Delineation Of Groundwater Potential Aquifers with Help of Remote Sensing and Geophysical Methods in Chandur Mandal of Nalgonda District, Telangana State, India

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Abstract— **Remote sensing, Geophysical and Geological surveys were conducted to delineate groundwater potential aquifers in Chandur Mandal, which is a part of Kangal river catchment area about 200.81 km2 in Nalgonda District, Telangana, India. The main litho units in the study area are Granites, Gneisses and Migmatites with intruded Dolerite Dykes. The Sentinal2A Satellite data acquired, processed and interpreted for ground water potential zones in the study area, based on result of remote sensing data, Forty-four Vertical Electrical Soundings (VES) and eight Electrical Resistivity Tomography (ERT) were conducted in Werner and Schlumberger configuration in field. The field data were interpreted with the help of master curves and auxiliary point charts and topography interpretation. The VES and ERI data were used to generate a top layer apparent resistivity contour map, pseudo sections and VES curve map. Resistivity contour maps were prepared and interpreted in terms of resistivity and thickness of various sub-surface layers. Resistivity contour diagrams depicting the depth to bedrock were prepared. Resistivity results were correlated with the existing lithology. Based on the depth to bedrock, the thickness of the layer and resistivity of the layer, groundwater potential map has been prepared, in which good, moderate, and poor zones are classified. The study reveals that the weathered and fractured portions in Granites and dolerite dykes that occur in the southern and central portions of the area constitute the productive water-bearing zones categorized as good groundwater potential aquifers**

Index Terms— **Vertical Electrical Soundings (VES), Electrical Resistivity Tomography (ERT) Electrical resistivity longitudinal conductance, Groundwater potential aquifers, Telangana and India**

INTRODUCTION

Groundwater exploration is most important in India owing to the ever-increasing the demand for water supplies, especially in areas with inadequate surface water supplies. The study area is a chronic drought-prone area in Telangana. Due to differential weathering and fracturing, the aquifers in the hard rock terrain show wide vertical and horizontal variations in their hydrologic characteristics. Many dug wells that were failed in the study area due to without an initial proper investigation and over exploitation. A systematic and scientific approach is essential for the study area in order to overcome these problems.
Hard rock areas are known to yield limited quantities of groundwater due to their mode of origin and the absence of intergranular porosity and infiltration. The extreme drought conditions, depletion of surface water, and large fluctuations in the water table prevailing in hard rock terrains all emphasize the need to locate potential groundwater aquifers in the study area.

THE STUDY AREA

The Chandur and Gattupal Mandals villages (Fig. 1) are covered an area of 200.81 km2, and lies between Latitudes 78°53' -79°6'and 17°6' - 16°54' Longitudes. The Nalgonda annual rainfall -821.0mm and highest monthly rainfall 180mm. The main aim of the current studies involving the Integration and interpretation of Remote Sensing, Hydrological data, Geological and Geophysical data to identifying the potential groundwater aquifers in the study area.

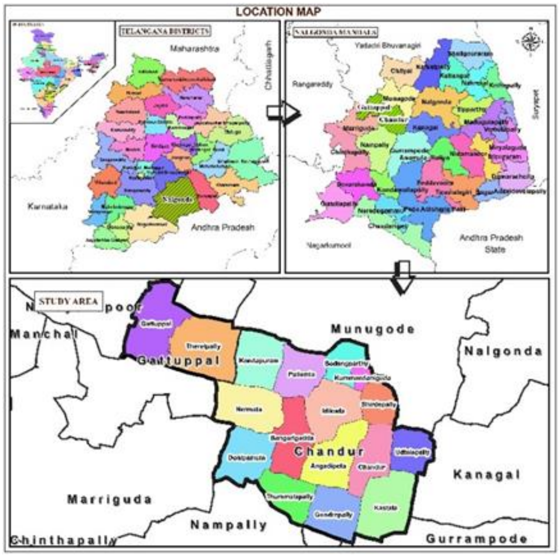


Fig.1. Location map of the study area

The study area is covers in entire Chandur Mandal in Nalgonda district of Telangana state, the area is generally plain with gentile undulating terrain. The general elevation range of the terrain is about 234m to 2584m measea level and the drainage network of the study area dendritic patten from West to East flowing, main river name is Kangal River.

GEOLOGICAL SETTINGS

Base of geological settings considered from the published GSI Geology and updated from the field traverses.

REGIONAL GEOLOGY

Regionally, the Chandur Mandal is covered in Peninsular Gneissic Complex (PGC) of Archean to Paleoproterozoic age belongs to Eastern Dharwar craton. The general trend of the rocks in the area is NE-SW. The area comprises mainly of granitoids which include granite, granodiorite, quartz monzonite and intrusive rocks of Precambrian to Archean age. The ground water occurs in weathered and fractured granite gneisses. These rocks possess negligible primary porosity but by virtue of secondary porosity, due to deep fracturing and weathering, they form potential aquifers and have a zone of weathering with variable thickness ranging from 10 to 20m (Ishrath 2011).

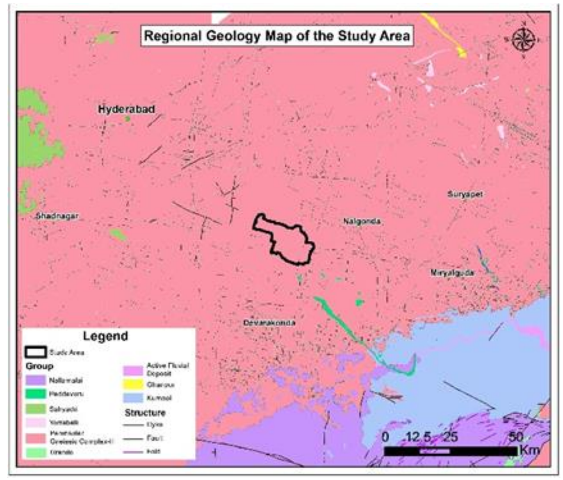


Fig.2. Regional Geology map of the study area

LOCAL GEOLOGY

The study area falls in Peninsular Gneissic Complex (PGC) of Archean to Paleoproterozoic age rocks. The main lithology of the area consists of Granites, Gneisses and Migmatites with intruded Dolerite Dykes. Southwestern part of the area is covered by migmatites and intruded Dolerite dykes are occupied in the eastern part with in the granites to granitic gneiss. In hard compact rock areas grey granite is present elevated area.

