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CHARACTERISTICS OF THE UPPER AQUIFER SYSTEM IN WADI EL LAJJUN CATCHMENT AREA, JORDAN

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ABSTRACT :

This paper describes the characteristics of the aquifer systems in Wadi El Lajjun Catchment Area, Jordan. The investigated area lies between coordinates 218-255E and 105-107.7N (according to Palestine grids) and covers an area of about 643.3 square kilometers. The Mesozoic system, especially the Upper Cretaceous sedimentary rocks are the most dominant formations in the study area.

The Upper Cretaceous rocks are composed mainly of marl, chalky marl, oil shale, limestone, chert, phosphorite, silicified limestone and massive limestone, in addition to alluvial gravels of Pleistocene age. The Hydrogeology of the study area is controlled by the geological set-up, which also controls the piezometry, occurrence and movement of the groundwater and the distribution of productive areas in the aquifers.

The main aquifers in El Lajjun catchment area consist of two main aquifer systems: Amman Wadi Es Sir Aquifer (B2/A7) and Kurnub/Ram Group Aquifer. The main objectives of this research were to determine the spatial and temporal distribution of hydrogeologic characteristics of the groundwater aquifer systems in Wadi El Lajjun catchment area and evaluating the water chemistry of the major water sources located in the study area. Data related to existing boreholes, geology, hydrology, hydrogeology, water level and the essential maps needed were collected and evaluated. Water samples were collected from the water resources available in the catchment area.

The horizontal hydraulic conductivity of the main aquifer system ranges from less than 0.5 m/d to more than 9 m/d. The majority of specific capacity values range from less than 3.8 m3/hour/m to more than 2400 m2/d; the transmissivity ranges between 100 and 400 m2/d. The chemical analysis of Ain El Lajjun spring for the different elements indicates that all these concentrations are with the permissible level, especially, the nitrate concentration is less than 45 mg/l according to the Jordan Standards, which is considered as a pollution indicator.

Key words: *Aquifer systems, Hydrogeology, Water Quality, El Lajjun Catchment, Sedimentary rocks, Boreholes.*

INTRODUCTION:

Jordan is considered one of the countries in the world with the scarcest of water resources. This has led to deterioration of the groundwater quality and an increase in the salinity levels. Water problems in Jordan are diverse and changing as the gap between supply and demand widens. Water issues are linked to scarcity, maldistribution, and sharing.

The development and management of water resources in Jordan presents a challenge for water managers and experts. The climate in Jordan is characterized by warm, dry summers and mild, wet winters, with annual average temperatures ranging from 12 to 25 C and summertime highs reaching the 40 C in the desert regions. Rainfall averages vary from 50 mm annually in the desert to 800 mm in the northern hills, some of which falls as snow, (JMD, 2010). Groundwater is considered as the major source of water in Jordan, and the only source of water in some areas of the country.

Twelve groundwater basins have been identified in Jordan, (MWI, 2008). Furthermore, due to the increasing demand, the withdrawal from these aquifers is almost double that of the safe yield. This will eventually lead to the depletion of water resources and deterioration in the water quality (Abdulla and Al-Assa'd, 2006).

Jordan must develop a strategy to manage its water resources sustainably, making full use of all available water resources. This research was carried out to determine the spatial and temporal distribution of the hydrogeologic characteristics of the groundwater aquifer systems in Wadi El Lajjun catchment area and to evaluate the water chemistry of the major water sources located in the study area. In the process of meeting the above objectives, aquifer characteristics such as aquifer thicknesses and depth to water table as well as static water level, would be defined. Aquifer parameters such as hydraulic conductivity (K) and transmissivity (T) would be established within the limits of the available data and information collected.

MATERIALS and METHODS

Climate and Physiography

The climate of the study area is characterized by a hot dry summer and cool wet winter with two short transitional periods in between. The first starts around mid-October and the second ends around the mid of May.

High temperatures, low relative humidity and high evapotranspiration also characterize the dry period. In addition, moderate temperatures and high relative humidity of about 75 to 90% characterize the wet period, while high temperatures and lower relative humidity ranging from 41% to 69% characterize the dry period. The mean temperature value ranges from 17.3oC to 25.2oC, (JMD, 2010). The prevailing wind direction is westerly winds in summer, shifting to the easterly winds in the winter season; southwesterly winds also occur. They are cold dry in winter, but hot, scorching and consequently harmful to the vegetation in summer. The annual average wind speed is 3.3 km/hr/d at Rabba and 2.8 km/hr/d at Qatrana station. The physiography of El Lajjun catchment area is made up of the residual hills, lowlands and intermittent valleys.

According to Palestine Grids, the study area lies between 218 to 255 E and 105 to 107.7 N, Figure 1. Wadi El Lajjun drains an area south of Amman with an extent of 643.3 square kilometers. It is bounded by the localities of Rabba and Karak from the north and North West Mazar from the west, Muhai from the south, and Qatrana from the east, lying at elevations range from more than1250 m above the sea level to less than 575 m below the sea level at the confluence of Wadi El Lajjun with Wadi Mujibm, (Atawneh,2016).

