https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

GROUNDWATER – QUARTZITE AREA STUDY USING SQUARE ARRAY METHOD IN PUTHUKOTTAI, TUTICORIN DISTRICT, TAMILNADU, INDIA.

A. Antony Ravindran[1*], S. Muthusamy[1], G.M. Moorthy[1], J. Vinothkingston[1], P. Mohana[2]

[1] Deparment of Geology, V.O.Chidamabaram College, Thoothukudi, Tamil Nadu, India
(Affiliated to manonmanium sundharnar University, India)

[2]*Centre for Remote Sensing and Geoinformatics, Sathyabama University, Chennai, India*

Email: antonicogeo@gmail.com,

Keywords: *Groundwater, Resistivity, Square array method, Quartzite, Puthukottai*

ABSTRACT

The aim of the study is to describe the principles and practices of the Azimuthal square array electrical resistivity method for groundwater potential zone identification in Puthukotai, Thoothukudi District. The geophysical properties of rocks were used in the aquifer study in the Quartzite ridge. The study area covered by black and red soil, gravel, Kankar, Quartzite and weathered gneiss and Charnockite in the study area. The azimuthal square array electrical resistivity (DC) surveys were carried out in fifteen profiles. The surveys were carried out using the help of the equipments CRM-500 Aqua meter, electrodes and wire spools with accessories. From the electrical resistivity study the water bearing zone occurs at a depth of 30m and 50m and 70m that range of apparent resistivity from 100-120 Ohm's in hard rock area. This is a suitable method for aquifer investigation for agricultural and domestic uses.

Citation: *A. Antony Ravindran, S. Muthusamy, G.M. Moorthy, J. Vinothkingston, P. Mohana (2018). Groundwater – Quartzite Area Study Using Square Array Method In Puthukottai, Tuticorin District, Tamilnadu, India. International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281 Vol 1, Issue 10, December, 2018, #Art.1016, pp 43-54*

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Introduction

The present study to focus the square array method and it is used for groundwater potential zone in puthukottai, Thoothukudi. The previous study about geophysical method and groundwater exploration was discussed by Busby. J.P. (2000), Dobrin M.B., and Savit C.H., (1988). Karanth K. R (1987), Meidav T (1960), Parasnis D. S (1997), Reynolds J. M. (1995). The square array method and it is application was studied by Habberjam, G.M. 1972, Habberjam, G.M., and Watkins, G.E. 1967, Habberjam, G.M.1975. Habberjam, G.M.1979, Ravindran, A. A. (2012). The study area choosen was in between in and around area of Puthukottai Quartzite ridge, Thoothukudi District, Tamilnadu. The in-between place was covered by recent alluvium with marine deposit reported (Figure.1).

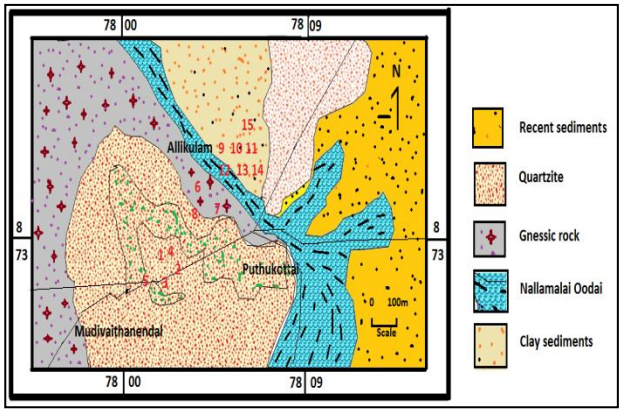

Figure. 1. Location map of the study area.

Thoothukudi district is one of the important coastal districts of Tamil Nadu State. The district is located between 8^0.19' and $9^0$20'N Latitudes and $77^0$40' and $78^0$10'E Longitudes. The northern border of the district is bounded by Virudhunagar district and the Western, Southern and Southwestern parts are covered by Tirunelveli district. The Eastern part of the district is bordered by the Gulf of Mannar. The selected study area a hillock which might have a genetic relation relict mountain (Western Ghats). We studied area structurally and stratigraphically. The surveys were done by brunton compass. The area studied was puddukottai region. It is separated hillock which is about 15kms west of Tuticorin. The area situated at a longitude of 78 west and latitude about 9 North of equator. The area we studied is complicated and irregular having a central peak and valleys present in the eastern and northern part of the area. Numerous irregular raises and falls area also present. The peak has a height of 11.mrs with steep slope in the eastern side. One valley is down streams towards west and another one towards the south. Small red dunes are also noticed. Thus the topography known, highly irregular.