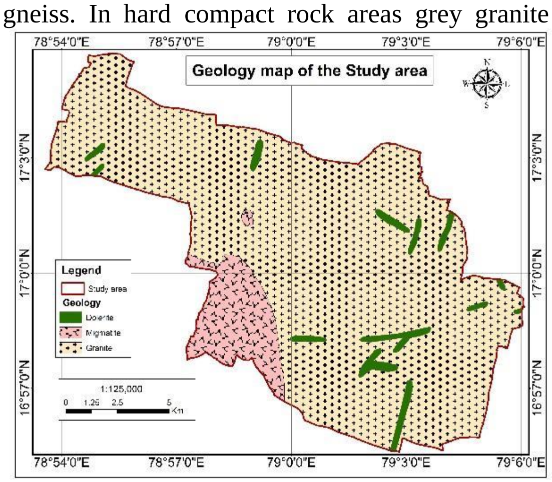


Fig.3. Geology map of the study area

The terrain, geomorphology, structure, fractures and weathering are the most important factors that control groundwater. Discharge areas which are normally low-lying areas are believed to contain much more groundwater than recharge areas which normally coincide with ridges. The poor ground water availability may be due to less subsurface runoff, influent seepage from upland areas, weak structural planes and thick weather mantle.

The granites exist–pink, grey and the granites (Fig.2) (Balakrishana and Rao, 1961Sitaramayya, 1968, 1971) and some pegmatite/quartz patches traversed by narrow white apatite veins, which intersect each other randomly. The dolerite dykes intruded at places host rocks is granite. The general geological section consists of a surficial soil layer underlain by weathered rock, which is in turn followed by the fractured rock at a few places. The basement, occurring at an average depth of 15 m consists of hard impervious granite.

METHODOLOGY

The methodology of the current study is involving the Remote Sensing and Field data acquisition. Digital image processing for spectral enhancement like band math, PCA (Principle Composite Analysis), enhancement zones of hydrothermal alteration (HT) and Mineral composite (MC). Field studies for collecting the Geological data, Vertical Electrical Soundings (VES) data, Electrical Resistivity Tomography (ERT) data using the Werner and Schlumberger configuration. Identification of suitable ground water potential zones by integration and interpretation of the Field data and remote sensing data.

REMOTE SENSING STUDY AND GIS

The database used in the present study is Sentinal-2A (Path T44QKD acquisition is 05th May 2022) and Landsat 8 imagery (Path143/Row048) were captured on December 28, 2023 under excellent weather conditions at <10% of cloud cover of Satellite data from USGS (United State Geological Survey) jointly managed by NASA (National Aeronautics and Space Administration), the Satellite data and ASTER Digital Elevation Model (DEM) are used for lithology, lineament mapping and structural features identification. For preparing of topographic maps (base map) from the Survey of India toposheet data and data of existing hydrogeological map and bore well/tube well data Source from TS Groundwater Department. Based on above mentioned studies to suggested and delineate the ground water potentiality zones.

The digital image processing Involves for the extraction of lithological and linear features, evaluation of digital elevation model (DEM). Preparation map pre field map for verification of satellite data interpreted alteration zones and lithological and linear features verification, which are useful for occurrence of ground water potential. The DEM was used to extract lineaments and to map drainage systems and landforms. The data were integrated and interpreted in Geographic Information System (GIS) and analysed to assess the groundwater controlling features. Finally, groundwater potential maps were prepared based on the GIS analysis.

The interpretation of Sentinal-2A and ASTER Satellite data includes histogram equalization, FCC, Principal Component Analysis (PCA), Hydrothermal Analysis (HT), Mineral Composite Analysis (MC), supervised classification and band rationing were performed and used for preparation of various thematic maps for lithology and lineament mapping were also assessed. More over comparisons of digital elevation models derived from contours and radar interferometry in the Shuttle Radar Topographic Mission (SRTM) were made in relation to location, extraction of drainage networks and linear features this will give the good potential zones of the area. The image processing software Erdas Imagine2017 version 3.5 was used for the remote sensing study. ArcGIS versions 10.4 were utilized for the GIS analysis.

Fig. 4.1 Sentinal-2A Satellite Image map,

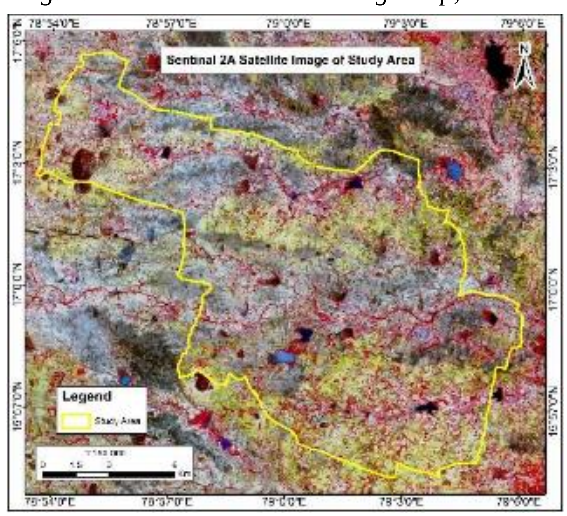
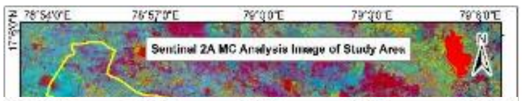


Fig. 4.2 Satellite Image derivative map of Principal Component Analysis (PCA) map.



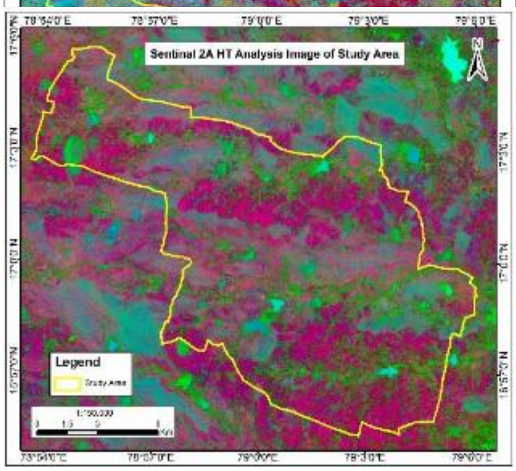


Fig. 4.3 Satellite Image derivative map of Hydrothermal Analysis (HT).

