Gravels distribute over a broad area in the alluvial plain of the Wadi El-Arish. The major portion of gravel distribution is in the area between the airport and El-Arish and it extends further east. The thickness of a gravel ranges between 25 and 50 m in this area. There is another distribution of a gravel bed in the area to the south of the airport and its extension is rather limited (Fig. 7-2-5).

The lithology of the Pre-Quaternary as the basement of the Quaternary aquifers is a significant concern in the study area since the salinity of the water in the Pre-Quaternary aquifers is generally high and varies over a wide range (Section 4-3). Some of wells reach to the bottom of the Quaternary. The lithology of the basement of the Quaternary is shale in many cases; however, some wells reach the limestone (wells Nos. 1-104, 2-26 and test well (D)). It is assumed that most of the area is underlain by impermeable shale; however, some parts of the area are underlain by limestone (Fig. 7-2-6).

7-2-3 Aquifer in Coastal Plain from Sheikh Zuwayid to Rafah

There are more than three hundred wells distributing in this area. There are about 40 wells having lithological profiles. These wells are distributed on sand dunes along the coast. Most of them are shallow wells having depths in a range between 40 m and 100 m. Promising aquifers in the Quaternary of this area are gravel, sand and kurkar (Fig. 7-2-7).

There are gravel beds having thicknesses exceed 30 m at wells No. 16-12 and 16-24. However, the extent of the gravel bed distribution seems to be limited to a small area. According to the existing well data the water level of these wells drilled into the strata with gravel bed stay below the gravel bed except at well No. 11-26. Accordingly, it is thought that the gravel beds in this area are of insignificant importance from a hydrogeological point of view.

The sand with an occasional intercalation of clay, and sandstone also distributes over the area overlain by sand dunes and the above