The geological and hydrological as well as the geotechnical and hydro-geochemical characteristics of the area and possibly human activities have contributed to gulley development and growth. The average rainfall ranges between less than 50 mm to more than 250 mm.

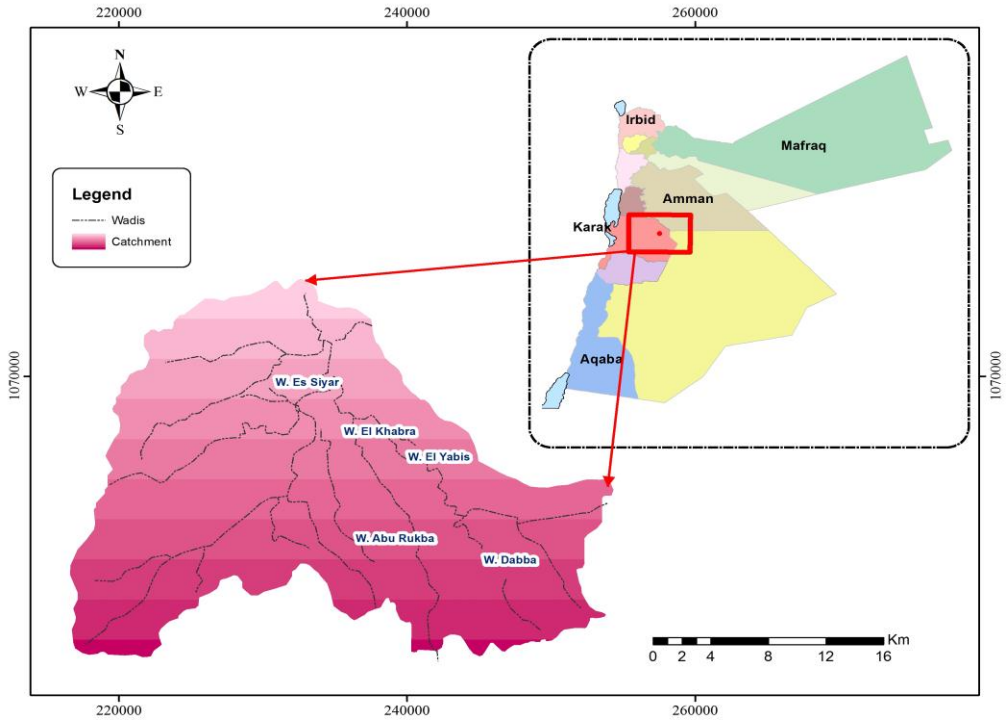

Figure 1: Location Map of Wadi El Lajjun Catchment Area

The geologic materials underlying a watershed are one of the most salient features influencing the hydrologic flow regime .The rate of flow of both surface and subsurface water are dependent upon the nature of the material in the path of flow. It will be worthwhile to note that vegetation cover affects the rate of erosion. In most part of the study area, disparity in the vegetation-cover exists. The vegetation is dense in the low-lying marly terrains thus hindering erosion. However, in the hilly area, there are sparse vegetations, making them more prone to erosion.

GEOLOGY OF THE STUDY AREA

The Mesozoic system, especially the Upper Cretaceous sedimentary rocks are the most dominant formations in the study area.

The Upper Cretaceous rocks are composed mainly of marl, chalky marl, oil shale, limestone, chert, phosphorite, silicified limestone

and massive limestone, in addition to alluvial gravels of Pleistocene age. Generally, Cretaceous rocks are mainly subdivided into two main sequences; these are the Early and Late Cretaceous. The Early Cretaceous rocks which are locally known as Kurnub, and the Late Cretaceous rocks which are further subdivided into Ajlun and Belqa Groups. The Early Cretaceous rocks are not exposed or recognized through drilling of different boreholes in the investigated area. The areal distribution of the outcropping formation is shown in Figure 2.

LATE CRETACEOUS

Late Cretaceous, according to the lithological characteristics of the Late Cretaceous, these rocks are sub-divided into two groups: Ajlun and Belqa Group. Ajlun group is subdivided into the following formations: Nau'r (A1/2), Fuheis (A3), Hummar (A4), Shue'ib (A5/6) and Wadi Es Sir Formation. Whereas Belqa Group is subdivided into the following: Um Ghudran (B1), Amman Silicified Limestone (B2), El Hasa Phosphorite Formation, and Muwaqqar Formation (B3). Belqa Group is overlain by the Pleistocene Deposits, (Abed, 2000).

PLEISTOCENE GRAVEL (PG)

The Pleistocene Gravel (PG) unit is poorly sorted, loose or weekly cemented pebbles and sand size, semi rounded chert and basalt fragments (Balawi,2003). The thickness of this unit ranges between 0-10 m and is mostly covered by a thin calcareous reddish brown soil (1-2 m) overlain by dark pavement of residual chert and basalt and rarely limestone loose pebbles. The reddish soil is partly utilized for vegetable farming around Ain El Lajjun, which is irrigated by El Lajjun spring discharge.

