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Groundwater Aquifer Boundary and Cone of Depression Detection Using Time-lapse Electrical Resistivity Tomography in Ma Khun Wan Sub-district Area, San Pa Tong District, Chiang Mai Province, Thailand

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Abstract

In many villages, water supply comes from groundwater pumping. Due to population expansion, the water supply is more demand causing an increase in well drilling. In the steady state of pumping, the groundwater level behaves like an inverted cone called a “cone of depression”. The excessive drilling of groundwater wells regardless of depth and location can cause problems. If the cone of depression of a neighboring well is too close, some wells may dry because the groundwater inflow rate is lower than the total pumping rate. Therefore, groundwater management is very necessary. This study aims to monitor the groundwater level through the season change using the conventional electrical resistivity tomography (ERT) and time-lapse electrical resistivity tomography (TL-ERT) methods. The 5-meter electrode spacing is set. The length of each line is 400 meters long. The electrical resistivity distribution of the subsurface, which is influenced by the types of ground material, porosity, and water saturation, is measured by the ERT method. To determine and define the boundary of each subsurface material, the ERT data are inverted. The groundwater aquifer in the research area can thus be identified using the ERT. The inverted model of resistivity contrast amply illustrates the aquifer boundaries. By correlating the ERT data with the lithological log of the surrounding drilling wells, the results are satisfied. For the TL-ERT result, the inverted percentage difference model of resistivity is calculated. The percentage difference model at the location of the pumping well behaves like the depression cone over the time. From the result, it can be considered that the TL-ERT survey can be an alternative tool for monitoring the groundwater level, aquifer boundary detection, and the cone of depression of the pumping well detection. The TL-ERT can be used efficiently for another groundwater management, especially for planning the location of drilling the pumping wells in the area without the observation well.

Keywords: time-lapse, electrical resistivity tomography, ERT, aquifer detection, groundwater