

REPUBLIC OF KENYA
MINISTRY OF WATER AND IRRIGATION
HYDROGEOLOGICAL SURVEY REPORT
FOR
KOTENO WATER PROJET
DOMESTIC WATER SOURCE

VILLAGE
KOMOLLO
SUB-LOCATION
NORTH KOBURA
LOCATION
WEST KANYIDOTO
DIVISION
NYARONGI
DISTRICT
NDHIWA

CATCHMENT AREA
LAKE VICTORIA SOUTH

WATER SURVICE BOARD
LAKE VICTORIA SOUTH

PROVINCE
NYANZA

COUNTRY
KENYA

DURATION OF SURVEY
JULY, 2009

INVESTIGATION BY REGISTERED GEOLOGIST
"RGEOL" ISAAH O. MAWINDA



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NP/HB/WRG-2009/0196 - 0199 WON - WATER PROJECT

HYDROGEOLOGICAL SURVEY REPORT

CLIENT : KOTEKO WATER PROJECT,
P.O BOX 27
NDHIWA

PROJECT: DOMESTIC WATER SOURCE

CATEGORY: NON INSURANCE

VILLAGE: KOMOLLO

SUB-LOCATION: NORTH KABURA

LOCATION: WEST KANYIDOTO

DIVISION: NYARONGI

DISTRICT: NDHIWA

CATCHMENT AREA: LAKE VICTORIA SOUTH

WATER BOARD: LAKE VICTORIA SOUTH

PROVINCE: NYANZA

COUNTRY: KENYA

DURATION OF SURVEY: JULY, 2009

LOCATION OF SURVEYED SITE
MAPSHEET: 130/2 (34° 19.357'00E, 00° 46.430' S)
ELEVATION: 1412 METRES (BY GPS)
INVESTIGATION BY REGISTERED GEOLOGIST
"RGEOL" ISALAH O. MAWINDA

Position of the investigated site shown on the attached map extract. The above two boreholes were drilled by the Catholic Church but its details can not be immediately established.

REGIONAL GEOLOGY

The area is underlain by ancient volcanic and intrusive hard rocks, overlain by a thick weathered layer. The ancient volcanic rocks of Precambrian are represented by the Nyanzian system, Kavirondian system and Bukoban system. The systems display markedly different rock types and both Nyanzian and Kavirondian rocks are folded and intensively invaded by mainly granitic intrusions of different periods within Precambrian.

TERTIARY

These units are encountered in a small scale represented by phonolitic lava in the far southern part of the project area. Phonolites are characteristically compact, massive, dense, fine grained in texture, of metallic sound, grayish-dark in colour and their main economic value is in the ballast industry.

GRITS

These units exist in small intercalations, characterized by medium coarse grained texture, compact and dense, easily weathered to silt clayey loam soil.

METABASALTS

These units are encountered in the Northern part of the project area. They are characteristically intensively altered by both external and internal earth processes subjecting them to metamorphism and weathering processes resulting into total distortion of lithological structure. The main economic value of these rocks units include good agricultural soil, a product of external earth processing and fair ground water prospects where weathered/fractured zones are intensive.

LATERITES

The unit is spread in whole project, but mainly confirmed to gently sloping environment. Thickness developed varies from less than 0.5 to 5 meters. Characteristically compact, massive and dense has high resistivity value when traversing using vertical electrical sounding method. The unit has minimal groundwater prospects and economic value in civil works.

GRANITES

This rock units cover nearly 10% of the project area, characteristically massive, compact, dense, fine-medium-coarse grained texture, gray-pink in colour and often ~~porphyrite, with feldspars~~ phenocrysts, usually pink in colour of often greenish, rarely hornblende phenocrystal are present.

INTRODUCTION

The site is located within Komollo village, North Kobura sub-location, West Kanyidoto location, Nyarongi Division, Ndhwa District, Lake Victoria South Waters Services Board, Lake Victoria South Catchment Area, Nyanza Province, Kenya.

The main objective of the investigation was to locate the most suitable prospective, exploitative point to enable development of a ground water point source.

LOCATION

Sited at a longitude $34^{\circ} 19.357' E$ and a latitude $00^{\circ} 46.430' S$, at an elevation of 1412 metres above mean sea level, in a topographic sheets 130/2.

