DELINEATION OF GROUND WATER POTENTIAL ZONES AT MOODBIDRI BY ELECTRICAL RESISTIVITY TECHNIQUE

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Abstract *- A geophysical survey conducted in the Moodbidri and nearby area of North-East part of Dakshina Kannada district, Karnataka using electrical resistivity method. The Schlumberger electrode configuration is used for the vertical electrical soundings. A total 20 vertical electrical soundings has been taken to delineate groundwater potential zone in the study area and also to understand the thickness of weathered zone/ formation relevant to groundwater behaviors of aquifers in alluvium and in the trap rock. The field data were interpreted by IGIS-VES software to determine the resistivity and thickness of the different layers. Results of geophysical data were used to prepare lineament and geo-morphological maps. The depth for the construction of tube wells and dug wells were suggested. The depth to water table varies from 30 meters to 90 meters at some places.*

Key words: Electrical resistivity1, Groundwater potential zone2, vertical electrical soundings3, geophysical data4, IGIS-VES softwar5.

1. INTRODUCTION

Groundwater resources play a major role in ensuring livelihood security across the world. The total water resource of our world is estimated as 1.37 Million ha m, of these global water resources, about 97.2% are salt water, mainly in oceans and only 2.8% are available as fresh water at any time on the planet earth. However, the economically extracted groundwater with the present drilling technique is about 0.3%, remaining being unavailable as it is situated below depth of 800 m. Groundwater is Often withdrawn for agricultural, municipal and industrial use by constructing and operating extraction wells. Groundwater is also widely used as a source for drinking supply and irrigation.

Utilization of groundwater reservoir as a viable source for meeting drinking and domestic water needs is safer and economical than surface water, as groundwater is available everywhere and is generally uncontaminated. As a result groundwater investigation has assumed top priority in recent years. Groundwater is usually held within porous soils or rock materials. People all around the world face serious water shortage because of the over exploitation of groundwater for domestic, industrial and agricultural purposes. The conventional Schlumberger resistivity sounding is extensively used for routine groundwater investigations both in laterite and hard rock terrain. Electrical resistivity survey provides much basic information to the hydro geologist, like depth to water table, depth to the basement topography in hard rocks.

The geophysical investigation done for 20 Stations such as Virasath Ground, Puttige, Pryanthya, Laadi, Swaraj stadium, Kadalakere, Hamsanagar, Gandhinagar, Mahaveer collage, Narampaadi, Murarji desai school, Narampadi, Marpaadi, Alangaru, Montry hospital, Palace door, Nagaragadde, Rani abbakka layout, Kadabalu, Handalu at Moodbidri.

2. STUDY AREA

The occurrence of groundwater in any type of terrain is largely dependent on topography, climate and geological setting. Moodbidri, is a town and a taluk in Dakshina Kannada District. It lies 34km North-East of the district head-quarters, Mangalore city, in Karnataka, India. Because of widely grown bamboo in ancient days, this place got named as Moodabidri. The latitude is 13.0688˚N and the longitude is 74.9936˚E. It has an average elevation of 22m above mean sea level. This area mainly consists of laterite, gneiss, granite and charnockite.

Figure 2.1: Locations of Vertical electrical Sounding Stations of Moodbidri

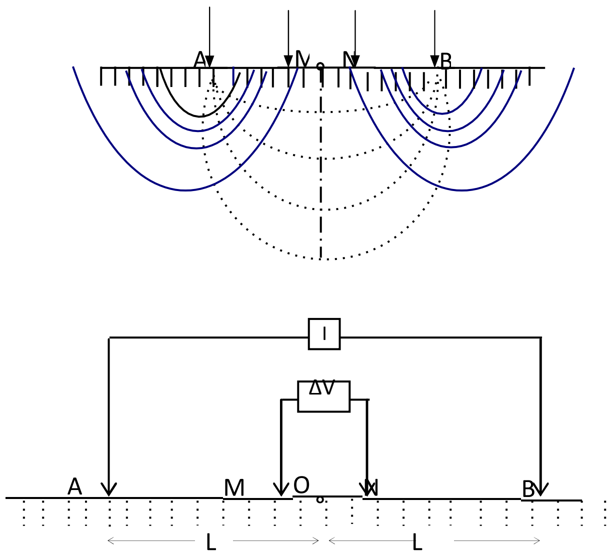

Figure 2.2: Schlumberger Array

The Moodbidri is situated on the West cost of India, and is bounded by the Arabian Sea to its West and the Western Ghats to its East. Moodbidri experiences moderate to gusty winds during day time and gentle winds at nights. The topography of changes to undulating hilly terrain sharply towards the east in Western Ghats the geology of the city is characterized by hard laterite in hilly tracts and sandy soil along the Sea shore. The geology survey of the India has identified this place as a moderately earthquake-prone urban center and categorized the city in the seismic 3rd zone.

