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ANNEX C: Geotechnical Investigations

LIST OF ABBREVIATIONS AND ACRONYMS

Fiscal Year:

Egypt: 01 July – 30 June

Ethiopia: 08 July – 07 July

Sudan: calendar year

MEASURES

Km	=	kilometre
Km^2	=	square kilometre
m	=	metre
m^3	=	cubic metre
mm	=	millimetre
Mm^3	=	million cubic metres
BCM	=	billion cubic metres
1 ha	=	2.38 feddans
1 feddan	=	0.42 ha

ABBREVIATIONS

ADB/F	African Development Bank/Fund
AGS	Addis Geo Systems
ANRS	Amhara National Regional State
API	Aerial Photo Interpretation
ARBID/MPS	Abbay River Basin Integrated Development Master Plan
ASTM	American Society for Testing of Materials
BCM	Billion Cubic Meters = 1 km^3
B/C ratio	Benefit Cost ratio
BH	Borehole
BS	British Standards

CEC	Cation Exchange Capacity
CS	Complementary Surveys
DC	Direct electrical current
DCTP1	Dinger canal Test pit 1
DTP	Dinger test pit
ResTP	Pump station test pit
DCoTP1	Dinger construction material test pit 1
DIU	Dams Implementation Unit (Sudan)
DOCS	Date of Commencement of Services
dS/m	deci-Siemens per meter
d/s	downstream
EC	Electrical conductivity
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMA	Ethiopian Mapping Agency
ENCOM	Eastern Nile Council of Ministers
ENPV	Economic Net Present Value
ENTRO	Eastern Nile Technical Regional Office
ENSAP	Eastern Nile Subsidiary Action Program
ENSAPT	Eastern Nile Subsidiary Action Program Team
ENCOM	Eastern Nile Council of Ministers
EPMS	Environmental Protection Monitoring Strategy
ESP	Exchangeable Sodium percentage
ESCP	Ethiopian Standard Code of Practice
EWA	Ethiopian Water Authority
FAO	Food and Agriculture Organization
FNPV	Financial Net Present Value
FIRR	Financial Economic Rate of Return
G	Gravity

GFDRE	Government of the Federal Democratic Republic of Ethiopia
GOE	Government of Egypt
GOS	Government of Sudan
GPS	Geographical Positioning System
GRP	Glass reinforced polyester
GTZ	German Technical Cooperation Agency
Ha	hectare
HDPE	high density poly ethylene
HP	hydro power
HQ	High Quality (classification for drilling core)
ICCON	International Consortium for Co-operation on the Nile
ICT	International Consultants and Technocrats Pvt LtD
IEE	Initial Environmental Examination
ISL	Isambert Salembier Lino Consultants
LUT	Land Utilisation Type
LUR	Land Use Requirement
masl	Meters above sea level
MC	Main Conveyor
MCA	multi-criteria analysis
mcm	Million Cubic Meters
MoIWR	Ministry of Irrigation and Water Resources (Sudan)
MoWR	Ministry of Water Resources (Ethiopia)
mS	micro Siemens
N1, N2	Land suitability classes
NBI	Nile Basin Initiative
NEDECO	Netherlands Engineering Consultants (Consulting Firm)
NELSAP	Equatorial Lakes Subsidiary Action Programme
NELT	North East Lake Tana
NGO	Non-Governmental Organization

Nile-SEC	NBI Secretariat
Nile-COM	Nile Council of Ministers
NQ	Normal Quality (classification of drilling core)
OIDA	Oromia Irrigation Development Authority
ONRS	Oromia National Regional State
O&M	Operation and Maintenance
P	Pumping
PA	Peasant Association
PF	Pre-feasibility
PFS	Pre-feasibility Study
PMO	Project Management Office
PS	Pump station
RfP	Request for Proposal
RQD	Rock Quality Designation
S1, S2, S3	Land suitability classes
SAP	Subsidiary Action Programmes
SAR	Sodium Adsorption Ration
SEIA	Social and Environmental Impact Assessment
SDS	Small Disturbed Sample
SPT	Standard Penetration Test
SPT-N	Standard Penetration Test-Normal
SVP	the Shared Vision Programme
TAMS	Tippets-Abbett-McCarthy-Stratton Engineers and Architects
tc	ton of cane
T_c	time of concentration (only used in hydrological calculations)
TCC	Technical Coordinating Committee
TDS	Total Dissolved Solids
TLU	Tropical Livestock Unit (metabolic weight equivalence)
TOR	Terms of Reference

TRBID/MPS	Abbay River Basin Integrated Development Master Plan
TTB2	a set of geological formations
UA	Unit of Account
u/s	upstream
USBR	United States Bureau of Reclamation
UTM	Universal Transverse Mercator
VES	Vertical Electric Sounding
WAPCOS	Water and Power Consultancy Services (India) Ltd.
WB	World Bank
WRMP	Water Resources Management Policy
WUA	Water Users Association
WWD&SE	Water Works Design and Supervision Enterprise

CONVERSION FACTORS

0.42 ha = 1.00 feddan

ANNEX C: GEOTECHNICAL INVESTIGATIONS

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Appendix A

Appendix B

APPENDIX A: VERTICAL ELECTRICAL SOUNDING SURVEY

1. INTRODUCTION

1.1 General

This Geophysical investigation report is prepared as per the contract agreement made with Metaferia Consulting Engineers to carryout detail surface electrical resistivity survey using the most frequently employed technique, namely Vertical Electrical Soundings at Dinger Bereha (Kobo Bereha) Irrigation Project Weir site.

The geophysical investigation was carried out from April 23 to 27, 2009. A total of eight Vertical Electrical Soundings (VES) were made, with the aim of determining the thickness of the overburden material, depth of the bed rock and anticipating the quality of the rock (degree of weathering) which of course supplement the geotechnical investigation.

1.2 Location, Topography and Accessibility of the Project Area

Dinger Bereha (Kobo Bereha) Irrigation Project Weir site is located on Didessa river in Oromia Regional State, Illubabor zone, it is accessible after driving 14 km along all weather road that runs to Nekemte, and then turning to the north-west and following the gravel road about 51km up to site I (resettlement village of western Harerge peasants).The last 14 km are hardly accessible by 4WD. The topography of the area is undulating and incised by gullies, the right bank was accessed by boat. The average elevation of the site is about 1248m.The land in the vicinity of river is extensively covered with thick forest and savannah grass.

1.3 Geology of the Area

Detail geological information or mapping was not made, however from field observation, the study area is dominated by Precambrian basement (granitic gneiss) overlain by a succession of alluvial unconsolidated sediments of varying grain size and sorting .Exposure of the basement rocks prevail on the river beds of the weir site and at the creek about 300m before reaching the site .

2. GEOPHYSICAL SURVEY

Geophysical survey has long been utilized by geologist, engineering geologist, and hydro geologist to determine indirectly the extent and nature of the geologic materials beneath the surface. In order to supplement the geotechnical investigation and also to provide additional subsurface information, geophysical survey namely, Vertical Electrical Sounding/VES was conducted.

2.1 Vertical Electrical Sounding /VES/ Survey

The Vertical Electrical Sounding (VES) or electrical drilling as it is often called is a technique by which depth investigations are made. It furnishes detailed information on the vertical succession of the various layers, their individual thicknesses and true resistivities. The basis for making VES is that by expanding the distance of the electrode spacing between readings a deeper vertical penetration or probing will be achieved.

2.2 Objectives of the Geophysical Survey

- The electrical resistivity/VES survey was aimed at:-
- Determining the nature and thickness of the overburden materials
- Estimating the depth to the bedrock
- Determining the quality of the bedrock, based on its resistivity value
- Identifying different lithological units

2.3 Survey Layout and Volume of Work

A total of eight Vertical Electrical Soundings (VESs) were conducted at the weir site. The VESs were conducted along the centre lines of the two proposed weirs (up and down stream). Specifically the resistivity investigation was conducted along two mutually parallel lines (up and down stream weir axis's) laid down perpendicular to Didessa river. On each lines four VESs were carried out, two at the right bank and the remaining two at the left bank.

The coordinates of each VESs were determined by the geotechnical expert. To facilitate their identification and orientation a hand held GPS was used. The total volume of the survey is presented by the following table.

Table 1 Summary of VES Survey

Survey Area	Number of VES Conducted	VES No	UTM coordinate of VES Points
Upstream weir axis	4	VES1	0203675E 0983580N
		VES2	0203691E 0983550N
		VES3	0203692E 0983375N
		VES4	0203712E 0983323N
Downstream weir axis	4	VES5	0203508E 0983546N
		VES6	0203499E 0983482N
		VES7	0203530E 0983303N
		VES8	0203543E 0983274N
Total	8		

2.4 Instrumentation, Field Procedure, Data Processing and Presentation

2.4.1 Instrumentation

The instrument used during the survey was a portable integrated (transmitter and receiver in one unit) resistivity meter, Terrameter (SAS 300C) powered by 12V battery. It has stacking and digital (LCD) readout features i.e., during resistivity survey it automatically calculates ΔV/I and displays the resistance either in ohms or milliohms.

2.4.2 Field Procedure, Data Processing and Presentation

Symmetrical Schlumberger electrode configuration was used during the survey. In this type of VES survey electric current is injected into the ground by means of two outer current electrodes, and the resulting potential difference or potential drop is measured by a second pair of potential electrodes placed near the centre of the current electrodes. A series of measurements are taken by progressively increasing the current electrode separation. Increasing or expanding the electrodes causes an increase in the fraction of the injected current that penetrates below a given depth, and this results a deeper vertical penetration or probing.

The maximum electrode separation (AB/2) used was 45m, it is based on the depth of interest (at least 30 meters) and subsurface geology. The sounding curve which is a plot of apparent resistivity versus half the distance between the current electrodes (AB/2), is readily plotted in the field (on a double logarithm coordinates with a module of 62.5mm), this is done because if any error is detected it could easily be corrected by taking repeated measurements.

The sounding curves collected in the field were initially interpreted by two layer master curves and auxiliary point charts (curve matching) the layer parameters obtained by curve matching have been used as a starting model (initial guess) in an iterative least squares inversion program, RESIST. (Velpen, 1988). In order to arrive at accurate and reasonable conclusion, the VES curves were interpreted in terms of the knowledge of the local geology.

To have a clear view of the subsurface geology, geo-electric section were constructed by correlating the interpreted true resistivities and thicknesses of adjacent soundings .The section shows both lateral and vertical variation of resistivity which could be related to different lithologies.

3. RESULTS AND INTERPRETATION

3.1 Upstream Weir Site

On the geo-electric section Fig 1, the interpreted top superficial layers are not shown due to their smaller thicknesses (less than 1m), rather the dominant and thick layers of geologic and geotechnical importance, are presented on the section. An interested reader can find detail interpreted layer parameters and probable lithologies of all VESs on Annex-1.

At the investigated site (up steam weir axis) the traverse line/weir axis along which the section is constructed is orienting in a N-S direction .Along the profile four VESs namely VES1, VES2 (right bank) and VES3, VES4 (left bank) were carried out. The total length of the surveyed line is 275 meters.

The geo-electric section (Fig. 1) clearly delineates three resistivity layers. The first layer resistivity value is about 11 Ohm-m and the thickness varies between 4m and 1.8m. It is relatively thin (1.8m) at VES4 (left bank), it gets progressively thicker (4m) towards VES1 - VES2. This horizon represents the alluvial soil that covers the river area. The low resistivity values of this layer along the whole traverse indicate that it is composed of uniform and fine material, i.e. Clay or Silty clay.

The second layer has an average thickness of 2m, and the computed true resistivity is almost 90 Ohm-m. This layer may correspond to a moderately weathered granitic gneiss which outcrops in the gullies and river bed.

The bottom electrical substratum is represented by a high resistivity values ranging between 330 and 380 Ohm-m, it is related to a fresh and massive basement rock/ granitic gneiss.

Table 2 VES Points and calculated over burden thickness along the upstream weir axis.

Survey Area	Number of VES Conducted	VES No	Elevation of VES Points (m)	Calculated or inferred thickness of the over burden material (m)	Probable lithology
Upstream weir site	4	VES 1	1249	3.9	Silty clay
		VES 2	1248	3.7	Ditto
		VES 3	1248	2.7	Ditto
		VES 4	1249	1.8	Ditto

3.2 Downstream Weir Site

The resistivity profile was laid down on the weir axis and its length is 270 meters. Similar to the up stream site, four VESs were conducted, VES5, VES6 (right bank) and VES7, VES8 (left bank).

The geo-electric section along VES5-VES8 (Fig.2) is marked by three distinct resistivity layers. The resistivities of the uppermost layer, range between 5 and 19 ohm-m, and has an average thickness of 3m. It possibly represents the top loose sediment along the banks of Didessa.

The second layer is dominantly marked by a moderate resistivities (74-90 Ohm-m), its average thickness is about 2.2 meters. This horizon is related to moderately weathered metamorphic rocks (granitic gneiss).

The underlying third layer along the section exhibits high resistivities ranging between 335-424 Ohm-m and lies relatively at shallow depth 4.2m) beneath VES7-VES8 (left bank) while under VES5 and VES6 (right bank) the inferred depth to the top of this resistive layer is about 5.5m. This strata is interpreted as representing massive basement rock (granitic gneiss).

The table below shows the overburden thickness or inferred depth to the bedrock, beneath each VES points along down stream weir axis.

Table 3 VES Points and calculated over burden thickness along downstream weir axis.

Survey Area	Number of VES Conducted	VES No	Elevation of VES Points (m)	Calculated or inferred thickness of the overburden material (m)	Probable lithology
Downstream weir site	4	VES5	1249	2.7	Silty clay
		VES 6	1248	3	Ditto
		VES 7	1248	2.2	Ditto
		VES 8	1249	1.9	Ditto

Figure 1: Geo-electric Section along VES 1-VES4 (Up Stream Weir Site Bereha Kobo)

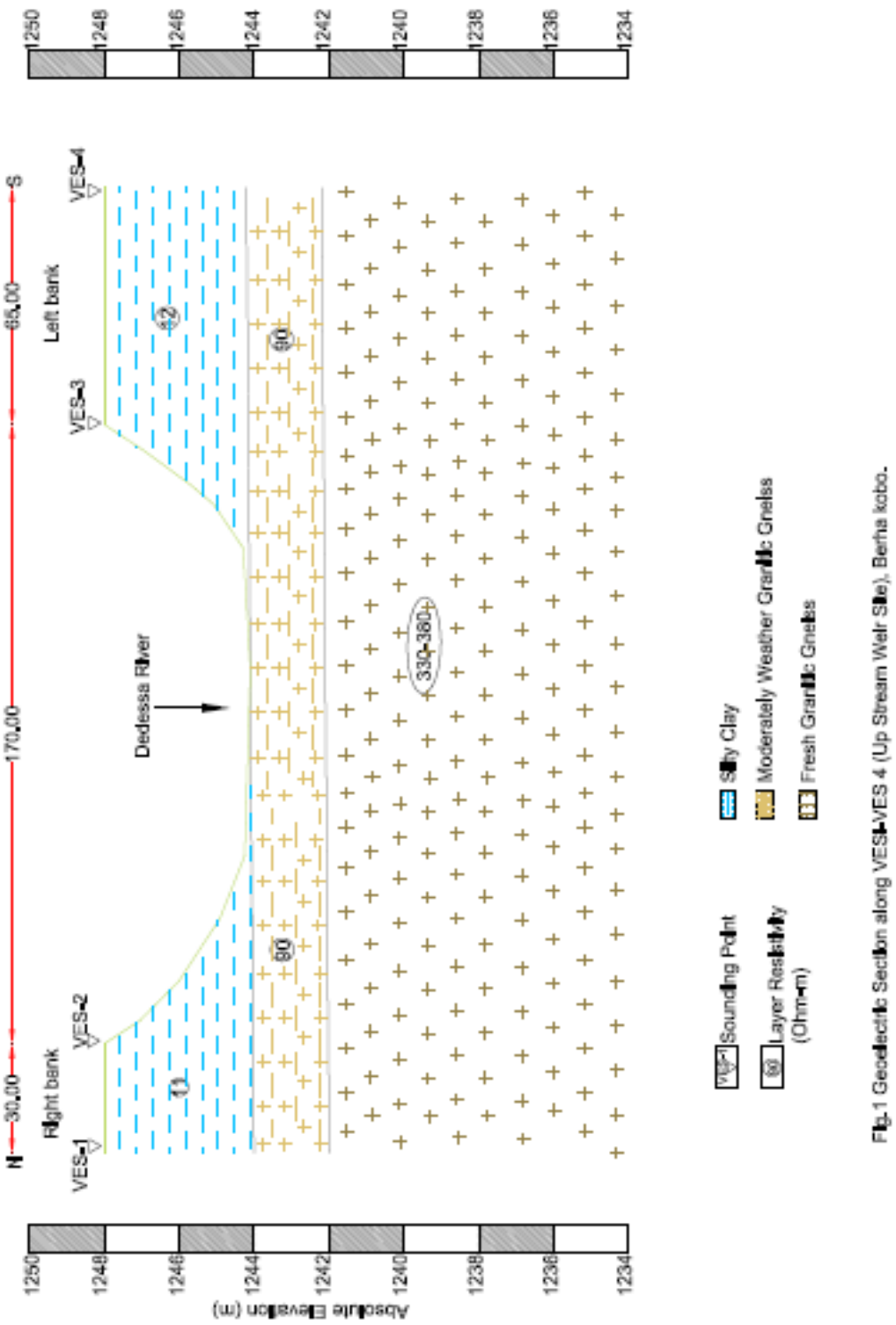
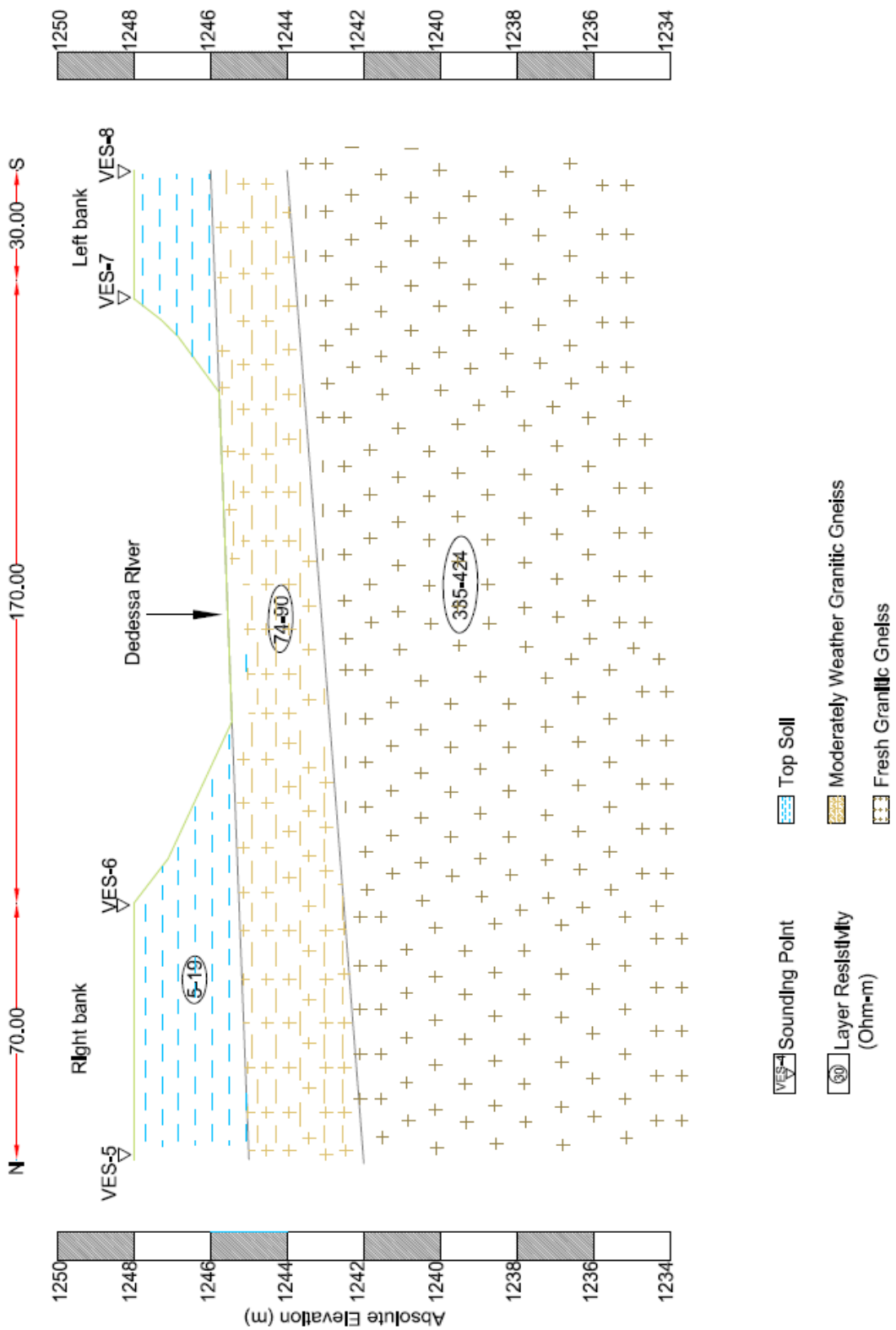


Fig.1 Geoelectric Section along VES1-VES 4 (Up Stream Weir Site), Bereha kobo.

Figure 2 Geo-electric section along VES 6- VES 8



4. CONCLUSION AND RECOMMENDATION

The electrical resistivity (VES) investigation conducted at Dinger Bereha Irrigation Project (Bereha Kobo) weir site was able to determine the thickness of the overburden materials and quality of the bedrock (based on its resistivity values). The results of all VESs indicate that the surveyed areas are underlain dominantly by a succession of low, moderate and high resistivity layers, which may be correlated to a sequence of alluvial sediments, moderately weathered and sound/massive bed rock (granitic gneiss).

On both weir axes the sediments is slightly thick on the right bank (about 4m), towards the left bank it is about 2meters. The asymmetry in thickness may be attributed to asymmetry in subsurface elevation of the bedrock, or due to variations in rates of erosion and deposition. However when the depth to the sound bedrock is compared on the two axes it lies at shallow depth along downstream weir site.

There is only slight variation of the resistivity along the bedrock, clearly indicating the uniform quality of the substratum, fresh and sound bedrock characterized by higher resistivities, more than 300 Ohm-m. Abrupt change in the calculated depth to the top of the bedrock has not been found along the two geo-electric sections, showing the absence of discontinuity or dislocation of the bed rock which can be caused by a normal fault .

