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1. INTRODUCTION

Action Contra La Faim (ACF) wants to explore the possibility of developing groundwater for the activities of the Evangelical College of Theology Health Post at Jui through borehole drilling.
In the quest to search for groundwater and as a prerequisite to borehole drilling, ACF therefore contracted the Water Directorate under the Ministry of Water Resources to carry out geological, hydrogeological / Geophysical investigations in sitting the borehole location.
These studies, amongst others provided enough data and information used in assessing the possibility of striking groundwater in the project area.
This report therefore documents the work carried out during the investigations.

2. BACKGROUND / GEOLOGY OF PROJECT AREA

The project area lies between the Bullom sedimentary formation and the Freetown Basic Complex. The Bullom Group is comprised of unconsolidated to poorly consolidated sediments occupying the coastal plains of Sierra Leone. The deposits extend up to 50k inland and are found at heights up to 40m above present sea level (Culver and Williams, 1979). Although outcrop of the Bullom Group are rare and generally poor, the available evidence suggest a lateral variable sequence of poorly consolidated, near horizontal, often iron-stained gravels, sands, clays with occasional intra- formational laterites.

The Freetown Basic Complex on the other hand outcrops in the west as a result of younger igneous intrusions and it is predominantly of basaltic magmatism. The Freetown Complex is a layered gabbroic anorthosite intrusion, emplaced gneisses and schist of the Kasila group. The Bullom Group is resting unconformably on the Freetown Complex.

However, groundwater potential could be high within the upper Sedimentary Formation and at depth within fractured bed rock if properly located using the appropriate siting methods.

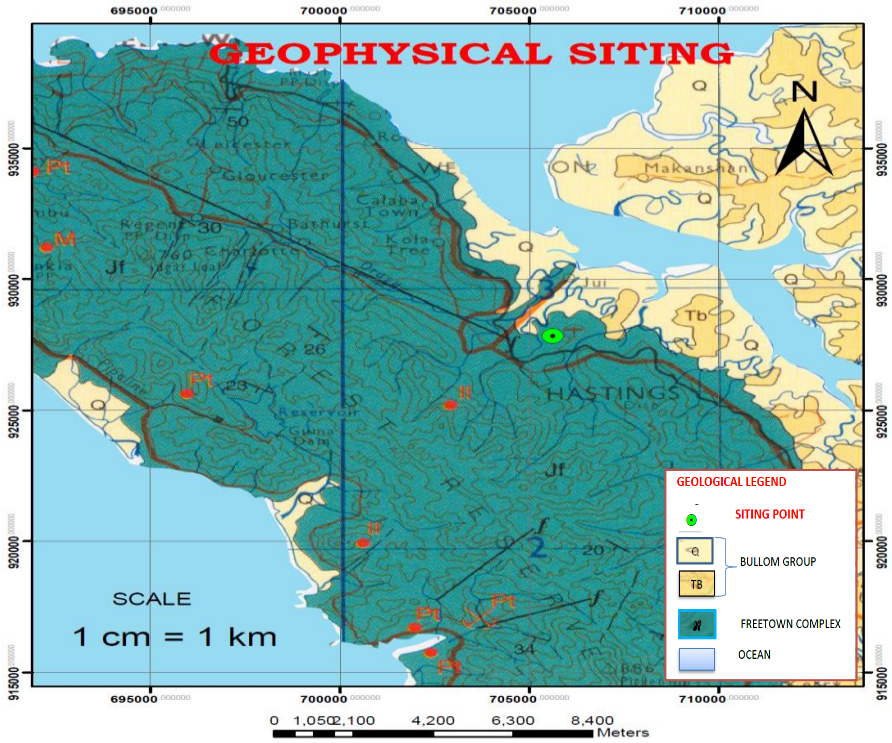


Figure 1. Geological Map of the Project Area

3. FIELD WORK

3.1 Reconnaissance Survey

The aim of the reconnaissance survey was to select suitable area (s) for geophysical survey; considering the geological/hydrogeological, environmental and other physical conditions.