Fig. 4.4 Satellite Image derivative map of Mineral Composite Analysis (MC),

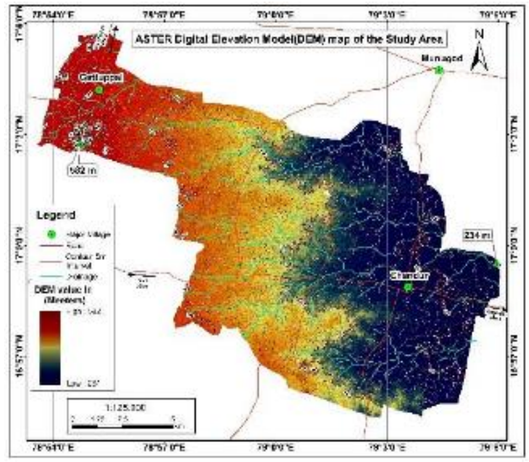


Fig. 4.5 Digital Elevation Model (DEM) map

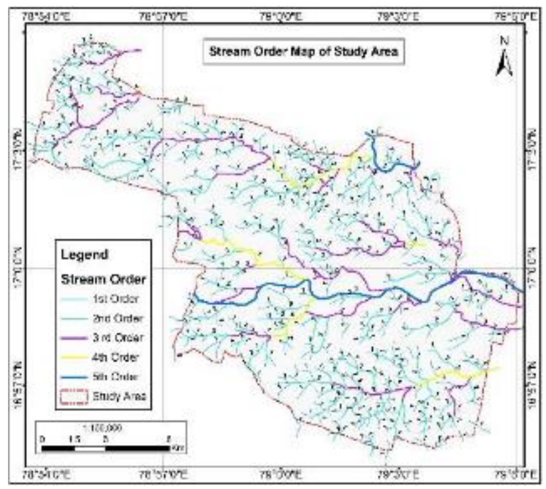


Fig. 4.6 Stream order map of the study area.

RESULT OF REMOTE SENSING

Geological, Geomorphological feature are identified on the satellite imagery using their characteristic tone/colour, texture, landform and drainage patten. Based on the satellite data characterisation the ground water possible potential zones are demarcated with comparison of existing geological formations zone are Northen part, central part and eastern parts are favourable for possible potential of ground water. The south part is moderately favourable for possible potential of ground water, western part is limited favourable for possible potential of ground water. The weathered and fractured portions in Granites and dolerite dykes that occur in the southern and central portions of the area constitute the productive water-bearing zones categorized as good groundwater potential aquifers.

GEOPHYSICAL SURVEYS

The aim of the geophysical survey is to investigate subsurface geological formation on the basis of remote sensing alteration zones. Vertical Electrical Resistivity Survey (VES) and Profiling Wenner-Schlumberger array are were carried out in the study area for identification ground water bearing zone with corresponding depth.

THE VERTICAL ELECTRICAL RESISTIVITY SURVEY (VES)

The Vertical electrical resistivity method, of all the surface geophysical methods, has been applied most widely in groundwater exploration studies (Todd 1995). The literature available on electrical resistivity prospecting is described in various books (Keller and Frischknecht 1966; Bhattacharya and Patra 1968; Zhdanov and Keller 1994; Appa Rao 1997). The electrical resistivity method can be best employed to estimate the thickness of overburden and also the thickness of weathered/fractured zones with reasonable accuracy. Though both Wenner and Schlumberger electrode configuration methods are popularly employed, the Schlumberger electrode configuration method is more suited to the study area, ensuring better results. The method has practical, operational, and interpretational advantages over other methods such as the Wenner method of electrode arrangement (Zohdy and others 1974; Bhimasankaram andGaur 1977). An indigenous portable D.C. earth resistivity meter was used for electrical probing. The Schlumberger electrode configuration was employed, with a maximum current electrode (AB/2) separation of 90 m. In the Schlumberger method, the four electrodes are arranged in such a way that the distance between the two inner potential electrodes (P) is kept small compared to the distance between the outer current electrodes (C), while making sure that all of the four electrodes are placed along a straight line.

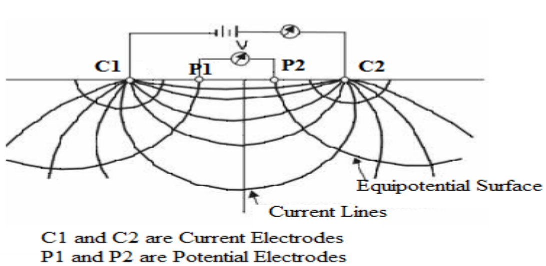


Fig. 5 Wenner-Schlumberger array of Vertical electrical resistivity method.

PROFILING WENNER-SCHLUMBERGER ARRAY

This is a new hybrid between the Wenner and Schlumberger arrays (Pazdirek and Blaha 1996) arising out of relatively recent work with electrical imaging surveys. The classical Schlumberger array is one of the most commonly used arrays for resistivity sounding surveys. A modified form of this array so that it can be used on a system with the electrodes arranged with a constant spacing is shown in Figure 10b. Note that the “n” factor for this array is the ratio of the distance between the C1-P1 (or P2-C2) electrodes to the spacing between the P1-P2 potential pair. The sensitivity pattern for the Schlumberger array is slightly different from the Wenner array with a slight vertical curvature below the centre of the array, and slightly lower sensitivity values in the regions between the C1 and P1 (and also C2 and P2) electrodes. There is a slightly greater concentration of high sensitivity values below the P1-P2 electrodes. This means that this array is moderately sensitive to both horizontal and vertical structures. In areas where both types of geological structures are expected, this array might be a good compromise between the Wenner and the dipole-dipole array. The median depth of investigation for this array is about 10% larger than that for the Wenner array for the same distance between the outer (C1 and C2) electrodes. The signal strength for this array is smaller than that for the Wenner array, but it is higher than the dipole-dipole array.

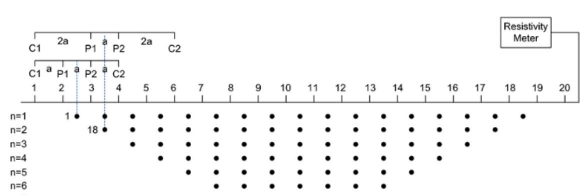


Fig. 6 Wenner-Schlumberger array of profiling resistivity method.