ANNEXES TO APPENDIX A

Annex 1: VES Results

Results of VES 1-VES 4 (along upstream weir axis)

VES 1

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	26.2	0.8	0.8	Dry top soil
2	Second	10.2	3.2	3.9	Silty clay
3	Third	90	2	5.9	Moderately weathered basement
4	Fourth	358	--	--	Massive/fresh Granitc gneiss

VES 2

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	33.7	0.9	0.9	Dry top soil
2	Second	12.5	2.8	3.7	Silty clay
3	Third	90	1.9	5.6	Weathered basement
4	Fourth	330		--	Massive/fresh basement

VES 3

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	30.3	0.7	0.7	Dry top soil
2	Second	13.9	2	2.7	Silty clay
3	Third	89.2	2.4	5.1	Moderately weathered basement
4	Fourth	361.3	--	--	Massive/fresh basement

VES 4

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	10.5	1.8	1.8	Silty clay
2	Second	89.5	2.5	4.2	Moderately weathered basement
3	Third	378.7	--	--	Massive/fresh Granitc gneiss

Results of VES 5-VES 8 (along downstream weir axis)

VES 5

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	19.3	2.7	2.7	Top soil/clayey or silty
2	Second	74.1	2.7	5.4	Moderately weathered basement
3	Third	335	--	--	Massive/fresh Granitc gneiss

VES 6

No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	66.7	1	1	Top soil l mixed with sand or gravel
2	Second	38.6	2	3	Clayey /sandy soil
3	Third	85.8	2.5	5.5	Moderately weathered basement
4	Fourth	484.6	--	--	Fresh/sound bedrock , Granitc gneiss

VES 7

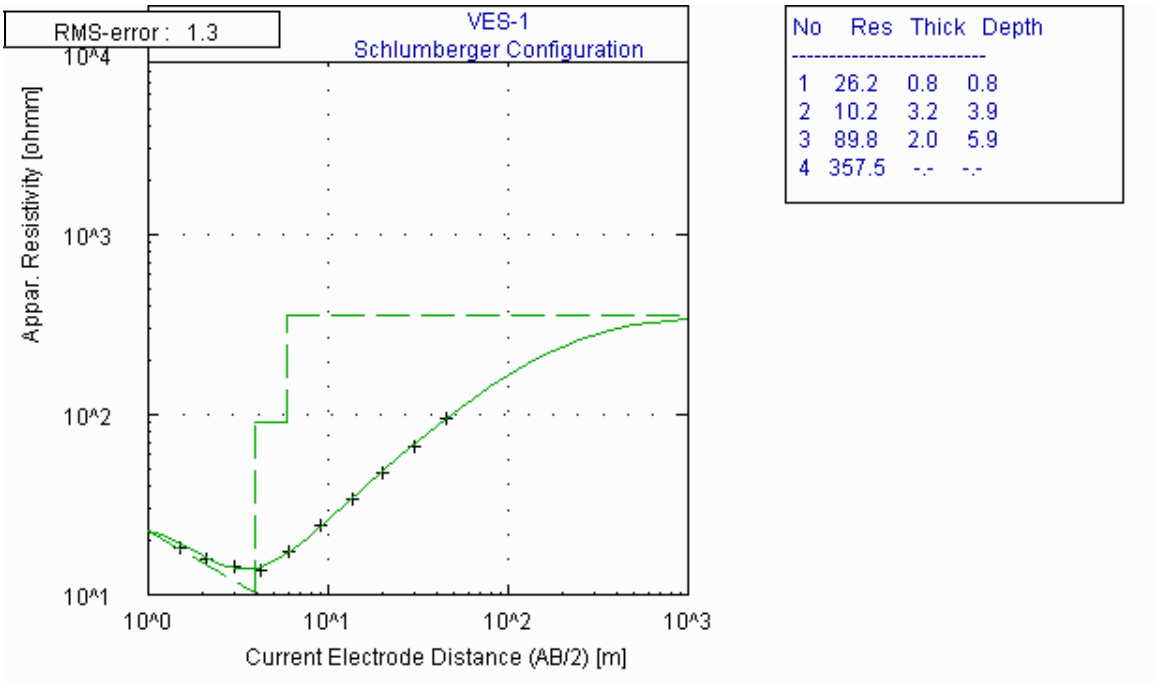
No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	18.2	2.2	2.2	Top dry soil
2	Second	85.8	2.3	4.5	Moderately weathered basement
3	Third	363.8	--	--	Fresh/sound bedrock Granitc gneiss

VES 8

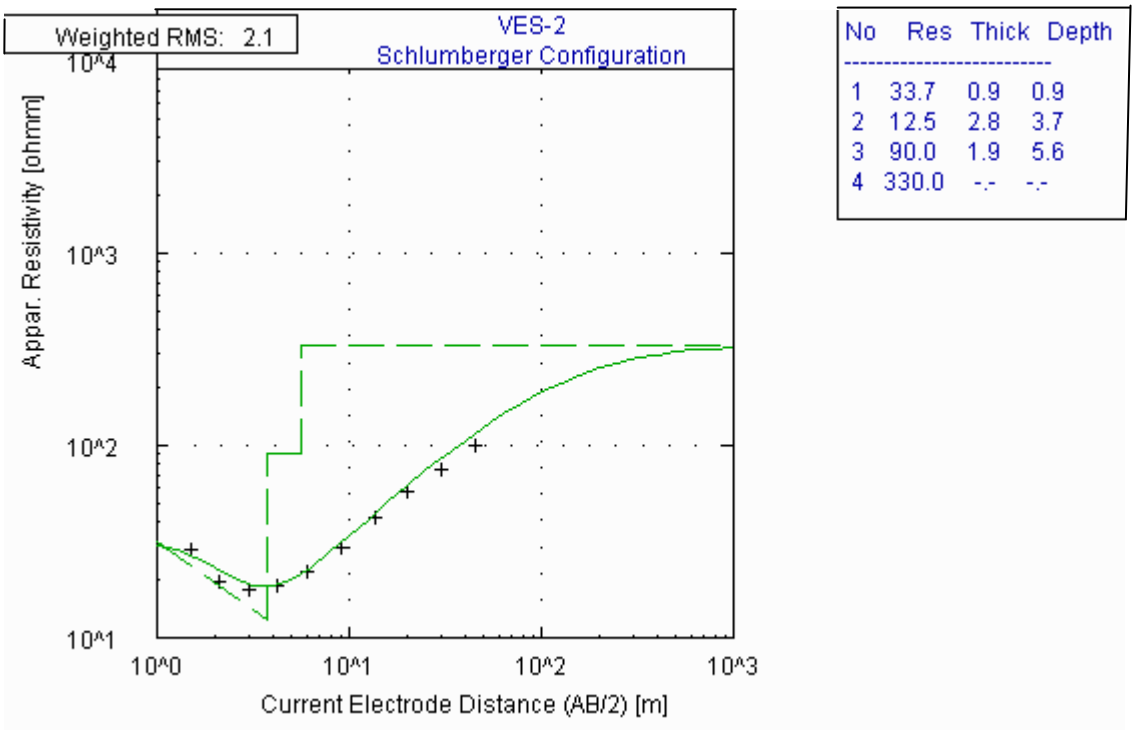
No.	Layer	Resistivity (ohm-m)	Thickness (m)	Depth (m)	Probable Lithology
1	First	5.4	1.9	1.9	Top clayey soil
2	Second	90.2	2.2	4.2	Weathered basement
3	Third	469.5	--	--	Fresh/sound bedrock ,Granitc gneiss

Annex 2: Smoothed and Interpreted VES Curves

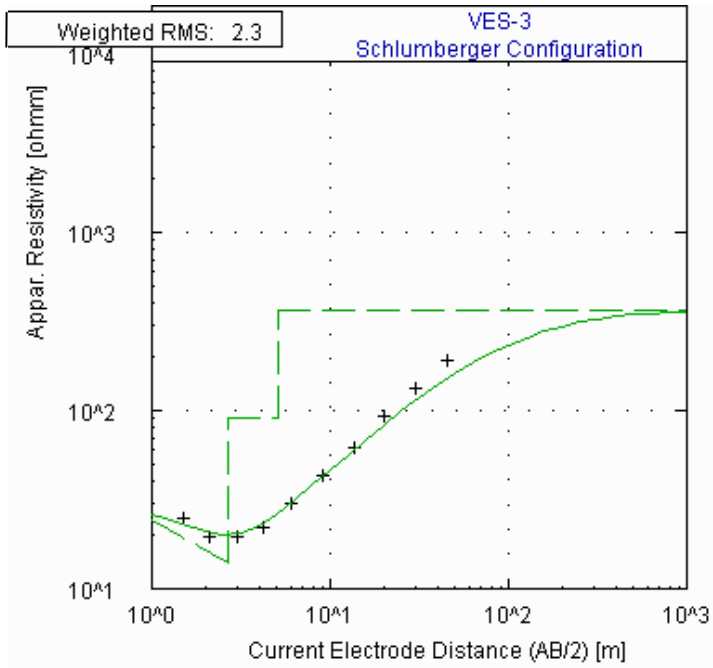
Upstream Weir Site



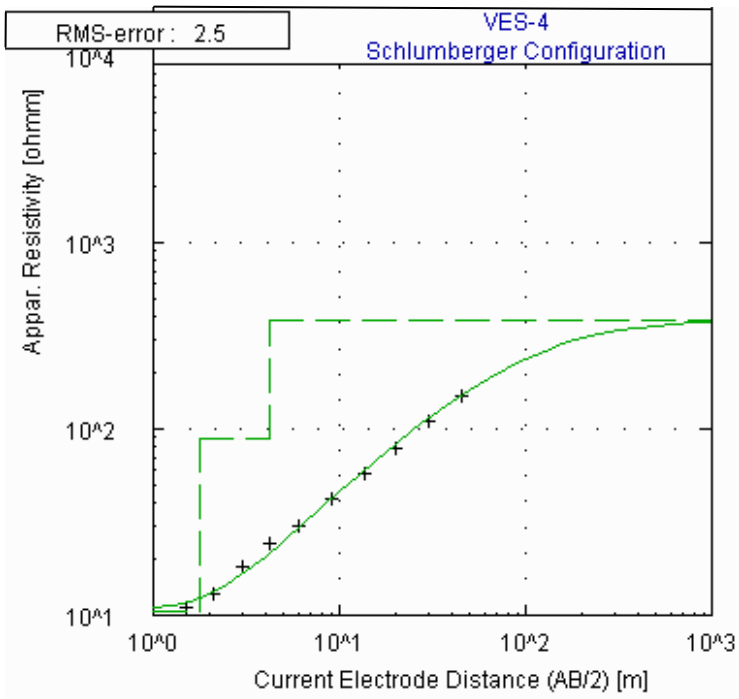
No	Res	Thick	Depth
1	26.2	0.8	0.8
2	10.2	3.2	3.9
3	89.8	2.0	5.9
4	357.5	-.-	-.-



No	Res	Thick	Depth
1	33.7	0.9	0.9
2	12.5	2.8	3.7
3	90.0	1.9	5.6
4	330.0	-.-	-.-

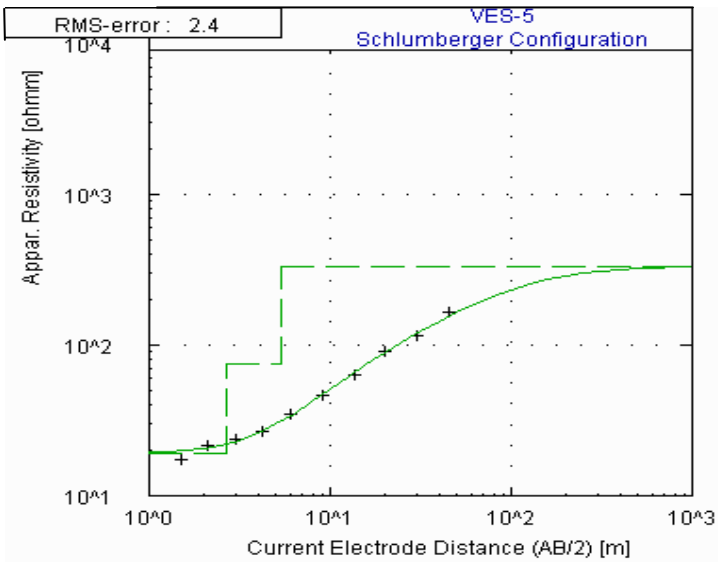


No	Res	Thick	Depth
1	30.3	0.7	0.7
2	13.9	2.0	2.7
3	90.0	2.4	5.1
4	361.0	-.-	-.-

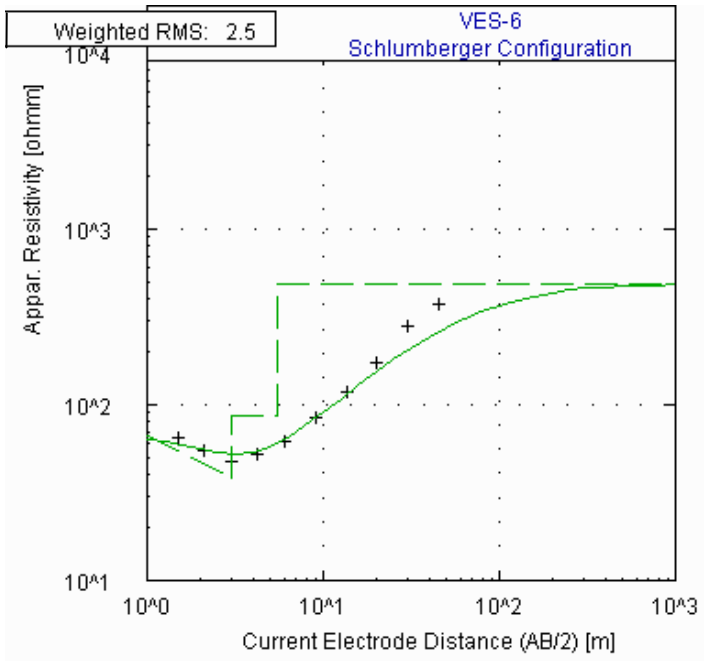


No	Res	Thick	Depth
1	10.5	1.8	1.8
2	89.5	2.5	4.2
3	378.7	-.-	-.-

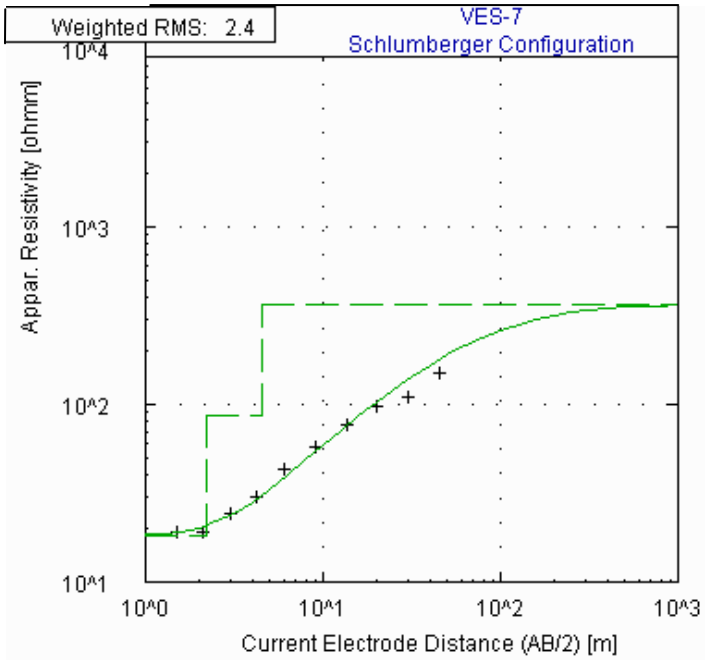
Downstream Weir Site



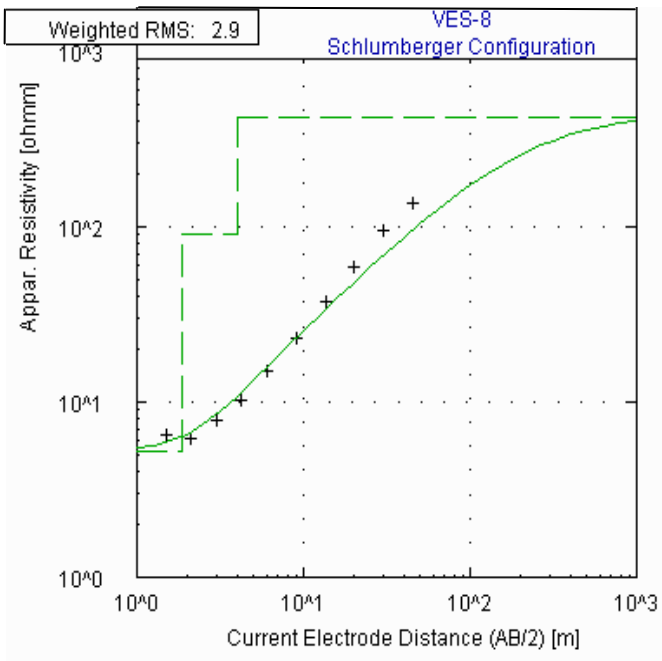
No	Res	Thick	Depth
1	19.3	2.7	2.7
2	74.1	2.7	5.4
3	335.0	-.-	-.-



No	Res	Thick	Depth
1	66.7	1.0	1.0
2	38.6	2.0	3.0
3	85.8	2.5	5.5
4	484.6	-.-	-.-



No	Res	Thick	Depth
1	18.2	2.2	2.2
2	85.8	2.3	4.5
3	363.8	-.-	-.-



No	Res	Thick	Depth
1	5.3	1.9	1.9
2	91.1	2.2	4.0
3	423.7	-.-	-.-

No.	AB/2	MN/2	K	VES1	VES2	VES3	VES4	VES5	VES6	VES7	VES8
				ρ_a	ρ_a	ρ_a	ρ_a	ρ_a	ρ_a	ρ_a	ρ_a
1	1.5	0.5	6.3	18	29	25	10.9	17.3	64.7	19	6.5
2	2.1	0.5	13	15.7	19.7	19.8	12.9	21.8	54.4	19	6.2
3	3	0.5	27.5	14.3	17.6	19.4	18	23.7	48	24	7.9
4	4.2	0.5	55	13.7	18.6	21.9	24	26.8	52	30	10.3
5	6	0.5	112	17.1	22.3	29.9	30	34.7	62.5	43.7	15
6	9	0.5	254	24	29.7	43	42	46.5	83.8	58	23.4
7	13.5	0.5	572	34	42	62	57	63.5	117	77	37.7
8	20	0.5	1256	48	58	93	78	90	173	97	59
9	20	6	94	50	78	91	77	90	142	94	63
10	30	0.5	2827	68	103	135	112	116	280	107	94
11	30	6	226	70	104	133	111	115	226	106	95
12	45	6	521	99	131	193	151	167	307	146	139

AB/2 --- half current electrode separation,

MN/2 --- half potential electrode separation

K --- the geometric factor

ρ_a --- apparent resistivity in Ohm-m

APPENDIX B: ROTARY CORE DRILLING

1. INTRODUCTION

1.1 Project Background

A contract for Geotechnical investigation at Dedesa River for Dinger Bereha Irrigation Project was signed on 21 May, 2009 between Metaferia Consulting Engineers PLC and Addis Geo-systems Co.Ltd (AGS). The project is part of the Eastern Nile Subsidiary Action Program of the Nile Basin Initiative. The Dinger Bereha irrigation project site, where the Geotechnical investigation was conducted, is located at the Didessa River Valley of the Abbay Basin at about 560km distance South-West of Addis Ababa. Mobilization of equipment and manpower to carry out the Geotechnical investigation to Didessa valley started on 29 May 2009 and field work completed on 11 June 2009.

The Geotechnical investigation carried out by AGS at a proposed weir site included drilling of two boreholes to depths of 12.5m and 10.65 m and recovery of core samples, four SPT tests, core logging and photographing, and grouting and boreholes head construction of the two boreholes.

This Geotechnical investigation report is a factual report and contains mainly the factual data obtained from the Geotechnical investigation at Dedesa valley. The report gives brief description of the methods and materials used in carrying out the field investigations and results obtained from these investigations. The report is presented as: Main report and Appendices that include Borehole log, Geological section and colored core photos.

1.2 Scope & Objective

The main objective of the Geotechnical Investigation at Didessa River Valley was to conduct field Geotechnical investigation which included borehole drilling and in-situ testing and collecting essential data that would enable the project consultant design a feasible weir structure for Dinger Bereha irrigation project.

- The scope of work of the Geotechnical investigation, as stated in the contract agreement is:
- Core drilling in soil and rock formations so as to verify the depth of the overburden and characterize the rocks under the overburden,
- Conducting Standard Penetration Test (SPT) in boreholes (SPT),
- Recovery of core samples for identification and laboratory test
- Preparation of factual Geotechnical report.

1.3 Location and Accessibility

The Dinger Bereha Irrigation Project site is located at the Didessa Valley of the Abbay Basin some 560 Km south west of Addis Ababa. It is within Illu-Harar (Chewaka) Wereda of Illuababora Zone of Oromia Regional State. The Geographic coordinate of the center of the weir axis is UTM E203644m, N983463m with an average elevation of 1247m amsl.

The weir site can be accessed by driving first to Bedele town which is 500km from Addis Ababa via Jima and again driving 14km passed Bedele along Bedele – Nekemte road and turning to North-West direction following a gravel road for another 51 up to Chewaka settlement village and finally another 15km from Chewaka village. The road from the junction at Bedele-Nekemte road to Chewaka village is an all weather gravel road where as the road from Chewaka village to the weir site is a track road constructed by local labour and is only accessible by 4WD and dry weather. The topographic feature of the area is undulating and incises by a serious of gullies. The location of Dinger Bereha Irrigation project is shown in Volume I : Main Report.

2. METHODOLOGY OF INVESTIGATION

2.1 General

The geotechnical investigation at Didessa River valley consists of drilling of two boreholes to determine depth and characteristics of geotechnical layers, collect disturbed and undisturbed samples, and conducting in-situ tests (SPT) at favourable depths with the objective of estimating in-situ strength. The two boreholes were drilling at the right and left bank of Didessa River and inter-borehole movement of the drilling rig and tools was done by using a 3X3m raft assembled on site. Methods and materials used in the field investigation are described in the following sections.

2.2 Drilling and In-Situ Test

2.2.1 Core Drilling

Rotary core drilling was conducted with a portable skid mounted core drilling rig fitted with water pump, appropriate core sampling and in-situ testing (SPT) equipment. Dry drilling technique was used in soils and drilling water was used when drilling in hard rock layers. Temporary casing was installed in overburden drilling to prevent collapse of materials. Generally, the methods applied in the investigation were incompliance with relevant BS and ASTM standards for site investigation (BS 5930:1981, ASTM D2488).

