TABLE OF CONTENTS

1. INTRODUCTION

Geological, hydrogeological/geophysical investigations are the prerequisite for borehole drilling.

These studies, among others, provided enough data and information used in assessing the possibility of striking groundwater in the project area.

2. BACKGROUND / GEOLOGY OF PROJECT AREA

The project area lies within the Freetown Basic Complex.

The Freetown Basic Complex outcrop 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. It forms part of the Peninsula and Banana Islands.

It is thought to have been formed due to multiple injections of magma that occurred intermittently.

Therefore, groundwater potential of the Freetown Basic Complex is found within weathered and fractured zones of these igneous (crystalline) rocks.

However, groundwater quality and quantity could be high if properly located through the appropriate hydrogeological /geophysical investigations.

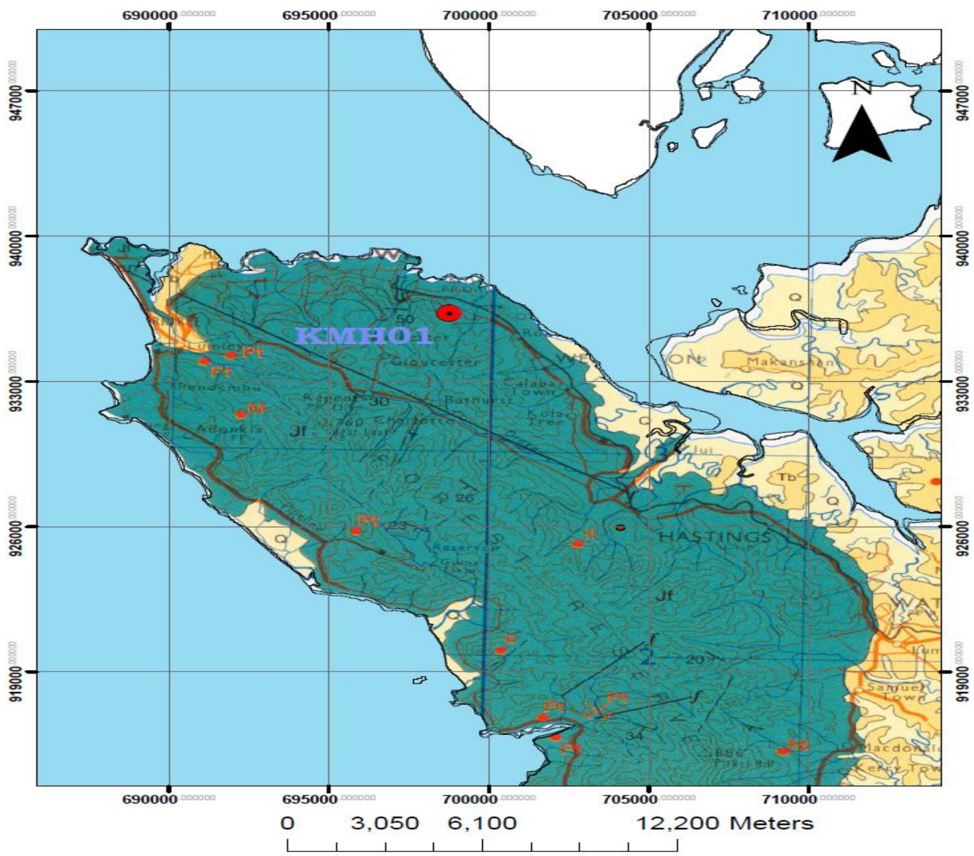
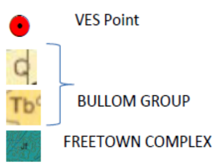


Figure 1. Geological Map of the project Area



3. FIELD WORK

3.1 Reconnaissance Survey

The aim of the reconnaissance survey was to select suitable area (s) for geophysical survey. The field reconnaissance survey was conducted together with a representative from Action Contra La Faim on the 18th September, 2015. The activities carried out included the following:

- **Geomorphological Survey of the Area**

This includes the landscape and other physical features.
The project area is relatively rugged with visible outcrops, elevated grounds and valleys in the immediate surroundings. The area contains streams (shown in blue on the map below).the borehole location is represented in red dots on the map (VES Point).

