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Research article

YIELD RATES MODEL ON ALLUVIA DEPOSITIONS INFLUENCED BY HYDRAULIC CONDUCTIVITY IN PHREATIC BEDS OF PORT HARCOURT METROPOLIS, NIGER DELTA OF NIGERIA.

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Abstract

Yield rate prediction has been express through various parameters found to pressure the deposition of fluid in Port Harcourt metropolis. The study were to ensure that yield rate at various strata are monitored in other to predict or determine their various coefficient for groundwater exploration in the study area, several abortive well has been experienced in the past due insufficient data of ground water characteristics in the study location. Mathematical modeling techniques were applied to monitor and predict yield rate of aquifers in phreatic beds, there some various variation in formation characteristics which has been found to develop lots of impact on yield rate coefficient in the study area. The study expresses various conditions on the derived solution to generate the predicted model for the study. Experts will definitely find this model useful in monitoring and prediction of yield rate in the study area.

Keywords: yield rates, alluvium deposition, and phreatic bed

1. Introduction

Study of water are in various dimension this include watershed with advancing to streams, and groundwater recharge, it can be predictable through stream hydrograph separation as it examined by (Meyboom, 1961; Rorabough, 1964; Mau and Winter, 1997; Rutledge, 1997; Halford and Mayer, 2000). The application of base-flow discharge to an approximation recharge is pedestal on a water-budget applications, these is through recharge equated to discharge. The application of Base-flow discharge, nevertheless, is not of necessity or directly equated to recharge, but it is due to pumpage, including evapotranspiration, and underflow to deep aquifers, that are found to be important. For certainty, it is observed that there are other discharge components. These should be predictable autonomously. Base on these conditions, the application of Bank storage may make difficult hydrograph examination because water discharging from bank storage is generally derived from Short-term vacillations in surface-water flow thus not from areal aquifer recharge, this could result in over prediction of recharge. a variety of approaches are applied for hydrograph separation, this include digital filtering (Nathan and McMahon, 1990; Arnold et al., 1995) expressed recession curve displacement techniques (Rorabough, 1964). Over longer times recharge can be predictable by rundown of approximation over shorter times. Current advancement has been made on the application of chemical and isotopic method to deduce the foundations of stream flow from end constituents; these include rainfall, soil water, groundwater, and bank storage (Hooper et al., 1990; Christophersen and Hooper, 1992). This concept is data intensive, but it makes available information that is functional in conducting hydrograph separation. Suecker (1995) applied sodium concentrations in a two-component integration model to decide the subsurface contribution to three alpine streams in Colorado. As an substitute to stream gauge, heat can be applied as a tracer to supply information on when surface water is flowing in ephemeral streams, it will give other information about the estimation on infiltration from surface-water bodies (Stallman, 1964; Lapham, 1989; Constantz et al., 1994; Ronan et al., 1998). These Examine variations of depths, it also depends on time scales, sediment types, and anticipated water fluxes beneath the stream. Modeling Watershed (rainfall/runoff) is applied to approximate recharge rates over huge areas. Singh (1995) assess many watershed models, and it definitely provides normal recharge estimates as a residual term in the water-budget equations (Arnold et al., 1989; Leavesley and Stannard, 1995; Hatton, 1998). More so Unsaturated- zone techniques for predicting recharge are applied typically in semiarid and arid regions, where the unsaturated zone is usually thick. These procedures are explained in detail in Gee and Hillel (1988), Hendrickx and Walker (1997), Scanlon et al. (1997), and Zhang (1998). The recharge calculates approximately in general the application of smaller spatial scales than those calculated from surface-water or groundwater approaches. Unsaturated-zone procedures make available approximation of potential recharge that is a foundation on drainage rates beneath the root zone; nevertheless, in some conditions, drainage is sidetracked laterally thus does not arrive at the water level.