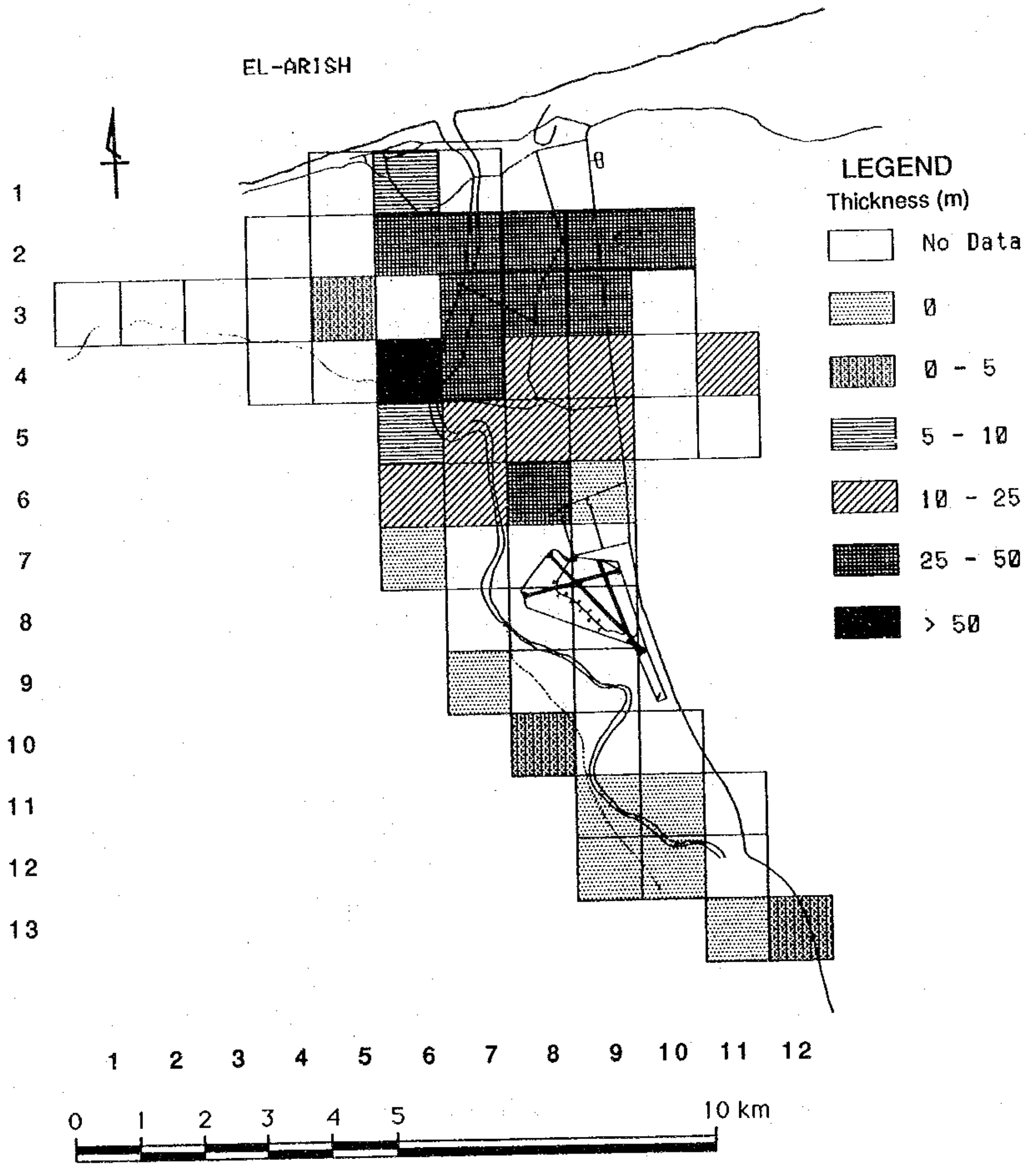


FIG. 7-2-4 THICKNESS OF KURKAR IN EL - ARISH AREA

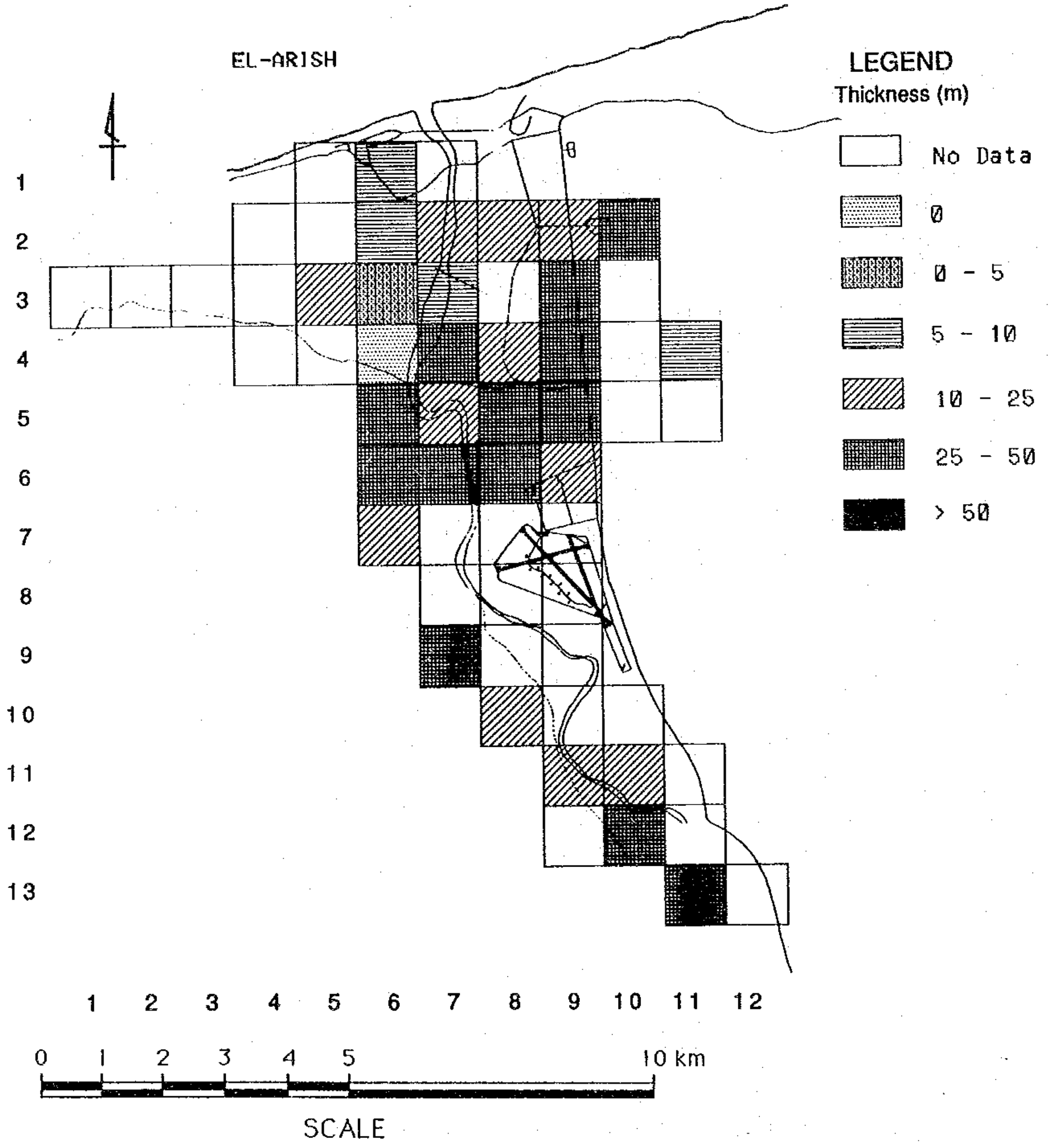


FIG. 7-2-5 THICKNESS OF QUATERNARY GRAVEL BED IN EL - ARISH AREA

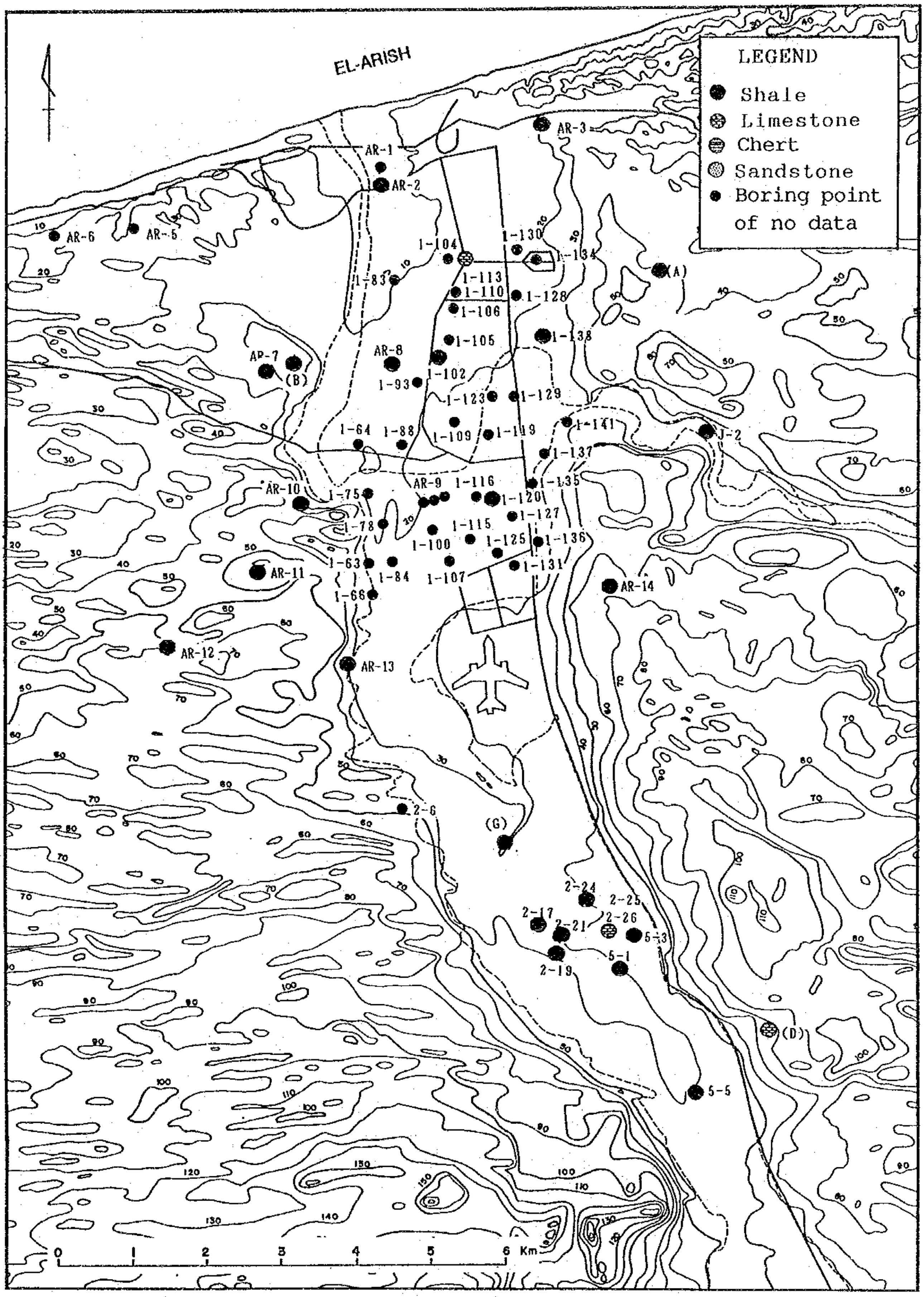


FIG. 7-2-6 LITHOFACEIS OF THE PRE - QUATERNARY AT THE BASEMENT OF THE QUATERNARY IN EL - ARISH AREA

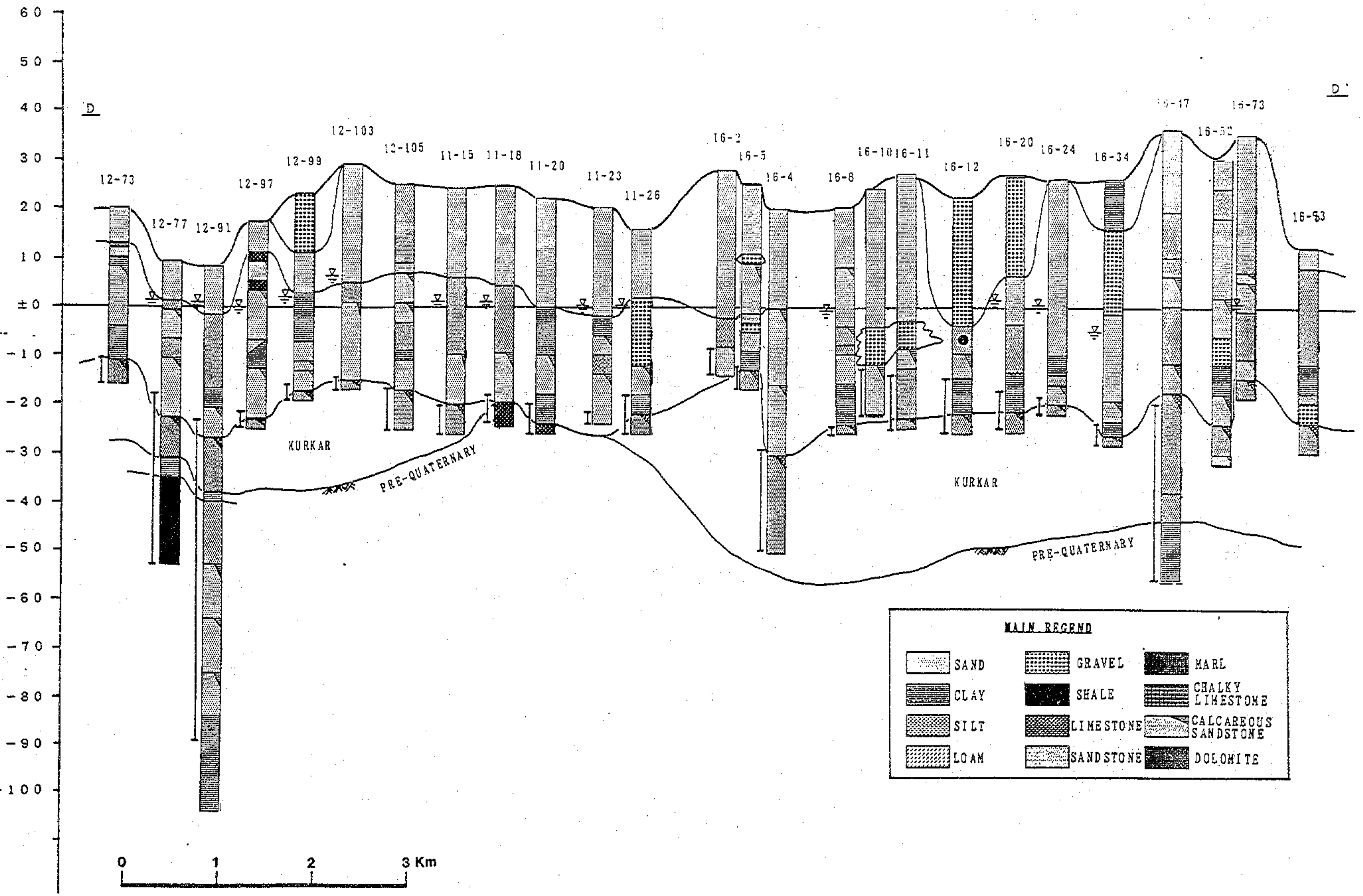


FIG. 7-2-7 GEOLOGICAL SECTION OF NORTHERN PLAIN IN THE SINAI PENINSULA (D-D')

mentioned gravel. This formation is assumed to correspond to the so-called old beach sand. The boundary between the old beach sand and overlaying sand dune is assumed in the western half of the cross section of Fig. 7-2-7. However, it is uncertain in the eastern half of the cross section.

Most of the static water levels of existing wells stay at elevation in the old beach sand. Hydrogeological properties of the old beach sand is unknown and the elevation of the water level may suggest the piezometric potential surface of the aquifer in kurkar.

The lowest formation of the Quaternary is the kurkar although it is absent in the area where wells No. 11-18 and 11-20 locate. Kurkar is underlain by shale, in general, and chalky limestone where kurkar is absent. The bottom surface of the Quaternary is assumed to be an elongated depression along the coastal sand dune (Fig. 7-2-8). The elevation of the deepest part of this subsurface depression is at -60 m asl around well No. 16-105. This depression further extends beyond the international border with Israel. The lithology of the Pre-Quaternary is represented by shale in the area southwest of the sand dune. In the eastern part, chert, sandstone and limestone are observed at test wells (Fig. 7-2-9). This may suggest a significant implication of the salinity of Pre-Quaternary aquifers on the water quality of aquifers in the Quaternary.

The thickness of the Quaternary sand bed including sand dunes and old beach sand ranges between 25 m and 50 m, but exceeds 50 m at some places as shown in Fig. 7-2-10.

The thickness of gravel bed is rather thin except for the area at grid 16-4 (Fig. 7-2-11). However, the thickness of the kurkar varies from 5 m to 50 m and, in the area behind the coastal sand dunes, available data are incomplete and cannot cover the entire well field (Fig. 7-2-12).

