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GEOELECTRICAL EXPLORATION OF THE GROUNDWATER POTENTIALITY AROUND THE MIDDLE PART OF WADI EL NATRUN - AL ALAMAIN ROAD, WESTERN DESERT, EGYPT

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استكشاف جيوكهربى لإمكانيات المياه الجوفية حول الجزء الأوسط من طريق وادى النطرون – العلمين ، الصحراء الغربية، مصر

الخلاصة: أدى إنشاء طريق وادى النطرون – العلمين إلى للاهتمام بمناطق لم تكن محط اهتمام من قبل، نظرا لصعوبة الوصول إليها أو التحرك خلالها . تلك هى المناطق الواقعة على جانبى هذا الطريق، حيث أصبحت هدفا للتنمية باستخدام مصادر المياه الجوفية المحلية بها. ولما كان المتوفر من المعلومات عن هذه المصادر ضئيلا، وخاصة بعد العشرين كيلومتر الأولى من بداية الطريق من ناحية وادى النطرون، فقد تم عمل دراسة جيوكهربيه تتكون من إحدى وثلاثين جسه حول الجزء الأوسط من الطريق لمعرفة خصائص مصادر المياه الجوفية بها. ومن تفسير نتائج القياسات الحقلية وتمثيلها على هيئة ستة قطاعات جيوكهربيه عرضية وخمس خرائط كتورية، أمكن التوصل إلى أن بالمنطقة تتابعا صخريا يتكون من خمس طبقات تمثل الطبقة الرابعة منه إلى أسفل تكوينا حاملا للمياه بعمق يتراوح بين٤٦ و ١١٦ متر، وسمك يبلغ ١٠ إلى ٢٩ متر، ومقاومة نوعية كهربية فى المدى من ١٢ إلى ٣١ أوم. متر. وتتكون هذه الطبقة من الحجر الرملى الطينى والرمال الطينية التابعة لعصر البليوسين. تم التوصل كذلك من خريطة للإمكانات المائية، تم عملها بناءا على تفسير النتائج الجيوكهربيه، إلى تحديد نصيب الأجزاء المختلفة من منطقة الدراسة من هذه الإمكانات. وقد حددت الدراسة كذلك أفضل المواقع لحفر آبار المياه بالمنطقة وخصائص كل من هذه المواقع من حيث عمق الحفر، وعمق سطح المياه، والسمك المتوقع للطبقة الحاملة للمياه، ونوعية المياه والاحتياطات اللازم إتباعها للاستفادة من هذه الآبار وما تنتجه من مياه. ويرجى من هذه الدراسة تنمية المنطقة على أساس علمى مدروس لمصادر المياه الجوفية بها وليس على أساس الحفر العشوائى للآبار مثلما يحدث فى الوقت الحاضر

ABSTRACT: *The construction of Wadi El Natrun- Al Alamain Road has created a new accessible desert area aimed for development that is based mainly on its local groundwater resources. Unfortunately little is known about the groundwater setting of the area on both sides of the road. A total of 31 Vertical Electrical Soundings (VES) were carried out to reveal the groundwater setting of the area. Interpretation of the VES curves indicated a sedimentary succession of 5 layers, the 4th layer downward of which is the water-bearing formation. The depth to top of that layer varies from 46 to 116 m, its thickness ranges from 10 to 29m, while its electrical resistivity is in the range of 12 to 31 Ohm.m. Based on the interpreted results, 6 cross sections and 4 contour maps were constructed to present these results. Based on these results, together with the previous regional and local data available for the area, a groundwater potential map was further constructed showing the ranking of water potential across the area. Recommended sites for the drilling of water wells were also pointed out with the specifications of each of these sites, as well as the precautions that should be taken during drilling and use of these wells.*

INTRODUCTION

Prior to the construction of Wadi El Natrun – Al Alamain road, the areas located at present on both sides of the road have received little attention as to its development. This was mainly due to its inaccessibility and shortage of water resources. After the construction of the road, people became encouraged to settle parts of the area and to carry out some small local developments. However, this was restricted to the first 20 kilometers of the road from its beginning, close to Wadi El Natrun. Ambitious state planes are regarded to develop the area on both sides of the road, all along its entire extension. To avoid the random drilling of water wells, based mainly on try and error, that took place around that part of the road and thus to contribute positively to the process of development, the present work was carried out to study the local groundwater resources of the area surrounding the middle part of the road and its groundwater potentiality.

Location of the study area

The study area lies, almost, midway between the western edges of the Nile Delta and the northwestern extension of Wadi El Natrun depression (figure 1).. The area is bounded by latitudes 30° 34' & 30° 43' N and longitudes 29° 45' & 29° 54' E. in the distance interval between km 35 and km 46 of Wadi El Natrun – Al Alamain road.