Therefore, the presence of streams in the area suggests high groundwater potentials as there is always a hydraulic continuity between groundwater and surface water.

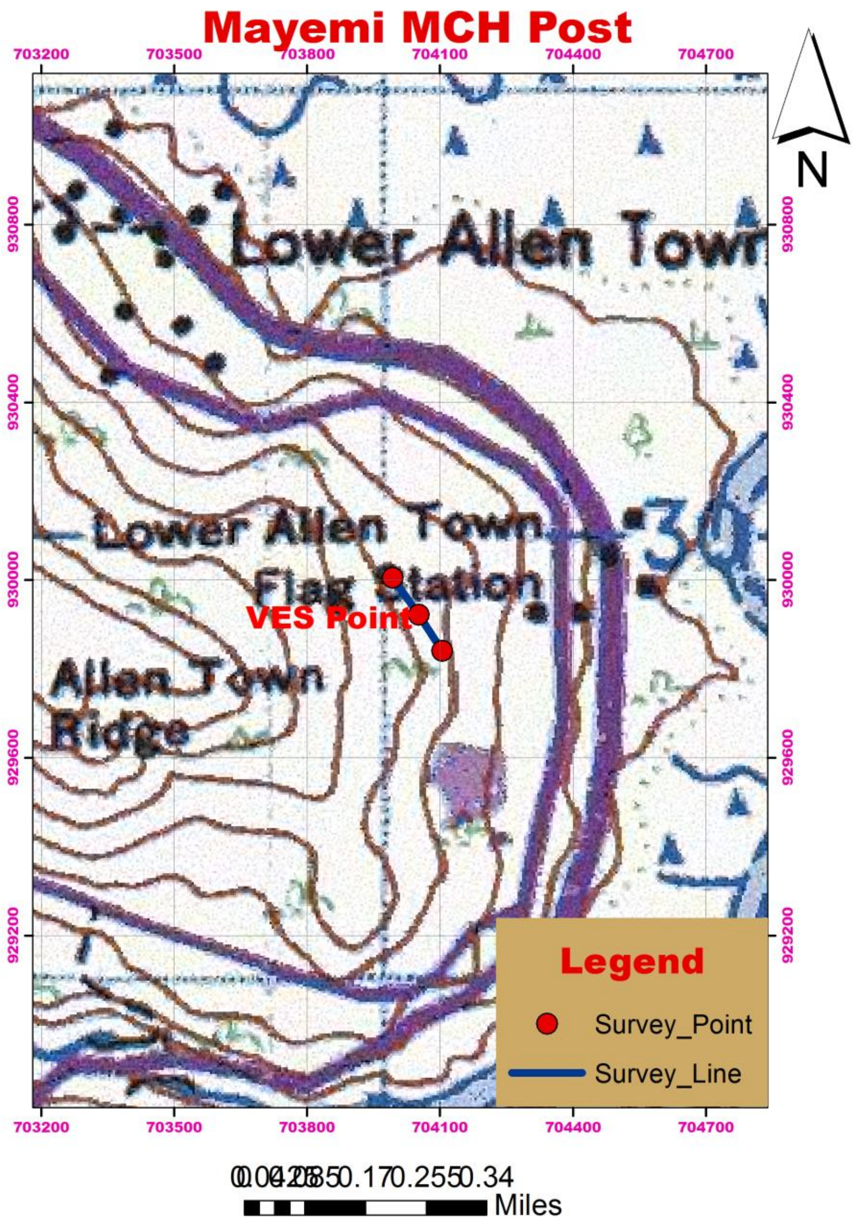


Figure 2. Topographic Map of the Area

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

The project area is overlain by laterites which are the direct weathered product of the crystalline gabbroic and basaltic rocks.
The intense weathering in the area is also a prospect for the existence of groundwater. Groundwater occurs mostly in weathered and unconsolidated materials as compared to consolidated and crystalline rocks.
Trees within the area are fresh with green leaves indicating that they are getting direct water intake at a more or less 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 close to the health post of about 15m deep with a static water level of approximately 7m which is a very good indication of the groundwater potential of the 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.

Point for the Vertical Electrical Sounding (VES) was selected based on the availability of space; considering the environmental and other physical conditions. The borehole location 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 as shown in the figure below.

