A PRELIMINARY EVALUATION OF THE SOILS OF THE PROPOSED SITE FOR THE MERU COLLEGE OF TECHNOLOGY (NCHIRU AREA - MERU DISTRICT)

by

J.K. Kanake and H.C.K. Kinyanjui

SITE EVALUATION REPORT No. p60, October, 1981

TABLE OF CONTENTS

Appendices:

LIST OF TABLES:

1. INTRODUCTION

The request to carry out a site evaluation of Nchiru area in Tigania Division of Meru District was received from the organisers of the proposed Meru College of Technology.

A general examination of the soils of the proposed site for the institute, which covers an area of about 253 hectares (624 acres), was carried out in the field from 19th to 29th August, 1981.

The authors are grateful to the former D.O. of Tigania (Mr. Itumbo), together with his Administration Police for allowing the survey team to camp and use some facilities on the office compound. We are also grateful to the officers working in the Meru - Town office of the Institute, for their cooperation and assistance, and to all other people who assisted us or worked with us, during the course of the fieldwork.

2. ENVIRONMENTAL CONDITIONS

2.1. Location and communication

The survey area is located about 12km to the northeast of Meru Town, and about 4km south of Kianjai Market. It is roughly intersected by Longitude and Latitude 37° 43' E and 0° 08' N respectively, and lies at an elevation of approximately 1400m (4600ft) above sea level.

A tarmacked diversion of the new road from Meru to Maua passes through the survey area to Kianjai Market. Both telephone and electric power lines bypass the area by about 3km.

2.2. Geology and physiography

The soils of the area are primarily developed from the Lower Nyambeni Basalts of Recent to Pleistocene age (Mason, 1955).

The survey area has two main physiographic units, namely the uplands and the bottomlands. The uplands occur almost at the boundary of the north-eastern slopes of Mt. Kenya and the south-western part of the Nyambeni Range. The relief varies from very gently undulating to gently undulating (slope 0-3%) on the summits, to undulating (slope 4-8%) on the slopes. The bottomlands occur immediately below the uplands and are generally flat to very gently undulating (slope 0-2%).

.../2

2.3. Climate

The survey area belongs to the humid to dry sub-humid climatic zone (Kenya Atlas, 1970). The area's climatic characteristics can be illustrated by the data for Uringu Farm (25 years of observation) which is about 6km northeast of the survey area. The annual rainfall distribution (table 1) shows two pronounced rainy seasons, namely, the long rains from March to May, and the short rains from October to December. The mean annual rainfall is about 1324mm. The highest mean monthly precipitation occurs in November (351mm) and the lowest in August (3.3mm).

The average annual temperature is 21°C. The calculated annual potential evaporation (Eo) is 1910mm and the r/Eo ratio is 68% (r = rainfall, Eo = potential evaporation.

Table 1: Average monthly rainfall (in mm) for IUringu Farm (EAMD, 1972)

Jan.	Feb.	Mar.	Apr.	May	June	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
41.1	33.0	102.0	275.6	127.0	5.2	5.5	3.3	34.2	237.7	351.6	107.8	1324.0

2.4. Vegetation

The vegetation of the area varies from open grassland to bushed grassland. The upland summits and their slopes are dominated by tall Hyperrhenia rufa grass and Combretum apiculatum shrubs and bushes. The bottomlands are covered with short grasses (probably due to imperfectly drained soils, overgrazing and past ploughing and cultivation) of which Chlorispycnothrix and Brachiara Sps. are dominating.

2.5. Present land use and agricultural practices

Two main types of land use are practiced in the area, namely grazing and cultivation. Grazing of cattle, goats and sheep is done mainly on the bottomlands which have imperfectly drained soils and are therefore not very suitable for cultivation.

Shifting cultivation is carried out on the uplands which have well drained soils. The main crops include maize, pigeon peas, sorghum, bonavist beans ("njahi") and bananas. A little coffee is planted but it seems to be doing rather poorly (personal observation). This could possibly be attributed to the very strong and cold winds, which blow across the area almost throughout the year, from the two adjacent mountains (Mt. Kenya and the Nyambeni range).

