Geophysical Studies For Groundwater Harvesting In Sus Basin, Solapur District Maharashtra India.

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Absract: In Sus basin, from Solapur District ($17^0 41'$ to $17^0 58'$N Latitude $75^0 20'$ to $75^0 30'$E Longitude) electric resistivity sounding has been estimated in a grid pattern. Further using these estimated values corresponding layered models were prepared and feasible, non- feasible and moderately feasible areas of different horizons (multistoried aquifers) for groundwater occurrences are demarcated. Using these models suitable rainwater harvesting structures are selected for groundwater recharge. This helped increase the groundwater level by artificial recharge.

Key wards: *Electric resistivity, Groundwater recharge, feasible zone.*

1. Introduction

Geological and geophysical (electrical resistivity) and groundwater flow pattern studies were carried out from Sus basin, from Solapur District ($17^0 41'$ to $17^0 58'$N Latitude $75^0 20'$ to $75^0 30'$E Longitude).Sus basin occupies part of Pandharpur, Mohol and Madhatalukas covering an area of 350 sq.km location map shown in fig.1

Using the above data lateral distribution and apparent distribution of resistivity at different horizons, equithickness (isopach) maps have been prepared, absolute resistivity distribution has been estimated and presented in the form of contour and 3D maps. Here logical step has been taken to develop empirical models to describe effect of each parameter on the groundwater conditions of the study area. Prediction, management and sustainable development of groundwater become easier with these studies.

2. Materials and Methods:-

2.1 Resistivity inferred layer by layer geological formations and its significance in groundwater studies:-

Resistivity of the different geological formations below the surface were obtained from electrical resistivity soundings at 45 locations (fig. 5.2), are taken into consideration to prepare a model of resistivity distribution and subsurface lithostratigrapy, inferred from these models are described in the following.

2.1.1 Top layer geology:-

Top layer resistivity ranges between 500 ohm m and less than 20 ohm m. The high resistivity peak is observed in the north central region around Modninb and Shetphal, where hard and massive basalt is exposed in that region, hence unsuitable for groundwater. Towards N-NE region the resistivity is between 60 and100 ohm m thereby representing, moderately weathered fractured basalt. North-western portion represents highly weathered top layer with less than 40 ohm m resistivity. However, the eastern and western margins have resistivity range of 80 to 140 ohm m representing harder formations around Telangwadi, also devoid of water.

In and around Tungat which occupies south central portion of the basin has 60 ohm m resistivity, represented by moderately weathered vesicular basalts, with moderately high secondary mineralization. The southern region of the basin around Narayanchincholi and Ishwarvatar where highly weathered vesicular zeolitic basalts occur, the resistivity gradually falls below 20ohm m. Along stream channels thick Quaternary alluvium is observed to show less than 20 ohm m resistivity. Contour map representing resistivity distribution is given in fig. 2 along with structure contour map at the top of first layer.

The observations made above agree with the surface geological map prepared by field observations as shown in fig. 2

2.1.2 Geology of second layer:-

Contour model of absolute resistivity and structure contour map at the top of second layer has been presented in the fig. 3. The north most region in the basin has resistivity below 20 ohm m gradually increasing to 40 ohm m around Solankarwadi, therefore it is inferred that this portion represents low resistivity formations, possibly weathered and unweathered vesicular/zeolitic basalts, at places merging in to red bole, around Solankarwadi. Red boles are encountered around 520 and 530m above mean sea level, as inferred from the structure contour map at the top of second layer.

North eastern tip represents a broad high resistivity patch extending towards NE in the form of nipple shaped region representing harder formationaroundAran, Shetphal and Modnimb. The formations in the central region show lower resistivity values orienting in NE- SW direction and represent highly weathered / vesicular/ zeolitic formation around Asti and Yavti. High resistivity contour closer oriented in the NE-SW direction, south of the above described area around Khandali, Tungat and Babulgoan, represent harder formation, having resistivity between 100 and 180 ohm m. However, portion between these peaks has lower resistivity (40 ohm m) representing vesicular basalt. It is also observed that the high resistivity peaks are exposed at higher altitudes (480 to 500m).

