

III-2 Soil sampling test

Report for soil sampling test

A- SAMPLING LOCATIONS:

Samples were collected at shallow depths upon your request in four different locations within the proposed project area. Sampling locations are shown on the attached figure.



B- TESTS CARRIED OUT:

Upon your request, the following tests were carried out, all in accordance with British Standard (BS 1377):

- 1- **Natural moisture content.**
- 2- **Grain size distribution (sieve analysis).** Standard sieves were used to perform the sieve analysis tests on material after washing on sieve No.200.
- 3- **Atterberg limits (Liquid and Plastic).** Liquid and plastic limits tests were conducted on soil samples and the plasticity index (PI) was determined.
- 4- **Specific gravity of solid particles test**
- 5- **Moisture-density relation (Modified compaction test)**
- 6- **Direct shear test,** where three identical (remolded) specimens were sheared under three vertical load conditions and the maximum shear stress in each case was measured. The strength parameters, namely cohesion (c) and angle of internal friction (ϕ) were determined from the maximum shear-vs- normal stress plot.
- 7- **PH value test** in accordance with BS 1377: Part 3: 1990.

C- SAMPLE DESCRIPTION:

Sample No.	Visual Description
1	Light brown fine grained cohesive non- organic silt
2	Light brown fine grained cohesive non-organic silt
3	Grayish fine grained cohesive laminations of silty non-organic formation
4	Grayish fine grained cohesive laminations of silty non-organic formation

D- TEST RESULTS:

The results of the carried out tests are summarized in the tables below:



D-1 Gradation:

Sieve No.	Sieve Size (mm)	Percent Passing			
		Sample 1	Sample 2	Sample 3	Sample 4
No. 3/8"	9.50	100	-	-	-
No.4	4.75	98.8	100	-	100
No.10	2.00	97.1	99.3	-	99.7
No.16	1.18	95.5	96.7	100	99.4
No.30	0.600	92.4	93.1	99.1	99.1
No.40	0.425	90.2	91.5	98.7	97.1
No.50	0.300	88.6	90.5	98.6	94.9
No.100	0.150	84.8	87.5	98.1	91.4
No.200	0.075	80.8	85.5	97.6	89.8

D-2 COMPCION TEST (Moisture density relation):

Sample No.	Optimum Moisture Content (OMC) (%)	Maximum Dry Density (MDD) (g/cm ³)
1	13.7	1.901
2	18.7	1.744
3	30.7	1.423
4	13.5	1.583

D-3 OTHER TESTS:

Sample No.	Moisture Content (%)	PH value	Atterberg Limits			Specific Gravity	Direct Shear Parameters	
			Liquid limit (%)	Plastic limit (%)	Plasticity Index		c (KN/m ²)	Ø (°)
1	8.1	7-8	29.1	19.0	10.1	2.542	12	14
2	3.6	7-8	34.7	23.0	11.7	2.450	13	12
3	5.5	7-8	49.0	35.4	13.6	2.501	15	15
4	2.6	7-8	39.3	26.4	12.9	2.459	14	13

Finally, we thank you for your confidence in our laboratory and look forward for further cooperation with your team. For further information or clarification regarding this report, please contact us.

Yours sincerely,

Dr. Sami A. Hijjawi
General Manager

III-3 Geological investigation

Report on geological investigation

GEOLOGICAL SURVEY

FOR THE AGRO INDUSTRIAL PARK

DEVELOPMENT IN

THE JORDAN RIVER RIFT VALLEY



Prepared for:
JICA STUDY TEAM/ KRI INTERNATIONAL CORP.

Prepared by:
HIJJAWI CONSTRUCTION LABS

JULY – 2008

M-S/ JICA Study Team
Jericho

Ref. : SI/269A
Date : 16/8/2008

Mr. Munenori TADA
Team Leader
KRI International Corp.

**Project – The Feasibility Study on Agro Industrial Park Development in
The Jordan River Rift Valley**
Subject – Geological Survey – Final Report

Dear Mr. TADA,

With reference to the signed Contract on June 5th, 2008 between **KRI International Corp.** and **Hijjawi Construction Labs**, we are pleased to submit this report with findings and results of tests carried out for the above mentioned project.

We look forward for further cooperation and would like to take this opportunity to highly considerate your confidence in our laboratories. For any clarification concerning this report, please contact us at your convenience.

Yours sincerely,

Dr. Sami A. Hijjawi
General Manager



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1. INTRODUCTION

1.1 GENERAL

This report presents the outcome of the geological survey carried out for the proposed construction site of the Agro Industrial Park Development in The Jordan River Rift Valley (south east of Jericho).

1.2 PURPOSE AND SCOPE

Investigation of the underground conditions at a site is prerequisite to the economical design of the substructure elements. It is also necessary to obtain sufficient information for feasibility and economic studies for any project.

For this particular project, and due to the type of proposed structures, which highly depend on the nature of soils, the site investigation becomes of special importance to obtain sufficient information about the geotechnical parameters of the ground.

In general, **the scope of this site investigation** was to provide the following:

- Core drilling for bedrock, soil and gravel deposits
- Standard Penetration Tests (SPT) at every 1.5m interval in each borehole
- Preparation of investigation report with borehole logs, SPT results, photos and all data related to the works and findings
- Preparation of geological map consisting of geological plan and two geological cross sections.

This was accomplished through the close cooperation of **HCL's** geotechnical engineer and the technical staff of its Geotechnical Department.

2. FIELD EXPLORATION AND TESTING

2.1 DRILLING

2.1.1 The geotechnical investigation program agreed upon with **Hijjawi Construction Labs** to explore the subsurface conditions included the drilling of five boreholes at the proposed site to a depth of 20m each.

The test borings were located in the field by JICA Study Team representative by measuring relative to the property corners and other identifiable landmarks using the provided site plan. The locations of the test borings are shown on the Boring Location Map. Soil logs for the test borings shown on the Boring Location Plans are presented in Appendix of this report.

2.2 SAMPLING

Samples were collected continuously within the drilled depths upon your request in all boring locations within the proposed project area. Sampling locations are shown on the attached figure.

According to the drilling requirements set in the agreement, continuous coring was carried out. For this purpose:

- double tube core barrel was used in rock formations (ASTM D2113),
- thin wall tubes were used for sampling of cohesive undisturbed relatively cohesive soil formations (ASTM D1587),
- split spoon samplers with accessories were used for SPT testing and sampling (ASTM D1586).

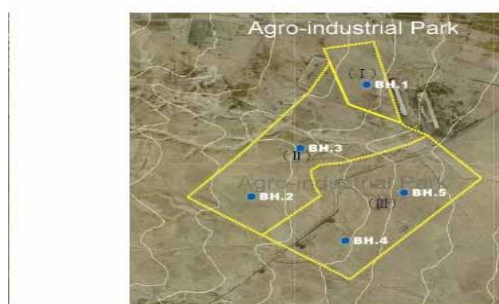


Fig. 1 Approximate locations of boreholes

Borehole No.	Location coordinates	Elevation	
		From	To
1	N 31 deg 49.808', E 35 deg 29.292'	-299.3	-319.3
2	N 31 deg 49.398', E35 deg 28.906'	-293.8	-313.8
3	N 31 deg 49.568', E 35 deg 29.049'	-294.5	-314.5
4	N 31 deg 49.246', E 35 deg 29.209'	-300.8	-320.8
5	N 31 deg 49.403', E 35 deg 29.395'	-307.5	-327.5

Soil samples were obtained from the test borings and placed in core boxes and delivered to JICA Field Office in Jericho. The soils observed during logging of the test borings were classified according to the Unified Soils Classification System (USCS), utilizing field classification procedures outlined in ASTM D 2488.



Sample in the split spoon



View of samples in the core box

The borings were advanced using a truck mounted, Mobile B-31 drilling rig. Standard Penetration Tests were performed, and representative samples were collected in accordance with ASTM D 1586 sampling procedures.

Depths referred to in this report are relative to the existing ground surface elevations at the time of our field investigation. The surface and subsurface conditions described in this report are as observed at the site at the time of our field investigation. Photos for core boxes with samples are attached to this report.

2.3 SAMPLING RECOVERY

Samples were collected from the whole strata within the depth of boreholes. It can be said that the sampling recovery was around 100% in all boreholes. Due to the dry and un-cemented nature of materials encountered, samples were loosened (collapsed) in most cases while extruding from the sampling devices.

2.4 FIELD TESTING – STANDARD PENETRATION TEST (SPT)

The Standard Penetration Test (SPT) was carried out in all boreholes (wherever applicable) at 1.5m interval as required. The test was carried out by means of the 50.8 mm outside diameter split - spoon sampler, which was driven to penetration of 450 mm by repeated blows of a 63.5 Kg monkey falling through 760 mm. The number of blows for the last 300-mm of driving was recorded as the standard penetration number (N-value).

The records from the SPT are given in the borehole logs.

3. GENERAL GEOLOGY OF THE SITE

3.1 JERICHO GENERAL GEOLOGY

The geology of Jericho district is characterized by the Jordan rift valley deposits which are mainly composed of Marl & Pleistocene Alluvial formations [Environmental; Profile for the West Bank – Jericho District Profile – ARIJ Institute, 1995]. The geologic formations in the eastern part of Jericho district are:

I. Alluvium Formation:

This formation covers the area adjacent to the Jordan Valley starting by a width of 1 km in the north and 5 kms in the south. It is of the Pleistocene to Recent in age. It is bounded structurally by the Jordan rift regional fault in the east and another fault of 12 km long in the west.

II. Lisan & Samra Formation:

This formation covers the greatest part of the Jericho district. It is of the Pleistocene to Recent age, and includes three local faults of up to 3 kms long. This area is bounded by the alluvium formation in the east and by a greater fault of about 13 kms long in the west. It is mainly composed of marl, chalk and conglomerates.

3.2 SOILS

The Jordan Valley is the only eco-geological system in Jericho district. Nine soil associations can be distinguished in this system:

3.2.1. Alluvial Arid Brown Soils

This type of soil association is located mainly in the Jericho city and Al-Auja areas. It covers an area of about 6,470 hectares. It exists of alluvial fans and plains, formed as a result of erosion of calcareous silty and clayey materials. This soil type supports

Herbaceous vegetation of desert annual halophytes and glycophytes and responds well to irrigation, producing various crops, mainly subtropical and tropical fruits, such as citrus, bananas, and dates, as well as winter vegetables.

3.2.2. Loessial Arid Brown Soils

This type of soil association is found on moderate slopes to the west and northwest of the Jericho district, covering an area of about 1,290 hectares. The soil is formed originally from conglomerate and/or chalk and mainly found on gently sloping plateaux as well as dissected plateaux with locally hilly topography. The major vegetation type found in this region is *Achillea santolina*, and the main current land use consists of various field crops and some horticultural crops planted as irrigated crops. Wheat, barely, and sorghum are also grown under rainfed conditions.

3.2.3. Reg Soils and Coarse Desert Alluvium

This type of soil association is located in the southern part of the Jericho district. It is found in plains and dissected low plateaux and characterize large valleys and alluvial fans. The soil covers an area of approximately 800 hectares and its parent materials are mainly of unconsolidated mixed stone and deposits. The vegetation on this soil is restricted in a few areas to rivulets. In most areas dwarf shrubs such as *Anabasis articulata* and *Reaumuria* are dominant. This soil is almost of no agricultural value and its native vegetation poor pastures for camels, goats and sheep.

3.2.4. Brown Lithosols and Loessial Serozems

This type of soil association is found on steep to moderate mountain slopes, in the areas southwest of Aqbat Jaber Camp and northwest of Nuwe'ma, covering an area of about 4,670 hectares. The soil is originally formed from limestone, chalk, dolomite and flint.

The major vegetation types found on this soil are *Anabasis articulata* and *Zygophyllum*.

The current land use is restricted to winter crops grown by Bedouins in some wadis.

3.2.5. Calcareous Serozems

This type of soil association is found southeast of Jericho city, northeast of Nuwe'ma and east of Al-Auja villages. It is formed mainly as a result of the flooding of the Jordan River. This soil covers an area of about 2,400 hectares and is originally formed from limestone, chalk and marl. The vegetation it hosts is restricted to *Salsola vermiculata* var *vilosa* and its current land use is limited to winter grazing.

3.2.6. Solonchalks

This type of soil association is found in the south eastern part of the district. It covers an area of approximately 3,460 hectares. The soil occupies the drainage valleys and closed basins in the district, where the groundwater table is near the soil surface. The soil parent rocks are recent alluvial deposits ranging in texture from sand to clay. Its major vegetation cover is halophytic with species of *Tamarix*, *Suaeda*, and *Nitraria* being dominant. Without proper drainage this soil is of almost no agricultural value. In the Jericho district some dates are grown on the periphery of the depressions, where the ground water is still relatively fresh.

3.2.7. Loessial Serozems

This type of soil association dominates the areas of Nuwe'ma, north of Al-Auja and south of Aqbat Jaber camp covering an area of approximately 4,920 hectares. This soil is typical of plateaux and moderate slopes. The soil parent materials are loessial sediments, gravel and highly calcareous loamy sediments. Its major vegetation cover is an association of the *Hammada scoparia*. Most of the area covered by this soil is used for grazing and only part of it is dry-farmed. There are also some irrigated orchards.

3.2.8. Regosols

This type of soil association characterizes the eastern border of the Jericho district. It is found as badlands along terrace escarpments in the Jordan Valley, covering an area of approximately 8,880 hectares. The soil parent materials are sand, clay and

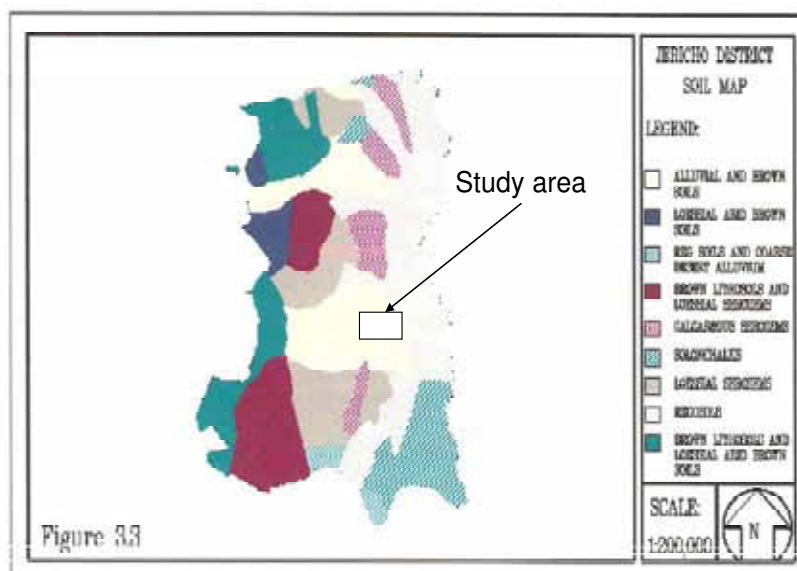
loess. The soil dominant vegetation cover are *Anabasis articulata*, *Salsola vermiculata* and *Salsola tetrandra*, and are used primarily for grazing.

