# Suggestion new procedure to construction Wells at south region of Iraq

**By**
**Eng. Yahya K. altemimi**
**University Babylon Civil Engineer Department**

## Abstract

This work studies contain the statement of wells construction in south and south-west of Iraq because the special geological information in this region ( hard rocks stratum and deep of ground water aquifer ) . therefore, we must have all ability and experiences to complete this work . under this situated I made wells construction program to complete this work .

## اقتراح أسلوب جديد لإنشاء الآبار في مناطق جنوب العراق

### الخلاصة

يتناول هذا البحث وضع الية مناسبة لانشاء الابار في منطقة جنوب وجنوب غرب العراق لما تمتاز بة هذة المنطقة من مواصفات جيلوجية تختلف عن بقية مناطق العراق( من الاعماق الكبيرة لخزانات المياة الجوفية وطبيعة الارض الصخرية القوية ) بسبب التكوينات الجيلوجية لهذة المنطقة لذلك فانة ليس من السهولة المباشرة بإعمال حفر الآبار بدون توفر القدرات والإمكانيات اللازمة لذلك من خبرات ومعلومات تساعد على أنجاز العمل.. إن هدف هذة الدراسة هو توفير برنامج عملي مناسب لعمليات الحفر وإدارة العمل بالطريقة التي توفر الوقت والكلفة وكذلك تبين هذة الدراسة المعلومات الهادرولوجية والجيولوجية عن هذة المنطقة والتي تمكن من معرفة نوعية المياة وكمياتها وأعماقها لغرض المشاريع الاستثمارية المستقبلية التي يتجة لها البلد.

## Introduction

6,000 new water wells are drilled in America every week. There are more than 15million wells in use in America for individual homes and farms . Groundwater is the source of daily drinking water for nearly 150 million Americans.

There are still nearly one million old-fashioned " dug wells " in use. These are very difficult to keep from water quality problems. Deep drilled wells are much more reliable and provide safer drinking water .[1]

In wells works no able to starting the work without have many of information and experiences to complete this work . in first , depended on aerial photo survey, geological and hydrological maps from " geological survey and manning " and Google earth program information to assistance for supply all information we can be use to located the well points and the stratum that storage the water . the main goal of this study give a good program to excavation and management the wells project in feature works " economy & fast " and give us hydrological information about quantity and quality of water. Therefore, we selected 6 sites for drilling work . also we used the Google earth program to assistance in fixing sites directions . After that we starting the

the drilling works and completed this jobs during 30 day work days for each well( this work include all drilling , geological test, geotechnical tests, and grouting work to support the wall of the well also all electrical &mechanical work ). We have varying depths ( 245m to 339 m ) from ground surface and varied quantity of flow ( from 4500 L/h to 20000 l/h ) .Also we found the varied in quality of ions and total soluble salt (TSS) . therefore, and depend on results of tested the soil stratum and chemical water test ( Lab. And site tests ) we pointed some recommended points to assistance all companies and labors in futures works.

**1-Description the site of study**

The site found in an Nejeef governorate region near the border between KSA and Iraq along southern east of Iraq .