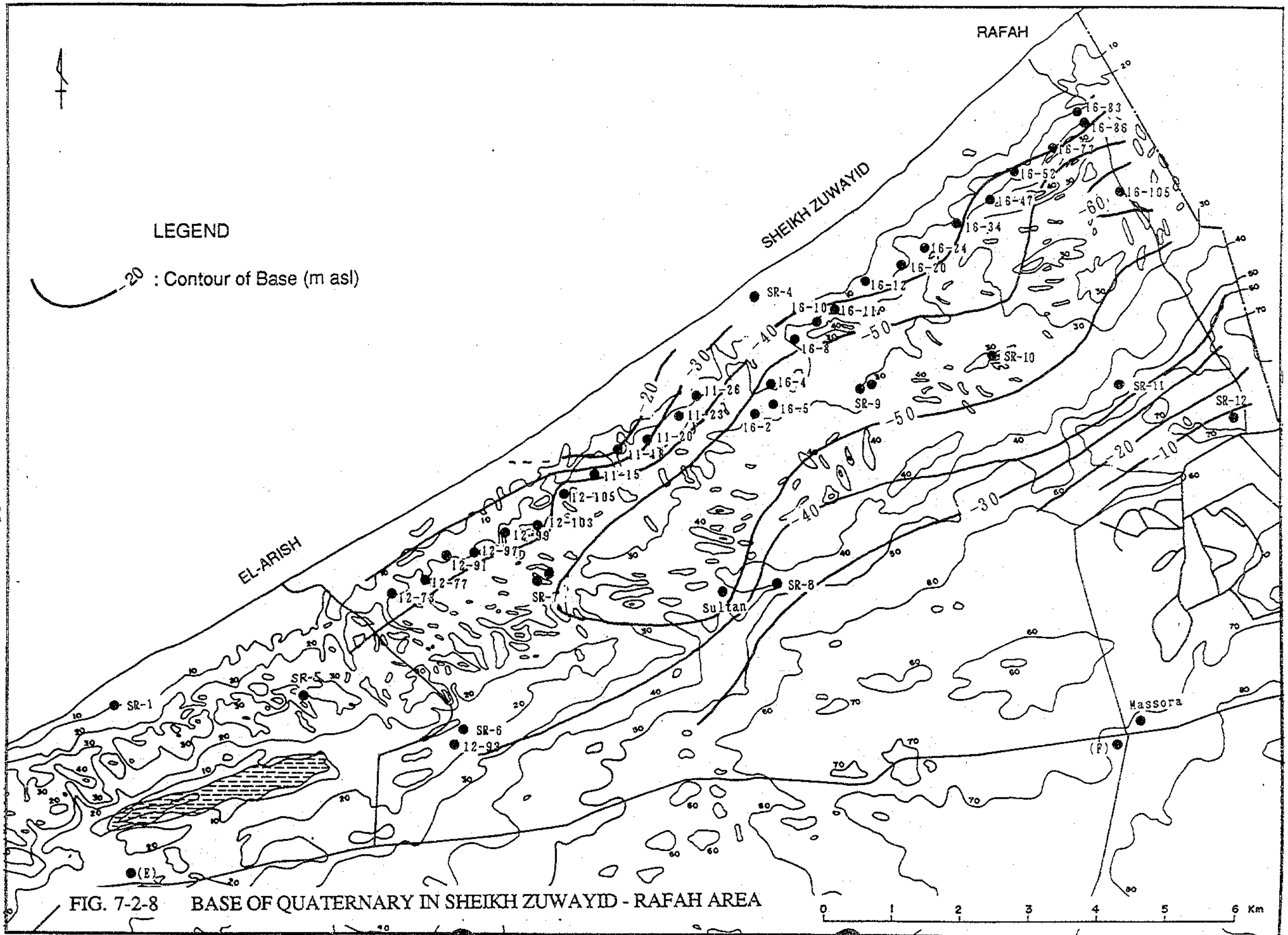


FIG. 7-2-8 BASE OF QUATERNARY IN SHEIKH ZUWAYID - RAFAH AREA

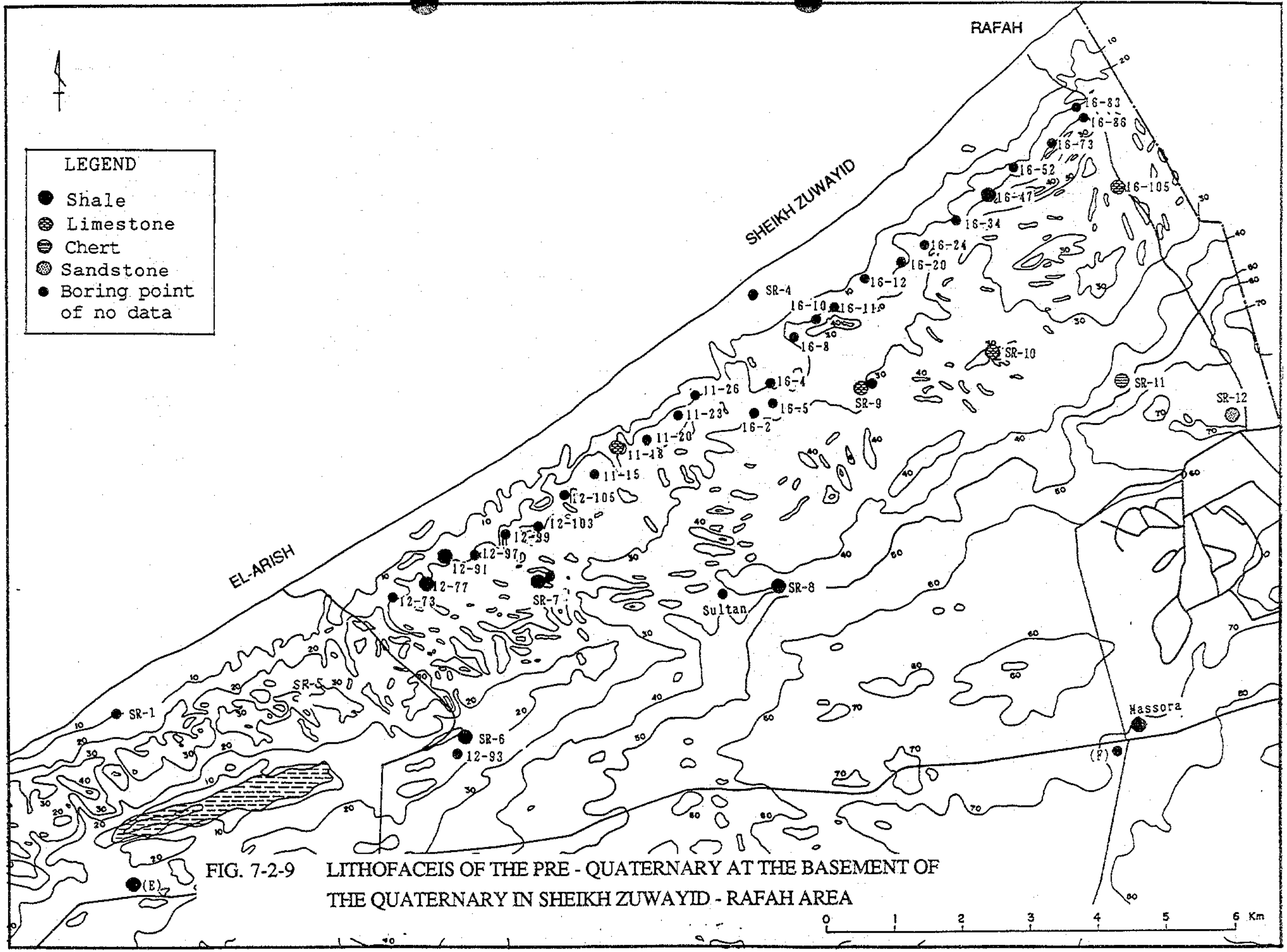


FIG. 7-2-9 LITHOFACEIS OF THE PRE - QUATERNARY AT THE BASEMENT OF THE QUATERNARY IN SHEIKH ZUWAYID - RAFAH AREA

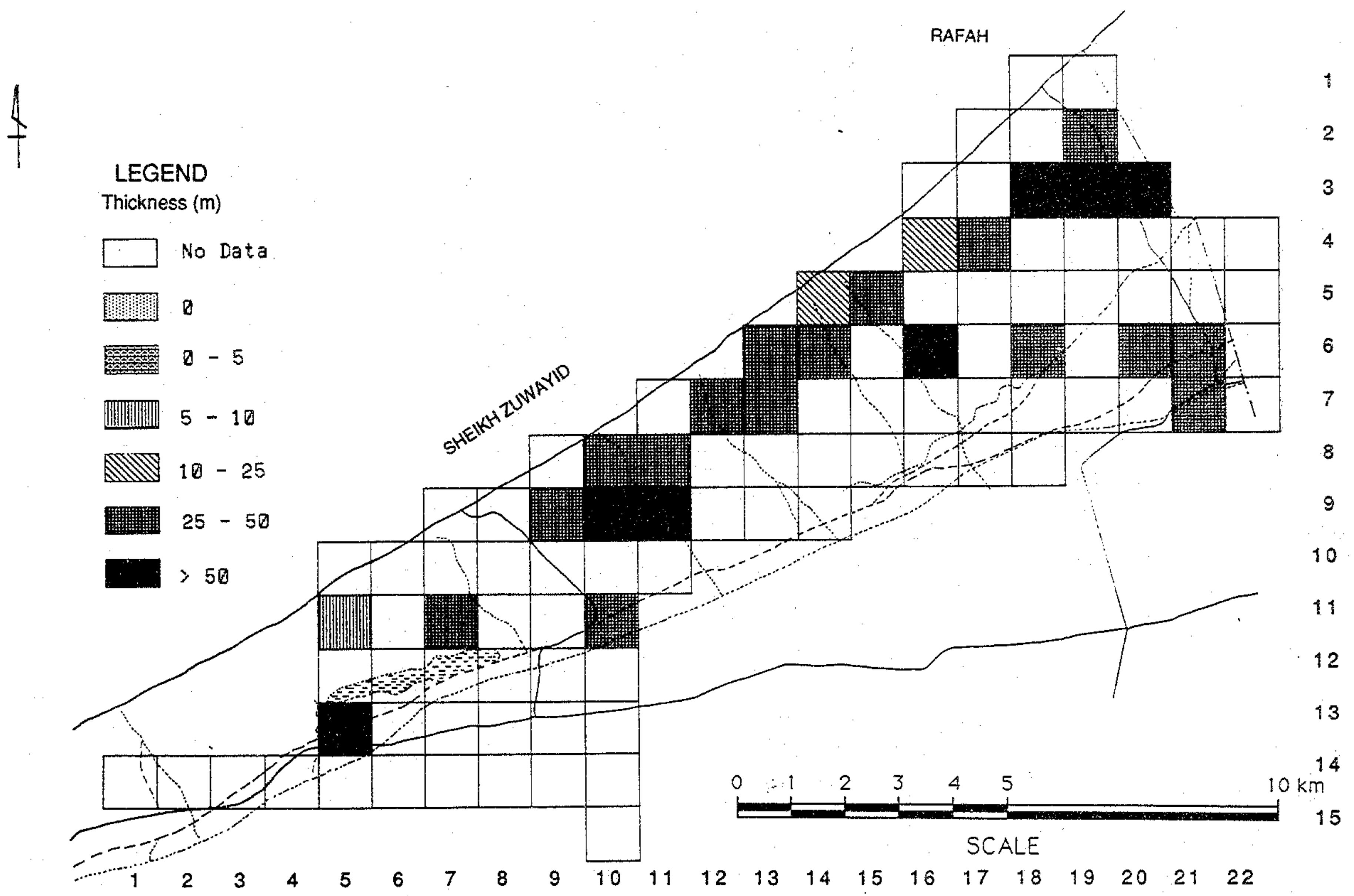


FIG. 7-2-10 THICKNESS OF QUATERNARY SAND BED IN SHEIKH ZUWAYID - RAFAH AREA

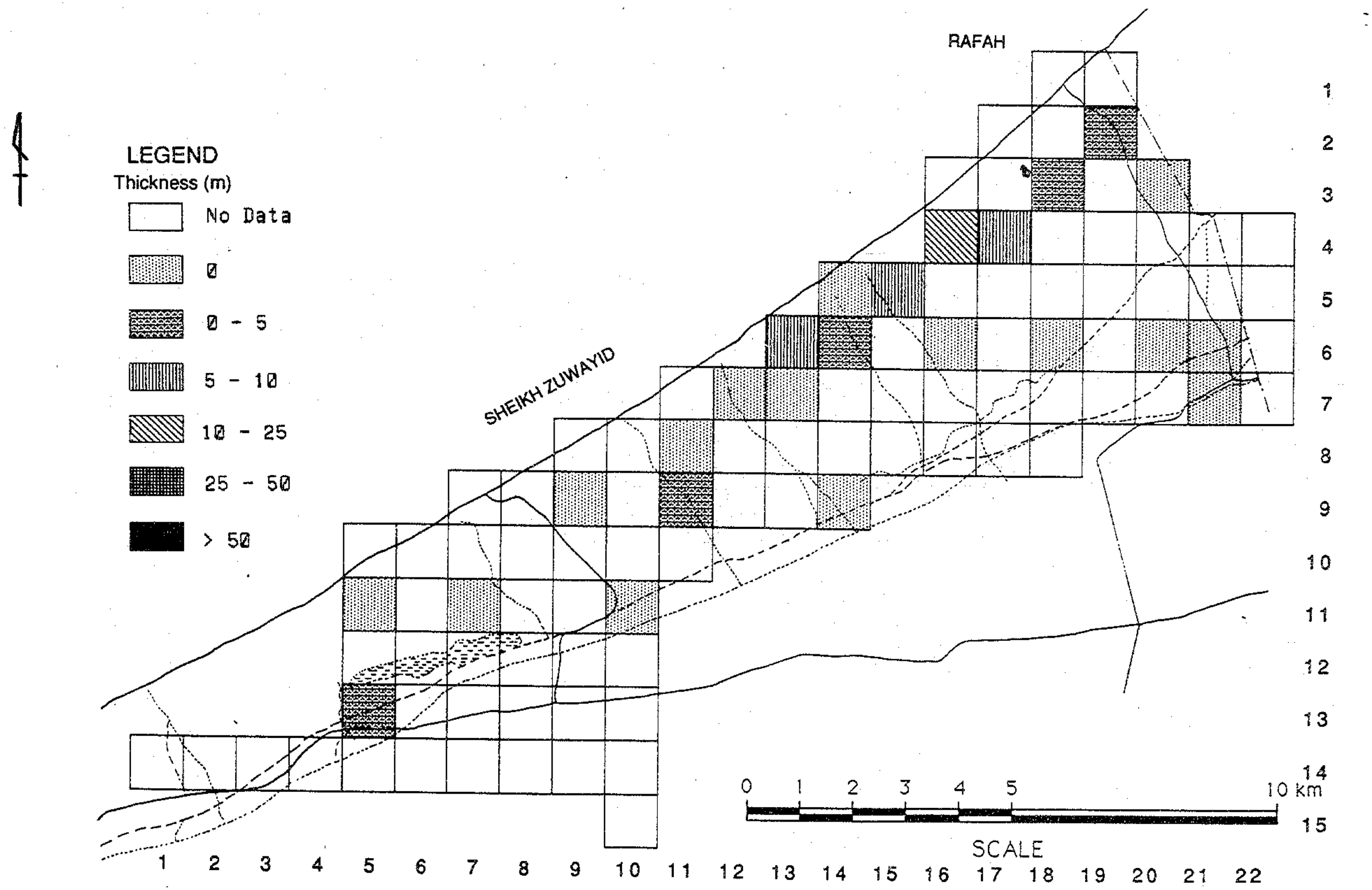


FIG. 7-2-11 THICKNESS OF QUATERNARY GRAVEL BED IN SHEIKH ZUWAYID - RAFAH AREA

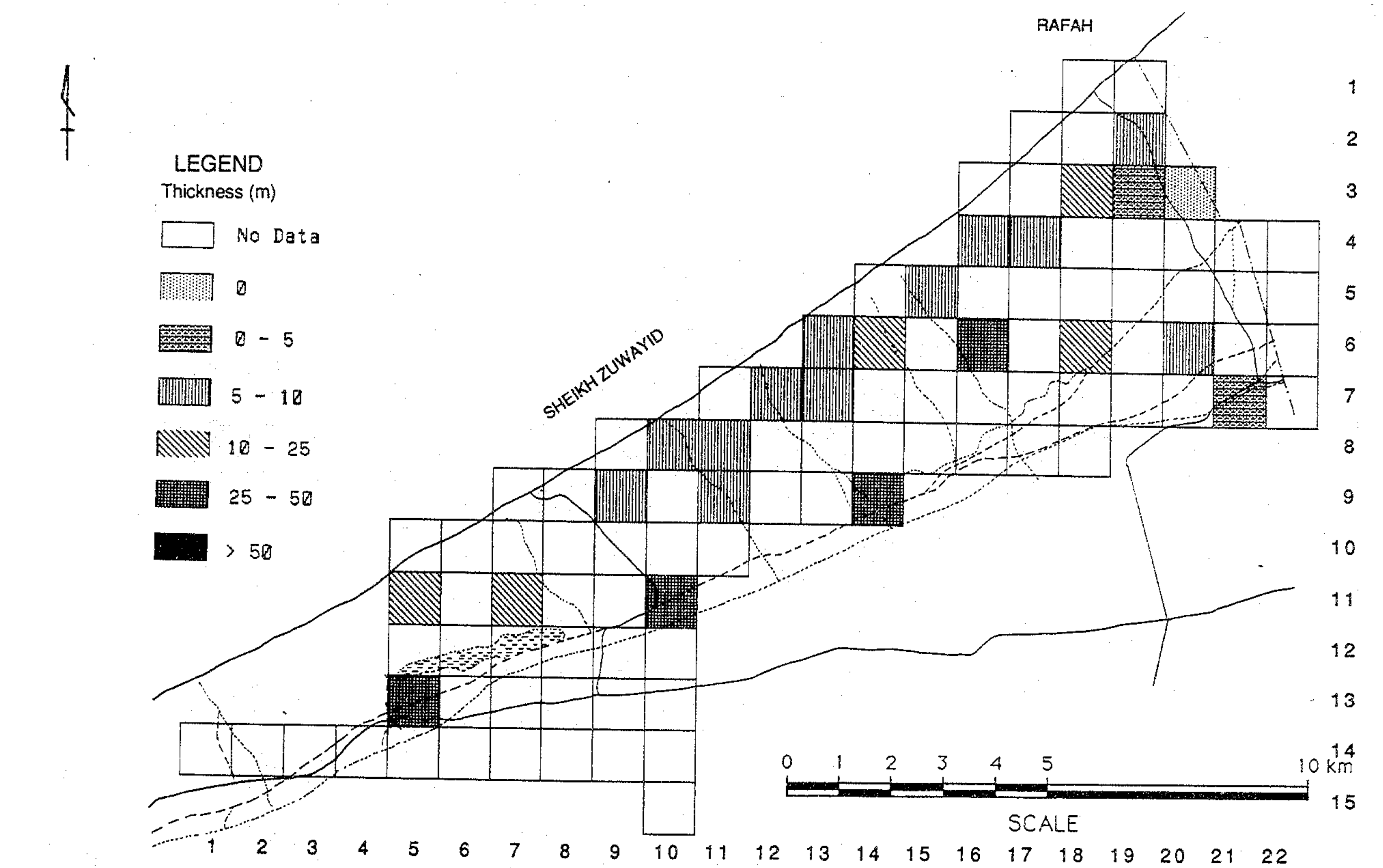


FIG. 7-2-12 THICKNESS OF KURKAR IN SHEIKH ZUWAYID - RAFAH AREA

7-3 Pre-Quaternary Aquifers

7-3-1 Tertiary Aquifer

7-3-1-1 General

According to the interpretation of the existing well data, groundwater aquifers are identified in the limestone and the sandstone of the Miocene and the lower part of the limestone of the Eocene. However, the water is highly saline with a TDS of more than 3,000 ppm except for the spring at Quseima yielding from the limestone of the Eocene.

7-3-1-2 Aquifer Developed in Miocene

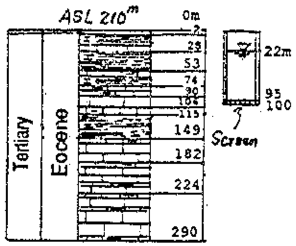
There are two wells identified as yielding water from the aquifer of the Miocene in the composite columns (Fig. 7-3-1);

J No.9 Masora
Misri-1

Well J No. 9 is located southwest of Rafah. The well is 90 m deep. The screen was installed in the conglomerate from 77 m to 83 m from the ground surface. The conglomerate is overlain by marly claystone so that this aquifer is confined. The water level is 68 m asl.

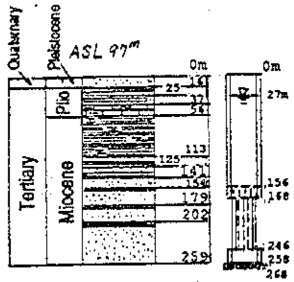
Misri-1 is located 7 km north from Magdaba. The depth of the well is 268 m and the screen is installed in the sandstone from 168 m to 246 m from ground surface where it is assumed to be about 100 m below the top of the Miocene. The bottom of the Miocene is unknown since the well does not reach to the base. But it is estimated that the thickness of the Miocene is 145 m, according to the composite columns in the vicinity.