As soon as cores were removed from core barrels, the retrieved core samples were placed in a standard partitioned wooden core boxes starting from top to bottom with a proper labelling indicating the top and bottom of each run and properly logged and eventually photographed. Colour photos showing core samples in core boxes are shown in appendix 5. A picture showing core drilling operation at BH1 is shown in figure 1 below.

Figure 1. Core drilling operation at DWBH-1 (left bank)

2.2.2 Standard Penetration Test (SPT)

Standard Penetration Test (SPT) was conducted inside boreholes using standard SPT equipment. The standard SPT equipment consists of standard automatic trip hammer, weighing 63.5 kg with a freely falling height of 760 mm along a frictionless guide rod. The test was conducted in accordance with test procedure described in test No. 19 of BS 1377. Blow counts for a total penetration depth of 450 mm from the bottom of a cleaned borehole were recorded and counts for the first 150 mm penetration were discarded since the ground is considered to be distributed by drilling activity prior to the test. SPT N-values for the last 300 mm penetration were thus recorded. SPT N-Values are shown in borehole logs.

2.2.3 Inter-borehole Movement

The drilling rig along with drilling tools and crew were moved from one side of the river bank to the other which is about 120m long with the help of a 3mX3mX1m raft which was assembled on site. The buoyancy space was obtained from a series of oil drums that were stuck within the wooden frames. Picture of the raft used for inter-site mobilization is shown in figure 2 below.

Figure 2. Picture showing a raft carrying drilling rig over Didessa river during inter-borehole movement.

2.3 Data Compilation and Presentation

Information on drilling operation and formation drilled were recorded on a daily drilling report format whenever there is drilling. Among the information put in the daily drilling report format were: casing depth, SPT N-values, drill run length, TCR, RQD, formation description, total daily drilling depth, and water level measurement. The daily drilling records were then used to produce a complete borehole log with the help of AutoCAD software.

Colour photo of each core box was taken for documentation at the completion of each borehole. Field data collected from borehole drilling and borehole testing were compiled in the office using appropriate software and standard report writing procedure.

The compiled field data are presented in hard and soft copy in the form of:

1) Main report

2) Borehole logs (Annex 1)

3) Core photos (Annex 2) and

4) Geological section (Annex 3)

3. REGIONAL AND LOCAL GEOLOGY

3.1 Regional Geology

The project area is situated in the western part of Ethiopia where the Precambrian Basement rocks of the country crops out. The regional geology of the project area is broadly represented by the Precambrian crystalline Basement and the Tertiary Volcanic Rocks.

The Precambrian Basement Complex
The Precambrian Basement of the Western Ethiopia is a mosaic of metamorphic gneissic domains separated by North-South trending belt of low grade metamorphic rocks that contain recognizable volcanic and sedimentary sequences, many of which are highly sheared and intruded by diverse suite of plutonic intrusions. In the Gore Map Sheet Mengesha and Seife (1987) recognized three major domains based on structural style, lithology, and metamorphic grade and referred to the Baro, Birbir and Geba Domains. The Geba Domains consist of gneisses and migmatites at upper amphibolite metamorphic grade where as the Birbir domain that lies in between them is a complex lower metamorphic grade rocks containing abundant mafic schists. The project area is located in the Geba Domain. Early plutonic bodies that are lenticular are recognized and are internally foliated and concordant with their host rocks. There are also late more equi-dimensional and discordant intrusions.

The Tertiary Volcanic
Around the project area the Precambrian basement terrain is directly overlain above 1,400m meter elevation by flat lying, fine grained, aphiric, Tertiary Basalt Flows that have preserved as a cape on pick points and mountainous terrain. There is no evidence of Mesozoic Sedimentary rock deposits between the basalts and the underlying Precambrian basement rocks. Thus the marine transgression and regression that led to the deposition of sedimentary rocks elsewhere (mainly in the North and East) of the country presumably did not reach here or were eroded away. Thus the Tertiary basalt lava flows uncomfortably overlie the Precambrian rocks resting directly on them.

3.2 Site Geology

The core drilling showed presence of two different geological layers at the proposed weir site. The two boreholes drilled at both sides of the river to a maximum depth of 12.25m depth disclosed the existence of biotitic quartz feldspatic gneiss overlain by a sandy gravelly clay soil of alluvial origin. The river bed is more or less flat characterized by exposures of crystalline basement rock namely Gneiss. This crystalline basement rock is strong, coarse grained and massive with some fracture at the top part. The geotechnical features of the layers are described as follows:

Alluvial Deposit (Overburden)
The overburden layer which is alluvial in origin is loose to very dense, dark grey to reddish brown, sandy gravelly clay with some silt. The standard penetration test (SPT) value conducted in the layer has an N-Value in the range of 23 to 39 for 30cm depth penetration. It has a maximum thickness of 4.75m in bore hole DHBH-1.

Quartz Feldspatic Gneiss
This layer is coarse grained, fresh, biotitic quartz feldspatic gneiss encountered beneath the overburden which is of alluvial origin. It shows fracturing and slight weathering appearances along discontinuities. The rock is moderately to highly fracture towards the top and slightly fractured to intact and very strong towards to bottom of the boreholes. This layer was encountered from 4.45m to the end of drilled depth in both bore holes.

A clear outcrop of light gray to pinkish colour, coarse grained, fresh gneiss characterizes the river bed. This rock outcrop is very strong and has discontinuities with spacing in the range of 0.5 to 2m.

4. GEOTECHNICAL INVESTIGATION

4.1 General

Geotechnical investigations conducted at the Dinger Bereha irrigation Project weir site included drilling of two boreholes, conducting four SPT tests and rock core sampling as directed by the site engineer. The present geotechnical investigation does not include and laboratory tests.

Table 1 Summary of the geotechnical investigation conducted in the Dinger Bereha irrigation project.

Bore Hole Designation	Drilled Depth (m)	Location	Standard Penetration Test (SPT)		Rock Core Sampling	
			Qty	Depth (m)	Qty	Depth (m)
DWBH-1	12.25	Left Bank	2	2.0-2.45 4.0-4.45	3	5.00-5.15 5.57-5.95 7.00-7.50
DWBH-2	10.65	Right Bank	2	1.50-1.95 4.0-4.45	3	5.68-5.85 6.65-6.87 9.75-9.96

The following sections briefly describe drilling and field tests performed at the during the geotechnical investigation at Didessa valley for Dinger Bereha Irrigation Project.

4.2 Drilling and Sub-Surface Condition

Two boreholes (one on each side of the river) with a total depth of 22.90m were drilled in the current investigation. Location of boreholes is shown on Map GE-01, attached in Volume III (Maps & Drawings). The boreholes were drilled vertical. Designation, Location and geographic coordinates of the two boreholes are shown in table 2 below.

Table 2 Designation, location and geographic coordinates of the drilled boreholes

Borehole Designation	Location	Coordinates (UTM)		Elevation (m)	Borehole Depth (m)	Ground Water level (m)
DWBH-1	Left Bank	N983381	E203652	1247	12.25	No Ground water
DWBH-2	Right Bank	N983545	E203635	1247	10.65	No Ground water

Detailed description of soil types encountered in all boreholes is presented in borehole logs as shown in Annex 1 below. A geological cross section constructed along the weir axis based on the two borehole logs is shown in Annex 3.

Very stiff to hard, dark gray to reddish brown, sandy clay with some silt (Overburden) was encountered in both boreholes DWBH-1 & DWBH-2 with almost equal depths of 4.45m and 4.75m respectively. The overburden soil is underlain in both boreholes by coarse grained, fresh, biotitic quartz gneiss (in DWBH-1) and quartz feldspatic gneiss (in DWBH-2). Ground water was not encountered in both boreholes. Both bore holes were grouted with cement after completion of drilling.

4.3 In-Situ Test in Boreholes

Standard Penetration Test (SPT) was the only type of in-situ test conducted in the current geotechnical investigation. A total number of four Standard Penetration Tests (SPTs), two in each boreholes were performed at different depths within the overburden soil with the objective of estimated in-situ strength of the overburden layer. SPT test related information is summarized in table 3 below.

Table 3 SPT N-Values, depth and relative density descriptive terms

Borehole Designation	Drilled Depth (m)	Location	Standard Penetration Test (SPT)		
			Test Depth(m)	N–value (Corrected)	Relative Density (Descriptive Term)
DWBH-1	12.25	Left Bank	2.00-2.45	23	Medium Dense
			4.00-4.45	39	Dense
DWBH-2	10.65	Right Bank	1.50-1.95	32	Dense
			4.00-4.45	36	Dense

5. SUMMARY

A Geotechnical investigation at Didessa River valley at the proposed weir site for irrigation project was conducted with the objective of providing additional geotechnical data and information on the sub-surface condition of the site. The geotechnical investigation included drilling of two geotechnical boreholes, one on the right side and the second on the left side of Didessa River, with a total depth of 22.90 meters, conducting two SPT test in each boreholes and sampling of four rock core samples for laboratory tests. Lithological logs of the two boreholes confirmed occurrence of loose to very dense, dark gray to reddish brown, sandy gravelly clay with silt of alluvial origin to depth of 4.74m overlaying light to dark gray, coarse grained, moderately fractured, moderately to slightly weathered, moderately strong to strong and fresh crystalline basement rock namely biotitic quartz/quartz feldspatic Gneiss. SPT N-values of the overburden soil range from 23 to 39 showing that the layer is medium dense to dense. The crystalline basement rock is also exposed in the river bed. No ground water was encountered at the time of drilling.

References

1. British Standard Institution. Code of Practice for Site Investigation, BS 5930:1981.

2. Mengesha Tefera & Seife M. Bereha, 1987, Geological Map of Gore Sheet.

3. Graham West 1991, The field description of Engineering Soils and Rocks.

4. M.Carter and S.P. Bentley. 1991. Correlation of Soil Properties.

ANNEXES TO APPENDIX B

Annex 1: Borehole Logs

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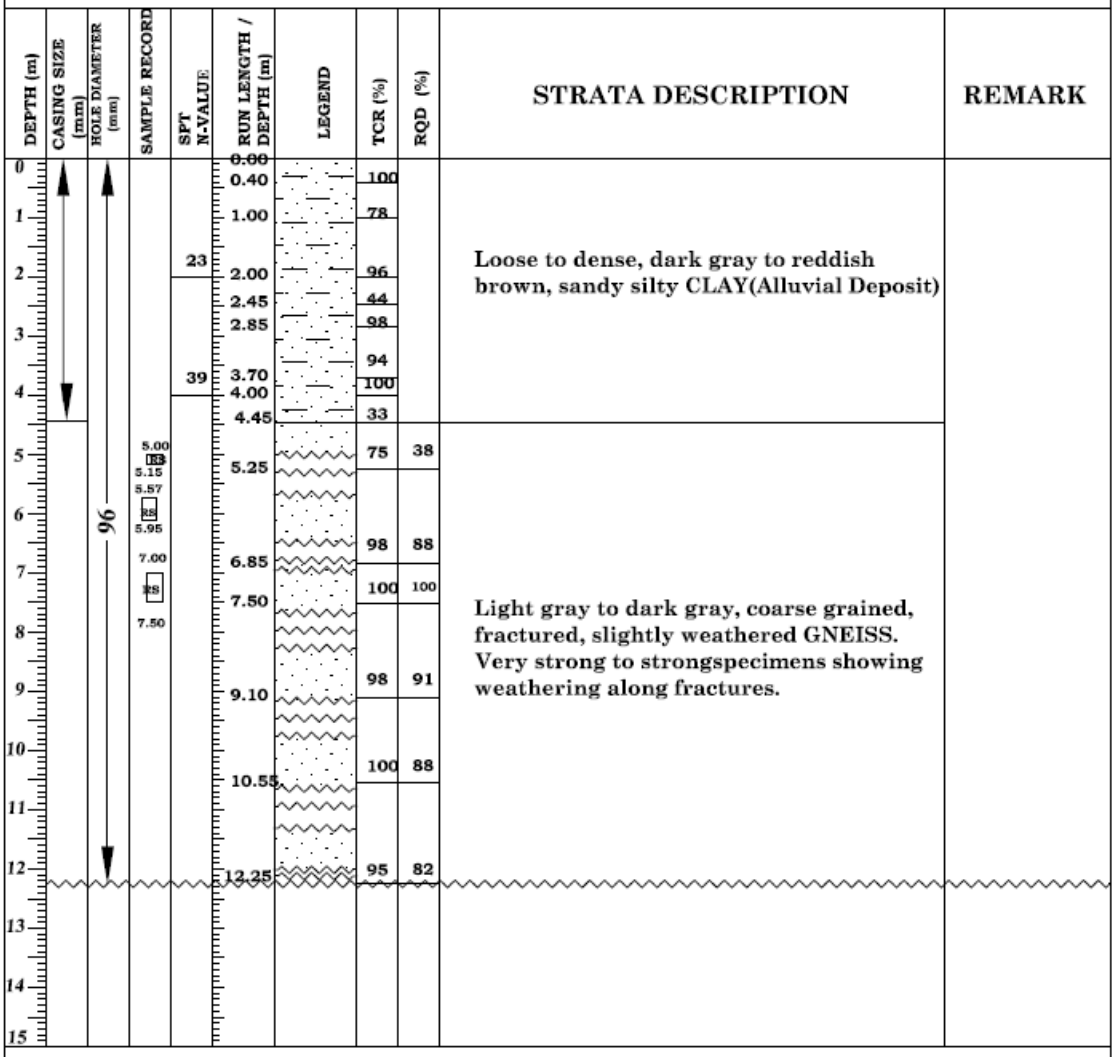
SHEET 1of 1

Title **BOREHOLE LOG SHEET**

DWBH No-1

PROJECT : Dinger Bereha Irrigation Project.
LOCATION : Dedessa River (560km from Addis Ababa)
CLIENT : Metaferia Consulting Engineers plc.
DATE STARTED :01/06/2009
DATE COMPLETED :03/06/2009

BORING TYPE : Rotary coring
GROUND WATER LEVEL :1247m
BH COORDINATES : N-983381 , E-203652
BH ELEVATION : 1247m
INCLINATION : Vertical



BH	BOREHOLE
(Ne)	CONE PENETRATION TEST
SPT	STANDARD PENETRATION TEST
N	BLOWS/30cm
RS	ROCK SAMPLE
W	WATER SAMPLE
NGL	NATURAL GROUND LEVEL
RQD	ROCK QUALITY DESIGNATION
TCR	TOTAL CORE RECOVERY

DISTURBED SOIL SAMPLE
UNDISTURBED SOIL SAMPLE
END OF DRILLING
STATIC GROUND WATER LEVEL

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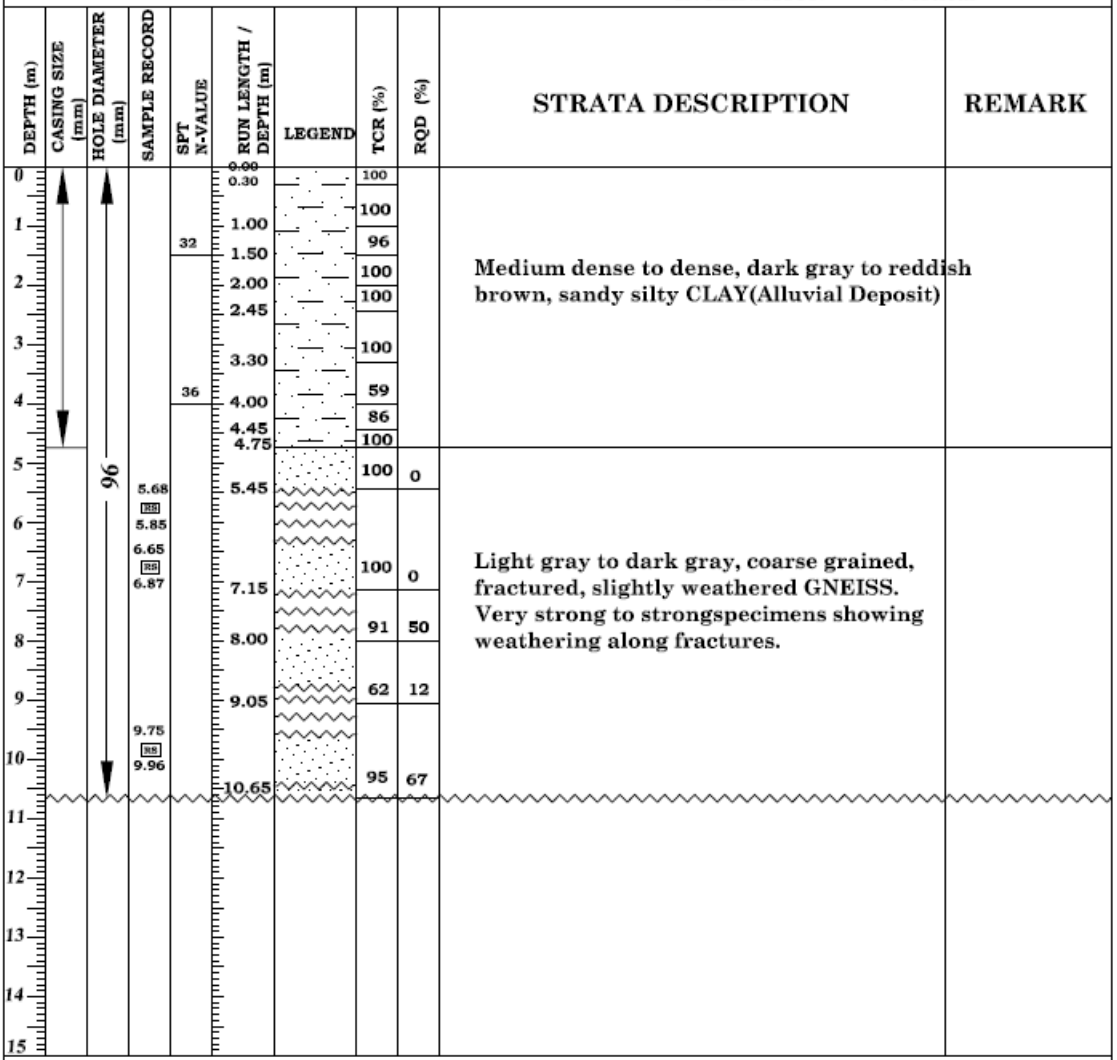
SHEET 1of 1

Title **BOREHOLE LOG SHEET**

DWBH No-2

PROJECT : Dinger Bereha Irrigation Project.
LOCATION : Dedessa River (560km from Addis Ababa)
CLIENT : Metaferia Consulting Engineers plc.
DATE STARTED :06/06/2009
DATE COMPLETED :10/06/2009

BORING TYPE : Rotary coring
GROUND WATER LEVEL :1247m
BH COORDINATES : N-983545 , E-203635
BH ELEVATION : 1247m
INCLINATION : Vertical



BH	BOREHOLE
(Nc)	CONE PENETRATION TEST
SPT	STANDARD PENETRATION
N	BLOWS/30cm
RS	ROCK SAMPLE
W	WATER SAMPLE
NGL	NATURAL GROUND LEVEL
RQD	ROCK QUALITY DESIGNATION
TCR	TOTAL CORE RECOVERY