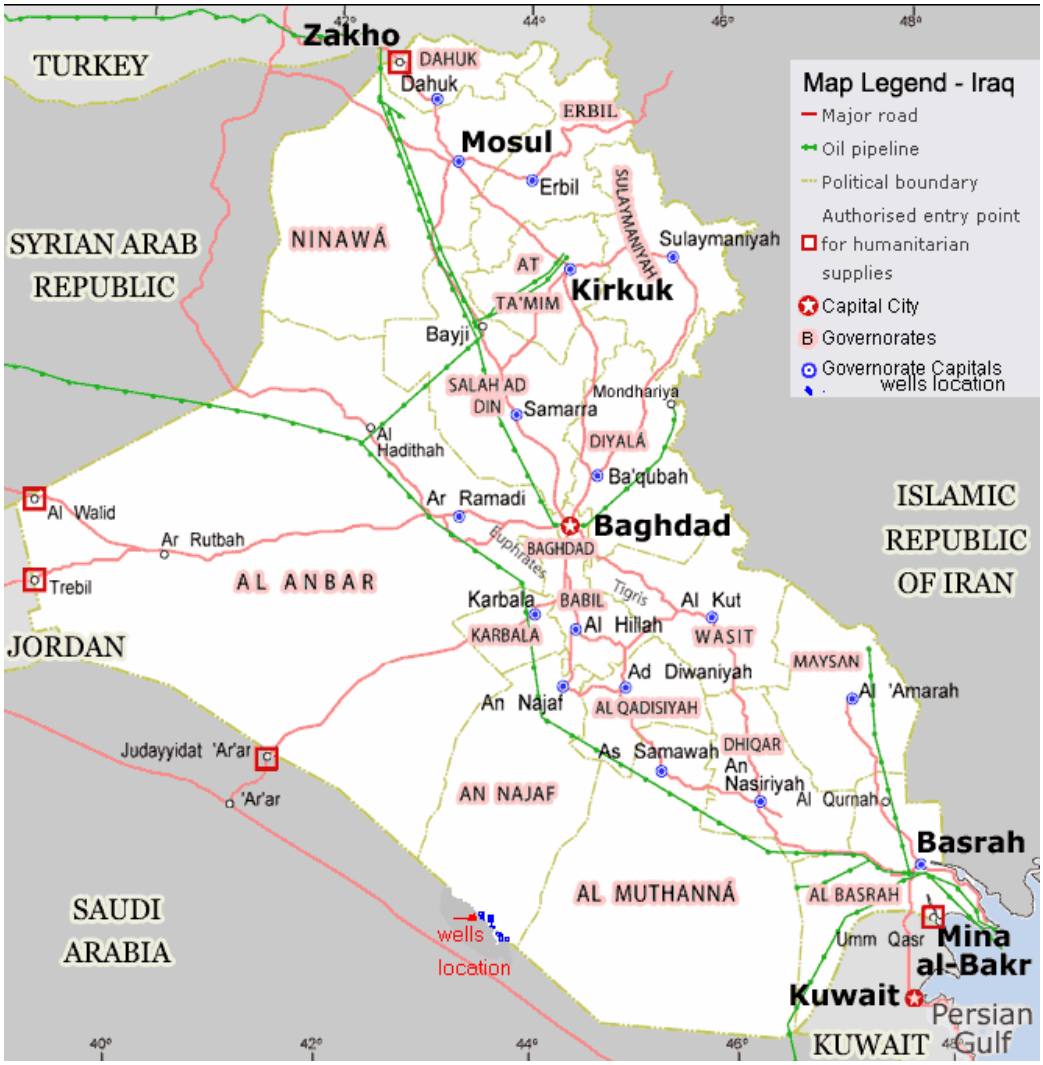



**Fig. (1) The location of the wells after the geological survey and manning [2]**

According to the Google earth photos and the information from the geological survey and manning company we can made the table below.

**Table ( 1 ) Explain the wells primary information [3]**

| WELL NAME | Est. depth m | Iraq coord. | Mil Grid Coord. | Direction |
|---|---|---|---|---|
| Farise | 200 | 809151 | 38RLU81300 15200 | N29 57.17 E 043 46.19 |
| AL-Sufawi | 200 | 704287 | 38RLU70100 28800 | N30 05.01 E043 39.13 |
| Treeq Ai-Hussein | 250 | 633365 | 38RLU68300 5900 | N29 52.60 E043 38.17 |
| Al-Hamza | 200 | 547478 | 38RLU54700 47600 | N30 15.08 E043 29.39 |
| ALHakim | 250 | 244718 | 38RLU 51100 11600 | N30 19.083 E043 19.547 |
| ALGazali | 250 | 399554 | 38RLU4387 554 | N30 19.18 E043 19. 34 |

## 2-Object of this study

1- evaluate the region from the hydrological properties and located the best depth for supply water.
2- Evaluate the geological information for this region to select adequate equipment to work in this soils type
3- Knowledge the type of water and evaluate this water from domestic used

## 3-Statement of Construction

### 3-1 Information collection

According to U.S GS procedure ( 1986), must be have the list information as we divided work to many stages as follow [4]
must be collection all important information for the site work such as : geological and hydrogeology publications at director of geological survey and manning ,air photos for water quality data ( available at Iraqi water code ) and existing maps, maps and photos showing historical lands uses from local city .every effort should be made to collect and review all applicable field and laboratory data from previous investigation of the project area .

### 3-2 Drilling Stage

:to select the type of drilling machine I follow **PIC** that say [1] " Water well drilling machines are used to make an "engineered hole" through the soil and rock layers to reach groundwater". Not all water wells are drilled the same way, but rotary drilling is the most common method used, in our soil this way not adequate ; therefore, we used the hummer driller machine because the rotary driller machine failed to reach for the adequate depth , this machine failed under many reason such as:

a- all stratums for this soils were too hard and had lime stone rock
b- most of this area have caves at different depth of it

c- no available water to supply the reservoir for the rotary ( the nearest water storage not less than 100 km from the well ) .
d- under the high depth and not professional labors , that caused inclined in the hole of the well that caused fixed the rotary head ( diamond head) and under this problems may be failed the well and transfer it to another place to drilling new one , that cause loss in time and money.