2.1.3 Geology of third layer:-

Absolute resistivity and structure contour at the top of third layer are presented in fig.4 It is observed from the figure that two resistivity peaks, one at north central portion, around Modnimb at 480m to 490m above msl altitude and another towards south of the basin near Narayanchincholi from 410 to 420m above mean sea level, represents high resistivity (150 to 210 Ohm m). NW tip of the basin also has high resistivity values (100 and 230 ohm m) in this region hard massive basalt from the earth from 500m to 520m above mean sea level.

Eastern and central portion of the basin shows low resistivity (20 ohm m) near Khandali, Telanwadi and Asti where saturated vesicular basalts an weathered basalts are encountered at 410m to 450m above mean sea level.

2.1.4 Geology of the fourth layer:-

Resistivity distribution and structure contour at the top of fourth layer are presented in fig. 5 Western portion of the basin has high resistivity values (200 to 500 ohm m) this suggest that the hard massive basalt would be encountered from 430 to 470m above mean sea level in this region. Eastern portion of the basin has very low resistivity (often shown by alluvium or red bole) and as one moves towards west the resistivity gradually increase to 50 ohm m, indicating vesicular / zeolitic basalt, around Telangwadi, Khandali and Papri. Towards further west, in the central portion of the basin near Asti, Rople and Babulgoan resistivity attains 200 Ohm m.

2.1.5 Geology of fifth layer:-

Resistivity distribution and structure contour map at the top of fifth layer are presented.North and north central portion of the basin has high resistivity (100 to 170 ohm m) and hence, massive basalt occurs in these regions above 450m to 470m above mean sea level. Whereas eastern patch around Telanwadi and Khandali resistivity values are 10 to 40 ohm m indicating saturated weathered and vesicular basalts. Southern and SW part is highly fractured and jointed and is represented by 40 to 60 ohm m resistivity between 370m to 395m above mean sea level.

3. Study of selection of suitable sites for groundwater recharge

- Southern portion of the basin is feasible for groundwater exploration as the resistivity is less than 40 ohm m.
- Also the resistivity less than 40 ohm m in the north central region along, Modnimb and Solankarwadi this area is also suitable for groundwater recharge.
- First layer having the surface rainwater harvesting structures like percolation tank, compartment bunding and parallel trenches in high ground area are used for rainwater harvesting.
- For third layer around Asti, Solankarwadi, and Narayanchincholi. Moderatly feasible area of Sus basin is southern zone along BabulgoanRopale and Tungat. Similarly in the north eastern side of the basin around Shidhewadi and most part of Asti in the central part of the basin.

- The fourth layer feasible area is found in the north around Papri, Solankarwadi and Shiddewadi and in the eastern zone around Papri and khandali
- Feasible sites for groundwater exploration at fifth layer are found in the eastern part around Khnadali and Telangwadi.
- Rainwater harvesting at third, fourth and fifth layer dug well and tube well recharge structures are used.

4. Result and Discussion

- Layer wise moderately feasible and feasible areas for groundwater have been demarcated with the help of modeling studies.
- At any location in the basin if one desires to know the groundwater condition it is possible to tell with the above studies.
- Moderately feasible and feasible areas for groundwater development are demarcated.
- Sites for artificial recharge demarcated and suggest the different structures at different layers where applicable.
- Therefore geophysical (electrical resistivity)studies for sustainable development of groundwater in Sus basin, Solapur district, Maharashtra, India is a useful tool for groundwater management and satisfies the social cause to overcome water scarcity.