DISTURBED SOIL SAMPLE
UNDISTURBED SOIL SAMPLE
END OF DRILLING
STATIC GROUND WATER LEVEL

Annex 2: Core Photos

Photo No.1:- DWBH-1, Box 1 of 3.Depth 0.00 to 5.15m

Photo No.2:- DWBH-1, Box 2 of 3 Depth 5.15 to 9.62m

Photo No.3:- DWBH-1, Box 3 of 3 depth 9.62 to 12.25m

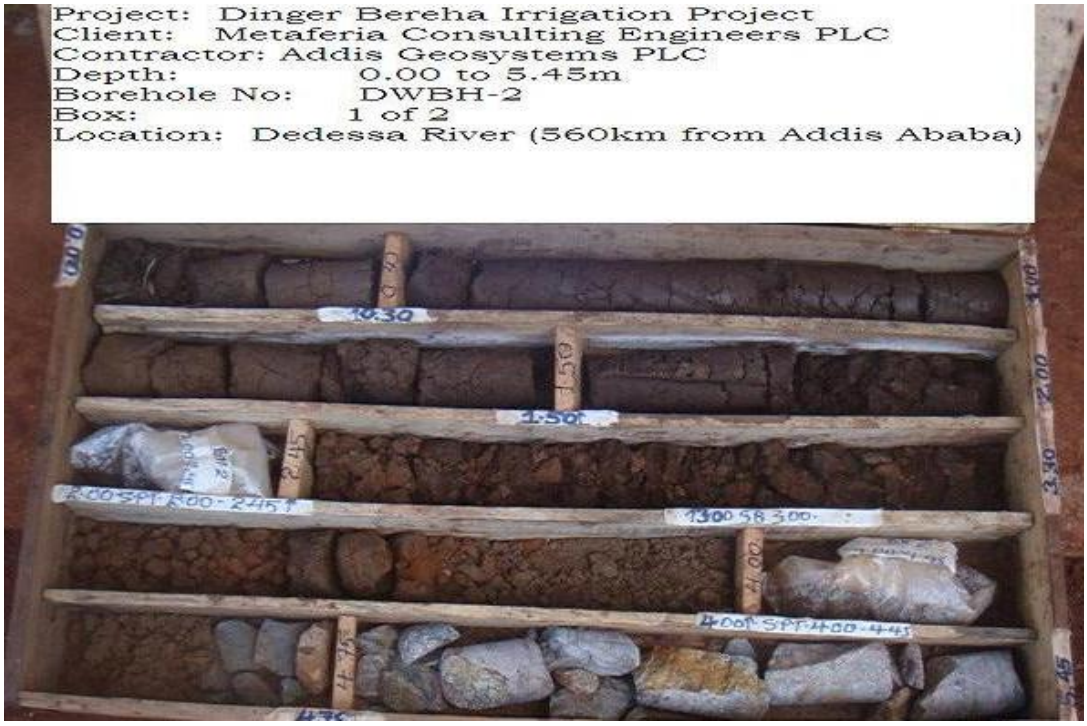
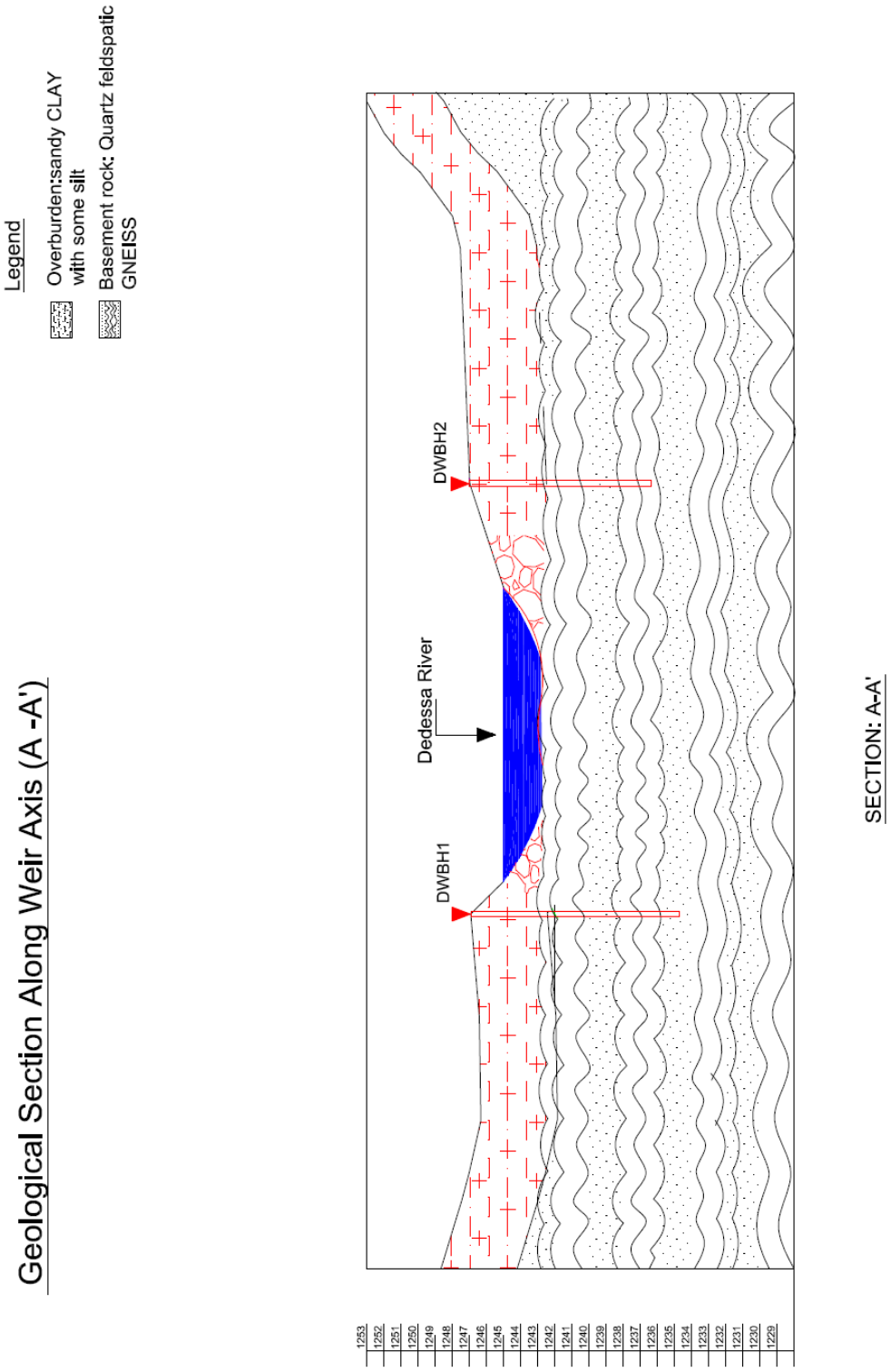


Photo No.4:- DWBH-2, Box 1 of 2 depth 0.00 to 5.45m

Annex 3: Geological Cross Section / Profile



APPENDIX C: TEST PIT LOGS

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP-01**
LOCATION (UTM): **E 203668 N 983259** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP- 02**
LOCATION (UTM): **E 203516 N 983185** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY	LDS	1	25	0.50-0.85		Permiability test conducted
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 03**
LOCATION (UTM): **E 203255 N 983126** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.60** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Black, silty CLAY , firm , with some sands						
0.40 to 1.05	gravely silty sand.	Gravel sand with some clay, light grey in color, with some boulders of quartz; mixiture of						
1.05 to 1.60	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 04**
LOCATION (UTM): **E 203065 N 983146** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.70** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.80	Top soil	Firm , moist, fine grained Black cotton CLAY, with few silt at the boundary						
0.80 to 1.20	gravely sand Clayey Silt.	Sandy gravel Clayey SILT,brown in color; mixiture of top layer and weathering reminant						
1.20 to 1.70	Residual sand with	Decomposed gneiss; gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 05**
LOCATION (UTM): **E 202819 N 983215** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.75** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.95	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.95 to 1.25	gravely silty sand.	Silty, gravelly SAND with some clay; mixiture of top layer and weathering reminant						
1.25 to 1.75	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 06**
LOCATION (UTM): **E 202724 N 983335** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.70** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.75	Top soil	Black, firm , moist, fine grained Black cotton CLAY with some grass roots at the top						
0.75 to 1.20	gravely silty CLAY	Dark grey, Silty CLAY with some sand and gravel; mixiture of top layer and weathering reminant						
1.20 to 1.70	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 07**
LOCATION (UTM): **E 202676 N 983481** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.60** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.30 to 1.30	gravely sandy boulders.	Boulders, cobbels and Sandy gravel of basaltic and gneiss origin with some clay; deposited by colluvial action						
1.30 to 1.60	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 08**
LOCATION (UTM): **E 202573 N 983621** Elevation: **1248** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.60	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.60 to 1.20	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.20 to 1.80	boulders and gravels	Boulders, gravels and sand deposited by colluvial action. Basaltic and gneiss orgin						
1.80 to 2.10	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 09**
LOCATION (UTM): **E 202447 N 983716** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Reddish grey CLAY with some grass roots						
0.40 to 1.70	gravely sandy boulder	Boulders, cobbels and Sandy gravel of basaltic and gneiss origin with some clay;						
1.70 to 2.00	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 10**
LOCATION (UTM): **E 202234 N 983764** Elevation: **1248** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.10** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.40 to 1.90	gravely sandy boulder	Boulders, cobbels and Sandy gravel of basaltic and gneiss origin with some clay;						
1.90 to 2.10	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 11**
LOCATION (UTM): **E 201998 N 983882** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.20	Top soil/Organic	Dark grey, friable , moist, fine grained organic CLAY						
0.20 to 0.90	gravely silty sand.	Light grey, Sandy silty CLAY, moist, firm. Clay exhibts the characteristic of black cotton						
0.90 to 2.00	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 12**
LOCATION (UTM): **E 201809 N 983950** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.40** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil/Organic	Dark grey, friable , moist, fine grained organic CLAY						
0.30 to 1.70	Black cotton CLAY	Black, moist, firm Black cotton CLAY with some sand and silt						
1.70 to 2.20	Sandy,silty Clay.	Light grey, firm, moist sandy silty CLAY						
2.22 to 2.40	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 13**
LOCATION (UTM): **E 201859 N 984211** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.90** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil/Organic	Dark grey, friable , moist, fine grained organic CLAY						
0.30 to 1.00	Black cotton CLAY	Black cotton CLAY, firm, moist, black to dark grey in color due to few silt inclusions						
1.00 to 1.90	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 14**
LOCATION (UTM): **E 201833 N 984536** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.55	Top soil	Dark grey, friable , moist, fine grained organic CLAY						
0.55 to 0.80	silty sand CLAY.	Sandy gravelly sity CLAY, reddish grey in color; mixiture of top layer and weathering						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 15**
LOCATION (UTM): **E 201750 N 984823** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 16**
LOCATION (UTM): **E 201280 N 985001** Elevation: **1248** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant		1	25	0.85-1.15		
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 17**
LOCATION (UTM): **E 2011148 N 985241** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 18**
LOCATION (UTM): **E 200763 N 985751** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 19**
LOCATION (UTM): **E 200564 N 986241** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.15	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 20**
LOCATION (UTM): **E 200488 N 986524** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.40	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.40 to 1.60	silty CLAY.	Dark grey Silty CLAY, moist firm and coarse			25	0.40-1.60		
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 21**
LOCATION (UTM): **E 200214 N 987431** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.30** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.30 to 1.90	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.90 to 2.30	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 22**
LOCATION (UTM): **E 199851 N 987435** Elevation: **1248** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.35** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.80	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.80 to 2.20	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
2.20 to 2.35	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 23**
LOCATION (UTM): **E 199752 N 987686** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.35** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.50	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.50 to 2.25	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant			2 & 25	0.5-1.80		
2.25 to 2.35	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 24**
LOCATION (UTM): **E 199632 N 988017** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.40 to 1.40	Black cotton	Dark grey, moist, slightly firm Black cotton clay						
1.40 to 1.80	Residual sand with some	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth with some sand and clay						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 25**
LOCATION (UTM): **E 199440 N 988305** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.80** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **June'09**

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.40 to 1.40	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.40 to 1.80	Residual sand with some	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth with clayey Sand						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 26**
LOCATION (UTM): **E 199248 N 988576** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.10** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **June'09**

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.30 to 2.00	gravely silty sand.	reddish to black, Silty Sand with some clay, mixiture of top layer and weathering reminant						
2.00 to 2.10	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 27**
LOCATION (UTM): **E 199048 N 988757** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.75** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **June'09**

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.30 to 1.60	sand, silty Clay .	Sandy silty Clay with some gravel, mixiture of top layer and weathering reminant, reddish in colour						
1.60 to 1.75	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 28**
LOCATION (UTM): **E 198904 N 989056** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.95** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **June'09**

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.20	gravely silty sand.	Sandy silty gravel with some clay, mixiture of top layer and weathering reminant						
1.15 to 1.95	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 29**
LOCATION (UTM): **E 198738 N 989299** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.60	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.60 to 1.65	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.65 to 2.00	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 30**
LOCATION (UTM): **E 198483 N 989492** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.80** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.85	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.85 to 1.30	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
1.30 to 1.80	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 31**
LOCATION (UTM): **E 198585 N 989737** Elevation: **1248 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.00** mts.
SURFACE AROUND PIT: **slopy, grass covered**
Logged by: **Abera A.** Date: **March'10**

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.60 to 0.85	gravely silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
>0.90	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 27**
LOCATION (UTM): **E 197418 N 990046** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.30** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **March'10**

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.60 to 2.00	silty sand Clay.	Sandy silty CLAY with some gravel, mixiture of top layer and weathering reminant						
2.00 to 2.30	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DTP - 28**
LOCATION (UTM): **E 196936 N 990095** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.50** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.70	Top soil	Brown, firm , moist, fine grained Silty CLAY with grass root						
0.70 to 2.50	Silty Clay	Yellowish Red, firm, moist Silty CLAY	Disturbe	1	2			
>2.50	Residual sand with some	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DTP - 29**
LOCATION (UTM): **E 196744 N 990361** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.70** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.60	Top soil	Brownish grey, firm , moist, fine grained Silty CLAY with grass roots						
0.60 to 2.60	Silty Clay	Yellowish red firm moist Silty Clay with some gravel	Disturbe	1	2			
>2.60	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 32**
LOCATION (UTM): **E 196518** **N 990522** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **3.10** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.70	Top soil	Brown, firm , moist, fine grained silty CLAY						
0.70 to 3.00	Silty Caly	Yellowish grey, Silty CLAY with some snd and gravels						
>3.00	Residual sand with some silt.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 33**
LOCATION (UTM): **E 196431** **N 990655** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.30** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.70	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.70 to 2.00	Sandy silty Clay	Yellowish Red Sandy Silty CLAY; firm and moist						
>2.00	Residual sand with some silt.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 34**
LOCATION (UTM): **E 196375 N 990898** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.50** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.65	Top soil	Brown, firm , moist, fine grained silty CLAY with plant & grass root						
0.65 to 2.00	gravely silty sand Clay.	Sandy, silt, gravelly CLAY; brownish yellow in color and moist						
>2.00	Residual sand with some silt.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 35**
LOCATION (UTM): **E 196358 N 991017** Elevation: **1240** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **3.50** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March'10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.65	Top soil	Brown, firm , moist, fine grained silty CLAY with some plant roots; looks mixed with organic material						
0.65 to 3.40	Silty CLAY.	Red, firm, moist Silty CLAY	Disturbed	1	2			
>3.40	Residual sand with some silt.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 36**
LOCATION (UTM): **E 196152** **N 991173** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.50** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Brown, firm , moist, fine grained silty CLAY						
0.60 to 2.00	Silty CLAY.	Red, firm, moist Silty CLAY	Disturbed	1	2			
>2.00	Residual sand with some	Decomposed gneiss; gravel, silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 37**
LOCATION (UTM): **E 195967** **N 991361** Elevation: **1240** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **3.20** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March'10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Brown, firm , moist, fine grained Silty CLAY						
0.60 to 3.00	Silty Clay.	Red Silty CLAY; firm and moist	Disturbed	2	2 &25			
>3.00	Residual sand with some	Decomposed gneiss; silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 38**
LOCATION (UTM): **E 195739 N 991552** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00 mts.** Width **1.00 mts.** Depth **2.50 mts.**
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **March '10**

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Brown, firm , moist, fine grained silty CLAY						
0.60 to 2.50	Silty CLAY.	Red, firm, moist Silty CLAY	Disturbed	1	2Kg			
>2.5	Residual sand with some silt.	Decomposed gneiss; silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 39**
LOCATION (UTM): **E 195564 N 991355** Elevation: **1241 asl.**
PIT DIMENSION: Length **1.00 mts.** Width **1.00 mts.** Depth **3.80 mts.**
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: **Abera A.** Date: **March '10**

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.60	Top soil	Brown Silty CLAY, firm, moist with some plant roots						
0.60 to 3.77	Silty CLAY	Brownish Red Silty CLAY ; firm and moist	Disturbed	2	2kg & 25K			
>3.77	Residual sand with some silt.	Decomposed gneiss; silt and sand size materials with some gravel. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCTP - 40**
LOCATION (UTM): **E 195299** **N 991366** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **1.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March '10

DEPTH (mts.)	SOIL TYPE	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.30	Top soil	Dark grey, friable , dry, fine grained silty CLAY						
0.30 to 1.00	Silty sand.	Sandy gravel with some clay, mixiture of top layer and weathering reminant						
>100	Residual sand with some silt.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **pumping site**
PIT No. : **Res01TP**
LOCATION (UTM): **E 198483** **N 989492** Elevation: **1248** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **3.50** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: March'10

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.25	Top soil	Black, firm , moist, fine grained Black cotton CLAY						
0.25 to 3.50	Silty CLAY	Brownish Red Silty CLAY ; firm and moist	Disturbed	2	2kg & 25Kg			

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Borrow area**
PIT No. : **DCoTP - 1**
LOCATION (UTM): **E 201692 N 982831** Elevation: **1286 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.35** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.30 to 2.20	Silty Clay	Red Silty CLAY with some sand; firm, moist			2 & 25	0.3-1.80		
2.2 to 2.35	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Borrow area**
PIT No. : **DCoTP - 2**
LOCATION (UTM): **E 201533 N 982719** Elevation: **1295** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.00** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.40	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.40 to 1.90	Black cotton	Red Silty CLAY with some sand; firm, moist			2 & 25	0.40-1.90		
1.90 to 2.00	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Borrow area**
PIT No. : **DCoTP - 3**
LOCATION (UTM): **E 201618 N 983035** Elevation: **1285 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.10** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.250	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.25 to 2.00	Silty Clay	Red Silty CLAY with some sand; firm, moist						
2.00 to 2.10	Residual sand with some	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCoTP - 4**
LOCATION (UTM): **E 201204 N 982218** Elevation: **1304** asl.
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.30** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	SOIL TYP	DESCRIPTION	SAMPLE Type*	No	Size (kg.)	Depth (mt.)	symbol	Remark
0.00 to 0.30	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.30 to 2.2	Silty Clay	Red Silty CLAY with some sand; firm, moist						
2.20 to 2.30	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCoTP - 23**
LOCATION (UTM): **E 199752 N 987686** Elevation: **1260 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.35** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.50	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.50 to 2.25	Silty Clay	Red Silty CLAY with some sand; firm, moist						
2.25 to 2.35	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCoTP - 22**
LOCATION (UTM): **E 199632 N 988017** Elevation: **1260 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.10** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.40	Top soil	Black, firm , moist, fine grained organic CLAY (humus)						
0.40 to 2.00	Silty Clay	Red Silty CLAY with some sand; firm, moist						
2.00 to 2.10	Residual sand with	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

TEST PIT LOG REPORT FORM

CLIENT: **ENTRO**
PROJECT: **Dinger Bereha Irrigation Project** SITE: **Canal route**
PIT No. : **DCoTP - 52**
LOCATION (UTM): **E 199752 N 987686** Elevation: **1240 asl.**
PIT DIMENSION: Length **1.00** mts. Width **1.00** mts. Depth **2.20** mts.
SURFACE AROUND PIT: **slightly flat, grass covered**
Logged by: Abera A. Date: June'09

DEPTH (mts.)	OIL TYP	DESCRIPTION	SAMPLE				symbol	Remark
			Type*	No	Size (kg.)	Depth (mt.)		
0.00 to 0.25	Top soil	Dark grey, loose, moist, silty CLAY with some plant roots; organic orgin						
0.25 to 2.20	sand, silty Clay.	Red, moist, firm Silty CLAY with some sand						
>2.20	Residual sand, gravel.	Decomposed gneiss, gravel silt and sand size. Resulted from the weathering of gneiss underneth						

APPENDIX D: PERMEABILITY TESTS

FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-1	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Gravelly clayey Sand
Type of test	Falling head	Date :	12/16/2009
Casing height (magl)	0		

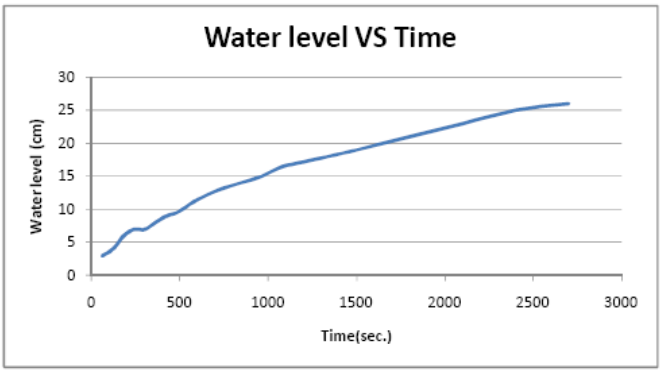
Time			Time elapsed (min)	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)		Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	3	97
08:01:00	08:02:00	120	00:01:00	4	96
08:02:00	08:03:00	180	00:01:00	6	94
08:03:00	08:04:00	240	00:01:00	7	93
08:04:00	08:05:00	300	00:01:00	7	93
08:05:00	08:06:00	360	00:01:00	8	92
08:06:00	08:07:00	420	00:01:00	9	91
08:07:00	08:08:00	480	00:01:00	9.5	90.5
08:08:00	08:09:00	540	00:01:00	10.5	89.5
08:09:00	08:10:00	600	00:01:00	11.5	88.5
08:10:00	08:12:00	720	00:02:00	13	87
08:12:00	08:14:00	840	00:02:00	14	86
08:14:00	08:16:00	960	00:02:00	15	85
08:16:00	08:18:00	1080	00:02:00	16.5	83.5
08:18:00	08:20:00	1200	00:02:00	17.2	82.8
08:20:00	08:25:00	1500	00:05:00	19	81
08:25:00	08:30:00	1800	00:05:00	21	79
08:30:00	08:35:00	2100	00:05:00	23	77
08:35:00	08:40:00	2400	00:05:00	25	75
08:40:00	08:45:00	2700	00:05:00	26	74
		Σ =	0:45:00		

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 97
H_2 = 74
D (m) = 10.6
t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 3.03E-06



FALLING HEAD PERMEABILITY TEST

Project:	Dinger Berha Irr. Canal	**Size of the tet pit (m)**	1X1X1.80
Test pit no	DCTP-2	**Diameter of casing (mm)**	106
Bottom of the pit (cm)	100	**Test section (m)**	Bottom
Ground water level (m)	-		
Type of test	Falling head	**Tested section material type:**	Gravelly clayey Sand
Casing height (magl)	0	**Date :**	12/06/2009

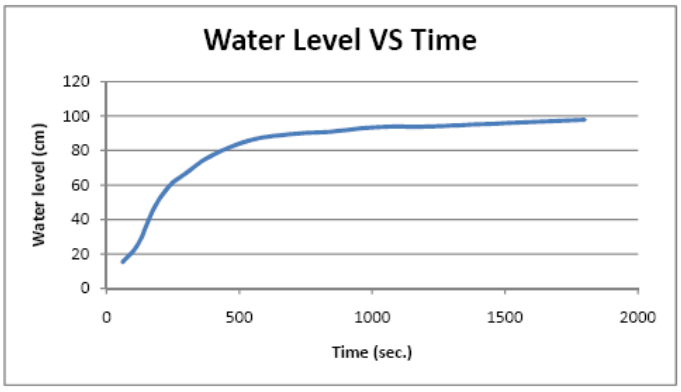
Time			Time elapsed (min)	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)		Depth (cm)	Head (cm)
08:00:00	08:00:30	60	00:00:30	15	85
08:00:30	08:01:30	120	00:01:00	26	74
08:01:30	08:02:30	180	00:01:00	47	53
08:02:30	08:03:30	240	00:01:00	60	40
08:03:30	08:04:30	300	00:01:00	67	33
08:04:30	08:05:30	360	00:01:00	74	26
08:05:30	08:06:30	420	00:01:00	79	21
08:06:30	08:07:30	480	00:01:00	83	17
08:07:30	08:08:30	540	00:01:00	86	14
08:08:30	08:09:30	600	00:01:00	88	12
08:09:30	08:11:30	720	00:02:00	90	10
08:11:30	08:13:30	840	00:02:00	91	9
08:13:30	08:15:30	960	00:02:00	93	7
08:15:30	08:17:30	1080	00:02:00	94	6
08:17:30	08:19:30	1200	00:02:00	94	6
08:19:30	08:24:30	1500	00:05:00	96	4
08:24:30	08:29:30	1800	00:05:00	98	2
		Σ =	**0:29:30**		100

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 85
H_2 = 2
D (m) = 10.6
t_2 = 1770