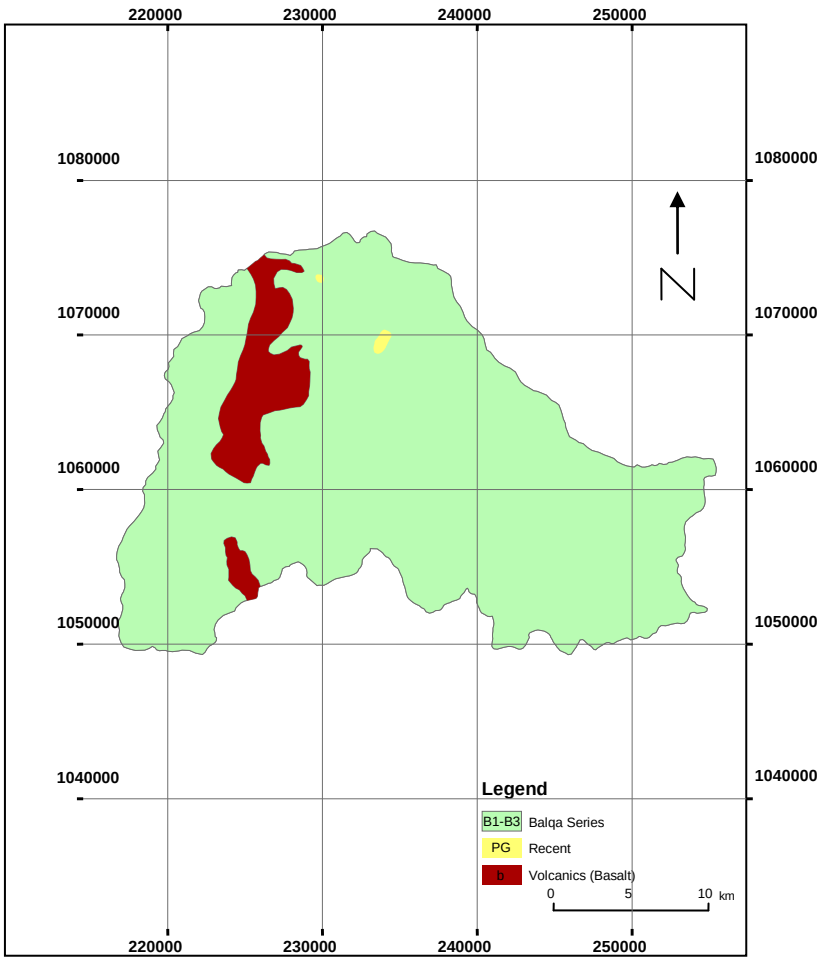

Figure 2: Geological map of Wadi El Lajjun Catchment Area

STRUCTURE

The structural geology of the proposed study area is dominated by Wadi Al-Hasa Fault, which strikes WNW. Wadi Al-Hasa Fault strikes generally E-W from the Dead Sea Fault. It lies to the east in a series of minor faults to merge with the regional Karak lineament. The geology of El Lajjun catchment area forms a graben bounded by two parallel faults striking approximately N-S. Extension of oil shale deposit in the east-west direction is limited by these two faults (Balawi, 2003). Also El Lajjun area forms part of a fault block complex, three down faulted blocks have developed adjacent to a number of other up faulted areas (Al Sawarieh, 2005). The southern part of the graben is a symmetrical and tilted to the west-northwest.

Field Study and Data Acquisition

This research was carried out in three stages; these are office work, fieldwork and laboratory work. During the implementation of this study, geological, hydrogeological and hydrological data were collected from Water published reports. Rainfall Isohyethal map was drawn using ArcGIS 10.3 software whereas Flow-net map was drawn using Surfer 8.

MEAN ANNUAL RAINFALL

The average depth of the rainfall over the study area was determined using the Isohyethal method and Thiessen method. The Isohyethal method involves the measurement of the areas between each two rainfall contour lines, multiplying this by the average precipitation between them, and then by dividing the summation of these products by the total area of the catchment as in the following formula (Chow and Mays, 1990):

$$Pm = \Sigma (Ai * Pi) / A \quad \text{.....1}$$

Where: Pm: mean areal rainfall in (mm), Ai: sub area, Pi: average precipitation between two successive contour lines and A: total area.

The mean annual rainfall in the normal water year condition ranges between less than 350 mm to more than 525 mm, Figure 3.

ESTIMATION OF STORM RUNOFF

Wadi El Lajjun catchment area was ungauged wadi. Therefore, to estimate the runoff which may occur in the winter season, the US Soil conservation services method (SCS), (Wanielista, 1990), is applied. This method takes in consideration the antecedent moisture conditions (AMC), the initial abstraction of rainfall, and the land use. The first step in the use of the SCS model is to estimate the volume of direct of runoff, (Q), in inches.

$$Q = (P - Ia)\ 2 / (P - Ia + S) \quad \text{.....2}$$

Where:

Q: is the accumulated depth of runoff in inches.

P: is the accumulated depth of storm rainfall in inches.

