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GEOELECTRICAL AND HYDROGEOLOGICAL ASSESSMENT FOR THE ESTABLISHMENT OF THE RELATIONSHIP BETWEEN ELECTRICAL RESISTIVITY VALUES AND HYDRAULIC PROPERTIES OF AQUIFER

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ABSTRACT

Hydraulic conductivity, (K) and transmissivity, (T) are considered an important principle for hydraulic characteristic and water flow in soil. Hydrological studies are intrinsic in planning water resources in regional area. Drilling tube well is one of the common techniques for groundwater studies and there are many tests that must be conducted to the characterisation of aquifer such as pumping test which is costly and time-consuming. Usually, to determine the suitable aquifer location, a tube well and minimum of 3 observation wells should be drilled. Geophysical methods are considered an alternative technique where provide a quick and cost-effective technique for mapping subsurface profile imaging. The pumping test data were analysed using the AquiferTest software employing the appropriate solution method. Solution methods used for the pump tests (constant discharge test) included double porosity, Moench Fracture Flow, and Theis. This methodology can be applied to other sites in case pumping test data are available. In this study, vertical and horizontal hydraulic conductivity was determined from electrical resistivity imaging data to evaluate their influence on pumping test results and develop a new relationship between hydraulic conductivity and electrical resistivity for aquifer in Malaysia. Also, to present a relationship for transmissivity with hydraulic conductivity following electrical resistivity. A linear relationship (coefficient of determination R^2 = 0.96) was observed between field hydraulic conductivity and electrical resistivity across all field sites. The Nash-Sutcliffe coefficient of efficiency (NSE) was 0.966 and the Mean Absolute Error (MAE) was 0.425. This study was successfully linked hydraulic conductivity with electrical resistivity imaging by using a novel methodology to select the resistivity value. It was concluded that the K-value of an aquifer can be estimated from the electrical resistivity technique. This study concluded also that vertical hydraulic conductivity was closer to the field hydraulic conductivity than horizontal hydraulic conductivity. Hence, estimating hydraulic conductivity from electrical resistivity can provide a non-intrusive, cost and time efficient way to evaluate aquifers of Malaysia.

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Groundwater is one of the most precious natural resources, where exist on the surface as oceans, lakes, rivers, and rains. For subsurface water, in the certain depth and if the permeability enough, some of the surface water will infiltrate. The upper layer of this subsurface zone called water table. The saturated zone under the water table is called an aquifer which is huge storehouses of water. Most of the rocks that lie beneath the water table have different porosity and permeability characteristics, which mean that water does not move around the same way in all rocks below ground (Haught & Meerveld, 2011).

In Malaysia, groundwater extraction has been increased because of several factors such as demands for the domestic use or agricultural and industrial or due to surface water depletion because drought (Fauzie et al., 2014). At the turn of the century, with the great development of drilling tools, several efforts have been made to study groundwater. Since then, the dependence on groundwater has increased significantly, especially with the increasing population around the world and insufficient surface resources to cover water needs.

There is need for further investigation and improving the confidence in the results of estimate potential aquifer. The technique of electrical resistance is useful in this regard, as it is an efficient and economical way to determine the presence of groundwater. The electrical resistivity method can be used in a wide range of geophysical investigations, such as study of minerals, archaeological surveys, geological mapping, and engineering site investigation. Geophysicists have also used it to delineate the thickness of clay aquitards, bedrock, the vertical extent of certain types of soil saltwater intrusion, and the spread of groundwater pollution (Anomohanran, 2015). The large area that electrical resistivity covered will lead to minimizing the amount of tube well by predict the aquifer locations which is important for optimized tube well site selection, thus will decrease the pumping test method cost substantially (Ariyo & Adeyemi, 2009); (Sajeena et al., 2018); (Hussain et al., 2017).