Open Journal of Waste Management and Environmental Protection
Vol. 1, No. 1, October 2013, PP: 15 - 20
Available online at http://scitecpub.com/Journals.php

Research article

EVALUATING THE VARIABLES OF STATIC WATER LEVEL IN RIVERS STATE: NIGER DELTA REGION OF NIGERIA

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Abstract

Studies on the evaluation of static water level in Rivers state has been carried out, this paper is to determine the static water level in fourteen location in Rivers State, samples from boreholes at different location were applied through the application of standard measuring instrument. The results has shows that the variations in static water level are influence by the deposition variation from geological formation, this include the characteristics of the strata known as porosity, permeability, and hydraulic conductivity of the formation at different location, the study has provided a baseline to understand the causes of shallow aquifers and shallow static water level including variation in the study area, the study has also provided a platform for practicing Engineers and scientist to understand the variation of static water level in deltaic environment, finally the study will enhance the performance of professionals to avoid abortive wells in the study location.

Keywords: Nigeria, river, water

1. Introduction

The Niger Delta is situated at the southern end of Nigeria bordering the Atlantic Ocean. History told us that the proto delta developed in the northern part of the basin during the campanian transgression and ended with the Daleocene transgression whereby the formation of the modern delta began during the Ecocene and it continued into present day where generate the third circle that the modern Niger Delta was formed. Meanwhile before now, the beginning deposition of the Niger Delta are the Albian sediment which consisted of stone over lain conformably by cenoniana and younger upper cretaceous sediments, these deposit were laid from during a predominantly marine depositional circle. Furthermore, the first cycle was concluded by a phase of folding, faulting and uplifting occurring in santonian time and which definitely affect particularly in general Abakaliki anticurrium (Kogbe, 1989).The delta

of deltaic environment of the Niger Delta Region strategraphic possible should explain the variable of the static water level in the Delta Region, explaining these variables can only be known through groundwater development i.e. construction and design once a borehole has been drilled, the water level in the borehole should be measured using a dipper, this should be done immediately after drilling, and also once water levels in the borehole have recorded (MacDonald and et al, 2005).

1.2 Vertical distribution of groundwater

The vertical distribution of groundwater are based on the interstices occupied partially by water and partially by air, in the zone of saturation, all interstices are filled with water under hydrostatic pressure. On most of the land masses of the earth, a single zone of aeration overlies a single zone of saturation and extends upward to the ground surface. In the zone of aeration, vadose water occurs. This general zone may be further subdivided into the soil water zone, the intermediate vadose zone, and the capillary zone. The saturated zone extends from the upper surface of saturation down to underlying impermeable rock. In the absence of overlying impermeable strata, the water table, or pheratic surface, forms the upper surface the zone of saturation. This is known to be surface atmospheric pressure and appears as the level at which water stand in a well permeating the aquifer (Todd, 2004).The static level of water in wells penetrating the zone of saturation is called the water table. The water table is often described as the subdued replica of the surface topography. It is generally higher under the hills and lower under the valleys, and a contour map of the water table in any area may look the surface topography (Garg, 2005) .Thus, the water is the surface of a water body which is constantly adjusting itself towards an equilibrium condition, with the water moving from the higher points to the lower points. If there were no recharge to or outflow from the groundwater in a basin, the water table would eventually become horizontal. But few basins have uniform recharge conditions at the surface as some areas receive more rain than others; and some portions of the basin have more permeable soil. Thus, when intermittent recharge does occur, mounds and ridges in the water table under the areas of greatest recharge; subsequent recharge creates additional mounds perhaps at other point in the basin and the flow pattern is further changed. Meanwhile various other factors, such as variation in permeability of aquifer; impermeable strata, influence of lakes, stream and well, etc. do make the water table constantly adjusting toward equilibrium (i.e. horizontal). Because of the low flow rates in most of the aquifers, this equilibrium is rarely altered before additional disturbance occur. This is subject to the variable of the water table in the Niger Delta environment due to all these conditions causes of variable in the region (Garg, 2005).

1.3 Movement of ground water

According to Garg (2005) water table is generally not horizontal, and has high and low points in it. I.e. it is not in equilibrium. In other that the equilibrium is approached, water moves inside the ground from the high points on the water table to the points lower down. The rate at which such movement occurs is dependent upon two factors

(i) on the ability of the porous medium to pass water through it, i.e. on the permeability; and

(ii) on the driving force or hydraulic gradient, I usually expressed as the ratio between the difference in elevation (H) of the two points on the water table (in the direction of flow), and the distance between the (h).

