International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

Geophysical Electrical Investigation of Groundwater Contamination Using Resistivity Method at a Dumpsite in Ibwa, Gwagwalada Area Council, Abuja, Nigeria

Christopher Kobodokuni, Tajudeen Olugbenga Adeeko, Adesokan Christianah Oluwatobi.

Date of Submission: 10-10-2024 Date of Acceptance: 20-10-2024

ABSTRACT
Ground water occurrence and distribution in a basement complex is localize and confined to weathered / fractured zone. Hence, exploration of groundwater in such terrain poses a great threat and challenge to the Ibwa community. This study was aimed at using vertical electrical sounding (VES) method to investigate the level of ground water contamination within the community of Ibwa village Gwagwalada area council. The result showed the presence of four geoelectric layers, top soil, Sandy clay, clayey sand and the basement. The resistivity values were obtained range from 20.1 Ωm to 149.0 Ωm at the first layers of most all the sounding points around the dumpsite. Other layers showed high resistivity values but not as that of high asthe control site, an indication that there are leachate plume from the dump through the process of percolation. The result is further back up with water analysis test which shows that all parameters measured falls within the World health organization standard for drinking water (WHO Threshold). The result showed that for the Well water sample is higher in acidity. It is clear therefore that there are more dissolved substances in the well water around the area as a result of leachate from the dumpsite.
KEYWORDS: Contamination**,** Dumpsite, Exploration, Groundwater, Layer Leachate, Resistivity.

A dumpsite was selected for this for the purpose of this work which is located at Ibwa, Gwagwalada area council with Latitude of 9.0552N/ Longitude of 7.70714E. Fig below shows the location map with a legend indicating the study area

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

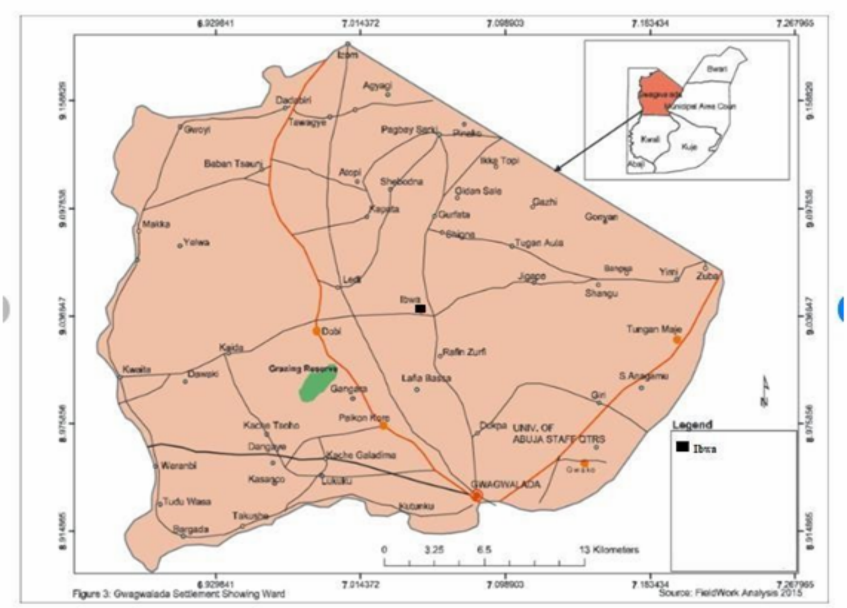


Figure 3: Gwagwalada Settlement Showing Ward
Source: FieldWork Analysis 2015

Water is a vital resource for human existence and the growth of any community is a function of the availability of basic infrastructures such as potable water, good road, electricity and industries (Ajibade, 2003; Mac Donald, 2005: Amadu, 2010 and Olasehinde et al., 2015).

Nigeria, like most developing countries is faced with the set back of inadequate supply of portable water to all her inhabitant. This has made people to result into exploration of ground water for industrial, agricultural and domestic purposes.

Groundwater is one of our most valuable resources. This very valuable resource becomes a threatto us when it is contaminated since pollutant is something which adversely interferes with health, comfort, property or environment of the people (Tamer et al., 2011).

Solid wastes are produced on daily basis as a result of direct consequence of inevitable human activities. The intensity of man's activities has led to increasing volume of solid waste worldwide despite the current level of global technological advancement and industrialization. Landfills have served for many decades as ultimate disposal sites for all types of wastes (Abu and Al-Kofahi, 2001). Landfill is an engineered waste disposal site facility with specific pollution control technologies designed to minimize potential impacts. Landfills are usually either placed above ground or contained within quarries, pits (Open landfills).

These leachates originate due to the disposal of domestic and industrial solid wastes, are highly conductive materials and are major source to aquifer contamination (Mojolagbe et al, 2011). In studying the leachate effects, it's expected that in areas of high concentrations of leachate, there will be a corresponding very high value of conductivity or a very low value of resistivity (Nwozor et al, 2012). Since resistivity is the inverse of conductivity, electrical resistivity method is a popular tool for ground water exploration (Arong, 2013), it is also used in determining groundwater quality, i.e whether the water is saline, fresh or contaminated (Rameeza, 2012).

Umar et al., (2014) carried a study to detect the leachate movement at Sungai Sedu landfill located on ten square acres near Banting town which result in the high concentrations of heavy metals and soil conductivities indicate the possibility of leachate migration from the dumping site to contaminate the nearby river, soil and groundwater of the study area.

In the work of Adebayo et al., (2015) on geophysical survey involving electrical resistivity method, soil sampling analysis and hydro-chemical. The elemental concentrations of K, Ca, Mn, Zn, Ni, Cu, Cr and Fe in the soil samples located at the periphery of the dump site are much higher than those of the control sample point indicating pollution while water quality analysis from existing hand dug wells showed increase in concentrations of nitrate exceeding the permissible

WHO limits. It was concluded that the soils and the groundwater in the vicinity of investigated dumpsite had been polluted.

Akpan, et al., (2018) use Electrical Resistivity Method to investigate an open dumpsite at Gosa, Abuja in order to determine the vulnerability of the groundwater in the area as well as the surrounding environment to the lechate contamination. From their result, they identified four geoelectric sections in the area. The result showed that the low protective capacity of the area aided the conclusion that the water aquifer in the area was highly vulnerable to lechate contamination from the dumpsite.

