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GEO ELECTRICAL STUDY ON THE UPSTREAM AREA OF WADI QENA ESTERN DESERT EGYPT

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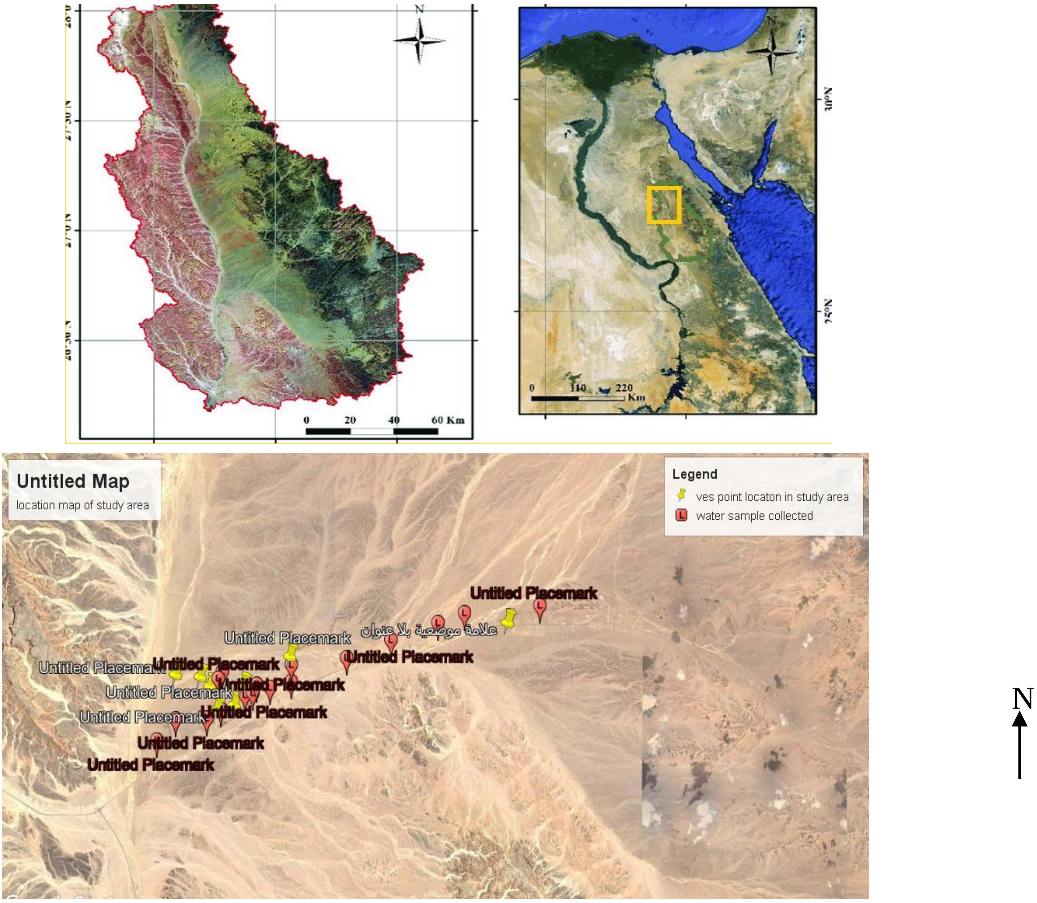
The study area is apart of the upstream area of Wadi Qena, Eastern Desert. It is one of the largest promising areas for development in Upper Egypt. A new road was Upper Egypt to Red Sea, new road passing through the study area. This accelerates forms of development in the selected part of WadiQena. The development focused on reclamation of new lands based on groundwater. The depth and thicknesses of the water- bearing formation clearly are not defined . Acrid widely applying of Vertical Electrical Sounding ''VES'' technique in camping with the utilized excesting groundwater wells were applied to detect both depth and thickness of the water-bearing layers in study area . was applied to define the subsurface lithology to depth around 200m below the ground surface description the lithology of the study area and the depth of ground water and the water bearing formation, Thirteen Vertical Electrical Sounding ''VES''usinge schlumber ger array with AB/2 ranging from 1.5m to 600m and MN/2 from 0.5m to 90m are reseanable for depth of uestuyatin till 200m in optimum cenditens the predominant subsurface litheolgy in the study area was defined from the drilled ground water wells . the litheolgy was used in calibrating the interpretation resalts of the measured VES'S based on the calibercition the water-bearing layer was cherateized by resistivity ranging from 40 Ω to 480 Ω this wide range of resistivity is depend on the areat lateral variation in water quality and litheolgic chorocter katuin of the water-bearing formation. the depth to the water- bearing formation in the study area ranging from 18.8m to 127m below the ground level, however it thickness is ranging from 45m to 158m

INTRODUCTION

Water is an important to food and important to life. The need for water is strongly ascending and has a diversified function, which is not only important for drinking purposes but is also vital for any developmental in these days, the use and sustainability of water is complex due to population growth, urbanization and industry. The study area is one of lateral extension for land reelimation. The area is located at the upstream of wadiqnea that bounded by latitude 26 38 28 N to 26 45 30 N and longitude 32 44 20 E to 32 58 10 E. the ground water investigation and evolution were the main objective in the study. The earth resistivity method Vertical Electrical Sounding ‘‘VES’’ technique was applied in the present study . this technique was applied for groundwater investigation and evaluation allover the world by Anthony A.Duha, Ralph Tagoe Kwasi preko in March 2019 Application of Vertical Electrical Sounding for groundwater exploration of cape coast municipality in the central Region of Ghana and Vertical Electrical Sounding ‘‘VES’’ Geophysical Exploration analysis of part of south-East Agroclimatic Zone of Karnataka, Kolar Distric , Karnataka, India using Geographical Information System (GIS) Techniques. and in Egypt by Groundwater can be discovery using different methods. The major groundwater discovery methods are the areal method, surface method, subsurface method. Among these methods. Each of the above listed ground water discovery methods have different sub-methods under them. Geophysical survey is one of the sub-methods under the surface method of groundwater discovery. This method is important for groundwater resource mapping and water quality evaluations. Its application for groundwater exploration purposes has increased over the last few years due to the rapid advances in computer packages and associated numerical modeling solutions



(Fig 1) Location map of study area latitude 26 38 28 N to 26 45 30 N longitude 32 44 20 E to 32 58 10 E

1. GEOMORPHOLOGY AND GEOLOGY OF THE STUDY AREA

The study area lies on the eastern bank of the River Nile. It is represents small part of wadi Qena. The erea is formed relatively from low-lying conspicuous plan covered by sediments of age ranged between plio-pleistocene and recent. These sediments are generally derived and deposited and deposited by the action of surface water runoff in addition to the role of winds.