GEOPHYSICAL DATA ACQUISITION AND ANALYSIS

Vertical electrical sounding is the study of resistivity variation with depth at a given location and gives information about the depth and thickness of various subsurface layers and their potential for groundwater. A Total number of 43 soundings points are selected for VES in Study Area among these points were selected in traverse manner and profiling conducted at the same location were sounding point. Sounding and proofing are done in N-S direction and also in azimuthal. The depth surveys by the VES are in Schlumberger arrangement and Profiling Wenner-Schlumberger arrangement the centre of electrodes are kept fixed, but the distance between current electrodes is increased until the maximum desired depth of penetration is reached. Usually, the measurements of apparent resistivity are carries out until the bed rock is touched, which is indicated 45° line in the graph of apparent resistivity values. The VES is in Schlumberger array separations of potential electrodes are taken as MN/2 = 2m, 5mand the separations of current electrodes are AB/2=3m (Min) - 100m (Max). The apparent resistivity values are plotted against the current electrode separation AB/2 on the double log paper as AB/2 values on the X-axis and obtained values of resistivity on Y-axis are plotted. The points are joined to yield a smooth curve. The Profiling Wenner-Schlumberger arrangement separations of potential electrodes are taken as MN/2 = 5m is fixed and the separations of current electrodes are AB/2=10m (Min) - 90m (Max). The apparent resistivity values are plotted against the current electrode separation AB/2 in the software.

The curves are interpreted quantitatively with the help of master curves Res2dinv and IPI2WIN Software using the direct and partial matching techniques. This interpretation includes determination of resistivity and thickness of those layers. The results are given in Table: 1

INTERPRETATION

The quantitative interpretation and quantitative interpretation of the geophysical data involves, the classification of vertical electrical sounding and profiling depth of horizontally layered earth model with a significant electrical contrast between the layers was assumed. The lithological identification based on the resistance where we acquired the data Interpretation of top soil cover, weathered zone, fracture, semi hard rock and Solid hard rock of the study area. The VES and Profile data were analyzed with curve matching techniques and available electrical interpretation software to estimate the apparent resistivity and thickness of the various layers comprising the subsurface. In most cases a five-layered subsurface was indicated – a first layer of topsoil (red, Black & loamy red), a second layer is weathered zone (morum + soil) characterized by moderate resistivity values, a third layer is semi hard rock (morum + gravel) characterized by moderate to high resistivity values, a fourth layer of fractured/weathered zone exhibiting resistivity ranging from low to high and lastly, the solid hard rock basement that is associated with hard rock and very high resistivity ranging to infinity. The water-bearing capacity (porosity and permeability) below the basement is insignificant.

RESULTS AND DISCUSSION

GEOPHYSICAL SURVEY

The results from four resistivity probes conducted in close proximity to forty-four sounding and eight profile with 2 km to 4 km length in different depth of formations have been correlated with the known lithology.

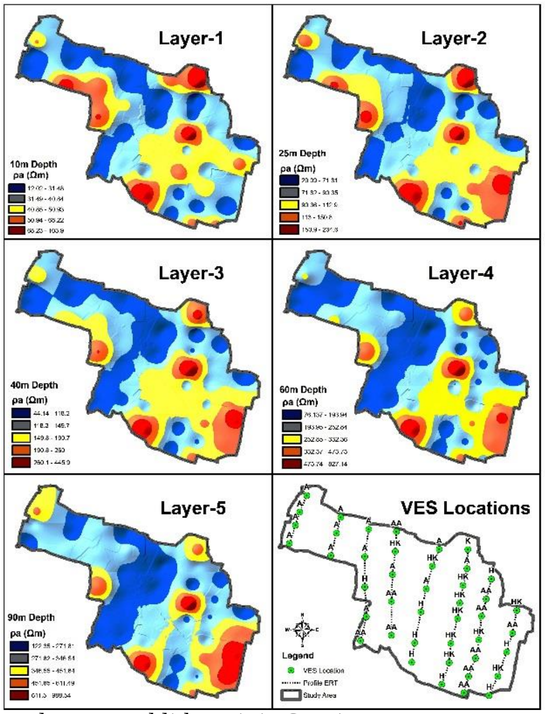
VERTICAL ELECTRICAL SOUNDING

The total No. of 43 VES sounding data were used to estimate the apparent resistivity and thickness of the layers constituting the subsurface.

The result of vertical electrical sounding type-A are VES-1, VES-2, VES-3, VES-4, VES-5, VES-6, VES-7, VES-8, VES-9, VES-11, VES-15, VES-18, VES-20 and VES-25 these curves are covered in western and Northwest part of the study area and lithounits are Granite and Dolerite Dyke. The sounding type-AA are VES-12, VES-13, VES-16VES-17, VES-33, VES-34, VES-36, VES-37, VES-38, and VES-40 these curves are covered in Eastern and South-Western part of the study area and lithounits are Granite, Migmatite and Dolerite Dyke.

The sounding type-HK are VES-14, VES-19, VES-26, VES-27, VES-28, VES-29, VES-30, VES-35, VES-39 and VES-42 curves are covered in Central portion of the study area and lithounits are Granite and Dolerite Dyke. The sounding type-H are VES-10, VES-21, VES-22, VES-23, VES-31, VES-32, VES-41 and VES-43 curves are covered in south and South-

Eastern portions of the study area and lithounits are Granite and Dolerite Dyke. The sounding type-K is VES-24 curve is located in North-Eastern part of the



study area and lithounit is Granite.

Fig. 7.1 Layer-1 Resistivity of 10m depth Map, Fig. 7.2 Layer-2 Resistivity of 25m depth Map, Fig. 7.3 Layer-3 Resistivity of 40m depth Map, Fig. 7.4 Layer-4 Resistivity of 60m depth Map, Fig. 7.5 Layer-5 Resistivity of 90m depth Map, Fig. 7.6 Layer-6 Location map of VES sounding and Resistivity Profiling Map.

