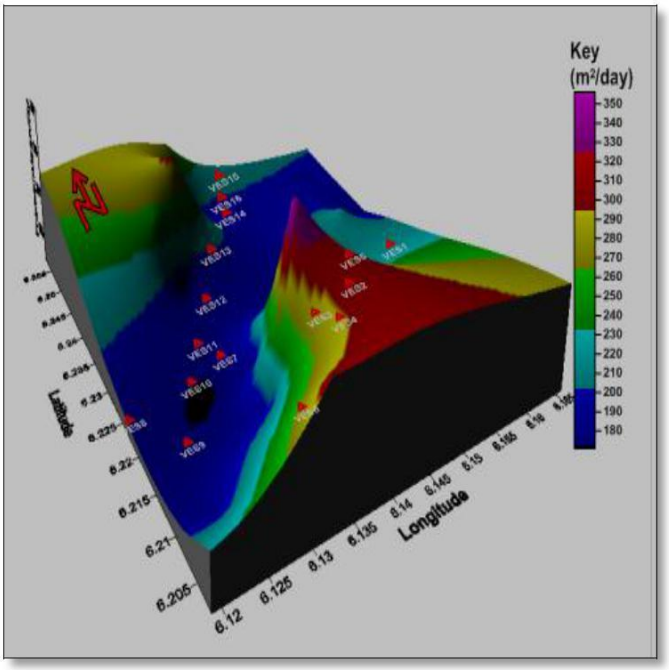

Figure 11: the 3D subsurface aquifer transmissivity of the various VES locations.

The map depicts six major colours in the study area such as blue, light blue, green, yellow, red, and pink respectively. The blue zone indicate the wide region that runs across the locations with higher transmissivity such as VES 1, 8, 11, 13, 14 etc. while VES 3, 15, 16 etc shows low transmissivity. As shown in table 2, the Dar Zarrouk parameter delineates the most prolific aquifer in the area due to its excellent transmission of water within the locations. Table 3 shows the first order Geoelectric parameter and Dar Zarrouk parameters for aquifer protective capacity of Agbor-Obi and environs. Oladepo *et al* 2004 modified the longitudinal conductance/protective capacity ratings as: greater than 10 (excellent), 5-10 (very good), 0.7-4.9 (good), 0.2-0.69 (moderate), 0.1-0.19 (weak) and less than 0.1 (poor). These were used for the interpretation of the protective capacity. The results obtained in table 4 show that Agbor-Obi and environs, the studied area is not protected since almost the entire VES area have poor protective capacity rating except VES 1 that has weak protective capacity.

The low and weak value of the protective capacity rating is due to the absent of clay as an overburden impermeable material resulting in the percolation of contaminants into the existing aquifer. The studied area are vulnerable to surface contaminants but as a result of low aquifer it takes a long time for the contaminant to get to the aquifer which makes the groundwater safe for drinking and use for domestic activities. The direction of flow of an aquifer in Agbor and environs is deteremined by groundwater level measurement, relative geographical position of the wells and elevation were collected and contoured in a map perspectives using software, thereby generating groundwater surface maps.

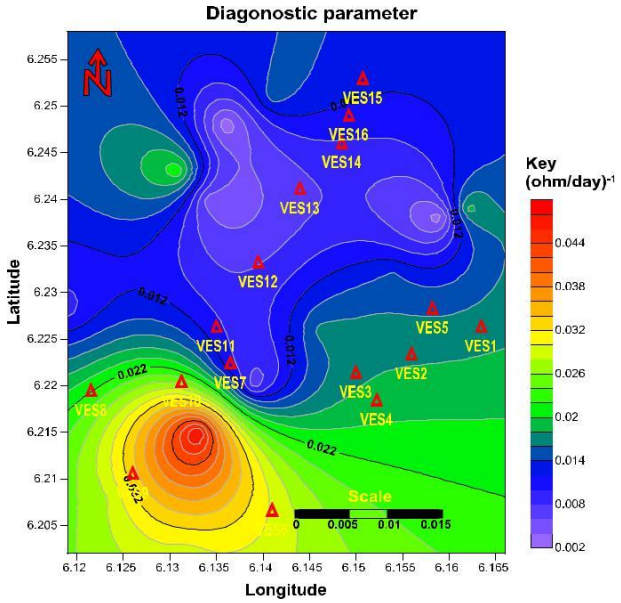

Figure 13: The diagnostic parameter of the study area.