Ia: is the depth of the initial abstraction in inches. Ia and S are related to soil cover conditions. Also the relation between initial abstraction (Ia) and potential abstraction (S) was derived from the studies of different watersheds in the United States of America as,

$$Ia = 0.2\ S \quad \text{.....3}$$

The above equation for the accumulated runoff is formulated as:

$$Q = (P - 0.2\ S)\ 2 / (P + 0.8\ S) \quad \text{.....4}$$

RESULTS AND DISCUSSION

GROUNDWATER FLOW AND AQUIFER PARAMETERS

The Hydrogeology of the study area is controlled by the geological set-up, which also controls the piezometry, occurrence and movement of the groundwater and the distribution of productive areas in the aquifers. The main aquifers in El Lajjun catchment area consist of two main aquifer systems: Amman Wadi Es Sir Aquifer (B2/A7) and Kurnub/Ram Group Aquifer. These two aquifer systems are separated by low permeable aquitards (A1-A6); also, Muwaqqar Chalk Formation (B3) is aquitards, (Bender et.al, 1987). These aquifers have been recognized in the project area, based on the potentiality of water bearing. There are many wells drilled in and around Wadi El Lajjun catchment area, Table 1, shows the main wells penetrating the Amman Wadi Es Sir Aquifer (B2/A7) and Kurnub/Ram Group Aquifer. The Wadi Es Sir Aquifer (B2/A7) is underlain by the A1/6 sequence, which consists predominantly of marls, marly limestone and limestone. This sequence acts as aquitard and separates the B2/A7 Aquifer hydraulically from the underlying Kurnub/Ram Group Aquifer.

GROUNDWATER FLOW PATTERNS AND HYDRAULIC PROPERTIES

Groundwater movement generally, depends on the hydraulic conductivity and the hydraulic gradient. Groundwater moves from areas of high potential to lower potential areas. The shape of the piezometric surface is illustrated in Figure 4. This figure shows that, the flow lines in this upper aquifer system converge towards the Mujib basin and then to the Dead Sea.

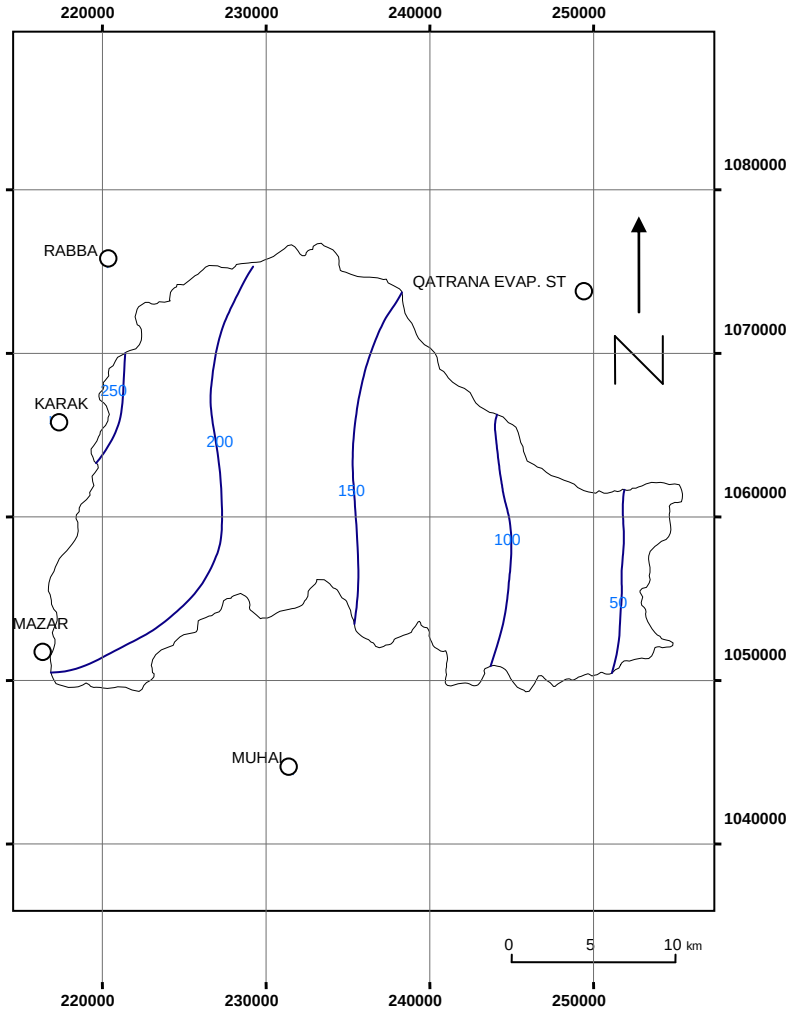

Figure 3: The mean annual rainfall in the normal water year condition

The elevations of the groundwater water table depth are highest in the extreme south of Wadi El Lajjun Catchment area, decreasing from 816 m to about 550 m above the mean sea level (a.s.l) towards the north (Mujib Basin). This indicates that, the general flow direction of the B2/A7 is from southeast and northwest to the north direction towards Mujib Basin. The Upper Aquifer (B2/A7) is considered productive when it has fissured and joints not massive and undisturbed. The hydraulic parameters in the B2/A7 aquifer are quite

variable as can be expected of a limestone aquifer. Based on WAJ drilling files, it is found that horizontal hydraulic conductivity ranges from less than 0.5 m/d to more than 9 m/d. The majority of specific capacity values range from 91.2 m2/d to more than 2400 m2/d. Moreover, it is found that the range of transmissivity is between 100 and 400 m2/d.