Ibwa in Gwagwalada Area Council is dominated by farmers who specialize in agriculture and livestock breeding base on the information gathered within the community. However the economic activities of the people are basically fresh meats and other farm products

Thus, solid, liquid and gaseous wastes are dumped or discharged into the dumpsite which could affect soil and groundwater. This sighting of borehole as the only source of good water in this area has become a serious challenge. This challenge is worsened by the fact that there are inadequately trained waste disposal personnel and equipment, poor waste collection, sorting and disposal without regards to the local geology and hydrogeology of the study area

As a result of the imminent impact of solid waste on the environment it is necessary to investigate the potential for the contamination of groundwater around the dumpsite.

The aim of this research is to use electrical resistivity method to investigate the level of groundwater contamination from the dumpsite within the study area to determine the resistivity of the geo-electric layer sections of the study area, to determine the thickness and depth of groundwater in the study areas and to evaluate and characterize extent of contamination in the study area

Materials

The materials used for the vertical electrical sounding includes the ABEM terrameter SAS 4000 and its accessories like the connecting cables, four electrodes (steel rods), measuring tapes, hammers, the Global Positioning system (GPS) and the computer software program WINREST.

Methods

For the purpose of this research, thirty (30) Vertical Electrical Sounding stations were obtainedwithin the study area.

These stations were taken at different locations within the study area. The Schlumberger array was employed. Current was passed into the ground through a pair of current electrode and the resultant resistance was be obtained through pair of potential electrode and then recorded on the resistivity recording sheets. The study were carried out by using earth resistivity meter (terrameter), measuring tapes, current and potential electrode, crocodile clips and hammers

Basically, a station is chosen and an iron rod was driven into the ground, this marks the base station which was used as a mid-point from where MN/2 (potential electrode) spacing was measured in both directions using the marked mid-point and measuring tape.

The potential electrodes were driven in either side of the base stations at a specified distance. The current electrodes were driven in on either side and the spacing is given as $\frac{AB}{2}$100m, $\frac{MN}{2}$15.0 m. The resistances of the subsurface were measured and recorded against the appropriate potential and current electrodes separation. The depth of penetration is proportional to the separation between the electrodes in homogeneous ground, and varying the electrodes separation provides information about the stratification of the ground (Dahlin. 2001). This method can be used in groundwater to determine depth, thickness and boundary of an aquifer (Zohdy. 1969). The measurement were repeated and recorded with AB fixed at its initial distance (current electrode) AB/2, is symmetrically increased where the resistance measured becomes too small AB/2 is increased symmetrically.

The change in distance between the current electrodes was increased the depth range at which current penetrates, the apparent resistivity was then when plotted against the corresponding half electrode spacing (AB/2,) on a bi-log paper. During the field work taking a sounding, the earth resistivity meter (terrameter) performs automatic recording of both voltage and current, stacks the results, computes the resistance m real time and digitally displays it. (Dobrin and King, 1976;Alile, 2008)

The computer software program WINRESIST was used and the data sets obtained from the manual interpretation stage were keyed as inputs into the computer modeling software (WINRESIST) to generate data for the estimated

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

model.

RESULTS AND DISCUSSION

The measurement of resistance and their corresponding apparent resistivity value for VES 1, VES 10, and VES 20 at the Dumpsite and VES 30 at the control site are presented on table 4.1, 4.2, 4.3 and 4.4 respectively.

Table 1: Measurement of Resistance and their corresponding Apparent Resistivity values for VES 1 (Dumpsite).

		VES 1		
GPS Coordinates - N 9,3,50.62" E: 7.3.29.95"				
AB/2 (m)	MN/2 (m)	G factor	Resistance (Ω)	Resistivity(Ωm)
1	0.5	2.36	36.015	84.9954
2	0.5	11.8	21.15	249.57
3	0.5	27.5	10.215	280.9125
5	0.5	77.8	6.815	530.207
6	0.5	112	2.78	311.36
6	1	55	4.181	229.955
8	1	99	5.7	564.3
10	1	155	1.6	248
10	1	58.9	7.34	432.326
15	1	137	1.61	220.57
20	1	245	4.221	1034.145
30	1	562	0.687	386.094
40	2.5	1001	2.9	2902.9
40	2.5	323	1.101	355.623
50	2.5	512	0.1	51.2
60	2.5	742	2.892	2145.864
70	2.5	1014	0.27	273.78
80	7.5	1329	0.37	491.73
80	7.5	647	0.37	239.39
90	15	825	0.014	11.55
100	15	1024	0.91	931.84

Table 2 : Measurement of Resistance and their corresponding Apparent Resistivity valuesfor VES 10 (dumpsite).

		VES 10		
GPS Coordinates - N 9°3'50.62" E: 7°3'29.95"				
AB/2 (m)	MN/2 (m)	G factor	Resistance(Ω)	Resistivity(Ωm)
1	0.5	2.36	29.37	69.3132
2	0.5	11.8	2.85	33.63
3	0.5	27.5	8.05	221.375
5	0.5	77.8	0.73	56.794

6	0.5	112	1.59	178.08
6	1	55	0.04	2.2
8	1	99	0.752	74.448
10	1	155	0.871	135.005
10	1	58.9	0.781	46.0009
15	1	137	1.41	193.17
20	1	245	6.512	1595.44
30	1	562	1.62	910.44
40	2.5	1001	0.871	871.871
40	2.5	323	0.571	184.433
50	2.5	512	0.551	282.112
60	2.5	742	8.53	6329.26
70	2.5	1014	0.117	118.638
80	7.5	1329	6.12	8133.48
80	7.5	647	3.015	1950.705
90	15	825	0.21	173.25
100	15	1024	0.168	172.032

Table 3 : Measurement of Resistance and their corresponding Apparent Resistivity valuesfor VES 20 (dumpsite).