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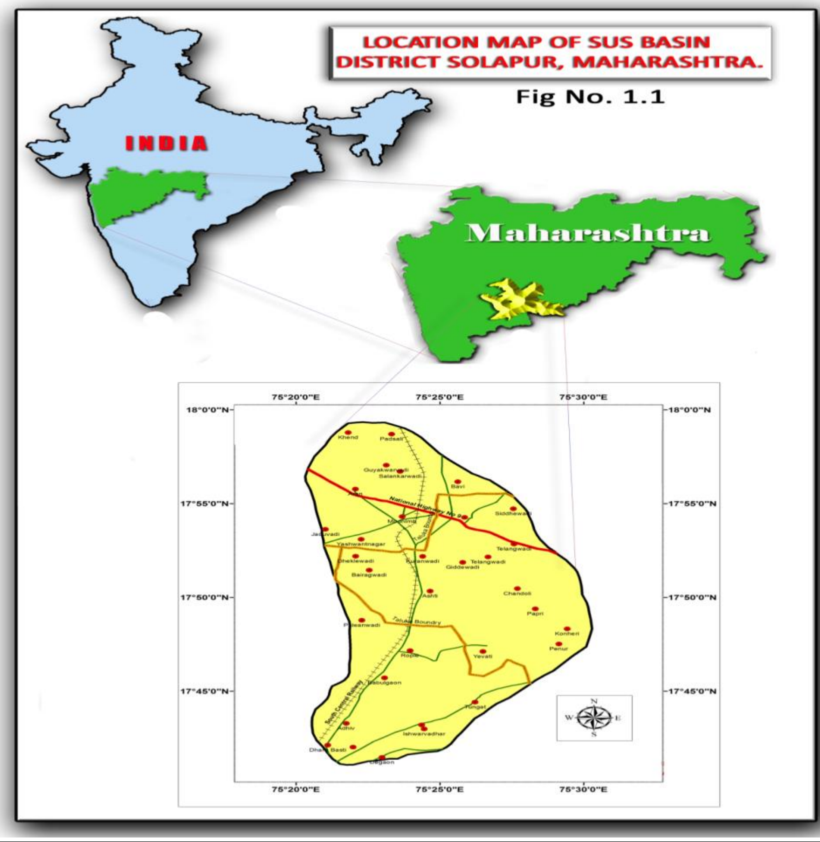