The field reconnaissance survey was undertaken together with ACF representative on the 18th September, 2015 and included the following:

- **Geomorphological Survey of the Area**

This includes the landscape and other physical features. The project area is relatively flat with no visible outcrops or elevated ground in the immediate surroundings. There are streams and river within the project area which also suggests high groundwater potentials because there is always a hydraulic continuity between surface and groundwater.

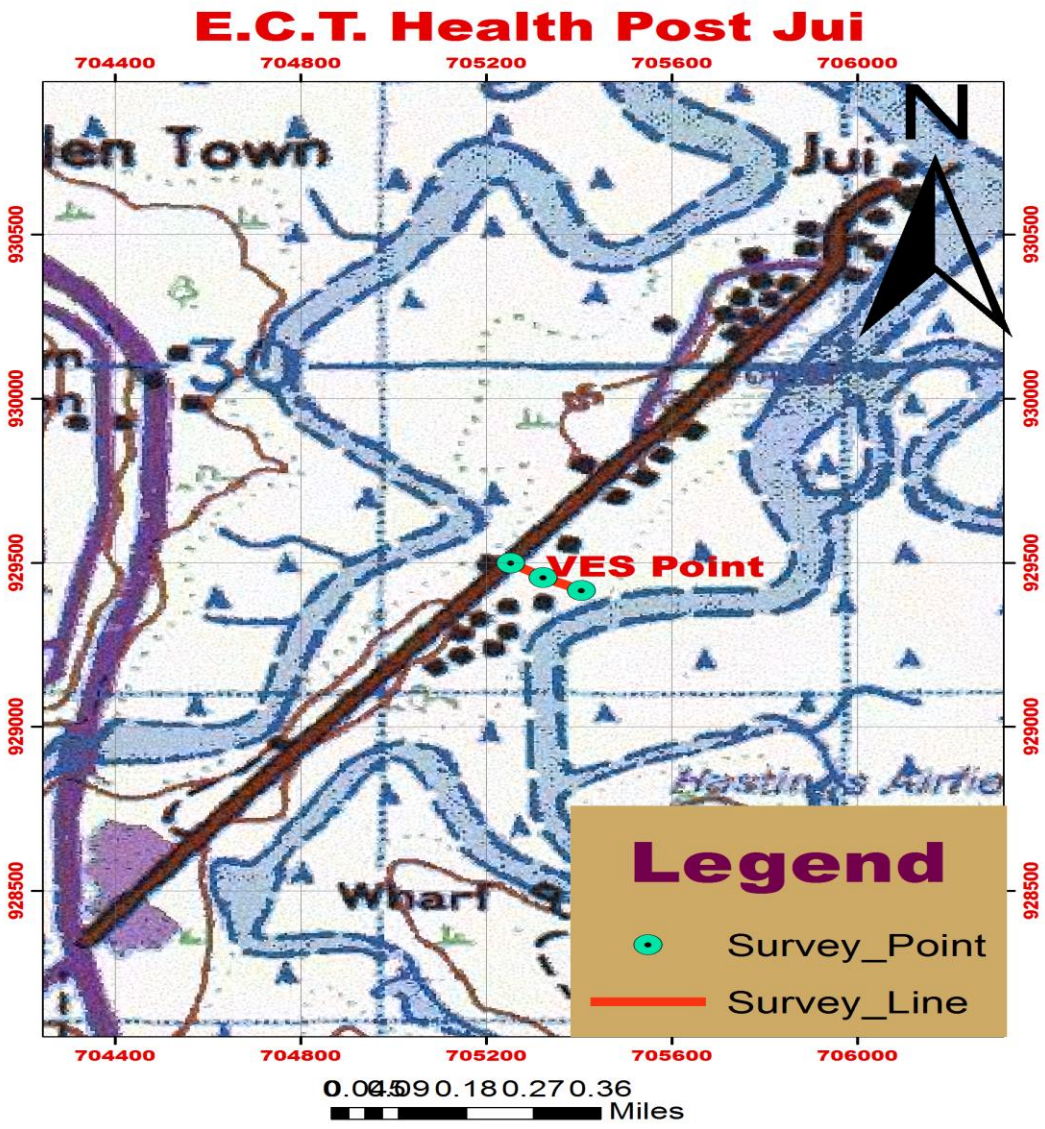


Figure 2. Topographic Map of the Project Area

- **Geological / Hydrogeological Survey to Determine the Formation of the Area and to Identify Possible Features.**

The project area is overlain by sedimentary formation ranging from unconsolidated, poorly consolidated sand, gravel and clay mixtures.

However, sedimentary formations hold high groundwater potentials because of their aquifer characteristics especially in poorly consolidated gravels and sands. There are streams and water channels around the project area.
Trees within the area are fresh with green leaves indicating that they are getting direct water intake at a shallow depth.
Note that trees/plants are essential component of the Hydrological Cycle.

- **Assessment of Existing Boreholes and other Water Points.**

There is a hand dug well of about 200m away from the selected location which is sustainable throughout seasons according to the locals. The well is approximately 20m deep with a static water level of about 7m. This is a clear indication of the groundwater potential of the project area.

- **Selection of Traverse Line for geophysical Survey**

The traverse line for resistivity survey was selected on the basis of geomorphologic and geological/hydrogeological features as well as the location of the project area. There were no visible strike directions of the geological formation of the area due to weathering and engineering activities.

The selected point was marked with a peg for identification.

3.2 Geophysical Survey

The Geophysical survey consisted mainly of Electrical Resistivity i.e. Vertical Electrical Sounding (VES) using the Syscal Junior Iris Instrument.

Figure. 3: Syscal Junior Iris Instrument

3.2.1 Selection of the Vertical Electrical Sounding (VES) point

The Vertical Electrical Sounding (VES) point was selected based on the location of the project area; taking into consideration environmental and other physical conditions.

3.2.2 Vertical Electrical Sounding (VES)

Vertical Electrical Sounding (VES) was carried out with the aim of determining the formation resistivities and the depth to bedrock, as well as the possibility of finding water bearing formations or aquifers at depth with the corresponding thicknesses of such aquifers. The Schlumberger electrode configuration and the required procedures were used for the VES.

