GEOELECTRICAL RESISTIVITY SURVEY TO INVESTIGATE GROUNDWATER AQUIFER DEPTH IN OWAN-WEST LOCAL GOVERNMENT AREA OF EDO NORTH, EDO STATE, NIGERIA

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ABSTRACT: Geophysical investigation to determine groundwater aquifer depth was carried out in some selected communities in Owan-West Local Government Area of Edo north, Edo State, Nigeria using one dimensional (1D) vertical electrical sounding (VES) technique. The Schlumberger configuration with current electrode (AB/2) spacing of 1 m to 100 m with potential electrode (MN/2) spacing was adopted. The data acquisition in the field was carried out using PASSI 16GL-N earth resistivity meter. The 1D data was also collated into a notepad and read into the RES1DINV software from where the molded 1D curve gave the depth of groundwater aquifer in the various investigated communities. It is evident from the result from the study, that good portable drinking water can be reached at a depth between 35 m – 45 m with a thickness of 23 m – 34 m. in all the communities investigated.

Keywords: *Groundwater, Geophysical, Aquifer, Potential, Depth.*

1. INTRODUCTION

Owan west is a local government in Edo State with a normal annual rainfall like other part of Southern part of Nigeria. There is no available record of hydrogeological and geophysical investigation ever carried out in this community to determine aquifer depth in the study area, thus this research is highly important as the existing hand dug boreholes were manually done without any geophysical survey. The science which is known as geophysics involves the applications of the methods of Physics to study the subsurface parts of the earth by taking measurements at or near the earth's surface [1]. Groundwater exists in the subsurface of the earth; therefore proper study and analysis are necessary to ensure that there is a significant quantity of water and the water is of high quality. In this regard geophysical tools play significant roles in addition to mapping the depth of aquifers, mapping aquitards or confined units, and locating preferential fluid migration paths such as fractures and faults. In recent time geophysical method are now applied to the study of environmental problems and investigating groundwater pollution. One of the emerging techniques to efficiently assess subsurface aquifer is to examine the groundwater media in situ, using geophysical techniques.

When rain falls to the ground, the water does not stop moving. Some of it flows along the surface to streams or lakes, some of it is used by plants, some evaporates and returns to the atmosphere, and some sinks into the ground. Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. Groundwater is stored in and moves slowly through layers of soil, sand and rocks called aquifers. Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are permeable because they have large connected spaces that allow water to flow through. The flow rate of groundwater depends on the size of the spaces in the soil or rock and how well the spaces are connected. The hydrological cycle is merely a chain of events involving water as it exists in all its forms on or within the earth. Figure 1.1 is a modeled diagram showing forms of groundwater and the hydrologic cycle.