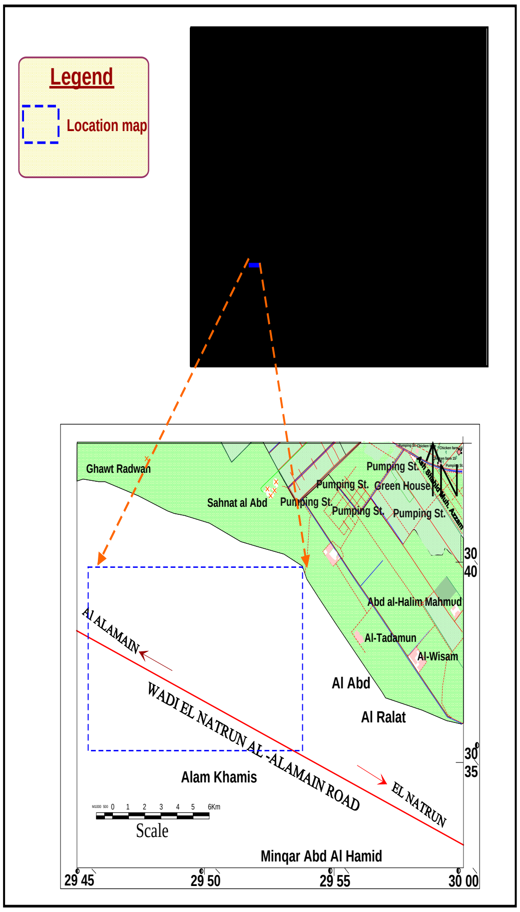

Fig. (1): Location Map of the Study Area

Physiographic features of the study area

The area is in the form of a rectangle covering an area of about 102 sq..km , It is characterized by a relatively high relief, where the southern and southwestern parts stand as high as 70 to103 m above Sea Level while the northern and northeastern parts have a ground elevation of 19 to 70 m. The region, including the area, has a northeastern slope towards the Nile Delta. According to Shata (1962), El Fayoumi (1967), Sanad (1973), Attia (1975), Abdel Baki (1983) and El Sheikh (2000), the area lies within the table land that forms a part of the region extending west of the Nile Delta. The region is covered on the surface by the Quaternary and Tertiary sedimentary rocks, including sand, gravel, sandstone, clay and limestone. Consolidated sediments form patches of duricrust that cover many parts of the study area.

FIELD MEASURMENTS

The field works comprised geoelectrical measurements in the form of Vertical Electrical Soundings (VES) and topographic measurements to determine the exact location and ground elevation of the VES stations.

A total of 31 VES stations, arranged in the form of a, more or less, regular grid were carried out (figure 2). As the intended depth of investigation was 100-160 m, the spacing, of the current electrodes ranged between one meter and 1500 to 2000 m. The direct current resistivity meters Terrameter SAS 300 C and Terrameter SAS 1000 were used for measurements. Each of the instruments measures directly the electrical resistance $\Delta V / I$ with high accuracy. The measured apparent resistivity values were plotted against the apparent depths, represented by half the current electrode spacing, (AB/2) in the form of resistivity sounding curves. Examples of these curves are shown in figure 3.

For the topographic survey, the GPS instrument was used together with the topographic contour map of the area, scale 1:50.000 to determine the location and ground elevation of the VES stations. The results of the topographic measurements are shown in table (1)**.**

Interpretation of the Geoelectrical Measurements

Most of the Sounding curves show a five layers case of the type QHK ($\rho_1 > \rho_2 > \rho_3 < \rho_4 > \rho_5$) or the HAK type (($\rho_1 > \rho_2 < \rho_3 < \rho_4 > \rho_5$). For the quantitative interpretation of the sounding curves the computer soft ware "RESIST" (Van Der Velpen 1988) and RESIX-PLUS, ver. 2.39 (Interpex, 1966) were used. The role of such softwares is to transform the sounding curves into layered models, describing the subsurface geoelectrical succession at each of the sounding stations. In this respect the only water well present near, by the area (DW2) shown in figure (4) was utilized as well as all the available information about the surface and subsurface of the area to help constructing the initial model that would, be iterated using the interpretation softwares. The results of interpretation of the sounding curves are shown in table (1)