		VES 20		
GPS Coordinates - N 9°3'51.62" E: 7°3'27.95"				
AB/2 (m)	MN/2 (m)	G factor	Resistance(Ω)	Resistivity(Ωm)
1	0.5	2.36	26.23	61.9028
2	0.5	11.8	13.65	161.07
3	0.5	27.5	3.26	89.65
5	0.5	77.8	1.71	133.038
6	0.5	112	0.91	101.92
6	1	55	2.01	110.55
8	1	99	13.26	1312.74
10	1	155	0.95	147.25
10	1	58.9	2.43	143.127
15	1	137	1.37	187.69
20	1	245	1.06	259.7
30	1	562	0.64	359.68
40	2.5	1001	0.51	510.51
40	2.5	323	1.44	465.12

50	2.5	512	0.83	424.96
60	2.5	742	0.59	437.78
70	2.5	1014	0.41	415.74
80	7.5	1329	1.02	1355.58
80	7.5	647	0.6	388.2
90	15	825	0.125	103.125
100	15	1024	0.81	829.44

Table 4 : Measurement of Resistance and their corresponding Apparent Resistivity valuesfor VES 30 (Control site).

		VES 30 (CONTROL)		
GPS Coordinates - N 9°3'51.62" E: 7°3'30.95"				
AB/2 (m)	MN/2 (m)	G factor	Resistance(Ω)	Resistivity(Ωm)
1	0.5	2.36	63.21	149.1756
2	0.5	11.8	21.51	253.818
3	0.5	27.5	9.22	253.55
5	0.5	77.8	7.98	620.844
6	0.5	112	1.79	200.48
6	1	55	1.61	88.55
8	1	99	1.18	116.82
10	1	155	1.87	289.85
10	1	58.9	0.25	14.725
15	1	137	0.26	35.62
20	1	245	0.41	100.45
30	1	562	0.512	287.744
40	2.5	1001	0.316	316.316
40	2.5	323	0.109	35.207
50	2.5	512	0.621	317.952
60	2.5	742	0.355	263.41
70	2.5	1014	0.91	922.74
80	7.5	1329	0.65	863.85
80	7.5	647	0.61	394.67
90	15	825	0.01	8.25
100	15	1024	0.21	215.04

The apparent resistivity values obtained from the field measurements were plotted against half current electrode spacing on a log-log graph sheet. The resulting data were iterated to the lowest root mean square (RMS) percentage error with the aid of the WinRESIST version 1-0 software (which uses raw data sounding interpretation method). An important step in the interpretation of resistive sounds survey data is to classify the apparent resistivity curves into types. In this research, the curves from the sites were predominantly type –H. This classification is made on the basis of the curves which depends on the number layers in the subsurface and the thickness of each layer. The uses of WinRESIST software which produce graphical representation of data grant the basis of making qualitative statement and observation of the study area. Figure 4.1, 4.2, 4.3 and 4.4shows the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

graph of apparent resistive plot against half current electrode spacing for VES 1,VES 10,VES 20 and VES 30 (Control)and the corresponding depth of each layer in the dumpsite. The graphs for the other VES points at the dumpsite are presented in appendix 3.

Ves 1
GPS Coordinates - N 9°3' 50.62" E: 7°3'29.95"

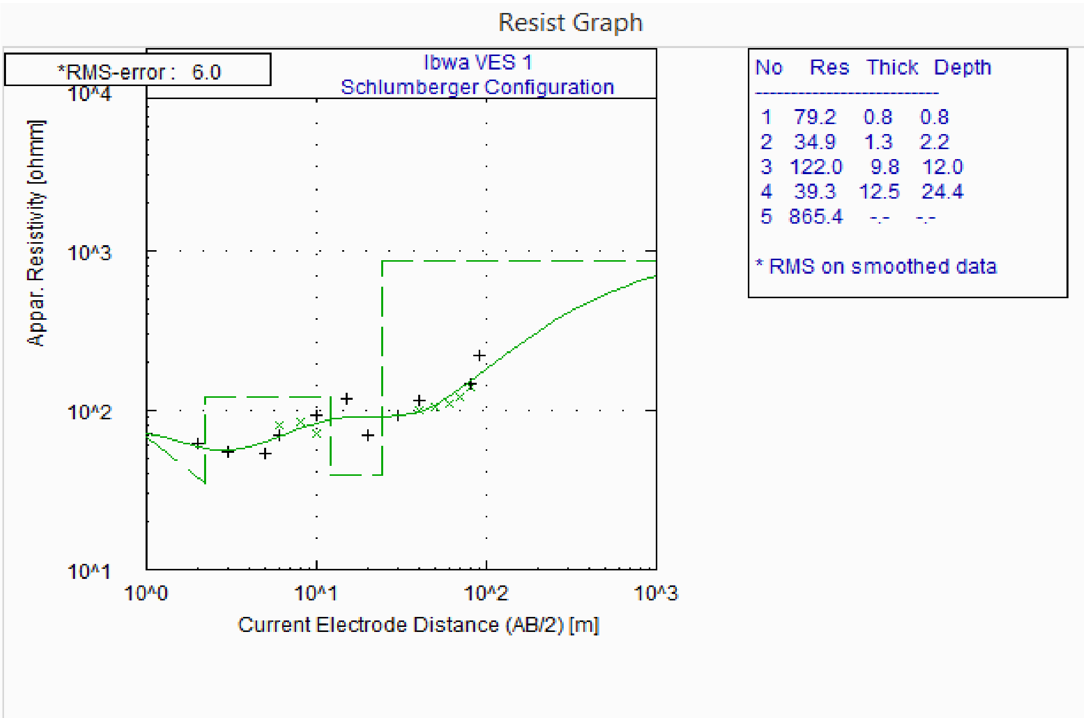


Fig 1: Graph of apparent resistivity plotted against half current electrode spacing for VES1 dumpsite.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

VES 10
GPS Coordinates - N 9°3'50.62" E: 7°3'29.95"

