
ARh52	CLhar, LVk	LVg	-	-	S17	140
ARh53	CLhar, LVkar	-	-	-	A40	210
ARh54	CLhar, LVkar	-	-	-	L16	70
ARh55	CLhar, LVkar	FLear, LVkso	-	-	A40	660
ARh56	CLhar, LVkar	LVg	-	-	A40	720
ARh57	CLhar, LVkar, LVkso	-	-	-	A40	190
ARh58	CLhhy, CLpar	ARo, LVkar, RGearpt	-	-	S17	220
ARh59	CLlhy, LVkar	-	-	-	KS17	130
ARh60	CLpar	-	-	-	KS17	310

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
ARh61	CLpar	-	-	-	L16	2110
ARh62	CLpar	LPepe	-	-	L16	800
ARh63	CLpar, LPepe	-	-	-	L16	120
ARh64	CLpar, LVhar	-	-	-	KS17	500
ARh65	CLpar, LVhar, LVkar	-	-	-	LS17d	960
ARh66	CLpar, LVk	GLe, LVg	-	-	A40	150
ARh68	LPepe	-	-	-	S17	210
ARh69	LPepe	-	-	-	A40	100
ARh70	LPepe, LPqpe	-	-	-	L16	150
ARh71	LVaar, LVhar	-	-	-	A40	520
ARh72	LVaar, LVkar	-	-	-	A40	630
ARh73	LVg, PHg	CLhar, LVkar, PHl	-	-	A40c	155
ARh74	LVh, LVk	-	-	-	A40	300
ARh75	LVhar	-	-	-	L16	880
ARh76	LVhar	-	-	-	KS17	390
ARh77	LVhar	ARlla	-	-	A40	7870
ARh78	LVhar	LVh, LVk	-	-	S17	820
ARh79	LVhar, LVkar	ARlag	-	-	A40	440
ARh80	LVhar, LVkar	CLpar, LVkpe	-	-	S17	250
ARh81	LVhar, LVkar	FLear, LVh, LVkpe	-	-	A40	740
ARh82	LVk	-	-	-	L16	200
ARh83	LVkar	-	-	-	A40	515
ARh84	LVkar	-	-	-	L16	100
ARh85	LVkar	CLhar, LVhar	-	-	L16	180
ARh86	LVkar, PHg	-	-	-	A40	140
ARh87	LVkar, RGc	CLh	-	-	KS17	190
ARh88	SChso	-	-	-	L16	75
ARh89	CHk	-	-	-	KS17	170
AR11	-	-	-	-	(K)S5	725
AR12	-	-	argi	-	S7	100
AR13	-	-	lamelli	-	KS5a	6140
AR14	-	-	lamelli	-	KS5b/5a	3135
AR15	-	ARc, CLh	-	-	S5	625
AR16	-	CLh, CLp, LXhar	-	-	S5	60
AR17	-	CLh, CMv, LVk	-	-	S5	170
AR18	-	CLpar, LVfar, LVk	-	-	S5	1230
AR19	ARh	-	lamelli	-	A41	240
AR110	ARh	-	lamelli	-	KS5b	2210
AR111	ARh	-	lamelli	-	KS5a	9610

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
AR112	ARh	ARo	lamelli	-	KS5a	2710
AR113	ARh	CLpar	lamelli	-	KS5a	760
AR114	ARh	LVk	lamelli	-	KS5a	700
AR115	ARh, ARo	-	lamelli	-	KS5a	31500
AR116	ARh, ARo	-	lamelli	-	KS5b	210
AR117	ARh,ARo	CLphy, LPepe	lamelli	-	KS5a	21980
AR118	ARh, CLpar	-	lamelli	-	KS5b	420
AR119	ARh, CLpar	-	lamelli	-	(K)S5a	120
AR120	CLhar, ARh, CLpar	LVkar	lamelli	-	KS5b	860
AR121	ARh, LVhar	-	lamelli	-	KS6a	1450
AR122	ARh, LVhar	-	lamelli	-	A41	340
AR123	AR1, CLpar	ARo	lamelli	-	KS5a	270
AR124	LXhar, AR1	-	argi	-	S7	600
AR125	AR1, LXhar	CMc	argi	-	S7	230
AR126	AR1ag	-	-	-	S5	310
AR127	ARo, AR1ag	CLpar, RGear	-	-	KS5	290
AR128	ARo, AR1ag	LVkar	lamelli	-	KS5a	370
AR129	ARo, LPq, AR1ag	LVx, ARh, LVh	-	-	S5	250
AR130	AR1ag, CLh	ARh, LVk, LXhar	-	-	S5	600
AR131	AR1ag, LVhar	-	-	-	S5	640
AR132	AR1ag, LVk	-	-	-	S5	605
AR133	AR1ag, LXhar	ARo	-	-	S5	240
AR134	ARo	-	lamelli	-	KS5a	18050
AR135	ARo	ARh, AR1ag	-	-	S5	560
AR136	ARo	LVhar, LVkar	lamelli	-	KS5a	2360
AR137	ARo, LVf	-	argi	-	S7	260
AR138	ARo, LVkar	-	-	-	KS5	140
AR139	ARo, LXhar	LVh, LVhar, LVk	argi	-	S7	130
AR140	CLhar, LVkar	-	lamelli	-	KS6a	510
AR141	CLpar	-	lamelli	-	KS5a	110
AR142	CLpar, LVhar	-	lamelli	-	KS5b	130
AR143	CMc	CLh, LVk, LVx	-	-	S5	340
AR144	LVfar, LVxar	ARo, LVh, LVk	argi	-	S9	170
AR145	LVhar	LVk	lamelli	-	KS5a	1360
AR146	LVkar	-	lamelli	-	L40	210
AR147	LVkar	-	-	-	S5	310
AR148	LVkar	CLhar	-	-	KS5	420
AR149	LVkar	LVhar, LVk	-	-	KS5	340
AR150	LXhar	-	-	-	S5	70
AR151	LXhar	-	argi	-	S7	100