3.2.9. Brown Lithosols and Loessial Arid Brown Soils

This type of soil association characterizes the western part and covers an area of approximately 2,410 hectares of the Jericho district. These type of soils are mainly found on steep rocky and eroded slopes. Brown lithosols are found in the pockets among the rocks, while Loessial arid brown soils are found on flat hilltops, plateaux and foot-slopes.

The parent rocks of this soil association are chalk, marl, limestone and conglomerates. Its major vegetation cover is *Artemisia herba-alba*.

The given below Jericho District Soil Map illustrates the described soil groups (taken from Reference No. 1 – Environmental Profile for the West Bank – Jericho District Profile – ARIJ Institute, 1995 – Fig.3.3).



3.3 SITE GENERAL GEOLOGY

Considering the collected samples from the drilled five boreholes within the borders of the proposed site, and reviewing the visual analysis and description given in the borehole logs, it can be concluded that the whole studied area (within the explored depth of 20m from the existing ground) consists of un-cemented alluvium, loose to medium dense, fine grained silts to sandy silts with occasional cemented particles in a form of gravels.

The encountered materials in the drilled boreholes, as described above, can be referred to the soil description given in §3.2.1 above (Alluvial Arid Brown Soils).

Geological cross sections illustrating the subsurface conditions encountered in the drilled boreholes are given in the Appendix to this report.

4. REFERENCES

- Environmental Profile for the West Bank – Jericho District Profile – ARIJ Institute, 1995.
- Earth Manual, Part 1 (3rd ed.). US Department of the Interior Bureau of Reclamation, 1998.

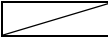
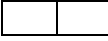


5. APPENDICES

BOREHOLE LOG

Project		Agro Industrial Park Development			Location	Jericho				
Borehole No.	1	Page No.	1/2	Date	28-6-2008					
Ground level	-299.3			Weather	Sunny					
Drill Rig	Mobile B-31			Operator	Sharif					
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)					
					15	15	15	N		
-299.3			Un-cemented, low dense, dry, grayish, fine grained silty formation	ML						
-300.3							8	4	5	9
-301.3										
-302.3							5	5	7	12
-303.3										
-304.3							10	10	9	19
-305.3										
-306.3							7	8	10	18
-307.3										
-308.3							9	13	15	28
-309.3										
			End of boring @ -309.3							
Water Record										
Level, at which water was encountered				None	Color of water		-			
Water level 24hrs. after completion					None					
Remarks :										
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>										
Approved :		Dr. Sami A. Hijjawi								

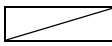
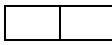
BOREHOLE LOG

Project		Agro Industrial Park Development			Location		Jericho	
Borehole No.		1	Page No. 2/2		Date		29-6-2008	
Ground level		-299.3			Weather		Sunny	
Drill Rig		Mobile B-31			Operator		Sharif	
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)			
					15	15	15	N
-309.3	▧	100%	Un-cemented, medium dense, medium moist, brownish, fine grained silty formation	ML	13	18	19	37
-310.3	▧				12	18	17	35
-311.3	▧				15	17	18	35
-312.3	▧				18	25	34	59
-313.3	▧				25	28	39	67
-314.3	▧				28	30	35	65
-315.3	▧	100%	Cemented, dense, medium moist, brownish, fine grained silty formation	ML	30	30	37	67
-316.3	▧				30	30	37	67
-317.3	▧							
-318.3	▧							
-319.3	▧		End of boring @ -319.3					
Water Record								
Level, at which water was encountered				None		Color of water		-
Water level 24hrs. after completion				None				
Remarks :								
USCS – Unified Soil Classification System R – Refusal (more than 50 blows)								
 SPT (Split spoon sampler)								
 Core barrel sampling								
Approved :		Dr. Sami A. Hijjawi						

BOREHOLE LOG

Project		Agro Industrial Park Development			Location		Jericho			
Borehole No.		2	Page No.	1/2	Date		2-7-2008			
Ground level		-293.8			Weather		Sunny			
Drill Rig		Mobile B-31			Operator		Sharif			
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)					
					15	15	15	N		
-293.8			Un-cemented, low dense, dry, light brown, fine grained silty formation with little cemented silts in a form of small pebbles	ML						
-294.8							4	6	8	14
-295.8										
-296.8							6	8	11	19
-297.8										
-297.8							5	8	12	20
-298.8										
-298.8							6	9	12	21
-299.8										
-300.8							9	11	14	25
-301.8										
-301.8					10	13	17	30		
-302.8										
-303.8			End of boring @ -303.8							
Water Record										
Level, at which water was encountered				None		Color of water		-		
Water level 24hrs. after completion						None				
Remarks :										
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>										
Approved :		Dr. Sami A. Hijjawi								

BOREHOLE LOG

Project		Agro Industrial Park Development			Location	Jericho		
Borehole No.	2	Page No.	2/2	Date	3-7-2008			
Ground level	-293.8			Weather	Sunny			
Drill Rig	Mobile B-31			Operator	Sharif			
Scale (m)	Sam- pler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)			
					15	15	15	N
-303.8	▧	100%	Un-cemented, medium dense, dry, light brown, fine grained silty formation with little cemented silts in a form of small pebbles	ML	11	14	18	32
-304.8	▧				10	14	19	33
-305.8	▧				9	16	20	36
-306.8	▧				13	17	22	39
-307.8	▧				12	17	23	40
-308.8	▧							
-309.8	▧							
-310.8	▧							
-311.8	▧	100%	Cemented, dense, medium moist, brownish, fine grained silty formation	ML	17	21	37	58
-312.8	▧				20	40	>50	R
-313.8	▧		End of boring @ -313.8					
Water Record								
Level, at which water was encountered				None	Color of water		-	
Water level 24hrs. after completion					None			
Remarks :								
USCS – Unified Soil Classification System R – Refusal (more than 50 blows)								
 SPT (Split spoon sampler)								
 Core barrel sampling								
Approved :		Dr. Sami A. Hijjawi						

BOREHOLE LOG

Project		Agro Industrial Park Development			Location		Jericho			
Borehole No.		3	Page No.	1/2	Date		30-6-2008			
Ground level		-294.5			Weather		Sunny			
Drill Rig		Mobile B-31			Operator		Sharif			
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)					
					15	15	15	N		
-294.5			Un-cemented, low dense, dry, light brown, fine grained silty formation	ML						
-295.5		100%					2	3	4	7
-296.5										
-297.5							4	5	7	12
-298.5							4	6	9	15
-299.5							5	5	8	13
-300.5										
-301.5							7	8	10	18
-302.5										
-303.5							6	8	9	17
-304.5					End of boring @ -304.5					
Water Record										
Level, at which water was encountered					None		Color of water		-	
Water level 24hrs. after completion					None					
Remarks :										
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>										
Approved :		Dr. Sami A. Hijjawi								

BOREHOLE LOG

Project		Agro Industrial Park Development			Location	Jericho			
Borehole No.	3	Page No.	2/2	Date	1-7-2008				
Ground level	-294.5			Weather	Sunny				
Drill Rig	Mobile B-31			Operator	Sharif				
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)				
					15	15	15	N	
-304.5	▧	100%	Un-cemented, low dense, dry, light brown, fine grained silty formation	ML	8	10	11	21	
-305.5	▧				8	9	11	20	
-306.5	▧				8	12	14	26	
-307.5	▧				12	14	21	35	
-308.5	▧				20	20	25	45	
-309.5	▧				22	25	27	52	
-310.5	▧	100%	Cemented, dense, medium moist, brownish, fine grained silty formation	ML	25	27	28	55	
-311.5	▧				25	27	28	55	
-312.5	▧				25	27	28	55	
-313.5	▧		End of boring @ -314.5						
-314.5	▧								
Water Record									
Level, at which water was encountered				None	Color of water		-		
Water level 24hrs. after completion					None				
Remarks :									
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p>▧ SPT (Split spoon sampler)</p> <p>▣ Core barrel sampling</p>									
Approved :		Dr. Sami A. Hijjawi							

BOREHOLE LOG

Project		Agro Industrial Park Development			Location	Jericho				
Borehole No.	4	Page No.	1/2	Date	18-7-2008					
Ground level	-300.8			Weather	Sunny					
Drill Rig	Mobile B-31			Operator	Adnan					
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)					
					15	15	15	N		
-300.8			Un-cemented, medium dense, dry, grayish, fine grained silty sand formation with little pebbles	ML						
-301.8							10	10	13	23
-302.8										
-303.8										
-304.8		100%					11	13	15	28
-305.8										
-306.8										
-307.8							12	12	16	28
-308.8			Un-cemented, medium dense, dry, grayish, sandy gravel with little fines	GP						
-309.8		100%					14	14	19	33
-310.8							20	25	25	50
			End of boring @ -310.8							
Water Record										
Level, at which water was encountered				None	Color of water		-			
Water level 24hrs. after completion					None					
Remarks :										
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>										
Approved :		Dr. Sami A. Hijjawi								

BOREHOLE LOG

Project		Agro Industrial Park Development			Location		Jericho				
Borehole No.		4	Page No.		2/2	Date			18-7-2008		
Ground level		-300.8			Weather		Sunny				
Drill Rig		Mobile B-31			Operator		Adnan				
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)						
					15	15	15	N			
-310.8	SPT	100%	Un-cemented, dense, dry, grayish, sandy gravel with little fines	GP	25	27	27	54			
-311.8	Core barrel				30	32	32	64			
-312.8	SPT				29	29	33	62			
-313.8	Core barrel				28	30	35	65			
-314.8	SPT				30	30	33	63			
-315.8	Core barrel				27	30	35	65			
-316.8	SPT				100%			29	33	35	68
-317.8	Core barrel										
-318.8	SPT										
-319.8	Core barrel										
-320.8	SPT		End of boring @ -320.8								
Water Record											
Level, at which water was encountered					None		Color of water		-		
Water level 24hrs. after completion					None						
Remarks :											
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>											
Approved :		Dr. Sami A. Hijjawi									

BOREHOLE LOG

Project		Agro Industrial Park Development			Location		Jericho		
Borehole No.		5	Page No.	1/2	Date		19-7-2008		
Ground level		-307.5			Weather		Sunny		
Drill Rig		Mobile B-31			Operator		Adnan		
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)				
					15	15	15	N	
-307.5		100%	Light brown, dry, fine, medium dense, slightly plastic silt	ML					
-308.5									
-309.5									
-310.5									
-311.5									
-312.5		100%	Light brown, medium moist, fine, medium dense sandy silt	SM					
-313.5									
-314.5									
-315.5									
-316.5									
-317.5			End of boring @ -317.5						
Water Record									
Level, at which water was encountered					None		Color of water		-
Water level 24hrs. after completion					None				
Remarks :									
<p>USCS – Unified Soil Classification System R – Refusal (more than 50 blows)</p> <p> SPT (Split spoon sampler)</p> <p> Core barrel sampling</p>									
Approved :		Dr. Sami A. Hijjawi							

BOREHOLE LOG

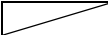

Project		Agro Industrial Park Development			Location		Jericho		
Borehole No.		5	Page No.		2/2	Date			19-7-2008
Ground level		-307.5			Weather		Sunny		
Drill Rig		Mobile B-31			Operator		Adnan		
Scale (m)	Sampler Type	Sample recovery	Description of soil strata	USCS	SPT (No. of blows)				
					15	15	15	N	
-317.5	▤	100%	Light brown, medium moist, fine, medium dense sandy silt	SM	12	12	12	24	
-318.5	▤				10	13	13	26	
-319.5	▤				13	15	18	33	
-320.5	▤				15	15	19	34	
-321.5	▤	100%	Un-cemented, dense, dry, grayish, sandy gravel with little fines	GP	19	19	23	42	
-322.5	▤				20	21	23	44	
-323.5	▤				22	23	24	47	
-324.5	▤								
-325.5	▤								
-326.5	▤								
-327.5	▤		End of boring @ -327.5						
Water Record									
Level, at which water was encountered				None		Color of water		-	
Water level 24hrs. after completion						None			
Remarks :									
USCS – Unified Soil Classification System R – Refusal (more than 50 blows)									
 SPT (Split spoon sampler)									
 Core barrel sampling									
Approved :		Dr. Sami A. Hijjawi							