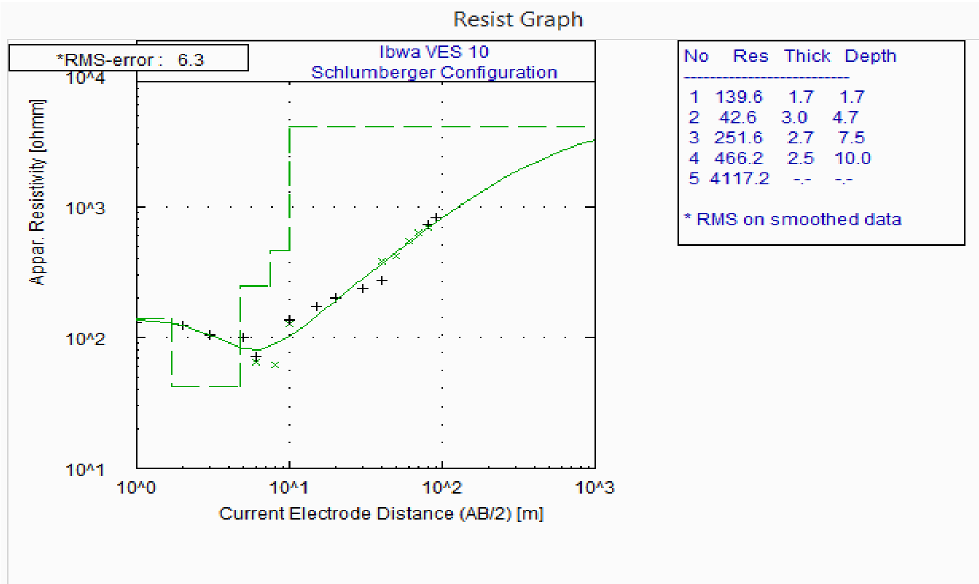


Fig 2: Graph of apparent resistivity plotted against half current electrode spacing for VES10 dumpsite.

VES 20
GPS Coordinates - N 9°3'51.62" E: 7°3'27.95"

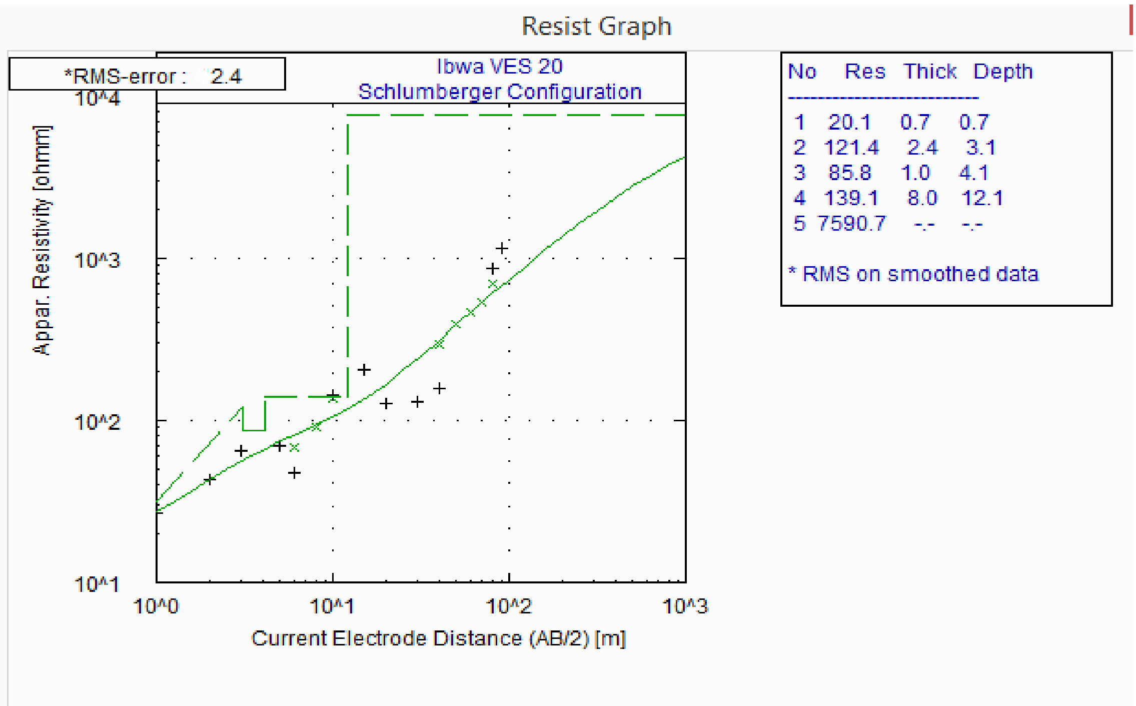


Fig 3: Graph of apparent resistivity plotted against half current electrode spacing for VES20 dumpsite.

VES 30 (CONTROL)
GPS Coordinates - N 9°3'51.62" E: 7°3'30.95"

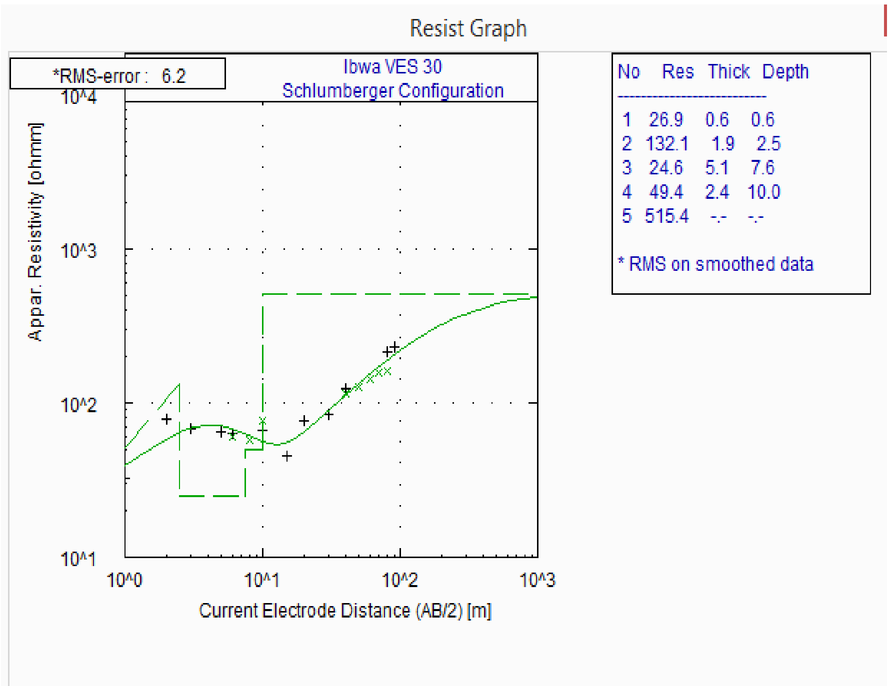


Fig 4: Graph of apparent resistivity plotted against half current electrode spacing for VES30(Control).

