



Well Completion Report

Jayous Municipality Well

تقرير الانجاز
بئر بلدية جیوس

10/9/2020



Al - Assad Company for contracting

شركة الاسد للتعهدات والمقاولات

Well Completion Report Jayous Municipality Well

Jayous - Qalqiliah

10/9/2020

HG. Sayel Wishahi

HydroGeologist
Sayel Wishahi

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Well Completion Report

Jayous Well

Introduction:

Well Name: Jayous Municipality Well.

Well Number:

Location: Jayous (Fig. 1).

Governorate: Qalqiliyah.

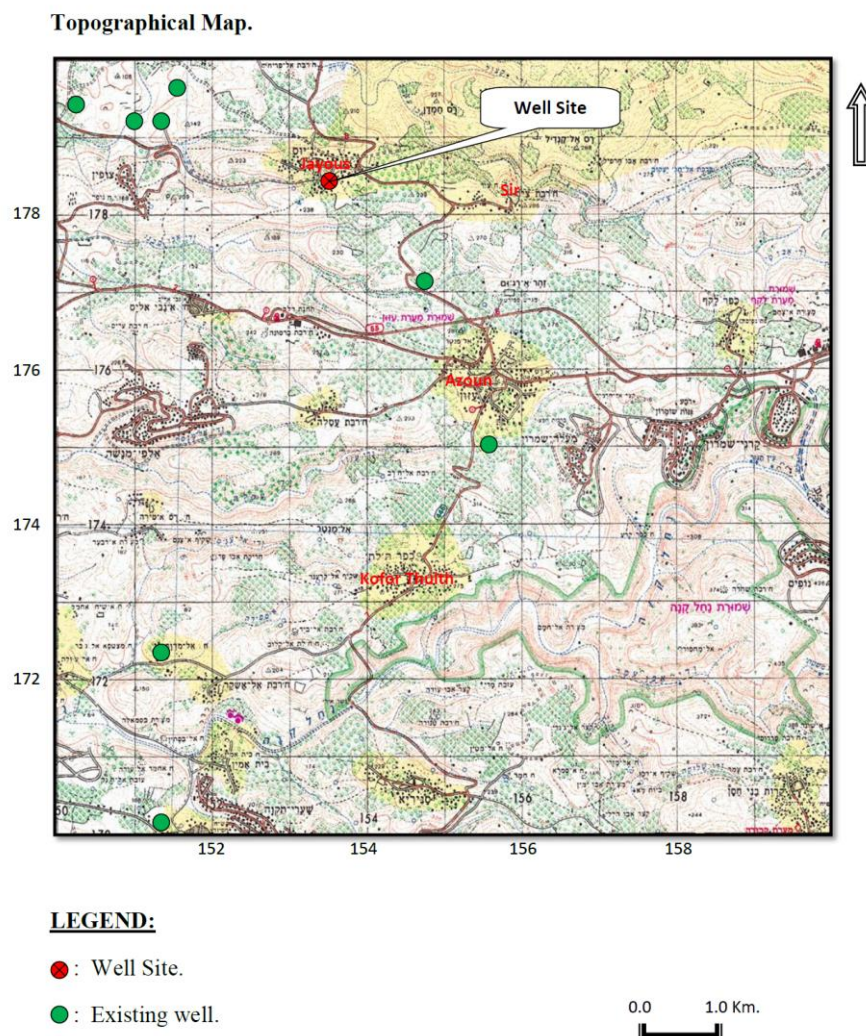
Purpose: Domestic.

Coordinates: 153.490.35/ 178.421.01.

Altitude: + 225 (m).

Target aquifer: Lower Aquifer System (Lower Yatta, and Upper Beit Kahil Formation).

Fig. (1): Location Map.