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
AR152	LXhar	CMc, LVk	argi	-	S9	90
ARo1	-	-	-	-	KS3	8300
ARo2	-	-	-	-	A19	70
ARo4	-	-	-	-	KS6	1410
ARo5	-	-	-	-	KS3/6	1690
ARo6	-	ARh	-	-	KS3	5730
ARo7	-	ARh, AR11a, LPepe	-	-	KS3	8270
ARo8	-	AR1ag, LVfar, LVk	-	-	KS3	920
ARo9	-	AR11a	-	-	KS3	360
ARo10	-	CLpar, CLphy, LPq	-	-	KS3	3890
ARo11	-	CLphy	-	-	KS3	50
ARo12	-	LVk	-	-	S4	680
ARo13	-	LVk, LVxpt, LXh	-	-	G4	30
ARo14	ARc	-	-	-	KS3	190
ARo15	ARc, ARh	-	-	-	KS6	12430
ARo16	ARc, ARh	-	-	-	KS3	8030
ARo17	ARc, ARh	LPepe,LVk	-	-	KS3	9450
ARo18	ARc, ARh, CLhar	CLpar	-	-	KS3	4450
ARo19	ARc, ARorh	-	-	-	KS6	930
ARo20	ARc, ARorh	CLhar, CLpar	-	-	KS6	4700
ARo21	ARh	-	-	-	KS3	46150
ARo22	ARh	AR11a	-	-	KS3	20320
ARo23	ARh	CLhar, LVf	-	-	S4	500
ARo24	ARh	LPepe	-	-	KS3	110
ARo25	ARh	LPepe, LVk	-	-	KS3	5750
ARo26	ARh	LVg, LVgka	-	-	S3	120
ARo27	ARh, AR1, LVhar	-	-	-	KS6	6510
ARo28	ARh, AR11a	-	-	-	KS3	8630
ARo29	ARh, ARorh	LPepe	-	-	KS3	510
ARo30	ARh, LPepe	-	-	-	S3	720
ARo31	ARh, LVh	LVhar	-	-	KS3	240
ARo32	ARh, LVhar	-	-	-	KS3	7150
ARo33	ARh, LVhar	CLpar, LVkar	-	-	KS3	790
ARo34	ARh, RGearpt	CLhar	-	-	S3	1200
ARo35	AR1	-	-	-	KS3	5980
ARo36	AR1	ARh, LVhar, LVkar	-	-	KS3	1550
ARo37	AR1	AR1ag, CLhar	-	-	S3	610
ARo38	AR1	LVfar,LVhar, LVk	-	-	KS3	1120

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
ARo39	AR1	LVk, LXhar	-	-	S6	330
ARo40	AR1, ARlag	LVh, LVk	-	-	S3	330
ARo41	AR1, ARlag	RGel1	-	-	S3a	190
ARo42	AR1, AR11a	ARh, LVhar, LVk	-	-	KS3	9720
ARo43	AR1, LPkpe	LPepe	-	-	KS3	50
ARo44	AR1, LVh	-	-	-	KS3	440
ARo45	AR1, LVkar	-	-	-	S4	90
ARo46	AR1, LXhar	ARh, LVx	-	-	S3	380
ARo47	AR11a	-	-	-	KS3	6680
ARo48	AR11a, CLpar	CLphy, LPq	-	-	KS3	440
ARo49	AR11a, LVhar	-	-	-	KS3	540
ARo50	CLhar, CLpar, LPepe	ARc, ARh	-	-	KS3	1540
ARo51	CLpar	-	-	-	KS3a/3	150
ARo52	CLpar, LVk	-	-	-	KS3	1630
ARo53	LPepe, LVhar	-	-	-	KS3	4520
ARo54	LPepe, RGearpt	-	-	-	S3	120
ARo55	LVf	-	-	-	L44	40
ARo56	LVfar	LVk	-	-	S4	220
ARo57	LVfar, LVh	-	-	-	KS3	140
ARo58	LVh, LVk	-	-	-	KS3	210
ARo59	LVk	-	-	-	KS3	60
ARo60	LXfpf	LVf, LVx	-	-	G4	70
ARo61	LXh	LVk, LVx, RGdsk	-	-	G4	610
ARo62	RGear	-	-	-	S3	130
ARo63	RGear	-	-	-	KS3	460
ARo64	RGear	ARc, LPepe, LVk	-	-	KS3a	230
ARo65	RGear	AR1, ARlag	-	-	S3	330
ARo66	RGesk	LPkpe, LVk	-	-	G4	130
CHk1	GLmka, LVgka	-	-	-	L36	900
CH11	-	-	calci	sodic	L35b	70
CLh1	-	-	areni	-	S13	200
CLh2	-	-	hypercalci	-	C4	190
CLh3	-	CLp, CLpar, LPepe	hypercalci	-	C4	210
CLh4	-	LPepe	hypercalci	-	C4a	170
CLh5	ARc, CLpar	-	hypercalci	-	C4	90
CLh6	ARc, CLpar	-	areni	-	L11	290
CLh7	ARc, SChar	LPepe, SCh	areni	-	L11	310