F (m) = 2.92E+01
K (m/sec)) = 6.41E-05



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	**Size of the tet pit (m)**	1X1X1.80
Test pit no	DCTP-5	**Diameter of casing (mm)**	106
Bottom of the pit (cm)	100	**Test section (m)**	Bottom
Ground water level (m)	-	**Tested Section material type:**	Gravelly clayey Sand
Type of test	Falling head	**Date :**	11/06/2009
Casing height (magl)	0		

Time			Time elapsed (min)	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)		Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	4	96
08:01:00	08:02:00	120	00:01:00	6	94
08:02:00	08:03:00	180	00:01:00	7	93
08:03:00	08:04:00	240	00:01:00	8	92
08:04:00	08:05:00	300	00:01:00	10	90
08:05:00	08:06:00	360	00:01:00	12	88
08:06:00	08:07:00	420	00:01:00	15	85
08:07:00	08:08:00	480	00:01:00	19	81
08:08:00	08:09:00	540	00:01:00	21	79
08:09:00	08:10:00	600	00:01:00	25	75
08:10:00	08:12:00	720	00:02:00	29	71
08:12:00	08:14:00	840	00:02:00	32	68
08:14:00	08:16:00	960	00:02:00	34	66
08:16:00	08:18:00	1080	00:02:00	35	65
08:18:00	08:20:00	1200	00:02:00	38	62
08:20:00	08:25:00	1500	00:05:00	40	60
08:25:00	08:30:00	1800	00:05:00	42	58
08:30:00	08:35:00	2100	00:05:00	46	54
08:35:00	08:40:00	2400	00:05:00	50	50
08:40:00	08:45:00	2700	00:05:00	55	45
		Σ =	**0:45:00**		

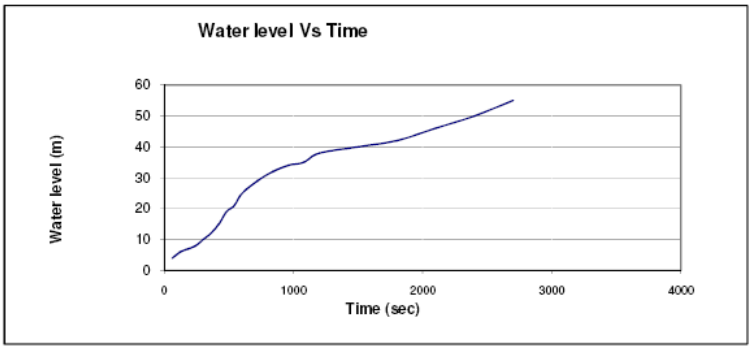
$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 96
H_2 = 45
D (m) = 10.6

t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 8.50E-06



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	**Size of the tet pit (m)**	1X1X1.80
Test pit no	DCTP-8	**Diameter of casing (mm)**	106
Bottom of the pit (cm)	100	**Test section (m)**	0.6
Ground water level (m)	-		1.2
Type of test	Falling head	**Tested section material type:**	Gravelly clayey Sand
Casing height (magl)	0	**Date :**	11/06/2009

Time			Time elapsed (min)	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)		Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	0.5	99.5
08:01:00	08:02:00	120	00:01:00	1	99
08:02:00	08:03:00	180	00:01:00	2	98
08:03:00	08:04:00	240	00:01:00	3	97
08:04:00	08:05:00	300	00:01:00	4	96
08:05:00	08:06:00	360	00:01:00	5	95
08:06:00	08:07:00	420	00:01:00	6	94
08:07:00	08:08:00	480	00:01:00	6.8	93.2
08:08:00	08:09:00	540	00:01:00	7.5	92.5
08:09:00	08:10:00	600	00:01:00	8.6	91.4
08:10:00	08:12:00	720	00:02:00	9.7	90.3
08:12:00	08:14:00	840	00:02:00	10.4	89.6
08:14:00	08:16:00	960	00:02:00	11.3	88.7
08:16:00	08:18:00	1080	00:02:00	12	88
08:18:00	08:20:00	1200	00:02:00	12.8	87.2
08:20:00	08:25:00	1500	00:05:00	13.6	86.4
08:25:00	08:30:00	1800	00:05:00	14	86
08:30:00	08:35:00	2100	00:05:00	14.8	85.2
08:35:00	08:40:00	2400	00:05:00	16	84
08:40:00	08:45:00	2700	00:05:00	17.4	82.6
		Σ =	**0:45:00**		

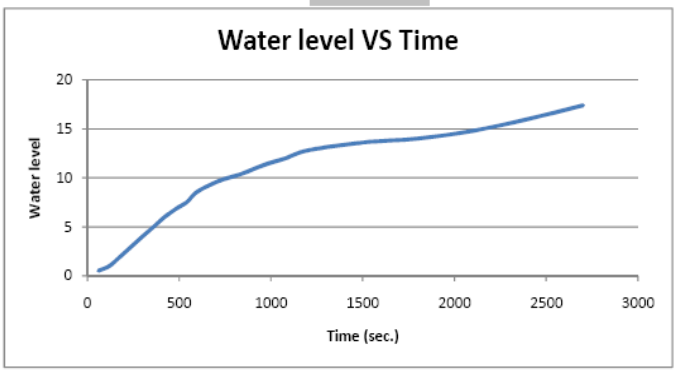
$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 99.5
H_2 = 82.6
D (m) = 0.106

t_2 = 2700

F (m) = 2.92E-01
K (m/sec)) = 2.09E-04



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-13	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Gravelly clayey Sand
Type of test	Falling head	Date :	17/06/2009
Casing height (magl)	0		

Time			Time elapsed (min)	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)		Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	10	90
08:01:00	08:02:00	120	00:01:00	13	87
08:02:00	08:03:00	180	00:01:00	16	84
08:03:00	08:04:00	240	00:01:00	20	80
08:04:00	08:05:00	300	00:01:00	26	74
08:05:00	08:06:00	360	00:01:00	37	63
08:06:00	08:07:00	420	00:01:00	42	58
08:07:00	08:08:00	480	00:01:00	53	47
08:08:00	08:09:00	540	00:01:00	65	35
08:09:00	08:10:00	600	00:01:00	74	26
08:10:00	08:12:00	720	00:02:00	83	17
08:12:00	08:14:00	840	00:02:00	86	14
08:14:00	08:16:00	960	00:02:00	88	12
08:16:00	08:18:00	1080	00:02:00	90	10
08:18:00	08:20:00	1200	00:02:00	91	9
08:20:00	08:25:00	1500	00:05:00	92	8
08:25:00	08:30:00	1800	00:05:00	94	6
08:30:00	08:35:00	2100	00:05:00	96	4
08:35:00	08:40:00	2400	00:05:00	97	3
08:40:00	08:45:00	2700	00:05:00	98	2
		Σ =	0:45:00		

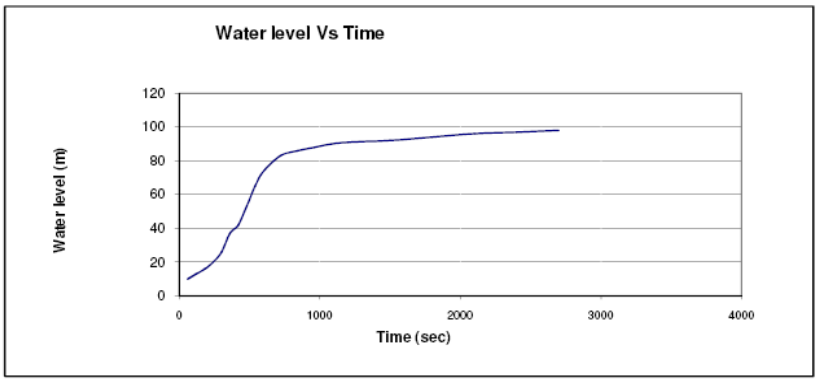
$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 90
H_2 = 2
D (m) = 10.6

t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 4.27E-05



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-23	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Silty Clay
Type of test	Falling head	Date :	10/06/2009
Casing height (magl)	0		

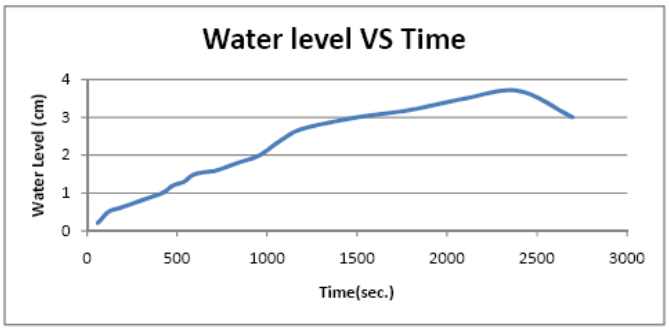
Time			Time elapsed	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)	(min)	Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	0.2	99.8
08:01:00	08:02:00	120	00:01:00	0.5	99.5
08:02:00	08:03:00	180	00:01:00	0.6	99.4
08:03:00	08:04:00	240	00:01:00	0.7	99.3
08:04:00	08:05:00	300	00:01:00	0.8	99.2
08:05:00	08:06:00	360	00:01:00	0.9	99.1
08:06:00	08:07:00	420	00:01:00	1	99
08:07:00	08:08:00	480	00:01:00	1.2	98.8
08:08:00	08:09:00	540	00:01:00	1.3	98.7
08:09:00	08:10:00	600	00:01:00	1.5	98.5
08:10:00	08:12:00	720	00:02:00	1.6	98.4
08:12:00	08:14:00	840	00:02:00	1.8	98.2
08:14:00	08:16:00	960	00:02:00	2	98
08:16:00	08:18:00	1080	00:02:00	2.4	97.6
08:18:00	08:20:00	1200	00:02:00	2.7	97.3
08:20:00	08:25:00	1500	00:05:00	3	97
08:25:00	08:30:00	1800	00:05:00	3.2	96.8
08:30:00	08:35:00	2100	00:05:00	3.5	96.5
08:35:00	08:40:00	2400	00:05:00	3.7	96.3
08:40:00	08:45:00	2700	00:05:00	3	97
		Σ =	0:45:00		

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 99.8
H_2 = 97
D (m) = 10.6
t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 3.19E-07



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-28	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Gravelly clayey Sand
Type of test	Falling head	Date :	15/06/2009
Casing height (magl)	0		

Time			Time elapsed	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)	(min)	Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	4	96
08:01:00	08:02:00	120	00:01:00	6	94
08:02:00	08:03:00	180	00:01:00	8	92
08:03:00	08:04:00	240	00:01:00	9.5	90.5
08:04:00	08:05:00	300	00:01:00	11	89
08:05:00	08:06:00	360	00:01:00	12.3	87.7
08:06:00	08:07:00	420	00:01:00	13	87
08:07:00	08:08:00	480	00:01:00	14.5	85.5
08:08:00	08:09:00	540	00:01:00	15.7	84.3
08:09:00	08:10:00	600	00:01:00	16.4	83.6
08:10:00	08:12:00	720	00:02:00	17.7	82.3
08:12:00	08:14:00	840	00:02:00	19	81
08:14:00	08:16:00	960	00:02:00	20	80
08:16:00	08:18:00	1080	00:02:00	20.9	79.1
08:18:00	08:20:00	1200	00:02:00	22	78
08:20:00	08:25:00	1500	00:05:00	23	77
08:25:00	08:30:00	1800	00:05:00	24.5	75.5
08:30:00	08:35:00	2100	00:05:00	26	74
08:35:00	08:40:00	2400	00:05:00	27.3	72.7
08:40:00	08:45:00	2700	00:05:00	29	71
		Σ =	0:45:00		

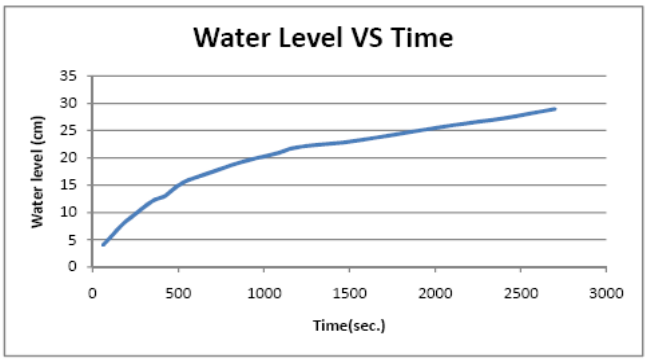
$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 96
H_2 = 71
D (m) = 10.6

t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 3.38E-06



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-45	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Silty Clay
Type of test	Falling head	Date :	17/06/2009
Casing height (magl)	0		

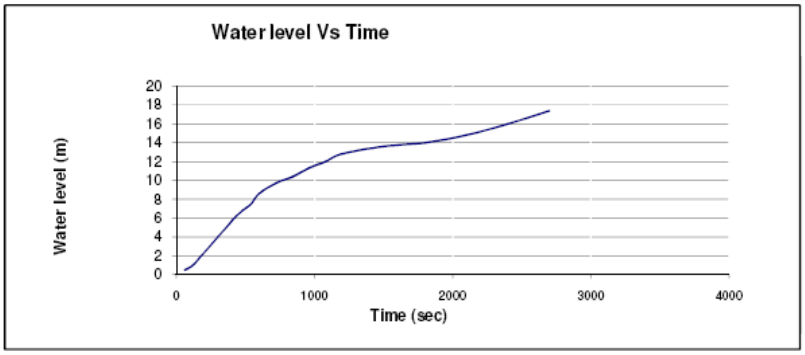
Time			Time elapsed	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)	(min)	Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	0.2	99.8
08:01:00	08:02:00	120	00:01:00	0.35	99.65
08:02:00	08:03:00	180	00:01:00	0.5	99.5
08:03:00	08:04:00	240	00:01:00	0.6	99.4
08:04:00	08:05:00	300	00:01:00	0.7	99.3
08:05:00	08:06:00	360	00:01:00	0.85	99.15
08:06:00	08:07:00	420	00:01:00	0.9	99.1
08:07:00	08:08:00	480	00:01:00	0.95	99.05
08:08:00	08:09:00	540	00:01:00	1.1	98.9
08:09:00	08:10:00	600	00:01:00	1.25	98.75
08:10:00	08:12:00	720	00:02:00	1.32	98.68
08:12:00	08:14:00	840	00:02:00	1.47	98.53
08:14:00	08:16:00	960	00:02:00	1.55	98.45
08:16:00	08:18:00	1080	00:02:00	1.67	98.33
08:18:00	08:20:00	1200	00:02:00	1.79	98.21
08:20:00	08:25:00	1500	00:05:00	1.95	98.05
08:25:00	08:30:00	1800	00:05:00	2.2	97.8
08:30:00	08:35:00	2100	00:05:00	2.4	97.6
08:35:00	08:40:00	2400	00:05:00	2.5	97.5
08:40:00	08:45:00	2700	00:05:00	2.8	97.2
		Σ =	0:45:00		

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 99.8
H_2 = 97.2
D (m) = 10.6
t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 2.96E-07



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	Size of the tet pit (m)	1X1X1.80
Test pit no	DCTP-48	Diameter of casing (mm)	106
Bottom of the pit (cm)	100	Test section (m)	Bottom
Ground water level (m)	-	Tested section material type:	Silty Clay
Type of test	Falling head	Date :	16/06/2009
Casing height (magl)	0		

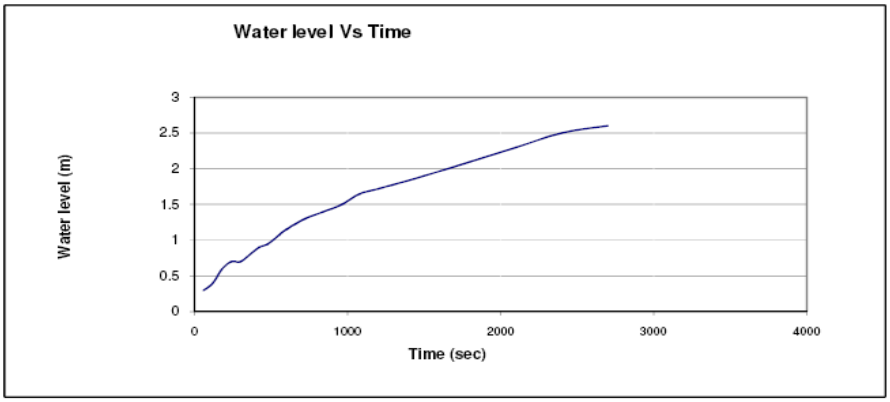
Time			Time elapsed	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)	(min)	Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	0.3	99.7
08:01:00	08:02:00	120	00:01:00	0.4	99.6
08:02:00	08:03:00	180	00:01:00	0.6	99.4
08:03:00	08:04:00	240	00:01:00	0.7	99.3
08:04:00	08:05:00	300	00:01:00	0.7	99.3
08:05:00	08:06:00	360	00:01:00	0.8	99.2
08:06:00	08:07:00	420	00:01:00	0.9	99.1
08:07:00	08:08:00	480	00:01:00	0.95	99.05
08:08:00	08:09:00	540	00:01:00	1.05	98.95
08:09:00	08:10:00	600	00:01:00	1.15	98.85
08:10:00	08:12:00	720	00:02:00	1.3	98.7
08:12:00	08:14:00	840	00:02:00	1.4	98.6
08:14:00	08:16:00	960	00:02:00	1.5	98.5
08:16:00	08:18:00	1080	00:02:00	1.65	98.35
08:18:00	08:20:00	1200	00:02:00	1.72	98.28
08:20:00	08:25:00	1500	00:05:00	1.9	98.1
08:25:00	08:30:00	1800	00:05:00	2.1	97.9
08:30:00	08:35:00	2100	00:05:00	2.3	97.7
08:35:00	08:40:00	2400	00:05:00	2.5	97.5
08:40:00	08:45:00	2700	00:05:00	2.6	97.4
		Σ =	0:45:00		

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 99.7
H_2 = 97.4
D (m) = 10.6
t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 2.62E-07



FALLING HEAD (PERMEABILITY) TEST

Project:	Dinger Berha Irr. Canal	**Size of the tet pit (m)**	1X1X1.80
Test pit no	DCTP-52	**Diameter of casing (mm)**	106
Bottom of the pit (cm)	100	**Test section (m)**	Bottom
Ground water level (m)	-	**Tested section material type:**	silty clay
Type of test	Falling head	**Date :**	16/06/2009
Casing height (magl)	0		

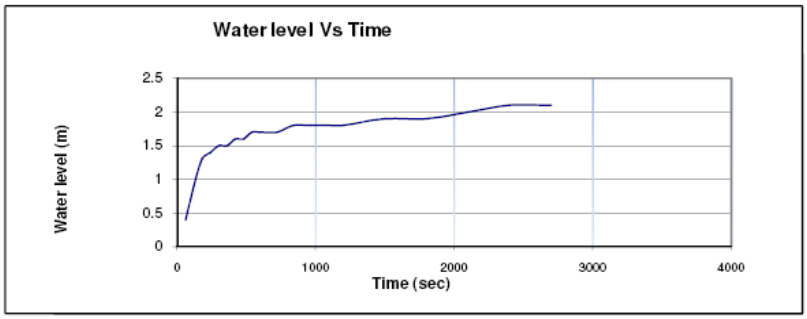
Time			Time elapsed	Depth to water level (cm)	
Initial	Final	$T_f - T_i$ (sec)	(min)	Depth (cm)	Head (cm)
08:00:00	08:01:00	60	00:01:00	0.4	99.6
08:01:00	08:02:00	120	00:01:00	0.9	99.1
08:02:00	08:03:00	180	00:01:00	1.3	98.7
08:03:00	08:04:00	240	00:01:00	1.4	98.5
08:04:00	08:05:00	300	00:01:00	1.5	98.4
08:05:00	08:06:00	360	00:01:00	1.5	98.3
08:06:00	08:07:00	420	00:01:00	1.6	98.2
08:07:00	08:08:00	480	00:01:00	1.6	98.1
08:08:00	08:09:00	540	00:01:00	1.7	98
08:09:00	08:10:00	600	00:01:00	1.7	97.9
08:10:00	08:12:00	720	00:02:00	1.7	97.7
08:12:00	08:14:00	840	00:02:00	1.8	97.5
08:14:00	08:16:00	960	00:02:00	1.8	97.3
08:16:00	08:18:00	1080	00:02:00	1.8	97
08:18:00	08:20:00	1200	00:02:00	1.8	96.8
08:20:00	08:25:00	1500	00:05:00	1.9	96.5
08:25:00	08:30:00	1800	00:05:00	1.9	96.2
08:30:00	08:35:00	2100	00:05:00	2	96
08:35:00	08:40:00	2400	00:05:00	2.1	95.4
08:40:00	08:45:00	2700	00:05:00	2.1	97.9
		Σ =	**0:45:00**		

$$K = \frac{A \ln(H_1/H_2)}{F(t_2 - t_1)}$$

$$F = 2.75\,D$$

A (m^2) = 8.82E-03
H_1 = 99.6
H_2 = 97.9
D (m) = 10.6
t_2 = 2700

F (m) = 2.92E+01
K (m/sec)) = 1.93E-07



APPENDIX E: LABORATORY TEST RESULTS

Company Name: CONSTRUCTION DESIGN SHARE CO.	Form No: OF/CDSCo./117
Title: LABORATORY TEST RESULT	Issue NO: 1 / Page N°: Page 1 of 1

Project No 00375
Date 20/08/09

Project :- Dinger Bereha Irrigation
Client :- Metaferia Consulting Engineers Plc
Location :- Dinger Bereha
Object :- Soil & Water samples

N°	TP No	Sample Type	Easting	Northing	Depth in (m)	Specific gravity	Moisture content (%)	Free Swell %	LL (%)	PL (%)	PI (%)
1	1	SDS	201692	982831	0.30-2.50	-	23.17	-	-	-	-
2	1	LDS	201692	982831	0.30-2.50	2.45	-	-	57.33	33.66	23.67
3	2	SDS	201692	982831	0.40-2.10	-	21.59	-	-	-	-
4	2	LDS	201692	982831	0.40-2.10	2.46	-	-	55.45	30.08	25.37
5	2	LDS	201533	982719	0.30-0.80	-	-	120	66.10	36.61	29.49
6	2	SDS	203516	983185	0.30-0.80	-	15.80	-	-	-	-
7	16	LDS	201280	985001	0.20-0.80	-	-	-	-	-	-
8	20	LDS	200488	986524	0.40-1.60	-	-	80	56.25	32.29	23.96
9	23	SDS	199752	987686	0.50-1.80	-	17.95	-	-	-	-
10	23	LDS	199752	987686	0.50-1.80	2.50	-	-	48.25	25.56	22.69
11	24	LDS	-	-	-	-	-	90	-	-	-
12	48	LDS,SDS	194113	990269	0.50-1.80	2.53	31.31	-	61.50	35.92	25.58
13	52	SDS	192898	990362	0.50-2.20	-	23.22	-	-	-	-
14	52	LDS	192898	990362	0.50-2.20	2.59	-	-	47.50	25.25	22.25