Geologically Wadi Qena had been studied by many authors, such as: ***Hume (1911***)Nakkady and (1958)Said (1962) and Awad and Abdallah (1966) and El-Tarabili (1966).and Abd Allah et al., (1977) Kassab (1982) and ***Issawi and Jux (1982)*** and***El Ramly (1973)*** and Issawi and

Jux (1982) and El Gaby et al. (1988) and Kassab (1985) and Soliman et al. (1986) and Bandel et al. (1987)

And Shalabi et al. (1987) and EI-Shami (1988) and ***El-Rakaiby (1989)*** and

Klitzsch and Hermmina (1989) and Luger and Groschke (1989) and Phi1obbos and Abdel Rahman (1990) and ***El-Shami (1992 a & b)*** and ***Omran et al. (1995)*** and Aggor (1997) and ***Senosy (1997)*** and ***Sultan et al. (2000)*** and

Elewa et al. (2000) pointed out that the area of Wadi Qena basin divided into the following main landforms:

1. Platforms.

(a) Limestone Plateau is dissected and consists mainly of beds of hard, jointed and fractured limestone. A flat-topped surface at Gebel Aras (524 m a.s.l.) represents a hard, massive, structurally controlled landform and provides a suitable

catchment area.

(b) Plateau of Nubian Sandstone is mainly composed of hard, massive sandstone beds forming dissected patches. These patches contain some beds of clay sand iron oxides that highly affect the groundwater conditions and quality. Also,

This plateau is cut by few main faults.

2. At the northeast corner of the investigated area, Tors is appear as a small part and represents Precambrian basement rocks exposures. Also, they are highly weathered and represent a part of the groundwater aquifers catchment areas

3. Fault Scarps: The area is affected by structural disturbances that created major fault scarps with steep slopes (38_ - 75_). These scarps moderate to trend NW-SE and N-S.

4. Alluvial Deposits

(a) Alluvial Fans which are dispersed in the area of investigation due to the presence of fault scarps inducing topographic difference between the plateaus and the wadis. These fans are composed mainly of sands, clay and gravels.

(b) Flood Plains which are nearly flat and completely cultivated. It belongs to the Pre-Nile and is of Quaternary age (Said,1981) and is composed mainly of mud, silt and clay with some sands.

2. STRATIGRAPHY

The area under investigation is formed of a sedimentary succession as ment area by Ahmed (1983)composed simply of Nubia Sandstone (at the base) overlain by a shaly sequence (Quseir Shale) intercalated in its lower part with two phosphorite horizons at Gabal Abu Had and by a phosphatic oyster bed in the southern part at Wadi Hamama. The Duwi Formation conformably overlies the Quseir Shale, and constituted of three phosphorite beds intercalated with shale, marl and sandstone. It is overlain by a succession of siliciclastics divided by the Tarawan Chalk (6 m thick) into Dakhla Shale (below) and Esna Shale (above). The Esna Shale is capped by Lower Eocene limestone which forms the surface of the plateau.

3. STRUCTURAL SETTING

According to the EGSMA (1983), WadiQena can be considered as an anticlinal structure plunging due south. Several faults affect the wadi and its tributaries. These faults take trends N-S, NNW-SSE, NNE-SSW and NESW. The most effective trend is the NW-SE (Elewa et al., 2000).

4. HYDROGEOLOGICAL SETTING

The hydrogeological setting of the study area was built up on the geological, geophysical investigations and the available data of old and recent drilled bore holes. The predominant hydrostratigraphic units of the WadiQena could be divided into five horizons in the following:

a) (first horizon) Quaternary aquifer,

The Quaternary aquifer lies on the top most part of the hydrogeological section. It consists of different types of deposits as; sandstone, gravels, conglomerate with silt and sand interbeded, with athickness ranging between few meters to more than 75m, this thickness decreases in north, and these facies change to clay, shale and silt. These deposits considered as a shallow aquifer.

b) (second horizon) Shale or clay,

It consists of different types of clay, shale with a thickness ranging between 50 to more than100m. These imporous deposits considered as aquiclude horizon.

c) (third horizon) Fracture limestone and dolomite:

It consists mainly from fractured limestone and dolomite with marl and gypsum intercalations.

The thickness of this deposits ranging between 100 to 250m, it considered as moderately productive aquifer, belonging to Upper Cretaceous age.

d) (Nubiansandstone horizon) Lower Cretaceous sandstone,

It is considered the main sandstone aquifer in the area and composed of sandstone with clay

intercalations, the thickness of this horizon ranges from 100 to 350m (the lower Cretaceous aquifer

e) (igneous and metamorphic horizon) The basement complex,

It consists of different types of igneous rocks. These rocks usually contain joints and cracks which are considered as conduits and very important for recharging all the aquifers in the Wadi area (lateral recharge). This type of rocks considered an aquifer horizon with thickness of more than 2000 m (Manal Abd El Monem, 2014).

5. RESISTIVITIES OF WATER BEARING FORMATIONS:

The resistivity of water bearing formations are mainly affected by a number of geological and hydrogeological factors mineralogical content, porosity and degree of water saturation as well as the texture and structure of the rocks, are the main factors that controlled the resistivity of the water bearing formation and shale content, pressureand temperature. Generally, statistical averages of the common rock types indicate that shale is low resistivity than sandstone, which in turn have Avery low resistivity than limestone. Saturated rocks have low resistivity than unsaturated and dry rocks. In addition to, saturated rocks, with higher salinity of water fluids have a lower resistivity. The presence of clays and conductive mineral, also, reduces the resistivity of the rock bearing formations. Also, the resistivity of water bearing formations decreases with increasing temperature; the dependence on pressure is complicated.

6. CALIBRATIONS OF RESISTIVITY RANGES CORRESPONDING TO DEFERENT ROCK TYPES IN THE STUDY AREA.

Several groundwater wells had been drilled in the study area. The subsurface lithology obtained from the oral discussion with the formers as sam in figure(1) is Start by dray sand and gravel with thickness range from 4 - 6m , followed by think clay and silt intercartion with average thickness 30 - 50m. them shallow water-bearing fine to medium sandstone with a verge thickness 18 -130 m. another water-bearing formation was recognized at depth ranging 400- 6oom with undefined thickness.

By Campaign the above mentioned general subsurface lithology in the stud area, the following resistivity ranging corresponding to the different lithology units can be established as follow:-

1- dry sand and gravels formation has resistivity range from 87144 Ω to 11000 Ω.
2- clay and silt interactions ha resistivity range from 35000 Ω – 2750Ω.
3- Shallow water-bearing fine to medium sandstone has resistivity ranging from470 Ω to 41 Ω.
4- The deep water-bearing sandstane has resistivity ranging between 500 Ω and 40 Ω This layer is only recommended at Ves no18
5- The dry weathered basement and dry sandstand situated at the bottom of resistivity more than 10000 Ω.

7. DATA ACQUISITION

About 13 vertical electrical sounding were measured in the study area the ves's located were distributed to cover most of the study area based on the topography and site acesability. The ves's were measured by ABES SAS300 by using schulmberger arrey.

the distance AB/2 ware ranging from 1.5m to 120m and from 0.5m to 90m fore MN/2.