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
CLh8	ARh	CLh	areni	-	L11	120
CLh9	ARh, CLpar	-	areni	-	L11	120
CLh10	ARh, CLpar	-	areni	-	S13	300
CLh11	ARh, CLpar	CMk, LPepe	areni	-	L11	240
CLh12	ARh, CLpar, LPepe	LVkar	areni	-	L11	220
CLh13	ARh, GLk	LVaka, PLeso	areni	-	L11	240
CLh14	ARh, LVkar	-	areni	-	L11a	160
CLh15	ARh, LVkar	ARlla, CLpar	areni	-	L11	660
CLh17	ARl	RGearpt	areni	-	S13	240
CLh18	ARlla, LVk	-	areni	-	A21	150
CLh19	ARo	CLpar, LVk	areni	-	A21	160
CLh20	CHl, LPepe	-	areni	-	L11	560
CLh21	CLhhy, LVx	-	-	-	A4b	70
CLh22	CLhhy, RGe	-	-	-	L11	110
CLh23	CLlhy	CLhar	hypercalci	-	C4	180
CLh24	CLlhy, CMc, VRepl	LVk	hypercalci	-	C4	555
CLh25	CLpar, LPepe	-	areni	-	A21	520
CLh26	CLpar, LPepe	-	areni	-	L11	160
CLh27	CLpar, LPepe	-	hypercalci	-	C4a	70
CLh28	CLpar, LPepe	-	-	-	L14	160
CLh29	CMc, LPepe	-	hypercalci	-	C4	190
CLh30	CMc, LPepe	CLh, LVg, LVh	-	-	A4a	150
CLh31	CMe	LVk, RGesk	hypercalci	-	C4	190
CLh32	CMe, LVg, LVk	LVh, VRepl	-	-	A4a/b	1695
CLh33	LPepe	-	hypercalci	-	C4	170
CLh34	LPepe	-	areni	-	L11	80
CLh35	LPepe	ARh, ARo, CMc	hypercalci	-	C4	320
CLh36	LVg, LVk	LVh, LVxpt, VRepl	-	-	A4b	280
CLh37	LVk, LXfpf	ARl	-	-	A4b	70
CLh38	RGcdu, SCgdu	CLhhy, LPepe, RGc	-	-	L14	70
CL11	-	-	hypercalci	-	C5	50
CL12	ARh, CLhhy	-	hypercalci	-	C5c	480
CL13	ARh, CLhhy, LVkar	LVk	hypercalci	-	C5c	160
CL14	CLhhy, LVkar	-	hypercalci	-	C5c	530
CL15	LPepe	-	hypercalci	-	C5	230
CLp2	ARc, CLhar	-	-	-	L15a	150

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
CLp3	ARc, CLhar	SChso	areni	-	L12	210
CLp4	ARc, FLear, LVkpe	ARh	areni	-	A21a	120
CLp5	ARc, SNh	SCharso, SChso	areni	-	L12a	180
CLp6	ARh	-	areni	-	L12a	200
CLp7	ARh, CLhar	-	areni	-	A21a	460
CLp8	ARh, LPepe	LVkar	areni	-	L12	180
CLp9	ARh, LVh	ARo, LVhar	areni	-	S13a	350
CLp10	ARh, LVkar	-	areni	-	L12b	120
CLp12	ARl, LVhar, LVkar	CLhhy, LVk	areni	-	S13a	400
CLp13	ARlag	ARo	areni	-	KS13a	60
CLp14	ARlag, ARo, CLhar	ARl, LVhar, LVkar	areni	-	S13a	200
CLp15	ARo	-	areni	-	S13a	4580
CLp16	ARo, CLlhy, LVk	CLhar	luvi	-	L24b	40
CLp17	CLh, CLhar	CLpar, SChso	-	-	L15a	330
CLp18	CLhar	-	areni	-	L12a/b	1410
CLp19	CLhar, LPepe	-	areni	-	L12b	390
CLp20	CLhar, LPepe	LVg	areni	-	L12	140
CLp21	CLh, RGcdu	LPepe	areni	-	L12b	290
CLp22	LPepe	-	areni	-	S13a	1230
CLp23	LPepe, RGear	-	areni	-	S13a	240
CLp24	LPepe, SChso	-	-	-	L15a	70
CLp25	LPepe, SChso	-	areni	-	L12	540
CLp26	LPk	-	areni	-	L12a	170
CLp28	LVkar	-	areni	-	KS13a	40
CMc1	CLhhy, GLk	RGd, RGe	-	-	A4	260
CMc2	CLh, LVk	-	-	-	A4	590
CMc3	LVf, LVk, LVx	-	-	-	A4	120
CMc4	LVg, LVh	LPepe, LVxpt	-	-	A4	280
CMc5	LVk	-	-	-	A4	20
CMc6	LVk, LVkar, LVx	CLh, LVh	-	-	A4	640
CMc7	LXf, LXfpf	CMv, LVk, VRepl	-	-	A4	140
CMo1	LVxpt, RGdsk	LVg, LVh, RGesk	-	petric	G2b	1190
CMo2	LVxpt, RGdsk	RGesk	-	petric	G2b	440
CMv1	-	VRepl	-	-	A3	260
CMv2	CLh, CMc	-	-	-	A3	100