Lithology and rock types:

The entire area is made up of Quartzite formation with a capping of red soil at some exposures. Weathering denudation is caused by physical and chemical process. Alteration of surface material mainly under the influence of air, moisture, temperature and the organisms present in the soil. Chemical weathering takes place through hydration, oxidation and reduction processes. Unaltered materials and rock fragments are the product which is transformed into soil by the action of organisms.

Mainly two types of soils are obtained and their residual and transformed. The first one is derived in-situ from the rock present in the area and second is brought in by flowing water over the wind from elsewhere. The colors of the soils are red, due to the oxidation of iron bearing minerals.

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Structural features:

The area that we have studied is a doubly plunging anticline. The limbs are dipping either side of fold axes in the direction of N45°W and S45°E. The fold axis striking in the direction of N45°E and plunging towards N45°E and S45°W with an amount of 30°. The limbs are in some area refolded and faulted. The limbs are dipping asymmetrically. The older formation was noted in the central (figure2. 1-2.4).

Fig.2.1. folded structure in Quartzite ridge

Figure.2.2. dipping of quartzite

Figure.2.3. weathering of quartzite

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Figure.2.4. Weathered fall of quartzite rock

Methods And Materials:

In the present study, the main aim of the investigation through Electrical Resistivity, Square Array method is used to measure the apparent resistivity of the selected locations, for subsurface condition. To determine depth wise soil types in different direction in the subsurface of the locations in the study area.

(i) To Use of a Square-Array direct-current resistivity method to detect shallow coastal aquifer in the study area.

(ii) To identify the groundwater level in the study area.

(iii) To study the quality of fresh or saline nature of the groundwater.

(iv) To find the aquifer condition using electrical resistivity method.

The Resistivity.

The survey field data was collected from the site using an Azimuthal square array and CRM 500 Aqua meter with four electrodes and four wire spool with accessories (Figure3).

Figure.3. Show the Electrical Resistivity data collection for groundwater.

Results and Discussion:

The depth sounding curve is plotted between apparent

https://doi.org/10.31426/ijamsr.2018.1.10.1016

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

resistivity and 'A' spacing. Plotting of 'A' spacing versus apparent resistivity values obtained from alpha, alpha', beta', beta' orientation implies the horizontal resistivity zones. In the square array, 'A' spacing is equal to the depth.

In the plot of the 1st location, we observed that there is a sudden decrease of resistivity values at the depth of 16 m for alpha' orientation and at the depth of 16m for beta orientation. It is an indication of the groundwater. At the depth of 16m all the resistivity curves goes to the peak and indicates the impermeable dry layer which is capable to store groundwater with marine area using contour plot and lithostratigraphical sequence of the Puthukottai Quartzite ridge Fig.4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13,4.14,4.15 and figure 4.16-4.27).

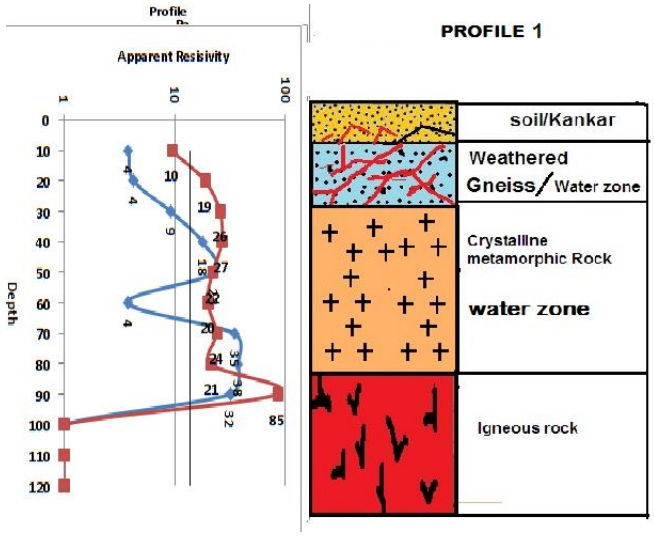

Figure 4.1 Geoelectrical Azimuthal Square Array Resistivity Study For Suitable Freshwater Aquifer Indentification Near Ramachandrapuram Profile 1

