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GEOLOGICAL AND HYDROGEOLOGICAL STUDY OF KEFRAIYA REGION (CAZA OF WESTERN BEKAA)

Final Report

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GEOLOGICAL AND HYDROGEOLOGICAL STUDY OF KEFRAIYA REGION (CAZA OF WESTERN BEKAA)

1 INTRODUCTION

Kefraiya town is located in Western Bekaa Caza at an elevation between 100 and 1300 m a.s.l. It is surrounded by Aana village to the south and Khirbet Qanatar to the north.

The yearly average rain precipitation on Kefraiya area is 1500 mm/year and it is characterized by cold weather in winter and nice warm weather in summer.

2 GEOLOGY OF KEFRAIYA AREA

After having undertaken detailed field studies and investigations, the attached geological map at a scale 1/10000 has been prepared.

This geological map (Map A) and the geological section made give a clear picture of the stratigraphic succession prevailing in the area, as well as the geological structure.

2.1 LITHO-STRATIGRAPHY

The outcropping rock formations in the study area extend from the middle Jurassic (J4) to the Miocene Formation (m1).

2.1.1 Middle Jurassic (J4)

The Middle Jurassic Formation consists of dolomitic rocks at its lower part (J4a) and limestones at its upper part (J4b).

- The stratigraphic thickness of the (J4a) is 600 m and consists of pure hard dolomite as well as disturbed dolomites that appear in the form of Dolomitic sands along the Faults that are present in the region.
- The (J4b) consists of limestones and sometimes of dolomitic-limestone rocks with an average thickness of about 200 m.

2.1.2 Upper Jurassic

The Upper Jurassic Formation includes the Oxfordian (J5) rocks and consists of an alternation of Chocolate Marls, tuffs and basalts, with an average thickness in the order of 50 m.

The Kimmeridjian (J6) rocks consists of limestone with chert in nodules with an average thickness of 60 m.

2.1.3 Cretaceous

The cretaceous layers outcrop in the south eastern part of the study area. The stratigraphic section starts with and limestones in Upper Aptian (C2b), Albian (C3) and Cenomanian (C4) at the top.

a- Lower Cretaceous (Neocomian, C1)

this formation outcrops in a very small patch to the cast of Kefraiya village and consists of sands and sandstone rocks interbedded with marly layers. The average thickness of this formation is around 50m.

b- Lower Aptian (C2b)

the Lower Aptian formation outcrops in small surface area on the eastern part of the study area. Its stratigraphic thickness is about 150m. It consists of sandstones, limestones and alterantion of limestone beds with marl and clay beds.

c- Upper Aptian (C2b)

This formation begins with a cliff (Falaise de Blanche), that consists of thick gray limestones (50 m), and turns toward the summit into unconsolidated volcanic material. The average thickness of (C2b) is around 70m.

d- Albian (C3)

The Albian Formation consists of green marls and marly limestones rocks with an average thickness of about 100 m.

e- Cenomanian (C4)

The Cenomanian formation is subdivided into 3 litho-stratigraphical units form bottom to top, these are:

1) The Lower Cenomanian unit (C4a) which is made of Dolomites and dolomitic limestones rocks.
2) The Middle Cenomanian unit (C4b) that consists of interbedded of limestones, marls and marly limestones.
3) The Upper Cenomanian unit (C4c) which is constituted of thin beds of limestones, cherty limestones and marly limestones.

f- Miocene (m1)

The Miocene rocks outcrops in a relatively wide surface area at the south-eastern part of the study area. It consists of Lacustrine marls and marly limestones, with an average thickness about 50m.

2.1.4 Quaternary Deposits (Q)

These deposits are recent in age and appear in Kefraiya plain as thick soils and different alluviums deposits, as well as eboulis along the toes of the slope.

2.2 STRUCTURAL GEOLOGY

- The major structural geological aspect that characterizes Kefraiya area is the presence of the regional Yammouneh fault with north east - south west trend. This Fault passes in the south eastern part of Kefraiya town and continues its way to the south. As a result of this Fault the, Cretaceous Layers dropped to the level of the dolomites related

to the lower part of the Middle Jurassic Formation (J4), with the consequent impact on the groundwater within the Jurassic reservoir.

- The presence of many other Faults that cut the high limestones and dolomites of the Massive Jurassic, and help in the concentration of the ground water inside it.

3 HYDROGEOLOGY

The studied area consists of different hydrgeological units, the main aquifers in the study area are the Jurassic aquifer and the Cenomanian Aquifer.