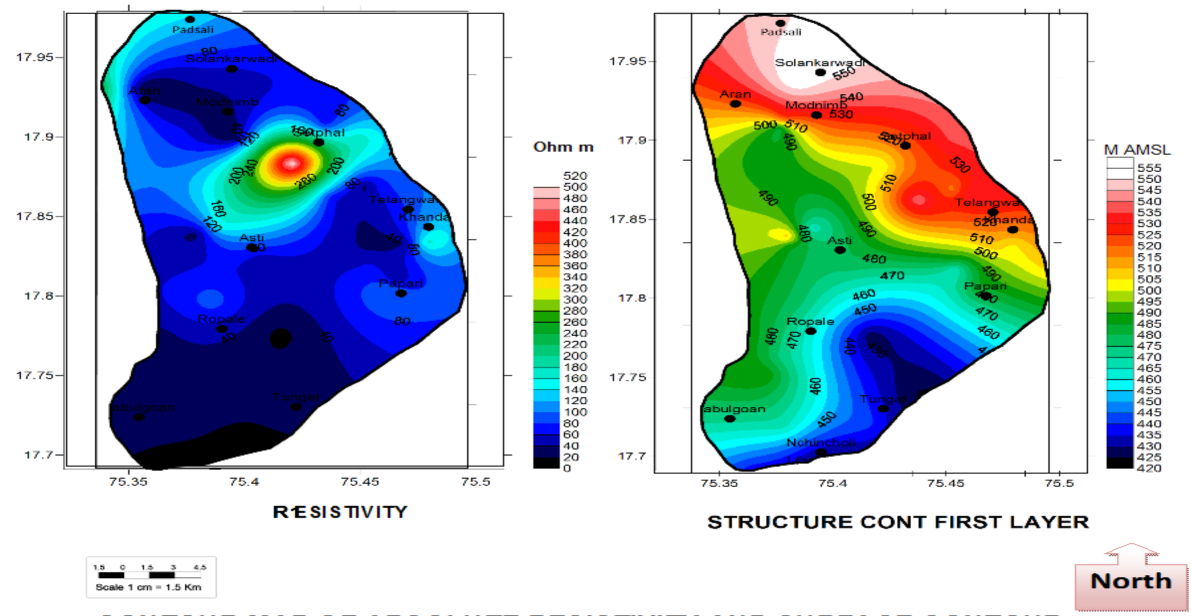


Fig.No. 2 CONTOUR MAP OF ABSOLUTE RESISTIVITY AND SURFACE CONTOUR MAP OF FIRST