Photo of core sample

Bore Hole No. 1



Depth 0 – 5 m



Depth 5 – 10 m

Bore Hole No. 1



Depth 10 – 15 m



Depth 15 – 20 m

Bore Hole No. 2



Depth 0 – 5 m



Depth 5 – 10 m

Bore Hole No. 2



Depth 10 – 15 m



Depth 15 – 20 m

Bore Hole No. 3



Depth 0 – 5 m



Depth 5 – 10 m

Bore Hole No. 3



Depth 10 – 15 m



Depth 15 – 20 m

Bore Hole No. 4



Depth 0 – 5 m



Depth 5 – 10 m

Bore Hole No. 4



Depth 10 – 15 m



Depth 15 – 20 m

Bore Hole No. 5



Depth 0 – 5 m



Depth 5 – 10 m

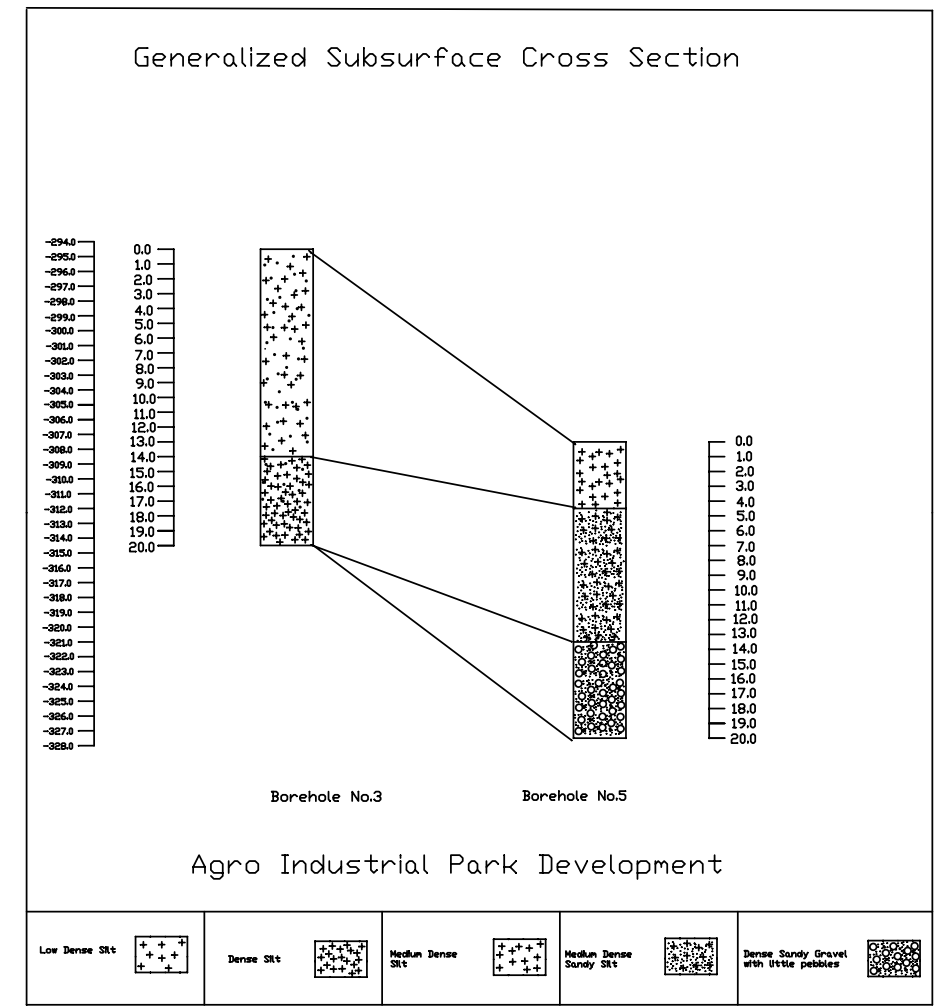
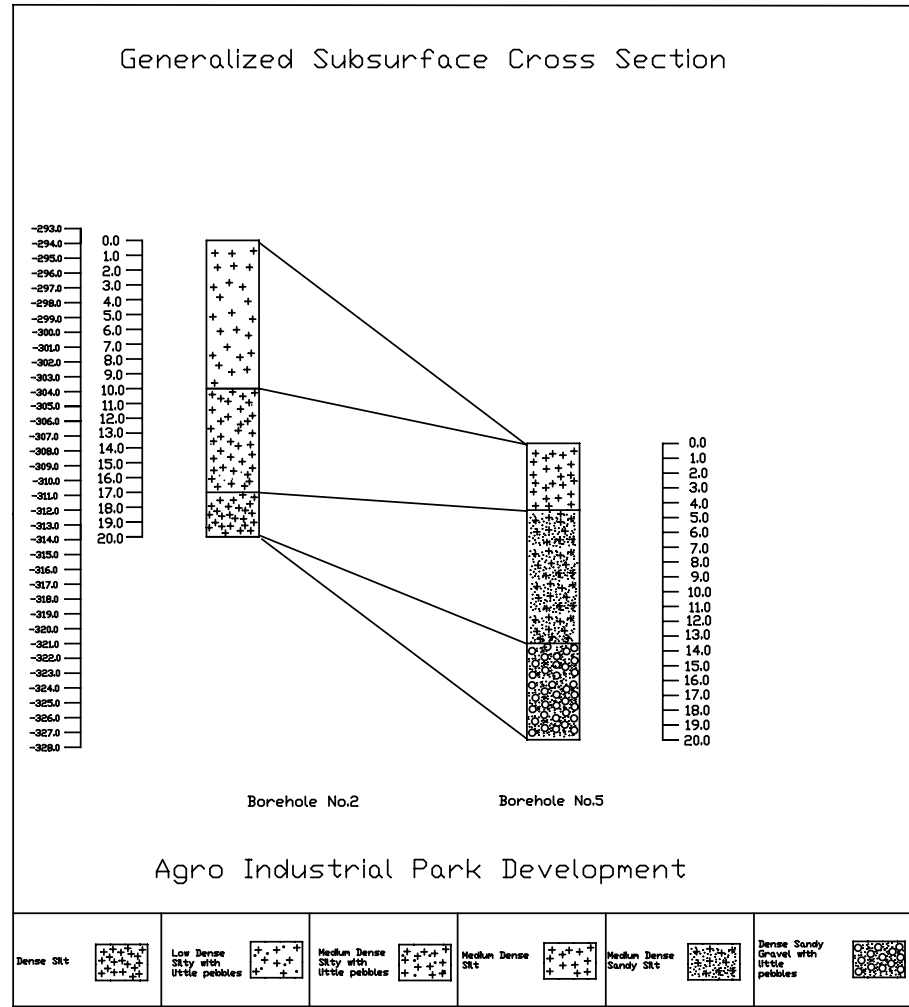
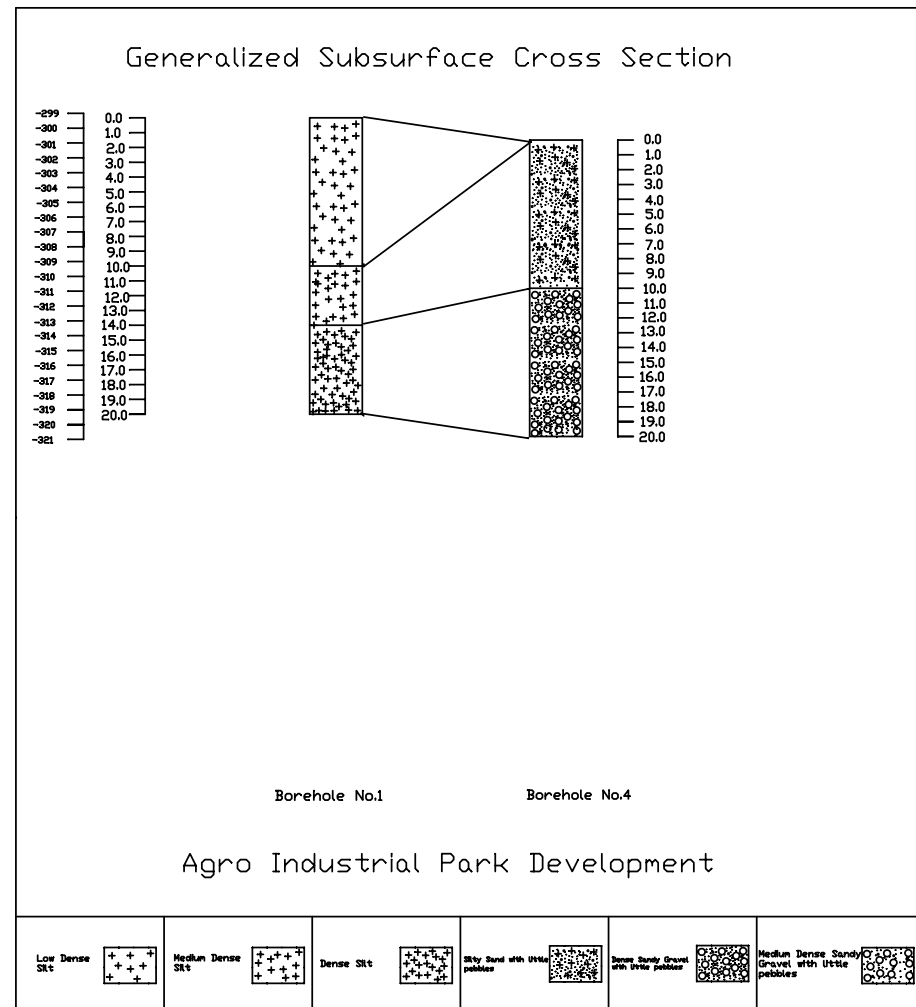
Bore Hole No. 5



Depth 10 – 15 m



Depth 15 – 20 m



Geological Cross Sections

III-4 Water quality and quantity survey

Report on waster quality and quantity survey

**WATER QUALITY AND QUANTITY SURVEY
FOR
THE FEASIBILITY STUDY
ON
AGRO-INDUSTRIAL PARK DEVELOPMENT
IN THE JORDAN RIVER RIFT VALLEY**



October, 2008

KRI International Corp
Nippon Koei Co. Ltd

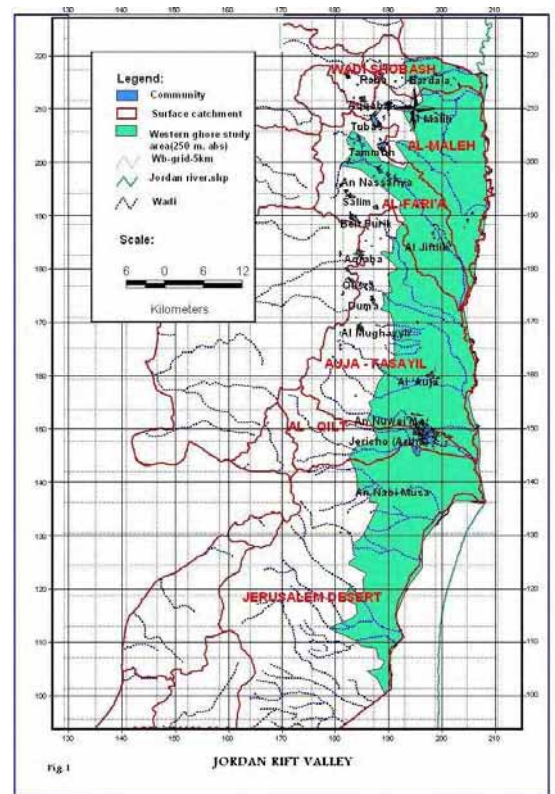
1 INTRODUCTION

Jericho Governorate is located in the eastern part of the West Bank of the Jordan River Rift Valley and has a population around 24000. The study area is bounded by the Jordan River from the east and by the mountainous areas from the west. In general, most of the study area characterized by flat areas with little relief ranged from 300 along the western sides to -370 meters below sea level.

The climate of the study area is categorized as arid to semi-arid zone with annual average rainfall ranges from less than 100 mm to 300 mm. Groundwater and surface water flow direction is toward the east to the Jordan River and the Dead Sea. However, water resources in the Jordan Valley are represented mainly by groundwater resources that are wells and springs; and by surface water resources which include Jordan River and some ephemeral flood flow wadis.

Water allocation in the area is 95% for agriculture and the remaining 5% for human consumption. Water for agriculture is mainly utilized for livestock and irrigation.

In terms of catchment areas, Jericho town area is located in the Jordan River Rift Valley of the West Bank, particularly includes the watershed areas of Wadi Al-Qilt fig .1.



Jordan Valley area plays a major role for economic development since it considered as the main Food Basket for all Palestinian District. Beside that, the health and cultural feature plus the unique landscape have made the area attractive also for tourism. Current economic activities in the area are restricted mainly to agricultural, industrial (water bottling), and tourism. Agricultural Sector represents the main current activity for most of the Palestinian residents. This sector consumes more than 60 % of available water resources for Palestinians which is in general limited to private Palestinian wells and some springs. The private Palestinian wells have been drilled since 1967 and characterized by shallow depths ranged from 50-250 m. Most of these wells are very old and have also old and malfunctioning water distribution systems with gradual decreasing in pump capacity.

Recently, most of Jordan Valley communities become extremely suffered from shortage of safe and reliable water supply for domestic, agricultural, and municipal purposes. The main water supply for these communities is groundwater that is considered as a limited source for wells and springs. Since few years ago, the groundwater resources in many locations of Jordan Valley become suffering from serious problems represented by severe decline in water level and increasing salinity in several production wells, which limit its role in the development.

2 OBJECTIVES

The objective of the survey is to obtain the current conditions of water quality and quantity for four (4) water wells for the Feasibility Study on Agro-Industrial Park Development in Jordan River Rift Valley:

1. Three of Pumping wells, for testing its capacity as well water quality analysis:
 - Ismail Deaq well, Id 19-13/26A
 - Hassan Handoun well, Id19-13/050A
 - Zuhdi Hashwah well, Id, 19-13/052
2. One of non pumping wells, Jericho well number one, Id (19-14/101, that delivered from Mekoroth to PWA, which needs cleaning from obstacles to test the well capacity and to analysis water quality.

3 GROUNDWATER AQUIFER SYSTEM

Generally, Jericho governorate in Jordan Valley Area is part of the Eastern Basin in the West Bank. The existing aquifer systems within Jericho area consist of the following main aquifers that most of agricultural wells are tapping them:

- The Quaternary Deposits
- The Upper Aquifer System (Jerusalem, Bethlehem, and Hebron Formations)
- The Lower Aquifer System (Yatta, Upper Beit Kahil, and Lower Beit Kahil Formations)

The various aquifer systems are described in detail below.

Quaternary Deposits

Quaternary Aquifer is the main ground water system in Jordan Valley Area since most of the agricultural wells are tapping this aquifer at different depths. The Quaternary Aquifer is not a continuous system along the Jordan Valley; it scattered over different and separated location in Jericho, Al-Uja, and Fasayel areas. These fan deposits were developed along the sides of major wadis that flow through Jordan Valley. Moreover, the geometry of these fans is not determined in precise way; they have a lenses shape with variable thickness and extension forming a good aquifer. The groundwater quality in these fans is varies with location. Generally, good groundwater quality occurs, where fresh groundwater recharge is available. It is believed that this aquifer is overlaying the Lisan Formation, which is act as impermeable or very low permeability layer. Groundwater recharge in this aquifer is taken place through two mechanisms: lateral flow from the Mountain Aquifer that is replenished in the mountain area some 10 to 30 km to the west; and the infiltration of storm water from flooded wadis that crossing the aquifer.

Water level in the Quaternary Aquifer can be found at variable depths ranging from 10 m to 70m or more below ground level. Changes in groundwater levels reflect changes in recharge to, and discharge from an aquifer. In general, groundwater flow in this system is directed to the Jordan River and the Dead Sea.

Upper Aquifer System

The upper aquifer system occurs in the Turonian and Upper Cenomanian Formations. It spreads over the West Bank and is mainly utilized from the Eastern Basin. The Turonian section of the Upper Aquifer consists mostly of massive limestone and dolomite which varies in thickness. It extends well into the Tulkarem area where produces a significant quantity of water.

The Upper Cenomanian section consists mainly of interbedded dolomites and chalky limestone formations (Bethlehem and Hebron formations according to Palestinian terminology). The formation's thickness ranges from 150 meters to 400 meters. Outcrops of this formation are located on the flanks of the Ramallah-Hebron Anticline where the rainfall is relatively high. Direct rainfall forms the main recharge source for this aquifer. The quality of the water from this aquifer is generally good.

Lower Aquifer System

The lower aquifer system is composed of the middle and lower Yatta Formations, the Upper and Lower Beit Kahil Formations (Palestinian Terminology).

The Yatta Formation consists mainly of marl, clay, and marly limestone; and divided into three parts: upper, middle, and lower. The Upper Yatta is an aquitard and generally restricts vertical groundwater flow between the Upper and Lower Aquifers. The Middle and Lower parts of the Yatta Formation form an aquifer which drains water to the lower layers.

The Upper Beit Kahil Formation is composed of regularly interbedded chalky limestone and dolomite. The formation becomes more massive and karstified upwards, while retaining the thin-bedded alternative.

The Lower Beit Kahil Formation is composed of dolomite and limestone interbedded 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. The Lower Aquifer is a deep-seated aquifer and classified as having excellent water quantity and quality. The outcropping formations in the Jordan River Rift Valley are shown in **Figure 2**.

