HYDROGEOPHYSICAL INVESTIGATION OF PARTS OF THE RIVER JAMA'ARE FLOODPLAIN, WEST CHAD BASIN, NORTHEASTERN NIGERIA.

BY MOHAMMED, MURAINA ZAID

B. Tech. (Applied Geophysics), M. Tech. (Exploration Geophysics), FUTA.

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D) IN APPLIED GEOPHYSICS OF THE DEPARTMENT OF GEOLOGY, FACULTY OF SCIENCE, OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE. NIGERIA.

2007

ABSTRACT

This study aimed at establishing the different subsurface geoelectrical/geological layers, the aquifer units and their hydraulic parameters, the subsurface structures and their influence on the general hydrogeological conditions of River Jama'are floodplain Northeastern Nigeria with a view to providing information for the development of the basin for water supply to Azare township in Bauchi State.

The study involved integrated geological, geophysical and hydrogeological investigations. The geological mapping involved direct observations of rock formations. surface landform features and correlation of lithological logs from existing boreholes. The geophysical investigation involved the electrical resistivity method. One hundred and six Schlumberger Vertical Electrical Sounding (VES) stations located at the corners of a 225 x 225 m square grid network were occupied. The inter-electrode spacing (AB/2) was varied from 1 - 225 m. The hydrogeological investigation involved acquisition of borehole lithological logs and pumping test data. The interpretation of the VES data involved partial curve matching and computer iteration technique using Resist software, while the analysis of the pumping test data was carried out using Cooper - Jacob analytical model.

Four subsurface geologic layers were identified from the geoelectric sections, aided by borehole lithological logs. These included topsoil, alluvial sand, Chad Formation/weathered basement column and the bedrock. The layer resistivity ranged from 5 - 5706: 69 - 3079: I I - 140 and 994 - co ohm-m respectively while the thicknesses of the upper three layers were 0.4 - 6.7; 1.6 - 32.2 and 15.9 - 168.6 m respectively. Four major parallel basement depressions suspected to be regional faults striking approximately NW-SE were delineated. The NW - SE trend correlated with one of the general trends of the regional structures in the Chad Basin. The isopach maps of the topsoil and alluvial sand mirrored a more recent NE-SW trend that

correlated with the Tibesti - Cameroon trough. The alluvial sand layer constituted the dominant aquifer unit while the clayey Chad Formation/weathered basement displayed aquitard characteristics. The groundwater yields varied from 2 - 13 litre sec. The pumping test derived transmissivity values varied from 122.7 - 18783.7 m^2 day while the hydraulic conductivity varied from 6.7 - 1329.4 m/day. The transmissivity and hydraulic conductivity obtained within the upper 25 - 30 m (142.6 - 18783.7 m^2/day and 6.7 - 1329.4 m2day/m) suggested a zone with high recharge and discharge capacities while deeper wells, gave significantly lower values (122.7 - 158.1 m^2/day and 5.5 - 11.1 m2/day/m), arising from the effect of thick low permeability clayey Chad formation/weathered basement column.

It was concluded from this study that the groundwater potential of the study area was, generally high when the depth of the abstraction boreholes was kept within the upper alluvial deposit or generally not deeper than 25 - 30 m. Deeper boreholes gave characteristically lower groundwater yield due to low transmissivity and hydraulic conductivity of the basal clayey Chad Formation/weathered basement.