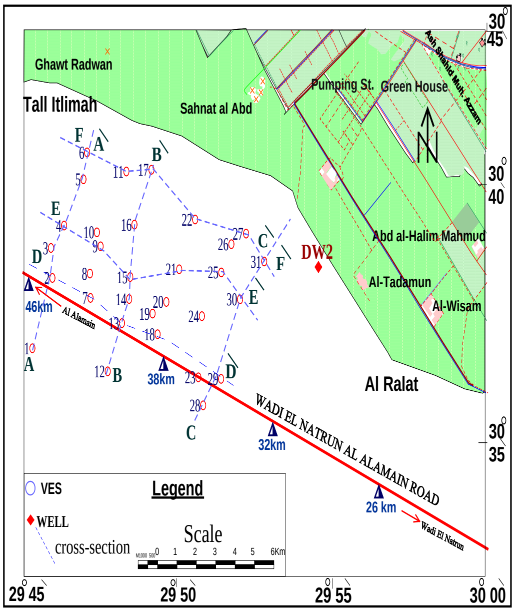

Fig. (2): Location Map of the Ves Stations

Table (1): Results of Interpretation of the Ves Curves

VES NO	Ground elevation in (m)	Geoelectrical layering												
		Layer A		Layer B			Layer C			Layer D			Layer E	
		ρ	H	ρ	H	D	ρ	H	D	ρ	H	D	ρ	D
1	97	1336	10	3	3.5	10	25	98	13.5	17	20	110	6	121
2	73	286	3.1	1.1	5.6	3.1	43	76	8.7	19	25	86	0.1	111
3	72	287	3.1	0.5	5.2	3.1	25	77	8.3	16	24	85	0.1	109
4	54	63	6.7	3.8	5.6	6.7	33	52	12.3	21	23	67	1.2	90
5	59	292	10	0.4	16	10	41	61	11	21	22	73	5.5	95
6	55	204	4	1	6	4	51	61	10	29	27	67	8.9	94
7	82	209	1.7	1.2	5.1	1.7	74	88	6.8	25	22	95	1.2	107
8	75	328	4.1	0.6	7	4.1	27	77	11.1	17	20	88	0.5	108
9	59	142	7.7	0.6	5.7	7.7	30	60	13.4	19	21	73	3.1	94
10	60	238	3	1.1	7.6	3	45	75	11	19	18	85	0.3	103
11	40	64	6.7	2.6	10	6.7	45	38	16.7	18	24	55	3.5	79
12	103	80	26.5	0.4	5	27	33	75	32	14	22	116	1.4	129
13	88	180	8.2	0.5	3.8	8.2	37	88	12	23	18	100	1.8	118
14	73	137	6.5	0.5	6.8	6.5	36	71	13.3	17	22	85	1.6	107
15	72	186	15	2	6.8	15	67	63	22	17	19	85	1.4	104
16	55	53	18	0.6	3	18	40	45	21	12	24	65	0.1	89
17	33	76	2.2	0.7	2.5	2.2	93	41	4.7	31	27	46	0.7	73
18	73	181	4.8	0.7	2.6	4.8	25	80	7.4	18	15	87	0.1	102
19	75	1072	3	0.5	5.6	3	30	79	8.6	22	10	87	4.1	97
20	66	458	3.9	2	18.3	3.9	31	57	22.2	19	17	79	0.1	96
21	60	217	6.5	0.8	3.5	6.5	33	63	10	20	20	73	2.1	93
22	49	49	1.6	0.6	4.2	1.6	44	57	5.8	27	25	63	1.2	88
23	75	218	5.7	0.3	2.3	5.7	39	80	٨	21	19.7	88	4	100
24	71	266	7.8	1.3	10	7.8	45	65	18	24	17.7	83	0.2	101
25	63	56	0.5	2.5	1.9	0.5	78	74	2.4	12	15	76	0.8	91
26	50	286	3.3	1	2.3	3.3	62	55	5.3	26	27	62	1.3	89
27	37	24	5.7	0.4	2.4	5.7	29	42	8.1	23	27	50	1	77
28	83	237	7.8	15.2	15	7.8	61	66	23	22	16	96	3.9	104
29	75	957	7	1.5	11	7	34	77	18	21	11	88	0.4	99
30	65	125	11	0.3	3.2	11	30	62	14	19	16	76	0.1	97
31	47	57	4	0.2	3.5	4	40	55	7.5	28	26	63	5.3	89
32	19	10	11	----	-----	11	59	21	32	26	27	32	3.5	59
33	29	1.8	11	-----	-----	11	37	22	42	21	21	33	1	54
34	70	584	2	3.4	30.6	2	31	45	32.6	18	24	77	0.4	101
35	50	48	2.1	7.4	16	2.1	56	45	18	25	26	63	6.2	89
36	31	25	10.4	0.7	12	10.4	62	22	22.4	29	25	44	3	69
37	29	87	2.3	6.5	13	2.3	296	23	15.3	26	38.6	38	6	77

ρ = Resistivity in Ohm.m, **H** = Thickness in meter, **D** = Depth in meter

Table (2): Summary of the Layering Characteristics

Layer No.	Depth (m)			Thickness (m)			Electrical Resistivity (Ohm.m)			Lithology
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	
A	-----	-----	------	0.5	27	6.7	1.8	1336	246.5	Sand, gravel and sandy limestone
B	0.5	27	1.6	1	30.6	7.1	0.3	15.2	1.8	C lay
C	2.4	33	15	21	98	60.6	25	246	51.5	Sandstone, calcareous sandstone
D	32	116	75	10	27	21.3	12	31	21	Sandy clay and clayey sandstone
E	54	129	94.5	-----	-------	-------	0.1	8.9	2.2	Clay