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
CMv3	CLp, CMc	CLh, VRepl	-	-	A3	210
CMx1	LPq, RGeli	-	-	petric	B5b	20
FLc1	ARc	-	-	-	L8	55
FLc2	SCgdu	SCkarso	-	salic	L8a	100
FLc3	SCkarso	LPepe	-	salic	L8a	90
FLe1	ARg, CLhar, LVkar	ARh, LVk	areni	-	A24e	490
FLe2	LVkar, RGesk	SChso	-	-	A24d	60
GLe1	ARh, LVg	CLhar, FLe, LVk	-	-	A31b	600
GLe2	ARh	CLhar, LVg, LVk	-	-	A31b	470
GLe3	CLhar, FLear, LVkar	ARh, LVg, LVkso	-	-	A31b	500
GLe4	FLear, LVg	ARh, CLhar, LVkar	-	-	A31b	380
GLe5	GLmka, GLm	CMc, GLk	-	-	A31b	90
GLk1	ARh	-	-	-	A30	20
GLk2	CLh, VRepl	-	-	-	A30	70
GLk3	FLcsa, SCharso	SCgso	-	-	L6	100
GLk4	FLear, GLm,	LPepe	-	-	L6b	120
GLk5	GLd, GLe	GLm	-	-	L6a	270
GLk6	LVkar	-	-	-	L6a	70
GLk7	SCgso	LPepe, SCk	-	-	L6	40
GLk8	VRepl	-	verti	-	L26	110
GLm1	CHk, GLm	-	calci	-	L37b	70
GLm2	GLk	ARh, CLhar, FLear	verti	-	A42	200
LPe1	-	-	petrocalci	-	C3	140
LPe2	ARc, CLh, CLpar	LPq	petrocalci	-	C3	290
LPe3	ARh, CLhhy, LVk	CLpar, RGe	petrocalci	-	C3	290
LPe4	ARh, CLpar	-	petrocalci	-	C3	280
LPe5	ARh, LPedu, RGeardu	-	petrocalci	-	C3	300
LPe6	ARh, SCk	-	petrocalci	-	C3	155
LPe7	ARlla, CLpar, RGeardu	-	petrocalci	-	C3	170
LPe8	ARo	-	petrocalci	-	C3	60
LPe9	CLhar, CLpar	-	petrocalci	-	C3	210
LPe10	CLhhy	-	petrocalci	-	C2	420
LPe11	CLhhy	CLhar	petrocalci	-	C2	110

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LPe12	CLhhy	CLlhy	petrocalci	-	C3	120
LPe13	CLhhy	SCk	petrocalci	-	C2	525
LPe14	CLhhy, CLpar	CLh	petrocalci	-	C2	480
LPe15	CLhhy, LPq	-	petrocalci	-	C3	350
LPe16	CLhhy, LPq	ARo, CLpar, RGesk	petrocalci	-	C3	190
LPe18	CLpar	-	petrocalci	-	C3	400
LPe19	CLpar, LPq	-	petrocalci	-	C2	170
LPe20	CLpar, LPq	-	petrocalci	-	C3	1060
LPe21	CMc, LVk	-	petrocalci	-	C3	90
LPe22	GLkso	LVg, RGesk, VRepl	petrocalci	-	C2	160
LPe23	LPk, LPq	LVk	petrocalci	-	C3	630
LPe24	LPkpe	-	petrocalci	-	C3	90
LPe25	LPkpe, LPqhy	CLhar, CLhhy, SCgso	petrocalci	-	C2/C3	1240
LPe26	LPqhy	-	petrocalci	-	C3	700
LPe27	RGcsk, RGesk	CLh, LVxpt, RGcli	petrocalci	-	C2	340
LPe28	RGeardu	ARh	-	duripan	L16d	240
LPk1	CLhar, CLpar, LPepe	-	petrocalci	-	C1a	285
LPk2	CLhar, CLphy, RGeardu	-	petrocalci	-	C1a	140
LPq1	-	-	-	-	R	2325
LPq2	-	-	hypercalci	-	C1	280
LPq3	-	LVx, LVxpt	-	-	R	60
LPq4	-	RGeli, RGesk	-	-	R	240
LPq5	Ara, LVxpt	LVh, LVxpt	-	-	R	390
LPq6	ARo, LVk, RGear	CLlhy, LPkpe	hypercalci	-	C1	70
LPq7	CLh, LVx	-	-	-	R	30
LPq8	CLhhy, LPepe	-	hypercalci	-	(L)C1	310
LPq9	LPepe	CLhhy, LPk	-	-	R	120
LPq10	LPepe, LPkpe	CLp, LVk	hypercalci	-	C1	300
LPq11	LPepe, LVkpe	LXh, RGeli	hypercalci	-	C1	330
LPq12	LPepe, RGearpt	-	hypercalci	-	C1	220
LPq13	LVk, RGdli	LVhpt, RGesk	-	-	R	390
LPq14	LXh	-	-	-	R	30
LPq15	RGeli	ACh, LXh	-	-	R	500
LPq16	RGesk	LXf, LXfpf	-	-	R	240
LPq17	RGesk	RGcsk	-	-	R	370
LVf1	-	-	areni	-	A12	80