For all this reason above I decided to choice the digging ( hummer ) machine .

### 3-3 Casing and Sub-Casing Stage: "

Casing is put in the well to stop the hole from collapsing and to prevent the risk of surface water getting into the well[1] . A seal of "grout" is often placed between the casing and the drilled hole to stop any surface water moving down outside the casing the sub-casing stage depend on the stratum of the well . when the rock stratums found can be don't used the sub- casing because no collapse failure will be occur . therefore, can be used the sub-casing at head of the well only for secure it . may be used 2-6m and fixed it by concrete pad .About casing stage , the pipes materials used in casing depend on type of the soil . when the well profile has weak soil such as ( clay , loam ,sand …..etc.) can used plastic , carbon steel or polyethylene pipes or any durable materials but when found the rock or hard soils must be used the carbon steel pipes. In this 6 well using carbon steel 8" dia. Pipes schedule 80 and slotted pipes that contact with the water .

### 3-4 Filter Back Materials

used clean gravels 5-19 will be placed in space between the carbon steel pipes and the wall of the well and above the slotted pipes about 2m .the quantity of this filter depend on the dia. Of the well hole . in this case diameter of well hole was 50cm therefore , each 10m depth must be supply $1m^3$ filter gravel .

the formula used to select the filter gravel size

**(D15 of filter /D85 of soil) <4 to 5< ( D15 of filter /D15 of soil)** [5].

### 3-5 Well Cleaning Stage

there are many way to cleaning the well can be used any one of it . this ways are :

1- compressor air jet
2- bucket way
3- used the submersible pump to mixing the mud with water and elevated it out side .