8. INTERPRETATION OF VES DATA

The field Ves data was tested for odd values which checked in the field severeal times to obtain actual data. The resistivity values Ves plotted against AB/2 on a bilogarthemic prepares for obtaing VES curve. The

VES curve were drown and smoothed using IP2Win software (2014) . The smoothed curves were analyzed automatically by the same software and verified by the Known subsurface lithology obtained from the existing ground water wells Figer no 2,3,4,5,6,7,8.9.10,11 are examples for the interpretation curves and ves.

Table no (1) shows the interpretation results of the VES'S.

VES			True Resistivity					Depth in meter						Thickness in	
	ρ١	ρ٢	ρ٣	ρ٤	ρ٥	٦	ρ̇٧	D_1	D_2	D_3	D_4	D5	D6	H_1	H_2
calprati	1810	64399	1320	690	4.44			0.6	1.81	28.2	234			0.588	1.2
1	25612	320000	180000					0.6	1.7 5	11.2				0.6	1.1
3	17000	5606	484	23000				4.64	51.3	181				4.64	46.
4	32000	9174	374	26000				2.84	48.4	87.9				2.84	45.
7	6431	39427	3679	226	59000			0.23	٦.١٥	٣٣.٧	٦١.٢			0.23	5.92
9	10833	2751	67.7	14000				3.88	21.2	43.5				3.88	17.
11	16000	5383	324	25000				4.32	14.8	45.7				4.32	14.
12	33837	11803	41.1	47331				1.35	3.97	11.4				1.35	2.62
13	87144	31000	14118	427	8000			2.09	4.95	29.8	59.8			2.09	2.8
14	22445	7133	163	9002				7.17	30.7	158				7.17	23.
15	10317	9109	3703	122	6339	59795		1.78	2.29	9.21	102	163		1.78	0.51
17	32891	3504	470	39000				1.7	7.88	47.1				1.7	6.1
18	49000	100000	6560	824	14997	375	21000	0.296	3.13	12.1	25.7	53.7	128	0.296	3.01
19	19704	11000	902	145	90429			0.99	1.91	20.7	45.4			0.99	0.92

Table: Results obtained from the interpretation data of the VES curves.

VERTICAL DISTRIBUTION OF SUBSURFACE RESISTIVITY
10. PARAMETERS

N	ρ	h	d	Alt
1	1810	0.588	0.588	-0.588
2	64399	1.23	1.81	-1.814
3	1320	26.4	28.2	-28.21
4	690	206	234	-234
5	4.44			

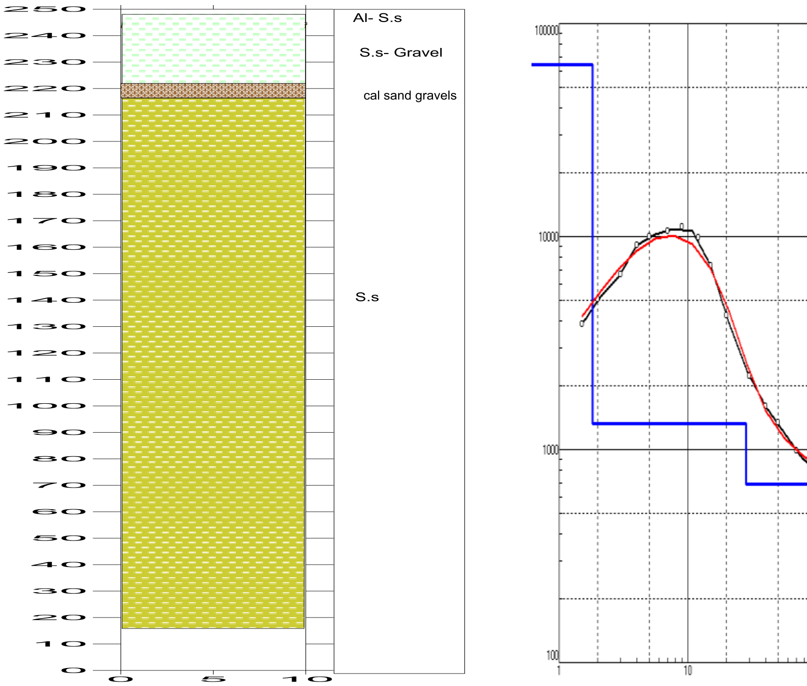
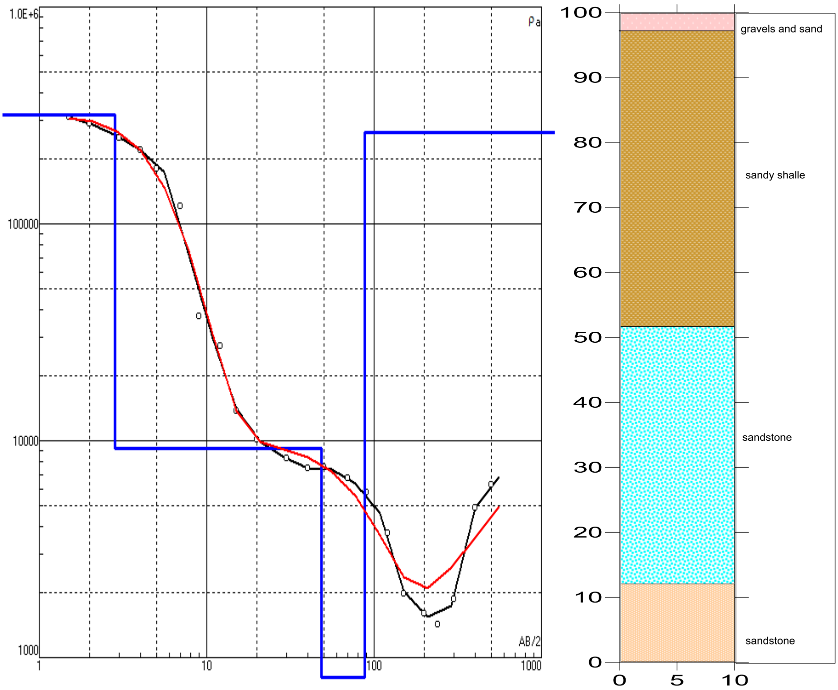
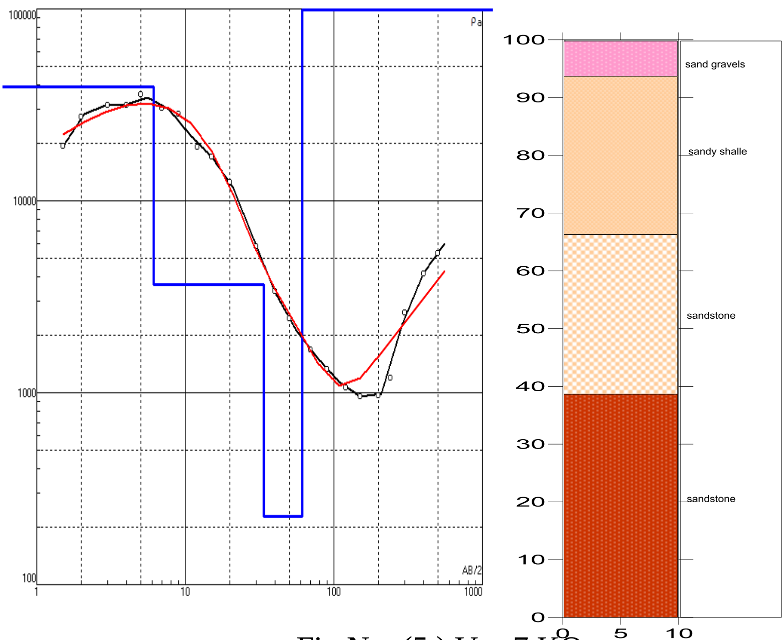