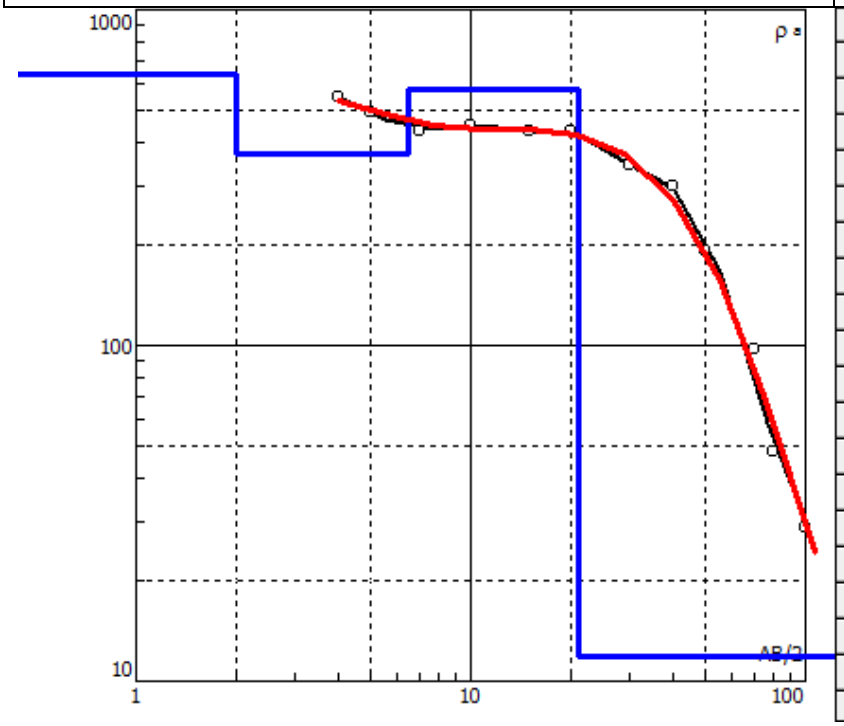
4.0 DATA ANALYSIS AND INTERPRETATION

Table 1: Schlumberger Array VES Data

Client: **ACF**			Community: **Jui**
Project: **Geophysical Survey**			Sounding Number: **1**
District**: Western Area**			GPS Coordinate East: **0705324**
Date: **21st September, 2015**			GPS Coordinate North: **0929455**
Field Operator: **Morlai Kanu**			Elevation: **46m**
Schlumberger Array VES Field Data			
No.	**AB/2**	**MN**	**Apparent Resistivity (ohm-m)**
1	4	0.8	565.6
2	5	0.8	497.2
3	7	0.8	436.9
4	10	0.8	455.0
5	15	1.5	434.9
6	20	1.5	436.7
7	30	1.5	346.3
8	40	1.5	299.1
9	50	7.6	192.6
10	70	7.6	097.5
11	80	14	048.0
12	100	14	028.7

The VES data is first presented in the form of a table (as shown above) from which a graph of Apparent Resistivity (p_a) Vs half the Current Electrode Spacing (AB/2) is plotted.

Schlumgerger Array– VES curve



Model Parameters

N	ρ	h	d	Alt
1	644	2	2	-2
2	372	4.48	6.48	-6.479
3	577	14.5	21	-20.99
4	11.8			

The data shows a three-layer subsurface in which $\rho_1 < \rho_2 > \rho_3$. The unusually low apparent resistivity registered in layer 3 is indicative of the presence of pore electrolyte, possibly groundwater within the sedimentary formation and fractures in bedrock at depth.