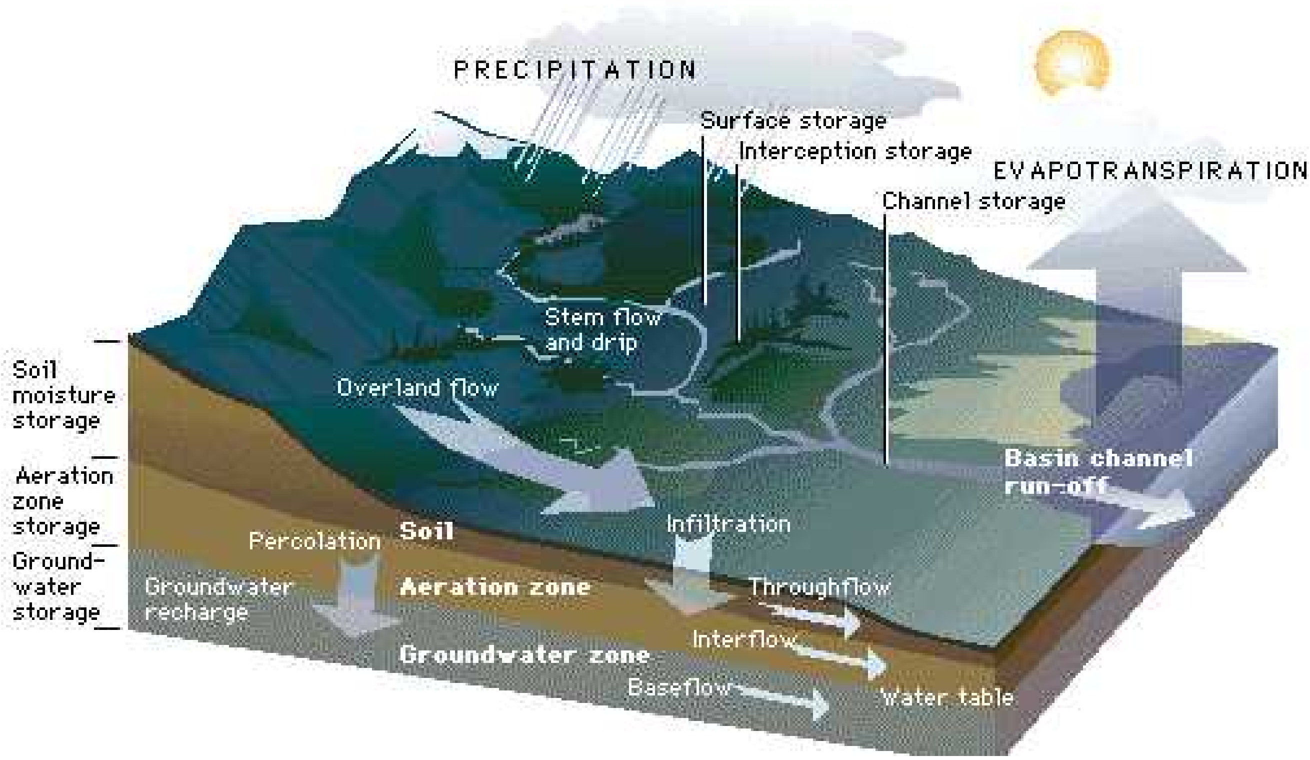

Figure1.1: A modeled diagram showing forms of groundwater and hydrologic cycle. (Source: Encarta Encyclopedia, 2007).

IMPORTANCE OF WATER

The specific role of groundwater in socio-economic development has been widely recognized for the last fifty years [2]. Groundwater continues to serve as a reliable source of water for a variety of purposes, including industrial, domestic uses and irrigation. Water is important to the mechanics of the human body. The body cannot work without it, just as a car cannot run without gas and oil. In fact, all the cell and organ functions made up in our entire anatomy and physiology depend on water for their functioning. Water serves as a lubricant Water forms the base for saliva Water forms the fluids that surround the joints. Water regulates the body temperature, as the cooling and heating is distributed through perspiration. Water helps to alleviate constipation by moving food through the intestinal tract and thereby eliminating waste. The best detox agent regulates metabolism in addition to the daily maintenance of our bodies, water also plays a key role in the prevention of disease. Drinking eight glasses of water daily can decrease the risk of colon cancer by 45%, bladder cancer by 50% and it can potentially even reduce the risk of breast cancer. It would make sense that the quality of the water should be just as important as the quantity. Drinking water should always be clean and free of contaminants to ensure proper health and wellness [3].

AIM OF THE STUDY

The aim of this research is to determine the groundwater aquifer in Owan-west local Government Area of Edo North, Edo State Nigeria.

2. LOCATION OF THE STUDY AREA

The study was carried out in some selected major communities in Owan-west LGA, in the northern part of Edo state, Nigeria. The communities include; Ozalla community, Uzebba community and Sabongida-ora community, all in Owan-west LGA, Edo North area of Edo State. Figure 2 shows the various local government areas in Edo North including Owan-west where this research was carried out. The study area falls under Edo State. Edo State is an inland State in central southern Nigeria. Its capital is Benin City. It was created from the defunct Bendel State on the 27th August 1991 and is located in the rain forest belt of Nigeria between Longitudes 5^0 42'N and 6^0 45'E and Latitude 5" 45'N and 7" 35'N. It is bounded by Kogi State to the north; and by Ondo State to the west. It has a total land mass/area of 19,281.93 square kilometers and eighteen (18) Local Government Areas that make up the three (3) Senatorial Districts, namely Edo South, Edo Central and Edo North. Natural resources abound in the state and these include: hardwood and timber, limestone, marbles lignite crude oil, gold, clay, Kaolin, granite, amongst others.