PHYSIOGRAPHY

The area lies within undulating plain; occasionally flood is expected but hardly affects groundwater facilities, such as shallow wells and deep drilled borehole.

CLIMATE AND VEGETATION

Climate is sub-tropical savannah characterized by hot-humid temperature, hot-dry months December-February, hot-humid month August, wet-cool months March- June. Mean temperature range $18-22^{\circ}C$ and $26-36^{\circ}C$.

Rainfall follow bimodal pattern, although minimal and irregular, long rains in March-June while short rains in August-October, mean precipitation range 1000-1300.mm.

Vegetation consists of shrubs, thickets, few scattered indigenous trees, within minimal grass, reflecting irregularity of rainfall pattern.

WATER SOURCES

Water sources include ponds, pans and water holes; piped water does not cover the area. Due to lack of reliable domestic water source, the client do intend to drill one borehole within the plot surveyed for domestic use and the estimated daily water demand is 5 cubic meters.

EXISTING BOREHOLE DATA WITHIN THE AREA

No	Name of site B/H C NO.	Distance to new site (m)	Depth (m)	Aquifer zone (m)	Yield (m ³ /hr)	Year drilled	Rock formation	Remark
1	6026	2km /S	42	34	1.2	-	TKV	Operational
2	Nyarongi comm..	1.5km/N					TKV	Operational
3	Nyarongi c.church	2km/W					TKV	Operational

Note: Distance of existing boreholes to the new site indicated in the table above.

was principally obtained in the field-using vertical electrical sounding and horizontal resistivity profiling.

RESISTIVITY METHOD:

The vertical electrical soundings (VES) were carried out to probe the condition of the sub surface to confirm the existence of possible aquifer to enable either drilling a borehole or construction of a shallow well.

BASIC PRINCIPLES:

The electrical properties of rocks in the upper part of the earth crust are dependent upon the lithology; porosity; the degree of pore space saturation and the salinity of the pore water.

Saturated rocks have lower resistivities than unsaturated and dry rocks.

- o The higher the porosity of saturated fluids and the lower the resistivity.
- o The presence of clayey and conductive minerals also reduces the resistivities of the rocks.
- o The resistivities of earth materials can be studied at the earth surface by an electrical current is passed through the earth.

GEOPHYSICS

During the field investigation, Three Vertical Electrical Soundings (VES) were conducted, within the target area, data analyzed and tabulated below.

Analyzed Geophysical data

Resistivity Curve No®	Altitude (M)	Layer No.	Resistivity (Oh-M)	Depth (M)	Expected Lithology	Water Prospect
R -2009/0196	1412	1	8	1.80	Loose top soil	Poor
		2	38	16.36	Weathered rock	fair
		3	30	46.86	Highly fractured zone	Good
		4	41	122.35	Fractured zone	Good
		5	85	160	Slightly fractured zone	fair
		6	90	>	Slightly fractured to basement rock	variable
R -2009/0197	1412	1	7	1.0	Loose top soil	Poor
		2	28	61.75	Fractured zone	Good
		3	45	81.75	Weathered fractured zone	Good
		4	103	>81.75	Slightly fractured to basement rock	variable
R -2009/0198	1317	1	5	1.76	Loose top soil	Poor
		2	25	10.87	fractured zone	fair
		3	31	58.34	Weathered/fractured zone	Good
		4	54	130	Slightly weathered zone	fair
		5	80	>130	Slightly wethered to basement rock	variable

The rock unit is resistant to weathering forming erosional remnant, tors and boulders, resulting to topographical feature of rough undulating terrain with valleys sandwiched between ridges.

The unit when weathered and eroded down streams, the product is sand which has application in civil works.

STRUCTURAL FEATURES

The main geological feature in Western Kenya is the Kavirondo Rift System. These branches from main south oriented towards central Rift Valley System and have ENE –WSW. The formation of the rift valley involved two strategies:

Stage of down warping relating to the formation of a shallow basin during the Miocene (2-6 million years) to Pleistocene time (2-01million years)the process of the Rift System let to dams of faults within the region; Kanyamwa faults which signifies the presence of minor faults superficial deposit the presence of minor faults thus making it difficult to delineate their lateral extent by use of Geophysics nevertheless numerous minor faults – have been mapped by use of satellite imagery and aerial photo interpretation

LOCAL GEOLOGY

The main rock formation within the project area include Tertiary Kaksingri Volcanics and sediments, overlying the Basement System, overlain by clayey loam soil

HYDROGEOLOGY

Hydrogeology describes aspects of Groundwater prospects and is dependent on:-

- The nature of parent rocks
- Structural features
- Weathering process
- Nature and pattern of precipitation
- Localized identified catchments

During field investigations, the natures of parent rocks and localized catchments were studied and identified through Geological mapping, structural features and weathering process through the applications of Geophysical techniques, precipitation pattern, from meteorological data.