1. Objectives

- Delineation of ground water potential zones.
- To determine the aquifers characteristics.
- Preparation of lineament map using satellite imageries

2. Methodology

Electrical Resistivity Method is one of the Geophysical techniques used to investigate the nature of the subsurface formations. In Electrical Resistivity methods current sent into the ground through a pair of electrodes, called current electrodes, and resulting potential difference across the ground is measured with the help of another pair of electrodes, called potential electrodes. The ratio between the potential difference (ΔV) and the current (I) gives the apparent resistance, which depends on the electrode arrangement and on the resistivity of the subsurface formations. There are several types of electrode arrangements (configurations) of which Wenner and Schlumberger configurations are more popular.

In Schlumberger Configuration all the four electrodes are kept in a line similar to that of Wenner but the outer electrode spacing is kept large compared to the inner electrode spacing, usually more than 5 times. For each measurement only current electrodes are moved keeping the potential electrodes at the same locations. The potential electrodes are moved only when the signal becomes too weak to be measured.

The Schlumberger configuration composed of four collinear electrodes. Current and potential electrodes are placed in such a way to maintain one fifth of the spacing between the inner and outer electrode. The current electrodes are increased to a greater separation during survey while, potential electrodes remain in same position until it observes, voltage becomes too small to measure.
There are two types of procedures for making resistivity observation, namely Resistivity Sounding (also called Vertical Electrical Sounding, VES) and Resistivity Profiling (Horizontal Electrical Profiling). In carrying out resistivity sounding surveys, electrodes are distributed along a line, centered about a midpoint that is considered the location of the sounding. The electrode arrangement used in data acquisition is the Schlumberger array of electrodes.

The Schlumberger array of electrodes involves the use of two current electrodes labeled A and B, and two potential electrodes M and N are used with 0.5 to 10 meter potential electrode spacing and 150 to 200 meter current electrode spacing in line with one another and centered on some location. The geometric arrangement for this array is shown in Figure4.1. The apparent resistivity data obtained from the measurements. The working principle of this method is by injected the electrode current (AB) into the earth surfaces. The potential electrodes will measure the result of the potential difference from the current that flow through the layers of rock. The calculation of the apparent resistivity values is done by using the Ohm's Law. Resistivity value is affected by the current that flow through down the surfaces, the potential differences and the geometry factor.

The VES data were interpreted using the below discussed interpretation techniques. The below tables gives the subsurface layer parameter their resistivity. The above graph gives the thickness of subsurface layers. The idealized vertical section gives the geological formations below the ground surface. The results indicated that in general the subsurface up to the depth of investigation is made up of a layered structure.

3. Conclusion

Resistivity data of all 20 VES Stations

Current electrodes distance AB/2 in m	1.5	2	4	6	8	10	15	20	25	30	40	50	60	70	80	90	100
VES1	1358.00	557.87	163.50	60.12	32.05	433.25	617.53	614.13	2934.12	1117.63	928.46	2910.07	4689.49	6779.64	-	-	-
VES2	5788.46	3096.78	3144.97	3219.96	2551.10	1979.38	463.26	207.35	1192.55	917.16	2502.02	2309.77	3296.69	6318.34	-	-	-
VES3	1130.86	1465.31	1985.22	1336.96	855.1	912.36	352.34	9.96	248.68	245.16	668.98	677.18	454.16	1340.81	-	-	-
VES4	796.02	737.50	601.15	515.40	488.11	432.57	259.06	288.12	286.43	341.27	343.30	603.48	204.51	593.44	-	-	-
VES5	491.27	427.85	261.33	183.85	199.95	242.15	384.44	569.23	766.32	962.09	1256.7	1224.38	1268.95	1215.5	-	-	-
VES6	10893.6	11593.7	7716.99	5045.9	3528.75	2289.66	1805.01	758.16	476.97	571.74	348.27	241.19	218.09	972.56	4656.88	-	-
VES7	2724.26	2524.16	2153.29	1640.56	1304.27	736.64	631.39	256.17	957.37	1896.65	513.94	10297.6	5097.58	21646.4	31303.7	31667.3	17090.7
VES8	504	462	277	192	147	970	560	179	195	964	105	129	171	138	272	104	1807.