in this work used the third way to cleaning the well

### 3-6 -Select the Adequate Submersible Pump

can be select this pump depend on the chart method and SP table. As below

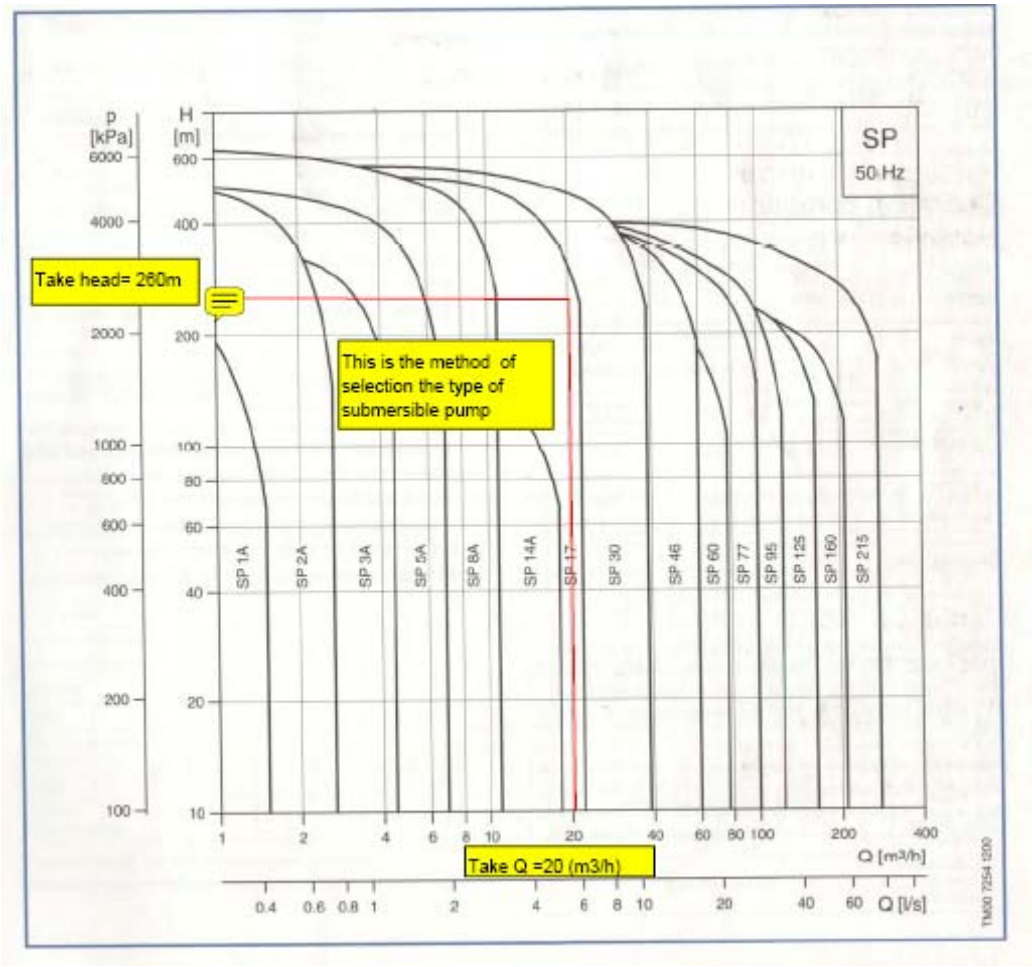