Table 1: Main wells penetrating Amman Wadi Es Sir Aquifer (B2/A7) Aquifer, (JICA and MWI,2001)

Well No	North	East	Alt(m)	Depth(m)	Aquifer	Yield(m3/h)	SWL(m)	DD (m)	Salinity (ppm)
CD1023	1060480	226000	920	202	B2/A7	8	152.84	26.06	-
CD1150	1070840	234520	673	224	B2/A7	75	21.55	58.42	739
CD1151	1072161	233872	667	223	B2/A7	90	24.2	41	848
CD1152	1068700	228350	840	235	B2/A7	84	121.03	2.8	595
CD1154	1067280	228510	839	243	B2/A7	61	123.7	26.6	621
CD1155	1066270	231600	757	197	B2/A7	50	27.3	32.7	1150
CD1156	1064700	225850	880	246	B2/A7	52	95.4	48.1	486
CD1157	1069255	234683	686	207	B2/A7	69	8.17	83.85	819
CD1158	1069390	239220	816	250	B2/A7	-	151.95	-	883
CD1160	1065485	234581	762	200	B2/A7	39	59.9	36.78	749
CD3351	1072306	232944	696	242	B2/A7	71	61.55	54.65	672
CD3442	1069570	240855	822	250	B2/A7	128	32	59.75	-
CD3445	1069082	231751	718	215	B2/A7	65	23	142	-
CD3454	1070023	234776	665	158	B2/A7	83	16.85	79.67	-
CD3456	1069600	232200	750	235	B2/A7	52	55.6	67	-
CD3458	1069630	232917	712	203	B2/A7	80	54.75	37	-
CD3461	1066595	232245	745	208	B2/A7	55	34.9	80.9	-
CD3462	1065382	233284	752	300	B2/A7	55	64.5	98.9	-
CD3466	1073607	233230	700	172	B2/A7	45	119.65	9.68	-
CD3467	1073595	233230	700	220	B2/A7	60	118.7	7.8	-
CD3479	1071188	232628	770	225	B2/A7	55	87.6	41.95	-

There are two wells existed in the proposed project area these wells penetrated the B2/A7 aquifer and both are governmental wells. The identification number of these wells are CD1155 and CD3 441 the depth of these wells are 197 and 211 m respectively; also the yield of these wells are 50 and 128 m3/hr., (Ta'any, 2012) .

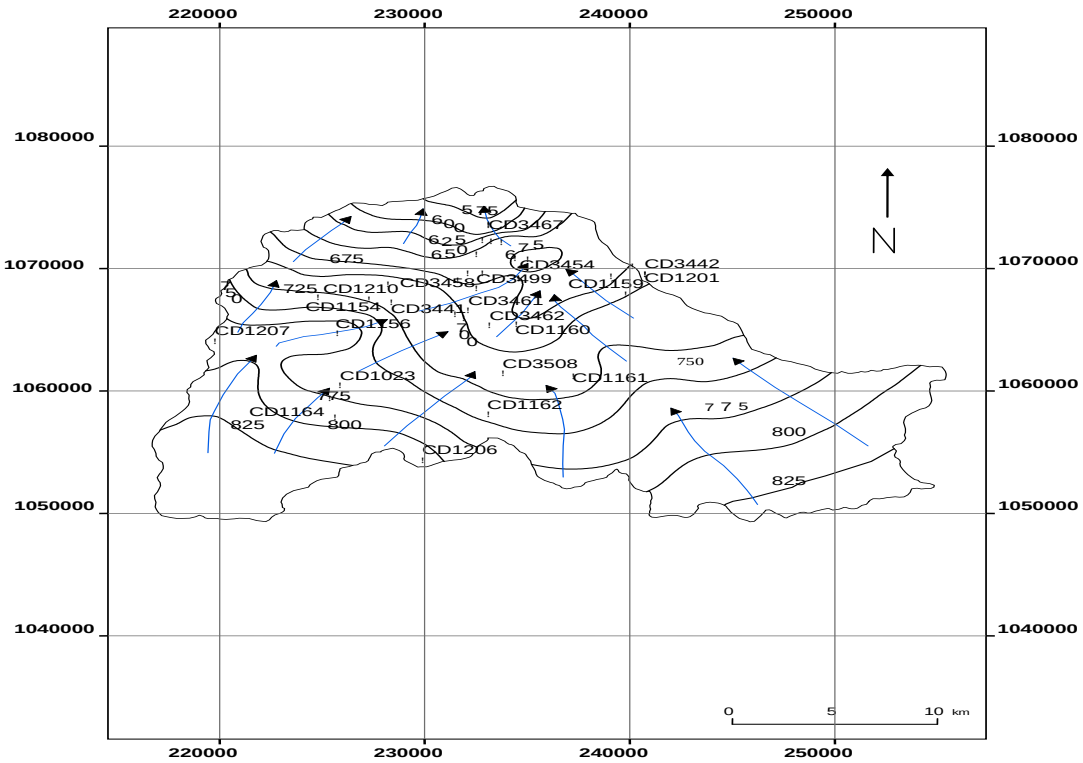

Figure 4: Groundwater Movement Map for Upper Aquifer (B2/A7).