N°	TP No	Sample Type	Easting	Northing	Depth in (m)	Natural Moisture Content %	Optimum Moisture Content %	Standard Procter Kg/m^3
1	1	LDS	201692	982831	0.30-2.50	11.6	22.6	1593
2	2	LDS	201692	982831	0.40-2.10	15.3	22.9	1541

2. Water Samples

Nº	BH No	PH Value	Sulpate Content (mg/l)	Chloride Content (mg/l)	Total Alkali Content (mg/l)	TDS (mg/l)
1	-	7.9	12	16	54.00	120

Note:

1. **Three graphs for grain size distribution are drawn and attached here with**
2. **Two graphs for Direct Shear test result are drawn and attached here with**
3. **Five graphs for double grain size distribution are drawn and attached here with**
4. **Six graphs for UU Triaxial are drawn and attached here with**
5. **Two graphs for CU Triaxial are drawn and attached here with**

Tested by :- Dawit Kebede
Date : 15/12/01
Checked by :- Isayas Demle
Date : 15/12/01

Approved by :- _____
Date :- _____

	Company Name	Form N°
	CONSTRUCTION DESIGN Sco.	OF/CDSCo/168
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation — Pro. N° :- 00375
Client : Metaferia Consulting Engineers Plc — Date :- '20/08/09
Location: Dinger Bereha
Test Type: Triaxial CU (Single Stage)(ASTM D 4767)
Object : Soil samples

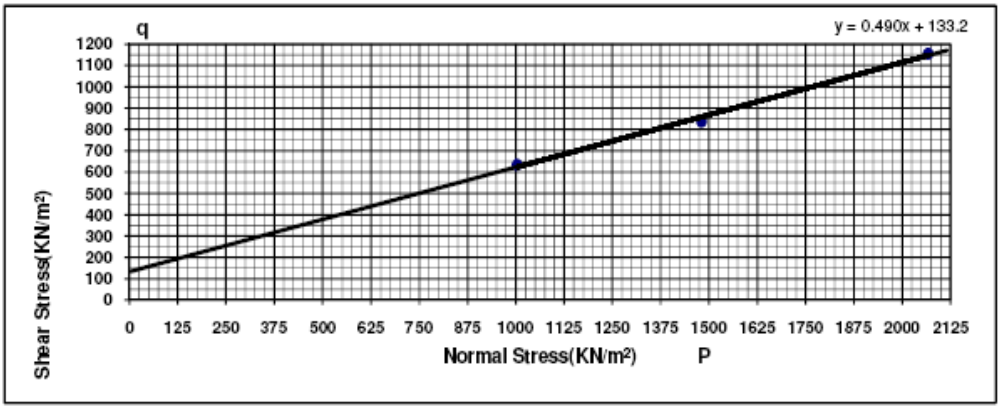
SPECIMEN DATA

TP/BH NO	1
Depth (m)	0.30-2.50
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	158.06
Final dry Weight (gm)	121.84
Moisture content (%)	29.73

Sample N°	
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.834
Dry density (gm/cm³)	1.414
Specific Gravity	-

Remark P = , $1/2\ (\sigma_1+\sigma_3)$, q = $1/2\ (\sigma_1-\sigma_3)$
α' 0.4904 a' 133.00
C' a'/Cos Φ' Φ' Sine $^{-1}$(tan α')

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C' (KN/m^2)	Ø ' (Degrees)
Deviator Stress , (KN/m2)	$(\sigma_1-\sigma_3)$	1272	1678	2311	153	29
Pore pressure (KN/m2)		33	59	89		



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

	Company Name	Form N°
	CONSTRUCTION DESIGN Sco.	OF/CDSCo/168
Title		Issue NO / Page No
TRIAXIAL TEST RESULT		1 / Page1of 1

Project : Dinger Bereha Irrigation — Pro. N° :- 00375
Client : Metaferia Consulting Engineers Plc — Date:- '20/08/09
Location: Dinger Bereha
Test Type: Triaxial CU (Single Stage)(ASTM D 4767)
Object : Soil samples

SPECIMEN DATA

TP/BH NO	2
Depth (m)	0.40-2.10
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	162.18
Final dry Weight (gm)	123.91
Moisture content (%)	30.89

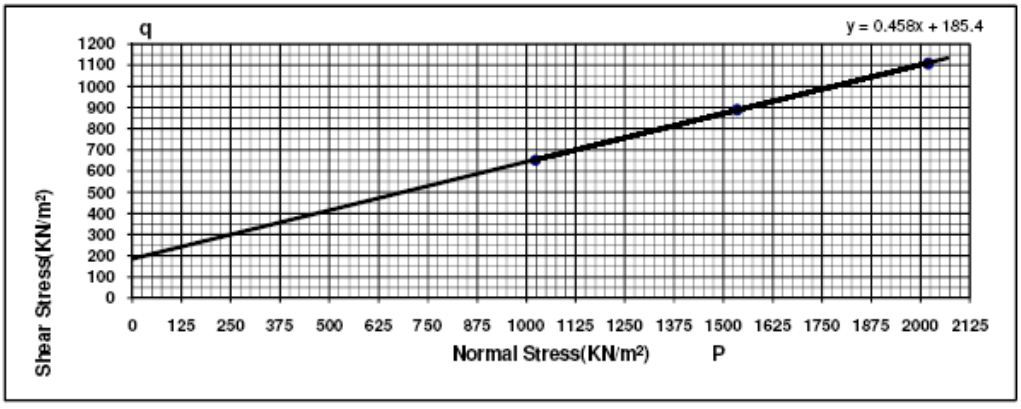
Sample N°	
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.882
Dry density (gm/cm³)	1.438
Specific Gravity	-

Remark P = , $1/2(\sigma_1+\sigma_3)$, q = $1/2(\sigma_1-\sigma_3)$

α' 0.4581 $\frac{a'}{\Phi'}$ 185.00

C' a'/Cos Φ' Φ' $\text{Sine}^{-1}(\tan\alpha')$

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C' (KN/m²)	Ø ' (Degrees)
Deviator Stress , (KN/m2)	($\sigma_1-\sigma_3$)	1305	1782	2218	208	27
Pore pressure (KN/m2)		30	57	90		



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation
Client : Metaferia Consulting Engineers Plc
Location: Dinger Bereha
Test Type: Triaxial UU
Object : *soil samples*

Pro. N° :- 00375
Date:- '20/08/09

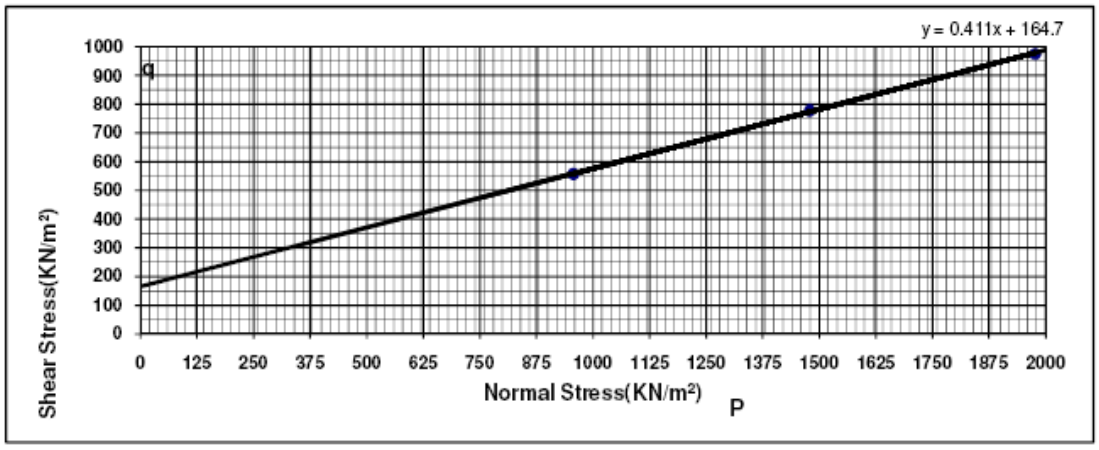
SPECIMEN DATA

TP/BH NO	1
Depth (m)	0.30-2.50
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	156.49
Final dry Weight (gm)	121.3
Moisture content (%)	29.01

Sample N°	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.816
Dry density (gm/cm³)	1.408
Specific Gravity	

Remark P = , $1/2(\sigma_1+\sigma_3)$, q = $1/2(\sigma_1-\sigma_3)$
α 0.4119 a 165.00
C a'/Cos Φ' Φ Sine $^{-1}$(tan α')

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m^2)	Ø (Degrees)
Deviator Stress , (KN/m2)	$(\sigma_1-\sigma_3)$	1113	1555	1953	181	24



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation
Client : Metaferia Consulting Engineers Plc
Location: Dinger Bereha
Test Type: Triaxial UU
Object : ___soil samples

Pro. Nº :- 00375
Date:- '20/08/09

SPECIMEN DATA

TP/BH NO	2
Depth (m)	0.40-2.10
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	161.21
Final dry Weight (gm)	123.67
Moisture content (%)	30.35

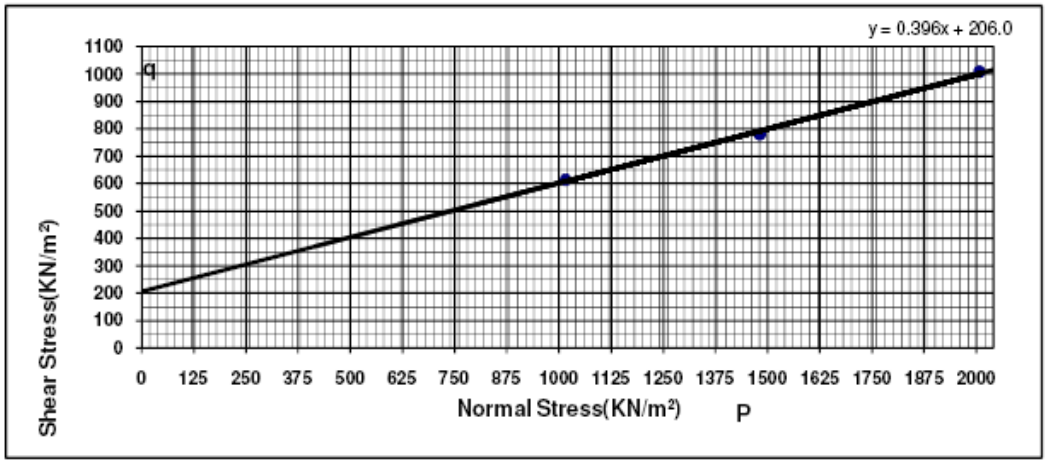
Sample Nº	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.871
Dry density (gm/cm³)	1.435
Specific Gravity	

Remark P = , $1/2(\sigma_1+\sigma_3)$, q = $1/2(\sigma_1-\sigma_3)$

α 0.3964 $\frac{a}{\Phi}$ 206.00

C a'/Cos Φ' Φ $\text{Sine}^{-1}(\tan\alpha')$

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m²)	Ø (Degrees)
Deviator Stress , (KN/m2)	($\sigma_1-\sigma_3$)	1229	1562	2015	224	23



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation — Pro. N° :- 00375
Client : Metaferia Consulting Engineers Plc — Date:- '20/08/09
Location: Dinger Bereha
Test Type: Triaxial UU
Object : *soil samples*

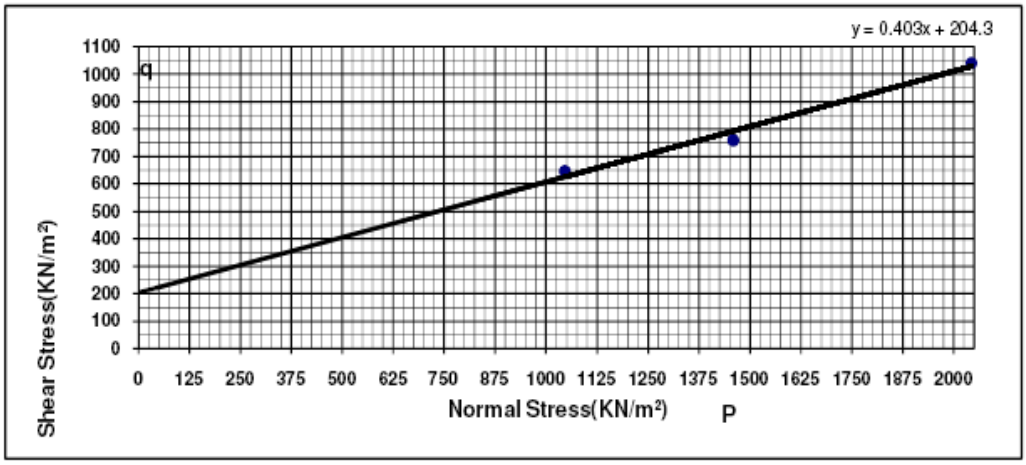
SPECIMEN DATA

TP/BH NO	20
Depth (m)	0.40-1.60
Initial height (mm)	76.00
Initial area (mm^2)	11.34
Initial Weight (gm)	150.20
Final dry Weight (gm)	112.56
Moisture content (%)	33.44

Sample N°	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm^3)	86.18
Bulk density (gm/cm^3)	1.743
Dry density (gm/cm^3)	1.306
Specific Gravity	

Remark P = , $1/2(\sigma_1+\sigma_3)$, q = $1/2(\sigma_1-\sigma_3)$
α 0.4034 a 204.00
C a'/Cos Φ' Φ $Sine^{-1}(\tan\alpha')$

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m^2)	Ø (Degrees)
Deviator Stress , (KN/m2)	$(\sigma_1-\sigma_3)$	1292	1519	2085	223	24



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation
Client : Metaferia Consulting Engineers Plc
Location: Dinger Bereha
Test Type: Triaxial UU
Object : ___soil samples

Pro. Nº :- 00375
Date:- '20/08/09

SPECIMEN DATA

TP/BH NO	23
Depth (m)	0.50-1.80
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	156.28
Final dry Weight (gm)	122.41
Moisture content (%)	27.67

Sample Nº	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.813
Dry density (gm/cm³)	1.420
Specific Gravity	

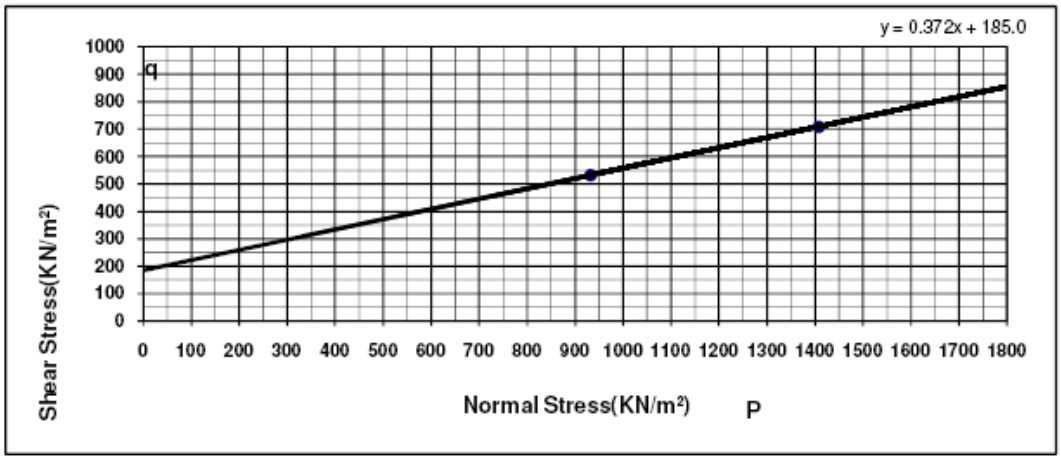
Remark

$P = \quad , \quad 1/2\,(\sigma_1+\sigma_3)$, $q = 1/2\,(\sigma_1-\sigma_3)$

α 0.3721 $\quad$ a 185.00

C a'/Cos Φ' $\quad$ Φ Sine $^{-1}$(tan α')

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m²)	Ø (Degrees)
Deviator Stress , (KN/m2)	$(\sigma_1-\sigma_3)$	1064	1417	1776	199	22



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation — Pro. Nº :- 00375
Client : Metaferia Consulting Engineers Plc — Date:- '20/08/09
Location: Dinger Bereha
Test Type: Triaxial UU
Object : soil samples

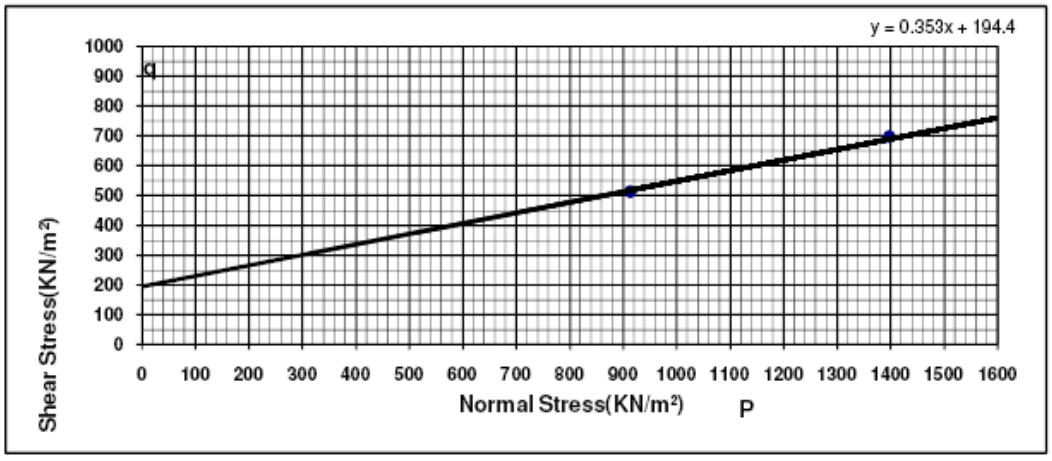
SPECIMEN DATA

TP/BH NO	48
Depth (m)	0.50-1.80
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	159.58
Final dry Weight (gm)	125.76
Moisture content (%)	26.89

Sample Nº	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.852
Dry density (gm/cm³)	1.459
Specific Gravity	

Remark P = , $1/2(\sigma_1+\sigma_3)$, q = $1/2(\sigma_1-\sigma_3)$
α 0.3537 a 194.00
C a'/Cos Φ' Φ Sine $^{-1}$(tan α')

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m²)	Ø (Degrees)
Deviator Stress , (KN/m2)	($\sigma_1-\sigma_3$)	1027	1395	1682	207	21



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

Approved by :- _____
Date :- _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation — Pro. Nº :- 00375
Client : Metaferia Consulting Engineers Plc — Date:- '20/08/09
Location: Dinger Bereha
Test Type: Triaxial UU
Object : *soil samples*

SPECIMEN DATA

TP/BH NO	52
Depth (m)	0.50-2.20
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	157.06
Final dry Weight (gm)	123.66
Moisture content (%)	27.01

Sample Nº	-
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.822
Dry density (gm/cm³)	1.435
Specific Gravity	

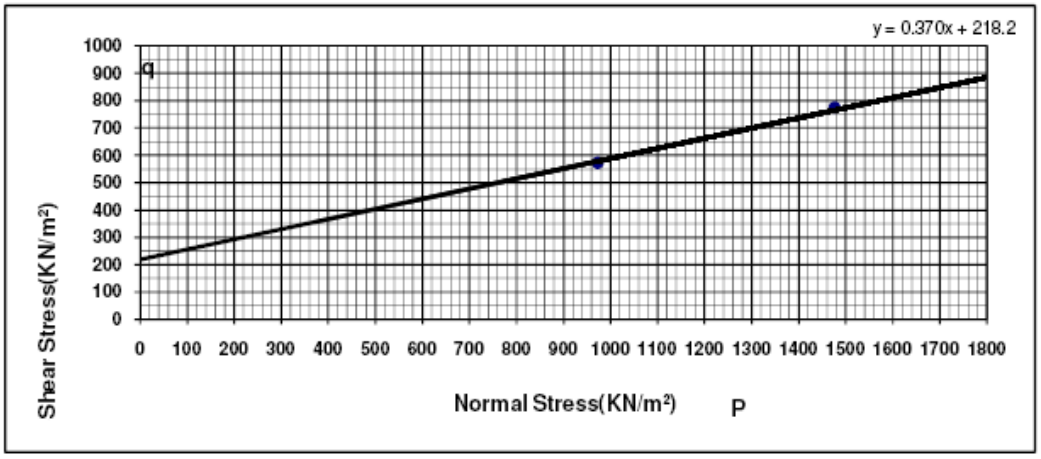
Remark

$P = \quad , \quad 1/2\,(\sigma_1+\sigma_3)$, $q = 1/2\,(\sigma_1-\sigma_3)$

α 0.3703 $\quad$ a 218.00

C a'/Cos Φ' $\quad$ Φ Sine^{-1}(tan α')

Chamber press. (KN/m2)	(σ_3)	400	700	1000	C (KN/m²)	Ø (Degrees)
Deviator Stress , (KN/m2)	($\sigma_1-\sigma_3$)	1146	1553	1849	235	22



Tested by :- Dawit Kebede
Date :- '15/12/01
Checked by :- Isayas Demile
Date :- '18/12/01