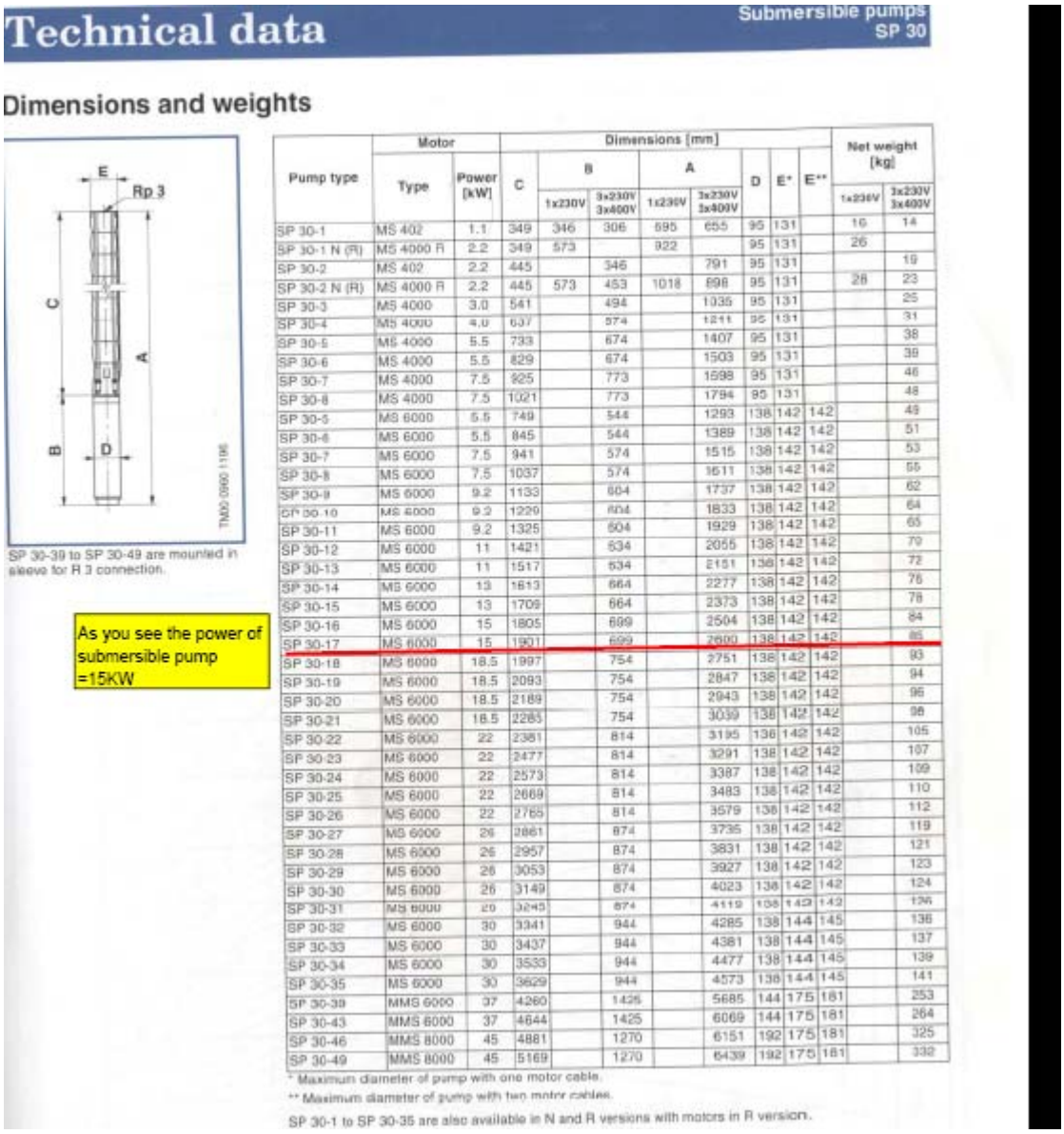



**Fig. 2-a S.P data from Grundfos motor manual [6]**



# Technical data

Submersible pumps SP 30

## Dimensions and weights




SP 30-39 to SP 30-49 are mounted in sleeve for R 3 connection.