2. Theoretical background

Yield rate influences from permeability are determined by the level of structural deposition of the soil under the influence of geological background. This is one of the foremost determinants of yield rate in soil and water environment. Subject to this condition, yield rate impacts develop several yield variations depending on the structural stratification of the soil reflecting the geological background in the study area. Formation characteristics which include porosity and permeability are the focal point of this study; more so, parameters such as void ratio in soil are through the rate of disintegration of the porous rock in grain size, they are structured with different variations deposits in either homogenous or heterogeneous in various intercedes. The micropores between intercedes formation of the soil are the void ratios, while that of the permeability may take advantage of the micropores in other to transmit fluid from one deposition to another. Therefore, the ability for such formations to transmit water determines the rate of permeability which can also be expressed at the rate of hydraulic conductivity in the formations. Fluid varies in different strata based on the rate of deposition of the micropores including grain size structures to be homogeneous or heterogeneous in the study location. Variation of void ratios also express in disintegration of the strata deposition of their grain size in different depositions, these express different micropores known as void ratio of the soil. Such deposition of intercedes including the grain size express several variations on the yield rate of fluid velocity, because the grain sizes experiences heterogeneous predominant in most conditions since it is determined by the rate of disintegration of these porous rocks. Fluids are influenced by different conditions such as climatic influence by high rain intensities that increase fluid depositions mostly in unsaturated vadose to saturated vadose, this can be described as aquiferous zones. The rate of hydraulic conductivity reflects the rate of permeability, subject to this relation; it is influenced by these conditions stated above. It is of interest that fluid pressure depositions reflect the influence of void ratio and permeability as expressed in this study (Eluozo 2013).

3. Developed governing equation

$$\bar{V}\frac{\partial h^2}{\partial X^2} + \frac{Q}{ne}\frac{\partial h^2}{\partial y^2} = 0 \qquad \text{.........................} \qquad (1)$$

The behaviour of yield rates in phreatic beds are base on several factors, but there basic fundamentals that generated variations of its yield rates in phreatic beds. The expression will explain the behaviour of the yield through the system developed that produced this governing equation.

$$\bar{V}\frac{\partial c}{\partial X^2} = -\frac{Q}{ne}\frac{\partial h^2}{\partial y^2} \qquad \text{.........................} \qquad (2)$$

$$h = xy$$

$$\frac{\partial h}{\partial Z} = XZ^1; \quad \frac{\partial^2 h}{\partial z^2} = Z^{11}y \qquad \text{.........................} \qquad (3)$$

$$\frac{\partial h}{\partial y} = Zy^1; \quad \frac{\partial^2 h}{\partial y^2} = ZY^{11} \qquad \text{.........................} \qquad (4)$$

$$\bar{V}\left(Z^{11}\right) = -\frac{Q}{ne}\left(ZY^{11}\right) \qquad \text{.........................} \qquad (5)$$

$$\bar{V}\frac{Z^{11}}{z} = \frac{Q}{ne}\frac{Y^{11}}{y} = \beta^2 \qquad \text{.........................} \qquad (6)$$

Let $\bar{V}\frac{Z^{11}}{z} = \beta^2$ .... (7)

$$-\frac{Q}{ne}\frac{Y^{11}}{y} = \beta^2 \qquad \text{.........................} \qquad (8)$$

From (7) $Z^{11} - \frac{\beta^2}{\bar{V}} Z = 0$ .... (9)

The auxiliary equation gives the result

$$Z = \pm \frac{\beta}{\underline{V}} \qquad \ldots\ldots\ldots\ldots\ldots \quad (10)$$

$$\Rightarrow Z = Ae \frac{\beta}{\sqrt{\underline{V}}} z \;\; Be - \frac{\beta}{\sqrt{\underline{V}}} z \qquad \ldots\ldots\ldots\ldots\ldots \quad (11)$$

Also from (8) $\frac{\underline{Q}}{ne} \frac{Y^{11}}{y} = -\beta$ ……………………… (12)

So that auxiliary equation gives the results

$$y = \pm \frac{i\beta}{\frac{\sqrt{\underline{Q}}}{ne}}$$

$$Y = C\ Cos \frac{\beta}{\frac{\sqrt{Q}}{ne}} y + \frac{Q}{ne}\ Sm \frac{\beta}{\frac{\sqrt{Q}}{ne}} y \qquad \ldots\ldots\ldots\ldots\ldots \quad (13)$$

$$C_1 = \left[Ae \frac{\beta}{\underline{V}} z + Be - \frac{\beta}{\sqrt{\underline{V}}} z \right] \left[C\ Cos \frac{\beta}{\frac{\sqrt{Q}}{ne}\, y} + \frac{Q}{ne} \frac{\beta}{\frac{\sqrt{Q}}{ne}} y \right] \ldots\ldots\ldots \quad (14)$$