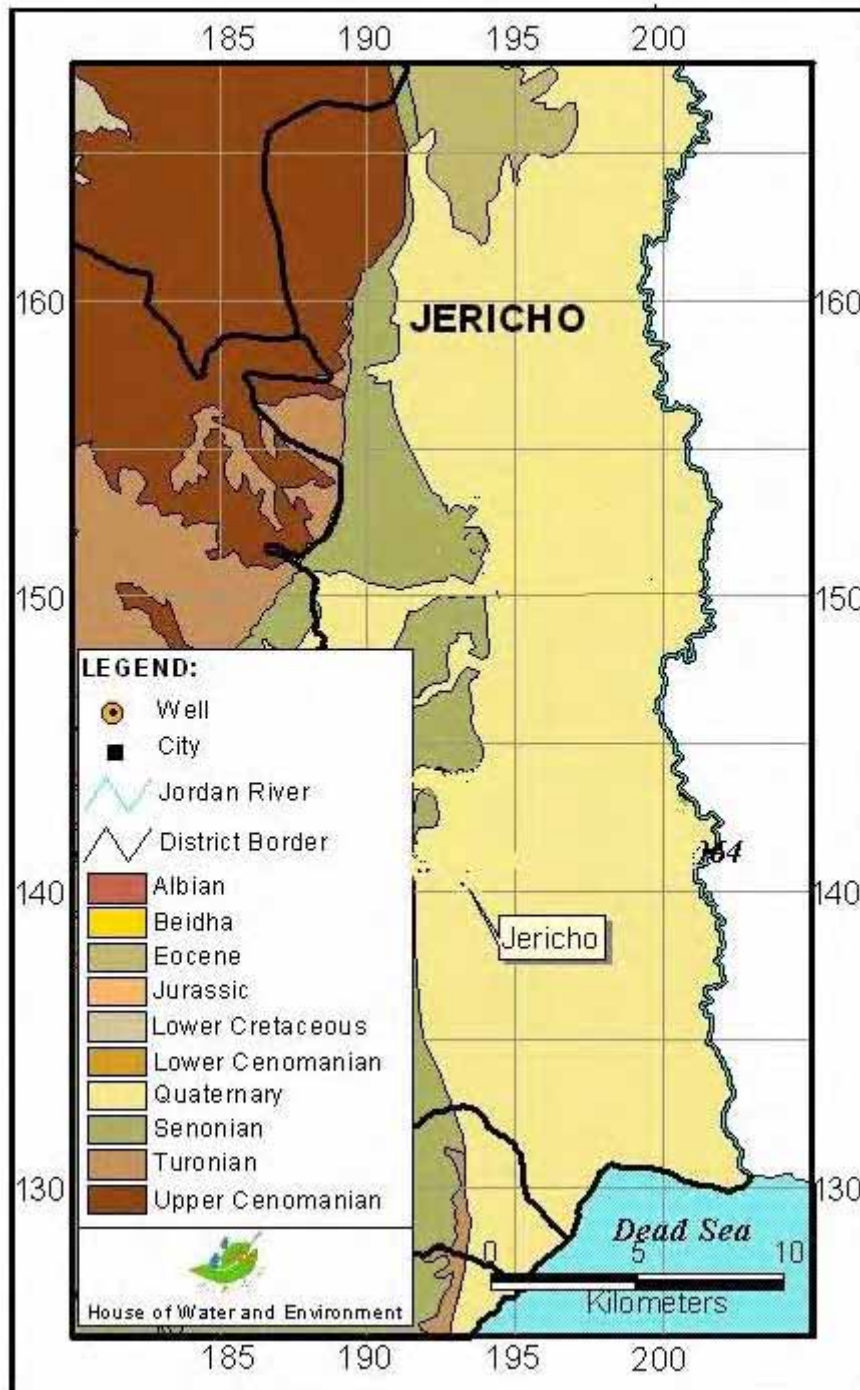


Figure 2: Geological Map of the study area

4 TARGETED WELLS IN JERICHO AREA

The main purpose of this survey is to obtain the current condition of water quality and quantity for four (4) water wells in Jericho area by execution pumping tests for these wells and analysis water quality for the bottled water from these wells.

The water wells that will be surveyed in Jericho area are presented in Table 1.

Table 1: Targeted water wells in Jericho area for Survey

No.	Code	Point name	Aquifer
1	19-13/026A	Ismail Deaq	Quaternary Deposits
2	19-13/050A	Hassan Handoun	Quaternary Deposits
3	19-13/052	Zuhdi Hashwah	Quaternary Deposits
4	19-14/101	Jericho well no.1	Lower Cenomanian

5 Wells pumping tests

1- Well No.19-13/026A

Well Profile

1. General Information

(The information is according to PWA data base)

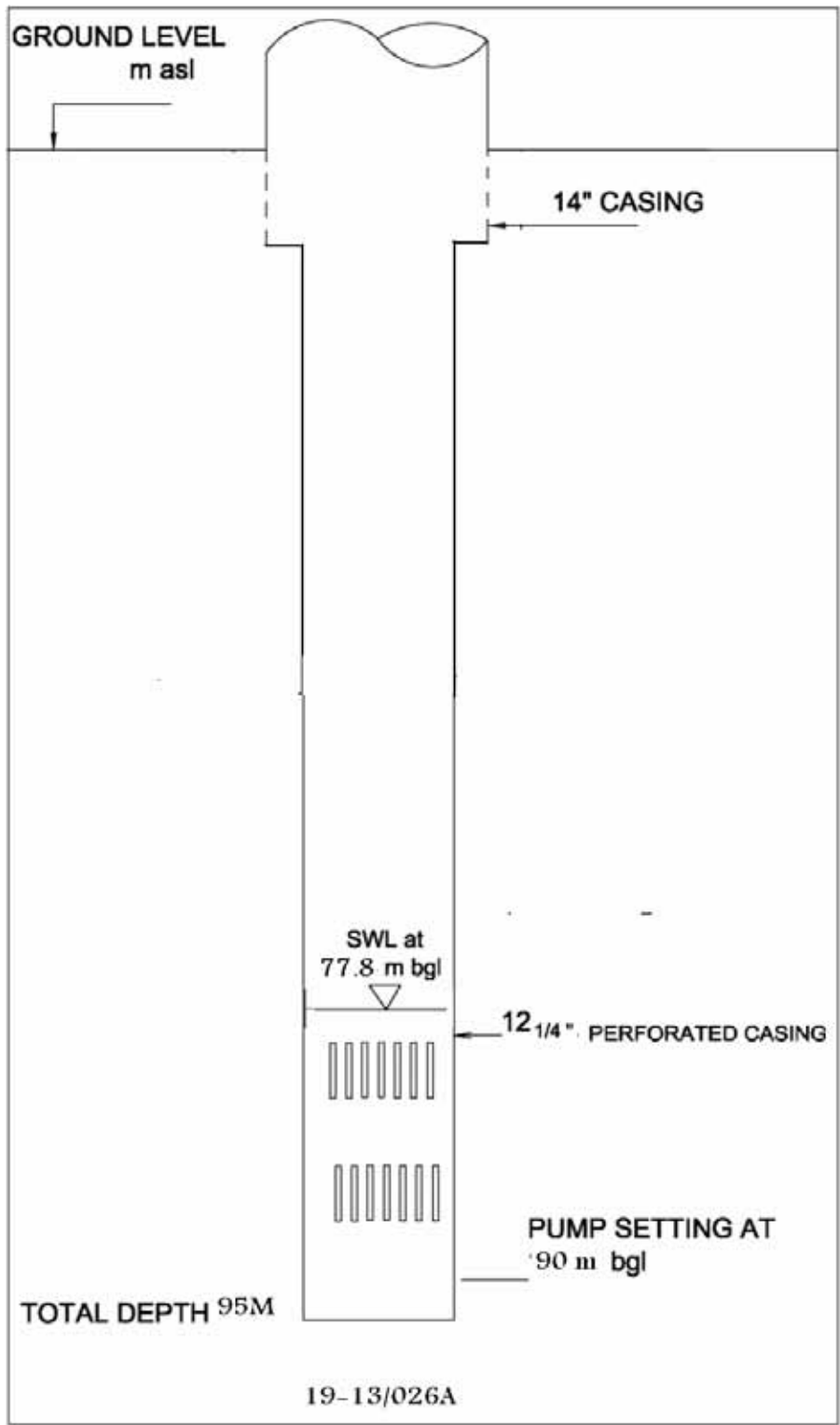
Well Name	Ismail Deaq
Locality Name	Jericho
Well Number	19-13/026A
Coordinates	PGE 195390/ PGN 138800
Status	Pumping
Extraction License	Not available at PWA data base
Average Abstraction	60500 m ³ /year (PWA)
Water Usage	Agriculture

2. Well Structure

Drilling Method	Cable Tool (Percussion)
Total Well Depth	95 m
Upper Casing (Blank)	Ø 14'' - steel / welded/ blank
Lower Casing (Screen)	Ø 12'' - steel / welded/ perforated

3. Hydro-geological Condition

Tapped Aquifer	Alluvium (Eastern Basin)
Static Water Level	77.77 meters below ground level on 29/08/2008
Discharge Rate	76 m ³ /hr
Dynamic Water Level	89.55 meters below ground level on 29/08/2008
Specific Capacity	6.5 m ³ /hr/m



Pumping test data and analysis

Pumping test data

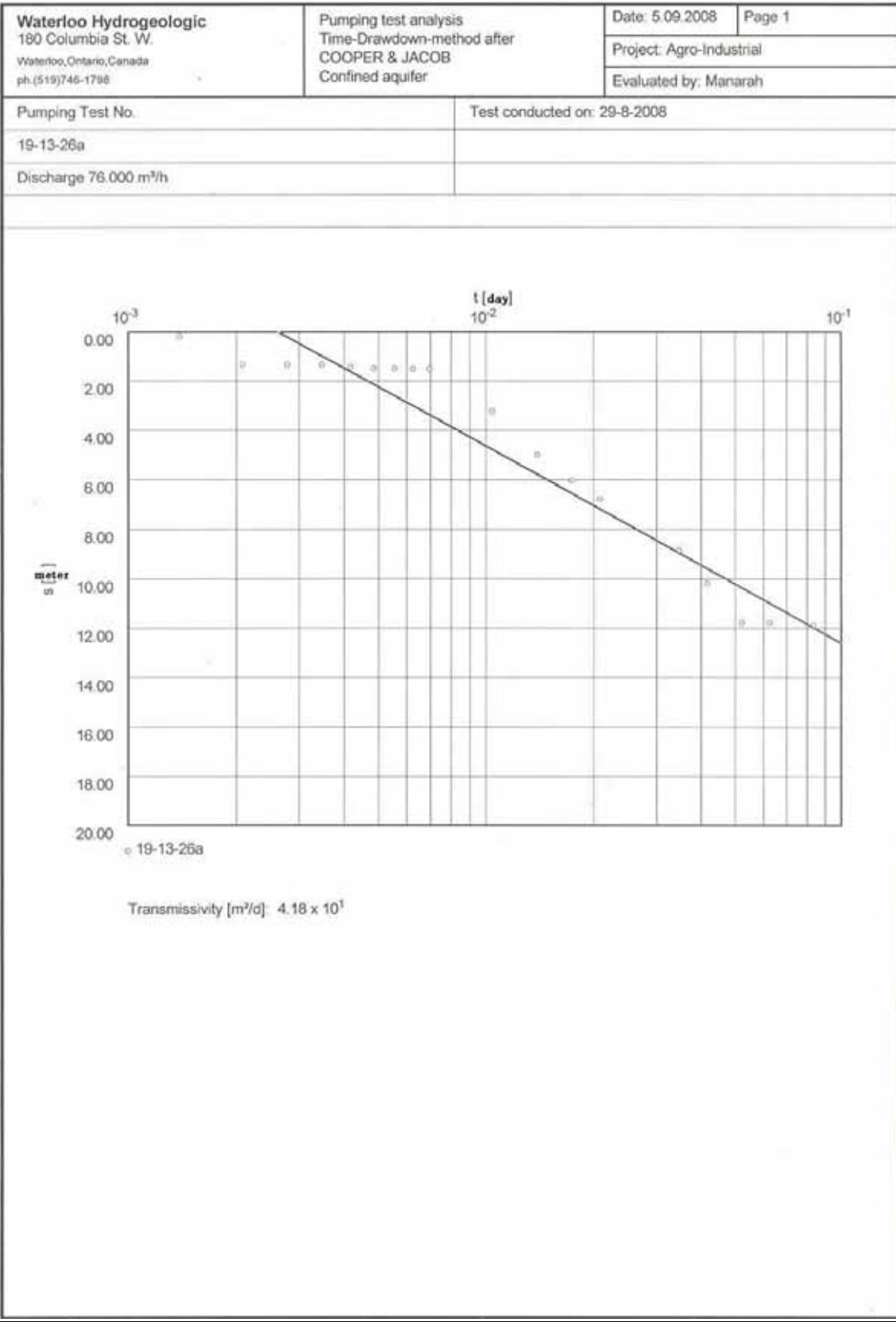
Well Name:19-13/26A Location: Jericho /Jordan Valley

S.W.L:77.77m, Well depth:95mbgl

Pump Setting: 90mbgl Date:29/08/2008

S.W.L:77.77m Pump Setting: 90mbgl Date:29/08/2008

Time (min)	Water Level (m)	Pumping Rate (m³/hr)	Remarks
1			
2	77.95	78	
3	79.1	78	
4	79.1	76	
5	79.1	76	
6	79.2	76	
7	79.25	76	
8	79.25	76	
9	79.27	76	
10	79.27	76	
15	81	76	
20	82.77	76	
25	83.8	76	
30	84.55	76	
50	86.62	76	
60	87.94	76	
75	89.55		
90	89.55		
120	89.65		water table reach to Pump turbine
150			stop pumping



Recommendations

- The dynamic water level comes near the pump turbine with 76m³/hr, so it's recommended to reduce the well abstraction to 65m³.hr to allow the dynamic water level over the pump turbine settings.

Well Water Quality analysis

Sampling Field trip was conducted to the Well site. The well was operated for certain time to reach a stable condition for the water. Sampling for Microbiological and Chemical testing took place as well as field measurements.

- Microbiological samples were collected in 500 ml sterile glass bottles.
- Chemical samples were collected in 250 ml bottles for major cations and anions
- 250 ml acidified samples collected for the trace measurements.
- Measurement: pH, EC, Turbidity, Temp were taken in the field.

Four (4) Water Samples were taken in accordance to PWA Standards. Samples collected and transported in Ice Box at 4°C, Samples for the major cations and anions were analyzed at the Water Authority of Jordan and the microbiology was done at the PWA labs.

Summary of water quality – Well No 19-13/026A

				Sampling Date : 03/08/2008			
Component	Symbol	Unit	Palestinian Water Quality Standards	Present Water Quality			
				19-13/026A	19-13/026A	19-13/026A	19-13/026A
				at 13:45	at 14:00	at 14:15	at 14:30
Electrical Conductivity	EC	Us/cm	No limit	4900	4840	4950	4970
Arsenic	As	mg/L	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	Se	mg/L	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Fluoride	F	mg/L	< 1.5	0.75	0.68	0.57	0.58
Iron	Fe	mg/L	< 0.3	< 0.1	< 0.1	< 0.1	<0.1
Copper	Cu	mg/L	< 1	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	Mn	mg/L	< 0.1	< 0.02	< 0.02	< 0.02	< 0.02
Chromium	Cr	mg/L	< 0.05	< 0.02	< 0.02	< 0.02	< 0.02
Silver	Ag	mg/L	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02
Sodium	Na	mg/L	< 200	641	618	631	589
Potassium	K	mg/L	< 10	83	78	81	59
Calcium	Ca	mg/L	< 100	137	115	118	95
Magnesium	Mg	mg/L	< 100	176	164	166	140
Bicarbonate	HCO ₃	mg/l	No limit	360	664 *	332	358
Chloride	Cl	mg/L	< 250	1295	1314	1372	1111
Nitrate	NO ₃	mg/L	< 50	33	27	27	50
Sulfate	SO ₄	mg/l	< 200	229	203	209	193
Carbonate	CO ₃	mg/l	No limit	<3.5	<3.5	<3.5	<3.5
Total Hardness	TH as CaCO ₃	mg/l	500	1066	960	978	813

Potential Hydrogen	pH	No Unit	Between 6.5 and 8.5	8.12	8.16	8.1	8.12
Total Dissolved Solids	TDS	mg/L	< 1000	2695	2710	2724	2783
Turbidity	Turb.	NTU	1	0.5	0.35	0.52	0.41
Temperature	T	°C	No limit	25.5	25.5	25.5	25.5
Total bacteria	TC	FCU	3	90	42	30	22
Fecal bacteria	FC	FCU	0	0	0	0	0
Escherichia coli	E.Coli	FCU	0	0	0	0	0
Organic matter	UV	Abs at $\lambda=254$ nm	3-10**	0.8	0.9	0.9	0.8

- * : High measured value than expected.
- **: Israeli Guidelines

From the above table

The four samples indicate good replicate results in terms of accuracy. Only one bicarbonate reading seems to be not normal. This could be due to certain error in the analysis.