GROUNDWATER ABSTRACTION IN EL LAJJUN CATCHMENT AREA

Groundwater abstraction commenced in the catchment area in the late 1980s. Increasing number of wells were dug and drilled in Wadi El Lajjun area from the mid of 1990 onwards. Total groundwater abstraction in 2004 from Wadi El Lajjun catchment area was 22.4 MCM. Of this amount, 12.4 MCM were abstracted from the B2/A7 aquifer, the remaining 10.0 MCM from the Ram Group aquifer. Of this amount, 20.0 MCM were used for domestic purposes in 2004, 0.6 MCM for industrial uses, 0.25 for irrigation from private wells, 1.5 MCM for irrigation from governmental wells and 0.03 MCM for pastoral purposes, Ministry of Water and Irrigation (MWI, 2008).

Total groundwater abstraction has continuously increased over the past 10 years in the El Lajjun area. This increase is mainly due to the development of the Ram Group Aquifer. Water from the Qatrana and El Lajjun well fields is transferred to Amman for drinking purposes. Water from the Qatrana well field meets with the El Lajjun feeder line at the Qatrana pumping station and then is transferred to the Swaqa pumping station through a 600 mm diameter pipeline at a rate of 249 m3/h. A new pumping station was established south of El Lajjun (near the junction of the Qatrana – Karak road with the El Lajjun road) to handle the increased transfer amounts from the B2/A7 and Ram Group aquifers. The new El Lajjun feeder line was completed in 2003 and now can transfer up to 40 MCM/a (800

m^3/h) to Qatrana via a 600 mm pipeline. The total capacity of the El Lajjun well field, comprising both, wells in the B2/A7 and Ram Group aquifers, presently is around 16 MCM/Y, Ministry of Water and Irrigation, (Al Sawarieh, 2005).

Due to the withdrawal from the drilled boreholes the water levels have declined in the whole area with rates range between 0.08 meter/annum(m/a) at well (CD 1152) and between 1.8 m/a at well (CD 1213).

Table 2 shows the groundwater abstractions from El Lajjun area. The abstractions values in Table 2 and Figure 5 show rapid increasing from 2001 onwards.

DISCHARGE OF THE GROUNDWATER

The discharge from the upper aquifer system (B2/A7) in Wadi El Lajjun catchment area occurs naturally from Ain El Lajjun Spring. Ain El Lajjun is the only main spring closed to the project area. This spring emerges at the fault, which constitutes the western boundary of the El Lajjun Graben. Discharge is measured since July 1947.

However, until 1980 measurements were scanty (on average only 4 measurements per year) so that discharge is difficult to evaluate for this time period. The long-term average discharge of Ain El Lajjun is about 10 39.5 m^3/h or 0.35 MCM/y. The chemical analysis of Ain El Lajjun spring from the year 2004-2013 for the different elements is presented in Table 3. This table shows that the nitrate concentration is less than 45 mg/l according to the Jordan Standards, which is considered as pollution indicator, (MWI, 2008).

Wadi Mujib dam, is located downstream of the proposed project area and completed in 2003 (dam height 62 m; live storage 35 MCM) is being used for domestic water supply to Amman. It may be affected by any contamination in the project area and must therefore be given special consideration in any land use planning in the upstream catchments area, (Atawneh, 2016).

Table 2: Groundwater Abstraction from El Lajjun Catchment Area in (MCM)

Year	Qatrana	Sultani	El Lajjun	Total
2004	2.31	4.07	0.34	6.72
2005	3.35	4.62	0.17	8.14
2006	3.05	4.66	0.16	7.87
2007	3.08	4.76	0.15	7.99
2008	3.27	4.17	0.26	7.70
2009	3.47	4.62	0.28	8.37
2010	3.44	5.01	1.14	9.59
2011	3.08	4.82	5.20	13.10
2012	2.67	4.59	8.28	15.54
2013	2.82	4.69	14.94	22.45