Fallow areas of the uplands are also used for grazing, while the taller trees and shrubs are cut down for charcoal making.

3. SURVEY METHODS

A topographical map of scale 1:2,500, supplied by the organizers of the Meru College of Technology was used as a base map. Observation points were selected and located both on the map and on the ground. Soil augerings were made to a depth of 2m. The soils were described in detail according to the Kenya Soil Survey standards, and sampled at various depths for field determinations of pH and EC. A total of 27 augerhole observations were made and described. These were plotted on the base map on which also the soil boundaries were drawn, delineating the different soil mapping units.

Representative sites for profile pits were selected in each of the different soil mapping units. A total of 6 profile pits were dug to a depth of about 2m, and described in detail according to the KSS standards, which are based on the FAO "Guidelines for Soil Profile Description" (FAO, 1977). Each soil horizon was sampled for chemical and physical analysis at the National Agricultural Laboratories, Nairobi.

4. SOILS

4.1. Systematics and nomenclature

Physiographically the survey area consists of two physiographic units, viz. uplands and bottomlands. Within each physiographic unit various soil mapping units were distinguished taking into account soil characteristics such as drainage condition, texture, structure, colour, etc. In the case of uplands the soil mapping unit has been sub-divided on the basis of slope only, the other soil characteristics being the same.

The whole survey area falls within the same geological unit namely the Lower Nyambeni Basalts.

Every mapping unit in the soil map is identified by a symbol for which a code system is used. The first letter in the code denotes physiography, the second letter geology and the third letter or numerical figure various soil characteristics. Letter(s) appearing below the symbol indicate(s) the slope class.

The following symbols are used:

U - Uplands
B - Bottomlands
B - Geology (Basalts)
r - red soils
1,2 - various soil characteristics

4.2. General properties of the soils

There are two major soil types in the survey area:-

(i) well drained, extremely deep, red friable clay soils occurring in the Uplands
(ii) Moderately well drained to imperfectly drained clay soils occurring in the Bottomlands

- The first soil type comprises soils which are well drained and extremely deep, with a colour range from red to dark red. They are very friable soils with a weakly developed structure. The soils are susceptible to erosion especially on the stronger slopes where the vegetation has been removed. Active erosion in the form of gullies and sheet erosion was observed along cattle tracks and old footpaths in soil mapping unit UBr/C.

- The second category is composed of moderately well drained to imperfectly drained soils with strong brown to dark red mottles in almost all horizons below the topsoil. Layers of ironstone concretions (murram), in places indurated, are found at different depths within the profile. The textures are dominantly clay with very poor porosity and little animal activity. The poor drainage is probably caused by accummulation of run-off and the fact that the soils are slowly permeable. The water table was very deep. In places a perched groundwater table was encountered at 150cm. The mapping unit BB1 has in places been buried with material from unit UBr.

4.3. Description of the soil mapping units

Mapping unit UBr

Extent	:	135 ha (slope class AB 62.0ha; slope class C 73.0ha)
Meso/micro relief	:	a few erosion gullies along cattle tracks and old footpaths
Slope	:	0-3% and 4-8% (slope class AB and C respectively).

Vegetation : Bushland and bushed grassland, made up of Combretum sp., Lantana camara and Hyperrhenia rufa grass

Land use : In flat areas (slope class AB) coffee, maize, sorghum, beans, bananas and cassava are grown.

The gently undulating to undulating areas (slope class C) are used for grazing. A few areas are overgrazed.

Soils : These are well drained, extremely deep (deeper than 200cm), red (2.5YR 3/6) to dark red (10R 3/6), very friable, clay soils.

The structure varies from moderate, fine subangular blocky in the topsoil to weak, fine angular blocky in the deeper subsoil.