Fig No(3)Ves calparation *HQ type*



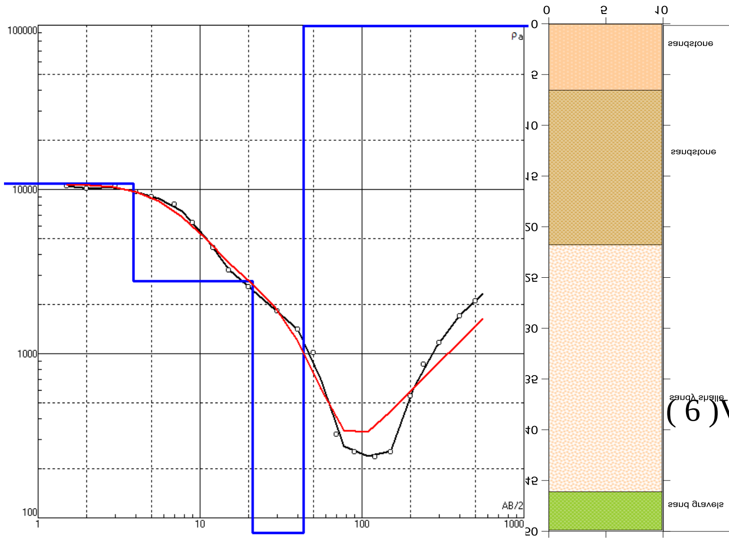
N	ρ	h	d
1	3.2E+5	2.84	2.84
2	9174	45.6	48.4
3	374	39.5	87.9
4	2.6E+5		

Fig No (4)Ves 4 QH type



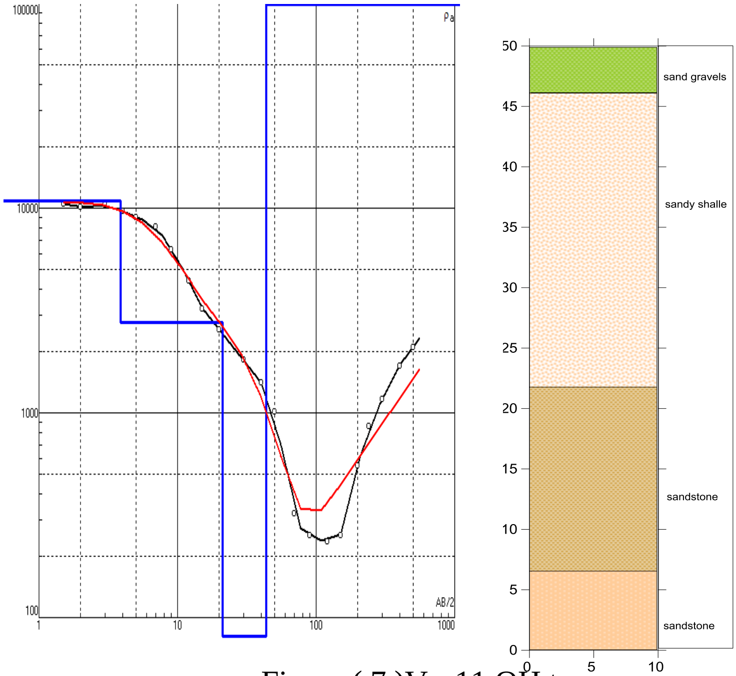
N	ρ	h	d
1	6431	0.23	0.23
2	39427	5.92	6.15
3	3679	27.5	33.7
4	226	27.5	61.2
5	5.9E+5		