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LVf2	-	LXf	-	-	D5	40
LVf3	ACfar, LVhar	-	areni	-	L32	40
LVf4	ACh, ARlag, LVk	LVkar	-	-	D5	340
LVf5	ACh, ARo, LXhar	ARlag, LVk, LVx	-	-	D5	290
LVf6	ARh, ARo	-	areni	-	KS10	60
LVf7	ARl	-	areni	-	S10	350
LVf8	ARlag, LVk	LVx, LXhar	areni	-	A12	450
LVf9	CLh, CLhhy	LVk	areni	-	S10	360
LVf10	CLpar	-	areni	-	S10	70
LVf11	LPe, LVf	LVk, RGesk	-	petric	D6	170
LVf12	LVhar, LVk	ARl	areni	-	A12	60
LVf13	LVk, LVkpe	CLplu	areni	-	A12	410
LVf14	LVx, LXf	-	areni	-	A10	70
LVg1	-	-	-	-	A7	30
LVg2	ARh, GLe	-	calci	-	A7b	290
LVg3	ARh, GLe, LVkar	CLhar, FLear, LVkso	-	-	A7	110
LVg4	ARh, PHg	CHk, FLe	-	-	A7	420
LVg5	CHk, CMc	-	calci	-	L28	160
LVg6	CLh, LVk	-	-	-	A7	370
LVg7	CLhar, LVk	-	-	-	L23	80
LVg8	GLeso	-	-	-	A7	50
LVg9	GLm, LVgso	VRepl	calci	-	L28	60
LVg10	LVh	-	-	-	A7	110
LVg11	LVh, LVk	CHlhy, GLk, VRepl	calci	-	L28	170
LVg12	LVk	ARh	calci	-	L28	320
LVh1	ARc, CLpar, LVk	-	-	-	A36	560
LVh2	ARh	-	areni	-	A15a	370
LVh3	ARh, ARlla	-	areni	-	A15a	430
LVh4	ARh, ARlla	CLhar	areni	-	A15a	460
LVh5	ARh, LVfar	ARo	-	-	L22	60
LVh6	ARh, LVk	-	-	-	A14a	50
LVh7	ARh, LVk	-	-	-	L22	90
LVh8	ARh, LVk	-	areni	-	L22a	710
LVh9	ARh, LVk	-	areni	-	A15a	190
LVh10	ARh, LVkso	-	areni	-	L22a	330
LVh11	ARlla, ARo	-	areni	-	L22c	2200
LVh12	ARlla, LVh	-	areni	-	L22a	210
LVh13	ARo, CLpar, LVhar	-	-	-	A14a	180

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LVh14	ARo, LVk	-	-	-	L22	810
LVh15	ARo, LVk	AR1	-	-	L22	110
LVh16	CLp	-	-	-	L22	160
LVh17	CLpar, LVkar	-	areni	-	L22a	80
LVh18	CMc, RGeli	CLh, LVh	-	petric	G2e	30
LVh19	LPepe, LVkar	-	areni	-	L22a	140
LVh20	LPepe, RGesk	-	-	duripan	L22e	120
LVh21	LPq, RGept	ACh, RGdsk	-	-	D7a	250
LVh22	LPq, RGeli	CLh, CLphy	-	petric	G2e	230
LVh23	LPq, LXh, RGeli	CLh, CMc, LVxpt	-	petric	G2e	420
LVh24	LVf,RGeli	LPq, LVk, RGesk	-	petric	G2e	490
LVh25	LVg, LVx	LVxpt, LXfpf	-	-	G10a	30
LVh26	LVhar	CL1hy, LVk, LXhar	-	-	A14	140
LVh27	LVk, LVx	CLh, CMv, LVg	-	-	A14	660
LVh28	LVk, LVx	LVg, RGesk	-	-	A14	260
LVh29	LVk, RGesk	-	-	petric	G2e	60
LVh30	LVx, LVxpt, LXhar	LVf, RGeli	-	petric	G7	320
LVh31	LVxpt, LXhar	LVfpf	-	petric	G7	230
LVh32	LXh, RGeli	CLh, CLhhy, CMc	-	petric	G2e	4540
LVk1	ARh	-	areni	-	A9a	110
LVk2	ARh	LPepe	areni	-	L24d	110
LVk3	ARh, AR11a, CLp	CLpar, LVkpe	areni	-	L24c	230
LVk4	ARh, CLhar	-	areni	-	A9a	1310
LVk5	ARh, CLhar	LVhar	-	-	A9	100
LVK6	ARh, CLhar, GLe	CLpar	-	sodic	A9a	340
LVk7	ARh, GLk	LVa, LVgka	-	-	L24	80
LVk8	ARh, LVhar	-	areni	-	L24c	175
LVk9	ARh, PHg	-	areni	-	A9a	140
LVk10	AR1	CLp	-	-	A10	170
LVk11	AR1, ARo	CLhhy, LVfar, LVx	-	-	A9	400
LVk12	AR1, CLhhy, LVx	-	-	-	A10	415
LVk13	AR1, CLpar	LVxar	areni	-	KS12a	120
LVk14	AR1, LVhar	LVx	-	-	A9	140
LVk15	AR1, LXfrh	ARo, CLh, LVx	-	-	A9	60
LVk16	AR1, LVk, RGeli	ARh	-	petric	B6a	80
LVk17	AR1ag	CL1, LPqhy, LXfar	-	-	A10	150
LVk18	AR11a	-	areni	-	L24d	100