Figure 3. Geophysical Survey Using Syscal Junior Iris Equipment

3.2.1 Resistivity Profiling

Electrical resistivity profiling is usually carried out along a selected traverse of 50 to 100m length at 10m interval to determine the lateral variation in subsurface resistivities so as to delineate anomalous point(s) with groundwater potential which can be used for the Vertical Electrical Sounding (VES).

However, there was no resistivity profiling for this site because of the unavailability of the required land extent.

Therefore, the Vertical Electrical Sounding (VES) was carried out at the selected point.

3.2.2 Selection of VES points

The Vertical Electrical Sounding (VES) point was selected based on the available space and location of the project area.

3.2.3 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 fractures or aquifer(s) at depth with the corresponding thicknesses of such aquifers. The Schlumberger electrode configuration and the required procedures were used for the Vertical Electrical Sounding (VES).

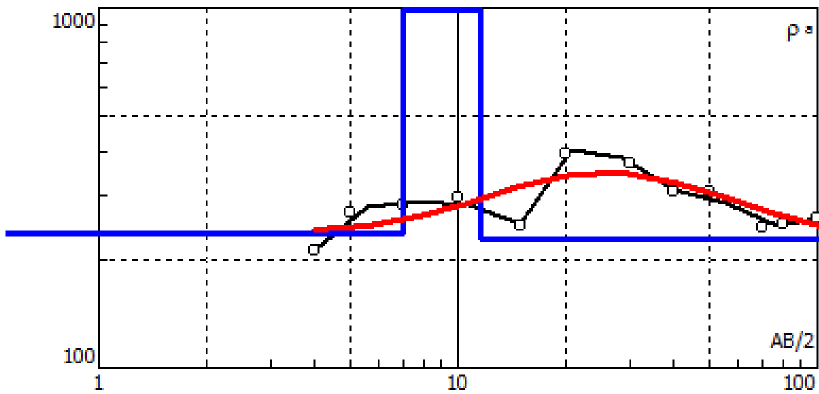
4.0 DATA ANALYSIS AND INTERPRETATION

Table 1: Schlumberger Array VES Data

Client: **ACF**			Community: **Mayemi**
Project: **Geophysical Survey**			Sounding Number: **2**
District**: Western Area**			GPS Coordinate East: **0704052**
Date: **23rd September, 2015**			GPS Coordinate North: **0929922**
Field Operator: **Morlai Kanu**			Elevation: **63m**
Schlumberger Array VES Field Data			
No.	**AB/2**	**MN**	**Apparent Resistivity (ohm-m)**
1	4	0.8	210.9
2	5	0.8	269.7
3	7	0.8	283.7
4	10	0.8	298.1
5	15	1.5	348.1
6	20	1.5	391.5
7	30	1.5	372.3
8	40	1.5	309.6
9	50	7.6	308.2
10	70	7.6	246.4
11	80	14	250.7
12	100	14	261.0

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

Schlumgerger Array– VES curve (A)	Model Parameters



N	ρ	h	d	Alt
1	237	7.04	7.04	-7.037
2	986	4.48	11.5	-11.51
3	227			

Figure 4. Schlumberger Array Ves Curve and Model

The data shows a three-layer subsurface in which $p_1 > p_2 < p_3$. The unusual low apparent resistivity registered in layer 2 is indicative of the presence of pore electrolyte, possibly groundwater, within fractures in bedrock. The equivalent layer thicknesses are 3.4m, 4.8m and 7.8m, respectively. Layer 1 is interpreted as weathered rock (Regolith) which, according to the data is relatively dry rock, while layers 2 and 3 constitute fractured bedrock which probably contains groundwater.