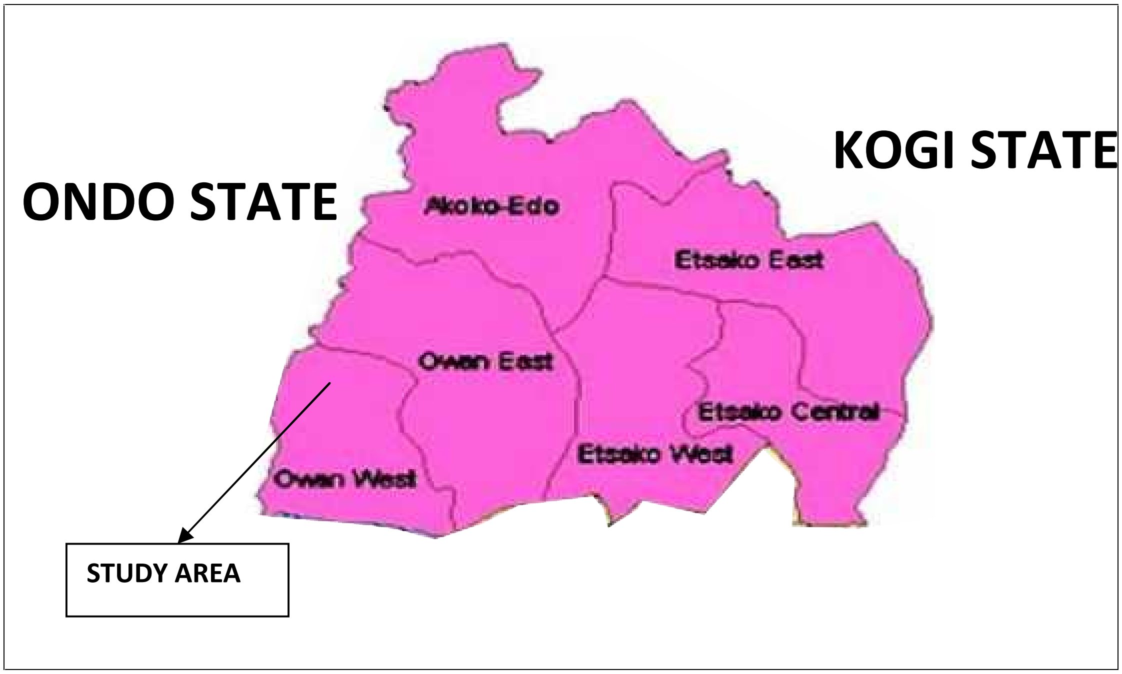

Figure 2: Map of Edo North Showing Various Local Government Areas.
(Source: Edo State ministry of land and survey, Benin City).

Figure 3: Aerial View of Ozalla Town (Source; Google Earth)

Figure 4: Aerial View of Uzebba Town (Source; Google Earth)

3. MATERIALS AND METHOD

One dimensional (1D) vertical electrical sounding (VES) was carried out in the field by acquiring 1D data using the Schlumberger configuration. This was done with the aid of PASSI 16GL-N Earth resistivity meter with current electrode (AB/2) spacing ranged from 1.0 m to 100.0 m and potential electrode (MN/2). The 1D data obtained from the survey was collated into a notepad and read into the RES1DINV software and then the data points checked for any bad data points. The RES1DINV software then molded the 1D curve which gave the depth of groundwater aquifer in the various investigated communities. From the modeled 1D resistivity curve delineated from the study area, the aquifer depth was determine from the point where the resistivity changes drastically.