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LVk19	ARo	-	petrocalci	-	A9b	170
LVk20	ARo	LXhar	-	-	A10	70
LVk21	ARo, CLpar	-	petrocalci	-	L24e	50
LVk22	CLh	ARh, CMe	-	-	A37	100
LVk23	CLh	RGear, RGearpt, RGeli	-	-	A37	200
LVk24	CLh	LVx	-	-	A10	60
LVk25	CLh, RGc	-	areni	-	A9a	130
LVk26	CLhar,CLpar	-	areni	-	S12a	70
LVk27	CLhar, GLe	ARh, FLe, GLd	areni	-	A9a	130
LVk29	CLhhy, CMc, RGc	LPepe	-	-	D9	220
LVk30	CLhhy, LPepe	CMc, GLk, LVhar	-	-	D9	130
LVk31	CLhhy, LVk	-	petrocalci	-	G13a	90
LVk32	CLhpt, LVk	-	-	petric	B6c	10
LVk33	CLp, LPepe	-	areni	-	L24d	30
LVk34	CMc	-	-	-	A9	30
LVk35	CMc, LVfar, LXf	ARo, RGear	-	-	A10	500
LVk36	LPepe	ARl, CLhhy, CMc	-	-	A9	290
LVk37	LVfar, LVkpe	-	-	-	A9	60
LVk39	LVgka, LVkso	GLkve	-	-	L24	60
LVk40	LVk, LXfpf	-	petrocalci	-	G13a	360
LVk41	LVkar, LVx	ARl, CLh, LXfpf	-	-	A10	330
LVk42	LVkar, LXf	RGesk	-	-	A9	90
LVk43	LVkpt	-	-	-	B6	50
LVk44	LVx	ARo	-	-	A9	120
LVk45	LVf, LVx, RGeli	-	-	-	D9	150
LVk46	LVx	-	-	-	A9	220
LVk47	LVx	LXf	-	-	A10	710
LVk49	LVxpt, RGcli	LVk	-	petric	B6c	415
LVk50	LVxpt, RGeli	ARlag	-	-	B6	100
LVk51	LXf, LXfpf	LVx, LPq, RGesk	-	-	B4	130
LVx1	-	CMc, LVxpt	-	-	A13	100
LVx2	-	LPq, LVk	-	-	A16	100
LVx3	-	LPq, RGdsk	-	petric	B2	60
LVx4	-	LVg, LVh	-	petric	G2c	220
LVx5	-	LVk, LVxpt, RGdsk	-	petric	G2c	100
LVx6	ACh, LVx	-	-	petric	G8	70

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LVx7	ARl	-	areni	-	S11	100
LVx8	ARo, LVk	RGeli	-	-	B3	230
LVx9	CLh, LVk	-	-	-	D8	110
LVx10	CLh, LVk, LXhar	-	-	-	B7	60
LVx11	CLhhy, LVk	LPq, RGearpt	-	petric	B5c	130
LVx12	CMc, LXfpf	-	-	-	D5a	60
LVx13	LPepe, RGcsk	LVk, LVkpe	-	petric	G2c	180
LVx14	LVfar, LXf	-	-	-	A16	60
LVx15	LVh, LVk	CMv	-	-	A16	220
LVx16	LVh, LVk	LVg	-	-	A16	140
LVx17	LVh, LXf	-	-	-	A16	140
LVx18	LVh, LXh	CLh, LVx	-	petric	G8	810
LVx19	LVhpt	RGesk	-	petric	G2c	370
LVx20	LVhar	CLh, CLp, CMc	-	-	A16	120
LVx21	LVk	CLh	-	-	A13	170
LVx22	LVk	CLpar	-	-	D10	380
LVx23	LVk	LVh	-	-	A16	300
LVx24	LVk, LXf	LXhar	-	-	A13	420
LVx25	LVkpe	-	-	petric	A13b	80
LVx26	LVkpt, RGcli, RGeli	ARh, CMe	-	-	B5c	110
LVx27	LVx	CMc, CMv, VRepl	-	petric	G8	80
LVx28	LVx, LXh	ARo	-	petric	G8	250
LVx30	LVxpt	ACh, LPq	-	-	G9	325
LVx31	LVxpt	LPq, RGeli	-	-	B3	240
LVx32	LVxpt	LVg, LVh	-	-	B3	170
LVx33	LXf	ARl, LVfar	-	-	A16	140
LVx34	LXf	ARo, CLh	-	-	D5a	120
LVx35	LXfpf	RGesk	-	petric	G2c	935
LVx36	LXfpf, LXh	LVk	-	petric	G2c	400
LVx37	LXfpf, RGesk	-	-	petric	G2c	1770
LVx38	LXhar	LVx, RGdsk, RGesk	-	petric	G8	310
LVx39	RGcli	CMc, LPepe, LVg	-	petric	G2c	540
LVx40	RGeli	-	-	-	G8a	140
LVx41	RGeli	LXfpf, RGept	-	petric	B2	190
LVx42	RGeli, RGesk	-	-	petric	B2	170
LVx43	RGesk	-	-	petric	G2e	1850
LXf1	ACh, LXhar	RGeli	-	petroferric	G2d	50
LXf2	ACh, LXhar	RGesk	-	petroferric	G2d	300