Hydrogeologic Setting:

The geological map is shown in Fig. (2), while the column of the West Bank is presented in Table 1 which gives a clear picture about its stratigraphy, and lithology. Below are the main hydrogeological units of the area and arranged by age from youngest to oldest:

- **The Upper aquifer system (Turonian-Upper Cenomanian):**

Geologically, this aquifer system regarding the Palestinian nomenclatures is comprised of Jerusalem, Bethlehem, and Hebron formations. Jerusalem formation rocks belongs on its age to Turonian, and mainly composed of dark grey –brown weathered massive limestone, locally cliff forming, finely grained lithographic pink and buff in the lower part, cream recrystallised dolomitic and occasionally silicified in the upper part. Thickness of Jerusalem formation is ranging between 75 and 100 meters.

Bethlehem Formation (Upper Cenomanian) consists mainly of cream-grey bedded chalky limestone; frequently completely recrystallised to cream or pink porcellaneous limestone, with softer marly chalky limestone and marl. Thickness of Bethlehem formation ranges from 50 to 100 meters.

Hebron Formation (Upper Cenomanian) is composed of grey weathered dolomitic limestones, and dolomite. The rock is hard, massive, and poorly bedded. It shows sugary texture, by this a high secondary porosity and well-developed karsts in many parts of the formation. Thickness of Hebron formation is ranging between 50 to 70 meters.

- **Lower Aquifer System**

The lower aquifer system is composed of middle and lower Yatta, Upper Beit Kahil, and Lower Beit Kahil formations (Palestinian Terminology). Yatta Formation consists mainly of marl, clay, and marly limestone (70-100m). Upper Beit Kahil Formation is composed of regularly interbedded chalky limestone and dolomite (150 m). The formation becomes more massive and karstified upwards, while retaining the thin-bedded alternative. While Lower Beit Kahil Formation is composed of dolomite and limestone inter-bedded with marl. Although the dolomitic limestone are well-fractured and have good aquifer potential, the chalky units contain clay which inhibits groundwater movement across the strata. Qatana formation is mainly composed of marl, marly limestone, and nodular limestone, while it acts as an aquiclude in the area. However, Lower Aquifer System is separated from the upper aquifer by the brown-

grey weathered marls and chalky limestone (Upper Yatta Formation) that act as a confining beds in the area.

Fig. (2): Geological Map.