GEOPHYSICAL METHODS:

The investigation of Groundwater involved the applied of Geophysical technique, to probe the sub surface Hydrogeology.

A variety of methods are available to assist in the assessment of Geological sub surface conditions. The main emphasis of the field undertaken was to determine the thickness and composition of the sub-surface formation and to identify water-bearing zone. This information

```

koteko water project ves 2
Depth [m] resist. [Ohm.m]
1.60 11.00 0
2.00 12.00 0
2.50 12.00 0
3.20 15.00 0
4.00 16.00 0
5.00 17.00 0
6.30 18.00 0
8.00 19.00 0
10.00 21.00 0
13.00 22.00 0
16.00 23.00 0
20.00 25.00 0
25.00 25.00 0
32.00 28.00 0
40.00 29.00 0
50.00 29.00 0
63.00 31.00 0
80.00 32.40 0
100.00 32.60 0
130.00 38.20 0
160.00 45.00 0
.00 .00 0
Koteko V 2
.000 .000 1330.000
4
1.00 7
61.92 28
81.75 45
99999.00 103
99999.00 100
99999.00 100
99999.00 100
99999.00 100
99999.00 100
99999.00 100
99999.00 100
100

```

Note: The vertical electrical sounding (VES modeled using geophysical - NileSoftware - Gewin V1.04©2001 data attached for ease of reference.

CONCLUSION AND RECOMMENDATION

The analyzed Geophysical data, revealed a possible prospective, exploitative weathered fractured zone. It is therefore recommended that a borehole to a maximum depth of **85 metres** be drilled at appoint marked along **VES I**. The selected site is known to Bernard Otieno, a family member.

THE NECESSARY REQUIREMENT

- Drilling must only take place after obtaining authorization from the Regional Manager, Water Resources Management Authority
- Drilling work must be adequately supervised by a qualified Hydrogeologist or Groundwater Inspector to ascertain quality work. .
- On successful completion of the work, standard water analysis must be done before any human use.