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units Third level	phase	Typifying pedon	Extent (km^2)
LXf3	ACh, RGeli	LPq	-	petroferric	G2d	80
LXf4	LVk, LXfpf	-	rhodi	-	A11	30
LXf5	LVkpe	ARo	rhodi	-	A11	90
LXf6	LVx	-	rhodi	-	A11	390
LXf7	LVx	CLh	-	petroferric	A11a	40
LXf8	LVx, LVxpt	-	-	petroferric	A11a	60
LXf9	LVx, LXf	LVh, RGept	-	petroferric	A11a	1990
LXf10	LVx, LXfpf	-	rhodi	-	A11	500
LXf11	LVx, LXhpt	LXh	-	petroferric	G2d	130
LXf12	LVx, RGesk	-	rhodi	-	A11	220
LXf13	LVxpt, LXh, LXhar	RGesk	-	petroferric	G2d	240
LXf14	LXh	-	-	petroferric	G2d	30
LXf15	LXh, RGeli	CLhhy, CMc	-	petroferric	G2d	770
LXf16	LXh, RGesk	-	-	petroferric	G2d	130
LXf17	LXhar, RGesk	LVxpt, VRepl	-	petroferric	G2d	80
LXf18	RGept, RGesk	LVk	-	petroferric	G2d	130
LXh1	-	-	-	-	G6a	1485
LXh2	ACh	ARo, LVk, LVxpt	areni	-	G6	460
LXh3	ACh, ARo	LVx	areni	-	G6	180
LXh4	ACh, CLh, LVxpt	-	areni	-	G6	280
LXh5	ACh, LXfpf, RGeli	CLh, LPepe	-	-	G6a	400
LXh7	ACh, RGdsk, RGesk	LVhpt	areni	-	G6	260
LXh8	ARo	-	-	-	G6a	560
LXh9	ARo	LVk, LXfpf	areni	-	G6	280
LXh10	ARo, LVxpt, LXh	ACh, LPqhy, LVkpe	areni	-	G6	370
LXh11	ARo, LXfpf	LVk	areni	-	G6	240
LXh12	LPq, LVh, LXfpf	LVhpt, LVxpt	-	petric	G6a	930
LXh13	LVh, LVxpt	LVg, LVx, LXh	areni	-	G6	340
LXh14	LVhpt, LXfpf	RGeli	areni	-	G6	210
LXh15	LVk, LXfpf, RGesk	LVh	areni	-	G6	400
LXh16	LVx, LVxpt	-	-	-	G6a	60
LXh17	LVx, LVxpt	LVh, LVk	areni	-	G6	250
LXh18	LVxpt	LVx	areni	-	G6	220
LXh19	LVxpt, LXfpf	CLh, LVk	-	-	G6a	160
LXh20	LXf, LXfpf	LVh, LVk, LXhar	-	-	G6a	875
LXh21	LVx, LXf, LXfpf	CMc	-	-	G6a	730
LXh22	LXfpf	LVh, LVhpt	-	-	G6a	1970
LXh23	LXfpf, RGeli	LPq, RGesk	areni	-	G6	330

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
LXh24	LXfpf, RGept	-	areni	-	G6	50
LXh25	LXh	CLh, CMv	areni	-	G6	280
LXh26	LXhar	-	-	-	G10b	330
LXh27	RGesk	LVh, LVk, LVx	-	-	D7	180
PHg1	ARh, LVg	CHk, CLhar	-	-	A47	290
PHg2	CLhar, LVh	-	-	-	A47	250
PH11	ARh, LVh	-	-	-	A45a	270
PLe1	GLkve, LVhar	-	-	-	L41	20
PLe2	LVhpt	ARa, RGe	-	sodic	G15	310
RGc1	-	CLp, RGc	-	duripan	L13a	540
RGc2	CLh	GLk	-	-	L13	105
RGc4	CLhpt, LVkpt, RGeli	-	-	lithic	B1b	510
RGc5	LPepe, LVxpt	-	-	skeletic	G1d	80
RGc6	LPepe, RGept	LVg	-	skeletic	D1b	120
RGc7	LPkpe, LVkpt	-	-	lithic	B1b	410
RGc8	RGept, RGesk	ARo, LPq	-	skeletic	D1b	440
RGd1	ARa, RGesk	LVg, LVh, RGe	-	skeletic	G1b	1040
RGd2	CMopt, RGesk	LVxpt	-	skeletic	G1b	80
RGd3	LVh, RGesk	LVg	-	skeletic	G1b	290
RGd4	RGept, RGesk	CMopt	-	skeletic	G1b	2065
RGd5	RGesk	CMopt, LVg, LVh	-	skeletic	G1b	720
RGe1	-	-	-	lithic	S1	100
Rge2	-	-	areni	petric	S1b/S1c	160
Rge3	-	ARo, LVx, LVxpt	-	lithic	G1a	330
RGe4	AR11a, CLpar, LPepe	-	areni	petric	S1c	570
RGe5	AR11a, LPedu, LVhar	-	areni	duripan	L16c	300
RGe6	ARo	-	areni	petric	S1c	120
RGe7	ARo	-	areni	petric	S1c/S1b	220
RGe8	ARo, CLpar	LPepe	areni	petric	S1c	390
Rge9	ARo, LXfpf	LVk	-	skeletic	G1c	270
Rge10	ARo, LXh	-	-	skeletic	G1c	190
Rge11	ARo, RGeli	-	areni	petric	S1c	250
RGe12	ARorh, LPepe	-	areni	petric	S1c	165