As you see the power of submersible pump =15KW

| Pump type | Motor | | Dimensions [mm] | | | | | | | Net weight [kg] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Power [kW] | C | B | | A | | D | E* | E** | |
| | | | | 1x230V | 3x230V 3x400V | 1x230V | 3x230V 3x400V | | | | 1x230V / 3x230V 3x400V |
| SP 30-1 | MS 402 | 1.1 | 349 | 346 | 306 | 695 | 655 | 95 | 131 | | 16 / 14 |
| SP 30-1 N (R) | MS 4000 R | 2.2 | 349 | 573 | | 922 | | 95 | 131 | | 26 / |
| SP 30-2 | MS 402 | 2.2 | 445 | | 346 | | 791 | 95 | 131 | | / 19 |
| SP 30-2 N (R) | MS 4000 R | 2.2 | 445 | 573 | 453 | 1018 | 898 | 95 | 131 | | 28 / 23 |
| SP 30-3 | MS 4000 | 3.0 | 541 | | 494 | | 1035 | 95 | 131 | | / 25 |
| SP 30-4 | MS 4000 | 4.0 | 637 | | 574 | | 1211 | 95 | 131 | | / 31 |
| SP 30-5 | MS 4000 | 5.5 | 733 | | 674 | | 1407 | 95 | 131 | | / 38 |
| SP 30-6 | MS 4000 | 5.5 | 829 | | 674 | | 1503 | 95 | 131 | | / 39 |
| SP 30-7 | MS 4000 | 7.5 | 925 | | 773 | | 1698 | 95 | 131 | | / 46 |
| SP 30-8 | MS 4000 | 7.5 | 1021 | | 773 | | 1794 | 95 | 131 | | / 48 |
| SP 30-5 | MS 6000 | 5.5 | 749 | | 544 | | 1293 | 138 | 142 | 142 | / 49 |
| SP 30-6 | MS 6000 | 5.5 | 845 | | 544 | | 1389 | 138 | 142 | 142 | / 51 |
| SP 30-7 | MS 6000 | 7.5 | 941 | | 574 | | 1515 | 138 | 142 | 142 | / 53 |
| SP 30-8 | MS 6000 | 7.5 | 1037 | | 574 | | 1611 | 138 | 142 | 142 | / 55 |
| SP 30-9 | MS 6000 | 9.2 | 1133 | | 604 | | 1737 | 138 | 142 | 142 | / 62 |
| SP 30-10 | MS 6000 | 9.2 | 1229 | | 604 | | 1833 | 138 | 142 | 142 | / 64 |
| SP 30-11 | MS 6000 | 9.2 | 1325 | | 604 | | 1929 | 138 | 142 | 142 | / 65 |
| SP 30-12 | MS 6000 | 11 | 1421 | | 634 | | 2055 | 138 | 142 | 142 | / 70 |
| SP 30-13 | MS 6000 | 11 | 1517 | | 634 | | 2151 | 138 | 142 | 142 | / 72 |
| SP 30-14 | MS 6000 | 13 | 1613 | | 664 | | 2277 | 138 | 142 | 142 | / 76 |
| SP 30-15 | MS 6000 | 13 | 1709 | | 664 | | 2373 | 138 | 142 | 142 | / 78 |
| SP 30-16 | MS 6000 | 15 | 1805 | | 699 | | 2504 | 138 | 142 | 142 | / 84 |
| SP 30-17 | MS 6000 | 15 | 1901 | | 699 | | 2600 | 138 | 142 | 142 | / 85 |
| SP 30-18 | MS 6000 | 18.5 | 1997 | | 754 | | 2751 | 138 | 142 | 142 | / 93 |
| SP 30-19 | MS 6000 | 18.5 | 2093 | | 754 | | 2847 | 138 | 142 | 142 | / 94 |
| SP 30-20 | MS 6000 | 18.5 | 2189 | | 754 | | 2943 | 138 | 142 | 142 | / 96 |
| SP 30-21 | MS 6000 | 18.5 | 2285 | | 754 | | 3039 | 138 | 142 | 142 | / 98 |
| SP 30-22 | MS 6000 | 22 | 2381 | | 814 | | 3195 | 138 | 142 | 142 | / 105 |
| SP 30-23 | MS 6000 | 22 | 2477 | | 814 | | 3291 | 138 | 142 | 142 | / 107 |
| SP 30-24 | MS 6000 | 22 | 2573 | | 814 | | 3387 | 138 | 142 | 142 | / 109 |
| SP 30-25 | MS 6000 | 22 | 2669 | | 814 | | 3483 | 138 | 142 | 142 | / 110 |
| SP 30-26 | MS 6000 | 22 | 2765 | | 814 | | 3579 | 138 | 142 | 142 | / 112 |
| SP 30-27 | MS 6000 | 26 | 2861 | | 874 | | 3735 | 138 | 142 | 142 | / 119 |
| SP 30-28 | MS 6000 | 26 | 2957 | | 874 | | 3831 | 138 | 142 | 142 | / 121 |
| SP 30-29 | MS 6000 | 26 | 3053 | | 874 | | 3927 | 138 | 142 | 142 | / 123 |
| SP 30-30 | MS 6000 | 26 | 3149 | | 874 | | 4023 | 138 | 142 | 142 | / 124 |
| SP 30-31 | MS 6000 | 26 | 3245 | | 874 | | 4119 | 138 | 142 | 142 | / 126 |
| SP 30-32 | MS 6000 | 30 | 3341 | | 944 | | 4285 | 138 | 144 | 145 | / 136 |
| SP 30-33 | MS 6000 | 30 | 3437 | | 944 | | 4381 | 138 | 144 | 145 | / 137 |
| SP 30-34 | MS 6000 | 30 | 3533 | | 944 | | 4477 | 138 | 144 | 145 | / 139 |
| SP 30-35 | MS 6000 | 30 | 3629 | | 944 | | 4573 | 138 | 144 | 145 | / 141 |
| SP 30-39 | MMS 6000 | 37 | 4260 | | 1425 | | 5685 | 144 | 175 | 181 | / 253 |
| SP 30-43 | MMS 6000 | 37 | 4644 | | 1425 | | 6069 | 144 | 175 | 181 | / 264 |
| SP 30-46 | MMS 8000 | 45 | 4881 | | 1270 | | 6151 | 192 | 175 | 181 | / 325 |
| SP 30-49 | MMS 8000 | 45 | 5169 | | 1270 | | 6439 | 192 | 175 | 181 | / 332 |