LAYER IN SUS BASIN, SOLAPUR DISTRICT

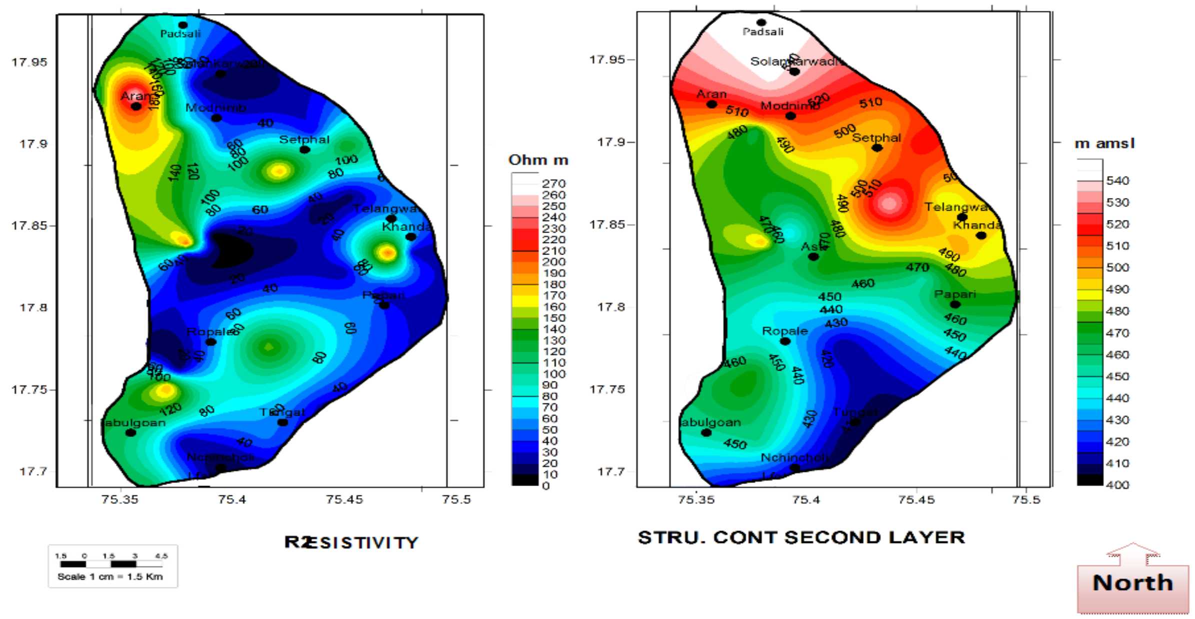
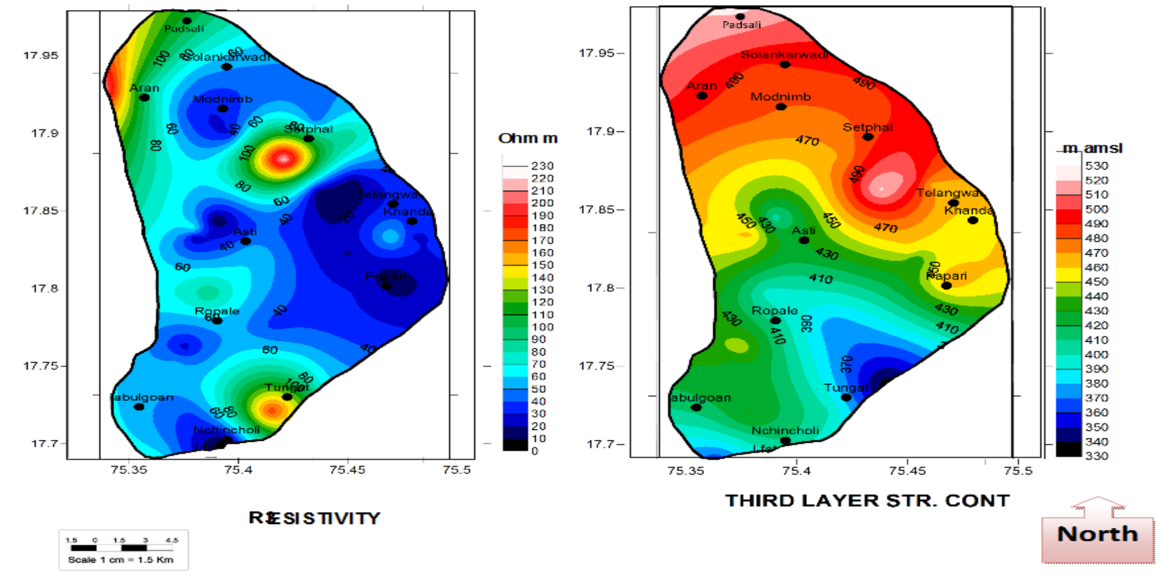