The resistivity value, thickness and depth shown in table 4.5 were derived from the graph of each VES point at the dumpsite. The water table (the level below which the ground is saturated with water) is the top of the basement which is a formation (geological formation) that is porous thus permeable such that groundwater can flow through it. The inferred lithology was based on apparent resistivity value accompanying each layer. The lithology presented in this research work includes topsoil, sandy clay, clayey sand, weathered/fresh basement. Table 4.5below show each VES, their different layers, resistive values, thickness, depth, groundwater level, and inferred lithology. The highest layer depth (24.4m) is found in the fourth layer of VES 1, this VES is the one with the deepest groundwater level (12.5m) while layer 1of VES 11 and VES 30 (Control) has the lowest layer depth (0.6m) with groundwater level of 19.6m and 24.4m respectively. The resistivity value for each VES point varies from layer to layer. The general pattern of resistivity variation from the table is that the resistivity increases and decreases as we move from layer to layer. This is the case for all VES point at the dumpsite except for VES 2, VES 10, VES 13, VES 15, VES 16, VES 18 points whose resistivity increases as we move from layer one, two to three and four

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

Table 5: Interpretation of results of the dumpsite

VES NO	Layer	Resistivity(Ωm)	Thickness(m)	Depth(m)	Probable depth to watertable (m)	Inferred lithology
1	1	79.2	0.8	0.8		Top soil
	2	34.9	1.3	2.2	24.4	Sandy clay
	3	122	9.8	12		Clayey sand
	4	39.3	12.5	24.4		Weathered Basement
	5	865.4	∞	∞		
2	1	82.2	1.3	1.3		Top Soil
	2	59.6	1.3	2.7	22.6	Sandy clay
	3	121.5	7	9.7		Clayey sand
	4	199.6	13	22.6		Fresh Basement
	5	3863.1	∞	∞		
3	1	85.4	2.8	2.8		Top soil
	2	36.6	2.7	5.5	9.3	Sandy Clay
	3	117.4	3.9	9.3		Clayey sand
	4	5989.1	∞	∞		Fresh Basement
4	1	87.7	1.3	1.3		Top soil
	2	208.1	1	2.3	20.6	Sandy clay
	3	89.4	18.4	20.6		Clay sand
	4	1791.3	∞	∞		Fresh basement
5	1	131.9	1.4	1.4		Top soil
	2	33.1	1.3	2.7	14.7	Sandy clay
	3	291.3	6.6	9.3		Clayey sand
	4	81.3	5.4	14.7		Fresh basement
	5	3908.9	∞	∞		
6	1	105.3	1.1	1.1		Top soil
	2	111.1	3.8	4.9	15	Sandy clay
	3	61.2	5.1	10.1		Clayey sand
	4	153.8	4.9	15		Weathered Basement
	5	1932.9	∞	∞		
7	1	106.7	1.1	1.1		Top soil
	2	88.9	4.2	5.3	16.7	Sandy clay
	3	58.7	4.3	9.6		Clayey sandy
	4	191.7	7.1	16.7		Fresh Basement

	5	3137	∞	∞		
8	1	86.7	1.1	1.1		Top soil
	2	121.4	5.3	6.4	22.5	Sandy clay
	3	105.3	8.7	15.1		Clayey sandy
	4	410.3	7.5	22.5		Fresh Basement
	5	1897.2	∞	∞		
9	1	115.3	0.8	0.8		Top soil
	2	86	5	5.7	19.8	Sandy clay
	3	65.9	8.4	14.1		Clayey sandy
	4	127.1	5.6	19.8		Fresh Basement
	5	1112.5	∞	∞		
10	1	139.6	1.7	1.7		Top soil
	2	42.6	3	4.7	10	Sandy clay
	3	251.6	2.7	7.5		Clayey sandy
	4	466.2	2.5	10		Fresh Basement
	5	4117.2	∞	∞		
11	1	149	0.6	0.6		Top soil
	2	78	3.3	3.9	19.6	Sandy clay
	3	144.6	8.4	12.3		Clayey sandy
	4	87.5	7.3	19.6		Weathered basement
	5	910.8	∞	∞		
12	1	142.7	0.9	0.9		Top soil
	2	97.5	4.4	5.3	21.3	Sandy clay
	3	140.9	4.6	9.9		Clayey sandy
	4	94.3	11.3	21.3		Weathered basement
	5	897.9	∞	∞		
13	1	22.3	0.7	0.7		Top soil
	2	93	3.5	4.2	13	Sandy clay
	3	199.1	3.6	7.9		Clayey sandy
	4	451	5.2	13		Fresh Basement
	5	2770.2	∞	∞		
14	1	68.1	12.4	12.4		Top soil
	2	55.4	1.2	13.7	22	Sandy clay
	3	42.9	5.8	19.5		Clayey sandy
	4	78.7	2.6	22		Weathered Basement
	5	1656.7	∞	∞		