The Total Dissolved Solids " TDS" and EC are higher than the recommended values for drinking water. These results varies between 2695-2783mg/l and 4840 – 4970 Us/cm respectively **where the ratio between the EC and TDS is (0.55-0.7)**. Low turbidity was found when measured in the field

Water Quality data for major Cations and Anions:

Magnesium indicate High concentrations (Average 162 mg/l) more than the recommended values for drinking water "100 mg/l) while relatively high Calcium Concentrations are found in the tested samples.

Fluoride and nitrate shows acceptable values for drinking water. While Sulfate concentration appears to be slightly high in concentration more than the recommended limits for drinking water.

Very High Concentrations of Chloride and Potassium were detected in the measured samples. This could be due to the Aquifer type underlying the well water.

Well water is classified as very hard water.

Water Quality data for Trace Metals

The analytical results shows acceptable concentrations of the analyzed trace metals compared to the Palestinian standards for drinking water.

Water Quality data for Microbiology

Water samples were tested for total and Feecal Coliform as well as E-Coli where the total Coliform bacteria found to be high (more than 3 coloni/100 ml) Thus the water samples are contaminated by total Coliform but free from Feecal contamination. This indicate that the well water is not suitable for drinking unless treatment is applied to the well water before use to drinking purposes.

Organic Matter was analyzed by measuring the absorbance at $\lambda = 254$ nm. There is no Palestinian Standards But according to the Israeli guidelines which is **(3-10)** the organic matter consider to be very low in the analyzed samples

2- Well No.19-13/050A

Well Profile

1. General Information

(The information is according to PWA data base)

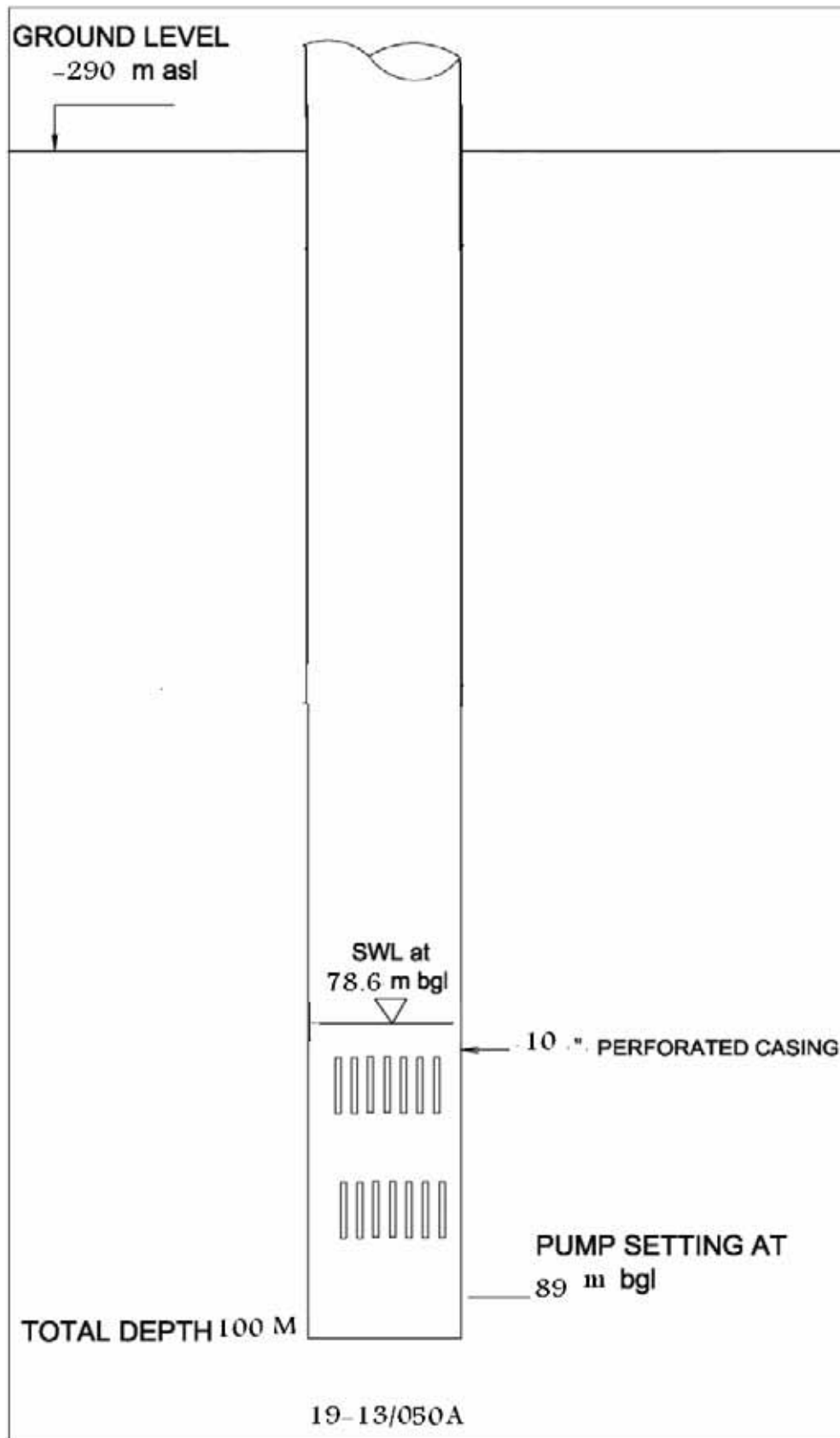
Well Name	Hassan Handoun
Locality Name	Jericho
Well Number	19-13/050A
Coordinates	PGE 195810/ PGN 1393800 / Z : -290 m asl
Status	Pumping
Extraction License	136000 m ³ /year, (PWA)
Average Abstraction	60524 m ³ /year (PWA)
Water Usage	Agricultural

2. Well Structure

Drilling Method	Cable Tool (Percussion)
Total Well Depth	100 m
Casing (Screen)	Ø 10" - steel / welded/ perforated

3. Hydro-geological Condition

Tapped Aquifer	Alluvium (Eastern Basin)
Static Water Level	78.60 meters below ground level on 29/08/2008
Discharge Rate	42 m ³ /hr
Dynamic Water Level	88.85 meters below ground level on 29/08/2008
Specific Capacity	4.1 m ³ /hr/m



Pumping test data and analysis

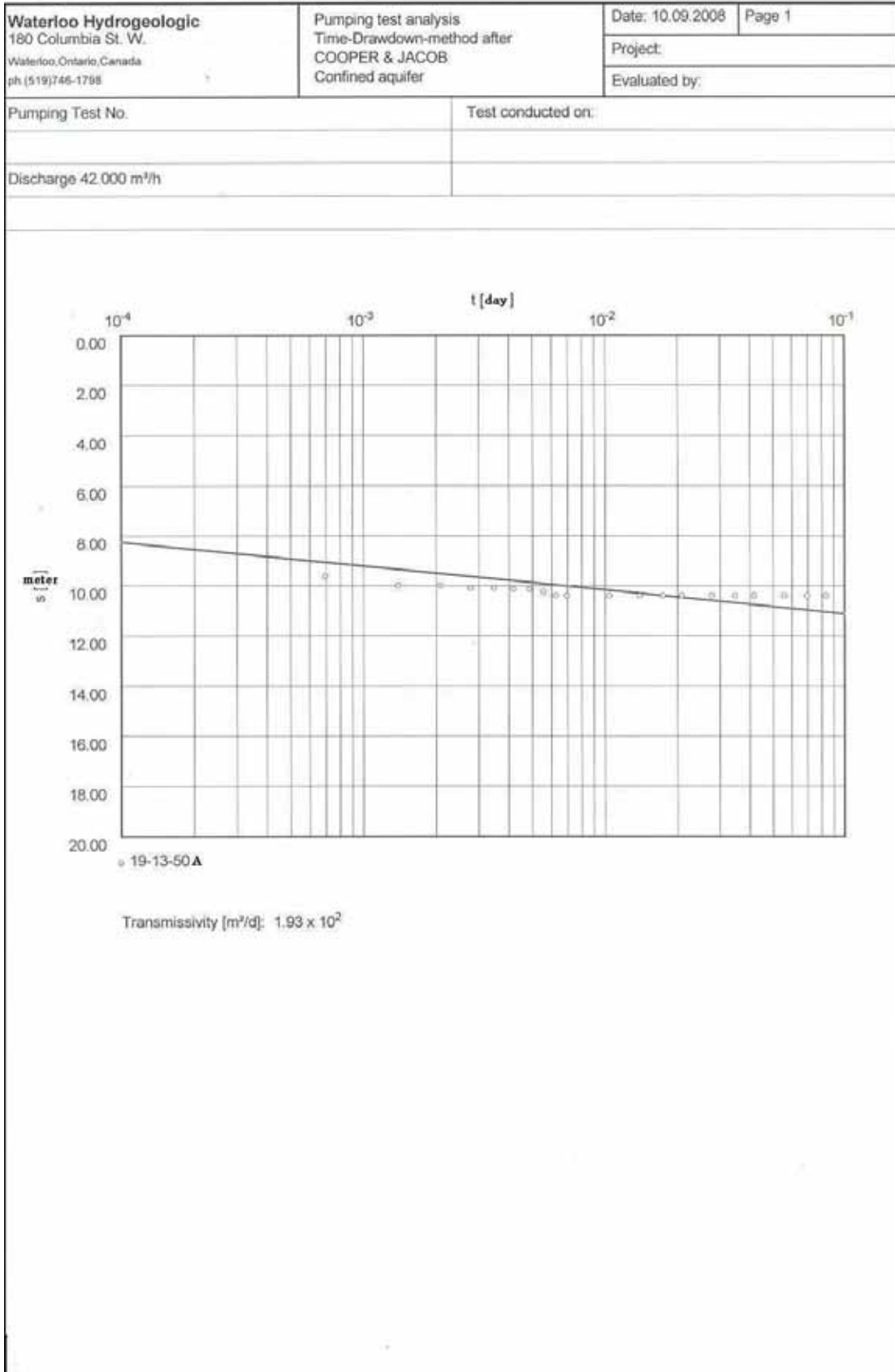
Pumping test data

Well Name:19-13/50A Location: Jericho /Jordan Valley

S.W.L:78.6m, Well depth:92mbgl

Pump Setting: 89 mbgl Date:29/08/2008

Time (min)	Water Level (m)	Pumping Rate (m³/hr)	Remarks
1	88.24	42	
2	88.6		
3	88.6	42	
4	88.7	42	
5	88.7	42	
6	88.75	42	
7	88.75	42	
8	88.85	42	
9	89	42	
10	89	42	Water table reach pump turbine
15	89	42	
20	89	42	
25	89	42	
30	89	42	
40	89	42	
50	89	42	
60	89	42	
80	89	42	
100	89		
120	89		
140			



Recommendations

- The dynamic water level comes near the pump turbine with 42m³/hr, so it's recommended to reduce the well abstraction to 35m³.hr to allow the dynamic water level over the pump turbine settings.

Well Water Quality analysis

Sampling Field trip was conducted to the Well site. The well was operated for certain time to reach a stable condition for the water. Sampling for Microbiological and Chemical testing took place as well as field measurements.

- Microbiological samples were collected in 500 ml sterile glass bottles.
- Chemical samples were collected in 250 ml bottles for major cations and anions
- 250 ml acidified samples collected for the trace measurements.
- Measurement: pH, EC, Turbidity, Temp were taken in the field.

Three Water Samples were taken in accordance to PWA Standards, Their was a shut down in the well before taking the 4th sample, which make it difficult to take the sample in the same day. Samples collected and transported in Ice Box at 4°C, Samples for the major cations and anions were analyzed at the Water Authority of Jordan and the microbiology was done at the PWA labs.

Summary of water quality - Well No 19-13/050A

				Sampling Date : 03/08/2008		
Component	Symbol	Unit	Palestinian Water Quality Standards	Present Water Quality		
				19-13/50A	19-13/50A	19-13/50A
				At 13:00	At 13:15	At 13:30
Electrical Conductivity	EC	Us/cm	No limit	1678	1671	1679
Arsenic	As	mg/L	< 0.05	< 0.005	< 0.005	< 0.005
Selenium	Se	mg/L	< 0.01	< 0.005	< 0.005	< 0.005
Fluoride	F	mg/L	< 1.5	0.55	0.46	0.3
Iron	Fe	mg/L	< 0.3	< 0.1	< 0.1	< 0.1
Copper	Cu	mg/L	< 1	< 0.02	< 0.02	< 0.02
Manganese	Mn	mg/L	< 0.1	< 0.02	< 0.02	< 0.02
Chromium	Cr	mg/L	< 0.05	< 0.02	< 0.02	< 0.02
Silver	Ag	mg/L	< 0.01	< 0.02	< 0.02	< 0.02
Sodium	Na	mg/L	< 200	156	149	152
Potassium	K	mg/L	< 10	25	24	24
Calcium	Ca	mg/L	< 100	74	62	58
Magnesium	Mg	mg/L	< 100	70	67	68
Bicarbonate	HCO ₃	mg/l	No limit	337	291	281
Chloride	Cl	mg/L	< 250	348	347	345
Nitrate	NO ₃	mg/L	< 50	33	32	31
Sulfate	SO ₄	mg/l	< 200	97	89	87
Carbonate	CO ₃	mg/l	No limit	<3.5	<3.5	<3.5
Total Hardness	TH as CaCO ₃	mg/l	500	475	431	427

Potential Hydrogen	pH	No Unit	Between 6.5 and 8.5	8.05	8.24	8.25
Total Dissolved Solids	TDS	mg/L	< 1000	923	936	940
Turbidity	Turb.	NTU	1	1.75	0.94	1.07
Temperature	T	°C	No limit	25.5	24.5	24.5
Total bacteria	TC	FCU	3	45	50	48
Fecal bacteria	FC	FCU	0	0	0	0
Escherichia coli	E. Coli	FCU	0	0	0	0
Organic matter	UV	Abs at $\lambda=254$ nm	3-10**	0.8	0.8	0.9

- **: Israeli Guidelines

Water Quality Data for Major Cations and Anions

As can be concluded from the above table that the Total dissolved solids and EC are within the limits for drinking water, while the Chloride concentration appears to be high (347 mg/l) compared to the allowable limits for drinking water (250 mg/l).