No. 45A
El Arish Well No.10



Grid : K5
W.L. : 188 m ASL
TDS : 5,200 ppm

Misri 1



Grid : K6
W.L. : 70 m ASL
TDS : 10,450 ppm

FIG. 7-3-1 TERTIARY WELL (MIOCENE)

Although available data are limited, the shale was commonly observed in the Miocene so that the sandstone being observed in the upper part and the limestone in the lower part may contain aquifers between the shale.

The TDS of the above two wells are 5,200 ppm and 10,450 ppm respectively. There are some other wells (Bir Gribir in the south of Libni and the well No. 43-6 in Hasana) that are assumed to be the wells tapping water from the aquifer in the Miocene, although it is not yet confirmed. The TDS of these wells are 19,200 ppm and 3,000 ppm, respectively. This may suggest that the water quality of the aquifers in the Miocene is highly saline.

These wells distribute in the structural low area in Gebel Maghara, Yellq and Halal and also in the coastal fore-shore area in the east-southeast of El-Arish where the Moicene formations extends over the area.

The aquifers in the Miocene are developed in the sandstone or the limestone.

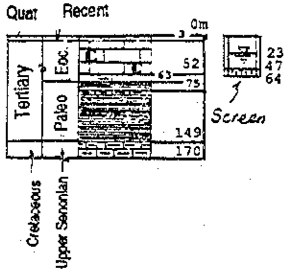
7-3-1-3 Aquifers Developed in Eocene

There are three wells of which age of the aquifers are confirmed in the composite columns (Fig. 7-3-2):

No. 83 El-Mewareh No. 1
Ain Gudeirat Spring
No. 76 Wadi El-Amro No.1
No. 45A El Arish Well No. 10

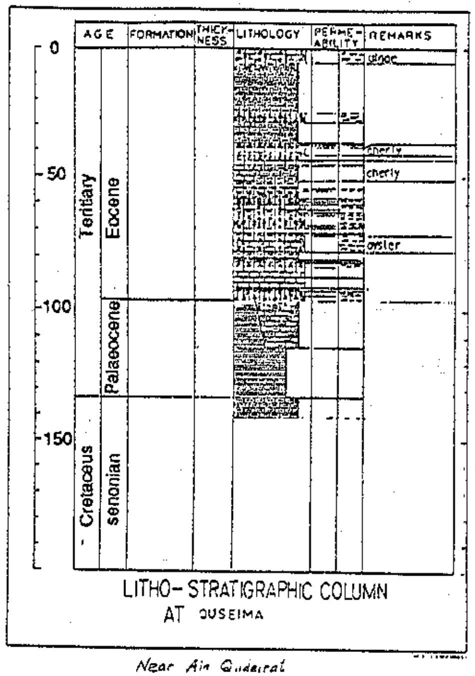
The aquifers of these wells are located in the limestone at the base of the Eocene overlying on the shale of the Palaeocene. The first two are located around Quseima. The third one is 5 km north from Quseima. The last one is located south of Gebel Maghara. An additional two springs are identified a few kilometers southeast of Quseima which have a similar geological set up: the limestone of the Eocene overlying the shale of the Paleocene.

No. 83
El Mewaleh Well -1



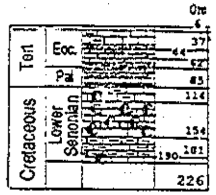
Grid : K6
W.L. : 257 m ASL
TDS : - ppm

Ain Gudeirat



Grid : K6
W.L : m ASL
TDS : 1440 ppm

No.76A
El Amro No.2



Grid : K6
W.L : m ASL
TDS : 5050 ppm

FIG. 7-3-2 TERTIARY WELL (EOCENE)

All the aquifers identified in the Eocene in the study area are developed in limestone. The salinity of the Ain Gudeirat spring is relatively moderate (1,440 ppm); however, the salinity of well No. 76 Wadi El-Amro is 5,050 ppm.

There are also some other wells distributing in the area around Quseima:

No. 80A El Quseima
P17
No. 43-3 Turkish Well

Well No. 80A is located at Quseima and well P17 is just near well No. 76 Wadi El-Amro and well No. 43-3 is at Hasana. The TDS of these wells are 3,430, 3,450 and 4,968 ppm, respectively.

The limestone of the Eocene stays at a relatively high elevation in areas other than the area around Quseima, so it is hardly expected to develop any productive aquifers.

The Salinity of groundwater from the aquifers of the Eocine is relatively moderate and is utilized for domestic and irrigation purposes in Quseima.

7-3-2 Upper Cretaceous Aquifer

7-3-2-1 General

Aquifers are identified in the marly facies of the Lower and the Upper Senonian and the limestone facies of the Cenomanian. However, the salinity and the water levels of the groundwater from the Senonian vary over a wide range-the water level is between 18 m and 680 m asl and the salinity is between 1,000 ppm and 8,500 ppm. The aquifers of the Cenomanian also indicate a certain range of water level and salinity-the water level is between 63 m and 223 m asl and the salinity is between 2,700 ppm and 5,600 ppm.

7-3-2-2 Aquifer Developed in Senonian

There are two wells of which the ages of aquifers are confirmed by the composite columns at wadi El Meleis and Gebel Libni. However, there are some other wells considered to be sunk into the Senonian aquifers (Fig. 7-3-3);

Table 7-3-1 Aquifer Developed in Senonian

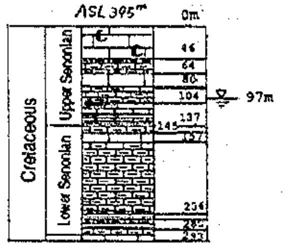
Well No. / Name	SWL (bgl)	SWL (asl)	TDS (ppm)
No. 70 Wadi Meleiz	97	298	8,480
No. 49 El-Arish No. 14	140	107	2,200
No. 50 El-Arish No.15	190	39	7,000
No. 63A Gebel Libni No. 1	132	58	4,500
No. 63C Gebel Libni No.3	132	18	4,500

All the aquifers identified are developed either in the limestone of the Upper Senonian or the Lower Senonian. Since shale and marl are developed in the Senonian, these aquifers are assumed to be a confined type.

The minimum value of the TDS was observed at Sheira Well-2 (1,100 ppm) which located in the south from Naqb on the southern side of the Ragabet El Naam fault. This structure may be a subsurface barrier in the aquifer.

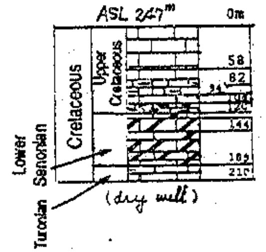
The second minimum TDS was found at well No. 49 El-Arish No. 14 at Hasana. Well No. 50 El-Arish No. 15 is also located at Hasana; however, the TDS indicates 7,000 ppm. The screen of well No. 50 is installed in the transition area between the Lower Senonian and the Turonian. On the other hand, well No. 49 is drilled into the Upper Senonian and the Lower Senonian although the location of the screen is not known. As the Upper Senonian consists of limestone, dolomite predominates in the Lower Senonian. It is assumed that this well is tapping water from the aquifer in the Upper Senonian. Therefore, although these two wells are located very near to each other, the aquifers are different.

No. 70
Wadi El Maleiz-1



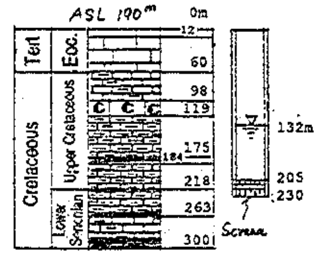
Grid : K1
W.L. : 298 m ASL
TDS : 8,480 ppm

No. 49
El Arish Well No.14



Grid : K2
W.L. : 107 m ASL
TDS : 2,200 ppm

No. 63A
Gebel Libni No.1



Grid : K5
W.L. : 58 m ASL
TDS : 4,500 ppm

FIG. 7-3-3 SENONIAN WELL

The aquifers of wells No. 63A and 63B are in the marly limestone in the transition area between the Lower Senonian and the Upper Senonian. The TDS of these wells is 4,500 ppm.

7-3-2-3 Aquifers Developed in Turonian

There are three wells with screens installed in the aquifer of the Turonian;

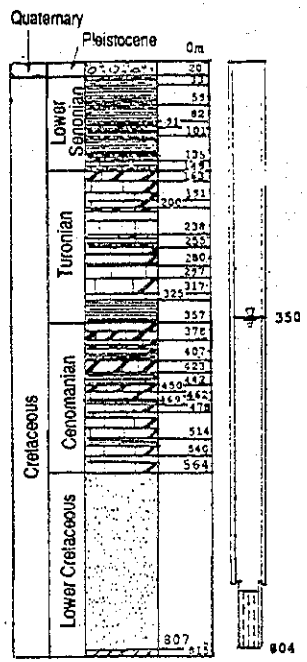
No.50 El-Arish well No. 15
Naqb-3
Sheira-2

The lithology of these aquifers is limestone as shown in the composite columns (Fig. 7-3-4).

The total depth of well No. 50 El-Arish well No. 15 at Hasana is 200 m from the ground surface reaching the level of 30 m asl. The aquifer locates near the boundary with the overlaying Upper Senonian. The thickness of the aquifer is about 10 m in this well. However, this well does not reach the bottom of this bed. It is not known if there is another aquifer below this bed or not. This is subject to further confirmation since the thickness of the limestone and the dolomitic limestone of this formation in this area is estimated to be more than 150 m according to the geologic columns and the composite columns (P4 Hasana and P18 Egyptian Army Hasana).

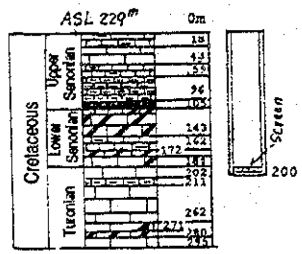
Well No. Naqb-3 penetrates into the Turonian reaching 82 m asl - 608 m deep from the ground surface but does not penetrate the Turonian. The location of screens of the well is unknown but the depth of the aquifer is assumed to be very deep since the static water level is recorded at 400 m from the ground surface (290 m asl).

Seira Well 2
(Shira Well 1)



Grid : H3
W.L. : 679 m ASL
TDS : 1,100 ppm

No. 50
El Arish Well No.15



Grid : K2
W.L. : 39 m ASL
TDS : 7,000 ppm

FIG. 7-3-4 TURONIAN WELL

The screens are installed at different levels; from a few meters below the boundary with the overlaying Lower Senonian to the level just above the boundary with the underlaying Cenomanian. The depth of the upper most aquifer is 180 m from the ground surface (580 m asl), and the total length of the screen is 124 m which is assumed to correspond to the total thickness of the aquifer.

The differences of the TDS values of the groundwater in the aquifers of the Turonian are remarkable. It is 1,100 ppm at well No. Sheira-2 and 35,000-40,000 ppm at well No. Naqb-3. Of all the water samples in the Pre-Quaternary aquifers in the study area, the minimum TDS value was at Sheira-2 while the maximum was at Naqb-3.

7-3-2-4 Aquifers Developed in Cenomanian

There are five wells of which the geologic age of the aquifers are confirmed by the composite columns (Fig. 7-3-5):

Table 7-3-2 Aquifer Developed in Cenomanian

Well No. / Name	SWL (bgl)	SWL (asl)	TDS (ppm)
P1 Gifgafa	219	79	3,500
P4El Hasana	172	63	4,120
No. 57AEl-Arish No.19	162	169	2,743
P16El-Amro	35	175	4,000
JNo.17 El Bruk-2	132	223	5,628

These composite columns are shown in Fig. 7-3-5. Screens are installed at the limestone or the dolomitic limestone except P4 which has the screen in the alternation of limestone and shale. In general, the wells in the aquifers of the Cenomanian have the screens in the limestone facies. The dolomite and the very tight shale are playing a role as the impermeable strata of the Cenomanian.