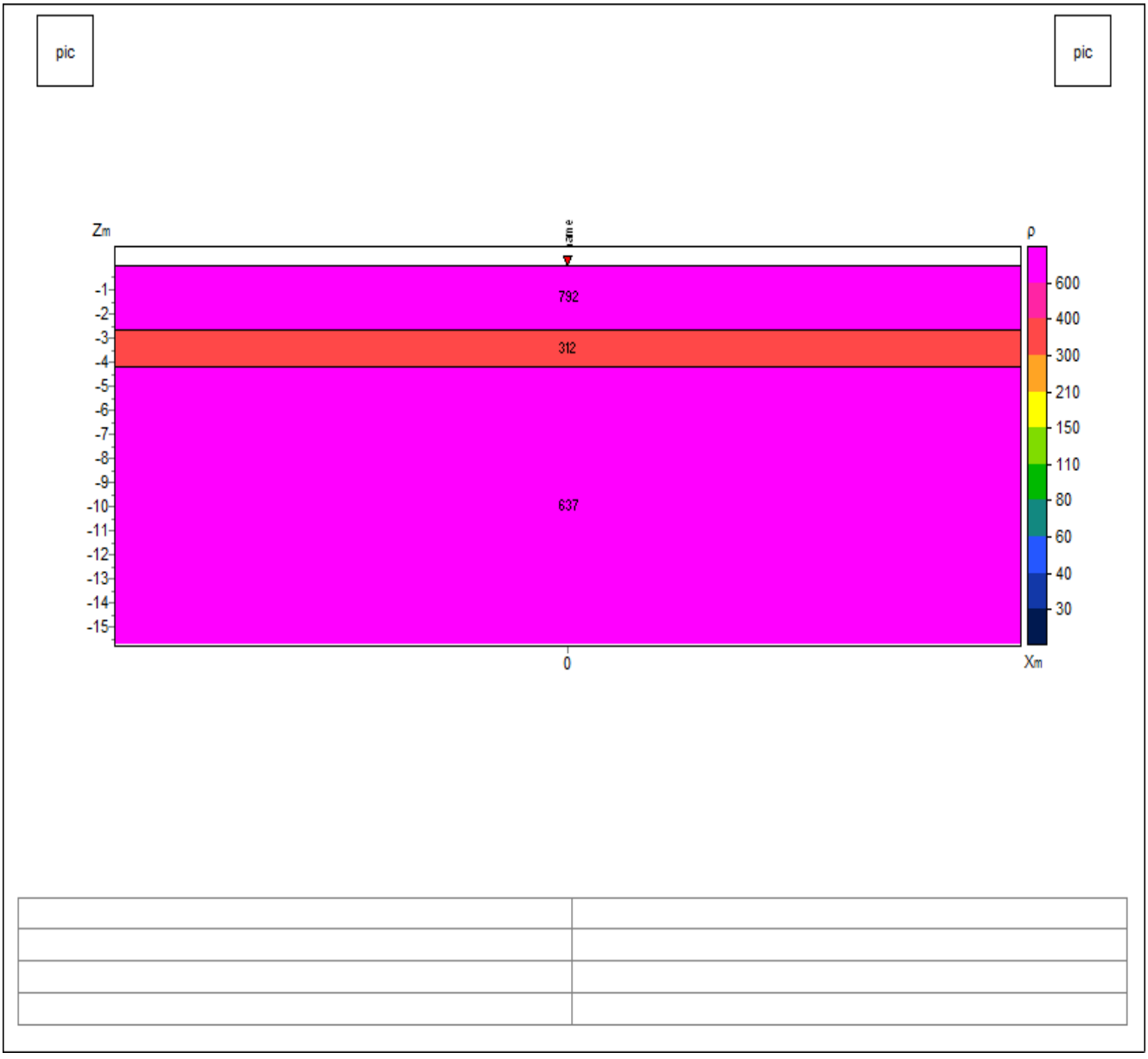


Figure 5: Pseudo-section showing apparent resistivities and layer thicknesses

Table 3: Selection of Promising Points from VES Data

No.	VES POINT	LAYER	THICK NESS (m)	DEPTH (m)	APPARENT RESISTIVITY (Ohm-m)	POSSIBLE WATER ZONES (M)	RANKING	MAX DRILLING DEPTH (M)
1	A	1 2 3	2 4.48 14.5	2 6.48 21	644 372 12	10-50	1st	50m

5.0 CONCLUSION AND RECOMMENDATION

Conclusion

Based on the analyses of the entire results, and in line with the aims of the study, the drawn conclusions are;

- The project area lies between the Bullom Sedimentary formation and the Freetown basic Complex.
- Because of the location of the project area, the sedimentary formation of the Bullom Group is probably underlain by the Freetown Igneous Complex.
- Groundwater potential could be high within the sedimentary formation especially at depth between 10 to 50m and probably within the fractured bed rock.
- It is premature however, to estimate quantities/volume which could only be determined during drilling and test pumping.
- The borehole location was selected in accordance with both national and international borehole siting guidelines.

Recommendation

In this regard, it is recommended that;

- Drilling could be carried out at the selected point to confirm the existence of groundwater.
- Borehole must be constructed using the correct and standard materials such standard PVC screens and plain casings, well sorted and siliceous gravels etc. for water quality and high yield.
- The maximum drilling depth should be 50m. However, the Driller can exceed this depth based on the field/prevailing condition.
- Both physico-chemical and bacteriological test should be carried out on the borehole water samples from completed well.

REPORT SUBMITTED BY:

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Morlai Kanu
Geologist/ Field Operator