3.1 JURASSIC AQUIFER

This is a karstic aquifer and is characterized by very high secondary porosity and permeability as well as an important thickness.

The limestones and the dolomitic limestones within the Middle Jurassic Aquifer form the biggest reservoir in the study area.

This reservoir is bounded to the east by the Yammouneh fault and to the west by Jabal Barouk.

The elevation above sea level of the Jurassic Layers reaches 1900 m in Jabal Barouk mountain to the north-west of Kefraiya town, which is covered by snow in winter season. The yearly average rain precipitation is 1500 mm/year. It infiltrates mostly inside the karst to form underground reservoirs.

3.2 CENOMANIAN AQUIFER

The limestones and dolomites within the Cenomanian Formation (C4) are characterized by a high permeability and form a large reservoir. But in Kefraiya area these layers are useless because it sends its water to the east and only collect small amounts that cannot be exploited.

3.3 CONCLUSION

The most potential underground water reservoir for exploitation is the one located in the limestones and dolomites layers of the Middle Jurassic Formation (J4), where we can find wells with a discharge rate more than 10 l/sec. The water characterized by its pureness and is located at a distance far from the pollution sources.

We suggest to drill a water well to the west of Yammouneh fault at the intersection of one minor fault with the Yammouneh fault, and at an elevation of 1145 m. This well is proposed to be drilled at the edge of an agricultural road, but in a public land.

4 DESIGN OF THE WATER WELL

4.1 BOREHOLE LOCATION

The well is located to the west of Kefraiya village at the following coordinates (Fig. 2):

X = -317088 m
Y =-53537 m
Z = 1150 m
(Barouk map, I-5, 1/20.000)

4.2 ACCESS TO BOREHOLE

The access of the site is easy because of the presence of a secondary road. Some cleaning and excavation for the well site is necessary in order to park the drilling machine.

4.3 DEPTH

400 m.

4.4 EXPECTED DISCHARGE

10-12 l/s (or 864-1037 m^3/day).

4.5 STATIC WATER LEVEL

100 m below ground level.

4.6 LAYERS THAT WILL BE PENETRATED

The layers that will be penetrated by the drilling are:

a) Agriculture soil.
b) Limestones and dolomitic limestones related to the Middle Jurassic Formation (J4).

4.7 SCHEDULE OF DRILLING, CASING AND GROUTING

The Contractor shall present the schedule for drilling in order to have a final casing and screen diameter of 12". The well is to be drilled with a rotary rig and provide for all additional equipment such as water and fuel, as well as treating collapsing rocks at his own expense.

Nevertheless, the schedule of the proposed works could be as follows (Fig. 3):

- Drilling by rotary methods with a 22" bit from 0 to 20m, with samples collection from this depth and onwards.

- Installing 18" I.D. casing (black steel, thickness 5mm)

- Grouting the annular space from the bottom to the surface, then waiting between 36 to 48 hours for the cement to set, and then continue the drilling works.

- Drilling with a 17.5" bit from 20m to the depth of 200 m.

- Installing 15.5" casing (black steel, thickness 5mm):

- Drilling with a 14.75" bit from 200 m to the total depth of 400 m.

- Installing 12" casing and screens as shown below:
  a) Casing:
     Diameter: 12" ID
     Type: Carbon steel
     Thickness: 6 mm
     Total length: 300 m

  b) Screens:
     Diameter: 12" OD
     Type: Carbon steel, tourch-cut screens 12.2% void, 1.5-2mm slots.
     Thickness: 6 mm
     Total length: 100 m.

  The installation of the casing and screens will be in accordance with the general specifications, and in particular, the welding and closure of all openings such that the water only enters the well through the screen openings, in order to minimize the pollution from zones above the SWL.