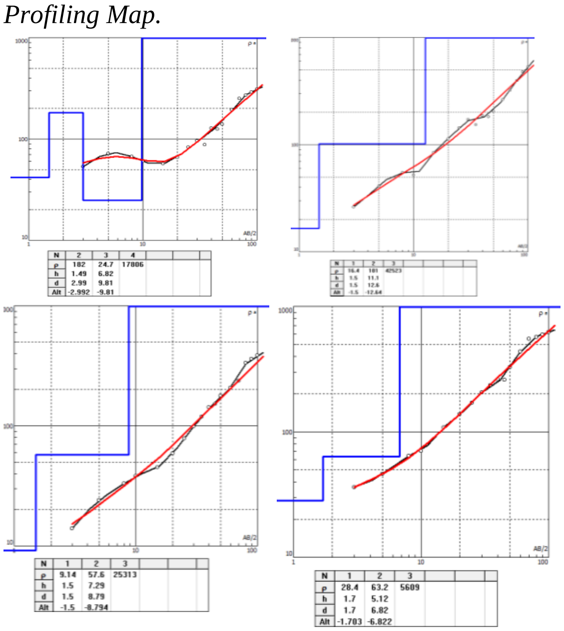


Fig. 8. Typical Interpreted VES Curves.

The results from soundings indicate four layers with absolute resistivity of top soil cover, weathered zone, fracture, semi hard rock and solid hard rock, respectively, for the first three layers are high resistivity, and the bottommost layer has very high resistivity. The average depth of the wells are 25 m, and the **first layer ρ1** resistance between 12.02 Ωm to 103.9 Ωm, correlates to the top soil, which extends down depth of 0. between 29.09 Ωm to 234.6 Ωm the 5m to 10m from the surface.

Latitude	Longitude	Type of Curve	ρ_1 (Ωm)	ρ_2 (Ωm)	ρ_3 (Ωm)	P_4 (Ωm)	$h_1 m$	$h_2 m$	$h_3 m$	Basement H
17.087650	78.915815	A	9.14	57.6	25313		1.5	7.29		8.7
17.074044	78.909998	A	16.4	101	42532		1.5	11.1		12.6
17.063427	78.906653	A	2.13	1449	807		1.5	71.2		72.7
17.048498	78.901604	A	2.28	7232	1614		1.5	66.5		68
17.069783	78.943511	A	13.4	25.1	28929		1.5	7.59		9.09
17.056837	78.940185	A	10	18080			3.3			3.37
17.038514	78.935480	A	28	384	24536		2.3	66.1		66.3
17.060007	78.966457	A	4.2	10848	2421		1.5	17.6		19.1
17.037750	78.963241	A	26.7	181	44152		3.42	23.4		26.9
17.012862	78.963247	H	28.4	63.2	5609		1.7	5.12		6.82
16.988526	78.964579	A	2.16	14449	807		1.5	71.2		72.7
16.968909	78.959840	AA	1.09	3349	807		1.5	139		40.2
17.058087	78.989113	AA	4.95	7569			2.87	27		27
17.041830	78.988193	HK	15973	4034			71.8			73.3
17.023052	78.985949	A	25007	216			4.18			5.63
17.001000	78.985000	AA	7.41	987			2.91			2.91
16.973300	78.985000	AA	47.3	835			12			13.5
17.043782	79.024136	A	182	24.7	17806		1.49	6.82		9.81
17.029853	79.018515	HK	17.4	19888			10.7			12.2
17.011250	79.013467	A	18.6	11.8	490		4.09	3.46		7.55
16.992382	79.009197	H	5.49	62507	874		1.5	23.7		25.2
16.967053	79.004091	H	13.5	25.1	17566		1.78	3.95		5.79
16.951257	79.001617	H	28.2	252	5209		1.5	11		12.5
17.043512	79.047594	K	24.8	270	841		1.5	11		12.5
17.027859	79.046870	A	2.79	2017	9040		1.5	17.6		19.1
17.014270	79.043578	HK	16.5	12466	247		6.98	11.7		18.7
16.999707	79.040982	HK	23.3	272	73587		1.5	8.16		9.66
16.986875	79.039110	HK	1298	526			66.8			68.3
16.966708	79.033685	HK	164	1441			11.3			12.8
16.951031	79.032328	HK	171	17059			23.1			24.6
16.933238	79.026284	H	50.9	7836			10.9			12.4
17.019369	79.066838	H	37.4	45201			12.5			14
17.002977	79.062546	AA	30.8	1641			3.85			5.35
16.988997	79.058767	AA	84.2	38928			21.2			22.7
16.969660	79.056458	HK	59.3	3031			8.28			9.78
16.954587	79.053830	AA	19888	6819			17.6			19.1
16.939693	79.048171	AA	12656	2824			66.5			68
16.926372	79.044444	AA	578	1845			7.79			9.93
16.993699	79.087546	HK	82.2	568			13.7			19.1
16.975132	79.084063	AA	35.5	45201			4.53			6.1
16.959716	79.079331	H	3227	727			27			7
16.939873	79.071985	HK	2017	9040			3.85			5.35
16.924245	79.064922	H	59.3	53194			11.7			13.2

Table: 1 Vertical Electrical Data

The **second layer ρ2** resistance resistivity increases to 25m correlation of weathered granite zone to depth of 5m to 25m. The **third layer ρ3** from 44.14 Ωm to 445.9 Ωm m shows a decreasing trend in resistivity, indicating fractured withered/fractured granite which yields significant quantities of groundwater zone to depth of 15m to 40m. The **fourth layer ρ3** from 76.137 Ωm to 827.17 Ωm high resistivity of semi hard rock zone to depth of 15m to 40m. The **fifth layer ρ5** from 122.35 Ωm to 988.84 Ωm very high resistivity of solid hard rock zone to depth of 30m to 90m Similarly, the results from sounding no. 37 conducted at Gurrapally village indicate four layers, with the top soil exhibiting a resistivity of 25 Ωm up to a depth of

5m to 10m, the second layer with a resistivity of 61 Ωm, indicating clay from 20m– 25m, and the third layer, a fractured zone with a resistivity of 113 Ωm, that occurs between 35m–40m. The well was drilled up to a depth of 55 m, Yielding Significant Quantities of Groundwater. The granite At the Bottom is the Fourth and fifth layers are very high resistivity seem to be solid hard rock zone.