* Maximum diameter of pump with one motor cable.

** Maximum diameter of pump with two motor cables.

SP 30-1 to SP 30-35 are also available in N and R versions with motors in R version.

**Fig: 2-b technical data from Grundfos motor manual . [6]**

**4- Geological Test**

There are many geological test made at the site ( visual test ) and lab. Test to know the soil stratum and estimate the water aquifer depth.

**5- Site Water Test**

there are many type of test at site but the important test are

1- static and dynamic water level ( used sounder device )
2- flow test ( time dependent test )

**6- Laboratory Water Test**

must be selected the water samples and complete all water test under health international code ( All water tests completed under the environment Lab. , Baghdad – Iraq )

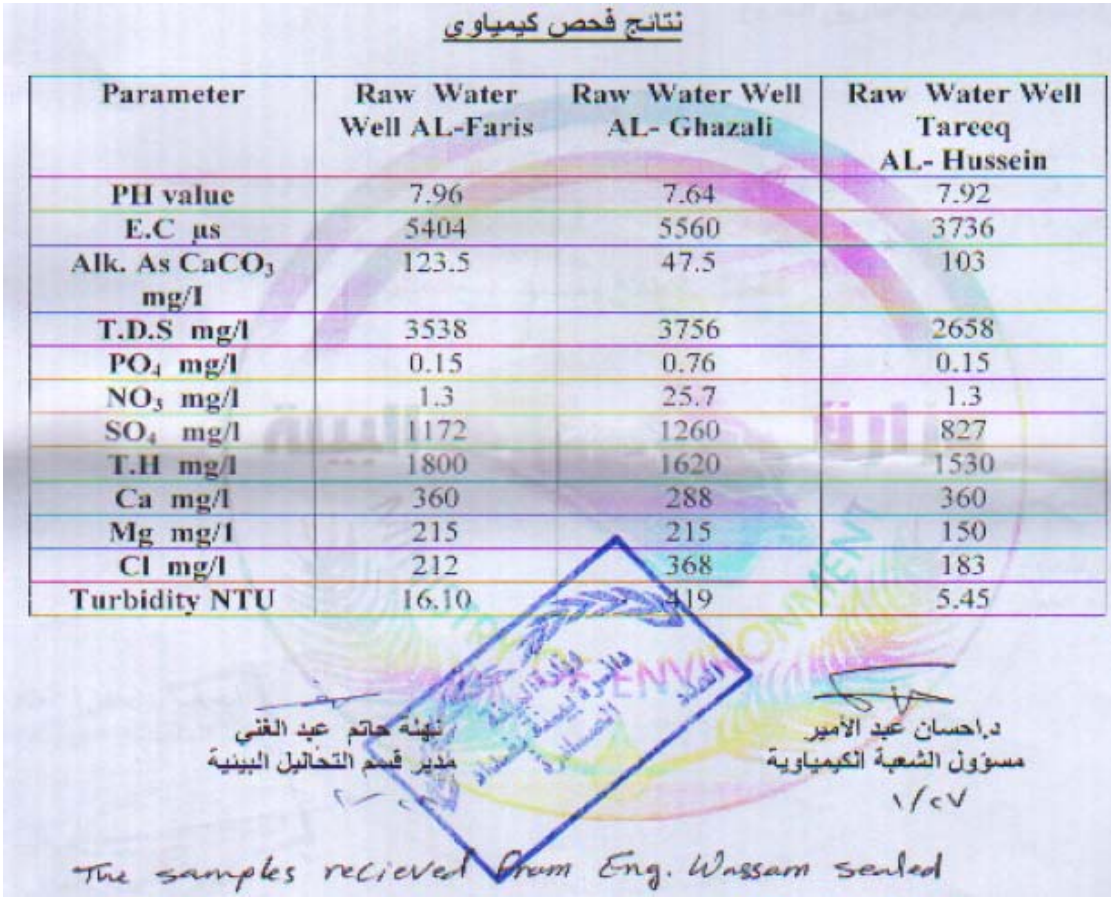
**Table ( 2 ) Explain the chemical information [ 7,8]**

| Parameter | WHO* Max. | Faris well | Al sufawi well | Treeq Alhussein well | Al-Hamza well | Al-Hakim well | Al-Gazali well |
|---|---|---|---|---|---|---|---|
| PH value | 7-8.5 | 7.96 | 7.61 | 7.92 | 7.28 | | 7.64 |
| E.C µs | | 5404 | 5752 | 3736 | 4680 | | 5560 |
| Alk.As $CaCo_3$ mg/L | 80-250 | 123.5 | 99 | 103 | 103 | | 47.5 |
| T.D.S mg/L | 500 | 3538 | 4188 | 2658 | 3618 | | 3756 |
| $PO_4$ mg/L | | 0.15 | 0.39 | 0.15 | 1.28 | | 0.76 |
| $NO_3$mg/L | | 1.3 | 8.8 | 1.3 | 2.1 | | 25.7 |
| $SO_4$ mg/L | 200-250 | 1172 | 1236 | 827 | 1116 | | 1260 |
| T.H mg/L | | 1800 | 2106 | 1530 | 2070 | | 1620 |
| Ca mg/L | | 360 | 360 | 360 | 396 | | 288 |
| Mg mg/L | | 215 | 288 | 150 | 258 | | 215 |
| Cl mg/L | 200 | 212 | 312 | 183 | 257 | | 368 |
| Turbidity NTU | 0.1-5 | 16.1 | 50.12 | 5.45 | 7.52 | | 4.19 |

1-*[7] .

2- all tests at ministry of environment Baghdad Lab.

**Table (3) Sample for Lab. sheet**



نتائج فحص كيمياوي

| Parameter | Raw Water Well AL-Faris | Raw Water Well AL- Ghazali | Raw Water Well Tareeq AL- Hussein |
|---|---|---|---|
| PH value | 7.96 | 7.64 | 7.92 |
| E.C µs | 5404 | 5560 | 3736 |
| Alk. As $CaCO_3$ mg/l | 123.5 | 47.5 | 103 |
| T.D.S mg/l | 3538 | 3756 | 2658 |
| $PO_4$ mg/l | 0.15 | 0.76 | 0.15 |
| $NO_3$ mg/l | 1.3 | 25.7 | 1.3 |
| $SO_4$ mg/l | 1172 | 1260 | 827 |
| T.H mg/l | 1800 | 1620 | 1530 |
| Ca mg/l | 360 | 288 | 360 |
| Mg mg/l | 215 | 215 | 150 |
| Cl mg/l | 212 | 368 | 183 |
| Turbidity NTU | 16.10 | 419 | 5.45 |