Normal results are found for fluoride, Sodium, Calcium, Magnesium, nitrate and sulfate. The water quality data are within the acceptable values for drinking water.

Potassium shows double values than the recommended limits and consider to be high.

Water is classified as moderate hard water.

Water Quality data for Trace Metals

The analytical results shows acceptable concentrations of the analyzed trace metals compared to the Palestinian standards for drinking water.

Water Quality data for Microbiology

Water samples were tested for total and Feecal Coliform as well as E-Coli where the total Coliform bacteria found to be high (more than 3 coloni/100 ml) Thus the water samples are contaminated by total Coliform but free from Feecal contamination. This indicate that the well water is not suitable for drinking unless treatment is applied to the well water before use to drinking purposes.

Organic Matter was analyzed by measuring the absorbance at $\lambda=254$ nm. There is no Palestinian Standards But according to the Israeli guidelines which is **(3-10)** the organic matter considers to be very low in the analyzed samples.

3- Well No.19-13/052

Well Profile

1. General Information

(The information is according to PWA data base)

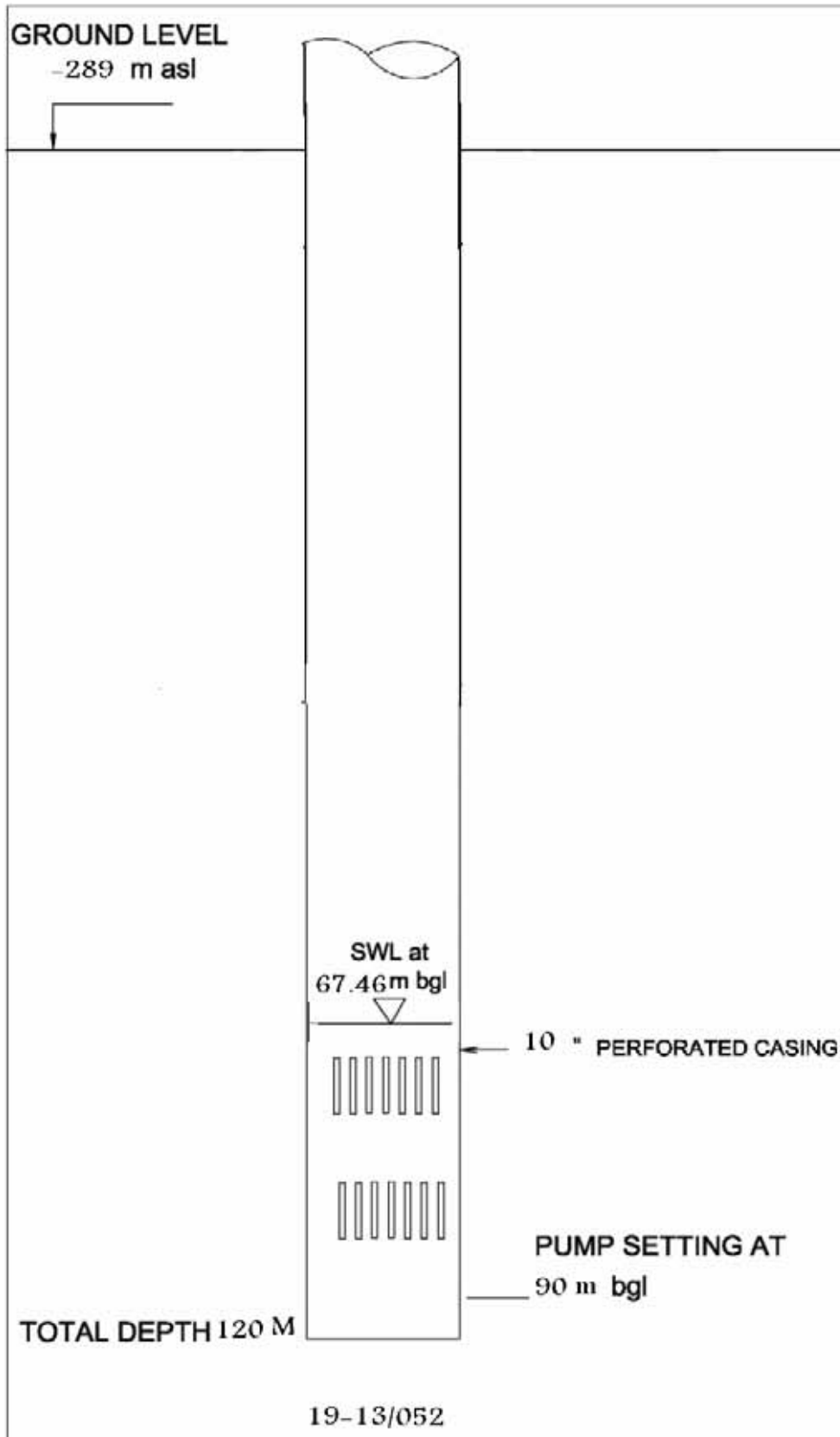
Well Name	Zuhdi Hashwah
Locality Name	Jericho
Well Number	19-13/052
Coordinates	PGE 195880/ PGN 139670 / Z : -289 m asl
Status	Pumping
Extraction License	241000 m ³ /year, (PWA)
Average Abstraction	15693 m ³ /year (PWA)
Water Usage	Agriculture

2. Well Structure

Drilling Method	Cable Tool (Percussion)
Total Well Depth	120m
Casing (Screen)	Ø 10" - steel / welded/ perforated

3. Hydro-geological Condition

Tapped Aquifer	Alluvium (Eastern Basin)
Static Water Level	67.46 meters below ground level on 29/08/2008
Discharge Rate	33 m ³ /hr
Dynamic Water Level	84.58 meters below ground level on 29/08/2008
Specific Capacity	1.9 m ³ /hr/m



Pumping test data and analysis

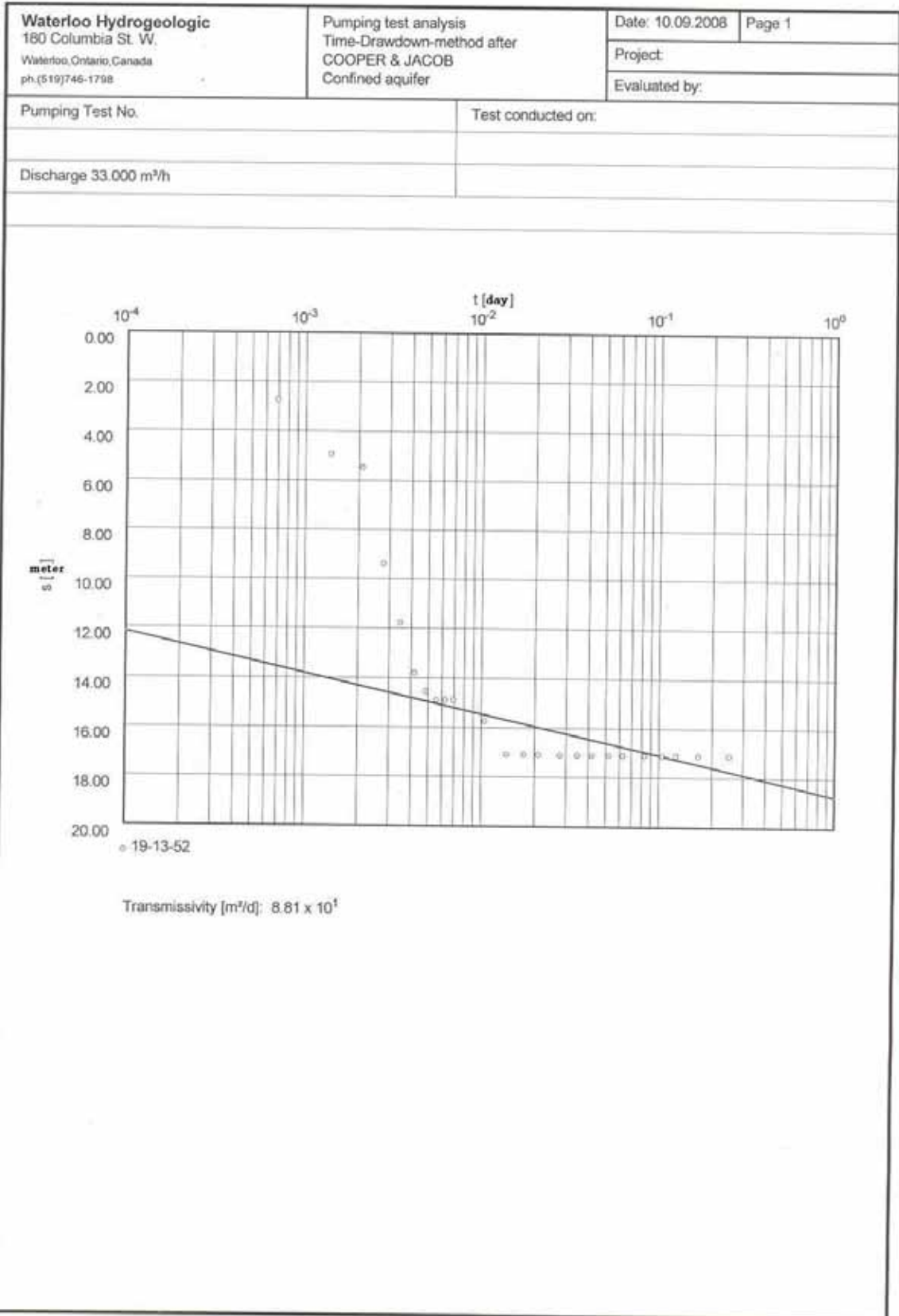
Pumping test data

Well Name:19-13/052 Location: Jericho /Jordan Valley

S.W.L:67.46m, Well depth:120mbgl

Pump Setting: 90mbgl Date:29/08/2008

Time (min)	Water Level (m)	Pumping Rate (m ³ /hr)	Remarks
1	70.2	38	
2	72.4	33	
3	72.93	33	
4	76.85	33	
5	79.25	33	
6	81.26	33	
7	82	33	
8	82.35	33	
9	82.35	33	
10	82.35	33	
15	83.2	33	
20	84.55	33	
25	84.55	33	
30	84.55	33	
40	84.58	33	
50	84.58	33	
60	84.58	33	
75	84.58	33	
90	84.58	33	
120	84.58	33	
150	84.58	33	
180	84.58	33	
240	84.58	33	
360	84.58	33	Specific capacity=2m3/h/m



Recommendations

- There is a possibility for increasing the well pumping capacity up to 40m³/hr with increasing the pump setting to 100mbgl.

Well Water Quality analysis

Sampling Field trip was conducted to the Well site. The well was operated for certain time to reach a stable condition for the water. Sampling for Microbiological and Chemical testing took place as well as field measurements.

- Microbiological samples were collected in 500 ml sterile glass bottles.
- Chemical samples were collected in 250 ml bottles for major cations and anions
- 250 ml acidified samples collected for the trace measurements.
- Measurement: pH, EC, Turbidity, Temp were taken in the field.

Four (4) Water Samples were taken in accordance to PWA Standards. Samples collected and transported in Ice Box at 4°C, Samples for the major cations and anions were analyzed at the Water Authority of Jordan and the microbiology was done at the PWA labs.

Summary of water quality - Well No- 19-13/052

				Sampling Date : 03/08/2008			
Component	Symbol	Unit	Palestinian Water Quality Standards	Present Water Quality			
				19-13/052	19-13/052	19-13/052	19-13/052
				at 11:30	at 11:45	at 12:00	At 12:15
Electrical Conductivity	EC	Us/cm	No limit	2100	1970	2080	2030
Arsenic	As	mg/L	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	Se	mg/L	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Fluoride	F	mg/L	< 1.5	0.59	0.53	0.66	0.52
Iron	Fe	mg/L	< 0.3	< 0.1	< 0.1	< 0.1	0.33
Copper	Cu	mg/L	< 1	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	Mn	mg/L	< 0.1	< 0.02	< 0.02	< 0.02	< 0.02
Chromium	Cr	mg/L	< 0.05	< 0.02	< 0.02	< 0.02	< 0.02
Silver	Ag	mg/L	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02
Sodium	Na	mg/L	< 200	170	187	191	190
Potassium	K	mg/L	< 10	25	27	27	28
Calcium	Ca	mg/L	< 100	80	56	78	65
Magnesium	Mg	mg/L	< 100	80	84	83	84
Bicarbonate	HCO ₃	mg/l	No limit	323	187	299	239
Chloride	Cl	mg/L	< 250	391	368	442	428
Nitrate	NO ₃	mg/L	< 50	44	43	35	36
Sulfate	SO ₄	mg/l	< 200	159	147	170	162
Carbonate	CO ₃	mg/l	No limit	<3.5	21.6 *	<3.5	12.6 *
Total Hardness	TH as CaCO ₃	mg/l	500	529	484	536	507

Potential Hydrogen	pH	No Unit	Between 6.5 and 8.5	8.05	8.47	8.1	8.33
Total Dissolved Solids	TDS	mg/L	< 1000	1155	1123	1133	1117
Turbidity	Turb.	NTU	1	0.89	1.72	1.49	1.82
Temperature	T	°C	No limit	25	25.5	25	25.5
Total bacteria	TC	FCU	3	88	70	65	63
Fecal bacteria	FC	FCU	0	0	0	0	0
Escherichia coli	E. Coli	FCU	0	0	0	0	0
Organic matter	UV	Abs at $\lambda= 254$ nm	3-10**	0.9	0.7	0.9	0.8

- * : Measured Values are Suspicious: Need to reanalyze Carbonate when start using the well
- **: Israeli Guidelines

Water Quality Data for Major Cations and Anions

Water quality results in the above table shows that the Total dissolved solids and EC are slightly higher than the recommended limits for drinking water, while the Chloride concentration appears to be high (407 mg/l) compared to the allowable limits for drinking water (250 mg/l).

Normal results are found for fluoride, Calcium, Magnesium and nitrate. The water quality data are within the acceptable values for drinking water.

Sulfate and chloride concentrations are less than the allowable limits but still consider relatively high.

Potassium shows triple values than the recommended and consider to be high.

Carbonate results are varied and questionable as big difference can be noticed between the four analyzed samples. Water is classified as moderate hard water.

Water Quality data for Trace Metals

The analytical results shows acceptable concentrations of the analyzed trace metals compared to the Palestinian standards for drinking water.

Water Quality data for Microbiology

Water samples were tested for total and Fecal Coliform as well as E-Coli where the total Coliform bacteria found to be high (more than 3 coloni/100 ml) Thus the water samples are contaminated by total Coliform but free from Fecal contamination. This indicate that the well water is not suitable for drinking unless treatment is applied to the well water before use to drinking purposes.