It can be inferred from figure 9 that water flows north-east direction as seen in the concentration of arrow head. A knowledge of the direction of groundwater flow is important as it helps in citing boreholes where considerable quantity of water can be obtain without having abortive boreholes.

Water samples were randomly selected from the various locations and analysed. The analysis show very low concentration of constituents in the various samples. The aquifer is not protected but for the low position of the aquifer the water from the locations is good for domestic and industrial purposes.

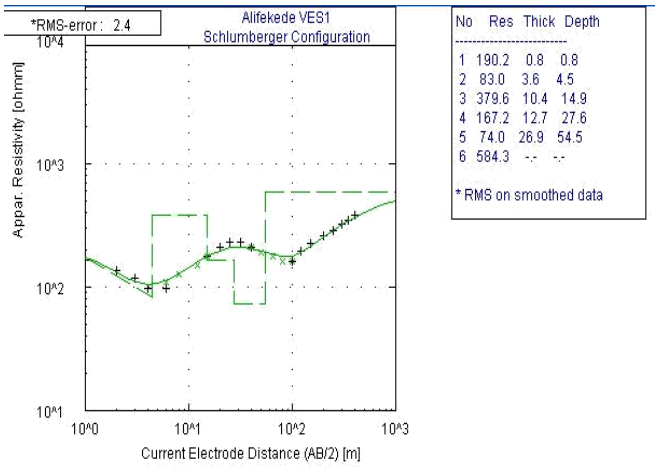

Figure 3: Typical Sounding Curve for Agbor-Obi Hydrogeophysical

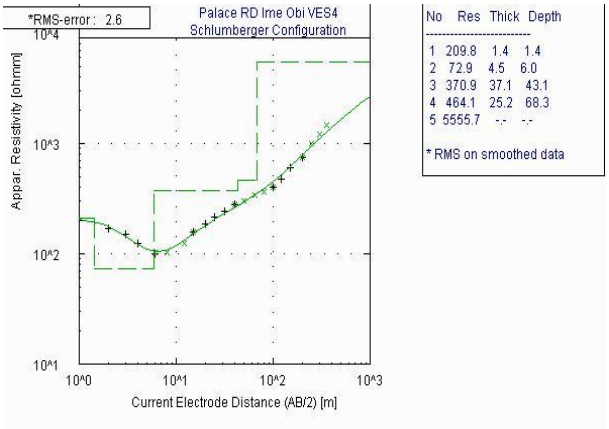

Figure 5: Typical Sounding Curve for Agbor-Obi Hydrogeophysical Investigation of VES 4

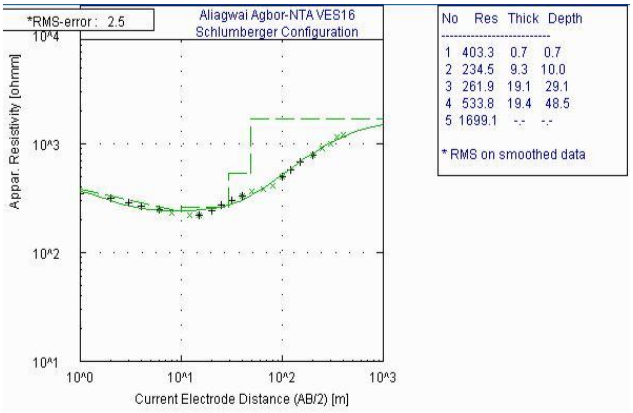

Figure 6: Typical Sounding Curve for Agbor-Obi Hydrogeophysical Investigation of VES 16