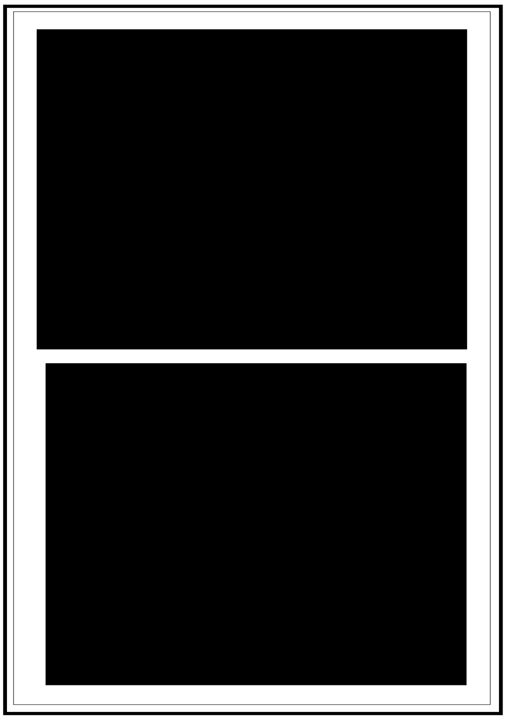

Fig. (3): Examples of the Ves Curves

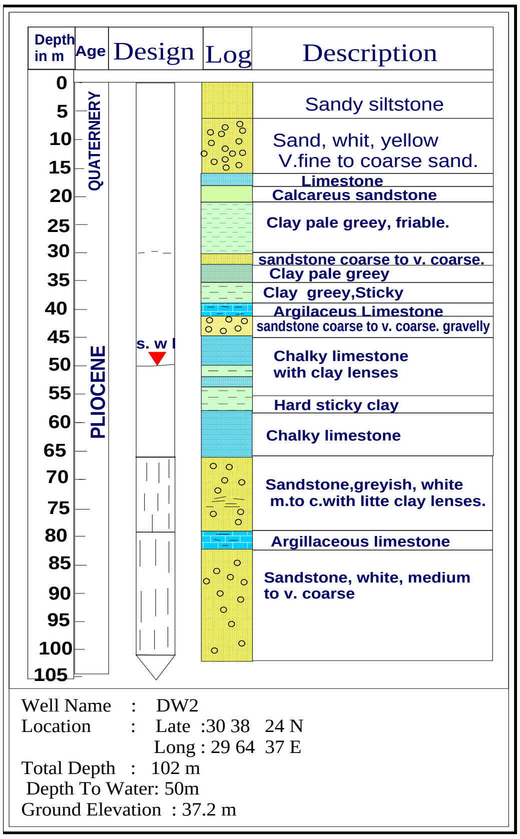

Fig. (4): Water Well DW2 (After El Sheikh, 2000)

PRESENTATION OF RESULTS

The results of interpretation are presented in two forms: geoelectrical cross sections, to show the layered sequence of the subsurface along specific directions and contour maps to display the lateral change of a given parameter within one and the same geoelectrical layer.

A. Geoelectrical cross sections

Six geoelectrical cross sections are constructed for the area, three of which show the geoelectrical succession along three successive NE-SW profiles (figure 2) and similar three along the NW-SE profiles. Each of the cross sections is discussed below:-

NE-SW cross sections

1 - Geoelectrical cross section (A-A')

This cross section represents the extreme western part of the area with a length of about 8 kilometers. It passes through VES stations 1 to 6, as shown in figure (5). All of the concluded five geoelectrical layers are represented along this cross section. The surface and near surface layers are relatively thin and display a wide range of electrical resistivity The third layer downward, formed of sand, gravel and calcareous sandstone, is the thickest in the succession, however it thins out in the NE direction towards the Nile Delta from about 98 m at VES station 1 to about 61 m at VES station 6. The water-bearing layer (4^{th} layer) has a rather uniform thickness of about 20 m. The top of that layer ranges in altitude from few meters below Sea Level (VES station 1) to about 17 m below that level towards the Nile Delta (VES station 6).The depth to top of this layer decreases in the same direction, affected mainly by topographic changes. The resistivity of the water-bearing layer is rather uniform, being in the range of 17-29 Ohm. m. The clay layer underlying the water-bearing layer shows a wide range of low resistivity (0.1- 8.9 Ohm. m.). No structural elements are shown to complicate the geoelectrical succession along this cross section.

2- Geoelectrical cross section (B-B´)

This cross section (figure 6) passes through 6 VES stations (12 to 17). The relatively great change in thickness of the dry layer (layer C) affects both the surface layer and the underlying clay layer (layer B) in their altitude, and thickness. The thickness of the surface layer (6.5 to 26.5m) is greater here, as compared to its range displayed along the previous cross section. Its resistivity ranges from 53 to 186 Ohm.m. The clay layer changes randomly in thickness from apart to another along the cross section, although still keeping the same range of low resistivity (0.4 to 2 Ohm.m.). The dry layer (layer C) wedges out towards the Nile Delta from 88 m at VES station 13 to 41m at VES station 17. In the same direction, the resistivity of this layer increases from 33 to 93 Ohm.m. The water-bearing layer (layer D) also fluctuates in its thickness (18- 27m) from one part to another along the cross section although to a less extant than that observed for the overlying geoelectrical layers. The same holds true for its resistivity, but within a narrow range of 12- 31 Ohm.m The clay layer E, representing the last layer in the succession is, well recognized through its remarkably low resistivity range of 0.1-1.8 Ohm.m

3- Geoelectrical cross-section (C-C')

This is a relatively long cross section along which VES stations 28, 29, 30 and 31 are situated (figure 7). It covers a horizontal distance of about 12.5 kilometers. The surface layer has an average thickness of about 10 m. in the main area, but it wedges out towards the Nile Delta with the observed decrease in ground elevation until it disappear, just after VES station 31, where it is replaced by the underlying clay, layer. The dry layer layer C, decreases in thickness in the same direction, it is about 66 m. at VES station 28. The water-bearing layer (layer D) with its resistivity range of 19-28 Ohm.m increases slightly in thickness in the middle of the cross section (about 25 m.), but at both ends of the cross section it reaches 20 m. The top of this layer keeps a uniform depth below sea level of about 10 m. allover the entire cross section.

B-NW-SE cross sections

1 - Geoelectrical cross section (D-D´)

This cross section runs parallel and close to Wadi El Natrun Al Alamain Road, with a total length of about 8 kilometers (figure 8). It involves VES stations 2, 7, 13, 18, 23 and 29. The surface and the underlying clay layers are relatively thin and are affected by the changes in the topographic features. Towards the depression of Wadi El-Natrun to the east, there is a gradual decrease in the ground elevation. This has its impact on the thickness of the layers A, B and C but neither the thickness of the water-bearing layer nor its depth with respect to sea level are affected along most of the cross section.