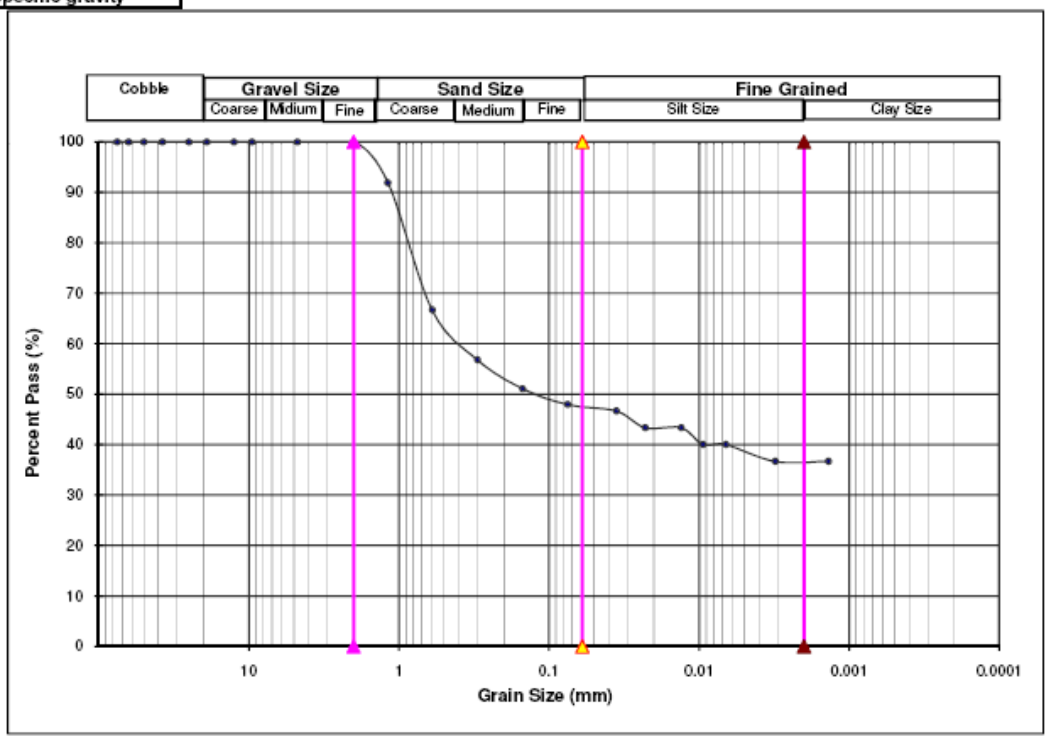
Approved by :- _____
Date :- _____

Company Name	Form N°
CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title	**Issue NO** / **Page N°**
Grain Size Distribution	1 / Page 1 of 1

W.O/Proj. No	00375
Date	20/08/09
Sample ID:	Gs-6/98/1514

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Grey Clayey Sand With Some Silt
Test method	ASTM D 421
TP	16
Depth (m)	0.20-0.80

Specific gravity	2.50



Tested by: Dawit Kebede
Date : 11/12/01
Checked by: Isayas Demle
Date: 12/12/01

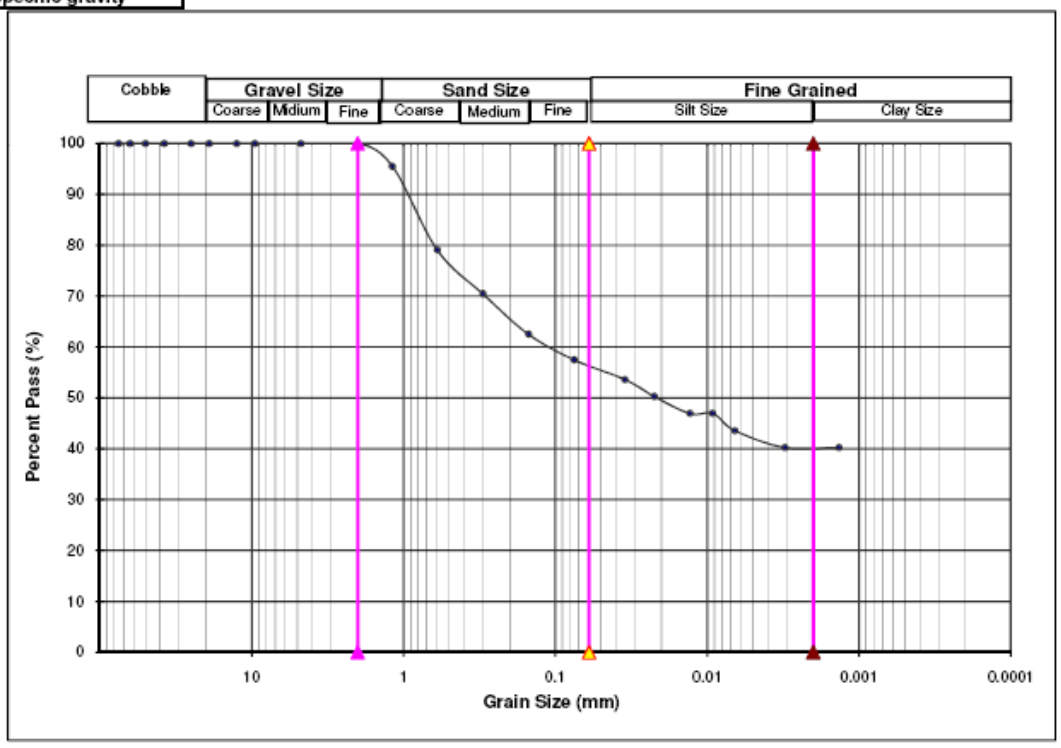
Approved by :_____
Date : _____

	Company Name	Form N°
	CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1	Page N°: Page 1 of 1

W.O/Proj. No	00375
Date	20/08/09
Sample ID:	Gs-6/98/1515

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Grey Clayey Sand With Some Silt
Test method	ASTM D 421
TP	20
Depth (m)	0.40-1.60

Specific gravity 2.48



Tested by: Dawit Kebede
Date : 11/12/01
Checked by: Isayas Demle
Date: 12/12/01

Approved by :_____
Date : _____

Company Name: CONSTRUCTION DESIGN SHARE SCo.	Form N°: OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1 / Page N°: Page 1 of 1

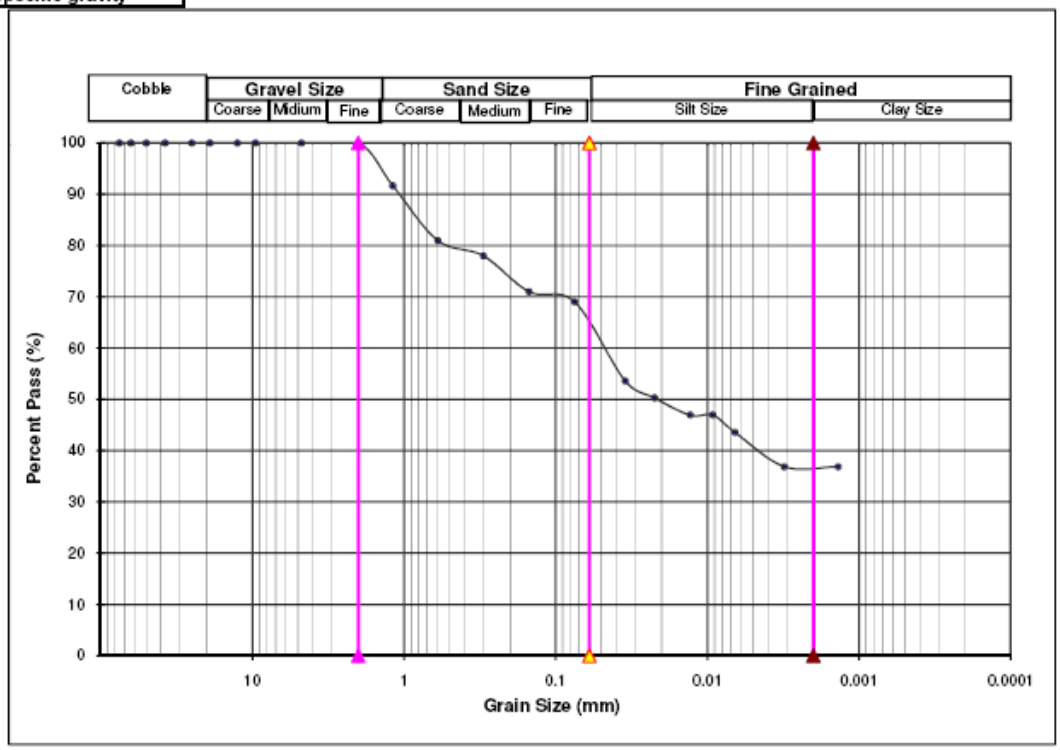
W.O/Proj. No	00375
Date	20/08/09

Sample ID:	Gs-6/98/1516

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Red to brown Sandy Clay With Some Silt
Test method	ASTM D 421

TP	23
Depth (m)	0.50-1.80

Specific gravity	2.48



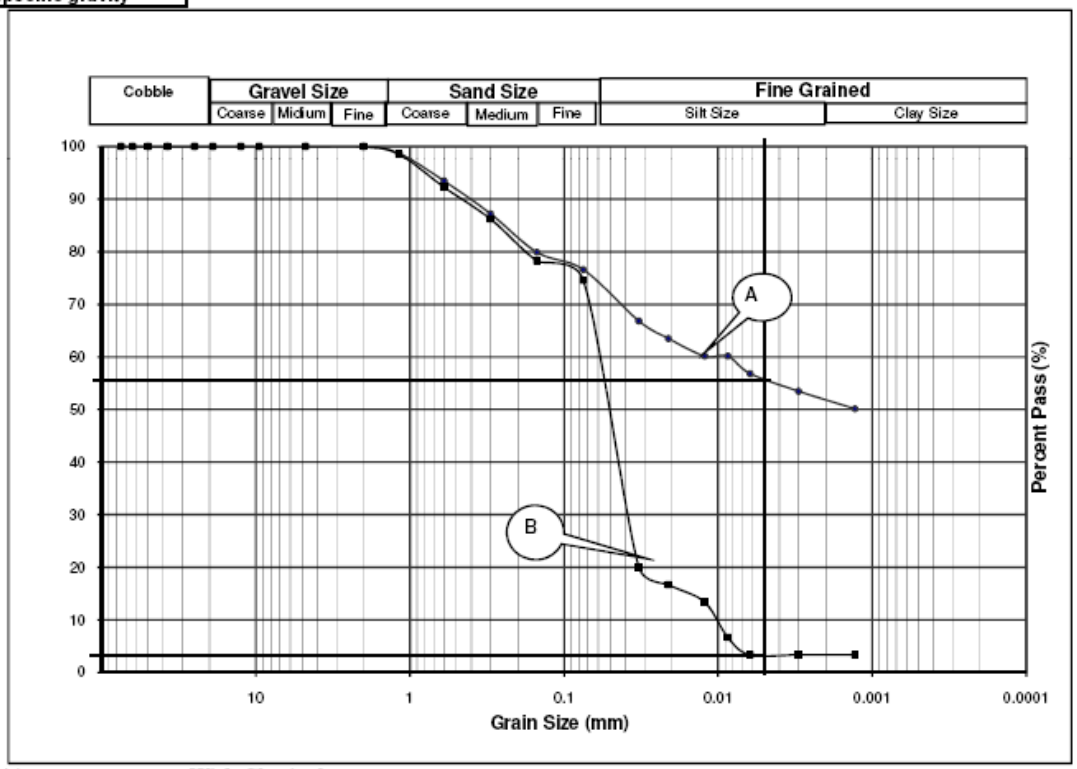
Tested by: Dawit Kebede
Date : 11/12/01
Checked by: Isayas Demle
Date: 12/12/01

Approved by :_____
Date : _____

Company Name	Form N°
CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1 / Page N°: Page 1 of 1

W.O/Proj. No	00375
Date	20/08/09
Sample ID:	Gs-6/98/1297

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Light Brown Silty Clay With Sand
Depth	0.50-2.20
BH/TP	52.00
Specific gravity	2.49



*A	With Chmical
*B	With Out Chmical
*Despersivness (%)	6.02
Tested by:	Dawit Kebede
Date :	15/12/01
Checked by :	Isayas Demle
Date :	15/12/01

percent dispersion = pass0.005 mm / pass 0.005 mm standard test

Approved by :_____

Date : _____

Company Name: CONSTRUCTION DESIGN SHARE SCo.	Form N°: OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1 / Page N°: Page 1 of 1

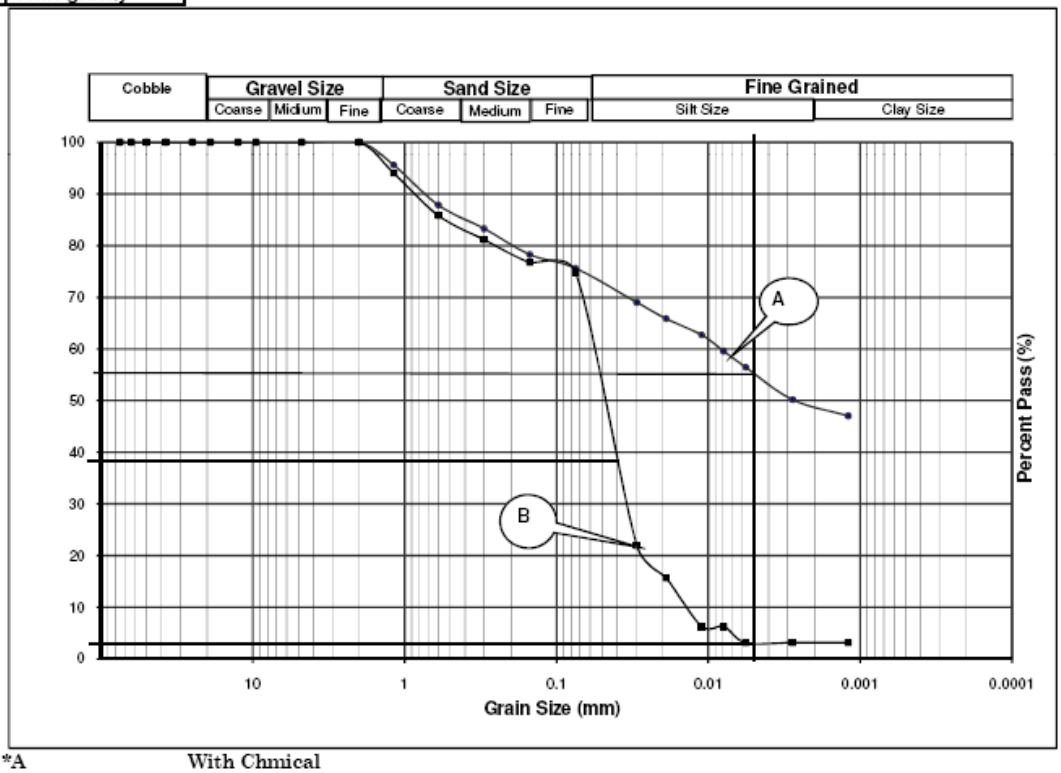
W.O/Proj. No	00375
Date	20/08/09

Sample ID:	Gs-6/98/1289

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Light BrownSilty Clay With Sand

Depth	0.30-2.50
BH/TP	1.00

Specific gravity	2.76



*A	With Chmical
*B	With Out Chmical
*Despersivness (%)	5.56

percent dispersion = pass0.005 mm
pass 0.005 mm standard test

Tested by:	Dawit Kebede
Date :	15/12/01
Checked by :	Isayas Demle
Date :	15/12/01

Approved by :_____
Date : _____

Company Name	Form N°
CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123

Title	Issue NO	Page N°
Grain Size Distribution	1	Page 1 of 1

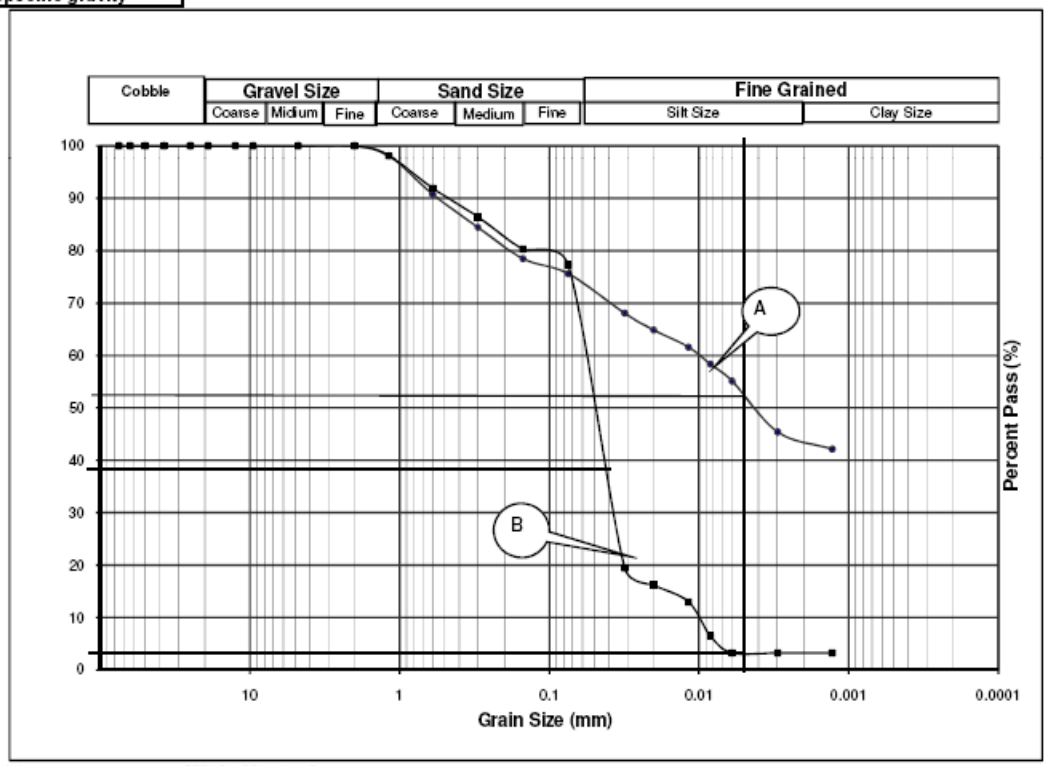
W.O/Proj. No	00375
Date	20/08/09

Sample ID:	Gs-6/98/1291

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Brown Silty Clay With Sand

Depth	0.40-2.10
BH/TP	2.00

Specific gravity	2.61



*A	With Chmical
*B	With Out Chmical
*Despersivness (%)	6.20

percent dispersion = pass0.005 mm / pass 0.005 mm standard test

Tested by:	Dawit Kebede
Date :	15/12/01
Checked by :	Isayas Demle
Date :	15/12/01

Approved by :_____
Date : _____

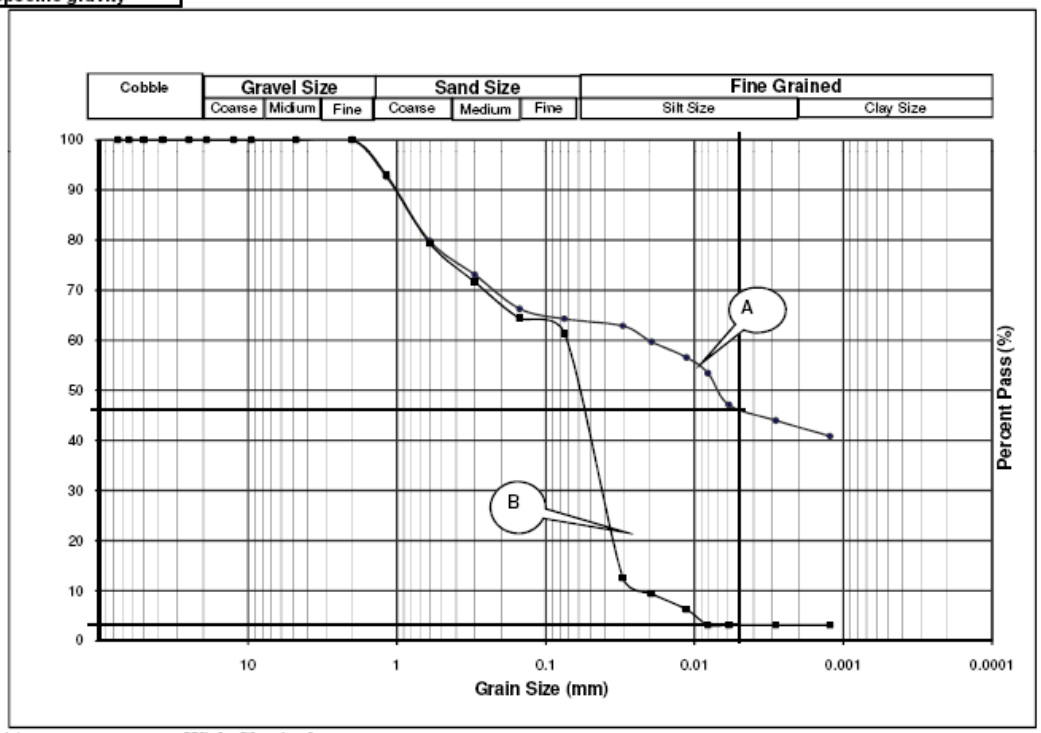
Company Name	Form N°
CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title	**Issue NO** / **Page N°**
Grain Size Distribution	1 / Page 1 of 1

W.O/Proj. No	00375
Date	20/08/09
Sample ID:	Gs-6/98/1293

Project Dinger Bereha Irrigation
Client Metaferia Consulting Engineers PLC
Location: Dinger Bereha
Description: Red to Brown Sandy Clay With Some Silt

Depth 0.50-1.80
BH/TP 23.00

Specific gravity 2.75



*A With Chmical
*B With Out Chmical
*Despersivness (%) 6.80 percent dispersion = pass0.005 mm
pass 0.005 mm standard test

Tested by: Dawit Kebede
Date : 15/12/01
Checked by : Isayas Demle
Date : 15/12/01

Approved by :_____
Date : _____

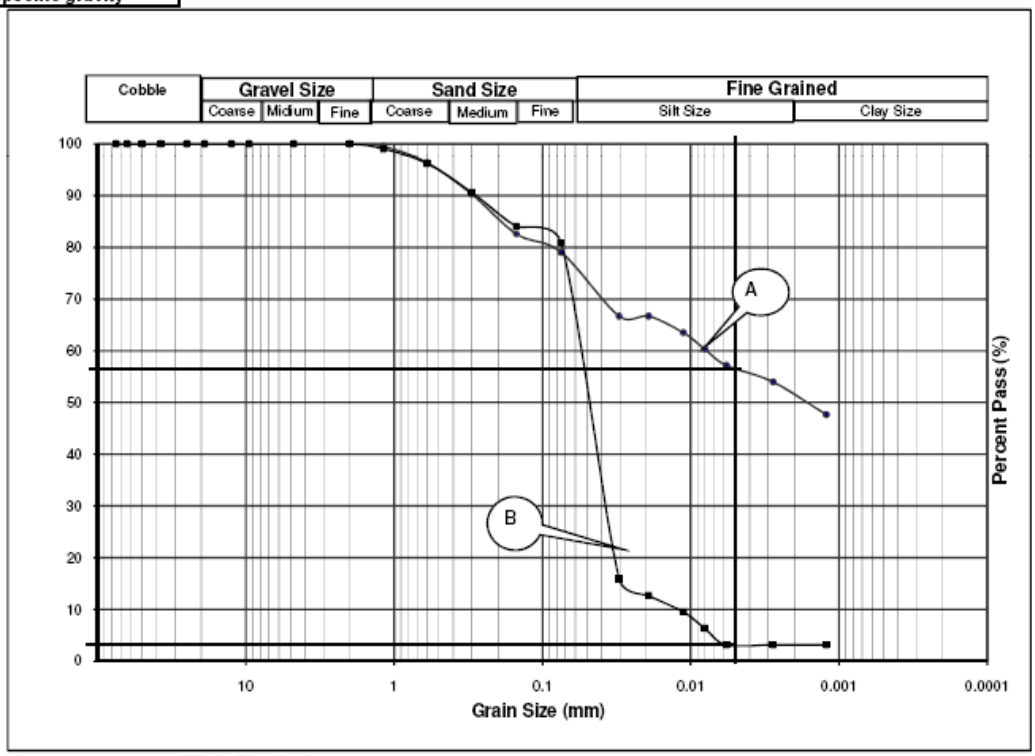
	Company Name	Form N°
	CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1	Page N°: Page 1 of 1