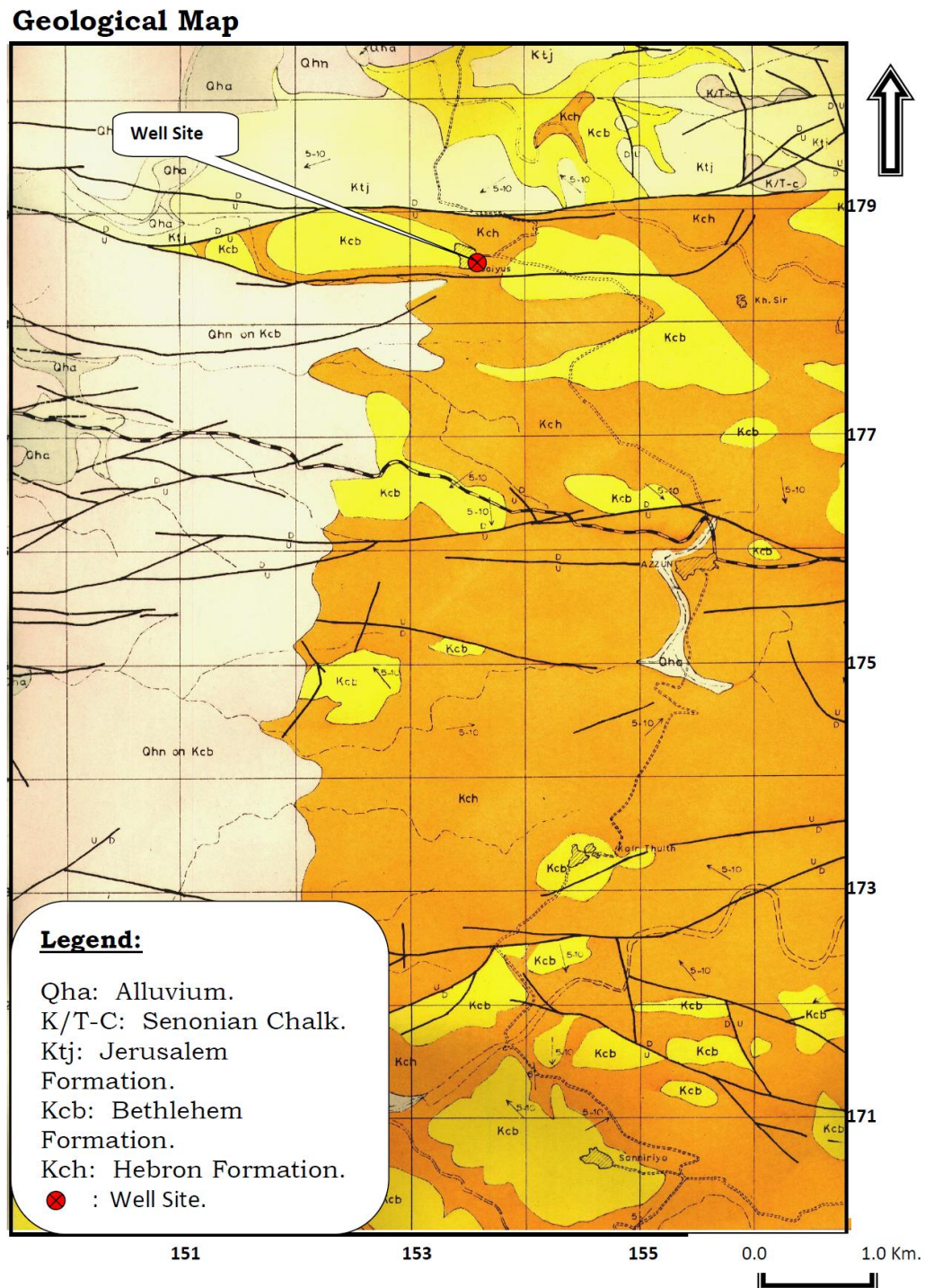


Table (1): Strata-graphic section of West Bank.