Mapping unit BB1

Extent : 8 ha

Meso/micro relief : common, 2-5cm wide, 20cm deep cracks

Slope : 0-1% (slope class A)

Vegetation : Grassland

Land use : Grazing and some patches of maize and sorghum

Soils : These are moderately well drained, very deep, strong brown (7.5YR 5/6) to pale brown (10YR 6/3-7/3); friable clay soils with a dark brown (5YR 3/4) to dark red (2.5YR 3/6) topsoil (in places as deep as 80cm).

The structure varies from weak, medium crumby to weak fine subangular blocky in the topsoil to massive with tendecy to weak, medium to coarse, subangular blocky in the subsoil.

Iron (Fe) and Manganese (Mn) concretions (10-15%) are present in horizons deeper than 120cm.

Mottles are only present in the deeper subsoil (150cm). Few, thin argillans were observed.

.../6

Mapping unit BB2

Extent	:	110 ha
Meso/micro relief	:	Nil
Slope	:	0-1%, flat to very gently undulating (slope class A)
Vegetation	:	Grassland
Land use	:	Grazing
Soils	:	These are imperfectly drained, deep to very deep, strong brown (7.5YR 5/6) to greyish brown (10YR 5/2) and light brownish grey (10YR 6/2), friable to firm, clay soils, with a very dark greyish brown (10YR 3/2) to dark brown (10YR 3/3) topsoil.
		The structure varies from weak, fine subangular blocky in the topsoil to massive with tendency to weak, fine subangular blocky in the subsoil.
		Iron (Fe) and Manganese (Mn) concretions are present in most of the horizons. The quantity varies from place to place and from horizon to horizon, in places over 80%. It is sometimes indurated.
		The soils have many, coarse and prominent, red to dark red (2.5YR 4/6-2.5YR 3/6) mottles Few, thin argillans were also observed.

4.4. Soil Fertility status

The appraisal of the soil fertility in the survey area has been carried out on the basis of the chemical analysis of composite topsoil samples taken from the vicinity of each of the profile pits representing the soil mapping units. However, this appraisal should be regarded as a general one due to the limited number of samples analysed. The analytical data on the available nutrients are presented in table 2.

../7

Table 2: Available Nutrients

Mapping unit	BB2	BB2	UBr	UBr	UBr	BB1
Field Designation (Profile Pit No.)	108/171	108/172	108/173	108/174	108/175	108/176
Lab. No. /81	8710	3711	8712	8713	8714	8715
Depth (cm)	0-30	0-30	0-30	0-30	0-30	0-30
pH	4.9	5.4	5.9	5.5	6.1	5.5
Na (me/100g)	0.06	0.10	0.06	0.04	0.06	0.06
K "	0.42	0.22	0.46	0.24	1.24	0.68
Ca "	2.8	3.6	2.2	1.0	6.4	2.8
Mg "	5.2	7.0	4.2	3.6	4.2	4.8
Mn "	0.70	0.52	0.64	0.72	0.78	0.84
P (ppm)	8	8	10	8	16	20
N %	0.23	0.24	0.18	0.15	0.24	0.15
C %	2.11	2.35	1.84	1.46	2.36	1.57
Hp (me/100g)	0.6	0.8	-	1.1	-	0.3

The analytical data presented in table 2 show that the soils are moderately to strongly acid, but are sufficiently supplied with Calcium (Ca) Magnesium (Mg), Potassium (K), Sodium (Na), and Manganese (Mn). Nitrogen (N) is also sufficiently supplied in soil mapping units BB2 (Bottomlands) and UBr/AB (level summits of the uplands), but is low in mapping units BB1 (part of the Bottomlands) and UBr/C (steeper slopes of the uplands). All the soils are deficient in Phosphorous (P).