PROFILING

The Profiling helps to subsurface configuration along profiles connecting the VES points were cover all the profiles of I, II, III, IV, V, VI, VII and VIII. Have been interpreted to evaluate the subsurface geo electric configuration of study area. The vertical section of apparent resistivity in the study area was obtained by contouring the apparent resistivity values plotted (on a logarithmic scale to maintain the reasonable size of inferred section) against AB/2 separation. Pseudo-resistivity sections help in deciphering the subsurface resistivity distribution and nature of the different geological formations present in the region. A comprehensive examination of the pseudo-section, geo-electric section (which gives the layer parameters of resistivity and thickness) helps in understanding the subsurface layer and structural features like fault/shear zones, contacts, and joints configuration.

PROFILE-I

Profile I is about 4600 m in length to the western side of the study area and consists of six VES points (VES-01, VES-02, VES-03, and VES-04) passing from Gattupal, Lacammagudem, Dharamatanda and Uappagutaa Villages. The pseudo-resistivity cross section along the N-S Profile. Subsurface section below VES-3 to VES-4 is characterized by low resistance zone (light blue, dark blue to black tones) have been demarcated with corresponding to up to 30 m spreads Furthermore continues indications of the moderate low ρa value (<6000 Ωm) continue to the surface. The top layer which consists of clayey soil, has resistivity values ranging from 14.7 to 68.1 Ωm. This low zones area possible potential for the occurrence of ground water availability. From VES-1 to VES-3 is about comparatively high resistivity ρa value (<47009 Ωm), thickness of the layer is about 50m which is hard and compact rock zone

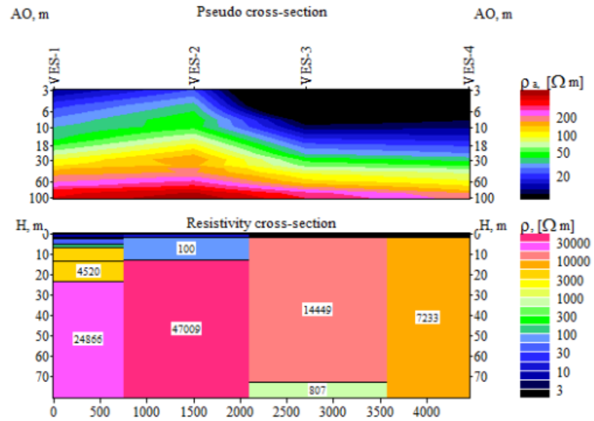


Fig. 9 Pseudo cross-section along Inferred electrical Resistivity configurations of the profie-1

PROFILE-II

Profile II is S-N with a trending, 3560 m long profile lies between Terataplli Village. It consists of five VES-5, VES-6 and VES-7. The pseudo-resistivity section along this profile is a low resistivity zone of 5 to27 Ωm at VES points VES-5 and VES-6 (black tones in the map) is evident up to a spread corresponding to an AB/2 separation of 25 m. This low resistivity zone is inferred to be clay. On the other h and, high ρa values are observed throughout the section, up to a maximum AB/2 separation of 100 m. The resistivity section, respectively along this profile. It is seen that the subsurface in the western part consists of two layers. The soil cover/weathered layer is first layer vary from resistivity 5 to 28 Ωm. The second layer is the low resistivity (384-18080 Ωm), the last layer hard rock exhibits higher resistivity ranging.

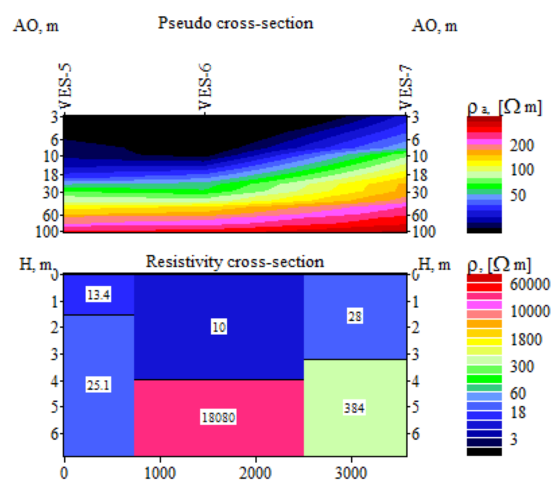


Fig. 10 Pseudo cross-section along Inferred electrical Resistivity configurations of the profie-I1

The depth to the basement topography is uneven, with depth to basement from 100 m below the sounding points.

PROFILE-III

Profile III is NW-SE trending, 10100 m long traverse from N-S and consists of five VES (VES-8, VES-9, VES-10, VES-11, and VES-12) Located western side of Kammagudem, Sherigudem and Nermata Villages. Low apparent resistivity values (ρa <14 Ωm; black tones in the figure) are seen below VES-12 sounding point to a depth corresponding to the 30 m separation. These lows can be attributed to clay strata and/or increase in moisture percentage present at the depth. The resistivity low contours are indicating tectonically disturbed/fractured zone with indications of increased permeability. The resistivity and interpreted electrical sections indicate layer strata consisting of a second layer, which shows comparatively low (>31.6 Ωm; in green and blue tones) and moderate resistivity (<46.4.5 Ωm; in green to blue tones). The third layer is characterized by resistivity values are of 100-215 Ωm at VES-9 and VES-10 and a thickness of 23-31 m and 42.2-56.3 m, respectively.

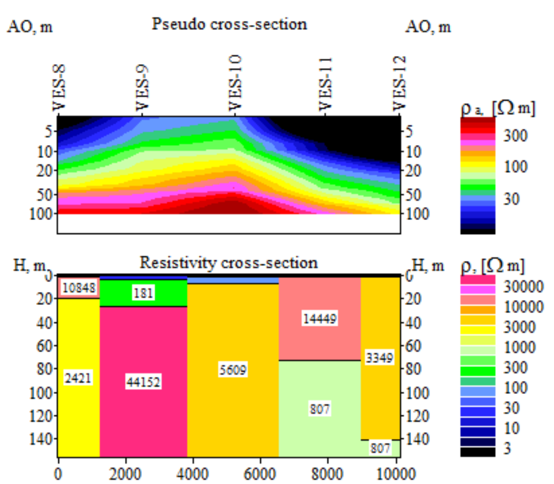


Fig. 11 Pseudo cross-section along Inferred electrical Resistivity configurations of the profie-II1

The second layer comprises fractured rock, which is shows resistivity at VES-11 and VES-12. The thickness of this layer varies from 4.22 to 7.7 m and 10 to 17.8 m forming a thick weathered granite characterized by high porosity and significant permeability. A weathered zone can be seen within this layer at VES-8 and VES-9 of resistivity ranges from 30 to 100. Ωm at depths of 5.62-13.3 m, respectively.