Fig. No. 3 CONTOUR MAP OF ABSOLUTE RESISTIVITY AND SURFACE CONTOUR MAP OF SECOND LAYER IN SUS BASIN, SOLAPUR DISTRICT



CONTOUR MAP OF ABSOLUTE RESISTIVITY AND SURFACE CONTOUR MAP OF THIRD LAYER IN SUS BASIN, SOLAPUR DISTRICT

Fig. No. 4

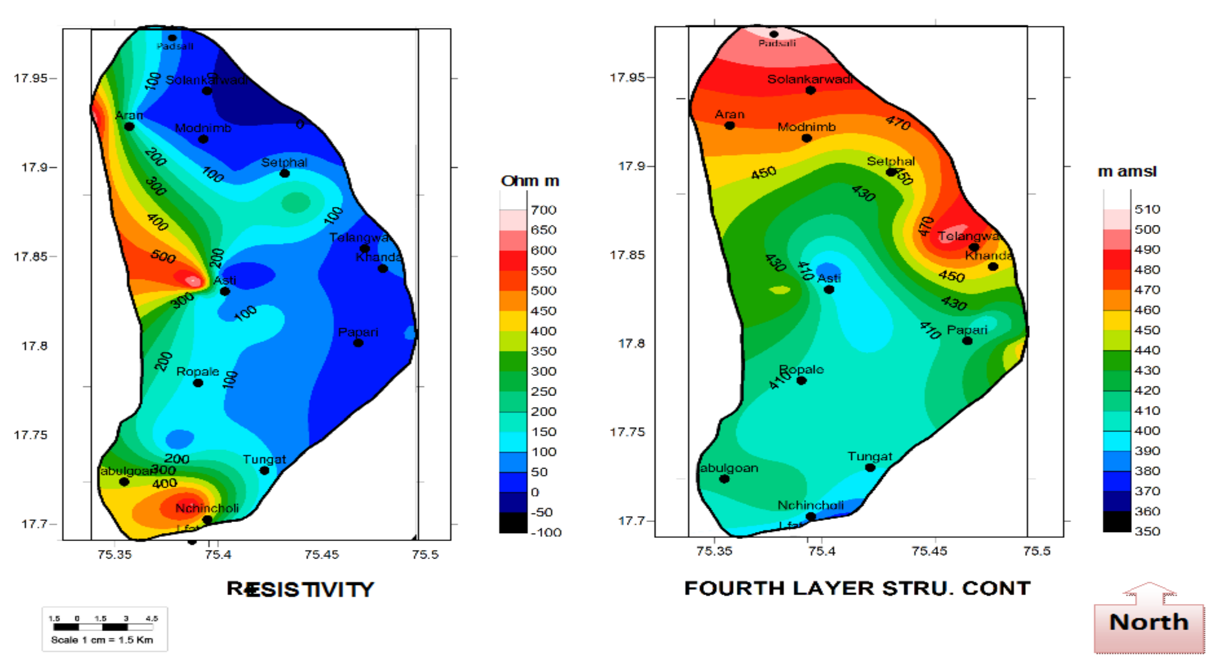


Fig. No. 5 CONTOUR MAP OF ABSOLUTE RESISTIVITY AND SURFACE CONTOUR MAP OF FOURTH LAYER IN SUS BASIN, SOLAPUR DISTRICT

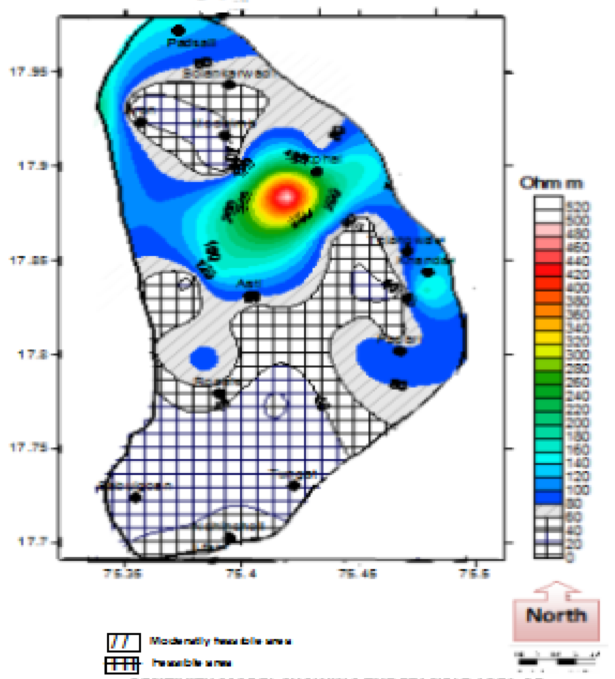
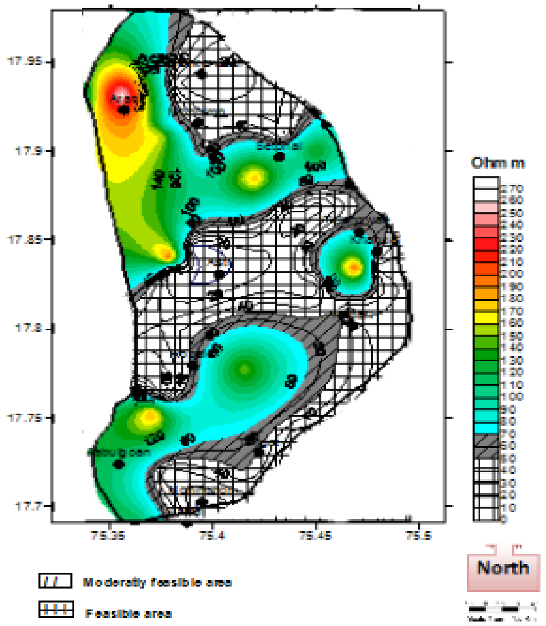
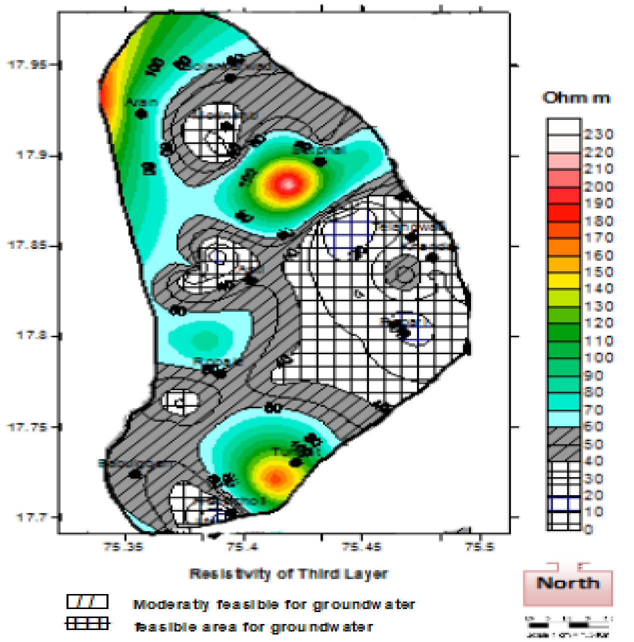