For optimum production of crops, it is recommended that phosphate and nitrogen fertilizers should be applied to P and N deficient soils to improve their phosphorous and nitrogen status; P_2O_5 should be supplied in the form of single super phosphate (ssp) (which would also increase the Ca level in the soil); and N in the form of Calcium Ammonia Nitrate (CAN) or Ammonium Nitrate (NH_4NO_3), should be applied. Also farm yard manure (FYM) may be applied to improve the soil structure and to supply both P and N to plants.

.. /8

It is also recommended to add lime to those soils with a low pH (i.e. all the soils, except for the upper slopes of unit UBr/C). Calcitic limestone is recommended to raise the pH and to reduce the H + Al toxicity in the affected soils.

5. CONCLUSIONS AND RECOMMENDATIONS

a) The survey area (the proposed site for the Meru College of Technology) has two soil types. Well drained soils are found in the uplands, and the moderately well drained to imperfectly drained soils are found in the bottomlands. Both types require different management practices.

b) The relatively level upland areas (mapping unit UBr/AB) would be most suitable for the construction of college buildings, while the bottomlands (mapping unit BB2) would be suitable for playing ground.

c) On the slopes the over-grazed areas have erosion and this is likely to increase with the consequent removal of the vegetation cover. In view of this the structure of the soil has to be improved by adding manure. Terraces have to be constructed on the slopes. These soils are suitable for cultivation, although they have a low level of fertility.

d) Soils of the bottomlands are flooded after heavy rains. With proper management these soils can be put into several uses. They are however not as suitable for agriculture as the soils in the uplands. A drainage system has to be designed to drain excess groundwater and run-off from the bottomland areas.

6. REFERENCES

E.A.M.D., Summary of the rainfall in Kenya (various years)

F.A.O., 1977, Guidelines for soil profile description (second edition); F.A.O.; Rome.

Manson, P., 1955, Geology of the Meru-Isiolo area, Government Printer, Nairobi.

Munsell Colour Co., 1971, Munsell Soil Colour Charts, Baltimore, Maryland (U.S.A.).

Survey of Kenya, 1970, National Atlas of Kenya, 3rd edition, Nairobi.

Soil Survey Staff, 1968, Soil Survey Manual, Handbook No. 18, U.S.D.A., Washington D.C.

LABORATORY DATA OF PROFILE DESCRIPTION No.

Observation no: 108/173 **Mapping unit:** UBr **Soil classification:** nito-rhodic FERRALSOL

Laboratory no. /81	8693	8694	8695	8696	8697	
Horizon	Ap	Bt1	Bt3	Bt4	Bt5	
Depth (cm)	0-30	30-85	85-155	155-210	210-260	
pH-H_2O (1: 2½ v/v)	5.9	6.0	5.8	6.0	5.9	
pH-KCl "	4.8	4.8	5.3	5.3	5.2	
EC (mmho/cm) "	0.05	0.02	0.02	0.02	0.02	
$CaCO_3$ (%)						
$CaSO_4$ (%)						
C (%)	1.5	1.0	0.7	0.5	0.4	
N (%)						
C/N						
CEC (me/100g), pH 8.2	15.0	9.6	8.2	8.0	8.0	
CEC " " pH 7.0						
Exch. Ca (me/100g)	5.0	1.8	1.4	0.6	0.4	
" Mg "	3.1	1.1	0.7	0.7	0.5	
" K "	0.7	0.12	0.12	0.14	0.1	
" Na "	0.3	0.4	0.3	0.3	0.3	
Sum of cations	9.1	3.4	2.5	1.7	1.3	
Base sat. %, pH 8.2	56	35	27	16	16	
" " %, pH 7.0						
ESP at pH 8.2						
Texture (limited pretreatment)						
Gravel % (>2.0mm)						
Sand % (2.0-0.05mm)	12	8	6	4	8	
Silt % (0.05-0.002mm)	14	20	10	12	0	
Clay % (0.002-0mm)	74	72	84	84	92	
Texture class	C	C	C	C	C	

Fertility aspects 0 - 30 cm **Laboratory no.** 8712 /81

General		Available nutrients			
pH-H_2O (1: 2½ v/v)	5.9	Na/me/100g)	0.06	Mn (me/100g)	0.64
Exch. acidity (me/100g)	-	K "	0.5	P (ppm)	10
C %	1.84	Ca "	2.2	P-Olsen (ppm)	-
N %	0.2	Mg "	4.2		

Remarks: These soils are moderately acid, and are deficient in N and P. Nitrogen and Phosphate fertilizers should be added to improve the fertility. Farm Yard Manure should be used whenever its available.