4. RESULTS

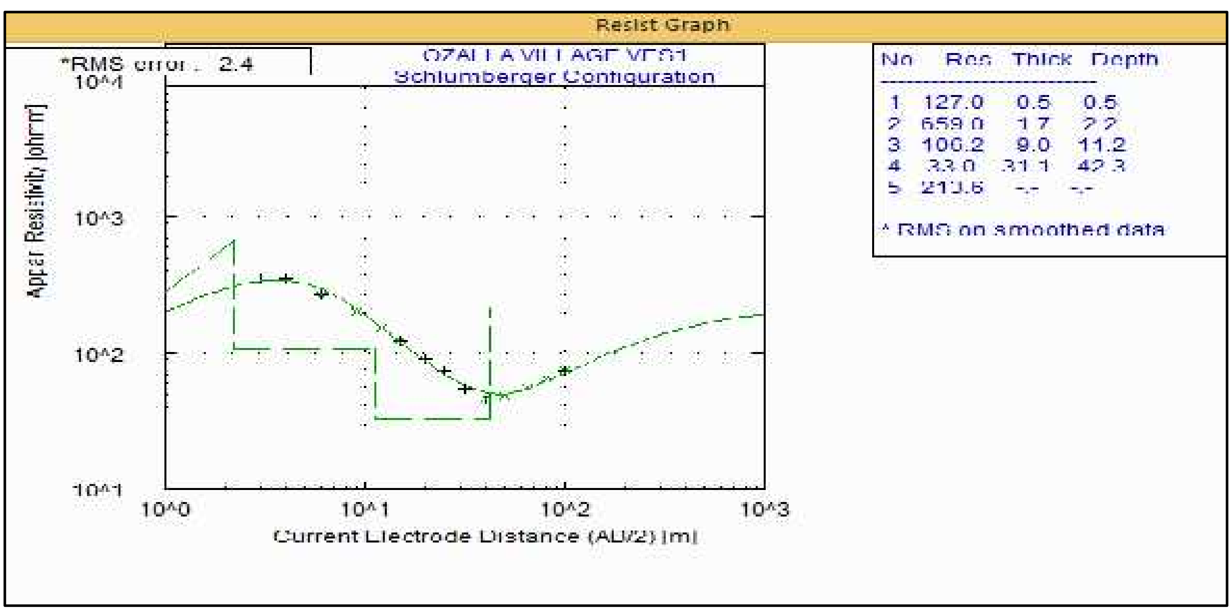

Figure 5: One dimensional resistivity curve obtained from Ozalla study area. (VES 1)

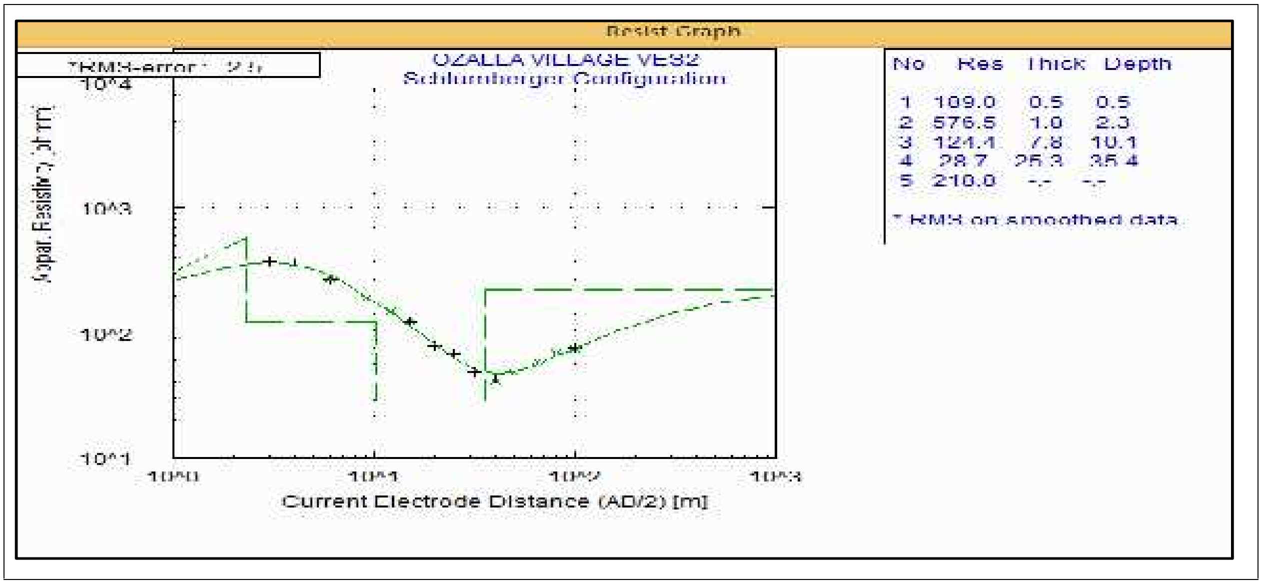

Figure 6: One dimensional resistivity curve obtained from ozalla study area. (VES 2)