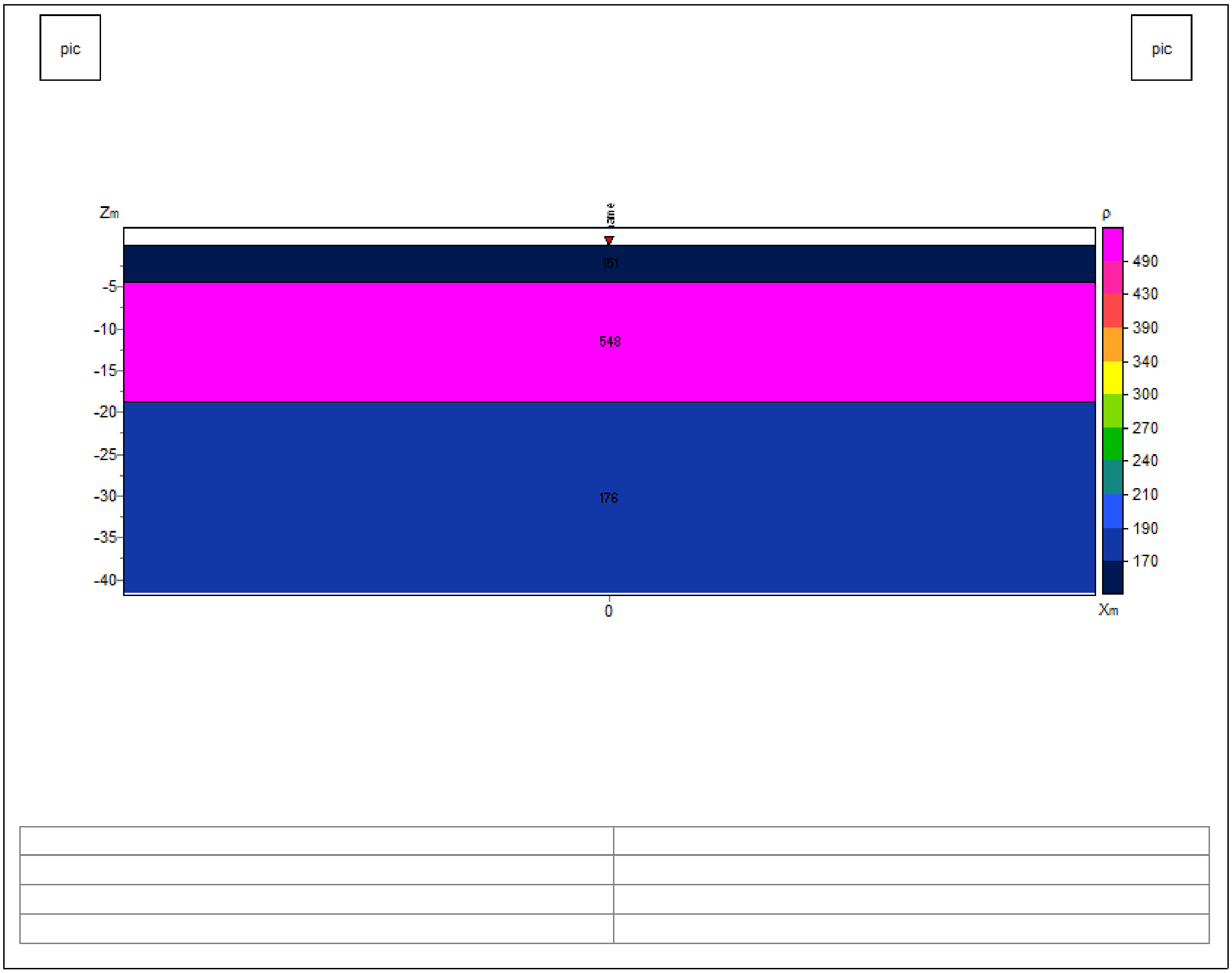


Figure 5. Pseudo - section Showing Apparent Resistivities and Layer Thicknesses

Table 2: Selected 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)
2	B	1 2	7.4 4.48	7.04 15.5	237 986 227	10-20 30-60	2nd	70m

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the analyses of the entire results, and in line with the aims of the study, the conclusions are as follows:

- The project area lies within the Freetown Basic Complex lithological formation.
- Groundwater potential (i.e. quality and quantity) could be high at depth within fractured bedrocks.
- The potential water zones are found between 10 - 20m and 30 -60m respectively as indicated from the resistivity values.
- It is premature, however, to estimate quantities, which could only be determined during test 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 should be carried out at the selected 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 70m to cut across the two promising zones of 10 to 20m and 30 to 60m respectively for sustainable productivity and high yield of the borehole. This depth might be exceeded however, based on field conditions.
- Both physico-chemical and bacteriological test should be carried out on the borehole water samples from completed well.

REPORT SUBMITTED BY:

…………………
Morlai Kanu
Geologist/ Field Operator
Cell: +232 76 950 032