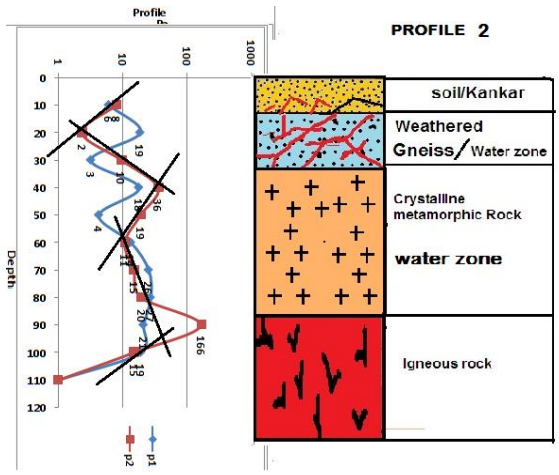

Figure 4.2 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in ramachandarpuram2.

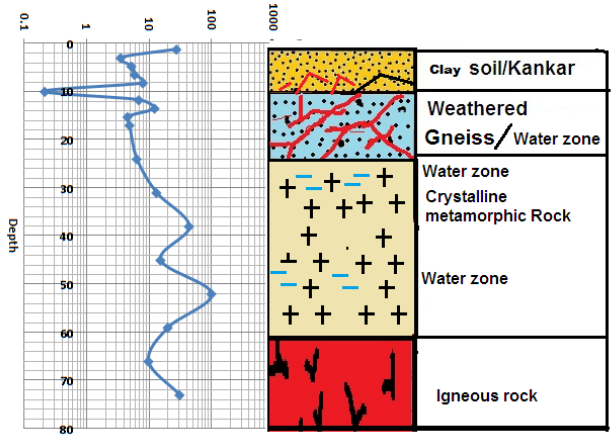

Figure 4.3 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Ramachandarapuram puthukottai 3

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

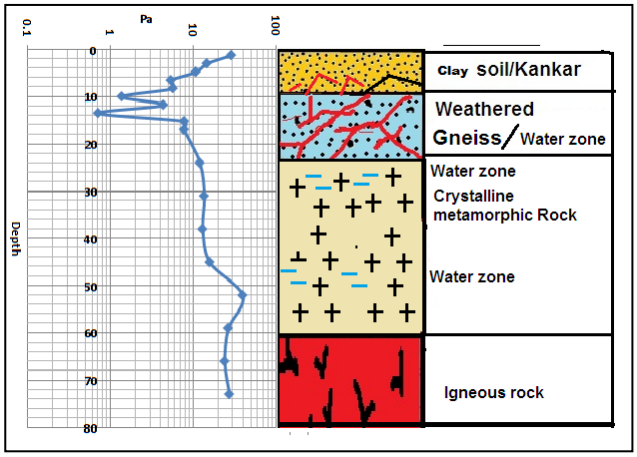

Figure 4.4 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Ramachandarapuram 4 .

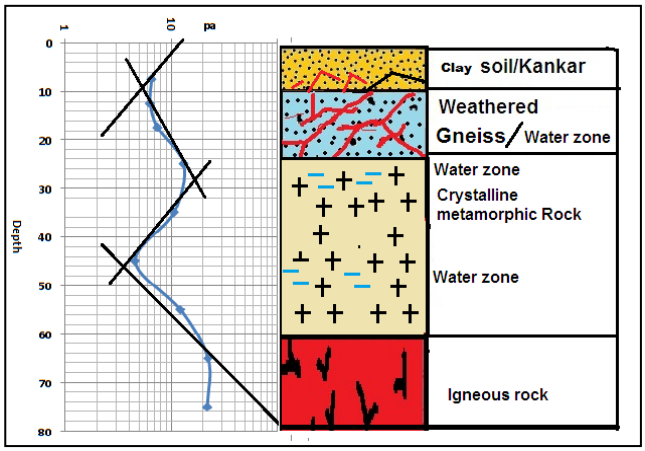

Figure 4.5 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Ramachandrapuram 5.