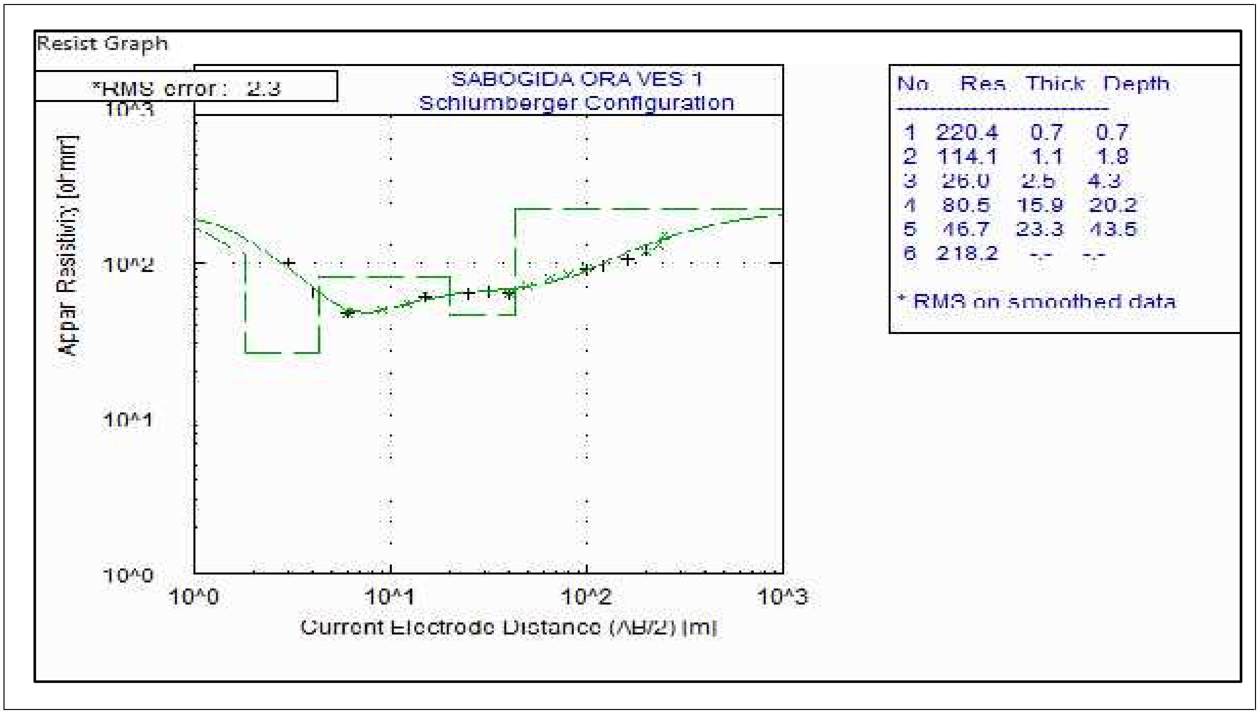

Figure 7: One dimensional resistivity curve obtained from Sabongida-ora study area. (VES 1)