Appendix 1: DETAILED DESCRIPTION OF REPRESENTATIVE SOIL PROFILES AND ANALYTICAL DATA

Mapping unit UBr — Profile No.108/173

Geology	:	Lower Nyanbeni Basalts
Physiography	:	Uplands
Relief, macro	:	level at top to gently undulating to undulating on the slopes
Relief, meso/micro	:	Nil
Slope at site/position	:	5%, middle of long gently undulating slope
Vegetation/land use	:	shrubs/presently fallow, but maize is usually planted.
Erosion	:	Nil
Surface stoniness	:	Nil
Rock outcrops	:	Nil
Flooding	:	Nil
Effective soil depth	:	extremely deep, over 250cm
Drainage class	:	Well drained

Ap	0-30cm	Dusky red (10R 3/4); clay; moderate, medium to coarse subangular blocky structure; hard when dry, very friable when moist, sticky and plastic when wet; many very fine and fine, common medium pores; many fine and medium, common coarse roots; diffuse and wavy transition to: (Lab.no.8693/81)
Bt1	30-85cm	Dark red (10R 3/6); clay; moderate, medium to coarse angular blocky structure; hard when dry, very friable when moist, sticky and plastic when wet; common, thin clayskins; many, very fine and fine, common medium, pores; many fine and medium, few coarse roots; diffuse and wavy transition to: (Lab.no.8694/81)

.../11

Bt3	85-155cm	Dark red (10R 3/6); clay; weak, medium to coarse, angular blocky structure; hard when dry, very friable when moist, sticky and plastic when wet; few, thin clayskins, many very fine and fine, common medium pores; many fine, common medium, few coarse roots; diffuse and smooth transition to: (Lab.no.8695/81)
Bt4	155-210cm	Dusky red (10R 3/4); clay; moderate, coarse angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine, common medium pores; common fine and medium, few coarse roots; (Lab.no.8696/81)
Bt5	210-260cm	Dark red (10R 3/6); clay; friable when moist, sticky and plastic when wet. (Lab.no.8697/81)

.../12

LABORATORY DATA OF PROFILE DESCRIPTION No.

Observation no: 108/176 **Mapping unit:** BB1 **Soil classification:** orthic ACRISOL

Laboratory no. / 81	8707	8843	8708	8709	8844	8845
Horizon	Ap	Bt1	Bt2	Bt3	BC	C1
Depth (cm)	0-20	20-40	40-84	84-123	123-163	163-208
pH-H_2O (1: 2½ v/v)	6.0	5.3	5.5	5.5	5.0	5.0
pH-KCl "	4.5	4.0	4.3	4.0	3.8	3.8
EC (mmho/cm) "	0.06	0.5	0.04	0.04	0.03	0.04
$CaCO_3$ (%)						
$CaSO_4$ (%)						
C (%)	1.5	1.1	0.6	0.8	0.8	0.6
N (%)						
C/N						
CEC (me/100g), pH 8.2	14.0	11.4	14.2	14.0	13.0	17.0
CEC " " pH 7.0						
Exch. Ca (me/100g)	7.0	4.0	3.6	3.2	1.4	2.0
" Mg "	4.3	2.4	2.7	3.5	2.7	3.0
" K "	0.6	0.4	0.2	0.1	0.1	0.2
" Na "	0.3	0.2	0.3	0.3	0.4	0.5
Sum of cations	12.3	7.0	6.8	7.1	4.6	5.7
Base sat. %, pH 8.2	87	59	47	51	35	30
" " %, pH 7.0						
ESP at pH 8.2						
Texture (limited pretreatment)						
Gravel % (>2.0mm)						
Sand % (2.0-0.05mm)	18	16	16	16	16	16
Silt % (0.05-0.002mm)	12	8	8	8	8	6
Clay % (0.002-0mm)	70	76	76	76	76	78
Texture class	C	C	C	C	C	C