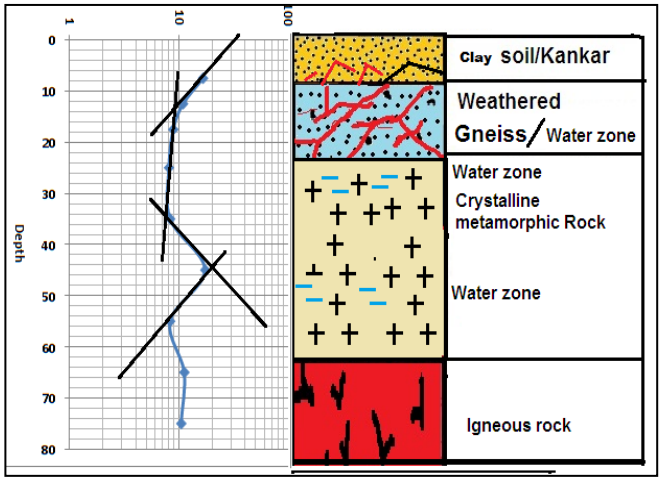

Figure 4.6 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Mangalagiri -6.

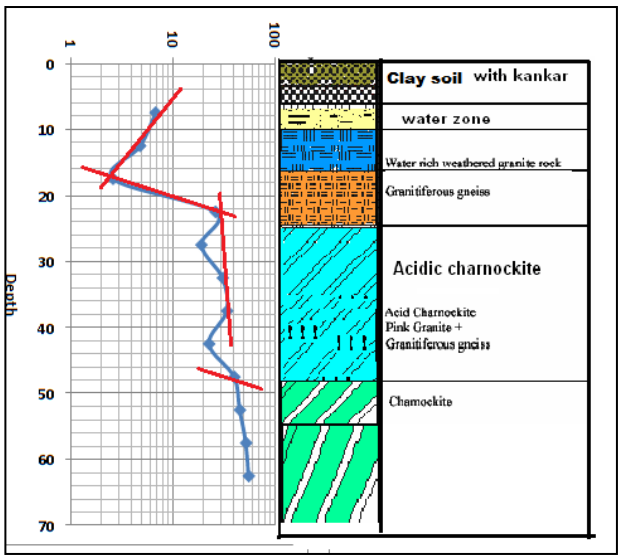

Figure 4.7 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Puthukottai Quartzite ridge Near Mangalagiri 7.

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

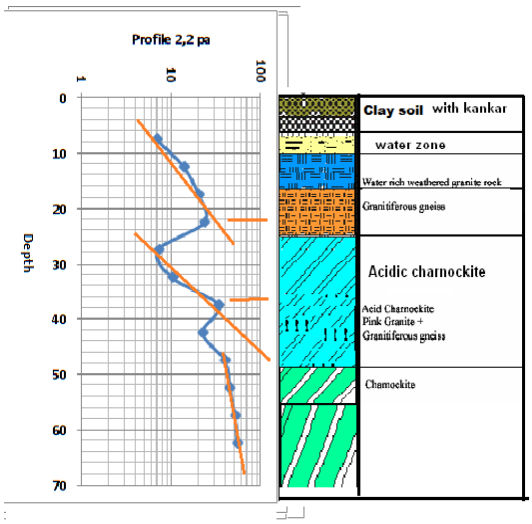

Figure 4.8. Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Mangalagiri -8.

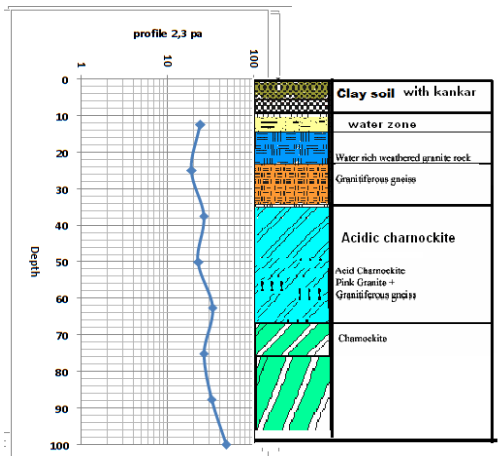

Figure 4.9 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai1-9.

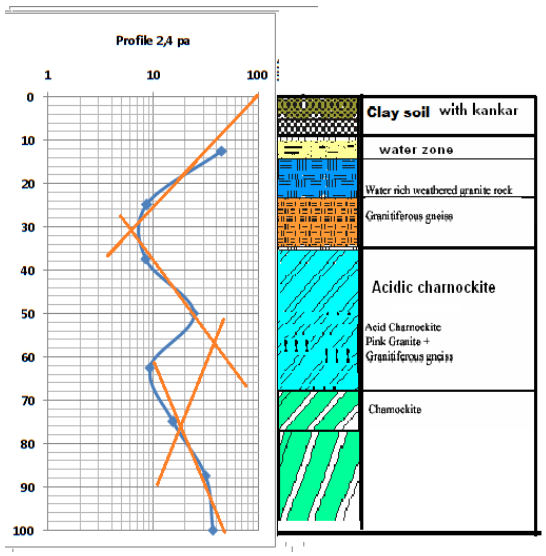

Figure 4.10 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai2-10.