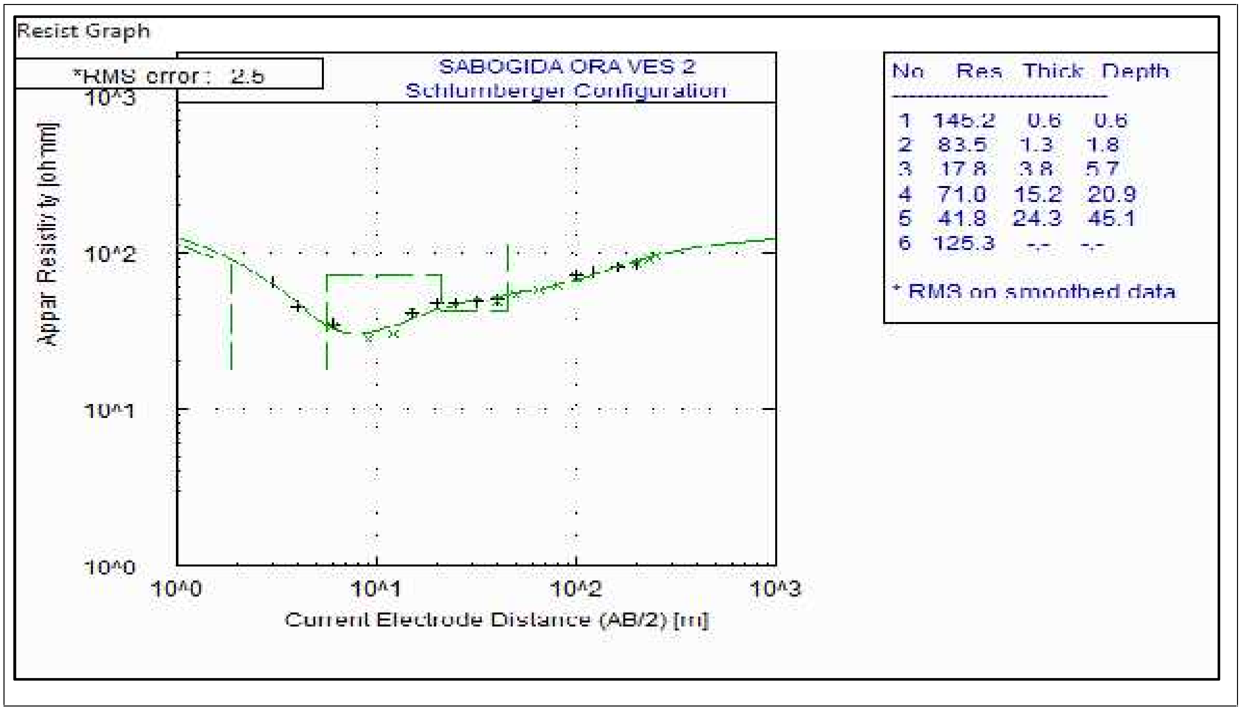

Figure 8: One dimensional resistivity curve obtained from Sabongida-ora study area. (VES2)

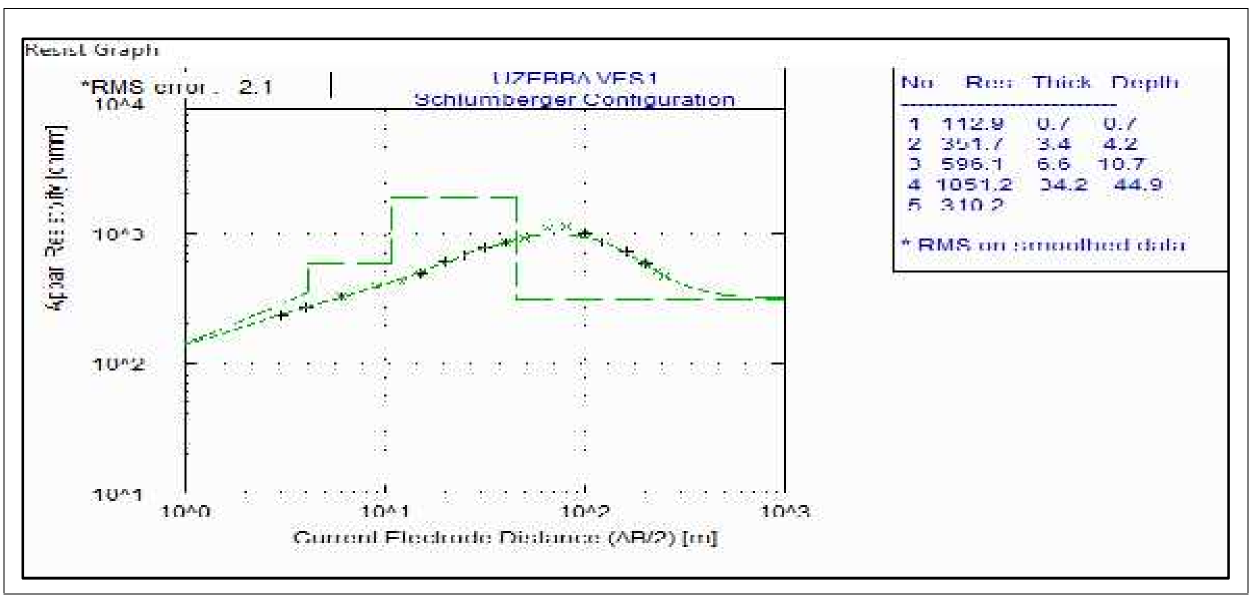

Figure 9: One dimensional resistivity curve obtained from Uzebba study area. (VES 1)