**"RGEOL" ISAIAH O. MAWINDA
REGISTERED GEOLOGIES**

**FOR
PROJECT MANAGER-LVEMP
(WATER QUALITY COMPONENT)**

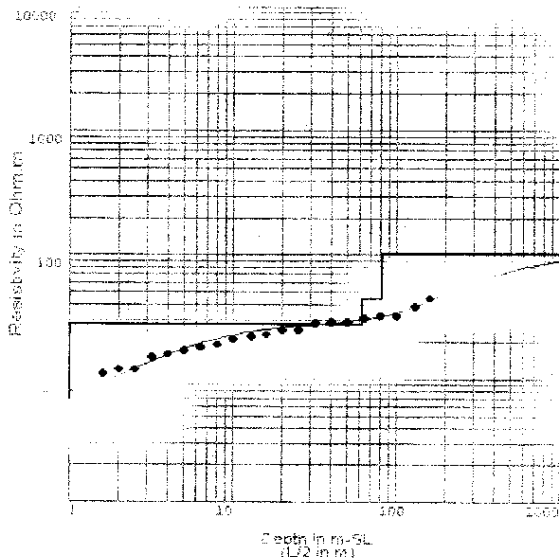
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koteko water project; ves 1
Depth [m] resist. [Ohm.m]
1.60 9.00 0
2.00 9.60 0
2.50 10.40 0
3.20 12.00 0
4.00 13.12 0
5.00 15.00 0
6.30 17.00 0
8.00 20.40 0
10.00 23.00 0
13.00 26.00 0
16.00 27.00 0
20.00 29.00 0
25.00 31.00 0
32.00 33.00 0
40.00 33.00 0
50.00 32.13 0
63.00 33.50 0
80.00 35.20 0
100.00 37.00 0
130.00 37.00 0
160.00 41.30 0
.00 .00 0
Koteko V 1
.000 .000 1330.000
5
1.80 8
16.36 38
46.86 30
122.35 41
99999.00 85
99999.00 90
99999.00 90
99999.00 90
99999.00 90
99999.00 90
90

```

***** NiLeSoftware ***** GEWin V1.04 © 2001 *****

Measurement : Koteko V 2



Coordinates : (0 , 0)
 Surface level: *****m+Ref.level

Geo-electrical model

Bottom Layer	Resistivity
m - SL	Ohm.m
1.00	7
61.92	28
81.75	48
99999.0	103
End resistivity:	100

SSD on log-scale : .01843

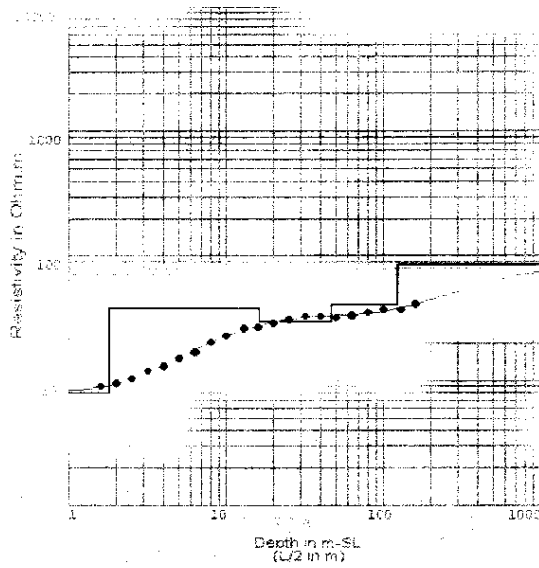
Date (y-m-d) : 2009-9 -9

koteko water project ves 3