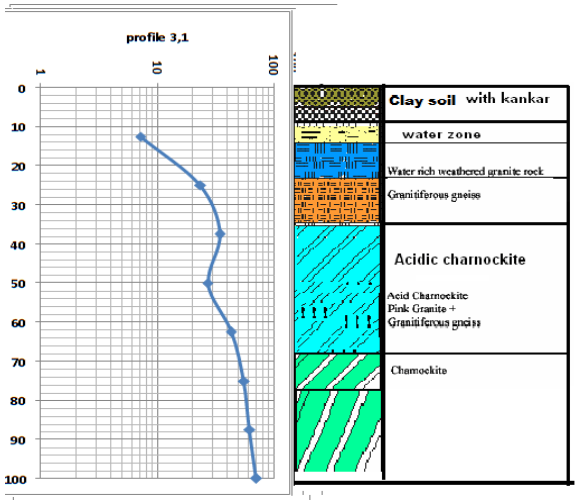

Figure 4.11. Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai3_11.

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

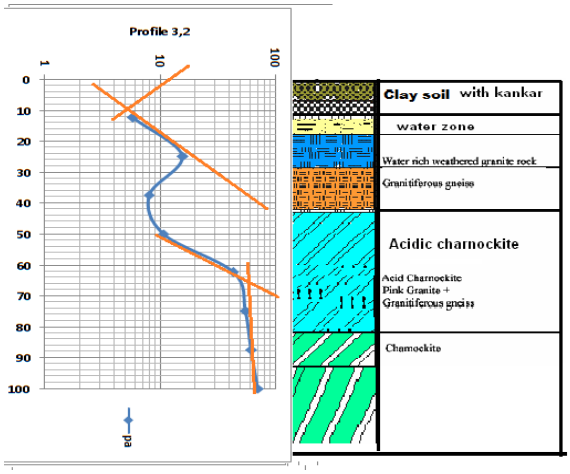

Figure 4.12 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai4_12.

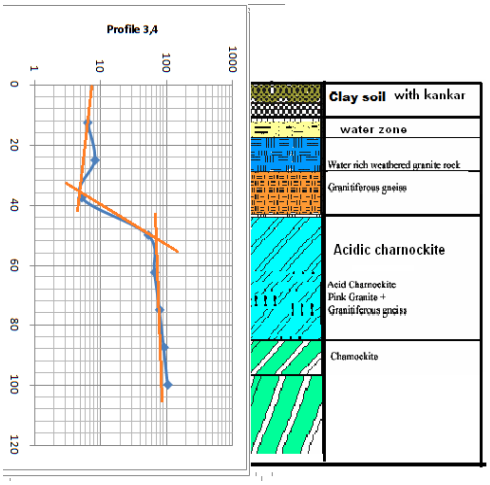

Figure 7.14 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai 14.

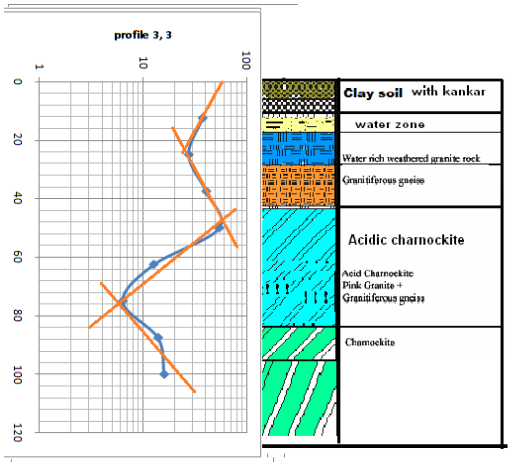

Figure 4.13 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Puthukottai Northern puthukottai_13.