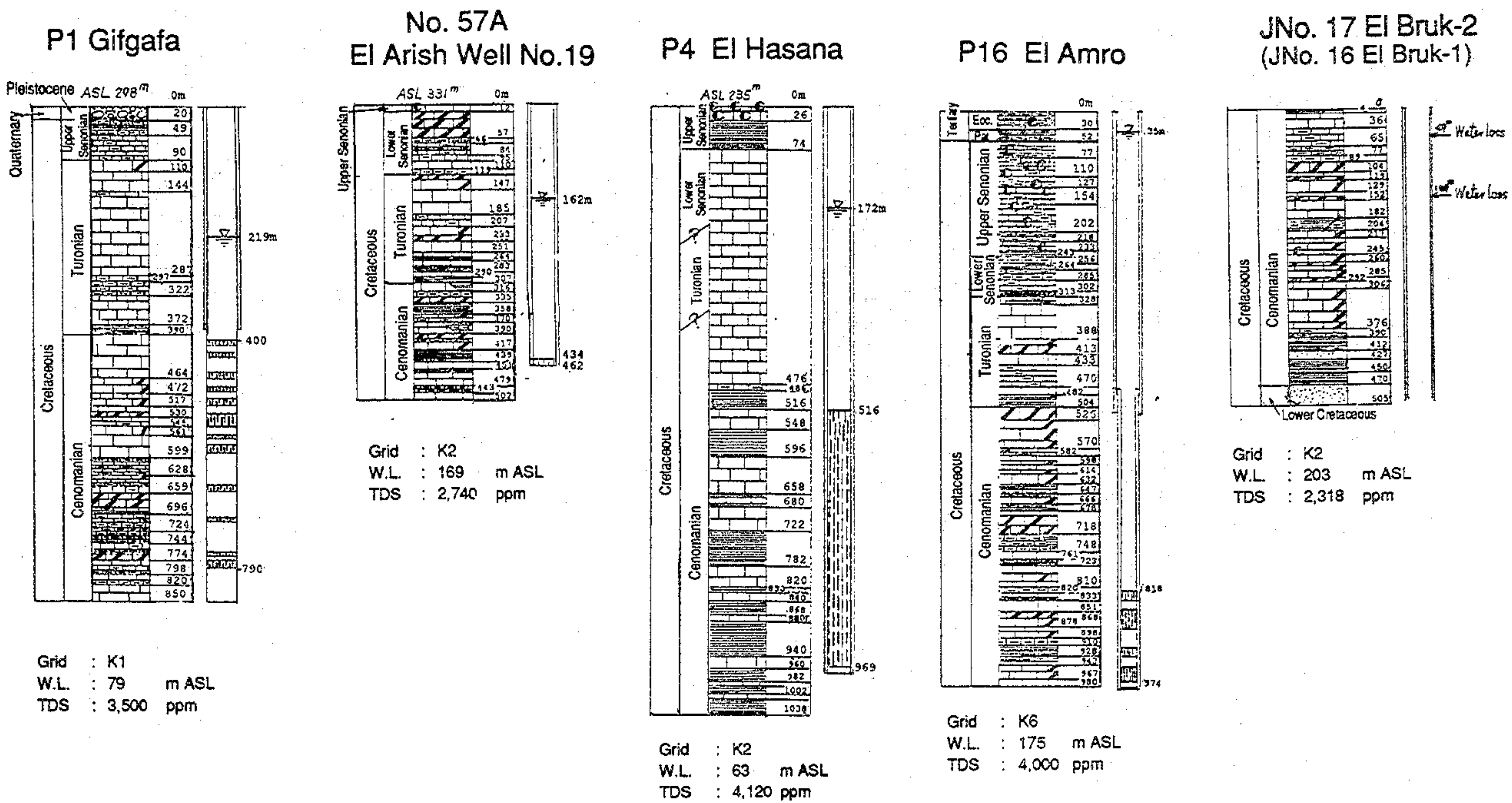


FIG. 7-3-5 CENOMANIAN WELL

The TDS of these wells varies between 2,700 and 5,600 ppm. The TDS of well No. 57A in Hasana seems to be relatively moderate. However, the TDS of the other wells are relatively saline. The wells with the high TDS distribute over a broad area in the northern part of El-Bruk which may suggest that the water quality of the aquifers in the Cenomanian is rather saline.

The Cenomanian broadly distributes in the study area except at the dome structures and its depth in the area north from the Syrian Arc is assumed to be considerably deep.

7-3-2-5 Aquifer Undifferentiated in Upper Cretaceous

There is a group of wells where the screen levels are unknown or where the screens are installed over different formations. These are shown in Figs. 7-3-6 and 7-3-7 and are listed below:

Table 7-3-3 Wells Tapping Water from the Different Aquifers

Well Name	W.L. (bgl)	W.L. (asl)	TDS (ppm)
El-Themed	-	-	3,500
El-Monbatch	-	-	2,500 - 3,500

Table 7-3-4 Wells Tapping Different Unknown Aquifers

Well Name	W.L. (bgl)	W.L. (asl)	TDS (ppm)
No. 15 Bir Hasana	118	142	1,500
Naqb 3	400	290	35,000 - 40,000

The screens are installed at the sandstone of the Lower Cretaceous and the limestone of the Cenomanian in the well at Themed. The screens are installed at all formations of the Lower Cretaceous, Cenomanian, Turonian and Senonian in the well El-Monbatch.

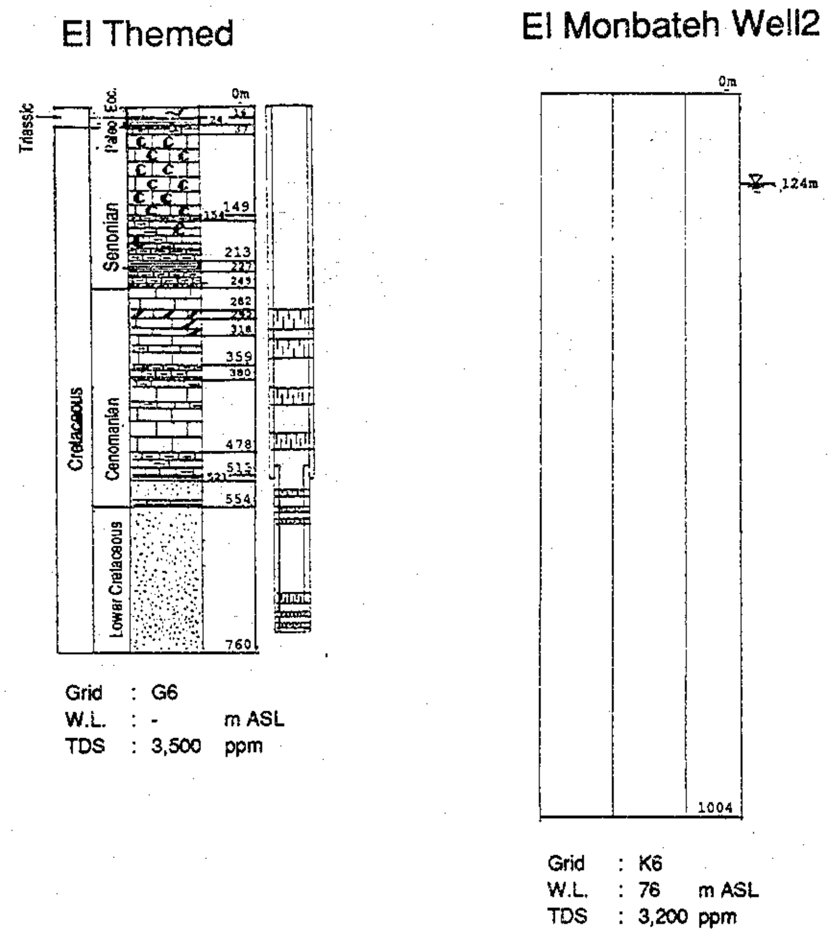


FIG. 7-3-6
WELL OF MULTIPLE AQUIFERS IN UPPER CRETACEOUS

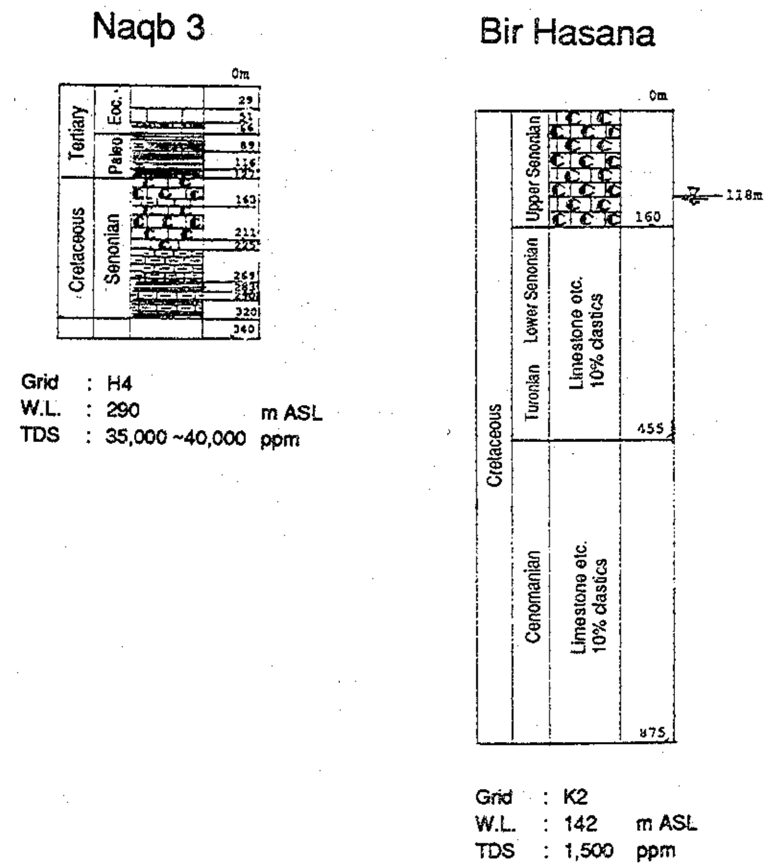


FIG. 7-3-7
WELL OF UNDIFFERENTIATED AQUIFER IN UPPER CRETACEOUS

Therefore the nature of the water from the specific aquifer is unknown.

7-3-3 Lower Cretaceous Aquifers

There are thirteen wells tapping water from the aquifers in the Lower Cretaceous (Fig. 7-3-8);

Table 7-3-5 Lower Cretaceous Aquifers

Well No./Name	SWL (bgl)	SWL (asl)	TDS (ppm)
Darag No.-1	183	263	1,490
Nakhl- 1	181	269	1,635
Nakhl- 2	210	260	1,200
Sheira-1	340	420	1,575
Abu Ghazala	219	101	-
Sudr Heitan	270	205	1,246
P18 Egyptian Army Well	172	63	4,120
Talet El-Badan	105	135	5,360
El-Hasana Israli Well	161	24	1,410
J No.12 Minshera	182	198	2,973
J No. 13 Falig	288	67	-
J No.16 El Bruk-1	152	203	2,318
J No. Arif El-Naga	296	159	3,008

The screens of the well tapping water from the aquifer of the Lower Cretaceous is installed at the sandstone.

At the well in Talet El-Badan, the Lower Cretaceous overthrusts the Upper Cretaceous so that the water quality of this well may be influenced by the water in the aquifer of the Upper Cretaceous. As the location of the screen of well No. P18 is not available, the origin of the water is not identifiable.

The TDS values of the rest of the wells vary between 1,200 ppm and 3,000 ppm which may suggest that the quality of the water from the aquifers of the Lower Cretaceous is much more favorable than that of the Upper Cretaceous.

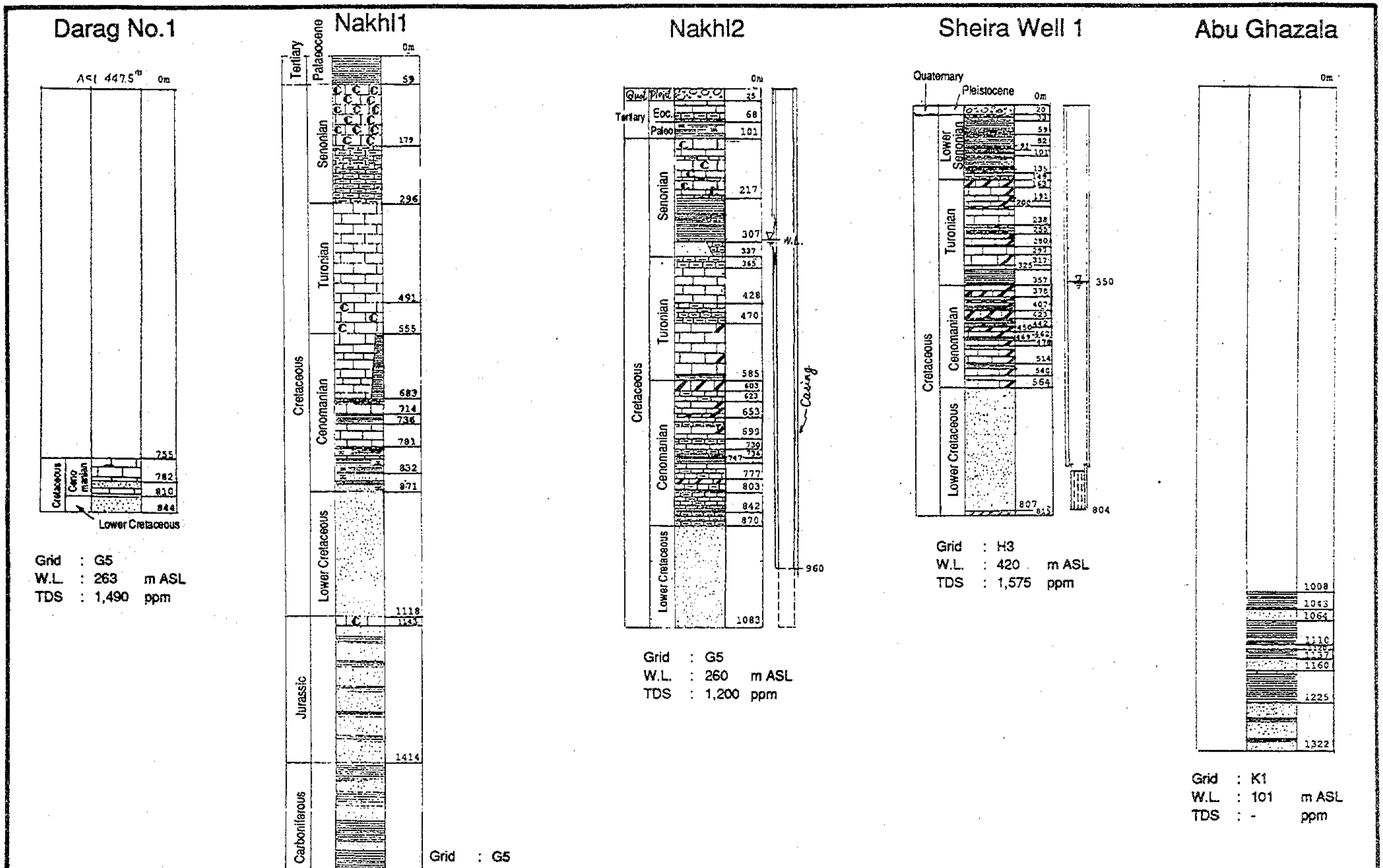
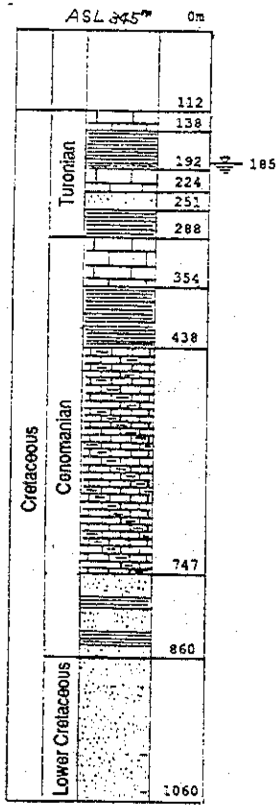


FIG. 7-3-8 (1) LOWER CRETACEOUS WELL

No. p18

Epytian Army Hasana



Grid : K2
W.L. : 160 m ASL
TDS : 1,500 ppm

FIG. 7-3-8 (2) LOWER CRETACEOUS WELL

As shown in the table above, it seems that the TDS values of the wells having static water levels higher than 200 m asl tend to be lower than that of deeper water level than 200 m asl. The distribution of the lower TDS is assumed to distribute in the area in the south of the line from Sudr El-Heitan to El-Kuntilla through El-Bruk. The TDS of J No. 16 requires further confirmation since the bottom of the well reaches the Jurassic.