Period	Age	Graphic Log	Typical Lithology	Formation (West Bank Terminology)	Sub-Formation	Group	Symbol	Formation (Israeli Terminology)	Hydro-stratigraphy	Typical Thickness (m)
Quaternary	Holocene		Soil (surface crust) and alluvium Gravels and fan deposits	Alluvium			Qh-a	Alluvium	Local Aquifer	0 - 100
	Pleistocene		Thinly laminated marl with gypsum bands poorly sorted gravel and pebbles	Lisan			Qp-l	Lisan\Kurkar Group	"Aquitard"	10 - 200
Tertiary	Miocene		Conglomerates, marl, chalk clay and limestone	Belda			Tmp-b	Saqiyeh Group	Local Aquifer	20 - 200
	Pliocene									
	Eocene - Lower - Middle		Reefal Limestone	Jenin	Jenin 4	Jenin	Te-j4	Avedat Group	Aquifer	90 - 670
			Nummulitic bedded Limestone		Jenin 3		Te-j3			
			Nummulitic Limestone, Chalk		Jenin 2		Te-j2			
			Chalk, Nummulitic Limestone		Jenin 1		Te-j1			
Cretaceous	Paleocene		Marl, Chalk	Khan		Nablus	Ka-ka	Mt. Scopus (Local Aquifer) Group	Aquitard	40 - 150
	Maastrichtian Danian		Chalk, Marl	Al-Ahmar			Ka-n		Local Aquifer	10 - 120
	Campanian		Main Chert, Phosphate	Wadi Al-Qilt			Ka-aq		Aquiclude	0 - 450
	Santonian		Chalk and Chert	Abu Dis			Ka-ad			
	Upper		White Limestone, Stalolithes Dolomite And thin bedded Limestone	Jerusalem		Ramallah (West Bank)	Kc-j	Bina	Upper Aquifer	40 - 190
			Dolomite, salt	Bethlehem	Upper		Kc-bu	Weradim		50 - 210
			Chalky Limestone, Chalk		Lower		Kc-bl	Kefar Sha'ul		65 - 160
	Lower		Karstic Dolomite	Hebron			Kc-h	Amminadav	Lower Aquifer	40 - 125
			Yellow marl	Yatta	Upper		Kc-y2	Moza		10 - 20
			Lime & Dolomite, Chalk, (Clay)		Middle		Kc-y1	Beit Meir		80 - 130
			Reefal Limestone	Upper	UBK2		Ka-ubk2	Kesalon		40 - 90
			Dolomite Limestone, interbedded with Marl	Beit Kahil	UBK1		Ka-ubk1	Sareq		100 - 160
			Dolomite		UBK2		Ka-lbk2	Ziv'at Ye'arin		42
Jurassic	Albian		Karstic Limestone	Beit Kahil	UBK1		Ka-lbk1	Kefira	Aquitard	55
			Marl, marly nodular Limestone	Qatana		Kabar	Ka-q	Qatana		300+
			Marly Limestone and Limestone	Ein Qinya			Ka-aq	Ein Qinya (Local Aquifer)		20+
			Shale	Tammun			Ka-t	Tammun		70+
	Aptian		Shale and Limestone	Ein Al-Assad		Kurnub	Ka-ea		Aquifer	35
			Marly Limestone, sandy	Nabi Sa'id			Ka-na			
	Neocomian		Sandstone	Ramali			Kn-r	Hatira	Aquifer	
			Volcanics	Tayasir			Kn-l			
Jurassic	Oxfordian		Marl interbedded with chalky limestone	Maleh	Upper Maleh	-	Jo-um	'Arad	Aquitard	100 - 200
			Nummulitic limestone, jointed and karstic		Lower Maleh	-	Jo-lm	Group	Aquifer	50 - 100

LEGEND

	Dolomite		Megafauna		Sandstone
	Limestone		Flint concretions		Volcanics
	Marl		Chalk		Relatively Permeable
	Conglomerate		Nari		Relatively Impermeable

Date: 7/8/2002

Lithological Description:

The lithological log of the drilled well is mainly composed of limestone, dolomitic limestone, dolomite, marl, and chert. These rocks belong to Bethlehem, Hebron, Yatta, and Upper Beit Kahil Formations. The lithological description of the collected geological samples is shown in Table (2).

Table (2): Lithological description of geological samples.

Depth (m)	Lithological Description	Geological Formation
0-8	Top soil with rock fragments of different sizes and types.	Alluvium
8-17	Grey hard dolomitic limestone, with some yellowish marly limestone.	Upper Bethlehem
17-20	Yellowish, and reddish hard limestone.	
20-23	Grey hard dolomitic limestone and yellowish hard limestone.	
23-29	Grey very hard dolomitic limestone.	
29-32	Grey hard dolomitic limestone, white limestone, and some black chert, with white calcite particles	
32-41	Grey hard dolomitic limestone, and yellowish limestone, with white calcite particles.	
41-43	Yellowish marly limestone, grey dolomitic limestone, with calcite particles.	
43-46	Grey hard dolomitic limestone, and yellowish marly limestone.	
46-58	Yellowish marly limestone, yellowish soft marl, and grey dolomitic limestone.	
58-85	Grey very hard dolomitic limestone.	
85-94	White hard limestone, and grey hard dolomite.	
94-100	Yellowish hard limestone, and yellowish soft marl.	Lower Bethlehem
100-130	Hard white limestone, grey hard dolomitic limestone, and brown chert.	
130-133	Yellowish soft marl.	
133-136	Yellowish soft marl, white limestone, and dolomitic limestone.	
136-141	Grey hard dolomitic limestone, and white limestone.	
141-147	Yellowish soft marl, and white limestone.	