Fig No (5) Ves 7 KQ type



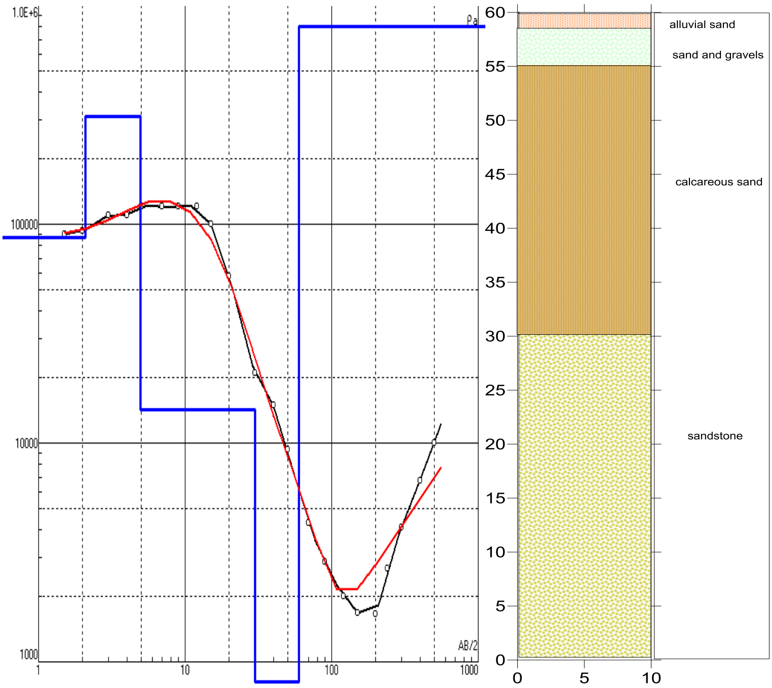
(6)Ve

N	ρ	h	d	
1	10833	3.88	3.88	-3
2	2751	17.3	21.2	-2
3	67.7	22.3	43.5	-4
4	1.4E+5			



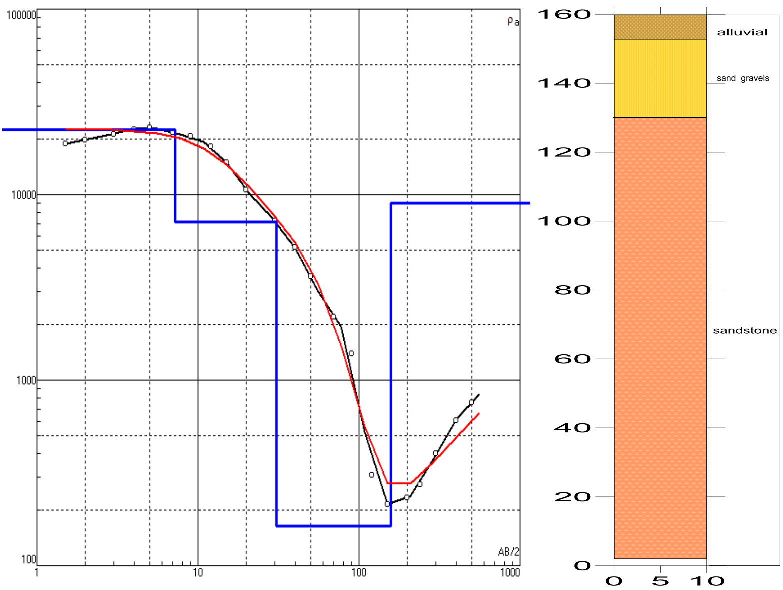
N	ρ	h	d	
1	1.6E+5	4.32	4.32	-4
2	5383	10.5	14.8	-1
3	324	30.9	45.7	-4
4	2.5E+5			

Fig no (7)Ves11 QH type



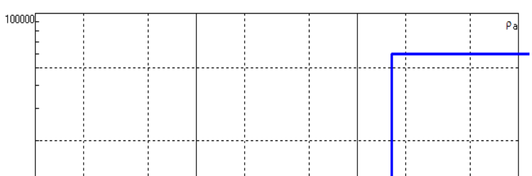
N	ρ	h	d
1	87144	2.09	2.09
2	3.1E+5	2.86	4.95
3	14118	24.9	29.8
4	427	29.9	59.8
5	8.0E+5		

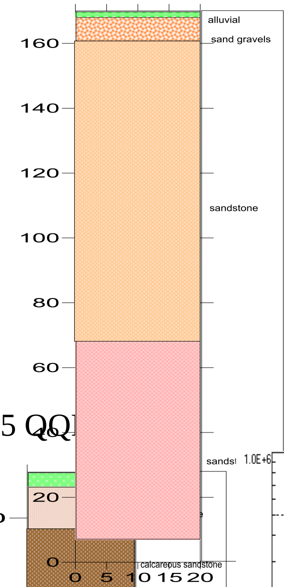
Fig no(8)Ves13 KQ type



N	ρ	h	d
1	22445	7.17	7.17
2	7133	23.5	30.7
3	163	127	158
4	9002		

Fig No (9)Ves 14 QH typ

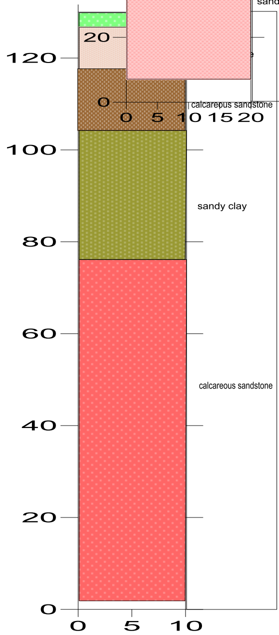




N	ρ	h	d
1	10317	1.78	1.78
2	9109	0.513	2.29
3	3703	6.92	9.21
4	122	93.2	102
5	6339	61	163
6	59795		

Fig No(10)Ves no 15 QQ

N	ρ	h	d	Alt
1	4.9E+6	0.296	0.296	-0.296
2	100000	3.01	3.31	-3.306
3	6560	8.81	12.1	-12.12
4	824	13.6	25.7	-25.72
5	14997	28	53.7	-53.72
6	375	74.1	128	-127.8
7	2.1E+5			



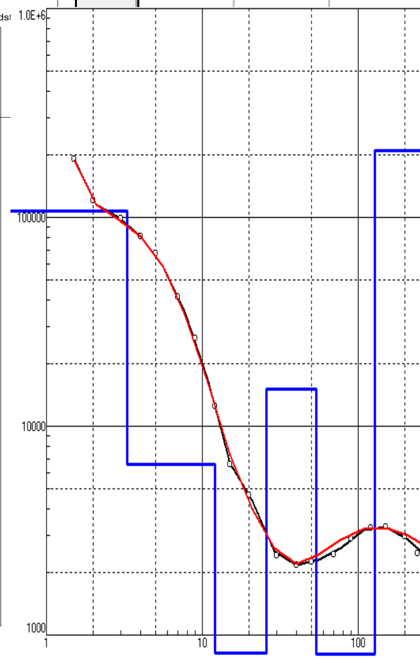


Fig No(11)Ves 18 QQH type

Apparent reistivity section.