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
RGe13	CLhar	LPepe, LVkar, RGear	areni	-	S1a	420
RGe14	CL1, RGc1i	LPkpe	-	lithic	B1	380
RGe15	CMopt, LPepe, LVxpt	-	-	skeletic	G1c	155
Rge16	CMopt, RGdsk	-	areni	petric	G2a	3105
RGe17	CMopt, RGdsk	LVg, LVh	areni	petric	G2a	200
RGe18	CMopt, RGe1i	LPq, LVxpt, RGdsk	areni	petric	G2a	60
RGe19	LPepe, LPqka, RGe1i	-	areni	petric	S1c	1885
RGe20	LPepe, RGcsk	CLhar, CLpar, LVkpe	areni	petric	S1c	1070
RGe21	LPq	RGc1i	-	lithic	B1	220
RGe22	LPq, LVxpt	-	-	skeletic	G1c	240
RGe23	LPq, LVx, LXh	LVk, LXf	-	skeletic	D1a	660
RGe24	LPq, RGe1i	-	-	skeletic	G1c	150
RGe25	LPq, RGesk	-	-	lithic	G1a	480
RGe27	LVhar, LVkar	-	areni	-	S1a	290
RGe28	LVhpt	-	-	lithic	G1a	900
RGe29	LVhpt	-	-	skeletic	G1c	10
RGe30	LVhpt, LXh	LVxpt	-	skeletic	G1c	130
RGe31	LVk, LVkpt	LPq, LVxpt, RGear	-	lithic	B1	260
RGe32	LVkar, RGear	ARo, LPepe	-	lithic	S1	40
RGe33	LVkpe	LPepe	-	skeletic	G1c	230
RGe34	LVkpt, LVxpt, RGc1i	LPq	-	lithic	B1a	1050
RGe35	LVxpt	-	-	lithic	B1	850
RGe36	LVxpt	ARh, CMe	-	skeletic	G1c	280
RGe37	LVxpt	CLh, CMc	-	lithic	G1a	480
RGe38	LVxpt	LPq	-	skeletic	G1c	1030
RGe39	LVxpt	LVkpe	areni	petric	G2a	120
RGe40	LVxpt, VRep1	-	-	lithic	B1a	170
RGe41	LXfpf	CLh, LPq	-	lithic	G1a	120
RGe42	LXfpf, RGcsk	LVxpt	-	skeletic	G1c	100
RGe43	LXfpf, RGept	-	-	skeletic	G1c	70
RGe44	RGcsk	LVhpt	-	lithic	G1a	110
RGe45	RGcsk, RGesk	LPepe, LVxpt	-	lithic	G1a	615
RGe46	RGeas	LVx, LXfpf, LXh	-	lithic	S1	660
SCg1	-	-	-	sodic	L1	250
SCg2	GLk, LVg, SChso	-	-	sodic	L2	100
SCg3	LPepe, SCkar	-	-	duripan	L2a	155
SCg4	SCgdu	-	-	sodic	L1	2990
SCg5	SCgdu	CLphy, LPepe	-	sodic	L1	1970
SCg6	SChso	-	-	sodic	L2	280

Soil Mapping Units	Associated Soils	Included Soils	Dominant Soil Units		Typifying pedon	Extent (km^2)
			Third level	phase		
SCg7	SChso	-	-	sodic	L1	220
SCg8	SCharso	CLphy, LPepe	-	sodic	L1	350
SCh1	-	-	-	sodic	L4	10
SCh2	ARc, CLpar	-	-	sodic	L4	60
SCh3	ARc, RGcdu	CLhar	-	sodic	L4	720
SCh4	CLhar, CLpar, SCgso	ARc, LPepe	-	sodic	L4	780
SCh5	CLp, RGc	-	-	sodic	L4	90
SCh6	CLpar, FLc, SCkarso	-	areni	sodic	L5	90
SCh7	CLpar, SCkarso	SCgso, SChso	areni	sodic	L5	80
SCh8	SCharso	-	-	sodic	L4	50
SCh9	SNhsa	-	-	sodic	L4	50
SNh1	FLe, LVhar	-	-	salic	L21	290
VRe1	-	-	pelli	-	A1	110
VRe2	-	CMe, LPq, LVxpt	pelli	-	B9	50
VRe3	-	LPq	pelli	-	B9	60
VRe4	-	LPq, LVxpt, RGeli	pelli	-	A1	50
VRe5	-	LVh, LVgve, VRkpl	pelli	-	L25	940
VRe6	-	LVxpt	pelli	-	A1	80
VRe7	-	VRkpl	pelli	-	L25	550
VRe8	CLh	-	pelli	-	A1	40
VRe9	CLh, CLp, CMc	GLk, LVk	pelli	-	A1	150
VRe10	CLh, VRe	-	pelli	-	A1	60
VRe11	CLp, CMv	CLh, VRe	pelli	-	A1	50
VRe12	CMv, LVxpt	CLh	pelli	-	A1	110
VRe13	LVkpe	-	pelli	-	A1	230
VRe14	LVg	CLh, LVk	pelli	-	A1	670
VRe15	LVg	CMv, LVh, LVx	pelli	-	A1	200