Although the water quality is relatively mild in these wells, it should be noted that the static water level from the ground surface is rather deep which may reflect on the energy cost of the water usage.

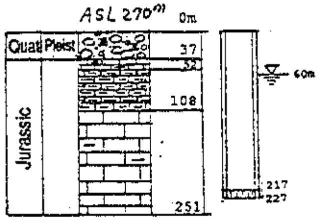
7-3-4 Jurassic Aquifers

There are ten wells tapping water from the aquifer of the Jurassic (Fig. 7-3-9). These wells are classified into two groups: the one tapping water from the aquifers of the Upper Jurassic formation and the other from the aquifers from the Middle to Lower Jurassic formation;

Table 7-3-6 Jurassic Aquifer

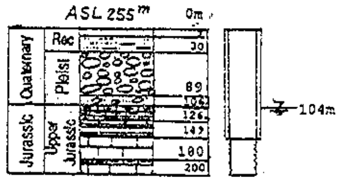
Well No. / Name	W.L. (bgl)	W.L. (asl)	TDS (ppm)
Upper Jurassic Formation			
No. 46 El-Arish No. 11	60	210	3,600
No. 47B El-Arish No.12	104	151	1,650
No. 52AEl-Arish No. 17	123	147	3,450
No. 53A El-Arish No.18	28	232	3,810
No. 54A El-Fath No. 4	113	167	-
No. 55 El-Massajid No. 4	115	162	2,800
Middle to Lower Jurasssic Formation			
No.5 Coal Mine	29	305	4,140
No. 6 Coal Mine	-	-	7,455
No. WX2 Coal Mine	120	157	2,700

No. 46
El Arish Well -11



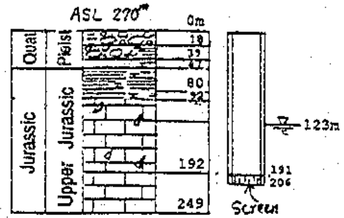
Grid : K4
W.L. : 210 m ASL
TDS : 3,600 ppm

No. 47B
El Arish Well -12



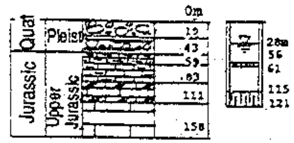
Grid : K4
W.L. : 151 m ASL
TDS : 1,650 ppm

No. 52A
El Arish Well -17A



Grid : K4
W.L. : 147 m ASL
TDS : 3,450 ppm

No. 53A
El Arish Well -18



Grid : K4
W.L. : 232 m ASL
TDS : 3,810 ppm

FIG. 7-3-9 (1) JURASSIC WELL

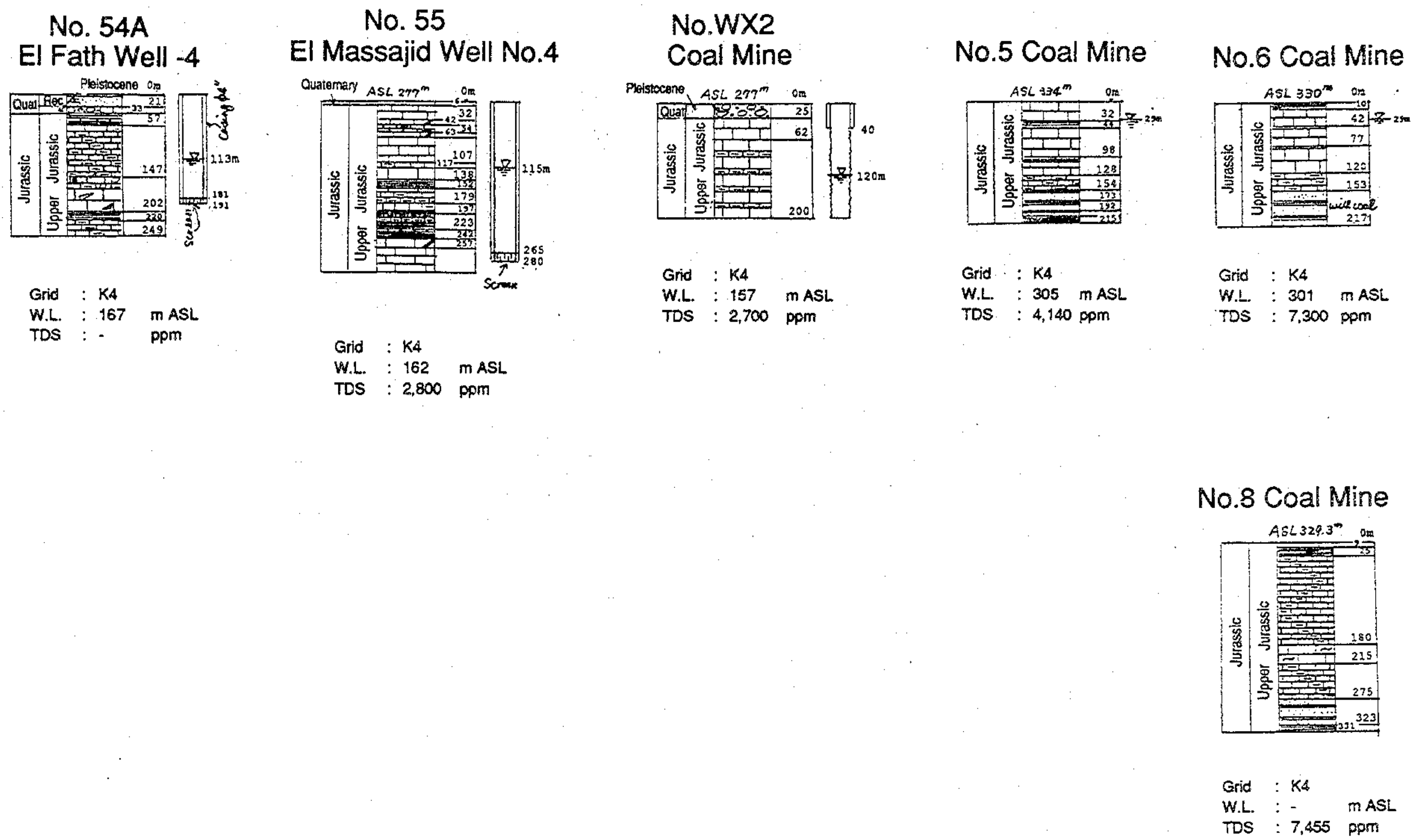


FIG. 7-3-9 (2) JURASSIC WELL

The wells tapping water from the aquifers of the Jurassic are limited only in the area on the northwestern side of Gebel Maghara. The aquifers in the Upper Jurassic formation are developed in the limestone. On the other hand, that of the Middle to Lower Jurassic formation are developed in the limestone and the sandstone. This sandstone is intercalated by the coal strata together with the rock salts. This may cause a wide variation of the TDS in the aquifers of the Middle to Lower Jurassic formation. It would be also pointed out that the area where these aquifers locate is geologically complicated. The Upper Jurassic formation locates on the outside of the dome structure where it coincides with the anticline and the Middle to Lower Jurassic formation locates under the quest at the boundary between the Upper Jurassic and the Middle to Lower Jurassic formations.

8. PRESENT STATE OF GROUND WATER USE

8 PRESENT STATE OF GROUND WATER USE

8-1 Introduction

There is a large number of wells in the study area. Except in a few cases, these wells drilled into the aquifers of the Pre-Quaternary are not operating due to the high salinity of the groundwater. However, the wells tapping water from the Quaternary aquifers are intensively operated, especially in the alluvial plain of Wadi El-Arish and in the coastal plain along the northeastern part of the Mediterranean. Although on a much smaller scale than the above two places, there is intensive use of groundwater from the shallow sand dune aquifers for irrigation of local farms along the coast.

The current situation of water use, together with the well data of El-Arish and Sheikh Zuwayid - Rafah areas, is compiled in GMS published by RIWR, 1988. Making some assumption on these data, the present state of the groundwater use is interpreted in the followings:

For this purpose an assumption is made that the yield of the wells remains at the present pumping rate since their construction.

The yields and number of wells are classified according to their construction period and are plotted on a 1 km^2 mesh.

8-2 Water Use in El-Arish

8-2-1 Historical Sketch of Water Use in El-Arish

The oldest group of wells still in operation are well No. 1-10 located at just out side of the southwestern corner of El-Arish town drilled in 1926, well No. 1-42 located just outside of the southern end of El-Arish town drilled in 1936, and well No. 1-95 located at the northern end of the airport drilled in 1935. The yield of wells Nos. 1-10 and 1-42 is estimated at 210 m^3/day. Well No. 1-95 produces 320 m^3/day (Fig. 8-2-1).

By the end of the 1940s, additional wells were drilled. Four wells were drilled in grid No. 7-3 on the southeastern side of El-Arish and two wells were drilled in grid No. 7-2. A also, one well was constructed in grid No. 5-1 and in grid No. 6-3.

By this time there should be eleven wells around El-Arish town having a total estimated yield of 1,300 m^3/day (Fig. 8-2-2).

By the end of the 1960s the number of wells in the Wadi El-Arish plain increased considerably to a total of 63 wells. There are 15 wells in grids Nos. 7-2, 7-3 and 7-4 located on the eastern and the southeastern sides of El-Arish town. There are five wells per square kilometer. The construction of wells in grids Nos. 8-3, 9-3, 4, 5 and 6 along the El-Arish - Lehfan road is remarkable. There are 18 wells drilled in this 5 km^2 area 3.6 well/km^2 (Fig. 8-2-3).

During this period the well field in Wadi El-Arish plain was extended 6 km (3 km wide) from the southeastern side of El-Arish town southward to the northern end of the airport. The total well field at this time is (25 km^2 and the total yield is estimated at 15,300 m^3/day (2.5 wells/km^2 and 245 m^3/day/well) (Fig. 8-2-4).