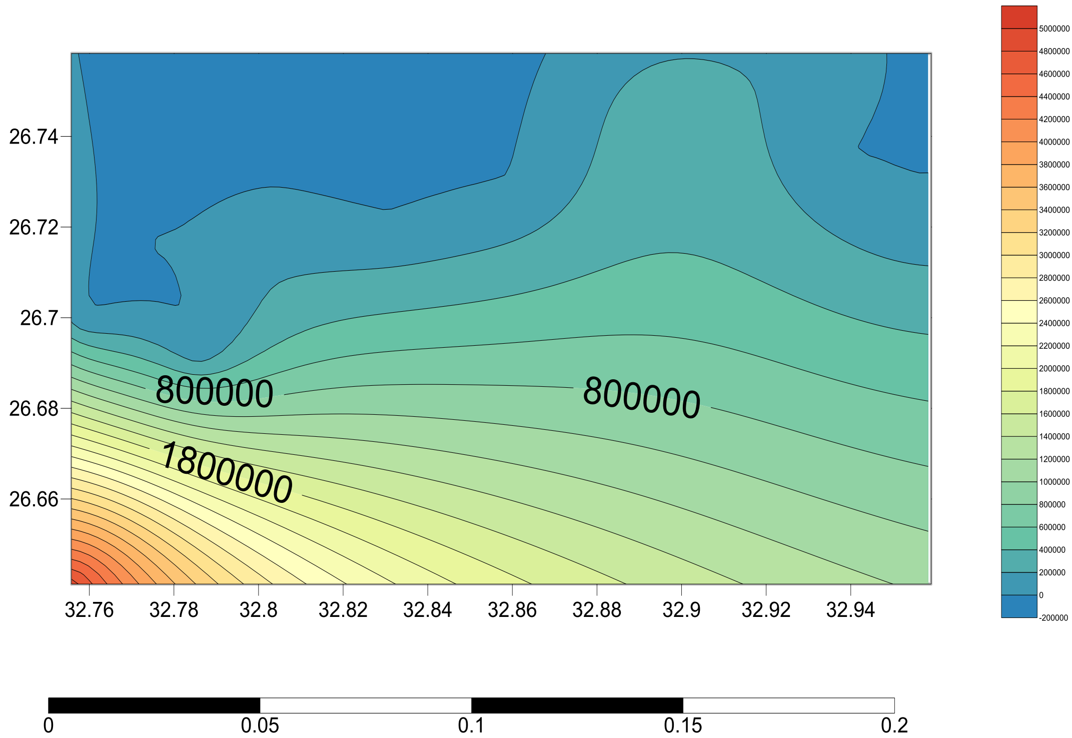
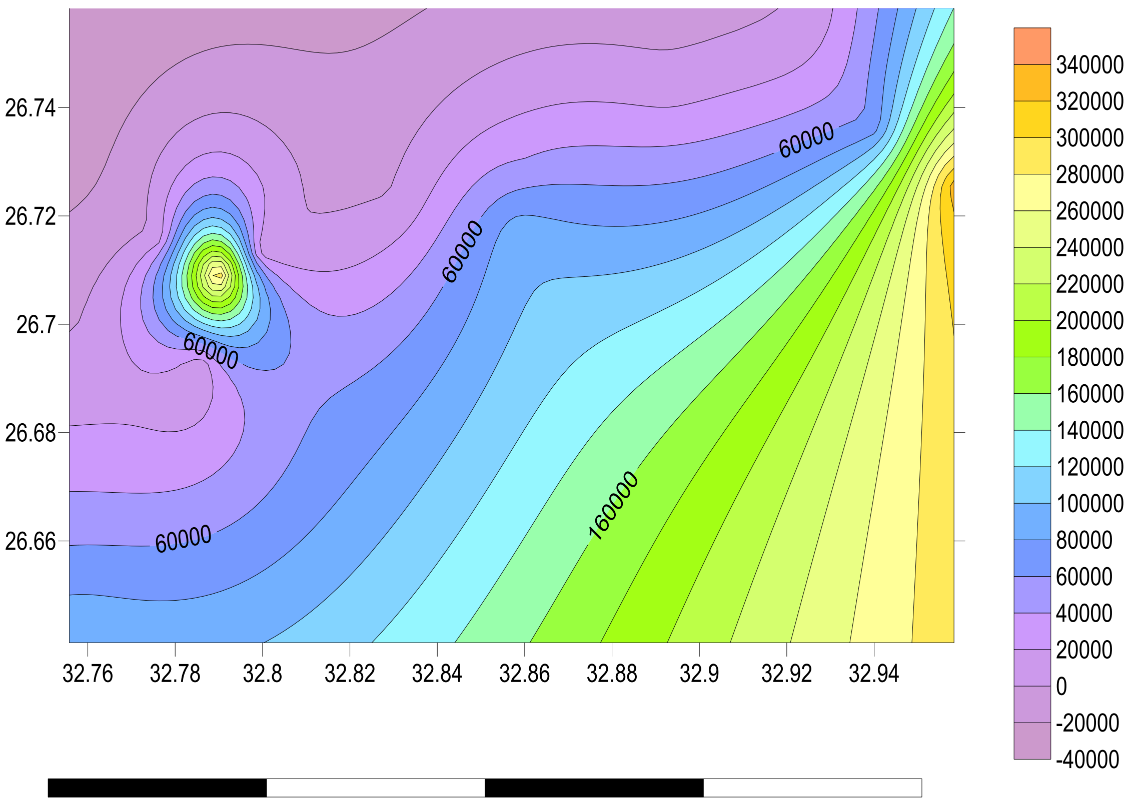
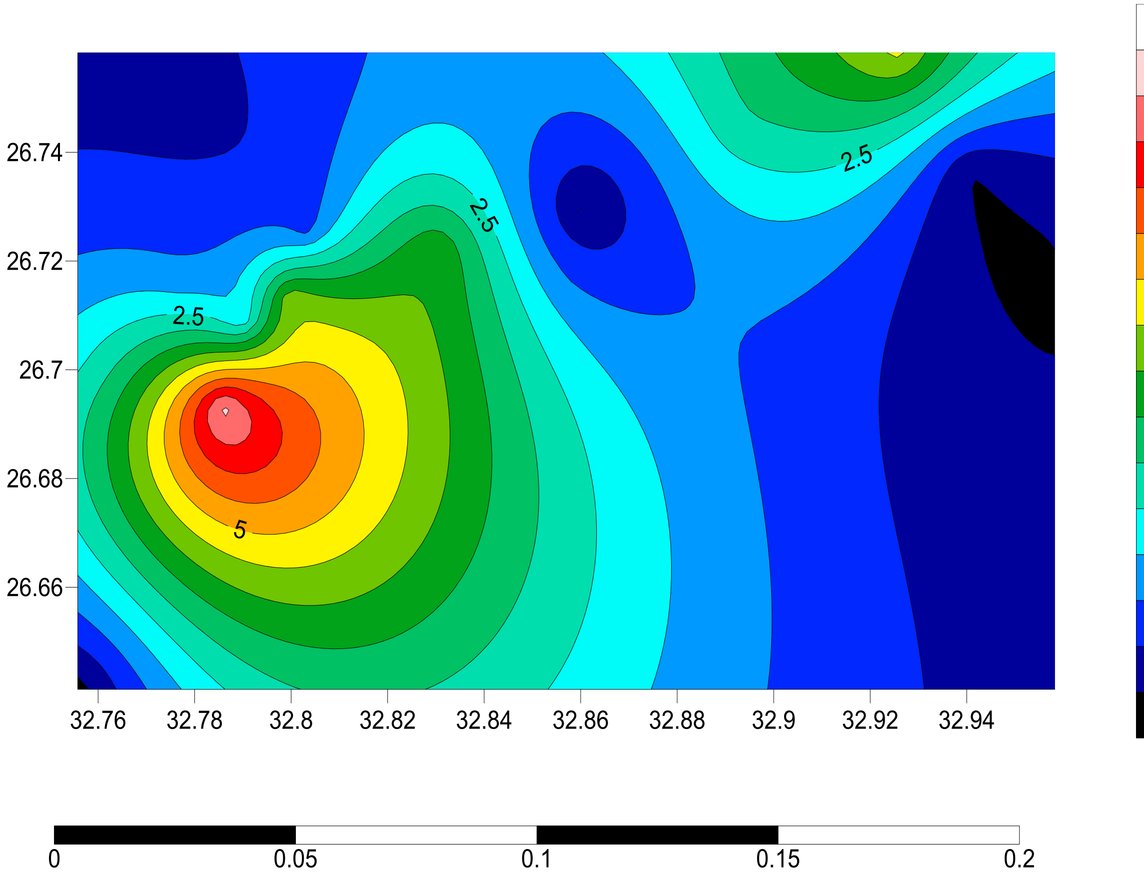
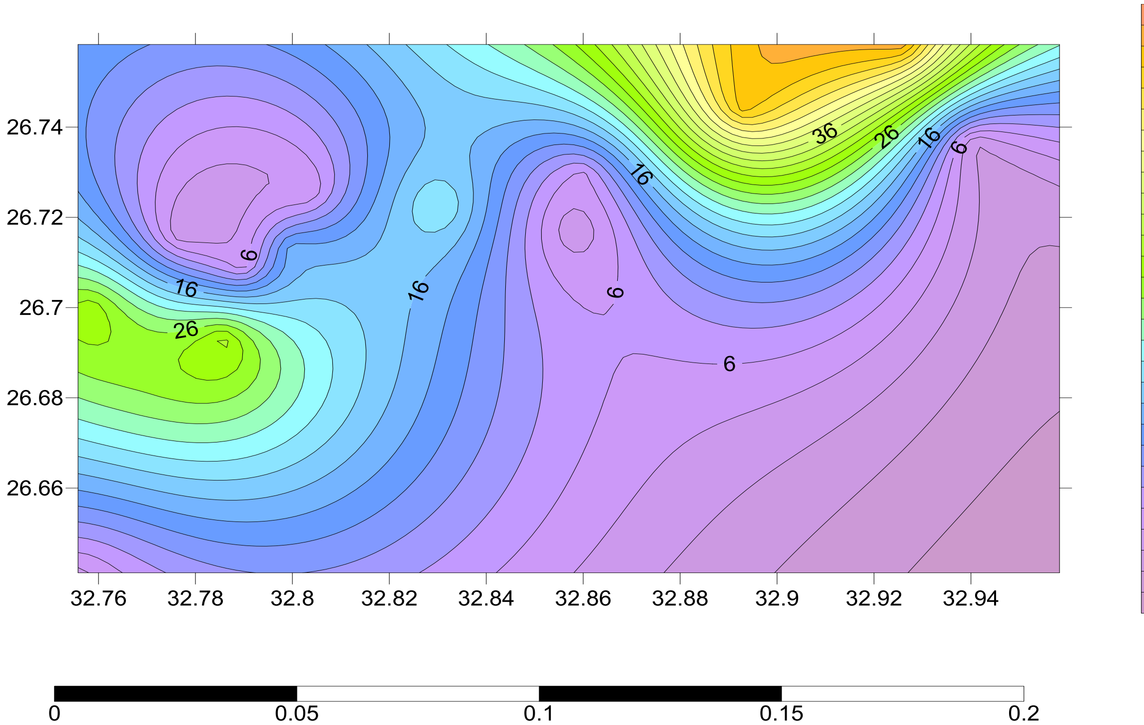