د.احسان عبد الأمير
مسؤول الشعبة الكيمياوية
١/٥٧

نهلة حاتم عبد الغني
مدير قسم التحاليل البيئية

The samples recieved from Eng. Wassam sealed

**Table (4) Explain the work result**

| Well name | Elevation from sea level (m ) | Stations km | Total depth m | Q L/h | Notes |
|---|---|---|---|---|---|
| Al-Farise | 444 | 0.0 | 339 | 18000 | Found cave at depth 98m from G.S |
| Al-Sufawi | 433.3 | 20 .0 | 330 | 20000 | |
| Treeq Al-Hussen | 438.3 | 33 .0 | 320 | 16000 | |
| Al-Hamza | 441.6 | 48 .0 | 280 | 4500 | Found cave at 140m from G.S |
| Al-Hakeem | 434.6 | 60 .0 | 283 | 7000 | |
| Al-Gazali | 432 | 75 .0 | 245 | 7000 | |

**7-Result and Discussion**

1- in each wells ( 6 well ) found the water appear at the depth between 195-205m from ground surface . at this quantity of the water not enough to supply water without cutting the flow therefore, must be reach to the second layer that have water , this layer between 280 – 310 m from G.S . in this depth can be have very good quantity of water as explain in table below .

2- From chemical water test found in all wells the TSS,SO4 over range in all wells while Cl over range in 5 wells without( **Treeq Al-Hussen well** ) and the Turbidity for 5 wells without **( Al-Gazali well) .**

3- All soil stratum for each 6 wells " lime stone rock " hard rock and found caves in depth between 98m to 140m from GS .

4- The flow rate exceed with the depth for all wells therefore, the wells have depth less than 300m gives flow rate not more than 7000 L/h while the wells have depth more than 300m gives flow rate more than 16000L/h

5- the best depth that give a good quantity of water was 300m

6- Type of the pumping motor depend on the depth and quantity of water in its static level depth .

7- all water found at sulphur stratums as shown in laboratory water test

8- all wells had dolomite stratum between 240-300 m

9- from the result found the elevation from sea level not important for supply a high quantity of water .

**Table (5) Explain the flow meter reading V.S time for the 6 wells**

| Time (min.) | Flow Meter Reading Farise | Flow Meter Reading Al-Sufawi | Flow Meter Reading Treeq Al-hussein | Flow Meter Reading Al-Hamza | Flow Meter Reading Al-Hakim | Flow Meter Reading Al-Gazali | | |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 3,7 L/sec | 5.2L/sec | 5 L/sec | 4.4 L/sec | 3.6 L/sec | 18000 L/hr | | |
| 5 | 3.8 L/sec | 5 L/sec | 4.9 L/sec | 4.4 L/sec | 1.88 L/sec | 18000 L/hr | | |
| 15 | 3.8 L/sec | 5 L/sec | 4.7 L/sec | 4.4 L/sec | 1.57L/sec | 13320 L/hr | | |
| 30 | 3.8 L/sec | 5 L/sec | 4.7 L/sec | 2 L/sec | 1.32L/sec | 13320 L/hr | | |
| 45 | 3.8L/sec | 5 L/sec | 4.7L/sec | 0.0 L/sec | 1.31L/sec | 7200 L/hr | | |
| 60 | 3.7L/sec | 5.0L/sec | 4.65 L/sec | 2.5 L/sec | 1.15L/sec | 7200 L/hr | | |
| 120 | 3.7L/sec | 5 L/sec | 4.6 L/sec | 1.4L/sec | 1.14 L/sec | 13320 L/hr | | |
| 240 | 3.9L/sec | 5.0L/sec | 4.7 L/sec | .78 L/sec | 1.1L/sec | 13320 L/hr | | |
| 480 | 3.8L/sec | 5 L/sec | 4.7 L/sec | 0.78 L/sec | 1.11L/sec | 14400 L/hr | | |
| 960 | 3.7L/sec | 5 L/sec | 4.7L/sec | 0.78 L/sec | 1.12 L/sec | 14400 L/hr | | |
| | | | | | | | | |
| | | | | | | | | |

**Note** : all wells have submersible pump( H.P between 20-30 )

## 8- Recommendations

1- don't use the rotary driller machine
2- usage the C.S pipes as a casing materials
3- used submersible pumps between 25 -30 H.P
4- don't used a water as a domestic used without treatment by R.O unit .
5- when storage water in storage tanks must be used plastic tank and opening the caver of this tank .
6- recommended used the submersible pump to cleaning the bad of the well by mixing all mud and elevated it to top
7- prefer used tie cable with submersible pump for maintenance at features

## 9- References

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