147-150	Grey hard dolomitic limestone.	Hebron
150-189	Grey hard dolomitic limestone, and white limestone.	
189-207	Yellowish soft marl, and grey dolomitic limestone.	Upper Yatta
199-246	White hard limestone, grey dolomitic limestone, and black chert.	Lower Yatta
246-276	Grey hard dolomitic limestone, white limestone, and yellowish soft marl.	
276-288	Yellowish marly limestone, and grey dolomitic limestone.	Upper Beit Kahil
288-303	White hard limestone, grey dolomitic limestone.	
303-325	Grey hard dolomitic limestone, and white limestone.	
325-340	Yellowish marly limestone, and grey dolomitic limestone.	
340-350	Grey hard dolomitic limestone, and white limestone.	

Video Camera:

The video survey viewed bedding planes, fractures, and water and conductor pipe. As it was shown the water turbidity increased with depth, while huge cavities were encountered at the lower part of the well.

Well Construction:

Drilling:

Total Depth: 350 meters.

Drilling Diameter:

- 0-9 m: 24"; conductor pipe.
- 9-350 m: 17 1/2"

Well completion date: 4/9/2020

Drilling Method: Direct Rotary.

Drilling Fluid: Air, Water and Foam

Casing:

Casing Setting:

- +0.3-9 m: 20" Conductor pipe.
- +2- 210 m: 13.3/8 "Blank casing.

-210-350 m: Open hole.

Casing Type: Sch. 40 / Steel.

Casing thickness: 11 mm.

Cementing:

Cement was injected through tremie pipe from the top downward to 9 meters on the annular space around the casing pipes.

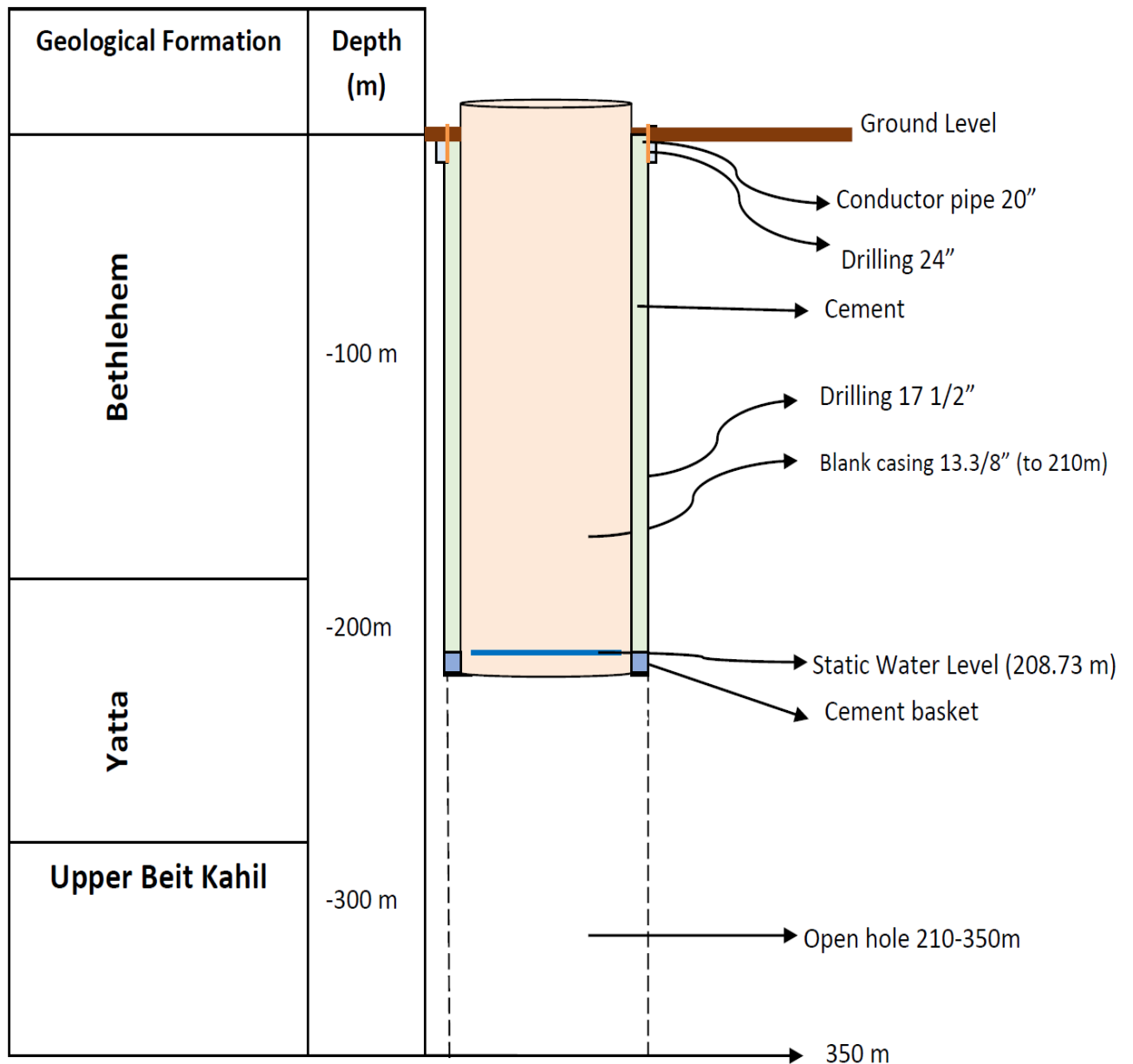
Verticality and Alignment Test:

This test was carried out by lowering into the well 12" diameter pipe of 20 meters length. The lowering process was done easily several times without any difficulties. The straightness (alignment) of the borehole is determined by dummy test. The equipment comprises a rigid hollow steel pipe of 10" diameter, with three coupling cylinders fixed on the top, middle, and end of the pipe. The dummy was lowered and withdrawn into the borehole several times without any binding or stuck in the borehole.

Development Method:

The well was developed by air surging and air lifting by air compressor. Development by air surging continues until the discharged water is clear and free from any cuttings and foreign materials.

Fig. (3): Jayous Well As Built Design



Acidification:

In order to increase the well specific capacity 10 cubic meters of hydrochloric acid (32% concentration) was injected into the well. The well head was capped for a period of 24 hours. After the 24 hours, the well was cleaned by air lifting for a period of 12 hours before pump installation. Then, a pumping of the well was carried out.

Pumping Test:

Table (3): Constant pumping rate test results.

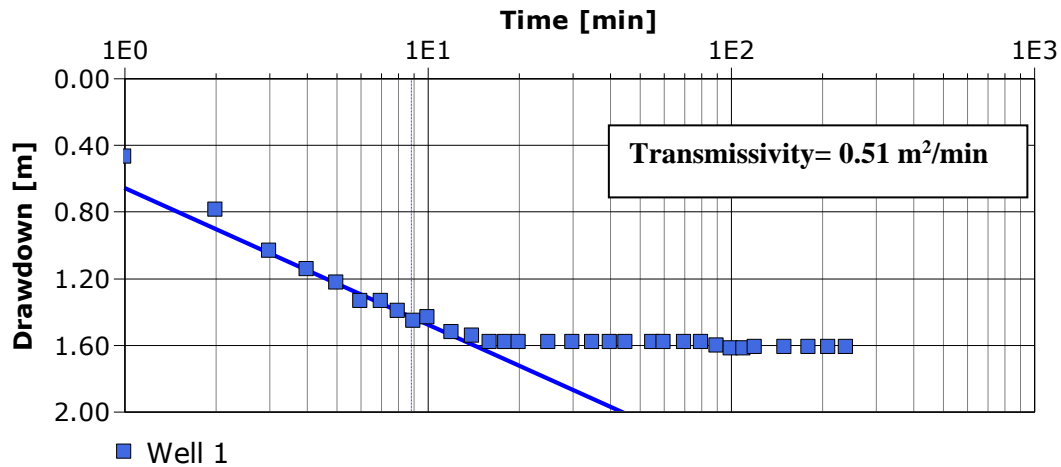
<u>BASIC DATA</u>				
Date: 2/9/2020				
Pumping Rate: 137 m ³ /hr.				
Duration: 240 minutes.				
SWL= 208.73 m bgl, DWL at end= 210.35 m bgl				
Reference point: Top of Casing pipe.				
Total Drawdown= 1.62 m.				
Pump Setting: 325 m.				
Pump capacity: 200 hp.				
Elapsed Time (Minutes)	Depth to Water Level (m)	Drawdown (m)	Discharge (m ³ /hr)	Remarks
1	209.2	0.47		
2	209.52	0.79		
3	209.77	1.04		
4	209.88	1.15		
5	209.96	1.23	137	Turbid water
6	210.07	1.34		
7	210.07	1.34		
8	210.13	1.4		
9	210.19	1.46		
10	210.17	1.44	136	
12	210.26	1.53		
14	210.28	1.55		Slightly turbid water
16	210.32	1.59		
18	210.32	1.59		
20	210.32	1.59		
25	210.32	1.59		
30	210.32	1.59	137	
35	210.32	1.59		
40	210.32	1.59		
45	210.32	1.59		
55	210.32	1.59		
60	210.32	1.59		
70	210.32	1.59		
80	210.32	1.59		