W.O/Proj. No	00375
Date	20/08/09
Sample ID:	GS-6/98/1295

Project	Dinger Bereha Irrigation
Client	Metaferia Consulting Engineers PLC
Location:	Dinger Bereha
Description:	Light Brown Silty Clay With Sand

Depth	0.50-1.80
BH/TP	48.00

Specific gravity	2.70



*A	With Chmical
*B	With Out Chmical
*Despersivness (%)	5.58

percent dispersion = pass0.005 mm / pass 0.005 mm standard test

Tested by:	Dawit Kebede
Date :	15/12/01
Checked by :	Isayas Demle
Date :	15/12/01

Approved by :_____
Date : _____

Company Name	Form No
CONSTRUCTION DESIGN SHARE CO.	OF/CDSCo./117
Title	**Issue NO** / **Page N°**
LABORATORY TEST RESULT	1 / Page 1 of 1

Wo No = 00375
Date = 20/08/09

Project :- Dinger Bereha Irrigation
Client :- Metaferia Consulting Engineers Plc
Location :- Dinger Bereha
Object :- Rock Samples

Nº	Sample No	Depth (m)	Specific Gravity SSD	Unit weight (Kg/m^3)	Point load Mpa	UCS KN/M^2	Porosity %	Water Absorption %	SSS %
1	1	5.00-5.15	-	-	5.74	-	0.85	-	-
2	1	5.57-5.95	2.72	2449	-	51604	-	0.55	-
3	1	7.00-7.50	-	2722	8.70	-	-	-	5.25
4	2	5.68-5.85	-	2688	4.62	-	-	-	-
5	2	6.66-6.87	-	2610	-	36369	0.72	-	-
6	2	9.75-9.96	2.7	-	7.32	-	-	0.49	-
7	Rock Agg.	-	-	-	-	-	1.21	-	5.97

*

Tested by :- Solomon Gamle
Date :- 11/12/01
Checked by :- Isayas Demle
Date :- '12/12/01

Approved by :- _____
Date :- _____

	Company Name	Form N°
	CONSTRUCTION DESIGN Sco.	OF/CDSCo/143

Title	Issue NO	Page No
Cement Test Result	1	Page1of 1

W.O. N° = 00375
Date = 20/08/09

Project:- Denger Bereha Irrigation
Client :- Metaferia Consulting Engineers Plc
Site :- Denger Bereha
Object :- Cement type OPC / Pakistan
Test :- Mortar Strength (River b/n V4&5)
Mix Proportion:- 1 : 3

Compressive strength

Item No	Date		Age in days	Dimen. -m LxWxH	Unit Weight Kg/m^3	Compressive Streng. Kgf/m^2
	Poured	Tested				
1	29/11/01	02/12/01	3	0.07x0.07x0.07	2187	68
2	29/11/01	02/12/01	3	0.07x0.07x0.07	2128	79
3	29/11/01	02/12/01	3	0.07x0.07x0.07	2140	71
4	29/11/01	06/12/01	7	0.07x0.07x0.07	2216	94
5	29/11/01	06/12/01	7	0.07x0.07x0.07	2157	114
6	29/11/01	06/12/01	7	0.07x0.07x0.07	2189	101

Tested by :- Airmeyas Aychew
Date :- '10/12/01
Checked by:- Isayas Demle
Date :- '12/12/01

Approved by:- Girma Mekonnen
Date :- '12/12/01

	Company Name	Form N°	
	CONSTRUCTION DESIGN Sco.	OF/CDSCo/143	
Title		Issue NO	Page No
Cement Test Result		1	Page1of 1

W.O. N° = 00375
Date = 20/08/09

Project:- Denger Bereha Irrigation
Client :- Metaferia Consulting Engineers Plc
Site :- Denger Bereha
Object :- Cement type OPC / Pakistan
Test :- Mortar Strength (Fante river)
Mix Proportion:- 1 : 3

Compressive strength

Item No	Date		Age in days	Dimen. -m LxWxH	Unit Weight Kg/m^3	Compressive Streng. Kgf/m^2
	Poured	Tested				
1	29/11/01	02/12/01	3	0.07x0.07x0.07	2187	75
2	29/11/01	02/12/01	3	0.07x0.07x0.07	2157	83
3	29/11/01	02/12/01	3	0.07x0.07x0.07	2157	79
4	29/11/01	06/12/01	7	0.07x0.07x0.07	2280	104
5	29/11/01	06/12/01	7	0.07x0.07x0.07	2241	117
6	29/11/01	06/12/01	7	0.07x0.07x0.07	2284	110

Tested by :- Airmeyas Aychew
Date :- '10/12/01
Checked by:- Isayas Demle
Date :- '12/12/01

Approved by:- Girma Mekonnen
Date :- '12/12/01

Company Name	CONSTRUCTION DESIGN SHARE CO.	Form No OF/CDSCo./117
Title	LABORATORY TEST RESULT	Issue NO 1 / Page N° Page 1 of 1

Project No 03323
Date 12/03/10

Project :- Dinger Bereha Irrigation
Client :- Metaferia Consulting Engineers PLC
Location :- Dinger Bereha
Object :- Soil samples

N°	No	Depth in (m)	ASTM D 854 Specfic Gravity	ASTM D 2216 Moisture content %	Optimum Moisture content %	Standard Procter (Kg/m^3)	ASTM D 423-424 LL %	PL %	PI %
1	DCTP 39	0.60-3.77	2.63	28.67	-	-	38.50	25.52	12.98
2	TPRes 01	0.50-3.00	-	34.12	27.50	1556	47.80	33.19	14.61
3	Dtp 28	0.70-2.20	2.63	13.14	-	-	-	-	-
4	DCTP 38	0.60-2.00	-	25.24	-	-	-	-	-
5	DCTP 37	0.60-3.00	-		-	-	46.20	28.99	17.21

Note:-
1. Two graphs for grain size distribution test result are drawn and attached here with
2. One graph for double grain size distribution test result is drawn and attached here with
3. One graph for UU triaxial test result is drawn and attached here with

Tested by :- Mulu Beyene
Date :- 17/07/02
Checked by :- Isayas Demle
Date :- 17/07/02

Approved by :- _____
Date :- _____

	Company Name	Form N°
	CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123
Title: Grain Size Distribution	Issue NO: 1	Page N°: Page 1 of 1

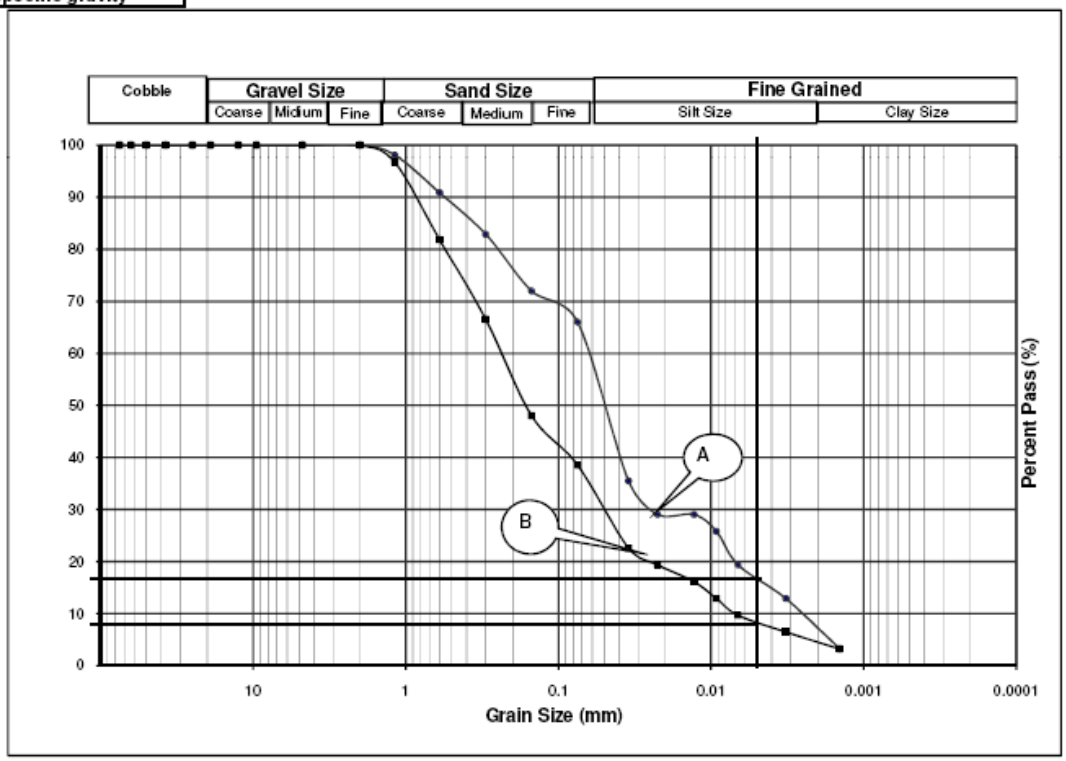
W.O/Proj. No	03323
Date	12/03/10

Sample ID:	Gs-6/98/1299

Project: Dinger Bereha Irrigation
Client: Metaferia Consulting Engineers PLC
Location: Dinger Bereha
Description: Red to Brown Silty Clay With Sand

Depth: 0.60-3.77
BH/TP: DCTP-39

Specific gravity: 2.63



*A With Chmical
*B With Out Chmical
*Despersivness (%) 45.14

percent dispersion = pass0.005 mm / pass 0.005 mm standard test

Tested by: Mulu Beyene
Date : 16/07/02
Checked by : Isayas Demle
Date : 17/07/02

Approved by :_____
Date : _____

Company Name: CONSTRUCTION DESIGN Sco.	Form N°: OF/CDSCo/168	
Title: TRIAXIAL TEST RESULT	Issue NO: 1	Page No: Page1of 1

Project : Dinger Bereha Irrigation — Pro. Nº 03323
Client : Metaferia Consulting Engineers PLC — Date 12/03/10
Location: Dinger Bereha
Test Type: Triaxial UU
Object : soil samples
SPECIMEN DATA

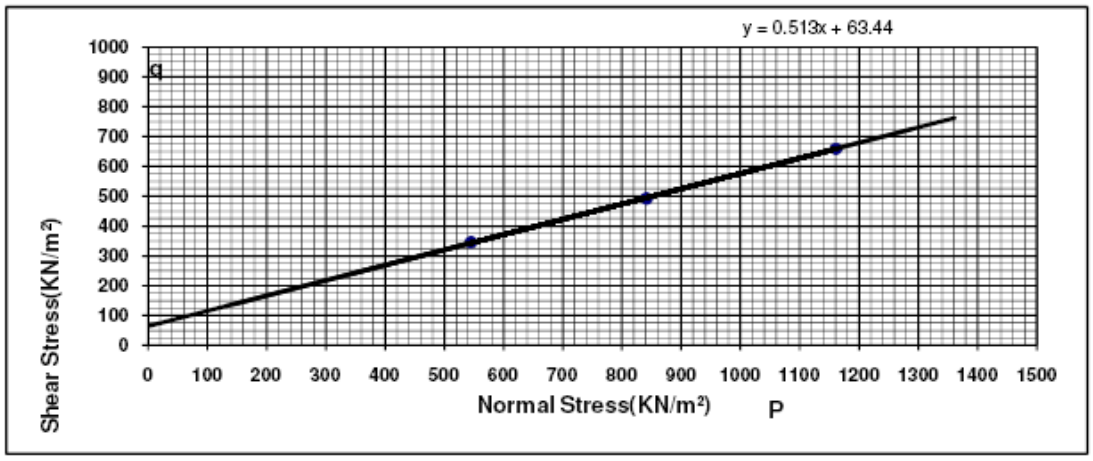
TP/BH NO	-
Depth (m)	0.50-3.00
Initial height (mm)	76.00
Initial area (mm²)	11.34
Initial Weight (gm)	170.08
Final dry Weight (gm)	133.46
Moisture content (%)	27.44

Sample Nº	TPRes-01
Sample condition	Disturbed
Initial diameter (mm)	38
Initial volume (cm³)	86.18
Bulk density (gm/cm³)	1.974
Dry density (gm/cm³)	1.549
Specific Gravity	

Remark

P = , $1/2\,(\sigma_1+\sigma_3)$, q = $1/2\,(\sigma_1-\sigma_3)$
α 0.5133 a 63.00
C a/Cos Φ Φ $\text{Sine}^{-1}(\tan\alpha)$

Chamber press. (KN/m2)	(σ_3)	200	350	500	C (KN/m^2)	Ø (Degrees)
Deviator Stress , (KN/m2)	$(\sigma_1-\sigma_3)$	690	984	1323	73	31



Tested by :- Seife G/senbet — *Approved by :-* _____
Date :- 18/07/02 — *Date :-* _____
Checked by :- Isayas Demle
Date :- 20/07/02

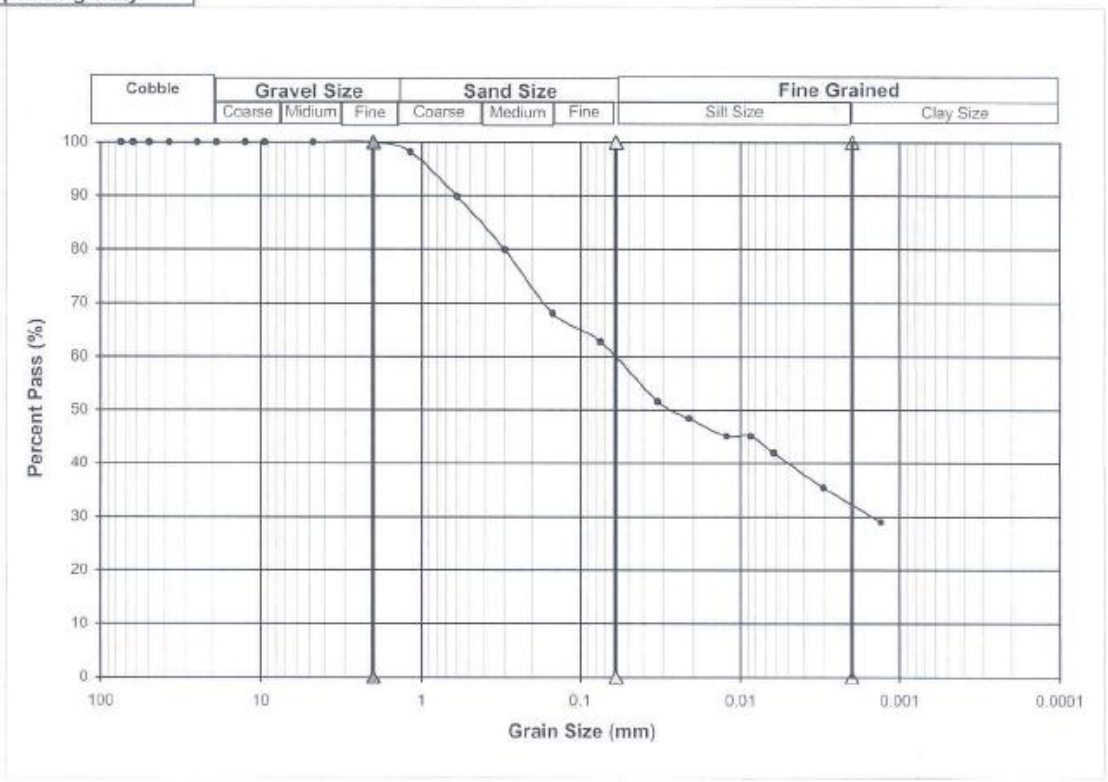
Company Name	FORM N°
CONSTRUCTION DESIGN SHARE CO.	OF/CDSCo./123
Title	**Issue NO** / **Page N°**
GRAIN SIZE DISTRIBUTION	1 / Page 1 of 1

W.O/Proj. No	3323
Date	03/12/10
Sample ID:	Gs-6/98/1605

Project :- Dinger Berha Irrigation Project
Client :- Metaferia Consulting Engineers
Location :- Dinger Berha
Description : - Red brown Silty Sand with some Clay

BH DCTP-28
Depth 0.70-2.20

Specific gravity 2.63



Tested by: Bizayheu Tadesse
Date : 13/07/02
Checked by: Isayas Demle
Date: 14/07/02

Approved by :- Girma mekonnen
Date:- 14/07/02

Central Laboratory

PLEASE MAKE SHURE THAT THIS IS THE CORRECT ISSUE BEFORE USE

Company Name	Form N°
CONSTRUCTION DESIGN SHARE SCo.	OF/CDSCo./123

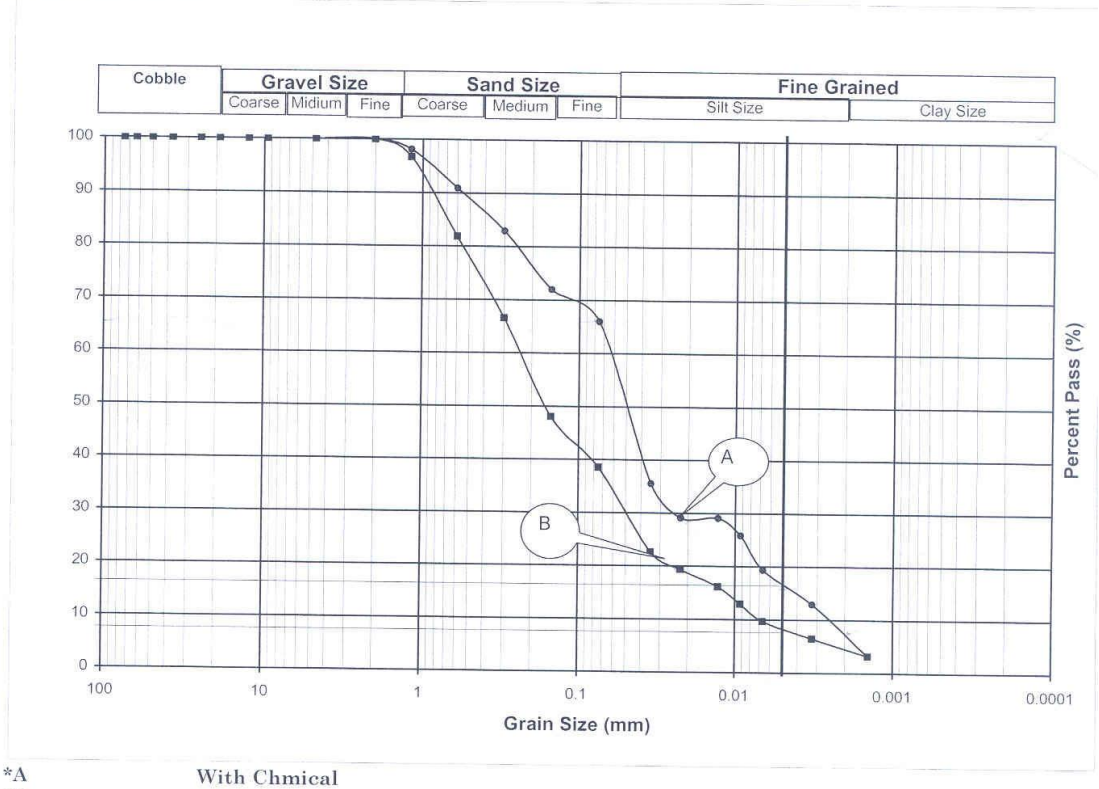
Title	Issue NO	Page N°
Grain Size Distribution	1	Page 1 of 1

W.O/Proj. No	03323
Date	12/03/10
Sample ID:	Gs-6/98/1299

Project Dinger Bereha Irrigation
Client Metaferia Consulting Engineers PLC
Location: Dinger Bereha
Description: Red to Brown Silty Clay With Sand

Depth 0.60-3.77
BH/TP DCTP-39

Specific gravity 2.63



*A With Chmical
*B With Out Chmical
*Despersivness (%) 45.14

percent dispersion = pass0.005 mm
pass 0.005 mm standard test

Tested by: Mulu Beyene
Date : 16/07/02
Checked by : Isayas Demle
Date : 17/07/02

Approved by :
Date :

Construction Design Share SCo.
Central Laboratory

PLEASE MAKE SHURE THAT THIS IS THE CORRECT ISSUE BEFORE USE

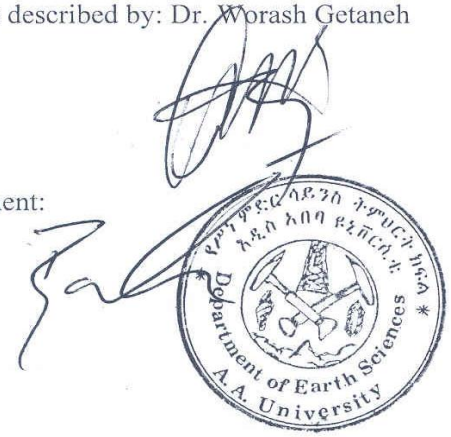
Laboratory Thin Section Analyses Result

of Rock Samples from the Cores

Thin section number = BH-1		
Minerals present	Relative %Vol.	Remark
Feldspars	55	K-feldspar/perthite
Quartz	12.5	
Biotite	22	
Epidote	Trace	
Hornblende	10	
The rock is coarse grained gneiss Rock name = **Biotite Feldspar Gneiss**		
Thin section number = BH-2		
Minerals present	Relative %Vol.	Remark
Feldspars	80	K-feldspar/perthite
Quartz	11.5	
Biotite	4	
Epidote	1	
Muscovite (Sericite?)	3	These are hypogene alteration products of k-feldspar
Opaque	Trace	
The rock is coarse grained gneiss Rock name = **Feldspar Gneiss**		

Samples described by: Dr. Worash Getaneh

Department:



APPENDIX F: PHOTOGRAPHS

Test pit in feeder canal alignment

Looking for another passage

Infiltration test

Assembling raft on left bank at diversion site

Launching raft at diversion site

Skid mounted rig

Off loading rig