1.4 Niger Delta formation and unconfined aquifers

According to Garg (2004) in water table or gravity wells, when an artesian well be driven and water pumped heavily so as to cause a sufficient draw down. When the water level in the well decreases, the water level in the neighbourhood will also fall down, forming what is called inverted cone of depression all around the well, the base of this cone is a circle of radius R, known as the circle of influence; and the inclined side is known as the draw down curve. The formation in the Niger Delta are known to be unconfined aquifers, based on the water contours beneath the ground and deposit of different types of formation which may have been predominant in the terrain resulted to having variable in the regions. Aghunnath (2006) in context state that if a well is drilled into an artesian aquifer, the water level rises in the well to its natural level at the recharged surface called the piezometric surface. If the piezometric surface is above the ground level at the location of the well, the well is called flowing artesian well since the water flows out of the well like a spring, and if the piezometric surface is below the ground level at the location. In such situation, the well is known to be non-flowing artesian well. In practice, a well can be drilled through 2-3 artesian aquifers (if multiple artesian aquifers exist at different depths below ground level). Sometimes a small band of impervious strata lying above the main ground water table (GWT) holds part of the water percolating from above.

2. Materials and Method

A measuring dipper including tape was applied to measured the static water level for fifteen location in the study area, each of the location were measured with this instrument, the values were recorded for analysis, the results for each location varies, this is base on the geological formation that may have influence the stratum deposition in the study area

3. Results and Discussion

Results of static water table variation are presented in tables and figures below.

Table 1: Variation of static water level at different locations

No.	Borehole Locations	Variation of Depths	Static Water Level (m)
1	Ifoko I	18	0.9
2	Ifoko II	18	0.9
3	Isiokpo	44	12
4	Mgbuoba	39	9
5	Borikiri	18	0.9
6	Okirika mainland	24	3
7	Omoku	39	9
8	Emelogu	24	3