Organic Matter was analyzed by measuring the absorbance at $\lambda= 254$ nm. There is no Palestinian Standards But according to the Israeli guidelines which is **(3-10)** the organic matter consider to be very low in the analyzed samples

1- Well No.19-14/101

Well Profile

1. General Information

(The information is according to PWA data base)

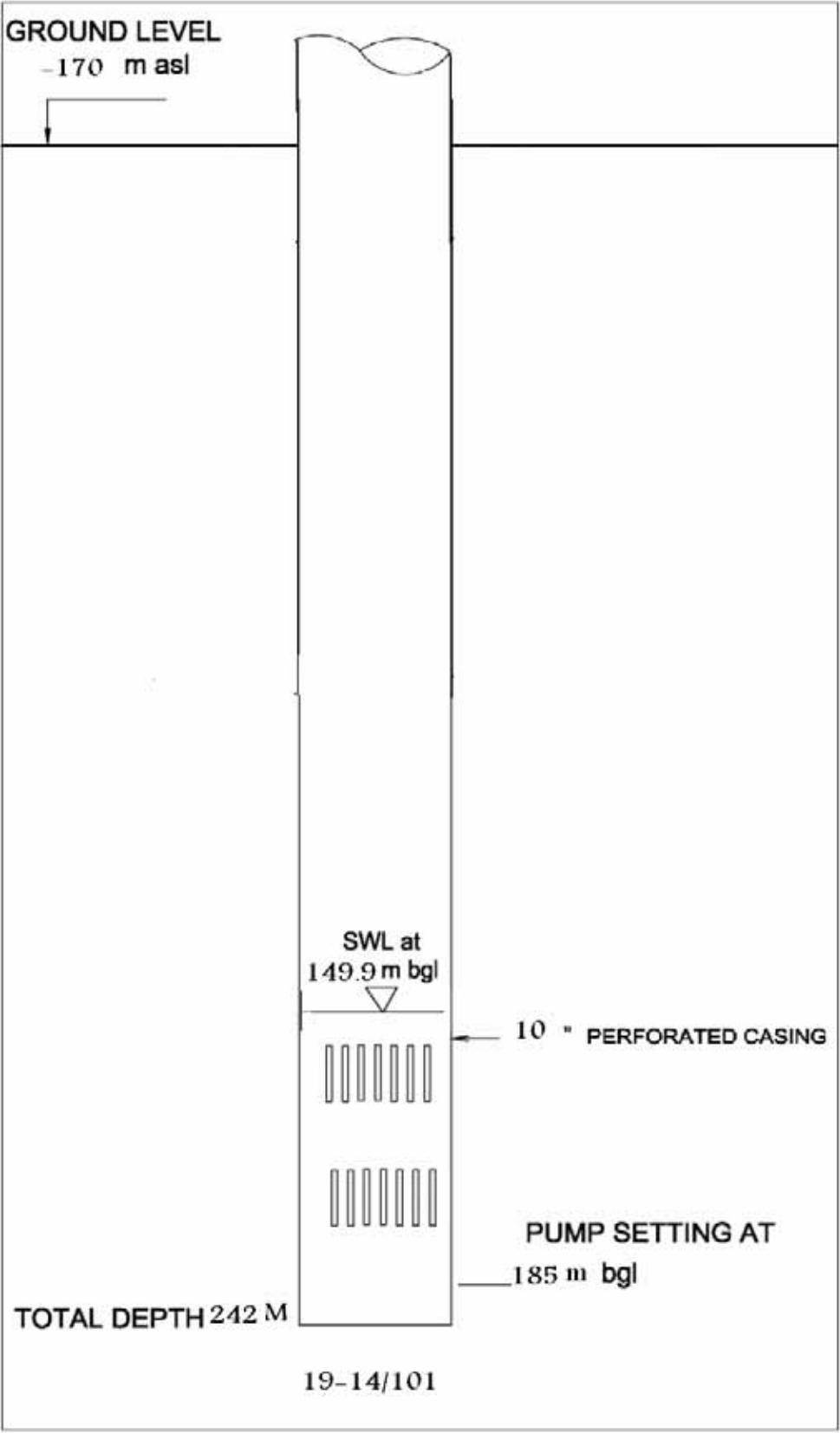
Well Name	Jericho well no.1
Locality Name	Jericho /Aqabat Jaber Camp
Well Number	19-14/101
Coordinates	PGE 190900/ PGN 140730 / Z :-170 m asl
Status	Non Pumping
Extraction License	Not available at PWA data base
Average Abstraction	Not available at PWA data base
Water Usage	Mekarothh

2. Well Structure

Drilling Method	Rotary..
Total Well Depth	243.5 m
Drilling Diameter/Length	Not available at PWA data base
Lower Casing (Screen)	Ø 10" - steel / welded/ perforated

3. Hydro-geological Condition

Tapped Aquifer	Lower Cenomanian (Eastern Basin)
Static Water Level	149.9 meters below ground level on 23/08/2008
Discharge Rate	50 m ³ /hr , pumping test on 23/08/2008
Dynamic Water Level	152.6 meters below ground level on 29/08/2008
Specific Capacity	19.2 m ³ /hr/m



Pumping test data and analysis

Pumping test data

Step Draw Down Test

Well Name: Jericho No.1 Location: Jericho /Jordan Valley
 S.W.L:149.9m Well depth:243.5mbgl Pump Setting:185mbgl
 Date:23/08/2008

Time (min)	Water Level (m)	Pumping Rate (m ³ /hr)	Remarks
1st step			
1	150.05	33	
2	150.05	33	
4	150.05	33	
6	150	33	
8	150	33	
10	150	33	
15	150	33	
20	150	33	
30	150	33	
45	150	33	
60	150	33	
75	150	33	
100	150	33	
120	150	33	
2nd Step			
1	150	42	
2	150	42	
4	150	42	
6	150	42	
8	150	42	
10	150	42	
15	150	42	
20	150	42	
30	150	42	
45	150	42	
60	150	42	
75	150	42	
100			
120			
3rd Step			
1	150.37	50	
2	150.37	50	
4	150.37	50	
6	150.37	50	

8	150.37	50	
10	150.37	50	
15	150.37	50	
20	150.37	50	
30	150.37	50	
45	150.37	50	
60 (1hr)	150.37	50	
75	150.37	50	
90	150.37	50	
120	150.37	50	

4th Step			
1	150.75	60	
2	150.85	60	
4	150.85	60	
6	150.85	60	
8	150.85	60	
10	150.85	60	
15	150.85	60	
20	150.85	60	
30	150.85	60	
45	150.85	60	
60 (1hr)	150.85	60	
75	150.85	60	
90	150.85	60	
120	150.85	60	

Continuous yield

Well Name: Jericho No.1 Location: Jericho /Jordan Valley

S.W.L:151.5m, Well depth:243.5mbgl

Pump Setting: 185mbgl Date:24/08/2008

Time (min)	Water Level (m)	Pumping Rate (m ³ /hr)	Remarks
1			
2	152.6	60	
3			
4	152.6	60	
5			
6	152.6		
7			
8	152.6		
9	152.6		

10	152.6	54	
15	152.6		
20	152.6		
25	152.6		
30	152.6		
40	152.6		
50	152.6		
60	152.6		
80	152.6		
100	152.6		
120	152.6		
140	152.6		
170			Pumping stop due to mechanical failure
200			
230	152.45	48	
260	152.45		
320	152.5		
380	152.55	48	
440	152.6		
500	152.6		
560	152.6	48	
620	152.6		
680	152.6		
740	152.6		
800	152.6	48	
860	152.6		
920	152.6		
980	152.6		
1040	152.6		
1100	152.6		
1160	152.6	50	
1220	152.6		
1280	152.6	50	
1340	152.6		
1400	152.6	50	
1460	152.6	50	
1520	152.6	50	
1580	152.6	50	
1640	152.6	50	
1700	152.6	50	
1760	152.6	50	
1820	152.6	50	
1880	152.6	50	
1940	152.6	50	
2000	152.6	50	
2060	152.6	50	
2120	152.6	50	
2180	152.6	50	

2240	152.6	50	
2300	152.6	50	
2360	152.6	50	
2420	152.6	50	
2480	152.6	50	
2540	152.6	50	
2600	152.6	50	
2660	152.6	50	
2720	152.6	50	

Recovery Test

Well Name: Jericho No.1 Location: Jericho /Jordan Valley

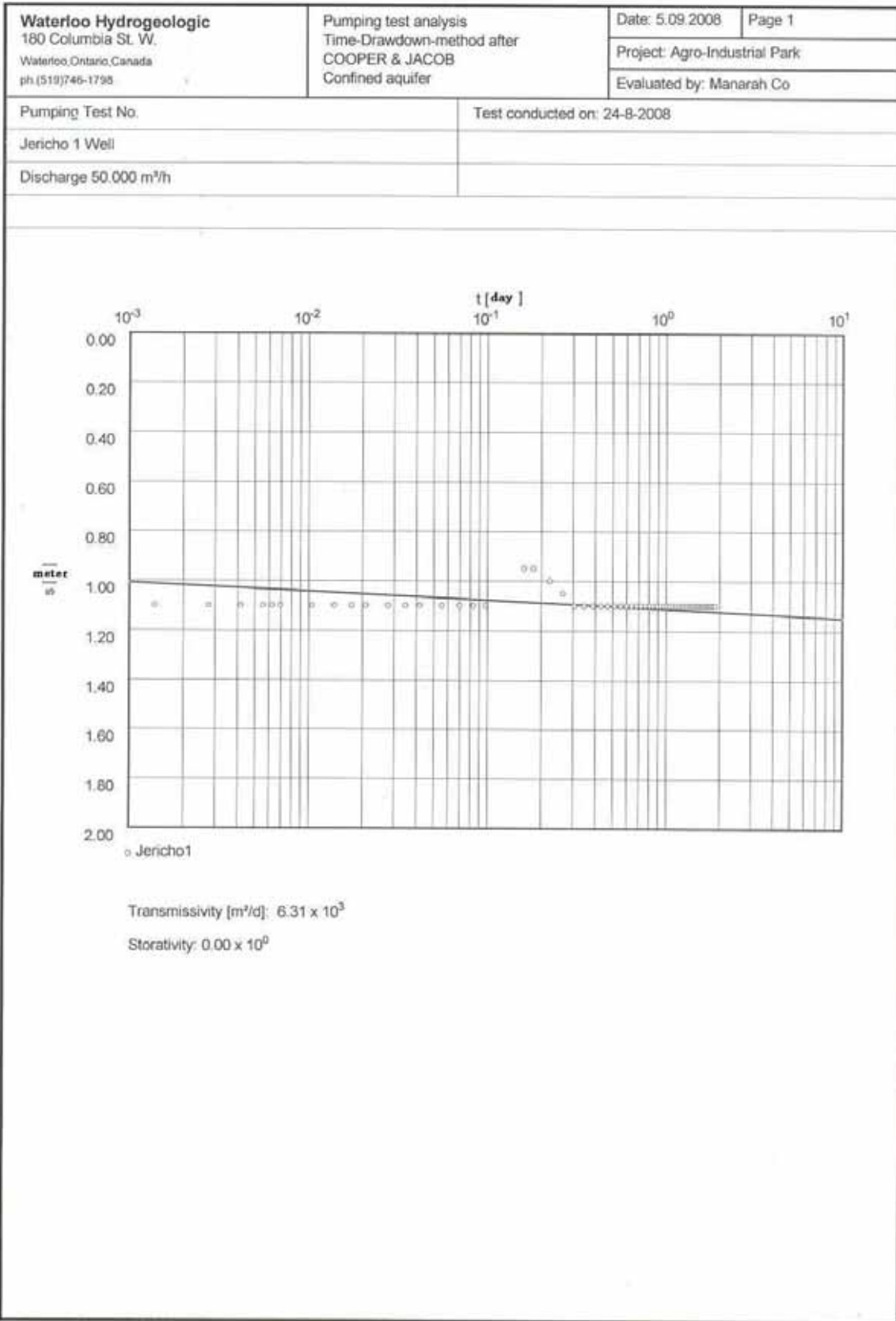
S.W.L:151.5m, Well depth:243.5mbgl

Pump Setting:185mbgl Date:24/08/2008

Time (min)	Recovered Water Level (m)	Remarks
1	151.35	
2	151.45	
3	151.45	
4	151.45	
5	151.47	
6	151.47	
7	151.53	
8	151.5	
9	151.55	
10	151.56	
12	151.59	
14	151.59	
16	151.59	
18	151.55	
20	151.55	
30	151.51	
40	151.51	

Pumping test analysis

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo, Ontario, Canada ph (519)746-1798		Pumping test analysis Time-Drawdown-method after COOPER & JACOB Confined aquifer		Date: 5.09.2008	Page 2
				Project: Agro-Industrial Park	
				Evaluated by: Manarah Co	
Pumping Test No.			Test conducted on: 24-8-2008		
Jericho 1 Well			Jericho1		
Discharge 50.000 m ³ /h			Distance from the pumping well 0.400 m		
Static water level: 151.500 m below datum					
	Pumping test duration [day]	Water level [meter]	Drawdown [meter]		
1	0.00139	152.600	1.100		
2	0.00278	152.600	1.100		
3	0.00417	152.600	1.100		
4	0.00556	152.600	1.100		
5	0.00695	152.600	1.100		
6	0.00834	152.600	1.100		
7	0.01042	152.600	1.100		
8	0.01389	152.600	1.100		
9	0.01736	152.600	1.100		
10	0.02083	152.600	1.100		
11	0.02778	152.600	1.100		
12	0.03472	152.600	1.100		
13	0.04167	152.600	1.100		
14	0.05556	152.600	1.100		
15	0.06944	152.600	1.100		
16	0.08333	152.600	1.100		
17	0.09722	152.600	1.100		
18	0.15972	152.450	0.950		
19	0.18056	152.450	0.950		
20	0.22222	152.500	1.000		
21	0.26389	152.550	1.050		
22	0.30556	152.600	1.100		
23	0.34722	152.600	1.100		
24	0.38889	152.600	1.100		
25	0.43056	152.600	1.100		
26	0.47222	152.600	1.100		
27	0.51389	152.600	1.100		
28	0.55556	152.600	1.100		
29	0.59722	152.600	1.100		
30	0.63889	152.600	1.100		
31	0.68056	152.600	1.100		
32	0.72222	152.600	1.100		
33	0.76389	152.600	1.100		
34	0.80556	152.600	1.100		
35	0.84722	152.600	1.100		
36	0.88889	152.600	1.100		
37	0.93056	152.600	1.100		
38	0.97222	152.600	1.100		
39	1.01389	152.600	1.100		
40	1.05556	152.600	1.100		
41	1.09722	152.600	1.100		
42	1.13889	152.600	1.100		
43	1.18056	152.600	1.100		
44	1.22222	152.600	1.100		
45	1.26389	152.600	1.100		
46	1.30556	152.600	1.100		
47	1.34722	152.600	1.100		
48	1.38889	152.600	1.100		
49	1.43056	152.600	1.100		
50	1.47222	152.600	1.100		



Recommendations

- The well specific capacity is good (well yield by the draw down), so can increase the well pumping rate to 100m³/hr with approximate dynamic water level around 155mbgl.

Well Water Quality analysis

Sampling Field trip was conducted to the Well site. The well was operated for certain time to reach a stable condition for the water. Sampling for Microbiological and Chemical testing took place as well as field measurements.