Depth [m]	resist. [Ohm.m]	
1.60	5.20	0
2.00	6.00	0
2.50	6.30	0
3.20	7.70	0
4.00	9.00	0
5.00	10.30	0
6.30	12.00	0
8.00	13.00	0
10.00	15.00	0
13.00	16.00	0
16.00	18.40	0
20.00	20.00	0
25.00	22.00	0
32.00	24.00	0
40.00	26.00	0
50.00	27.00	0
63.00	28.00	0
80.00	31.40	0
100.00	31.90	0
130.00	32.00	0
160.00	35.00	0
.00	.00	0
Koteko V 3		
.000	.000	1317.000
4		
1.76	5	
10.87	25	
85.34	31	
99999.00	54	
99999.00	80	
99999.00	80	
99999.00	80	
99999.00	80	
99999.00	80	
99999.00	80	
80		

***** NiLeSoftware ***** GEWin V1.04 © 2001 *****

Measurement : Koteko V 1



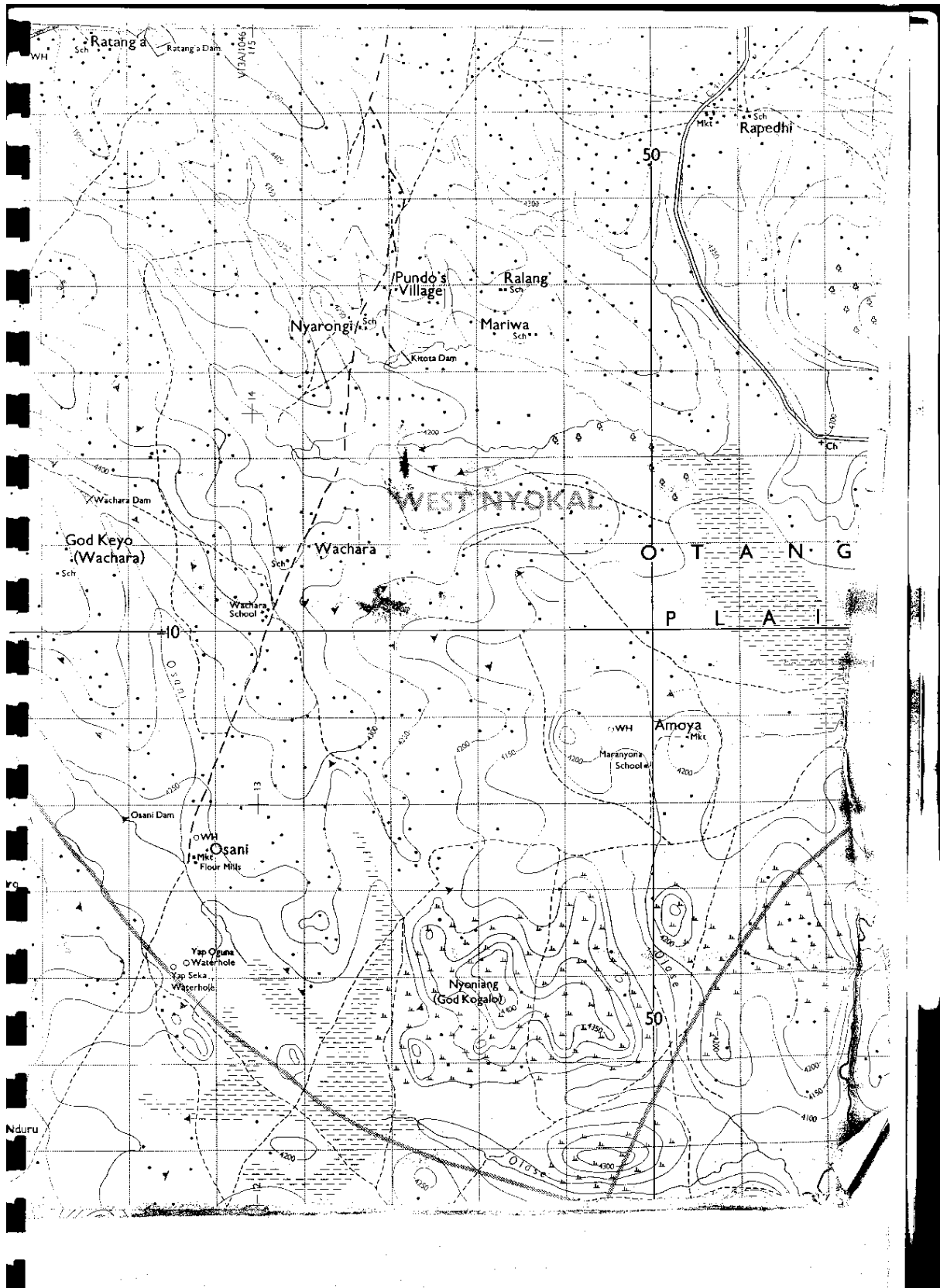
Coordinates : (0 , 0)
 Surface level: *****m+Ref.level

Geo-electrical model

Bottom Layer	Resistivity
m - SL	Ohm.m
1.80	8
16.35	38
46.85	30
122.35	41
9999.0	88
End resistivity :	90

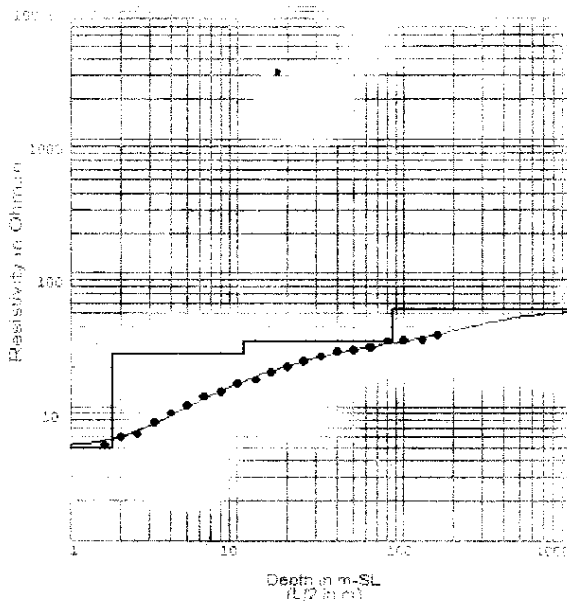
SSD on log-scale : .00180

Date (y-m-d) : 2009-8 -9



***** NiLeSoftware ***** GEWin V1.04 © 2001 *****

Measurement : Koteko V 3



Coordinates : (0 , 0)
Surface level: *****m+Ref.level

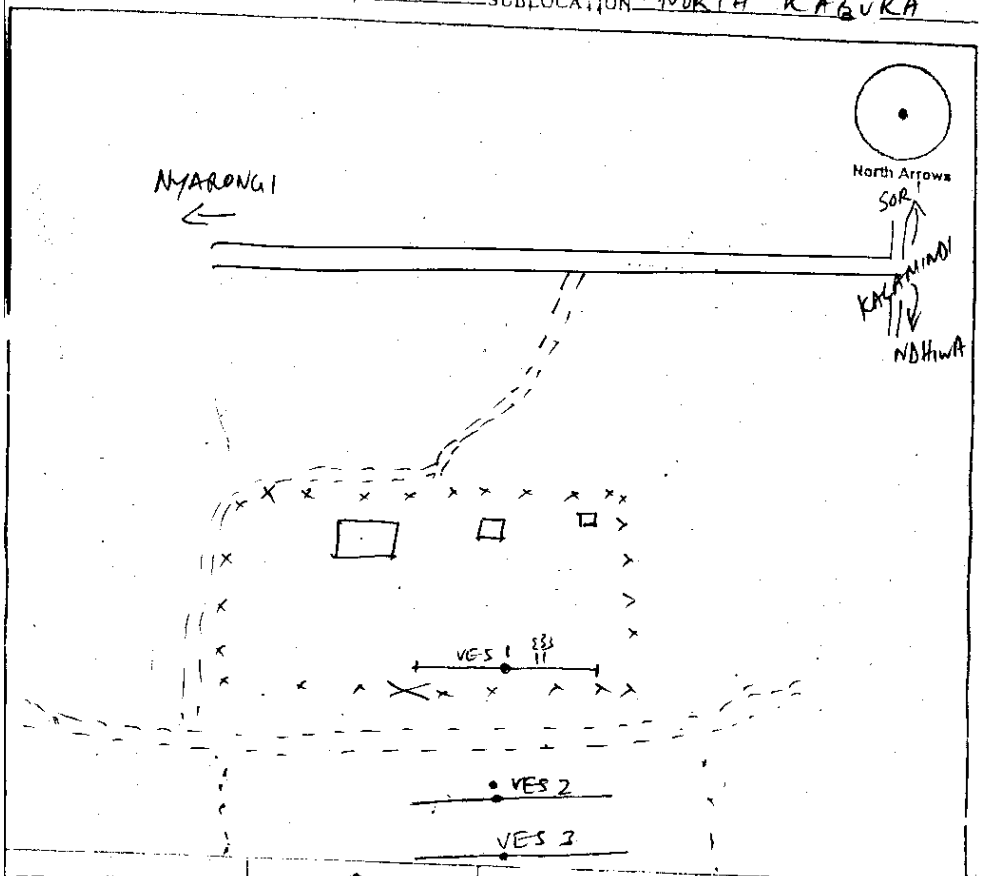
Geo-electrical model

Bottom Layer	Resistivity