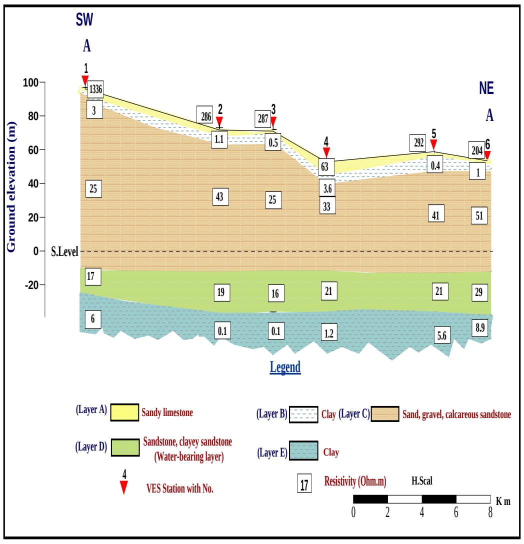

Fig. (5): Geoelectrical cross section A-A'

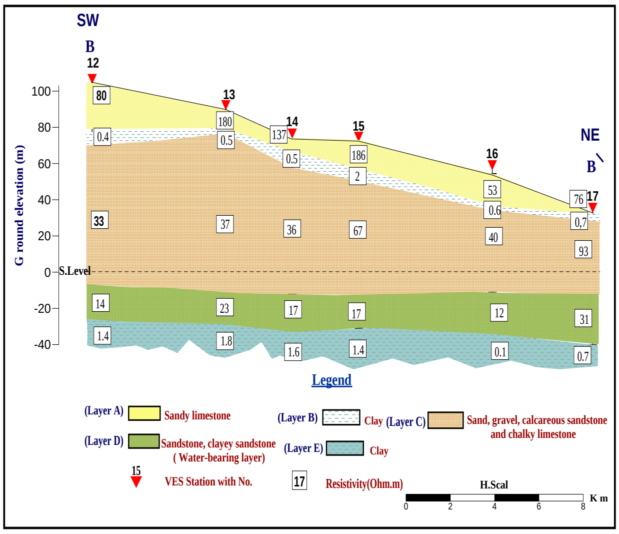

Fig. (6): Geoelectrical cross section B-B'

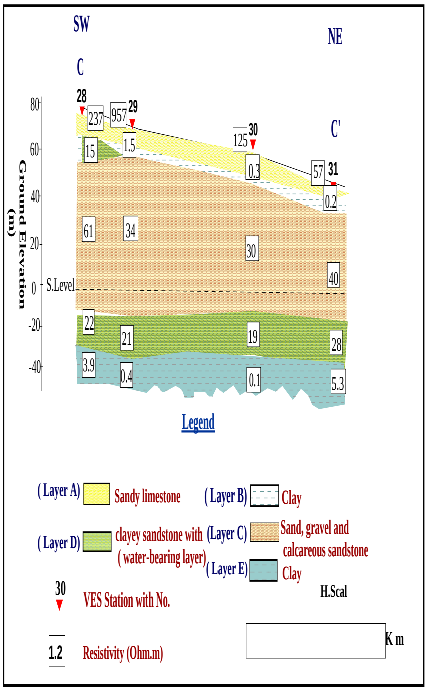

Fig. (7): Geoelectrical cross section C-C'

2 - Geoelectrical cross section (E-E´)

This cross section is based on six soundings, namely 4, 9, 15, 21, 25 and 30, as shown in figure (9). It extends for 10 kilometers. Due to topographic effects, the surface layer changes in thickness from few meters at both ends of the cross section to about 20 meters at the middle part, with a resistivity range of 63-117 Ohm.m. The shallow clay layer also follows the surface undulations. It is few meters in thickness and has a resistivity range of 0.6-3.8 Ohm.m. The dry layer (layer C) increases slightly in thickness towards the eastern part of the cross section, from 52 m at VES station 4 to 74 m at VES station 25, with a resistivity range of 30-78 Ohm m. The water-bearing layer has a more or less constant thickness of 15 m. in the interval between VES stations 9 and 30. At VES station 4, the thickness increases to reach about 23 m. This layer has a relatively low resistivity range of 12-21 Ohm.m along this cross section. The top of this layer is uniformly located at a level of about -13 m below Sea Level, in exception to VES station 4, where this level is two meters higher (-11 m.)

Geoelectrical cross section (F-F´)

This cross section has a length of about 18 kilometers. It passes through VES stations 6, 11, 17, 22, 27 and 31, as shown in figures (10). All of the concluded geoelectrical layers are represented along this geoelectrical cross section. The surface layer is relatively thin (1.6 to7 m) within the distance interval covered by the VES stations. Its resistivity varies widely from 24 Ohm.m at VES station 27 to 204 Ohm.m at VES station 6.The same holds true for the shallow clay layer (layer B), as far as the change in thickness is concerned (2.4 - 10 m.), while its resistivity is in the range of 0.2 to 3.6 Ohm.m. The third geoelectrical layer (layer C) shows variable thickness (38 m to 57 m). Consequently, the level to its top changes from 4.7 to 16.7 m and its resistivity also fluctuates with no specific trend from 29 to 93 Ohm.m. The water-bearing layer has a uniform thickness along the cross section ranging from 24 to27m. The Level to its top changes from about –15 m in the west to –13 m. in the east. Its resistivity varies from 18 to 31 Ohm.m. The clay layer underlying the water-bearing layer shows a wide range of low resistivity (0.7 to 8.9 Ohm .m) with the higher value being restricted to the western part of the cross section. This may be explained as due lithological changes across this layer such, as the increase of sand fraction, where high resistivity values are displayed.