9	Diobu	64	22.4
10	Elimgbu	36	7.5
11	Ada George	42	10.5
12	Rumuigbo	36	7.5
13	Ogbunabali	18	0.8
14	Aba Road	18	0.9

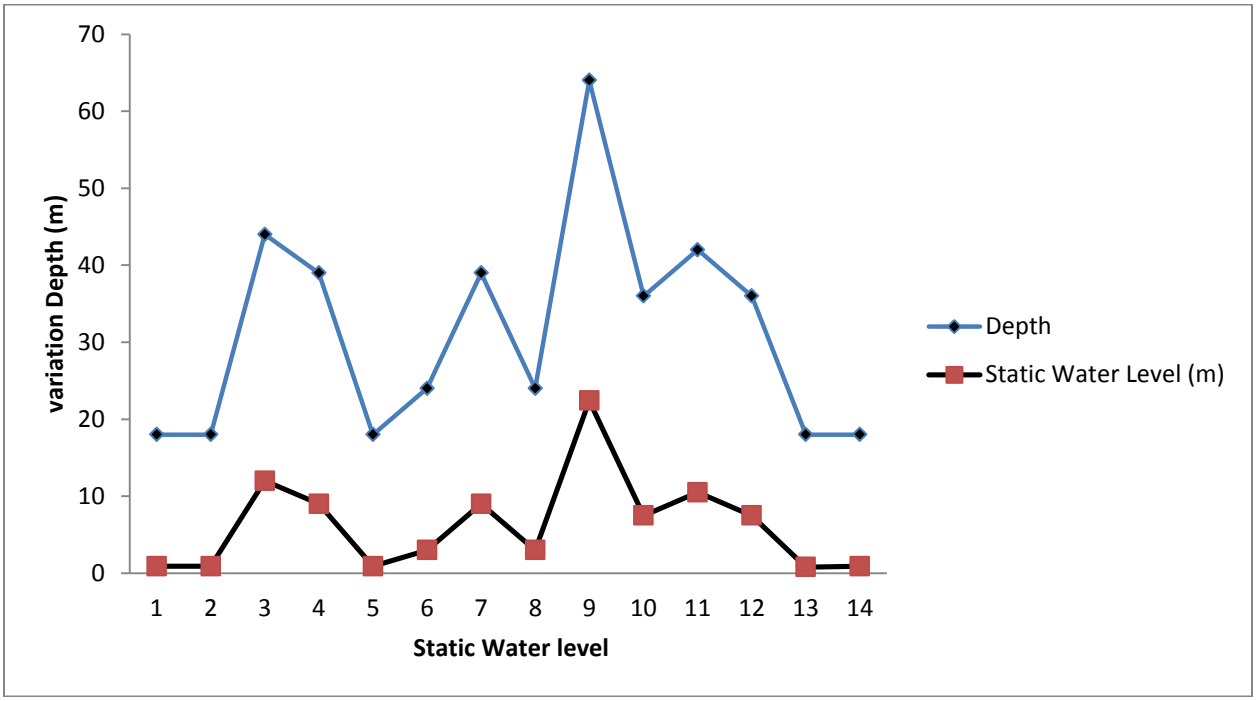

Figure 1: Variation of static water level at different locations

From the figure presented it shows that the static water level varies in location one and two it deposited there static water level at 0.9m, this condition is because the environment is in the deltaic known to be coastal location, and it is found in a shallow deposition with homogeneous formation and high degree of porosity, the influence of the coastal environment definitely influence it static water level. Location 3 deposited its static water level at 12m more deep than the location one and two the location were found to be in the upland environment of delta, the condition of its deposition are influence by deposition of lacucstrine were the static water level in such location always deposit in deeper depth compared to the coastal zone, although the alluvium deposit are found to be predominant in very part of the study location, but the tendency of coastal environment are found to be high, this condition influence the static water level at 12m deeper than location one and two. Location 4 developed its static water level in similar depth but not as compared to location 3 the static water level is deposited at nine metres, the geological deposition develop an influence base on the variation of formation and variation of hydraulic conductivity, this condition may have cause the slight variation as compared to location 3 at twelve metres, location 5 appear to deposit at the coastal

environment they are influenced by alluvium deposit that developed homogeneous formation with high degree of porosity including hydraulic conductivity, the influence is the same like that of location one and two. Its static water level are found to deposit at 0.9m Location 6 are found to be in the same environment with location 5 but there is variation comparing the both location, the static water level is at 3m, the parameter are not as deep base on the fact that the location are not out of the coastal environment including alluvium deposition, the variation can be attributed to the formation variables that will also influence the rate of porosity and hydraulic conductivity of the formation in the study area. Location 7 deposited its static water level at 9m, this environment are at upland environment of the delta and the static water level are influenced by the deposition of lacucstrine that transit from Benin formation at Ahoada River, the transition zone from sombrero developed heterogeneous formation in location 7 the formation at location 7 is like other upland environment with little variation from this transition zone. Location 8 produces its static water level at 3m, it is found to be in the upland land environment of the delta, but are more influence by lacucstrine deposit whereby alluvium deposition were also predominant in the environment, this influence the static water level, including porosity and permeability in the environment. Location 9 are found to have the highest level of static water level in the study location, it deposits its static water level at 22m the environment are found to develop a high variation although it is in alluvium deposition base on the formation, but the environment are found to be influence through the distance between the surface water the sea and Rivers, base on the fact that the environment are were human settlement are found , the condition of manmade activities may have influence the variation of the static water level producing the highest level in the study area. location 10 deposited it static water level at 7.5m similar to others location from the upland environment of the delta, the variation are base on some variation of formation variation that also develop variation in porosity permeability and hydraulic conductivity in the environment location 11 deposited its static water level at 10.5m, the location produce a similar condition like that of location 10 because the environment are found to deposit a similar geological formation, developing variation in stratum deposition hydraulic conductivity, porosity, and permeability. Location 12 the static water level are found to deposit at 7.5m deep, this condition are found in the upland location in the deltaic environment were alluvium and lacucstrine are found to develop some variation in some location influencing other condition that can generate shallow aquifers. Location 13 produced its static water level at 7.5m similar to that location 12 this condition are base on the variation of geological formation since they not in the coastal environment where the influence of the rivers and sea at a very short distance cause more shallow depth and water tables in those environments. Location 14 and 15 generated it static water level at 0.9 and 0.8 respectively both location are found in the coastal environment where the deposition are influenced by mangrove sea and Rivers, they develop shallow aquifers producing static water level at shallow depth. The variation of static water level in the study location shows the influence of other formation characteristics displaying a lot of variation, base on the influence that is found in the study area. This study is imperative because it has produce a lot of influence deltaic shallow aquifers deposition in the study area, the abstraction of ground water at shallow aquifers base on this influence should be designed in other to drill to optimum productive yield aquifers, this will prevent abortive well or polluted water in some instance. This

study to determine the static water level and its assessment will definitely produce a better result in construction of water bole hole in the study area.

4. Conclusion

The evaluation of static water level in River State were carried out to determine the influence on the variation of water table in the study location, sample from fifteen location has provide a platform for engineers and scientist to understand the level of shallow aquifer and the influence behind the shallow depth in the study area, the variation has explain the characteristics of formation variation and the output from the this influence, the study has also provide a platform for practicing Engineers to understand the relationship between static water level and formation of the stratum deposition . The static water level in the coastal environment producing the highest shallow depth and the locations from the upland of the deltaic environment producing the lowest, although comparing it to out side the deltaic environment they are shallow aquifers and depth. Finally the study will enhance the design of productive boreholes in the study area including quality groundwater; it will also prevent abortive well construction and water pollution, because the study is a baseline to all professional in the study areas.

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