Fig no (12) ῤ1




26.74
26.72
26.7
26.68
26.66
2.5
2.5
2.5
2.5
5
32.76
32.78
32.8
32.82
32.84
32.86
32.88
32.9
32.92
32.94
0
0.05
0.1
0.15
0.2



Depth contour map

11. RESULTS AND DISCUSSION

Interpretation the measured ves curves showed that most of curves are pointing foure and five geoelectric layer (table…….)there curves are of QH, KH, KQ, QQH, KQH, types. To show the lateral and vertical variation of the geoelectric layers and ther lithelogy two geoelectrice cross section (AĀ - BB̄)were constricted. There section were selected to cross the study area from North to south and another from North East to South West The second geoelectriclayershows resistivity smaller than the first layerrange from **32000 Ω to 2750 Ω** corresponds to dry sand and gravels intercalated with clay lenses with thickness range from 1.5 m in some ves increasing to 30m in other veses

3-The third geoelectric layer have low resistivity rang from 18000 Ω decrees to less than 160 Ω with a thickness range from 5 m increase to 150 m in other ves corresponds to water- bearing sediments which are made of calcareous sandstone.

Generally the ground water in study area is found near to the surface the distance between water table and the surface is about 50-70 m

The ground water is found in sandstone rock

12. Geoelectric Resistivity

Geoelectric Cross–Section 1(A-A')

This section extends along the main stream of WadiQena from north east to south west north, starting from VES 4 and passing through VES7 and 9 in the south. Foure geoelectric layers are recognized along this section. The first geoelectric layer shows resistivity value ranging from 32000 Ω to 10833 Ω.m. with thickness range from 4m to 6m corresponding to gravel and sands this layer considered the surface layer in the study area.

The second geoelectric has resistivity ranging from 39427 Ω - 2751 Ω.m with thickness range from 45.6m in ves no 4 decrease to 17.3m in ves no 9 this wide range resistivity indicating great lateral litheology variation of the layer. this layer corresponds to sandstone.

The third geoelectric layer has resistivity range from 374Ω to 67 Ω the resistivity les than 470 Ω corresponds to water- bearing sediments with a thickness range from22 m to 40 m which are made of sandstone.

The fourth geoelectric layer is accrued as lenses of limited lateral extension corresponds to the basement rock intercalated with sandstone that has relatively high resistivity values range from14000 Ω to 59000 Ω.

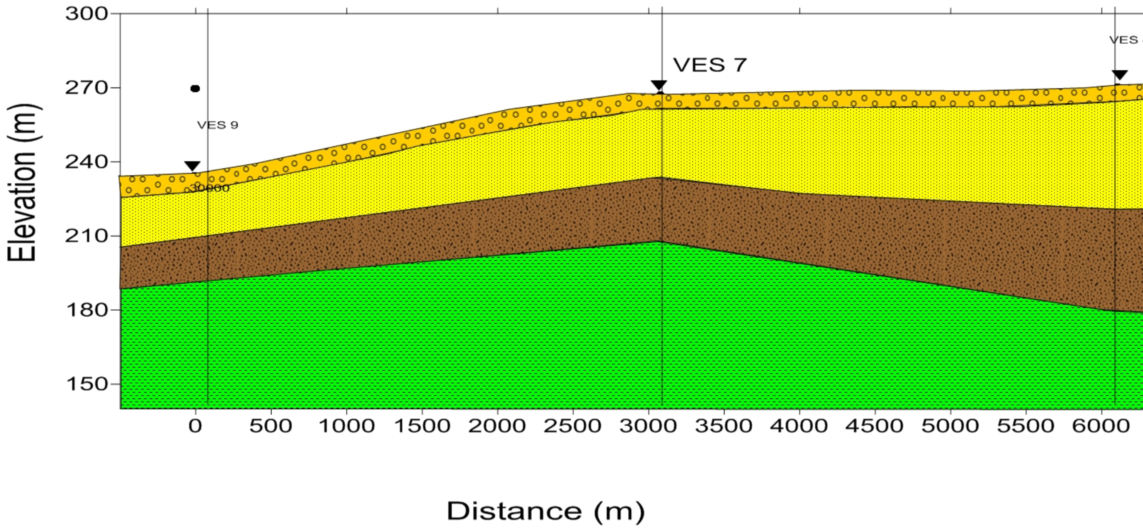


fig (2.28) cross section 1 between ves's(4.7.9)