Fig. No. 6 RESITIVITY MODEL SHOWING THE FEASIBLE AREA OF FIFTH LAYER IN SUS BASIN FOR GROUNDWATER DEVLOPMENT



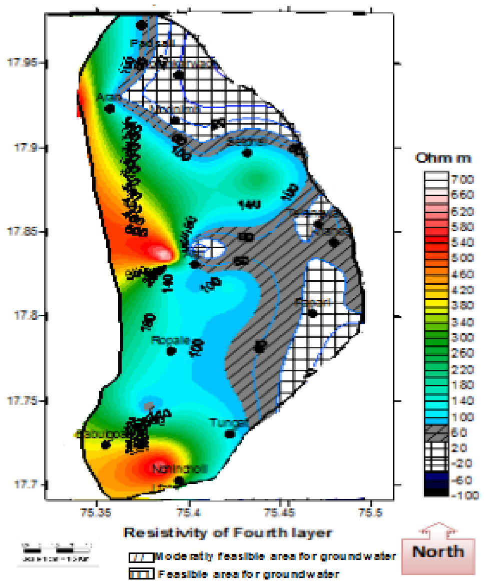
RESISTIVITY MODEL SHOWING THE FEASIBLE AREA OF SECOND LAYER IN SUS BASIN FOR GROUNDWATER DEVLOPMENT

Fig. No. 7.



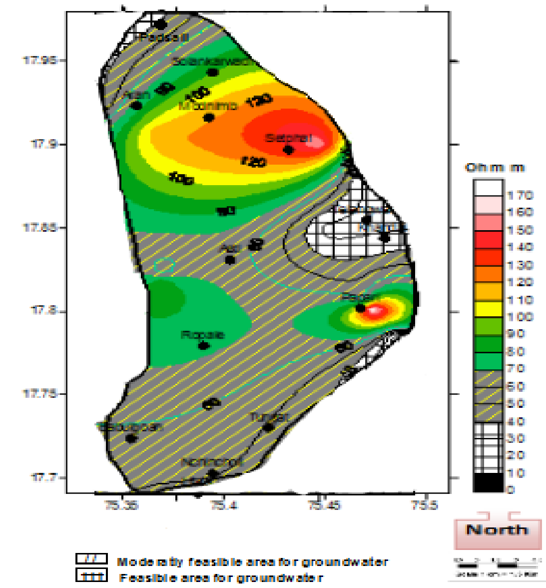
RESISTIVITY SHOWING THE FEASIBLE AREA OF THIRD LAYER IN SUS BASIN FOR GROUNDWATER DEVLOPMENT

Fig. No. 8



RESISTIVITY MODEL SHOWING FEASIBLE AREA OF FOURTH LAYER IN SUS BASIN FOR GROUNDWATER DEVLOPMENT

Fig. No. 9



RESISTIVITY MODEL SHOWING FEASIBLE AREA OF FIFTH LAYER IN SUS BASIN FOR GROUNDWATER DEVLOPMENT

Fig. No. 10