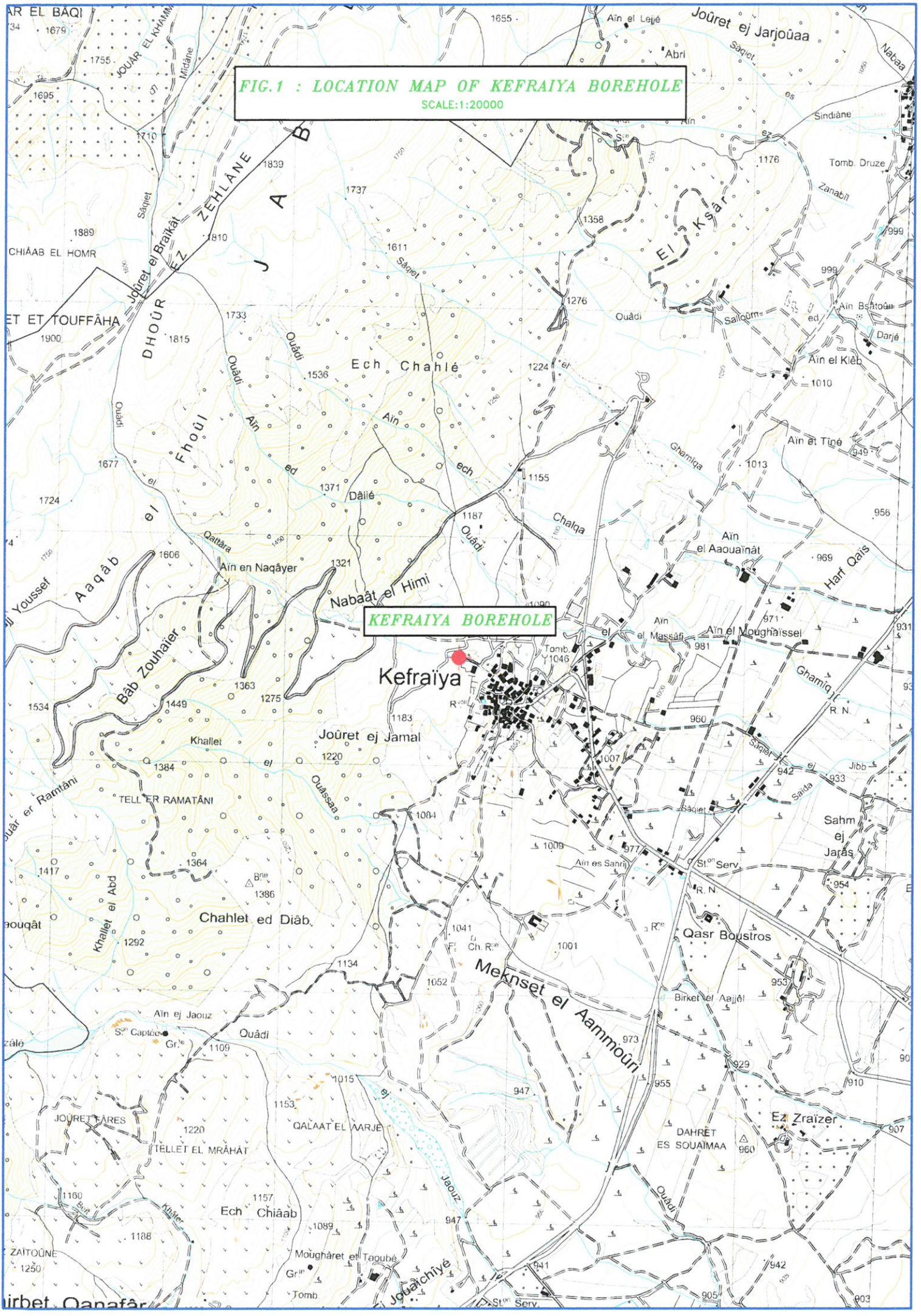
FIG.1 : LOCATION MAP OF KEFRAIYA BOREHOLE
SCALE:1:20000
KEFRAIYA BOREHOLE
Kefraïya
Joûret ej Jarjoûaa
Ech Chahlé
Joûret ej Jamal
Chahlet ed Diâb
Qasr Boustros
Mekneset el Aammoûri
Ez Zraïzer
Ain el Leijé
Abri
Sindiâne
Tomb. Druze
Ain Bsâtoûn
Darjé
Ain el Kléb
Ain et Tiné
Ain el Aaouaïnât
Ain el Moughaïssel
Ain el Massâfi
Ain en Naqâyer
Nabaât el Himi
Bâb Zouhaïer
Aaqâb el Fhoûl
DHOÛR EZ ZEHLÂNE
JOÛAR EL KHAMM
CHIÂAB EL HOMR
TELL ER RAMATÂNI
Khallet el Abd
Ain ej Jaouz
JOÛRET TARES
TELLET EL MRÂHAT
QALAAT EL AARJE
DAHRET ES SOUAÏMAA
Ech Chiâab
Moughâret et Taoubé
ZAÏTOÛNE
Ain es Sahrij
Sahm ej Jarâs
Ouâdi
Dâlié
Chalqa
Ghamiqa
Harf Qaïs
Tomb. Y1046
R. N.
St.on Serv.
Sâqiet
Nabaa
Midâne
Jibb
Saida
Ouassaa
Khâter
Jouaïchîyé

FIG. 2 : VERTICAL CROSS SECTION OF KEFRAIYA BOREHOLE