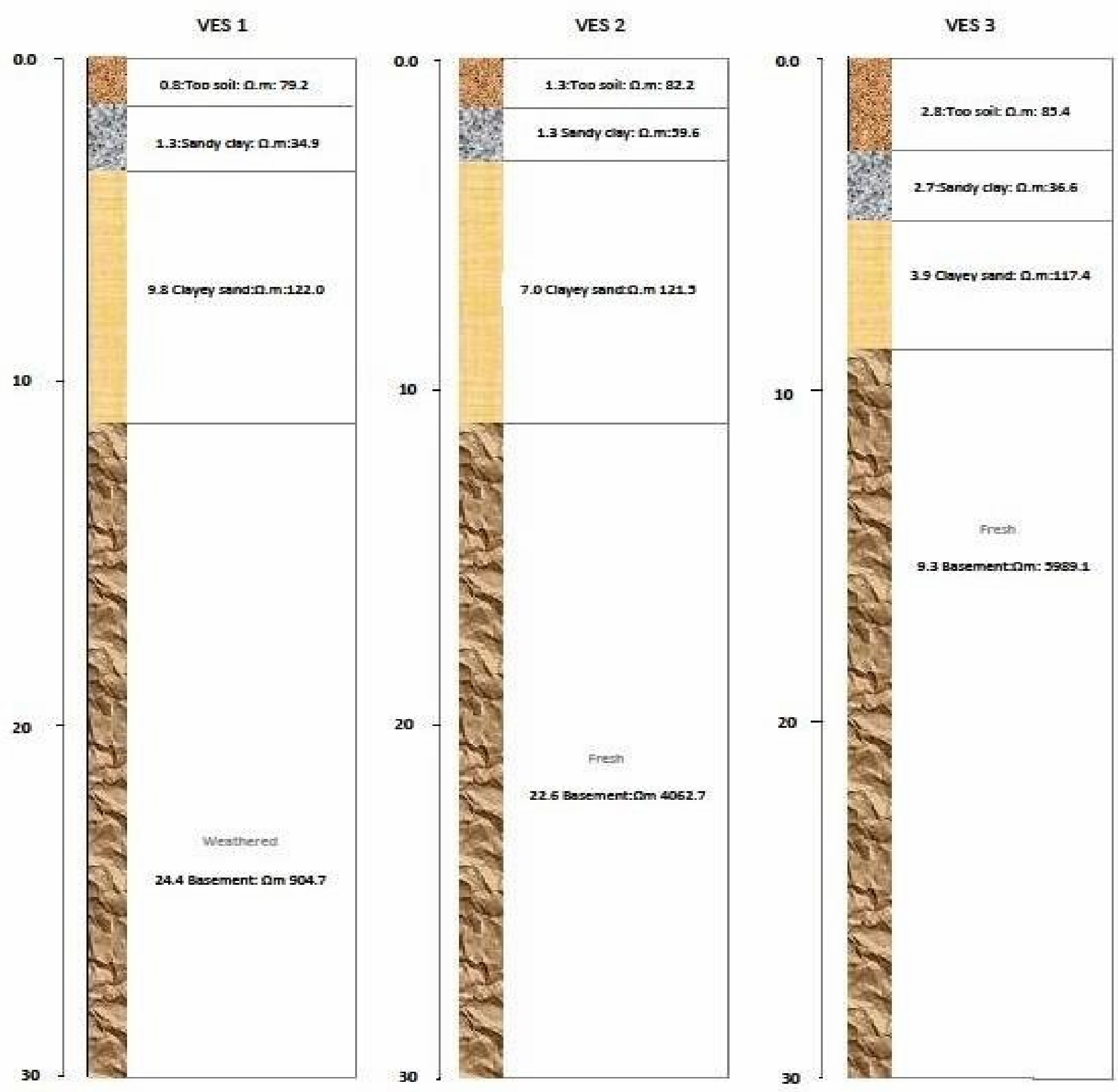
15	1	50.1	0.9	0.9		Top soil
	2	33.1	2.1	2.9	15.7	Sandy clay
	3	133.5	4.2	7.1		Clayey sandy
	4	194.4	8.6	15.7		Weathered Basement
	5	2295.3	∞	∞		
16	1	75	11	11		Top soil
	2	58.7	3.6	14.6	19.6	Sandy clay
	3	130.5	3	17.6		Clayey sandy
	4	189.1	2	19.6		Fresh basement
	5	2443.9	∞	∞		
17	1	30.9	1.1	1.1		Top soil
	2	272.2	3.5	4.6	11.1	Sandy clay
	3	216.7	3.2	7.8		Clayey sandy
	4	241.3	3.3	11.1		Weathered Basement
	5	1270.3	∞	∞		
18	1	43.3	3.6	3.6		Top soil
	2	51.4	1.7	5.3	13.6	Sandy clay
	3	115.8	2.6	7.9		Clayey sandy
	4	335.7	5.6	13.6		Weathered basement
	5	3254.7	∞	∞		
19	1	49.9	0.9	0.9		Top soil
	2	259.4	1.5	2.3	6.4	Sandy clay
	3	149	1.5	3.9		Clayey sand
	4	37	2.5	6.4		Weathered basement
	5	194.1	∞	∞		
20	1	20.1	0.7	0.7		Top soil
	2	121.4	2.4	3.1	12.1	Sandy clay
	3	85.8	1	4.1		Clayey sand
	4	139.1	8	12.1		Fresh basement
	5	7590.7	∞	∞		
21	1	61	2.9	2.9		Top soil
	2	94.1	2.8	5.6	9.6	Sandy clay
	3	28.5	2.4	8.1		Clayey sandy
	4	43.7	1.5	9.6		Weathered Basement
	5	2689.7	∞	∞		
22	1	59.3	0.9	0.9		Top soil
	2	17.2	1.3	2.3	7.9	Sandy clay
	3	357.6	2.6	4.9		Clayey sandy
	4	367.3	3	7.9		Weathered Basement
	5	509.9	∞	∞		
23	1	55.7	0.8	0.8		Top soil

	2	152	1.9	2.7	11.3	Sandy clay
	3	27.9	5	7.8		Clay sandy
	4	40.5	3.5	11.3		Fresh basement
	5	2441.4	∞	∞		
24	1	73.5	0.7	0.7		Top soil
	2	43.4	1.9	2.6	11.7	Sandy clay
	3	153.4	2.4	5		Clayey sandy
	4	115.5	6.7	11.7		Fresh basement
	5	1989.2	∞	∞		
25	1	90.4	0.9	0.9		Top soil
	2	70.2	5	5.9	20.5	Sandy clay
	3	87.9	7.9	13.8		Clayey sandy
	4	58.9	6.7	20.5		Weathered basement
	5	917.1	∞	∞		
26	1	68.1	0.9	0.9		Top soil
	2	142.3	3	3.9	9.4	Sandy clay
	3	34.1	4.4	8.3		Clayey sandy
	4	78.1	1.1	9.4		Fresh Basement
	5	3211.2	∞	∞		
27	1	78.9	1	1		Top soil
	2	96.6	2.7	3.7	9.2	Sandy clay
	3	26.4	3.1	6.8		Clayey sandy
	4	59	2.4	9.2		Fresh Basement
	5	2173.7	∞			
				∞		
28	1	73	1.3	1.3		Top soil
	2	102.1	4.5	5.8	9.5	Sandy clay
	3	99.3	2.6	8.4		Clayey sandy
	4	106.8	1.1	9.5		Weathered basement
	5	407.3	∞	∞		
29	1	90.6	1.2	1.2		Top soil
	2	70.6	6.6	7.8	20.1	Sandy clay
	3	99	7.9	15.7		Clayey sandy
	4	83.1	4.3	20.1		Fresh Basement
	5	1703.2	∞	∞		
30	1	26.9	0.6	0.6		Top soil
CON TROL	2	132.1	1.9	2.5	10	Sandy clay
	3	24.6	5.1	7.6		Clayey sandy
	4	49.4	2.4	10		Weathered basement
	5	515.4	∞	∞		