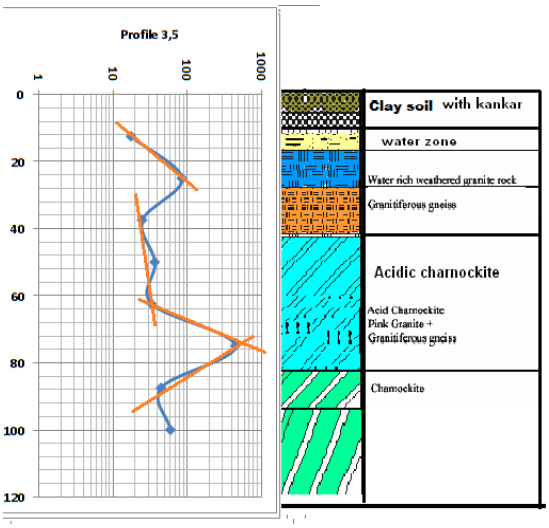

Figure 4.15 Geoelectrical azimuthal square array resistivity study for suitable freshwater aquifer identification in Northern puthukottai -15.

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

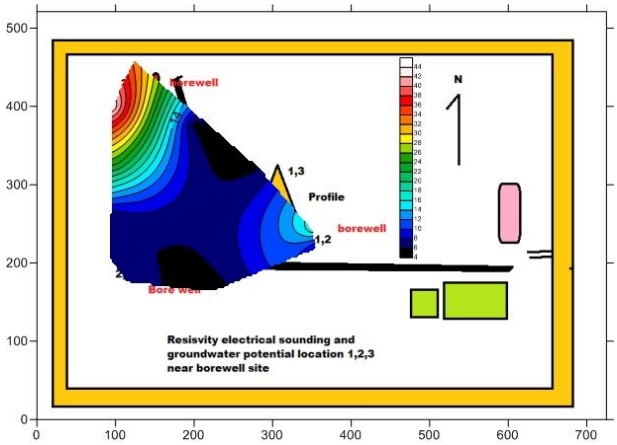

Figure. 4.16. . Shows the resistivity variation in the depth of 10m.

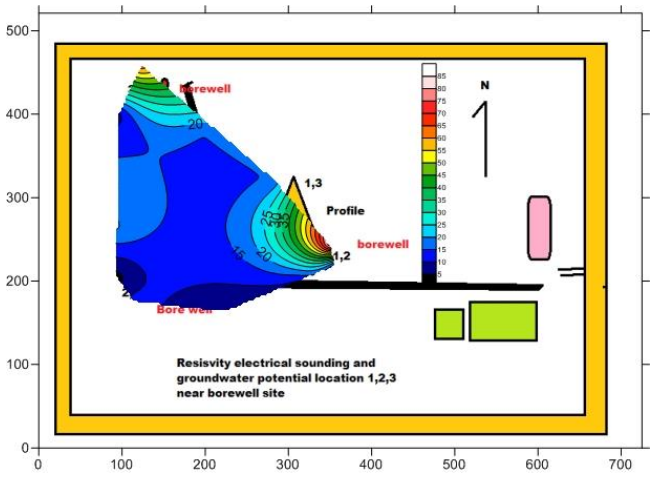

Figure. 4.17. Shows the resistivity variation in the depth of 20m.

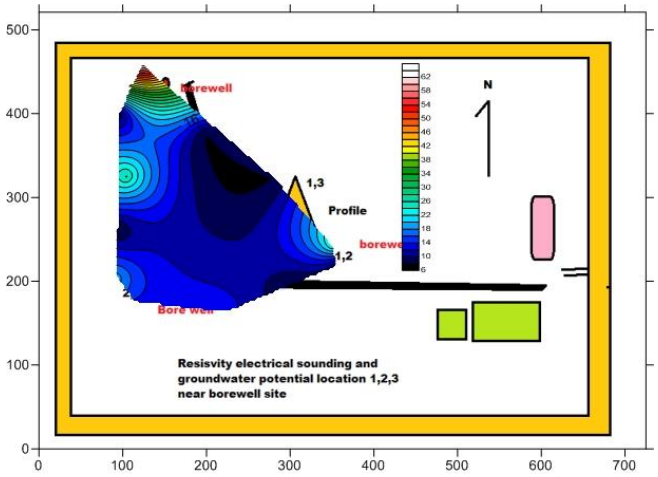

Figure. 4.18 Shows the resistivity variation in the depth of 30m.