90	210.34	1.61		
100	210.36	1.63	136	Clean water
110	210.36	1.63		
120	210.35	1.62		
150	210.35	1.62		
180	210.35	1.62		
210	210.35	1.62		
240	210.35	1.62	137	Clean water

Table (4): Recovery Test-Data.

Pumping Rate: 137m ³ /hr.			
Pump Shut Down at: 240 min.			
Time since pumping stopped t ¹ (min)	Elapsed Time t (min)	Depth to water level (m)	Residual Drawdown S ¹ (m)
1	241	209.9	1.17
2	242	209.73	1
3	243	209.6	0.87
4	244	209.25	0.52
5	245	209.18	0.45
6	246	209.18	0.45
7	247	209.18	0.45
8	248	209.18	0.45
9	249	209.16	0.43
10	250	209.18	0.45
15	255	209.18	0.45
20	260	209.17	0.44
25	265	209.16	0.43
30	270	209.17	0.44
20	260	209.19	0.46
25	265	209.19	0.46
30	270	209.19	0.46
35	275	209.19	0.46
40	280	209.18	0.45
45	285	209.18	0.45
50	290	209.18	0.45
55	295	209.18	0.45
60	300	209.18	0.45

Fig. (4): Analysis of the constant pumping rate test.



As a result, the following values were obtained on the basis of the tests, as shown in Table (5).

Table (5): Transmissivity and Specific Capacity Results.

Test	Transmissivity (T)			Specific Capacity (m ³ /hr/m)	
	(m ² /min)	(m ² /hr)	(m ² /day)	(m ³ /hr/m)	(m ³ /day/ m)
Constant Rate	0.51	30.6	734.40	84.57	2029.6

Water Quality Data:

It can be concluded from Table (1) in the Annex, that the Calcium (166 mg/l), Nitrate (66 mg/l), Potassium (15 mg/l), and Total hardness as CaCO₃ (704 mg/l) are higher than the recommended values for drinking water. The other chemical components show acceptable values for drinking water.

Microbiologically, the total Coliform bacteria (1355 coloni/100 ml), and the fecal coliform (36 coloni/100 ml) are high, and exceeding the recommended limit. Water is classified as very hard water where the total hardness exceeding 300 mg/l.

Disinfection of the well:

The disinfection process was carried out by injecting 250 liters of sodium hypo-chloride solution of 10% concentration into the well.