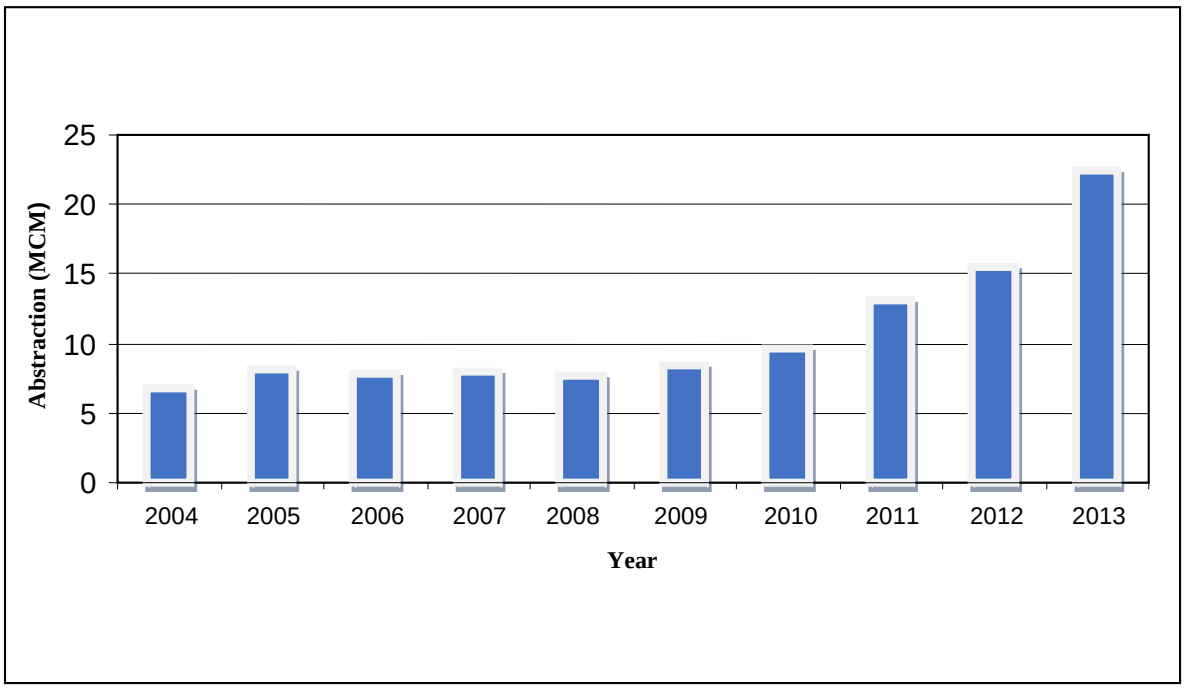

Figure 5: Groundwater Abstraction from El Lajjun Project Area

Table 3: The chemical constituents of Ain El Lajjun Spring

Year	E.C (µ/cm)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)	P (mg/l)	Cl (mg/l)	HCO3 (mg/l)	NO3 (mg/l)	SO4 (mg/l)	pH
2004	1050	55.6	106	100.1	1.9	94.7	383.08	5.9	77.28	7.41
2005	633	30.1	57.5	24.3	3.9	47.5	166.53	38.5	71.52	7.9
2006	961	55.2	98.5	31.8	2.7	91.2	389.79	8.4	46.08	7.65
2007	1120	59.1	100.2	29.5	2.7	100.1	398.33	9	30.24	7.5
2008	1026	57.9	110.2	34.0	4.3	92.3	390.4	7.2	91.2	7.77
2009	1021	57.0	104.9	36.2	2.7	94	386.13	5.7	73.44	7.49
2011	998	58.4	106.9	33.3	3.1	93.7	395.89	11.3	70.56	6.76
2012	1082	56.5	107.6	31.9	1.9	75.2	335.5	18	139.68	7.75
2013	990	56.1	94.2	38.4	2.7	89.4	373.32	6.5	66.72	7.3

HYDROLOGICAL CHARACTERISTICS

Five rainfall stations exist in and around the study area these are: (Muai, Rabba, Qatrana, Mazar and Karak station). All stations measure the daily rainfall and one of them have also rainfall recorder, giving hourly rainfall events. Table 4, represents the rainfall stations, their locations, type of gauges, and their approximate altitudes. The density of the stations is about 128.7 km² per station. This density is sufficient for the evaluation of regional distribution and the determination of annual averages, according to the World Meteorological Organization Guide, (WMO, 1994).Generally, the mean annual rainfall decreases across the catchment area from northwest to southeast

(Figure 3). The water balance was performed using the water budget approach. The average annual evapotranspiration (ET) according to Penman equation was found to be 162.41MCM, 98.95 MCM and 79.04 MCM in the wet, normal and dry conditions, respectively. The rate of evaporation ranges between 88.30% in the wet year and 94.01% in the dry water year, while average annual recharge of the upper aquifer of Wadi El Lajjun catchment was found to range between 3.66 and 18.13 MCM in dry and wet water years representing an infiltration rate of 4.35% and 9.82%, respectively. The results of the water balance calculations for the whole catchment area are presented in Table 5.

Table 4: The Rainfall Stations Exist in Wadi El Lajjun catchment area

Name of Rainfall Station	Coordinates		Altitude (m)	Type of station
	East	North		
Muhai	231.800	44.500	1000	Daily
Rabba	220.500	75.500	970	Daily and Hourly
Qatrana	249.500	72.500	770	Daily and Hourly
Mazar	216.500	52.000	1140	Daily and Hourly
Karak	217.000	66.000	1000	Daily and Hourly

Table 5: Calculated water balance for Wadi El Lajjun catchment area

Water Year	Rainfall (MCM)*	Runoff (MCM)	Evaporation (MCM)	Infiltration (MCM)	Runoff (%)	Evaporation (%)	Infiltration (%)
Dry	84.08	1.38	79.04	3.66	1.64	94.01	4.35
Normal	109.49	2.15	98.95	10.99	1.96	90.37	7.66
Wet	184.56	4.02	162.41	18.13	2.18	88.00	9.82

(MCM)*: Million Cubic Meters

CONCLUSIONS

The Hydrogeology of the study area is controlled by the geological set-up, which also controls the piezometry, occurrence and movement of the groundwater and the distribution of productive areas in the aquifers.