Fertility aspects	0 - 30cm			Laboratory no. 8715 /81
General		Available nutrients		
pH-H_2O (1: 2½ v/v)	5.5	Na/me/100g)	0.06	Mn (me/100g)	0.84
Exch. acidity (me/100g)	0.3	K "	0.7	P (ppm)	20
C %	1.6	Ca "	3.0	P-Olsen (ppm)	-
N %	0.15	Mg "	5.0		

Remarks: These are moderately acid soils, which are sufficiently supplied with most of the nutrients, except N and P. N and P fertilizers should therefore be added, together with Farm Yard Manure (FYM) to increase the soil fertility.

Mapping unit BB1 — Profile No. 108/176

Geology	: Lower Nyambeni Basalts
Physiography	: Bottomland
Relief, macro	: Level to very gently undulating
Relief, meso/micro	: Nil
Slope at site/position	: 0-1%
Vegetation/land use	: Grassland/cultivation - maize and sorghum
Erosion	: Nil
Surface stoniness	: Nil
Rock outcrops	: Nil
Flooding	: Nil
Effective soil depth	: over 120cm, very deep
Drainage class	: moderately well drained

Ap	0-20cm	Dark reddish brown (5YR 3/4); clay; crumby with tendency to moderate, fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine, common medium, pores; many very fine and fine roots; clear and wavy transition to: (Lab. no. 8707/81)
Bt1	20-40cm	Dark red (2.5YR 3/6); clay; moderate, medium to coarse, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; common, thin clay skins; common, very fine, fine and medium pores; few very fine and fine roots; gradual and wavy transition to: (Lab. no. 8843/81)
Bt2	40-84cm	Dark reddish brown (2.5YR 3/4); clay; weak, coarse subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few, thin clayskins; many very fine and fine, few medium pores; few very fine roots; gradual and smooth transition to: (Lab. no. 8708/81)

...../14.

Bt3	84–123cm	Yellowish red (5YR 4/8); clay; weak, fine to medium subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few, thin clay skins; many very fine and fine, common medium, pores; gradual and smooth transition to: (Lab.no.8709/81)
BC	123–163cm	Strong brown (7.5YR 3/6), clay; massive; friable when moist, sticky and plastic when wet; many very fine and fine; few medium pores; gradual and wavy transition to: (Lab.no.8844/81)
C1	163–208cm	Brownish yellow (10YR 6/6); clay; massive; friable when moist; many very fine and fine, few medium, pores; (Lab.no.8845/81)
C2	208–238cm (Augered)	Pale brown (10YR 6/3); clay; 20% Fe and Mn concretions, 2–5mm in size;
C3	238–278cm (Augered)	Pale brown (10YR 6/3); clay; 40% Fe and Mn concretions, 2–10mm in size.

../15

LABORATORY DATA OF PROFILE DESCRIPTION No.

Observation no: 108/171 **Mapping unit:** BB2 **Soil classification:** mollic GLEYSOL