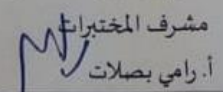

Conclusions & Recommendations:

Based on the results of the tests, it can be concluded that:

- It is possible to pump the well at a discharge of about 135 m³/hr.
- Future Pump Setting to be between 260-280-meters depth.
- The water quality analysis results show slightly high values of Calcium, Potassium, Total hardness, and Nitrate. The higher values of these constituents are suggested to be a result of the acidization process, and the presence of foam traces in the well that used during the drilling process as a drilling fluid. It is expected that the concentration of these chemical constituents will decrease gradually with pumping when the well is put on operation.
- It should be taken into consideration the results of the bacteriological analysis that exceeding the recommended limit of drinking water standards. Thus, Purification (chlorination) of the water should be carried out when the well puts on operation.
- Water level and water quality of the well should be measured and tested on a monthly routine basis.

ANNEX

Table (1): Water quality analysis results.

An-Najah National University Chemical and Biological Analysis Unit		 جامعة النجاح الوطنية وحدة التحاليل الكيماوية والبيولوجية		
تقرير نتائج فحص				
رقم العينة : 2020090428		رقم العينة في مصدرها: بئر جيوس		
اسم طالب الفحص	شركة الأسد	رقم الهاتف	عنوانه	
نوع العينة	ماء ⁽¹⁾	مكان استلام العينة	المختبر	
العلامة التجارية		تاريخ الاستلام	3/9/2020	
رقم الخلطة، التشغيل		ساعة الاستلام	12:44	
تاريخ الانتاج		تاريخ إجراء التحليل	3/9/2020	
تاريخ الانتهاء		تاريخ صدور النتائج	9/9/2020	
طريقة حفظ العينة في المختبر	2-4 C°	تاريخ صدور التقرير	9/9/2020	
وصف حالة العينة (الوحدة، العدد، ودرجة حرارتها، علامات فارقة) عند الاستلام: سائل شفاف لا لون له داخل عبوة بلاستيكية شفافة مغلقة الأولى سعة 0.5 لتر والثانية 1.5 لتر.				
Tests Results				
Test	Units	Results	Limits	Reference
Total coliform count	cfu/100ml	135.5x10 ¹		SMWW 9222 B(2017)
Total fecal coliform count	cfu/100ml	36		SMWW 9222 D(2017)
² Total hardness (as CaCO ₃)	mg/L	704		SMWW 2340- C (2017)
² Cl ⁻	mg/L	232.25		SMWW 4500B (2017)
² Ca	mg/L	166.4		SMWW 2340- B (2017)
² Mg	mg/L	70		SMWW 2340- C (2017)
² SO ₄	mg/L	15.9		SMWW 4500 S (2017)
NO ₃	mg/L	66.9		HI 83214(2002)
² Na	mg/L	49.6		SMWW 3500-Na (2017)
² K	mg/L	15.2		SMWW 3500 K (2017)
² HCO ₃	mg/L	416		SMWW 2320 B (2017)
² EC	μs/cm ²	1412		HACH (HQ14d)
² Fe	mg/L	0.07		HI 93746(2002)
² F	mg/L	0.29		SMWW 4500F (2017)
² TDS	mg/L	946		SMWW 2540 C (2017)
² pH	---	7		SMWW 4500H (2017)
² Turbidity	NTU	0.7		HACH 2100 Q
PO ₄	mg/L	0.06		HI83214(2002)
The Above Tests are Accredited From PALAC.				
ملاحظات: هذه النتائج تخص العينات المفحوصة فقط. - لا يجوز إعادة إصدار هذا التقرير إلا بموافقة خطيه من الوحدة				
 مشرف المختبرات أ. رامي بصلات		 مدير الوحدة د. عبد الفتاح الملاح		
تعريف الرموز	1: اجري الفحص لدي متعهد فرعي	2: فحص غير معتمد	3: معلومات مصدرها الزبون	
رقم التقرير: 2020090428		جوال الوحدة: 0592444282		البريد الالكتروني: wesi@najah.edu
اسم النموذج : تقرير فحص عينة ، رقم النموذج F24 ، تاريخ الاصدار 2019\7 ، رقم الاصدار 1				