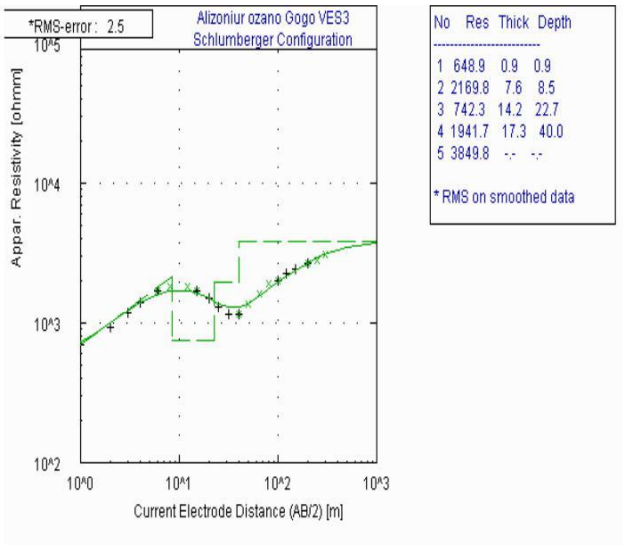

Figure 4: Typical Sounding Curve for Agbor-Obi Hydrogeophysical Investigation of VES 3.

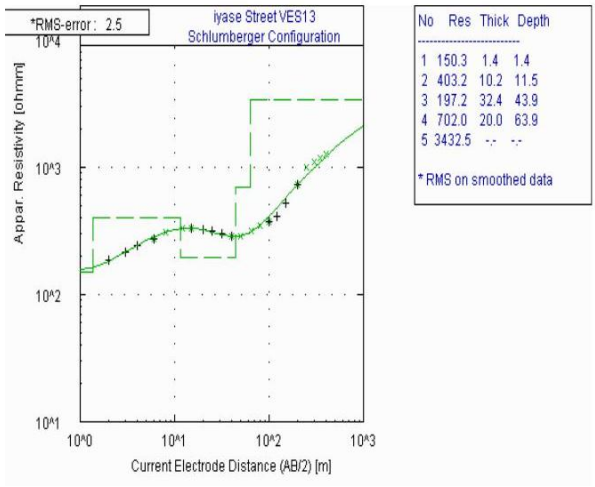

Figure 7: Typical Sounding Curve for Agbor-Obi Hydrogeophysical Investigation of VES 13

GEOELECTRIC SECTION OF THE STUDY AREA

Geoelectric section from VES 1 to VES 7 of the study area

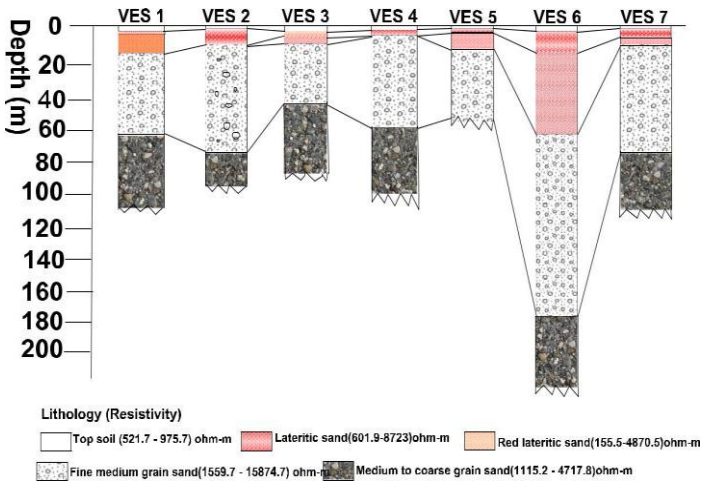

Figure 12 a: shows the Geoelectric section from VES 1 to VES 7 of the study area.

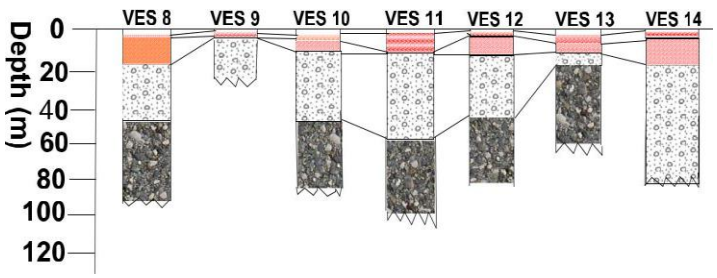

Figure 12 b: shows the Geoelectric section from VES 8 to VES 14 of the study Area.Geoelectric section from VES 15 to VES 16 of the study area.