Laboratory no. / 81	8680	8681	8682	8683	8684	8685
Horizon	Ap	AB	BsC	Bg1	Bg2	BC
Depth (cm)	0-25	25-45	45-78	78-122	122-150	150-180
pH-H_2O (1: 2½ v/v)	5.2	5.3	6.4	5.8	6.1	6.0
pH-KCl "	3.9	3.8	4.3	3.7	3.7	3.6
EC (mmho/cm) "	0.04	0.03	0.02	0.03	0.03	0.04
$CaCO_3$ (%)						
$CaSO_4$ (%)						
C (%)	2.1	1.3	1.2	0.6	0.5	0.2
N (%)						
C/N						
CEC (me/100g), pH 8.2	26.0	16.3	13.4	25.0	19.2	19.0
CEC " " pH 7.0						
Exch. Ca (me/100g)	7.0	6.4	4.0	11.4	4.0	5.0
" Mg "	5.3	4.0	2.2	7.0	2.2	3.1
" K "	0.5	0.4	0.1	0.1	0.4	0.1
" Na "	0.4	0.4	0.6	1.4	0.6	0.2
Sum of cations	13.4	11.2	6.9	19.1	7.2	2.1
Base sat. %, pH 8.2	52	70	51	81	69	46
" " %, pH 7.0						
ESP at pH 8.2						
Texture (limited pretreatment)						
Gravel % (>2.0mm)						
Sand % (2.0-0.05mm)	18	16	42	30	32	26
Silt % (0.05-0.002mm)	18	12	6	14	18	20
Clay % (0.002-0mm)	64	72	52	56	50	54
Texture class	C	C	C	C	C	C

Fertility aspects 0 - 30cm **Laboratory no.** 8710 / 81

General		Available nutrients			
pH-H_2O (1: 2½ v/v)	4.9	Na/me/100g)	0.06	Mn (me/100g)	0.7
Exch. acidity (me/100g)	-	K "	0.42	P (ppm)	8
C %	2.11	Ca "	2.8	P-Olsen (ppm)	-
N %	0.23	Mg "	5.2		

Remarks: These soils are strongly acid; and they are sufficiently supplied with all nutrients except P, p fertilizers, together with Farm Yard Manure (FYM) should therefore be added to these soils for optimum production of crops.

Mapping unit BB2 — Profile No. 103/171

Geology	:	Lower Nyambeni Basalts
Physiography	:	Bottomland
Relief, macro	:	Flat to very gently undulating
Relief, meso/micro	:	Nil
Slope at site/position	:	0–1%, bottomland
Vegetation/land use	:	Grassland (very short grass)/grazing
Erosion	:	Nil
Surface stoniness	:	Nil
Rock outcrops	:	Nil
Flooding	:	Seasonal
Effective soil depth	:	Very deep (more than 120cm)
Drainage class	:	Imperfectly drained

Ap	0–25cm	Dark brown (10YR 3/3); clay; fine to medium subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine pores; many fine and medium roots; clear and smooth transition to: (Lab.no.8680/81)
AB	25–45cm	Brown (10YR 4/3); clay; weak, fine to very fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine, few medium pores; common fine roots; clear and wavy transition to: (Lab.no.8681/81)
Bcs	45–78cm	Yellowish brown (10YR 5/4); common, fine and medium, distinct, reddish yellow mottles; clay; massive structure, very hard when dry, friable when moist, sticky and plastic when wet; common medium pores; 50–70% Fe and Mn concretions 5–10mm; clear and wavy transition to: (Lab.no.8682/81)

.../17

Bg1	78–122cm	Greyish brown (10YR 5/2); common, fine and medium, prominent, red mottles; clay; strong, very fine and fine, subangular and angular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few, fine and medium pores; gradual and smooth transition to: (Lab.no.8683/81)
Bg2	122–150cm	Light-grey (10YR 7/2); many, medium prominent, red mottles; clay; weak, fine and medium subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; few, thin clay skins; many very fine and fine, common medium, pores; clear and wavy transition to: (Lab.no.8684/81)
BC	150–180cm	Light grey (10YR 7/2); clay; strong, medium platy structure; hard when dry, friable when moist, sticky and plastic when wet; few, very fine and fine pores; clear and wavy transition to: (Lab.no.8685/81)
C	180–270cm (Augered)	Light brownish grey (10YR 6/2); clay; hard when dry, firm when moist, sticky and plastic when wet. (Lab.no.8686/81)