PROFILE-IV

Profile IV this 9350 m and trending in an N-S direction, consists of five VES (VES-13, VES-14, VES-15, VES-16, and VES-17) and passes from Eastern side Kammagudem, Sherigudem and Donipamula villages which is nearby central portion of the study area. The pseudo-resistivity section along this profile shows significantly low values at VES-13, VES-14 and VES-15 (ρa <48.7 Ωm), discernible from the surface to a depth corresponding to 21.5 m separation

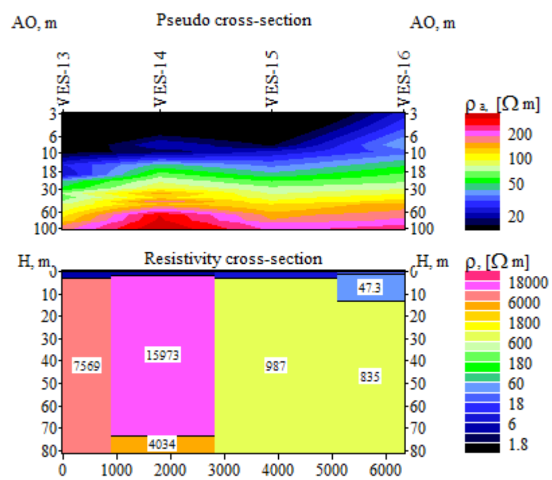


Fig. 12 Pseudo cross-section along Inferred electrical Resistivity configurations of the profile-IV

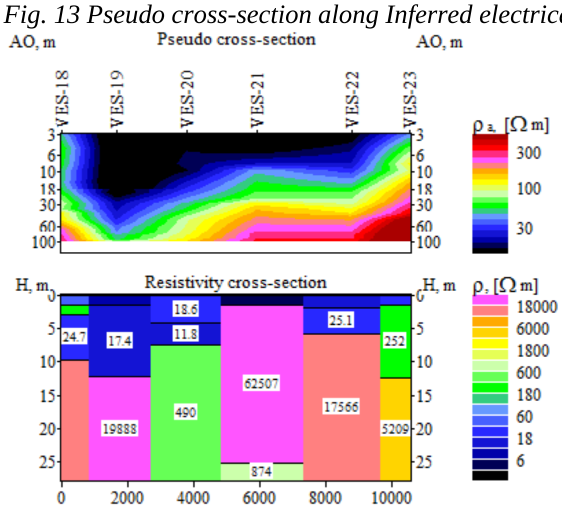
The resistivity and electric cross sections along with the inferred profile, the top layer (soil) has a variable resistivity 3-100 Ωm and a thickness ranging from 1 to 25 m. The second layer is the weathered layer with very low resistivity (<36.5 Ωm; in black to dark blue tones), at VES-13, VES-14 and VES-15. Within this layer, low resistivity are observed at depth ranges from 0.75 to 12.9 m.

The third layer comprises fractured rock, which shows resistivity of 48.7-86.6Ωm. The thickness of this layer varies from 15 to 40 Ωm, forming a thick overburden characterized by high porosity and significant permeability. It is seen that the electric profile configuration along this profile is similar to that along Profiles II and III the low resistivity zone in the weathered layer is a clay zone.

PROFILE-V

The Profile-V is situated Pullemla, Kasaigudem, Gollagudem, Bangarugadda and Tummalapalli. The profile length is about 10510 m north to south direction the profile consists of VES-18, VES-19, VES-20, VES-21, VES-22, and VES-23. Very low resistance zone are observed from VES-19 to VES-22. The pseudo cross section and resistivity cross section along this profile, interpretation of subsurface configuration the top layer consists soil with clay has a variable resistivity 3-60 Ωm and a thickness ranging from 1 to 22.8 m. The second layer is weathered layer resistivity ranging from 60-300 Ωm and thickness ranging from 1m to 26m. The third layer is semi weathered rock that overlie the fractured zone with resistivity 300-1000 Ωm and thickness ranging from 10m to 30m. The basement layer at depths varying between 27.8 to 60 m while the corresponding resistivity ranges from 1800 Ωm to infinity.

Fig. 13 Pseudo cross-section along Inferred electrical

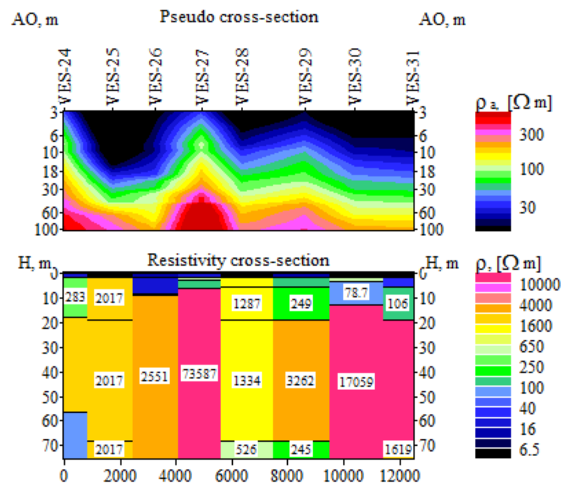


Resistivity configurations of the profile-V

PROFILE-VI

Profile VI is trending from North to South profile consists 12400 m long, consisting of eight VES sounding are VES-24, VES-25, VES-26, VES-27, VES-28, VES-29, VES-30 and VES-31. It passes from Bodamparti, Taskhanigudem, Angadipeta and Gundrapalli Villages. The pseudo-resistivity section along this profile shows a horizontal pattern of contours below a depth corresponding to the 30 m separation. Very low resistivity are seen at VES-25 and VES-26. From the resistivity and electric sections it is seen that the top layer at VES-28, VES-29, VES-30 and VES-31. The top layer soil and clay, resistivity values of 1-25 Ωm. The second layer weathered zone resistivity ranges from 58 to 119 Ωm and Resistivities of 80-119 Ωm observed at VES-25 represent fractured granites and resistivities >250 Ωm indicate unweathered granites. The layer thickness ranges from 16.7 to 27.8 m for the weathered layer and 10-27 m for the fractured granites. The bedrock occurs at depths of 50 m along the profile.