	2.54	9.14	9.92	8.46	1.7	.23	.03	5.95	6.69	.05	7.99	3.71	4.66	4.56	2.03	6.03	20
VES9	1130.86	796.92	491.27	10893.6	2724.26	5042.54	2765.90	1344.44	5871.48	477.50	278.02	2100.05	8098.91	23308.8	20810.5	18748.7	8064.5
VES10	2765.9	2209.10	1489.43	1398.64	1079.89	955.88	1062.69	1756.97	8829.83	1487.24	864.30	1362.22	1615.05	1970.73	2261.49	2851.83	505.51
VES11	1344.44	1258.82	1228.44	428.73	1316.46	1327.15	1055.27	876.10	942.98	1146.63	1300.03	3818.61	3742.01	3714.54	1099.10	9439.53	6720.52
VES12	5871.48	1258.82	1541.85	1857.35	632.22	3256.04	944.31	776.47	3855.34	1069.17	237.72	5084.96	628.63	7698.03	72844.7	12172.1	10042.3
VES13	4775.50	29.20	219.00	154.94	126.70	129.50	196.76	398.377	395.04	780.86	286.83	352.90	422.98	289.70	742.19	837.69	1328.48
VES14	278.02	273.80	213.29	186.69	190.64	225.01	320.99	425.07	532.07	615.29	780.91	921.84	1071.15	1221.22	1239.22	1216.37	1167.54
VES15	2100.05	1807.54	209.96	1661.64	1681.91	2095.63	2045.50	831.47	5773.50	3496.16	2067.30	2672.81	3208.56	4385.59	5170.09	2149.14	42993.6
VES16	7154.65	6139.00	5017.10	3254.95	2803.79	2619.59	2840.36	3393.98	4180.34	4866.64	4631.35	5332.17	5583.81	4658.71	5164.22	3849.60	3285.33
VES17	370.35	273.70	218.96	196.92	209.60	243.35	288.44	316.37	364.43	423.80	544.74	798.59	974.03	1167.53	1228.87	1258.39	1273.73
VES18	4167.67	1653.35	1355.25	1066.81	1429.62	1239.73	2200.27	1187.11	1546.71	472.82	867.39	673.49	3136.20	2725.74	2120.47	2513.54	2109.15
VES19	938.02	628.48	282.27	238.03	188.53	124.88	64.03	44.06	51.41	55.84	216.49	292.48	176.27	69.86	429.22	12.30	131.69
VES20	1530.79	1091.35	597.01	543.00	474.03	338.30	520.23	890.79	1037.64	883.28	1069.94	769.42	1488.02	2830.15	1830.21	3904.78	3148.

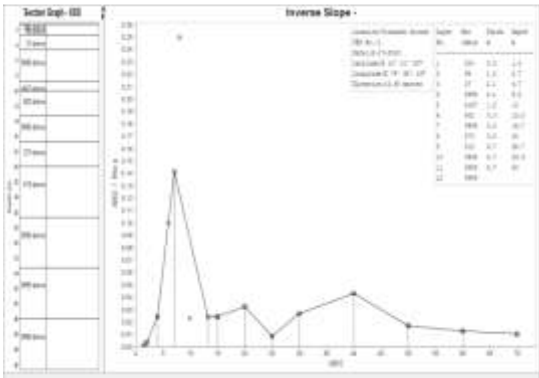

Figure5.3: Electrodes distance –resistivity graph of VES Station

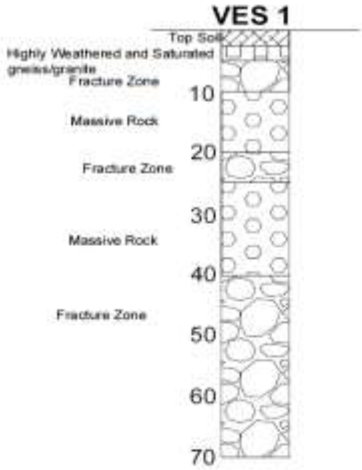

Figure5.1: Geological formations of VES Station below the ground

The resistivity of the first layer in most cases a soil layer or laterite soil with highly weathered layer varies from less than 1 ohm meter to as high around 100 ohm meter. The second subsurface layer is weathered, jointed and fractured layer. The resistivity varies from100 ohm meter to 400 ohm meter with the thickness varying from 10m to 20m. The third sub surface layer is massive rock and in few cases fractured. The resistivity varies from 400 ohm meter to 600 ohm meter. The fourth subsurface layer is un weathered granite with resistivity more than 600 ohm meter. In some cases, after the third layer, a low resistivity layer is encountered indicating fractured or sheared zone at that depth. This indicates presence of deeper aquifers.

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