m - SL	Ohm.m
1.76	5
10.87	25
85.34	31
99999.0	54
End resistivity :	50

SSD on log-scale : .00437

Date (y-m-d): 2009-8 -9

SITE KOTEKO WATER PROJECT SITE NO _____
 NYARONGI DIVISION NDHWA DISTRICT
 MAP SHEET 130/2 GRID REFERENCE 34°19'39"E 00°46'40"S
 LOCATION WEST KANYIDOTO SUBLOCATION NORTH KABURA



<ul style="list-style-type: none"> Tarmac road Murrain road Foot Path Railway Telephone line Bridge Culvert Wire fence Building House Round houses Steep hill Stones/boulders 	<ul style="list-style-type: none"> Trees Strubs Shamba Sisal fence Hedge Long grass Bananas River perennial River-Seasonal Pond/dam Area temporarily flooded 	<ul style="list-style-type: none"> Domestic Water point Spring Perennial Spring Seasonal Shallow Well Borehole Small waterhole Roof Catchment with hand pump 	<ul style="list-style-type: none"> Vertical Electrical Sounding (VES) Geographical profile 20m Distance In Metres Recommended well location Recommended borehole location
<p> VES1 VES2 = 5.0 VES2 - VES3 = 5.0 VES3 - VES4 = 4.0 VES4 - VES5 = 0.0 VES5 - VES6 = 0.0 VES6 - VES7 = 0.0 </p>			