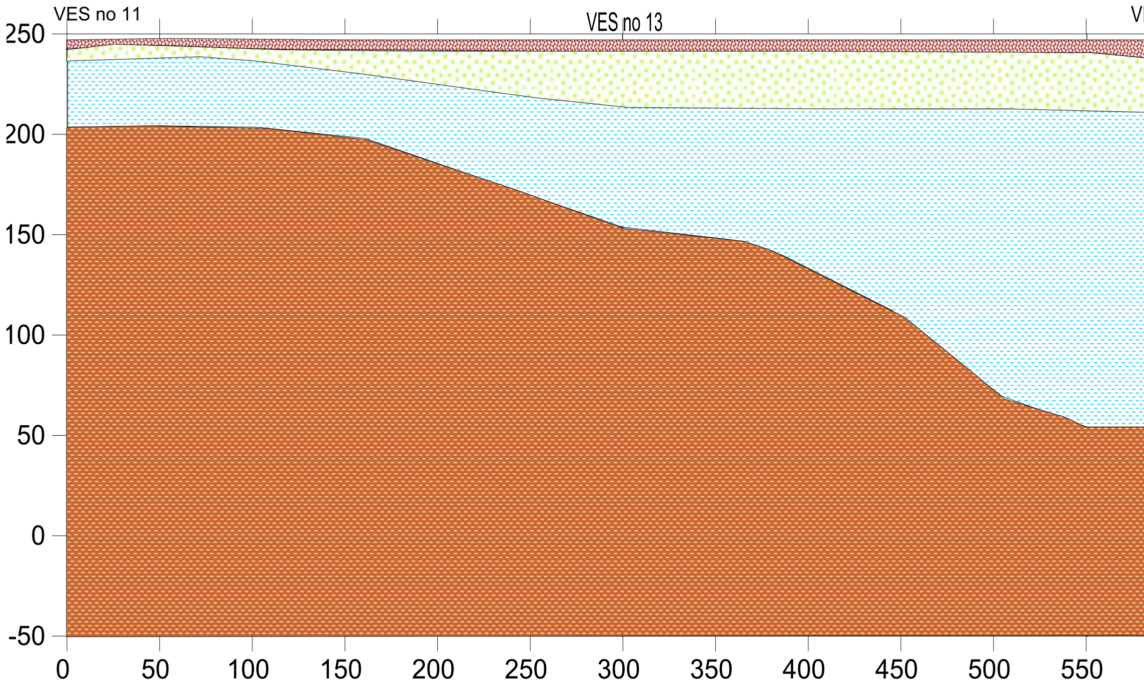
Cross–Section (B - B̄)

Geoelectric cross section B – B/ , extends along the main stream of WadiQena from, North to South starting from VES 11and passing through VES13 and 14.The first geoelectric layer shows resistivity value ranging from 22400 **Ω** in ves no14 increase 16000 **Ω** in ves no 11 to 87000 **Ω** in ves no 13 corresponds to gravels and sands on the surface land of Wadi Qena with thickness 2 m e increasing to 7 m.

The second geoelectric layer corresponds to the sandstone that has high resistivity range from 5383 in ves no 11 to 31000 **Ω** in ves no 13 and 7130 in ves no 14with thickness range from 2 m increasing to 23 m.

The third geoelectric layer have resistivity range from420 **Ω** in ves 13decreasing to less than 3 20 **Ω** in ves and 11and decrese to less than 120 **Ω** in ves no 14 with a thickness range from 25 in ves 13 increasing to 130 m in ves 14 corresponds to water- bearing sediments which are made of sandstone.

The fourth geoelectric layer corresponds to the basement rock intercalated with sandstone that has relatively high resistivity values range from25000 **Ω** to 9000 **Ω**



Cross section (B - B̄)between ves'sNo(11-13-14)

CONCLUSION

From the study the following Conclusion can be achieved

1- Four to five geoelctrice layer were identified
2- The first geoelectric layer shows high resistivity range from 80000 **Ω** - 30000 **Ω** correspond to gravels and sand on in most ves's of WadiQena with thickness range from 0.5m in some ves increasing to 6m meters in other ves.
3- The second geoelectric layers how resistivity changing from **30000 Ω -7000** Ω correspond to dry sand and gravels intercalated with clay lenses with thickness range from 1.5 m to 30m.
4- The third geoelectric layer has resistivity range from 3000 Ω to 50Ω with a thickness range from 5 m to 150m this layer is

considered the water- bearing sediments in the study area. Thickness of this layer increase south ward indicating good water quality. However, the resistivity increasing also south ward pointing to good water quality.

5- The depth to the water- bearing layer is changed from shallow depth 30m at ves no 7 to deep depth 158m at the ves no 14.
6- Generally the ground water in wadiqena is found near to the surface the distance between water table and the surface is about 50-70 m
7- The ground water is found in sandstone rock

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الملخص العربي

منطقة الدراسة هى جزء من وادى قنا الذى يقع شرق مدينة قنا وتبعد منطقة الدراسة بحوالي ٥٠ كيلوا متر عن مدينة قنا عند مدخل طريق سوهاج قنا سفاجا الجديد وتهدف الدراسة الى تحديد التتابع الصخريفي هذه المنطقة عن طريق الدراسة الجيوفيزيائية للمنطقة باستخدام الطرق الكهربية وهى طريقةالموجات الكهربية الرأسية

(VERTICAL ELECTRICAL SOUNDING) (VES)

وقد قمنا بعمل عدد ١٣وحدة VESبأجمالي فرد من ٥٠٠ إلى ٦٠٠متر وتم استخدام برنامج IP2وسمكلتحديد مقاومة الطبقات ومعرفة نوع الطبقات وتحديد الطبقة الحاملة للمياه وقد تبين من هذه الدراسة الاتي:

١. الطبقة الأولى تتكون من حبيبات الرمال الكبيرة المسماة بال gravels مع بعض حبات الرمال وتتميز هذه بمقاومة تتراوح بين Ω ٥٠ الى ٥٠٠Ω ويتراوح سمك الطبقة من ٠.٥ م الى ٥ م
٢. الطبقة الثانية تتميز هذه الطبقة بمقاومة تتراوح بين ٧Ω الى ٥٠Ω وتكون هذه الطبقة من الsandstone الجاف متداخلة مع الclay ويتراوح سمك الطبقة من ١.٥م الى ٣٠م
٣. الطبقة الثالثة وتتميز هذه الطبقة بمقاومة أقل من واحد Ω ويتراوح سمك الطبقة بين ٣٠م الى ١٥٠م وتتكون هذه الطبقة من sandstone وهذه الطبقة هي الطبقة الحاملة للمياه
٤. الطبقة الحاملة للمياه تتكون من ال sandstone وتتواجد المياه على بعد من ٥٠م الى ٧٠م