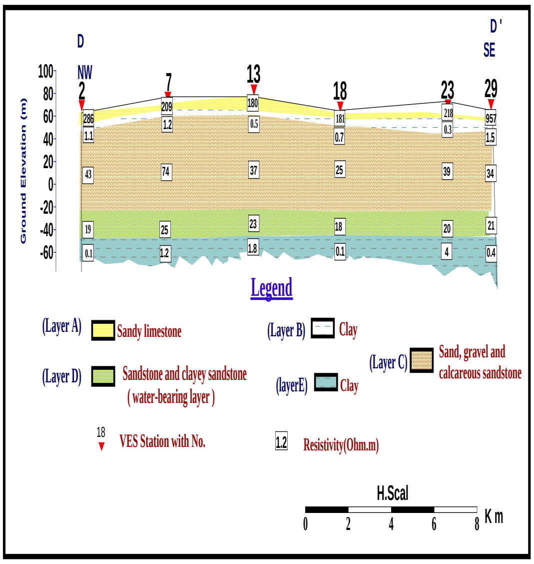

Fig. (8): Geoelectrical cross section D-D'

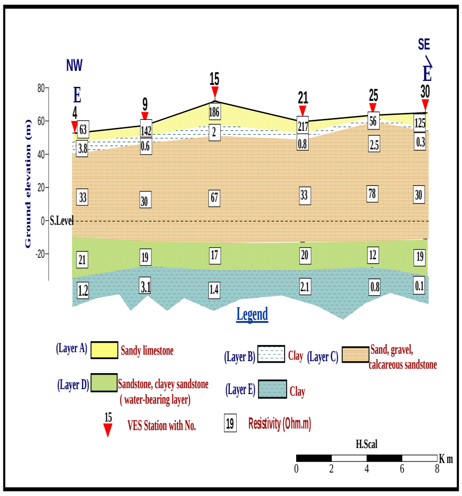

Fig. (9): Geoelectrical Cross Section E-E'

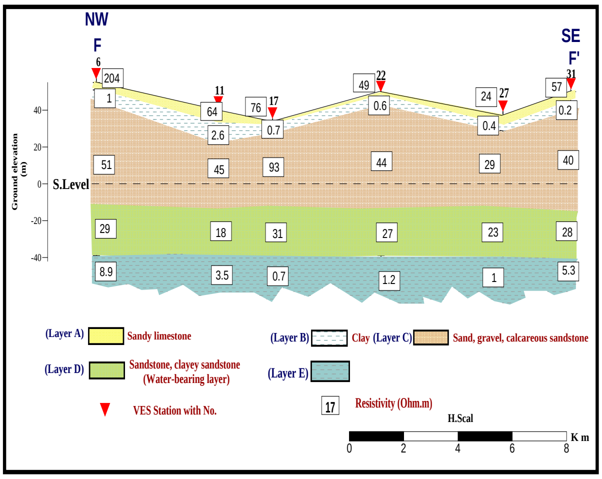

Fig. (10): Geoelectrical Cross Section F-F'

B- Contour maps

The contour maps are here constructed to describe mainly the water-bearing formation recognized within the interpreted geoelectrical succession as the 4th layer downward (layer D)

1-Depth to water contour map

The depth to top of this layer varies from 46 m in the northeastern part of the area to 116 m in the southwestern part, as shown in figure (11).The top of this layer lies 10 to 15 m below Sea Level, as shown in figure (12).The narrow and rather smooth change in altitude of this layer reflects the more or less evenness of its top surface. This can also be observed from the set of cross sections displayed previously.

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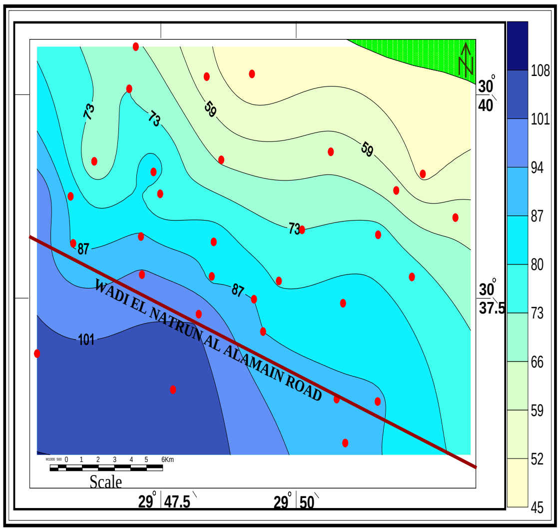

Fig. (11): Depth to Water contour Map.