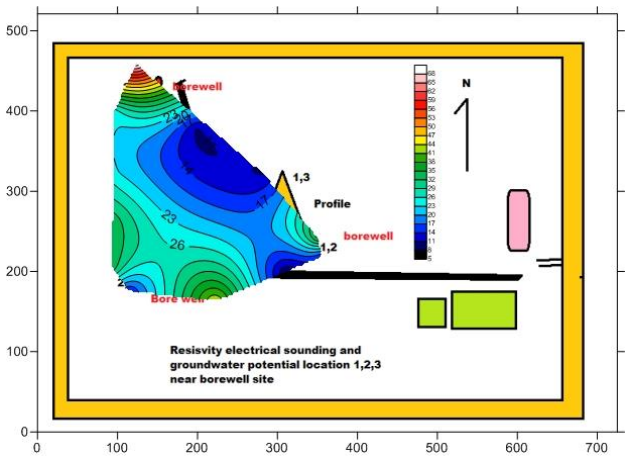

Figure.4.19 Shows the resistivity variation in the depth of 40m.

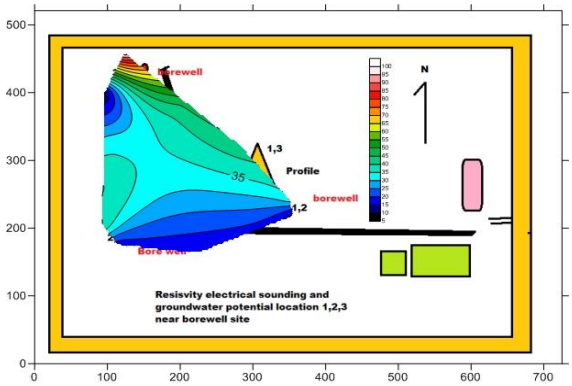

Figure.4.20. Shows the resistivity variation at the depth of 50m

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

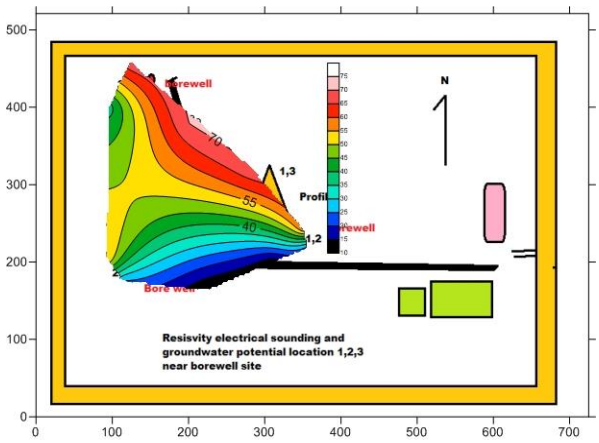

Figure. 4.21 Shows the resistivity variation in the depth of 60m.

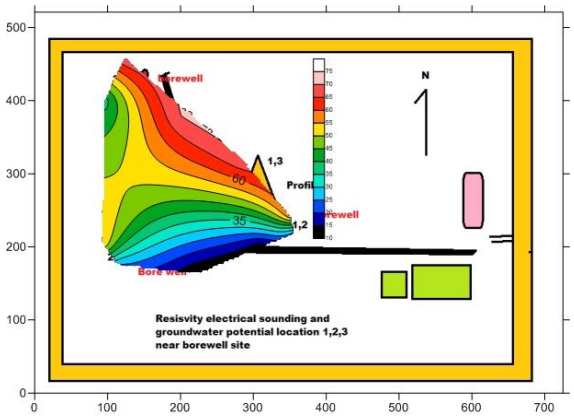

Figure. 4.22 Shows the resistivity variation in the depth of 70m.

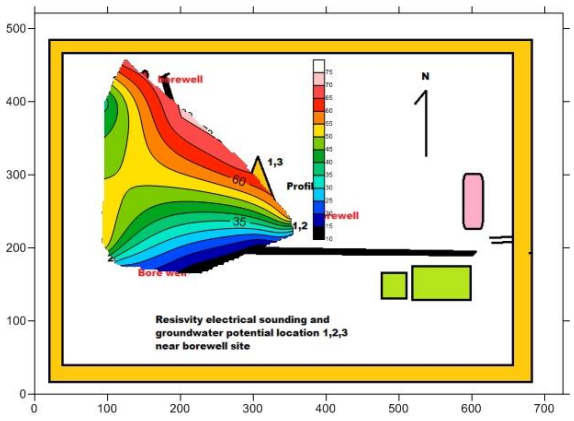

Figure. 4.23. Shows the resistivity variation in the depth of 80m.

Fig.5. shows the Geo electrical resistivity method validated by drilling

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

Geophysical investigations held within the premises of Puthukottai quartzite area, Thoothukudi point to fairly uniform subsurface geological conditions. Coastal marine sands predominantly occur. Hard indurate of Quartzite, calcareous sandstone with shells and ferruginous matter at depth of around 15m. Beneath this formation is also marine sand wherein the present ground water occurs with domestic usage quality. Deep down greater than 70m Groundwater for drinking purpose. As aquifer is shallow level, dug well or bore well upto a depth of 35ft recommend for water extraction.