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

All graphs demonstrate a common pattern. There are H- type curves which is typical of a basement complex environment. Each resistivity begins with low resistivity which decreases to their lowest value at certain depth and thereafter increases steadily in all the curves. The apparent resistivity values for the first layer for VES 1- 29 ranges from 20.1Ωm (VES 20) to 149.0Ωm (VES 11). The apparent resistivity value for the first layer of VES 1-29 is low compared to the control site (VES 30) whose first layer resistivity is 26.9Ωm. This inferred that the top soil of the dumpsite is co
V
al
o
si
a
(V
ar
1(
cl
co
T
o
o
is
re

A maximum of four geo-electric layers were identified and delineated as show in figure 4.5-4.8. The identified include topsoil, sandy clay, clayey sand, weathered/fresh basement. The geo-electric resistive value of the control site VES 30 is shown in table 4.5. The topsoil resistivity is characterized by resistivity values range of 26.9Ωm. The layer thickness range is 0.6m.The topsoil is slightly affected by dump/refuse, thus the reason for it low resistivity value. The second layer (sandy clay) resistivity range of 132.1Ωm with a thickness of 1.9m shows on contamination.



The resistivity value of less than 200Ωm ideally has sandy clay characteristics while resistivity more than 200Ωm are characteristic of compact sand or sand (longpia et al, 2013).The third layer (clayey sand) showed resistivity values from 24.6Ωm. This value of resistivity in the basement layer is characteristically high thus no contamination due to leachate from the dumpsite at this layer. The basement has generally characterized resistivity value of over 500Ωm (longpia 2013).

Figure 6.0 : Geo-electric sections of VES 1, 2, and 3 of the dumpsite.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 10 Oct. 2024, pp: 292-307 www.ijaem.net ISSN: 2395-5252

A water sample from the well close to the dumpsite was collected for analysis. The water samplewas analyzed at chemical laboratory of the science and technology complex (SHESTCO), for selected parameters. The result of the physicochemical analysis of water is presented in table 4.6.

Table 6: Result of physicochemical analysis of water

Parameter	Unit	WELL	WHOThreshold	Remarks
PH		5.59	6.5-8.0	Disagreed
Conductivity	µs/cm	83.90	100	Agreed
Salinity	mg/	82.90	600	Agreed
Potassium	mg/	2.48		
Nickel	mg/	0.22	0.5	Agreed
Iron	mg/	0.07	0.3	Agreed
Lead	mg/	-	0.01	Disagreed
Magnetism	mg/	0.88	150.0	Agreed
Manganese	mg/	0.21	0.1	Disagreed
Cobalt	mg/	0.06	-	
Sodium	mg/	6.01	200	Agreed

For Well water to be portable for drinking, the concentration of the substance must not exceed the level recommended by world health organization (WHO threshold). Basically, the parameters PH, lead and manganese disagree with world health organization (WHO threshold) while conductivity, salinity, nickel, iron magnetism and sodium agree with world health organization (WHO threshold). The PH measured in the water sample 5.59 (which indicate acidity) are low; the well water sample acidity is more moderately high which is harmful for consumption.

In conclusion, the result of the geoelectric resistivity survey using Vertical Electrical Sounding has shown that the dumpsite region of the Ibwa Area of Gwagwalada is only slightly contaminated. This conclusion is based on the low resistivity values of 20.1Ωm to 149.0Ωm at the first layer of virtually all the sounding points of the dumpsite. Other layer shows high resistivity value not as high as the control site, an indication that there are little leachate plumes from the dump percolation. The result showed that for the Well water sample is higher in acidity. It is clear therefore that there are more dissolved substances in the well water around the area as a result of leachate from the dumpsite. The result is back up with water analysis test which shows that all parameters measured falls within the World health organization standard for drinking water (WHO Threshold). This work also qualitatively compared the PH value of Well water samples from the dumpsite area. The result showed that for the Well water sample is higher in acidity. It is clear therefore that there are more dissolved substances in the well water around the area as a result of leachate from the dumpsite. There is greater possibility of more percolation at this site in future to the extent that might affect the groundwater quality. On the basis of the finding from this study; I therefore suggest that the site should be subjected to further investigation using electrical resistivity imaging (ERI), induce polarization, seismic refraction tomography (SRT) in other to get a clearer picture of the degree of the contaminations. Dipper drilling, more and constant monitoring of boreholes is also recommended. The government should also consider the control of leachate generation, its treatment and subsequent recycling of waste.

AKCNOWLEDGEMENT

We extend our sincere gratitude to the University of Abuja, particularly the Department of Physics, for their support and guidance throughout this project. Special thanks to my supervisor for their invaluable insights and mentorship.

We are deeply grateful to SHESTCO (Sheda Science and Technology Complex), where all laboratory tests were conducted. The excellent facilities and assistance from the staff were essential to the success of this research.

Finally, we thank our family, friends, and colleagues for their unwavering support and encouragement during this journey.

REFERENCE

[1]. Akpan, M.L, Abdulsalam N.N, Mallam A. (2018). Vulnerability of groundwater to contamination using Elecricity Method at the open dumpsite in Gosa, Abuja Nigeria Semantic Scholar Feb 22, 2018 – ISSN; 2381-8719.

[2]. Abu, R.Y and Al-Kofahi, O.: (2001). The assessment of the effect of landfill leachate groundwater quantity. El_Akadu land fill site. North Jordan.

[3]. Abubakar Y.I and Auwal L.Y (2012). Geoeletectrical investigation of groundwater Potential Of Dawakin Tofa Local Governmen Area of Kano State, Nigeria; American International Journal of Contemporary Research, Vol. 12 No. 9, PP 192-193.

[4]. Adebayo Y.A (2015). Delineation of contamination plumes at Olubonku dumpsite using geophysival and geochemical approach at Ede town, southwestern Nigeria.