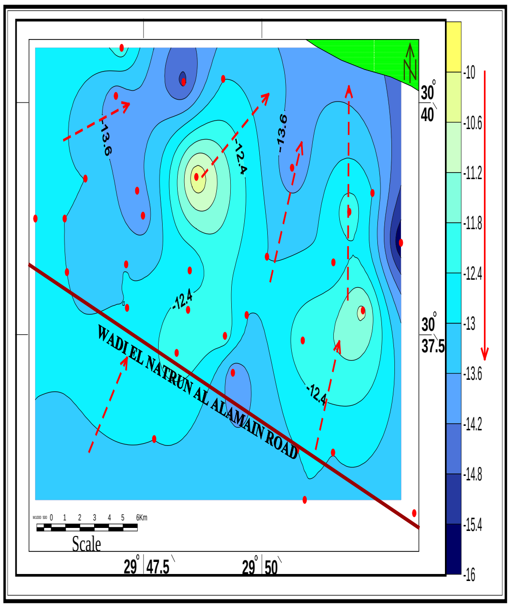

Fig. (12): Water Table Contour Map.

Isopach contour map

The thickness here (figure 13) varies from 10 to 29 m. contrarily to the trend of change in thickness of the other layers of the succession, this layer increases in thickness in the northern and northeastern directions towards the Nile Delta, as well as towards the western direction.

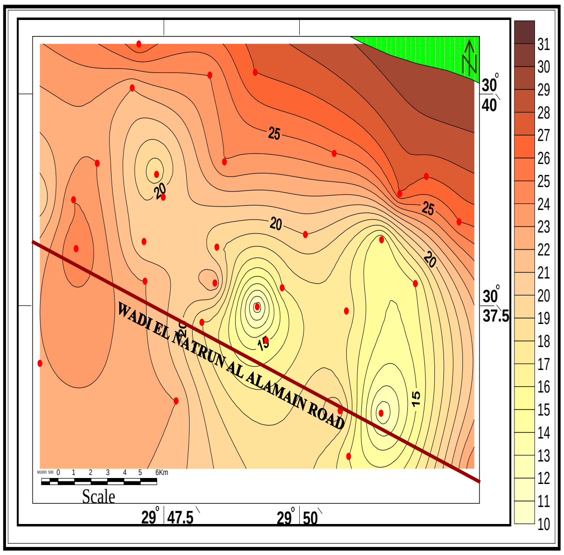

Fig. (13): Isopach Contour Map

Iso-resistivity contour map

The resistivity of this layer has a narrow range of change across the area of 12-31 Ohm.m. (Figure 14) This points out to a rather homogenous lithologic composition, as well as the presence of water within this layer.

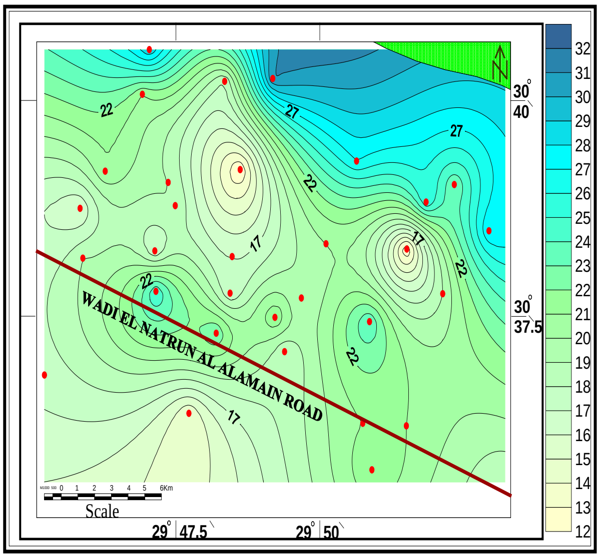

Fig. (14): Iso-Resistivity Contour Map

GROUNDWATER OCCURRENCE

According to the results derived from the interpretation of the geoelectrical measurements, it can be stated that, within the investigated depth interval of 46 – 116 meters in the area, there is a water-bearing formation, the characteristics of which can be described as follows:

Characteristics of the water-bearing formation

1- The depth to top of the water-bearing formation varies between 50 and 107 meters. This is equivalent to a level range of – 4 to – 16 meters with respect to the Sea Level. This wide range of depth is mainly attributed to a corresponding wide variation in topography, as the ground elevation of the study area varies between 19 meters in the northern and northeastern parts, towards the Nile Delta, to 113 meters in the southern and southwestern parts, towards the tableland.

2- The thickness varies between 10 and 29 meters, however, in most parts of the study area it has a rather uniform thickness with an average value of about 21 meters. Relatively greater thickness is observed mainly towards the Nile Delta.

3- The electrical resistivity of the formation has the range of 12-31 Ohm.m, which is considered to be slightly less than that of an aquifer having properly fresh ground water.

4- From the interpreted geoelectrical succession, it is clear that the present aquifer is of the free type, where it is underlain by a clay layer, while the overlying dry sediments are not of the water confining type. According to the water table map, the groundwater flow lines are directed from the southwest towards the northeast.

5- The present interpreted geoelectrical data, together with the data available from the water well DW2 and the known regional geology and hydrogeology of the area point out to the conclusion that, the water-bearing formation is formed of the Pliocene deltaic deposits in the form of sandy clay and clayey sand.

6- The aquifer water is expected to be slightly brackish, as the overall formation resistivity does not exceed 31 Ohm.m. In this respect, the water quality is mainly affected by the type of sediments rather than the salinity of water itself.