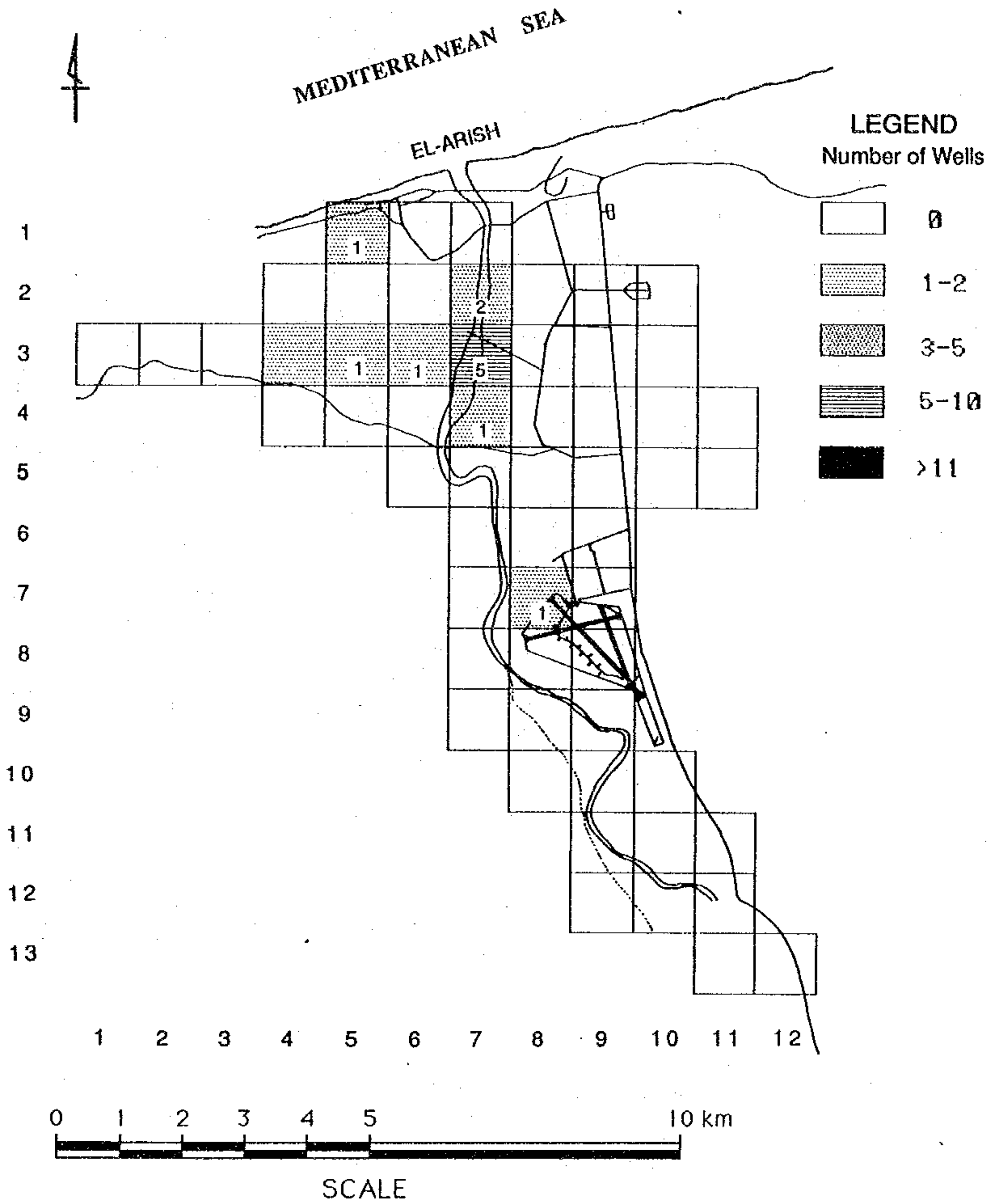


FIG. 8-2-1 WELL NUMBERS AT EL - ARISH AREA BY 1950

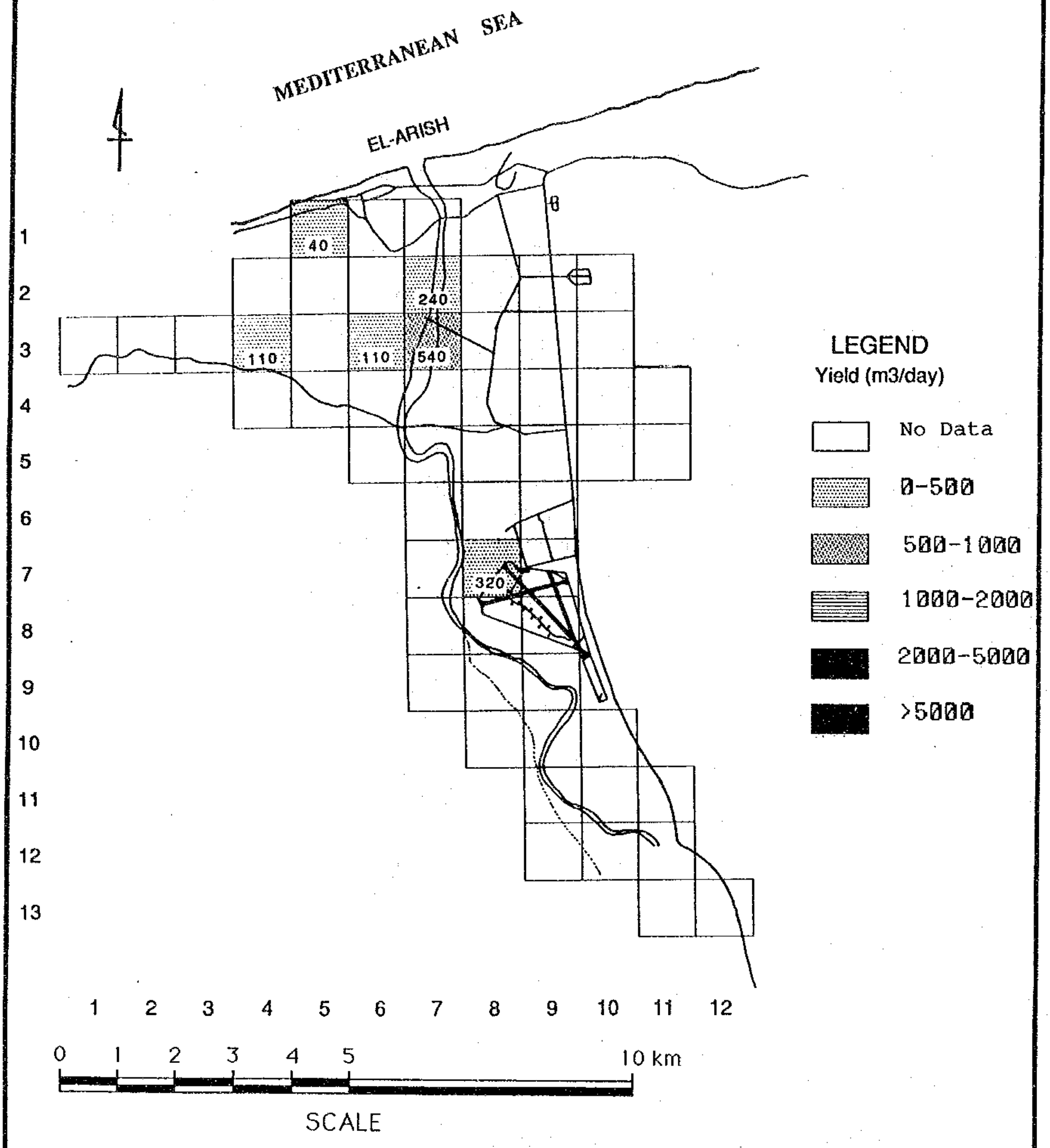


FIG. 8-2-2 PUMPAGE RATE AT EL - ARISH AREA BEFORE 1950

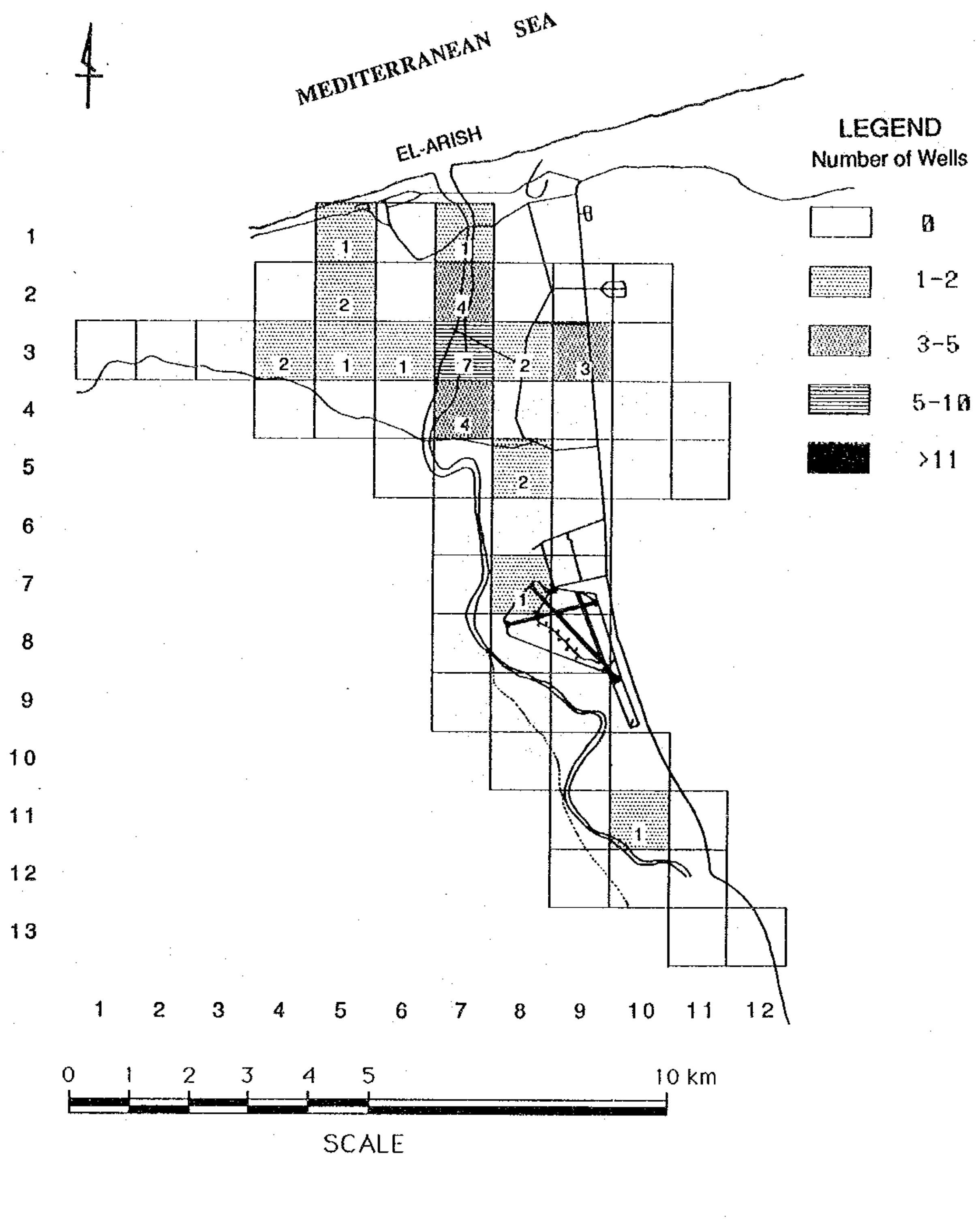


FIG. 8-2-3 WELL NUMBERS AT EL - ARISH AREA IN 1960s

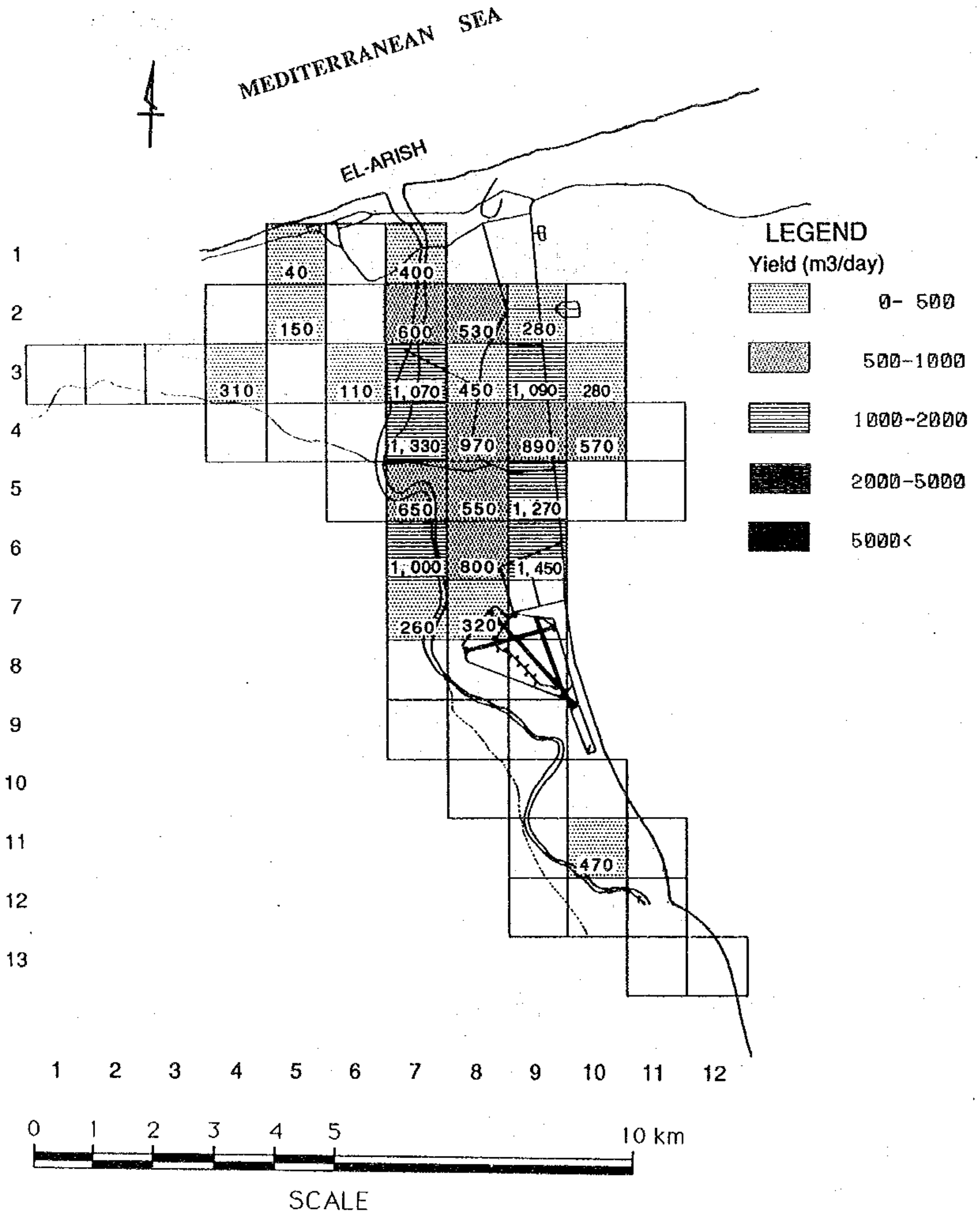


FIG. 8-2-4 PUMPAGE RATE AT EL - ARISH AREA AT THE END OF 1960S

8-2-2 Present State of Water Use in El-Arish

The well field of 25 km^2 at the end of the 1960s is remarkably expanded to the west and to the southeast of of El-Arish. On the eastern side of El-Arish, the well field stretches to the south for about 10 km (about 3 km wide) beyond the airport and reaches test well No. 5-5 in grid No. 11-13. The total area of well field is estimated to be about 50 km^2; doubled the size it was at the end of the 1960s (Fig. 8-2-5).