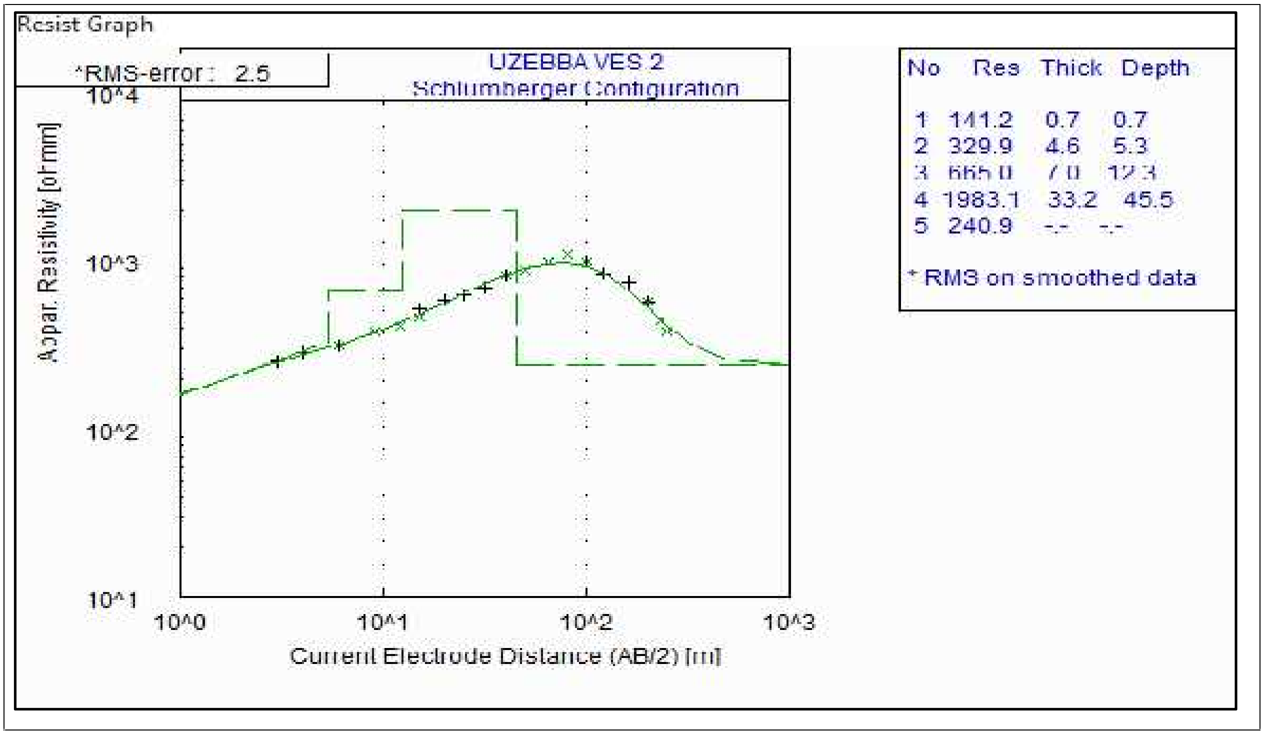

Figure 10: One dimensional resistivity curve obtained from Uzebba study area. (VES 2)

5. DISCUSSION

Figures 5 to 10 shows the one dimensional resistivity curve obtained from the study area. Figures 5 and 6 is the one dimensional resistivity modeled curve obtained from Ozalla community with aquifer depth of 42.3 m and a thickness of 31.1 m in VES 1 and aquifer depth of 35.4 m with thickness of 25.3 m in VES 2. In Sabongida-Ora community, figures 7 and 8 shows the one dimensional resistivity modeled curve obtained , with aquifer depth of 42.5 m and a thickness of 23.5 m in VES 1 and aquifer depth of 45.1 m with thickness of 21.3 m in VES 2. Figures 9 and 10 is the one dimensional resistivity modeled curve obtained from Uzebba community with VES 1 having aquifer depth of 44.9 m and a thickness of 34.2 m and aquifer depth of 45.5 m with thickness of 33.2 m in VES 2. The study shows that the aquifer depth in the study area is between (35 m – 45 m) and thickness (23 m – 34 m). The One dimensional resistivity curve was determined at the points where the resistivity values drop form the delineated modeled curves, this point indicate the presence of fresh water zone called aquifer (the water depth) in the study area. The study area is a basement complex and has some parts as transition zone. Personal communication with the local drillers in the study area shows that at a depth of 42.3 m (139.59 ft) aquifer can be reached, which correlate with the one dimensional resistivity curve. Water also springs from hand dug well in the study area which also serves as a major source of water for domestic uses.

6. CONCLUSION

The geoelectrical investigations performed in Owan-West LGA, in some selected communities in Edo North, Edo State, Nigeria has help in the determination of depth of groundwater aquifer in the study area. It is evident from the result from the study area that good portable drinking water can be reached at a depth between (35 m – 45 m) with a thickness of (23 m – 34 m). The result also provides information on drilling depth of groundwater to the local drillers in the study area.

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