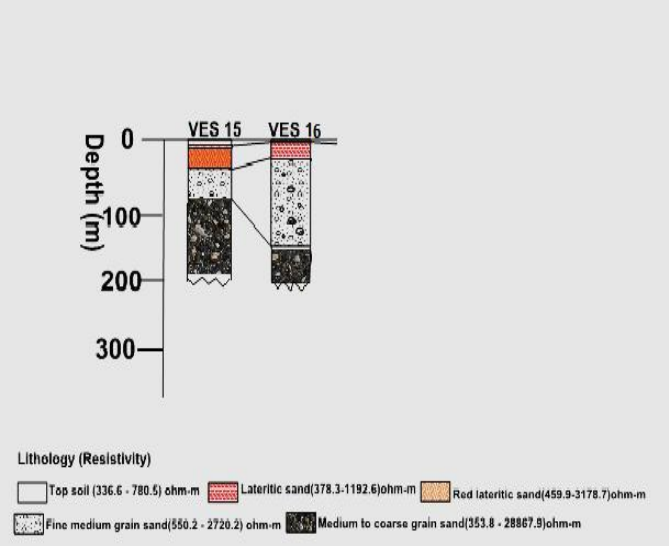

Figure 12 c: shows the Geoelectric section from VES 15 to VES 16 of the study area.

CONCLUSION

Geoelectric investigations were carried out in Agbor-Obi and environs to determine the aquifer protective capacity. The result shows five to six distinct geoelectric layers. The longitudinal conductance is a measure of aquifer protective ratings and the values obtained in Agbor-Obi and environs show poor ratings for all 15 VES locations except location 1 which shows weak protective capacity rating.

The result obtained from Dar Zarrouk parameters shows a fair idea about aquifer protection capacity of Agbor-Obi and environs.

ACKNOWLEDGEMENT

We wish to appreciate the part played by our undergraduate and post graduate students during the field work where the data were obtained. We are equally indebted to Delta State Ministry of Water Resources whose Terrameter was hired for the field work.

REFERENCES

[1] Sorensen, K.I., Auken, E., Christensen, N.B., Pellerin, L. (2005). An intergrated Approach for Hydrogeological Investigations: New Technologies and a Case-History-In Butler D K. (ed.) Near Surface. Geophysics 2, Investigations in Geophysics 13, 585-603. Society of Exploration Geophysics.

[2] Egbai, J.C., Efeya, P. and Iserhien-Emekeme, R.E (2015). Geoelectric Evaluation of Aquifer Vulnerability in Igbanke, Edo State, Nigeria. Int. Jour. of Sc. Environment and Tech. 4(3) 701-715.

[3] Amidu, S.A and Olayinka, A.I. (2006). Environmental assessment of Sewage disposal systems using 2D electrical imaging and geochemical analysis. A case study from Ibadan, South-western Nigeria. Environmental and Engineering Geoscience, 12(3), 261-272.

[4] Ehirim, C.N. and Ofor, W. (2011). Assessing aquifer Vulnerability to contaminant near solid waste landfill sites in a Coastal environment, Port-Harcourt, Nigeria. Trends in applied Sc. Research, 6, 165-173.

[5] Atakpo, E. (2009). Hydrogeological deduction from Geoelectric Survey in Uvwianmuge and Ekakpamre communities, Delta State, Nigeria. International Jour. of Physical Sciences, 4,477-485.

[6] Utomi, A.U., Odoh, B.I and Okoro, A.U (2012). Estimation of aquifer Transmissivity Using Dar Zarrouk Parameters derived from surface Resistivity measurements: A case History from parts of Enugu Town, Nigeria. Jour. of Water Resource and Protection, Vol. 4 pp 993-1000.

[7] Egbai, J.C. (2012). Vertical Electrical Sounding for the determination of Aquifer Transmissivity. Australian J. Of Basic and Applied Sciences Vol 5(6): 1209-1214.

[8] MWT (Ministry of works and Transport) Abudu 1990. Hyhdraulic conductivity K obtained by MWT, Edo State, Nigeria

[9] Vander, B.P.A., 2004. Win Resist Version 1.0. M.Sc Research Project ITC, Deft, Nertherlands.