[5]. AdeekoT.O, and Ojo E.O (2016). Determination of Subsurface Delineation Using Electrical Resistivity Sounding in Zuba and environs Gwagwalada area council, Abuja, north central, Nigeria.

[6]. Ajibade, A.C (1982). The Origin of Older Granite of Nigeria: some evidence from the Zungeru Region, Nigeria. Journal of mining and Geology, 19(1), 223-230.

[7]. Akpan M.L (2016).Electrical Resistivity investigation Of Dumpsite in Municipal Area Council, Abuja Nigeria; Unpublished M.Sc Thesis, University Of Abuja.

[8]. Ariyo S.O, Omosanya K.O, Oshinloye B.A (2013).Eletrical Resistivity Imaging Of Contaminate Zone at StuboDumpsie Along Sagamu-Ikorodu Road, Southwestern Nigeria. African Journal of Science and Technology 7; PP 312-320

[9]. Arong T.0.,Oghenero A.E.,Adv. In Applied Sci.Res,2013, 2(5),10-24

[10]. Balogun O (2001). The Federal Capital Territory Of Nigeria; A Geography of its Development; Ibadan University Press, Nigeria; PP 29-32.

[11]. Bayode S, Omosuyi G.O, MogajiK.A , Adebayo S.t (2011).Geoelectric Delineation of Structurally –Controlled Leachate Plume around Otutubiosun Dumpsite, Akure, Southwestern Nigeria. Journal of Emerging Trends Engineering and Applied Science 2(6): PP 987-992.

[12]. Center for People and the Environment (2010).Lanfill Recovery and Use in Nigeria (Prefeasibility Studies of Using LFGE); Prepared for US environmental Protection Agency by Center for People and the Environment; PP 15- 26

[13]. Enikanselu P.A (2008).Detection and Monitoring of Dumpsite-induced Groundwater Contamination Using Electrical Resistivity Method; The Pacific Journal of Science and Technology, Vol. 9 No1.

[14]. FCDA Report (2000). Apublication of Work carried out For the Federal Capital Development Authority.

[15]. FCT (2003).Facts about the Federal Capital Territory (www.fct.gov.ng). Geology of FCT (2018).www.researchgate.net(internet Extract).

[16]. Hassan S.M (2009).Information on Physical Characteristics of FCT (extract); PP 1-3, 8- 10.

[17]. Jagloo J.A (2002). Analysis of landfill component in estimating the percolated leachate to groundwater using the help model.

[18]. Koppen and Geiger (1999).www.Climate-data.org/ climate: Abuja.

[19]. LokmanM.Hossain, Satyajit R.D and Mohammed K.H (2014). Impact of Landfill Leachate on Surface and Ground Water Quality; Journal of Environmental Science and Technology, 7: 337-346.

[20]. Mac Donald, A, (2005).Developing Groundwater, A guide for rural water supply ITDG PUBLISHING Warwickshine CV 23 9QZ, UK, www.itdgpublishing.org. UK.

[21]. Mallo I.I and Mghanyi L.L (2013). Assessment of Soil Wash and Soil Erodibility Indices on Miniature Badlands at GadaBiyu, Abuja, Federal Capital

Territory, Nigeria; Ethiopian Journal of Environmental Studies; Vol. 6 No. 2; PP 136-137.
[22]. Mamman A.B and Oyebanji. J.O (2000). Geoelectric investigation of subsurface water resources. Misra S. and Mani D (1991).Soil Pollution.(1st Ed). Efficient Offset Printer, ABC; New Delhi,
[23]. India, PP: 6-42.
[24]. Nasir A., Isaac B. O., Babatude O., Abraham O. (2010). Detecting Municipal Solid Waste Leachate Plumes through Electrical Resistivity Survey and Physico – Chemical Analysis of Groundwater Samples; Journal of American Science, Vol. 6 No.8
[25]. Nwozor K.K, Nfor B.N, Chiaghanam A, Edorah O. and Chiazor J.E. Adv. In Applied Sci. Res,2012, 3(1):188-200
[26]. Obaje N.G (2009). Geology and Mineralogy Resources of Nigeria; Lecture Note on earthscience; PP 120.
[27]. Obi N.A (2013). Electrical Resistivity Survey of a waste dumpsite at Uyo Akwaibom, Nigeria .
[28]. Olasehinde, P.I, Amadi, A.N, Okunola, I.A, &Ejiofor, I.C. (2010).Assessment of Groundwater Transmissivity, Yield and Quality in Parts of Niger State;Bayero Journal of Physics and Mathematical Science, 4(2), 23-30. .
[29]. Omeje M, Husin W, Noorddin I, Oha I.A, Onwuka O.S and Soheil S (2014). Integrated Geoelectrical and structural Studies for Water Investigation in Parts of Abuja, North Centre Nigeria; Near Surface Geophysics; Vol. 12; PP 517.
[30]. Omeje M, Husin W, Noorddin I, Oha I.A, Onwuka O.S, Ogwuoke P.E and Medundu O (2013). Geolectrical Investigation of Aquifer Problems In Gosa Area of Abuja, North Central Nigeria; Internal Journal of Physical Sciences; Vol. 8, No. 13; PP 2-3, 6-10.
[31]. Oyawole M.O (1972). The basement complex of Nigeria; Afrivcan Geology Hall, London. Rahaman M.A (1988). Review of the Basement Geology of Southwestern Nigeria; Elizabethan Publishing Co Lagos, Nigeria.41–58.
[32]. Rameeza S., Srikant V.N.V., Rao D. M, Ramakrishna C.H., Adv in Applied Sci.Res (2012): 3(4)2463-24 Resistivity Sounding in Zuba and Environs of Gwagwalada Area Council, Abuja, North centre Nigeria; Physics Journal, Vol. 1, No. 2, 2015, PP 97-104
[33]. Slomczynska B and Slomczynski T (2004).Physicochemical and toxicological characteristics of leachates from MSW landfills. Polish J. Environ. Stud., 13(6): 627-637
[34]. Umeokafor Marcel Ugochukwu, (2011). Automall, Abuja (FCT). M.Sc. Thesis, University of Nigeria.
[35]. Zohdy, A.A, Eaton, C.P, &Mabey, D.R. (1974).Application of Surface Geophysical to Ground Water Investigation Technology. Water Resources Investigation, Washington, U.S Geological survey.