Several conditions influence the depositional level of yield rate in phreatic beds, the derived solution expressed these conditions by providing platform for variables in the system to express their various impact on the deposition of yield rate in phreatic beds, base on these condition, the depositions of flow rates under the influences of porosity are expressed to determined there various levels of impact in phreatic beds, such unconfined bed deposit variation of flow base on the velocity deposition in the formation, the derived solution integrated the impact from velocity since both parameters established relationship in the system as it expressed in [14].

$$h = 0 \quad x = y + 0$$

$$0 = [A + B][C] \Rightarrow h \neq o,\ A + B = 0$$

$$\Rightarrow A = -B$$

$$C_1 = \left(Ae \frac{\beta}{\sqrt{\underline{V}}} Z + Be - \frac{\beta}{\sqrt{\underline{V}}} \right) C\ Cos \frac{\beta}{\frac{\sqrt{\underline{Q}}}{ne}} Y \qquad \ldots\ldots\ldots\ldots\ldots \quad (15)$$

When $\frac{\partial h_1}{\partial z} = 0 \quad y = 0$

$$0 = \left(A \frac{\beta}{\sqrt{\underline{V}}} - B \frac{\beta}{\sqrt{\underline{V}}} \right) Cos \frac{\beta}{\frac{\sqrt{\underline{Q}}}{ne}} y \Rightarrow Cos \frac{\beta}{\frac{\sqrt{\underline{Q}}}{ne}} y \neq 0 \quad \ldots\ldots\ldots \quad (16)$$

i.e $$A\frac{\beta}{\sqrt{V}} - B\frac{\beta}{\sqrt{V}} = 0 \Rightarrow A = B = 1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (17)$$

If $$C\,Cos\frac{\beta}{\frac{\sqrt{Q}}{ne}}y = 0 = \frac{n\pi}{2} \quad n = 1, 3, 5 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (18)$$

$$Cos\frac{\beta}{\frac{\sqrt{Q}}{ne}}y = 0 \quad n = 2, 4, 6 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (19)$$

$$\frac{\beta}{\frac{\sqrt{Q}}{ne}} = \frac{n\pi}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (20)$$

$$\beta \quad \frac{n\pi}{2} \quad \frac{\sqrt{Q}}{ne} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \quad (21)$$

$$\therefore\ h(X_1Y) = \left(e\frac{n\pi\frac{\sqrt{Q}}{ne}Z}{2\sqrt{V}} + e\frac{-n\pi\frac{\sqrt{Q}}{ne}Z}{2\sqrt{V}} \right) Cos\frac{n\pi\frac{\sqrt{Q}}{ne}y}{2\frac{\sqrt{Q}}{ne}} \qquad \ldots\ldots\ldots.. \quad (22)$$

$$h(X_1Y) = \left(\ell^{\frac{n\pi\frac{\sqrt{Q}}{ne}z}{2\sqrt{V}}} + \ell^{\frac{-n\pi\frac{\sqrt{Q}}{ne}}{2\sqrt{V}}} \right) Cos\frac{n\pi}{2}y \qquad \ldots\ldots\ldots\ldots\ldots.. \quad (23)$$

$$\boxed{\therefore\ h_1(X_1Y) = 2Cos\frac{-n\pi\frac{\sqrt{Q}}{ne}}{2\sqrt{V}}z \ \ Cos\frac{n\pi}{2}y} \qquad \ldots\ldots\ldots\ldots\ldots. \quad (24)$$

The behaviour of yield rates in unconfined beds were monitor in the study location, this is to determine the level of yield variation in deltaic formations. The concepts of the study also include monitoring the system in various conditions that pressure the deposition of yield rate to vary in different formation. The behaviour of fluid flow including its yield coefficient are base on the formation parameters that developed predominance variation in deltaic environment, the expressed model has shows various conditions from the developed system thus from the derived solution that has provided the model for the study.

4. Conclusion

Yield rate coefficient studies has been carried out through mathematical modeling techniques, the study were to monitor the rate of yield at various phreatic bed in deltaic formations, the derived solution were generated from the variables, these were coupled to formulated and produce the governing equation, several conditions that influence these parameters at various phase of the depositions of yield coefficient were expressed in the derived solution. The study is imperative because yield rate rates are not monitored or determined in deltaic formation, several assumption are applied which has resulted to abortive well, but with the application of these model, experts can predict the yield coefficient at various location in deltaic environment of port Harcourt metropolis.

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