# 9 SUMMARY, CONCLOUSION AND RECOMENDATIONS

# *SUMMARY, CONCLUSIONS AND RECOMMENDATIONS*

The present work is an attempt to evaluate the groundwater potentiality of the Quaternary aquifer in the middle part of El-Qaa plain, which lies parallel to the Gulf of Suez in the western part of Sinai Peninsula. The importance of El-Qaa plain lies in the fact that it is one of the most promising areas in Sinai Peninsula for integrated development due to its even surface, easy access, presence of groundwater resources and strategic location.

The main objective of the present study is to recognize in detail the characterstics of the Quaternary aquifer. This is important because most of the previous studies carried out in the area was on a regional scale for the whole area of El-Qaa plain which is much larger than the area studied here. Besides, these studies were not as integrated as is regarded here.

To fulfil this objective, a geoelectrical survey was carried out in the area to reveal the subsurface succession including the water-bearing formation, define the aquifer geometry (depth, thickness and extension) and determine the approximate water quality in the different parts of the aquifer. The Transverse Unit Resistance and Average Transverse resistivity were correlated with the two corresponding hydraulic parameters; namely the aquifer Transmissivity and Hydraulic conductivity calculated from pumping test data. Chemical analysis were applied to water samples obtained from several wells in the area to determined the water salinity, hardness, and type, concentrations of the different chemical elements and suitability of water for different purposes. Comparison was made between the distribution of the water quality as concluded from the actual chemical analysis and that concluded from the geoelectrical survey.

The geoelectrical survey involved carrying out 39 Vertical Electrical Soundings (VES), well distributed across the area along nine profiles. Six of these soundings were carried out at the locations of wells of known lithologic logs to correlate geoelectrical and geological data. Using the Schlumberger electrode arrangement during field measurements, the spacing of the current electrodes was varied from 2m to 2000m at each sounding station.

The qualitative and quantitative interpretation of the sounding curves using the methods of Velpan (1988) and Zohdy (1989) indicated that the subsurface of the area down to the investigated depth consists mainly of four geoelectrical layers as follows from top downwards:-

1-A surface layer varying in thickness from few meters to 12m, characterized by a wide range of resistivity (20-15122 Ohm.m.). This layer consists of sand, gravel and boulders drived to the plain from the surrounded highlands.

2-A dry layer consists of sand and gravel but with a relatively narrower range of resistivity (12-329 Ohm.m). The thickness of this layer varies from 2 to 52m.

3-A water-bearing layer with a thickness of 30–86m. and a narrow range of resistivity of 3-89 Ohm.m. This layer consist also of sands and gravel with some clay intercalation.

4-A water-bearing layer, which represents actually the downward extension of the overlying layer as it is more or less similar in its lithologic composition. However, the water quality of this layer is lower as it is characterized by both low and narrow range of electrical resiustivity (1-23 Ohm.m). The thickness of this last layer was not determined because of the principle of the D. C. electrical exploration itself and regarding the great thickness of the Quaternary aquifer.

However, the thickness of this layer-within the present explored depth-is expected to be not less than 50m.

The interpretation of the electrical soundings indicated also that the water-bearing formation extends across the whole studied area with its top at a depth of 3.2 –65m from the ground surface.

The resistivity distribution of the water-bearing formation indicated that the middle and eastern parts of the area have the relatively best water quality while the western and southwestern parts have the least water quality. This was confirmed later by the chemical analysis of water samples.

The results reached from the geoelectrical measurements and interpretation are illustrated in the form of graphs, contour maps vertical section and cross sections.

The analysis and interpretation of the pumping test data using the methods of Theis (1935), Jacob (1947) and the recovery test curves together with rather recent computer programs indicated that the hydraulic conductivity of the aquifer ranges between 1.26 and 71.5 m/day and its transmissivity ranges between 100 and 1900 $m^2$/day. This points out to an aquifer of good potentiality. The reached parameter values were found to be in agreement with the values determined before by conventional computation methods.

The comparison of the hydraulic parameters with the corresponding geoelectrical parameters indicated that the two groups of parameters are directly proportional to each other in such a way that from the measured geoelectrical parameters it would be possible to expect the behavior of the corresponding hydraulic parameters in the different parts of the area and consequently judge upon the aquifer potential before the drilling of the water wells.

The chemical analyses of water samples carried out by the author indicated that the aquifer water is chemically favorable for human drinking purposes except water samples No. 5, 12,15,22 and 23 according to international standards. As to irrigation and water use by livestock and poultry, the water of all parts of the aquifer are acceptable except sample No.23 due to high salt concentration and high Sodium Adsorption Ratio.

The concentrations of each of the determined chemical elements present in the aquifer across the area are given in the form of contour maps, tables and diagrams.

According to the results and conclusions reached from this study, the following recommendations can be presented: -

1- For future drilling of groundwater in the area, the middle parts of the study area are recommended as they are characterized by the following:-

a- appropriate depth to top of the aquifer (20-30m.).

b- Good water quality as the total water salinity is less than in the other parts of the study area.

c- Relatively higher values of Transmissivity and Hydraulic conductivity of the aquifer.

d- Relatively greater thickness of the upper part of the aquifer where the water quality is better.

2- The total depth of any of the water wells to be drilled in the area in future should be in the range of 75 - 125 m according to the topography of the area and thickness of the upper part of the aquifer where fresh water is present.

3- The present pumping rates of wells Nos.9, 25, 27 and 28 should be reduced to allow for higher well Specific Capacity and well efficiency and lower well loss and aquifer loss.

4- Use could be made of the "Transverse Unit Resistance" and " average Transverse Resistivity" calculated from the electrical sounding curves in differentiating between areas having high and low values of the aquifer Transmissivity and hydraulic conductivity prior to well drilling.

5- The use of water derived from wells Nos. 5, 12, 15, 22 and 23 for drinking purposes should be re-considered as the chemical contents of this water don't agree with international standers. Similarly, water derived from well No. 23 should be avoided as drinking water for livestock and poultry for its high salt content and high sodium adsorption ratio (SAR).

It has to be mentioned here that the geophysical study carried out in the present work was able to yield more successful picture about the characteristics of the Quaternary aquifer when it was linked to a complementary hydraulic investigations and chemical analyses.