Geophysical investigations held within the premises of Tuticorin to fairly non uniform subsurface geological conditions. The square array electrical resistivity method curve matching was used to identify the geological layers of clay with calchie, gneiss and Charnockite. The water bearing freshwater zone is identified fresh water zone (120 0hm. m) is identified below zone I - 6m, Zone II - 30m and Zone III 70m. Deep down greater than 25m Groundwater turns more good aquifer yield. As aquifer is shallow level, dug well or bore well upto a depth of 25ft recommend for water extraction and borewell up to 60m depth. The square array method was validated by drilling method in the field site (Figure 5.)

Conclusion:

In this study area, well logging data were compared with VES technique, and an intercalation of clay and loose soils was identified at 2 m depth. However, at a depth of 7 m to 8 m, a seam of consolidated sandstone is encountered, with a comparatively high resistivity value (200 0hm. m). The delineation of saltwater intrusion, the freshwater zone, brackish water zone, and beach ridges based on the contour pattern of apparent resistivity was retrieved from the electrical resistivity method.

The square array electrical resistivity method curve matching was used to identify the geological layers of clay, sand with concrete, and weathered gneiss rock. The water bearing freshwater zone is Identified fresh water zone (120 0hm. m) is identified below zone I - 30m-50m. Deep down greater than 250m Groundwater turns more good aquifer yield. As aquifer is deep level depth is up to 200ft borewell upto 70m depth.

(i) The profile 1, 5, 6, 8, 11, 15 drilling can be done up to a depth of 70m.

(ii) The aquifer in the area at depth of 40m and 70m.

(iii) The top soil covered by sandy soil, sandy clay and sediments.

In this resistivity study or VES (Vertical Electrical Sounding were carried out to predict the depth of soil and rock thickness in the study area. Based on this study is used for drilling for groundwater investigation.

Acknowledgments:

First author expresses his sincere thanks to Mr. A.P.C.V. Chockalingam, Secretary and Principal, V.O.C. College, Tuticorin. The helps extended by Dr. N. Ramanuajam, Professor and Head, Department of Disaster Management, Podicherry University, Andaman. The authors are thankful to them.

https://doi.org/10.31426/ijamsr.2018.1.10.1016

IJAMSR

International Journal of
Advanced Multidisciplinary Scientific Research (IJAMSR) ISSN:2581-4281

References

1) *Antony Ravindran, A. Azimuthal square array configuration and groundwater prospecting in Quartzite Terrian at Edaikkal, Ambasamudram, Tirunelveli. Research Journal of Earth Sciences2012, 4(2), p49-55.*
2) *Busby. J.P.The effectiveness of azimuthal apparent-resistivity measurements as a method for determining fracture strike orientations. Geophysical Prospecting, 2000, 48:4, p677–695.*
3) *Dobrin M.B., and Savit C.H.,). Introduction to Geophysical Prospecting (4th ed.,1988, McGraw – Hill, New York.*
4) *Habberjam, G.M. The effects of anisotropy on square array resistivity measurements. Geophysical Prospectin, 1972.. v. 20, p. 249-266.*
5) *Habberjam, G.M., and Watkins, G.E. The use of a square configuration in resistivity prospecting. Geophysical Prospecting, 1967.. v. 15, pp. 221-235.*
6) *Habberjam, G.M. Apparent resistivity, anisotropy and strike measurements. Geophysical Prospecting, 1975.. v. 23. p. 211-247.*
7) *Habberjam, G.M. Apparent resistivity observations and the use of square array techniques, in Saxov, S., and Flathe, H. (eds.),1979. Geoexploration Monographs. series 1, no. 9, p. 1-152.*
8) *Karanth K. R Groundwater assessment, development and management, 1987,Tata McGraw Hill Publishing Co. Ltd.*
9) *Meidav T (1960), An electrical resistivity survey for ground water, Geophysics, vol. 25(5), pp 1077-1093.*
10) *Parasnis D. S (1997), Principles of applied geophysics, Chapman & Hall, 2-6 Boundary Row, London SE1 8HN, UK.*
11) *Reynolds J. M. An Introduction to Applied and Environmental Geophysics, 1995, John Wiley & Sons, 796 p.*