Groundwater potential map

To transform all the conclusions reached about the water-bearing formation into "practically working" information, a decision map or water priority map is constructed to reflect the groundwater potential across the different parts of the study area. In constructing this map use was made of simple BASIC program written for this purpose (El Shenawy 2005), and also the following were taking into consideration.

1- The water-bearing formation has a more or less uniform thickness and lies at almost the same level with respect to that of the sea, while due to the topographic features, it has different depths to its top. So, the depth to water plays an important role in the availability of water .

2- Both of the relative thickness and resistivity play a role, which can be considered a secondary role as to the water potential.

So, the depth to water was given the value of 50 %, while each of the thickness and resistivity were given the value of 25 % in constructing the map shown in figure (15). The map indicates, area-wize, the graded parts of the area according to the conditions governing the occurrence of groundwater. First priority parts reflect the relatively best characteristics including topographic conditions, depth to water, thickness of aquifer and electrical resistivity (and consequently water quality).

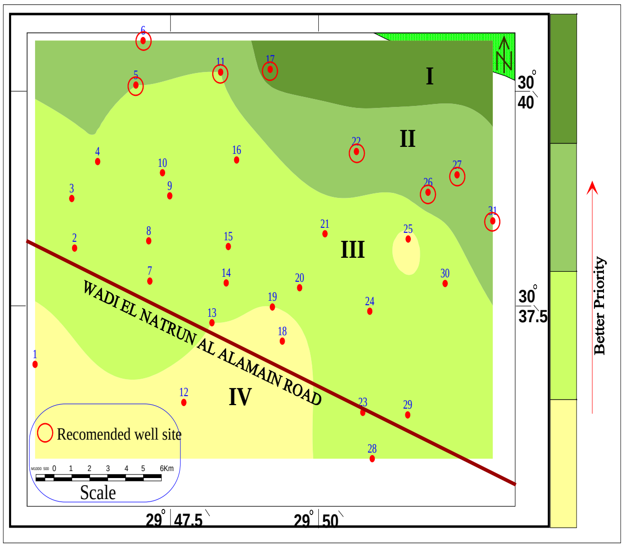

Fig. (15): Groundwater Potential Map.

The map indicates that, the area can be recognized as consisting of four "belts" running consecutively in the NW-SE direction; i.e. more or less parallel to the Wadi El Natrun – Al Alamain road. The relatively best priority is given to the northeastern belt, which is relatively closer to the Nile Delta, while the least priority is that of the southwestern belt which is the highest, of more rough topography and of more rocky surface. In between come two other belts of intermediate priorities. The four belts are categorized according to table 3

This map is considered to be of a practical importance when dealing with the overall development of the area, based on its local groundwater resources.

Table (3): Water Potential Categories

Category	Depth to water (m)	Thickness (m)	Resistivity (Ohm.m)
I	49 – 66	27 – 33	23 – 31
II	66 – 82	21 – 27	20 – 23
III	82 – 99	16 – 21	16 – 20
IV	< 116	< 16	< 16

RECOMMENDATIONS

According to the reached results in this work and the concluded groundwater potential map, the following recommendations could be derived:

1. There is an aquifer in the study area. that can be exploited for most of the development purposes.
2. The best sites recommended for the drilling of water wells are marked on the water potential map, with the site specifications given in table 4.
3. The indicated sites for the drilling of water wells in the study area are actually not the only sites to be recommended, but they are rather the sites confirmed by the VES measurements and located through the topographic survey. This implies that, more wells can be drilled on the condition that they should be guided with the given water potential map, the amount of water required for a specific project and of course the budget allocated for that project.
4. Well logging, pumping test analysis and monitoring of water salinity should be carried out for each of the wells to insure precise location of the water producing zone, to determine the proper safe yield with the suitable draw down and to keep the pumping rate with the desired groundwater salinity.

Table (4): Specifications of the sites recommended for water well drilling

Site (VES Station No.)	Total Depth of well (m)	Depth To Water (m)	Water Table (m)	Aquifer Thickness (m)	Resistivity (Ohm.m)
17	73	46	-13	27	31
6	94	67	-13	27	29
31	89	63	-16	26	28
22	88	63	-14	25	27
26	89	62	-12	27	26
27	77	50	-13	27	23
5	95	73	-13	22	21
11	79	55	-15	24	18

CONCLUSIONS

The method of Vertical Electrical Sounding (VES) has been successfully applied to an area of about 102 sq. km. surrounding the middle part of Wadi El Natrun –Al Alamain road with the objective of revealing its groundwater setting. Interpretation of the 31 resulting sounding curves and presentation of results through 6 geoelectrical cross sections and 5 contour maps indicated that, a water-bearing formation formed of Pliocene clayey sandstone and sandy clay exists in the area within a sedimentary succession of 5 layers. The depth to top of this formation is 46 – 116 m, governed mainly with topography; its thickness has the range of

10 – 29 m, and the range of its electrical resistivity is 12 – 31 Ohm.m.. The water table lies at the level of-10 to -13 as related to the Sea Level. The measured true resistivity of the water-bearing formation suggests its water to be slightly saline. The groundwater potential of the different parts of the study area is clearly displayed through a groundwater potential map (priority map or decision map) which indicates 4 " belts " having 4 grades of groundwater potential. At least, 8 sites are recommended for the drilling of water wells with the specifications of each of the sites and wells, together with the precautions that should be followed for the wells and extracted water.

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