The main aquifers in El Lajjun catchment area consist of two main aquifer systems: Amman Wadi Es Sir Aquifer (B2/A7) and Kurnub/Ram Group Aquifer. These two aquifer systems are separated by low permeable aquitards (A1-A6). The horizontal hydraulic conductivity of the main aquifer system ranges from less than 0.5 m/d to more than 9 m/d. The majority of specific capacity values range from less than 3.8 m3/hour/m to more than 2400 m2/d; the transmissivity ranges between 100 and 400 m2/d. The discharge from the upper aquifer system (B2/A7) in Wadi El Lajjun catchment area occurs naturally from Ain El Lajjun Spring. The long-term average discharge of Ain El Lajjun is about 10 39.5 m^3/h or 0.35 MCM/y.

The chemical analysis of Ain El Lajjun spring for the different elements indicates that all these concentrations are with the permissible level, especially, the nitrate concentration is less than 45 mg/l according to the Jordan Standards, which is considered as a pollution indicator.

The total groundwater abstraction in 2004 from Wadi El Lajjun catchment area was 22.4 MCM. Of this amount, 12.4 MCM were abstracted from the Upper aquifer (B2/A7), the remaining 10.0 MCM from the Middle (Ram Group aquifer). The rate of evaporation ranges between 88.00% in the wet year and 94.01% in the dry water year, while the average annual recharge of the upper aquifer of Wadi El Lajjun catchment was found to range between 3.66 and 18.13 MCM in dry and wet water years representing an infiltration rate of 4.35% and 9.82%, respectively.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance of Engineers Mohammad Bani Mustafa, and Hydrologist Mohammad Karajoghly (from the Ministry of Water and Irrigation) during the fieldwork and data collection. I am also very grateful to Dr. Alaeddin Tahboub (Associate Professor of Water Resources and Soil Physics) from Al Balqa' Applied University, for providing us valuable comments and revising our manuscript.

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خصائص نظام الخزان العلوي في حوض وادي اللجون /الأردن

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الملخص العربي :

تصف هذه الورقة خصائص أنظمة المياه الجوفية في حوض وادي اللجون في الأردن. تقع منطقة الدراسة بين الإحداثيات ٢١٨–٢٥٥شرقاً و١٠٥–١٠٧.٧شمالاً (حسب احداثيات فلسطين)، ويغطي مساحة تبلغ حوالي ٦٤٣.٣ كيلومتر مربع. إن نظام العصر المتوسط، وخاصة الصخور الرسوبية العائدة للعصرالطباشيري العلوي هي التشكيلات السائدة في منطقة الدراسة. وتتكون صخور العصر الطباشيري العلوي بشكل رئيس من المارل، المارل الطباشيري، الصخر الزيتي، والحجر الجيري، الصوان، والفوسفوريت، والحجر الجيري السيليكاتي والحجر الجيري الركامي، بالإضافة إلى الحصى اللحقي والعائد للعصر الجليدي.إن التكوينات الجيولوجية هي التي تتحكم في جيولوجيا المياه في منطقة الدراسة كما تتحكم أيضا في حركة المياه الجوفية ونوع التكوينات الجيولوجية وتوزيع المناطق المنتجة للماء في خزانات المياه الجوفية. وتتكون طبقات المياه الجوفية الرئيسية في حوض اللجون المائي من نظامين للخزانات المياه الجوفية الرئيسية: وهي خزان عمان وادي السير الجوفي (A7 / B2) وخزان الكرنب / مجموعة رام الجوفي. إن الأهداف الرئيسية لهذا البحث هي: تحديد التوزيع المكاني والزماني للخصائص الهيدروجيولوجية لأنظمة الخزانات المياه الجوفية في حوض وادي اللجون المائي وتقييم نوعية المياه للمصادر المائية الرئيسية الواقعة في منطقة الدراسة. وقد تم جمع البيانات المتعلقة للآبار الموجودة، والمعلومات الجيولوجية والهيدرولوجية والهيدروجيولوجية ومنسوب المياه والخرائط الأساسية اللازمة وتقييمها.كما تم جمع عينات المياه من الموارد المائية المتاحة في الحوض المائي. تراوحت الموصلية الهيدروليكية الأفقية للخزان المائي الجوفي الرئيسي بين أقل من ٠.٥ م / اليوم إلى أكثر من ٩ م / اليوم. كما أن أغلبية قيم القدرة النوعية تتراوح بين أقل من ٣.٨ م٣ / ساعة / م إلى أكثر من ٢٤٠٠ م٢ / اليوم. كما تراوحت الناقلية بين ١٠٠ و٤٠٠ م٢ / اليوم. أشار التحليل الكيميائي لنبع اللجون للعناصر الكيميائية المختلفة إلى أن جميع هذه التراكيز تتوافق مع المستوى المسموح به في المواصفة الأردنية لمياه الشرب، وخاصة تركيز النيترات لذي كان أقل من ٤٥ ملغم / لتر وفقاً للمواصفة الأردنية، والتي تعتبر مؤشراً للتلوث.

كلمات البحث:

أنظمة الخزانات الجوفية، جيولوجيا المياه، نوعية المياه، حوض اللجون المائي، الصخور الرسوبية، آبار المياه الجوفية.