

CHAPTER 6

CONCLUSION AND DISSUSION

The purpose of the thesis is to study hydrogeology of Bang Khla Royal Development Project in order to determine its groundwater resource potential, using Geographic Information System (GIS) to establish systematic description of hydrogeological data. The study has been focused on geological setting, hydrogeological setting, groundwater recharge, groundwater quality, and groundwater potential. GIS has been used to simplify data management, analysis, and display.

Bang Khla Royal Development Project is located in Bang Khla District, Chachoengsao Province. The study area covers about 0.2 square kilometers and is characterized by flat terrain of flood plain deposits. The topography of the study area is relatively flat with the average elevation of 2 meters above mean sea level (MSL). The drainage system in its adjacent area is a dendritic pattern. In the study area there is no drainage system. The study area has no distinctive geological feature. The area consists entirely of alluvial deposits, which consists of clay, clayey sand and some gravel presented in place.

Geological data and geophysical survey are used to identify hydrogeological unit. Geological data including lithology log and geophysical survey is conducted using resistivity method. Lithologic log data were recorded in 14 wells in the study area and its adjacent. In the study area, lithology can be divided into 3 units including clay unit, sand unit, and shale interbeded sandstone unit. Clay unit composed mainly of clay. The thickness range from 9 to 21 meters. Sand unit composed of fine sand to medium sand that the thickness ranges from 10 to 100 meters. Shale interbeded sandstone unit, shale is gray to black, slightly weathered to moderately weathered. Sandstone is gray, composed of quartz, feldspar, and dark minerals, hard to very hard. Resistivity is determined using Schlumberger array with 35 locations in the study area. These data were processed using RESIS 87[®] computer program. From the interpretation of 35 resistivity surveys, the study area is mainly consisted of unconsolidated sediment and shale that is found in a limited area. Unconsolidated

unit including clay, sandy clay, clayey sand, and sand. The resistivity values of unconsolidated sediment range from 1.6 to 88.2 ohm-m. Its thickness varies between 0.5 to 76.2 meters. Shale units have resistivity values from 154.8 to 756.1 ohm-m.

Pumping test data is analyzed to determine the hydraulic properties of aquifer. In the study area, four pumping test data carried out by Department of Groundwater Resources in 2003 are used. Analysis of the pumping test data to determine the transmissivity (T) and storage coefficient (S) were carried out by Theis method and Cooper & Jacob method, using aquifer test Version 2.5 Software. Hydraulic properties of the aquifer can be calculated from equation. The interpreted hydraulic properties show transmissivity range from 1.75×10^{-4} to 1.55×10^{-3} m²/min (0.252 to 2.232 m²/d), storage coefficient range from 8.7×10^{-3} to 1.41×10^{-2} , and hydraulic conductivity range from 2.13×10^{-6} to 1.43×10^{-5} m/min (3.07×10^{-3} to 0.02 m/d).

Groundwater flow pattern are constructed from groundwater level that were collected from 14 wells in the study area and its adjacent. The general direction of groundwater flow is from the central to the rim of the area.

Groundwater quality were collected from 17 groundwater wells. Different in the chemical characters of groundwater is apparent and demonstrated by the Stiff diagram. Most groundwater from the study area and its adjacent are similar in chemical content, and that sodium and calcium are dominated cations and chloride are dominated anions. Based on hydrochemical facies, in the study area, groundwater can be classified into 3 groups, as follows: Na-HCO₃-Cl-SO₄ facies, Na-Ca-Cl-SO₄-HCO₃ facies, and Na-Ca-HCO₃-Cl-SO₄ facies. In the study area, groundwater quality are generally, with their constituents, below the maximum allowable limits except fluoride concentration in some groundwater samples is higher than 1.5 mg/l. From the most desirable and maximum allowable limits of WHO and drinking water quality standards of Thailand, groundwater in the study area can be used for drinking purpose without any risk if fluoride is removed. According to sodium percentage (% Na) and Wilcox diagram, groundwater quality in the study area and its adjacent are not suitable for agricultural use.

Assessment of groundwater recharge in this study has been carried out by the hydrologic budget method, and a combination of Geographic Information System database and permeability testing. The hydrologic budget based on hydrologic cycle

that was computed from precipitation, evapotranspiration, and surface water runoff. The calculated groundwater recharge using the hydrologic budget is 94.94 millimeters per year or 18,988 cubic meters per year that is about 7.43 % of the annual rainfall. The combination of GIS database and permeability testing based on the property of soil to water through into storage in aquifer. This method was computed using the permeability values of soil and hydrologic map that represent the potential recharge map. The slope in the study area is not considered as it is very small. The calculated groundwater recharge using the combination of GIS database and permeability testing is 83.21 millimeters per year or 16,642.7 cubic meters per year. It is about 6.52 % of the annual rainfall. Therefore, the calculated groundwater recharge from the two methods shows similar results. The approximately available quantity of groundwater at 16,000-19,000 cubic meters per year is therefore served as the guide line for future abstraction in the study area.

The following recommendations are provided in order to further study and better development and management of the groundwater resources of the study area and its vicinity:

1. Groundwater modeling, using the basic hydrogeologic and hydraulic properties derived from the present study should be applied. Specifically, modeling to analyze flow and solute transport in the groundwater system. Modeling should also be useful in predicting the groundwater storage of the system.

2. This study can also be applied for the hydrogeologic study in its adjacent area in order to obtain better groundwater development and management, and do not have adverse impact to environment.

3. Groundwater recharge and groundwater quality should be monitored because they are of importance in controlling groundwater uses in the study area.

4. Reliability of the study depend on input parameters in each method. In future, when more new data are available, verification of obtained figures and interpretation should be carried out.

Understanding hydrogeology and the impact of groundwater utilization is necessary in order to control groundwater development activity and to prevent adverse environmental impacts in Bang Khla Royal Development Project.