- Microbiological samples were collected in 500 ml sterile glass bottles.
- Chemical samples were collected in 250 ml bottles for major cations and anions
- 250 ml acidified samples collected for the trace measurements.
- Measurement: pH, EC, Turbidity were taken in the field.

Four (4) Water Samples were taken in accordance to PWA Standards. Samples collected and transported in Ice Box at 4°C, Samples for the major cations and anions were analyzed at the Water Authority of Jordan and the microbiology was done at the PWA labs.

Summary of water quality - Well No. 19-14/101

Sampling Date : 24/08/2008							
Component	Symbol	Unit	Palestinian Water Quality Standards	Present Water Quality			
				Jericho 1	Jericho 1	Jericho 1	Jericho 1
				at 6:00	at 7:00	after 3 hrs pump	after 30 hrs pump
Electrical Conductivity	EC	Us/cm	No limit	1760	1743	1731	1782
Arsenic	As	mg/L	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	Se	mg/L	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Fluoride	F	mg/L	< 1.5	0.33	0.39	0.4	0.4
Iron	Fe	mg/L	< 0.3	0.57	0.88	0.41	0.78
Copper	Cu	mg/L	< 1	< 0.02	0.02	< 0.02	< 0.02
Manganese	Mn	mg/L	< 0.1	0.13	0.11	0.08	0.11
Chromium	Cr	mg/L	< 0.05	< 0.02	< 0.02	< 0.02	< 0.02
Silver	Ag	mg/L	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02
Sodium	Na	mg/L	< 200	152	148	151	Not Measured
Potassium	K	mg/L	< 10	15	14	14	Not Measured
Calcium	Ca	mg/L	< 100	86	87	80	Not Measured
Magnesium	Mg	mg/L	< 100	64	63	64	Not Measured
Bicarbonate	HCO ₃	mg/l	No limit	243	267	255	261
Chloride	Cl	mg/L	< 250	419	426	448	430
Nitrate	NO ₃	mg/L	< 50	15	13	13	13

Sulfate	SO ₄	mg/l	< 200	44	34	35	38
Carbonate	CO ₃	mg/l	No limit	<3.5	<3.5	<3.5	Not Measured
Total Hardness	TH as CaCO ₃	mg/l	500	479	479	464	Not Measured
Potential Hydrogen	pH	No Unit	Between 6.5 and 8.5	7.98	7.98	8.03	7.97
Total Dissolved Solids	TDS	mg/L	< 1000	985	959	978	964
Turbidity	Turb.	NTU	1	0.95	0.81	0.9	0.83
Temperature	T	°C	No limit	Not Measured	Not measured	Not Measured	Not Measured
Total bacteria	TC	FCU	3	TMTC	TMTC	TMTC	TMTC
Fecal bacteria	FC	FCU	0	7	6	8	8
Escherichia coli	E.Coli	FCU	0	***	***	***	***
Organic matter	UV	Abs at $\lambda= 254$ nm	3-10**	0.9	0.8	0.9	1.1

- TMTC: too many to count
- **: Israeli Guidelines
- *** Colonies were not clear in the cultured samples , unable to repeat the test due to closure of the Well

Three water samples were analyzed for complete parameters the 4th water sample was partially analyzed at the PWA lab. The WAJ lab did not analyze the 4th sample it seems some misunderstanding.

Water Quality Data for Major Cations and Anions

Water quality results shown in the table shows that the Total dissolved solids and EC are slightly higher than the recommended limits for drinking water, while the Chloride concentration appears to be high (426 mg/l) compared to the allowable limits for drinking water (250 mg/l).

Normal results are found for fluoride, Calcium, Magnesium, sodium, Sulfate and nitrate. The water quality data are within the acceptable values for drinking water.

Potassium concentrations are higher than the allowable limits for drinking water. Water is classified as moderate hard water where the calcium concentration is dominate.

Water Quality Data for Trace Metals

The water quality analytical results show acceptable concentrations of the analyzed trace metals compared to the Palestinian standards for drinking water **except for Iron and Manganese** which indicate high results and expected to need treatment before use for drinking purposes.

Water Quality Data for Microbiology

Water samples were tested for total and Feecal Coliform as well as E-Coli where the total Coliform bacteria found to be (Too Many To Count TMTC) higher than 3 Colony /100 ml which indicate that the water samples are contaminated by total Coliform bacteria. Feecal contamination for the analyzed samples could be resulted from the long closure period of the well or due to the use of not disinfected equipments. More accurate results can be judged after the well development and disinfection. **E –coli colonies were not clear, it was unable top repeat the test for more accurate results. This should be considered later when decision to be taken to use the well water for drinking**

Organic Matter was analyzed by measuring the absorbance at $\lambda= 254$ nm. There is no Palestinian Standards But according to the Israeli guidelines which is **(3-10)** the organic matter consider to be very low in the analyzed samples

Submission No : 100068789

Location Description : 19 -13 / 52 Jericho

Sample No & Lab Ref. 200196910

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 11:30:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	2100	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.05	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	80.36	mg/L	0.3	Ion Chromatographic Method
N Magnesium	79.89	mg/L	0.3	Ion Chromatographic Method
N Sodium	170.43	mg/L	0.3	Ion Chromatographic Method
N Potassium	24.63	mg/L	0.3	Ion Chromatographic Method
N Chloride	391.21	mg/L	0.5	Ion Chromatographic Method
N Sulfate	159.36	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	322.69	mg/L	8.5	Titrimetric Method
N Nitrate	44.41	mg/L	0.2	Ion Chromatographic
N Hardness	529	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 52 Jericho

Sample No & Lab Ref. 200196911

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 11:45:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1970	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.47	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	55.71	mg/L	0.3	Ion Chromatographic Method
N Magnesium	84.03	mg/L	0.3	Ion Chromatographic Method
N Sodium	187.22	mg/L	0.3	Ion Chromatographic Method
N Potassium	27.76	mg/L	0.3	Ion Chromatographic Method
N Chloride	368.49	mg/L	0.5	Ion Chromatographic Method
N Sulfate	146.88	mg/L	0.3	Ion Chromatographic Method
N Carbonate	21.6	mg/L	3.5	Titrimetric Method
N Bicarbonate	186.66	mg/L	8.5	Titrimetric Method
N Nitrate	42.72	mg/L	0.2	Ion Chromatographic
N Hardness	484	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 52 Jericho

Sample No & Lab Ref. 200196912

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 12:15:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	2030	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.33	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	64.53	mg/L	0.3	Ion Chromatographic Method
N Magnesium	84.03	mg/L	0.3	Ion Chromatographic Method
N Sodium	190.9	mg/L	0.3	Ion Chromatographic Method
N Potassium	28.15	mg/L	0.3	Ion Chromatographic Method
N Chloride	427.78	mg/L	0.5	Ion Chromatographic Method
N Sulfate	162.24	mg/L	0.3	Ion Chromatographic Method
N Carbonate	12.6	mg/L	3.5	Titrimetric Method
N Bicarbonate	239.12	mg/L	8.5	Titrimetric Method
N Nitrate	36.03	mg/L	0.2	Ion Chromatographic
N Hardness	507	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 52 Jericho

Sample No & Lab Ref. 200196913

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 12:00:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	2080	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.10	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	78.16	mg/L	0.3	Ion Chromatographic Method
N Magnesium	82.81	mg/L	0.3	Ion Chromatographic Method
N Sodium	191.13	mg/L	0.3	Ion Chromatographic Method
N Potassium	27.37	mg/L	0.3	Ion Chromatographic Method
N Chloride	442.33	mg/L	0.5	Ion Chromatographic Method
N Sulfate	170.88	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	298.9	mg/L	8.5	Titrimetric Method
N Nitrate	34.83	mg/L	0.2	Ion Chromatographic
N Hardness	536	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 50 A Jericho

Sample No & Lab Ref. 200196914

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 13:00:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1678	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.05	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	74.15	mg/L	0.3	Ion Chromatographic Method
N Magnesium	70.41	mg/L	0.3	Ion Chromatographic Method
N Sodium	156.63	mg/L	0.3	Ion Chromatographic Method
N Potassium	24.63	mg/L	0.3	Ion Chromatographic Method
N Chloride	347.9	mg/L	0.5	Ion Chromatographic Method
N Sulfate	96.96	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	337.33	mg/L	8.5	Titrimetric Method
N Nitrate	33.22	mg/L	0.2	Ion Chromatographic
N Hardness	475	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 50 A Jericho

Sample No & Lab Ref. 200196915

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 13:15:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1671	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.24	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	62.12	mg/L	0.3	Ion Chromatographic Method
N Magnesium	67.12	mg/L	0.3	Ion Chromatographic Method
N Sodium	148.81	mg/L	0.3	Ion Chromatographic Method
N Potassium	23.85	mg/L	0.3	Ion Chromatographic Method
N Chloride	347.55	mg/L	0.5	Ion Chromatographic Method
N Sulfate	89.76	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	291.58	mg/L	8.5	Titrimetric Method
N Nitrate	31.8	mg/L	0.2	Ion Chromatographic
N Hardness	431	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 50 A Jericho

Sample No & Lab Ref. 200196916

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 13:30:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1679	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.25	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	58.52	mg/L	0.3	Ion Chromatographic Method
N Magnesium	68.46	mg/L	0.3	Ion Chromatographic Method
N Sodium	152.72	mg/L	0.3	Ion Chromatographic Method
N Potassium	24.24	mg/L	0.3	Ion Chromatographic Method
N Chloride	345.42	mg/L	0.5	Ion Chromatographic Method
N Sulfate	87.36	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	280.6	mg/L	8.5	Titrimetric Method
N Nitrate	30.98	mg/L	0.2	Ion Chromatographic
N Hardness	427	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 26 A Jericho

Sample No & Lab Ref. 200196917

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 13:45:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	4900	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.12	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	137.47	mg/L	0.3	Ion Chromatographic Method
N Magnesium	175.71	mg/L	0.3	Ion Chromatographic Method
N Sodium	640.55	mg/L	0.3	Ion Chromatographic Method
N Potassium	82.89	mg/L	0.3	Ion Chromatographic Method
N Chloride	1294.69	mg/L	0.5	Ion Chromatographic Method
N Sulfate	229.44	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	360.51	mg/L	8.5	Titrimetric Method
N Nitrate	33.37	mg/L	0.2	Ion Chromatographic
N Hardness	1066	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 26 A Jericho

Sample No & Lab Ref. 200196918

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 14:00:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	4840	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.16	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	114.83	mg/L	0.3	Ion Chromatographic Method
N Magnesium	163.92	mg/L	0.3	Ion Chromatographic Method
N Sodium	618.93	mg/L	0.3	Ion Chromatographic Method
N Potassium	78.98	mg/L	0.3	Ion Chromatographic Method
N Chloride	1314.57	mg/L	0.5	Ion Chromatographic Method
N Sulfate	203.04	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	664.29	mg/L	8.5	Titrimetric Method
N Nitrate	27.12	mg/L	0.2	Ion Chromatographic
N Hardness	960	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 26 A Jericho

Sample No & Lab Ref. 200196919

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 14:15:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	4950	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.10	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	117.84	mg/L	0.3	Ion Chromatographic Method
N Magnesium	166.35	mg/L	0.3	Ion Chromatographic Method
N Sodium	630.66	mg/L	0.3	Ion Chromatographic Method
N Potassium	81.33	mg/L	0.3	Ion Chromatographic Method
N Chloride	1372.43	mg/L	0.5	Ion Chromatographic Method
N Sulfate	208.8	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	332.45	mg/L	8.5	Titrimetric Method
N Nitrate	27.21	mg/L	0.2	Ion Chromatographic
N Hardness	978	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : 19 -13 / 26 Jericho

Sample No & Lab Ref. 200196920

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 03-AUG-2008 14:30:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	4970	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.12	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	94.99	mg/L	0.3	Ion Chromatographic Method
N Magnesium	140.2	mg/L	0.3	Ion Chromatographic Method
N Sodium	589.03	mg/L	0.3	Ion Chromatographic Method
N Potassium	59.04	mg/L	0.3	Ion Chromatographic Method
N Chloride	1111.15	mg/L	0.5	Ion Chromatographic Method
N Sulfate	193.92	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	358.07	mg/L	8.5	Titrimetric Method
N Nitrate	49.88	mg/L	0.2	Ion Chromatographic
N Hardness	813	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : Jericho 1

Sample No & Lab Ref. 200196921

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 24-AUG-2008 06:00:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1760	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	7.98	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	85.77	mg/L	0.3	Ion Chromatographic Method
N Magnesium	64.45	mg/L	0.3	Ion Chromatographic Method
N Sodium	152.26	mg/L	0.3	Ion Chromatographic Method
N Potassium	14.47	mg/L	0.3	Ion Chromatographic Method
N Chloride	418.55	mg/L	0.5	Ion Chromatographic Method
N Sulfate	43.68	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	242.78	mg/L	8.5	Titrimetric Method
N Nitrate	15.43	mg/L	0.2	Ion Chromatographic
N Hardness	479	mg/L As CaCO3	5	EDTA Titrimetric Method

Submission No : 100068789

Location Description : Jericho 1

Sample No & Lab Ref. 200196922

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 24-AUG-2008 07:00:00

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1743	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	7.98	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	87.17	mg/L	0.3	Ion Chromatographic Method
N Magnesium	63.6	mg/L	0.3	Ion Chromatographic Method
N Sodium	148.35	mg/L	0.3	Ion Chromatographic Method
N Potassium	14.47	mg/L	0.3	Ion Chromatographic Method
N Chloride	426.36	mg/L	0.5	Ion Chromatographic Method
N Sulfate	34.08	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	267.18	mg/L	8.5	Titrimetric Method
N Nitrate	12.97	mg/L	0.2	Ion Chromatographic
N Hardness	479	mg/L As CaCO3	5	EDTA Titrimetric Method

Analysis Test Report

Sample No & Lab Ref. 200196923

Submission No : 100068789

Location Description : Jericho NO.1 After 3 hrs pumping

Sampled By : E.Majedah Alawna

Sample Received On : 28-AUG-2008

Issue Status&Date : Complete 25/09/2008 09:54 AM

Sampling Date : 25-AUG-2008

Report Status : Routine

Component	Result	Units	LRV	Method Used
A Electrical Conductivity	1731	Us/cm	0.62	Laboratory Method (Ref: CHI-EC-R*004)
A pH	8.03	unit	N/A	Electrometric Method (Ref: CHI-PH-R*003)
N Calcium	80.36	mg/L	0.3	Ion Chromatographic Method
N Magnesium	64.2	mg/L	0.3	Ion Chromatographic Method
N Sodium	150.65	mg/L	0.3	Ion Chromatographic Method
N Potassium	14.47	mg/L	0.3	Ion Chromatographic Method
N Chloride	447.66	mg/L	0.5	Ion Chromatographic Method
N Sulfate	35.52	mg/L	0.3	Ion Chromatographic Method
N Carbonate	<3.5	mg/L	3.5	Titrimetric Method
N Bicarbonate	254.98	mg/L	8.5	Titrimetric Method
N Nitrate	13.09	mg/L	0.2	Ion Chromatographic
N Hardness	464	mg/L As CaCO3	5	EDTA Titrimetric Method