Fig. 14 Pseudo cross-section along Inferred electrical



Resistivity configurations of the profile-VI

PROFILE-VII

Profile VII passing from Sirdepalli, Chandur, Choppavarigudem and Allarajubhavigudem Villages, contains five VES points of VES-32, VES-33, VES-34, VES-35, VES-36, VES-37 and VES-38, with a total length of 10500 m and situated from North to south direction Profile. The pseudoresistivity section along this profile the low layered resistivity of <10 Ωm (seen in black tones), possibly due to a clay zone in the soil. This zone is evident up to an AB/2 separation of 10 m. the resistivity and electric ayer ections along with the profile having four layer subsurface configurations. The first is Soil (up to 10 Ωm), weathered layer (10-60 Ωm), fractured zone (60-1000 Ωm) and bedrock with respective layer thickness ranges from 35 m to infinity. The depth to bedrock varies from 25 to 40 m.

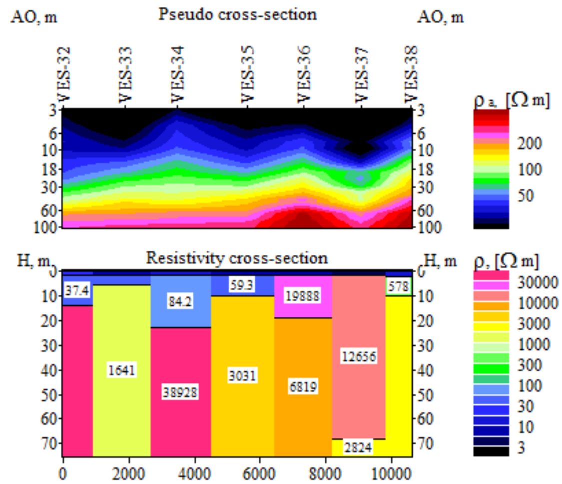


Fig. 15 Pseudo cross-section along Inferred electrical Resistivity configurations of the profile-VII

PROFILE-VIII

Profile VIII is situated Dubbagudem, Uduthapalli, Kastala, and Rananibavigudem. The profile length is about 8050 m north to south direction the profile consists of VES-39, VES-40, VES-41, VES-42 and VES-43. Very low resistance zone are observed from VES-41 to VES-42 (dark black tone).

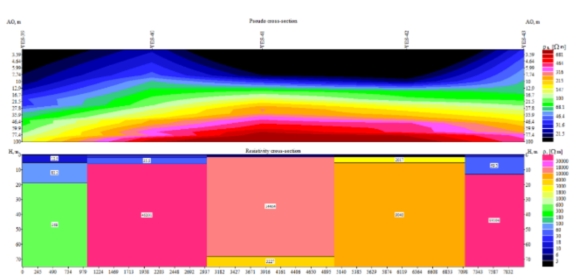


Fig. 16 Pseudo cross-section along Inferred electrical Resistivity configurations of the profile-VIII

The pseudo cross interpretation of subsurface configuration, the top layer consists soil with clay has a variable resistivity 3-60 Ωm and a thickness ranging from 1 to 12.9 m. The second layer is weathered layer resistivity ranging from 60-180 Ωm and thickness ranging from 10m to 27.8m. The third layer is semi weathered rock that overlie the fractured zone with resistivity 180-1000 Ωm and thickness ranging from 15m to 35m. The basement layer at depths varying between 35 to 60 m while the corresponding resistivity ranges from 1000 Ωm to infinity.

CONCLUSIONS

Remote sensing, Geological mapping and Geophysical surveys were conducted to delineate groundwater potential aquifers in Chandur Mandal. The satellite data interpretation characterization the ground water possible potential zones are demarcated with comparison of existing geological formations zone are Northern part, central part and eastern parts are favorable. The south part is moderately favorable, western part is limited favorable for possible potential of ground water. The geophysical survey is to investigate subsurface geological formation on the basis of remote sensing alteration zones. Vertical Electrical Resistivity Survey (VES) and Profiling Wenner-Schlumberger array are were carried out in the study area for identification ground water bearing zone with corresponding depth. The data has been interpreted with master curves and later the interpretation is redefined by using IPI2Win software.

The layer curves of different parameters such as resistivity (ρ1, ρ2, ρ3 and ρ4) and thicknesses (h1, h2 and h3) of various layers indicating top soil, weathered, fractured and basement respectively have been prepared The results from soundings indicate four layers with absolute resistivity of top soil cover, weathered zone, fracture, semi hard rock and solid hard rock, respectively, for the first three layers are high resistivity, and the bottommost layer has very high resistivity. The average depth of the wells are 25 m, and the first layer ρ1 resistance between 12.02 Ωm to 103.9 Ωm, correlates to the top soil, which extends down depth of 0.5m to 10m from the surface. The second layer ρ2 resistance between 29.09 Ωm to 234.6 Ωm the resistivity increases to 25m correlation of weathered granite zone to depth of 5m to 25m. The third layer ρ3 from 44.14 Ωm to 445.9 Ωm m shows a decreasing trend in resistivity, indicating fractured withered/fractured granite which yields significant quantities of groundwater zone to depth of 15m to 40m. The fourth layer from 76.137 Ωm to 827.17 Ωm high resistivity of semi hard rock zone to depth of 15m to 40m. The fifth layer from 122.35 Ωm to 988.84 Ωm very high resistivity of solid hard rock zone to depth of 30m to 90m. The Psudosection profiling helps to subsurface configuration along profiles connecting the VES points were cover all the profiles of I, II, III, IV, V, VI, VII and VIII. And interpreted to evaluate the subsurface geo electric configuration of study area.

The result of vertical electrical soundings of type-A curves are covered in western and Northwest part of the study area covers lithounits are Granite and Dolerite Dyke. The soundings type-AA are curves are covered in Eastern and South-Western part of the study area and lithounits are Granite, Migmatite and Dolerite Dyke. The soundings of type-HK are curves are covered in Central portion of the study area and lithounits are Granite and Dolerite Dyke. The soundings type-H are curves are covered in south and South- Eastern portions of the study area and lithounits are Granite and Dolerite Dyke. The sounding type-K is curve is located in North-Eastern part of the study area and lithounit is Granite. The weathered granites and semi weathered granite are concluded that the water bearing zones with associated with resistivity well 90 Ωm. Geophysical survey result is showing low values having a sufficient thickness can be chosen as possible potential zone for occurrence of ground water.

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