As the size of the well field increased, so did the wells. It is remarkable that the number of wells existing in grids Nos. 4-3, No. 5-3, No. 6-3 and 4, No. 7-2 and No. 7-3, No. 8-2, 8-3 and 8-7, and No. 9-3 and 9-6. There are 5 to 9 wells in each grid. There are 6 wells in these grids covering a 16 km^2 area. There are 5.5 wells per square kilometer.

In most grids the yield was less than 1,000 m^3/day by the end of the 1960s. However, in 13 of 50 grids the yield exceeds 1,000 m^3/day. Of these, a pumpage of 6,500 m^3/day is recorded at grid No. 6-3 located on the western side of El-Arish town. The yield exceeds 2,000 m^3/day/ grid at six grids around El-Arish town.

The total amount of groundwater use is estimated at 51,000 m^3/day. There were 142 wells in operation in 1988 in the Wadi El-Arish plain (3 well/km^2 and 360 m^3/day/well) (Fig. 8-2-6).

Major water use in this area is for irrigation of local farms.
A prevailing problem of the groundwater from aquifers of the Quaternary is the high salinity in the study area. In order to deduce the limitation of the water use, TDS values are classified from the view point of water use.

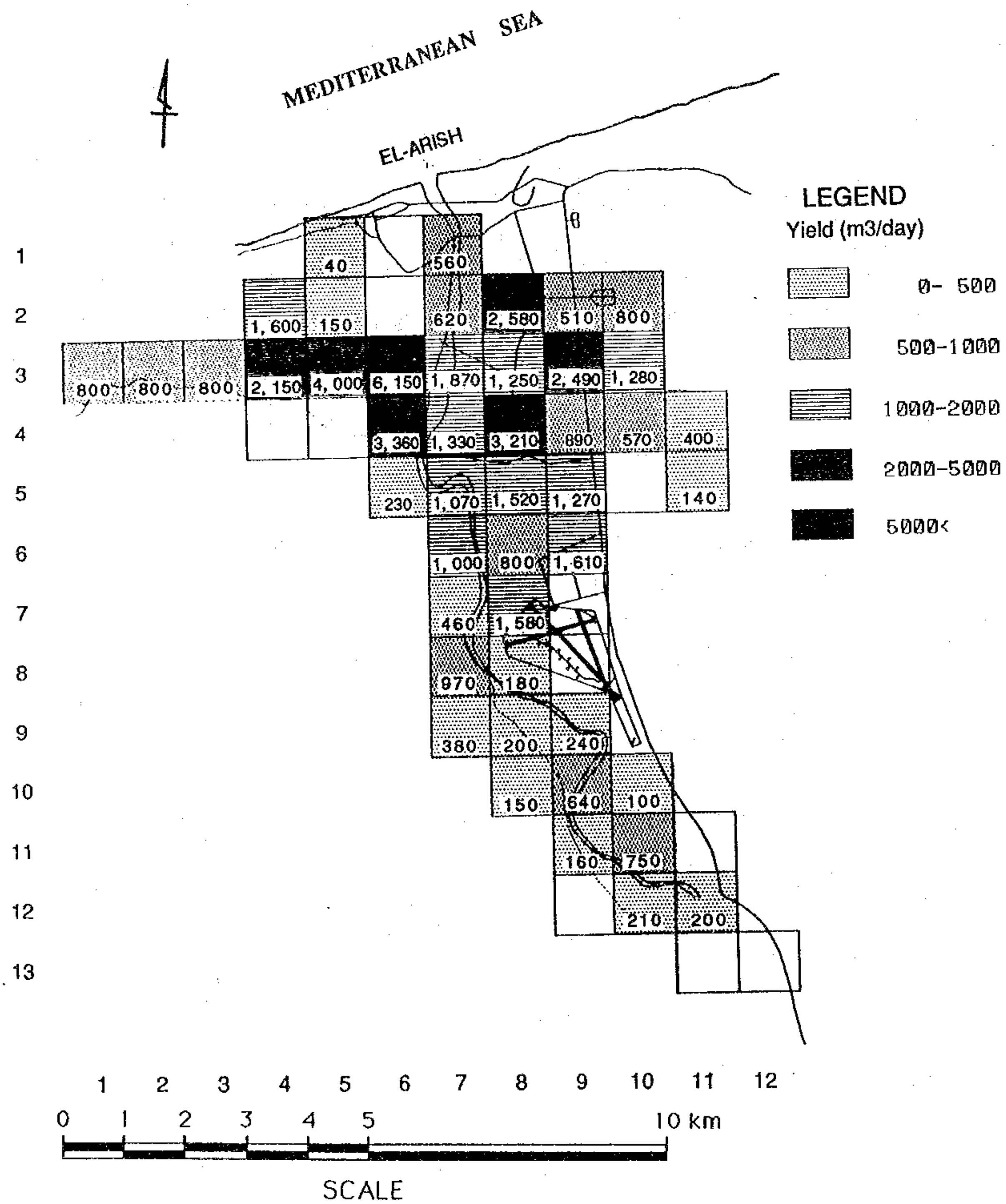


FIG. 8-2-5 PUMPAGE RATE AT EL - ARISH AREA IN 1988

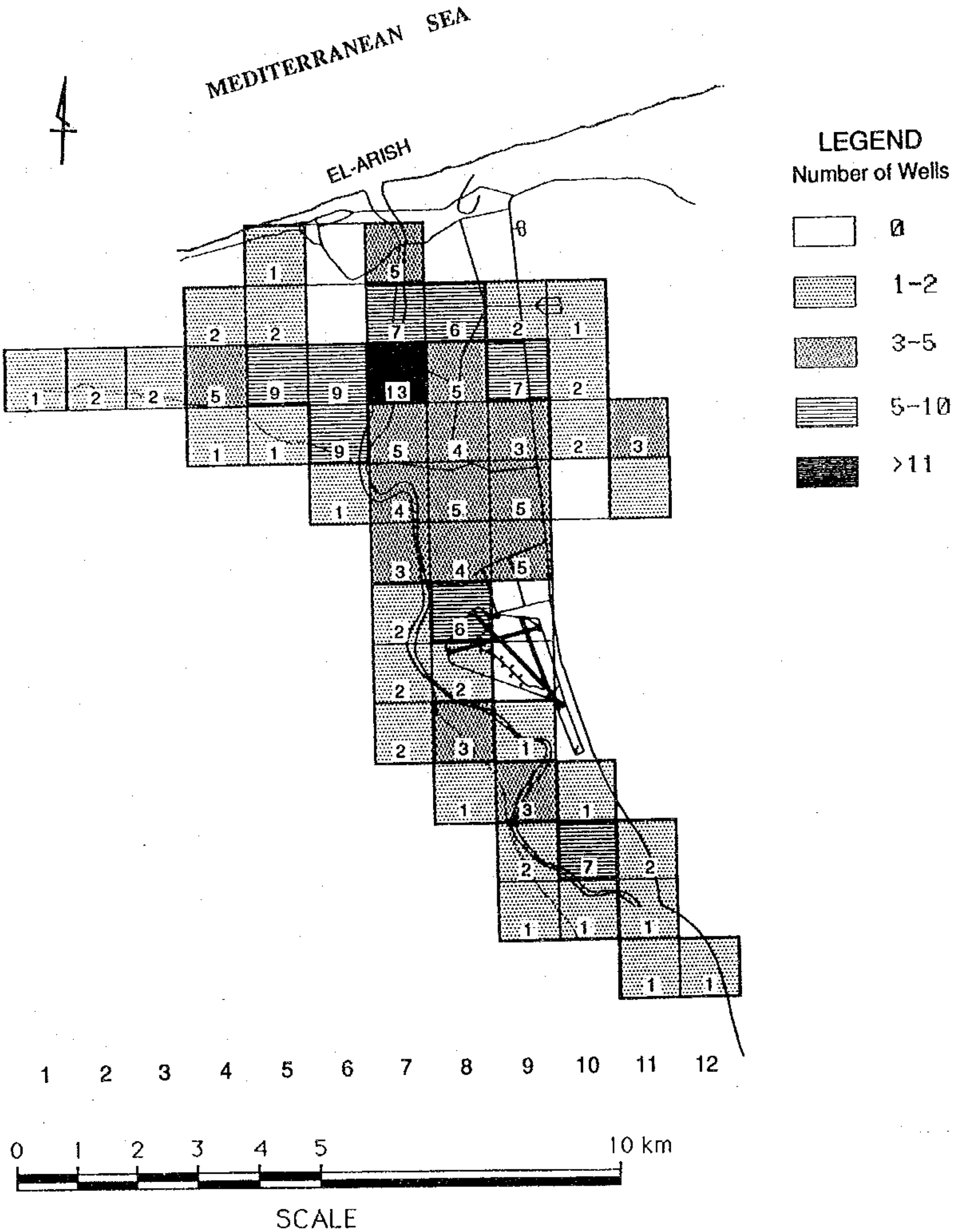


FIG. 8-2-6 WELL NUMBERS AT EL - ARISH AREA IN 1988

The TDS value, which indicates the limit of the water use, is suggested based on experience in the Australian desert (Goudie A. and Wilkinson. E, 1977) as shown below;

1	Suitable for irrigation	< 750 ppm		
2	Hazardous for salinity sensitive crops	750 ppm	-	1,500 ppm
3	Hazardous for most of crops	1,500 ppm	-	3,500 ppm
4	Only for salinity tolerance crops	3,500 ppm	-	6,500 ppm
5	Hazardous for salinity tolerance crops	6,500 ppm	-	8,000 ppm

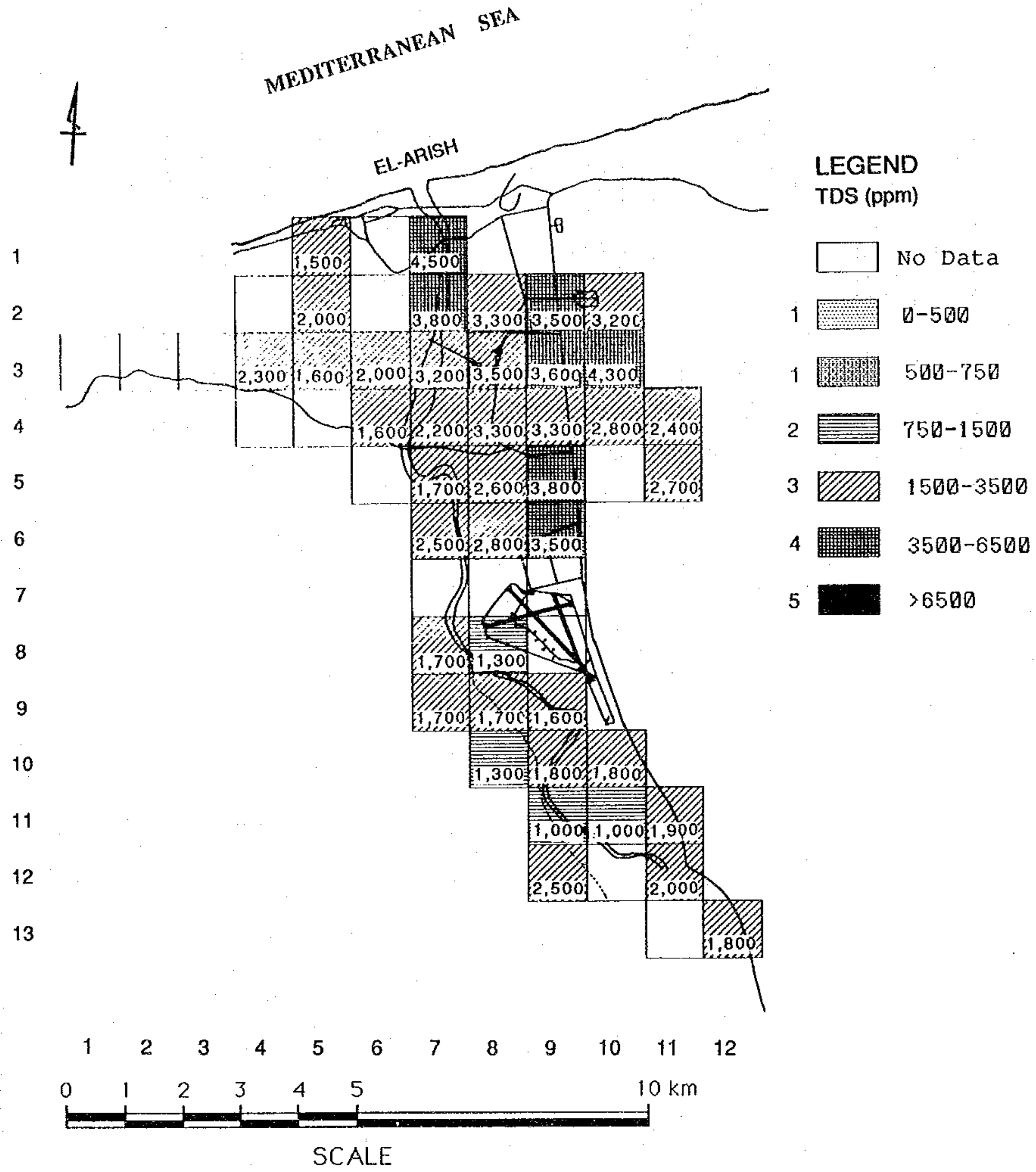
In addition to the above TDS indicator for crop cultivation, the limit of TDS value of 1,000 ppm for potable water was suggested by WHO. However, in the above suggestion, 750 ppm was recently selected for the limit of drinking water for human.
Taking the above TDS values into consideration, the TDS values of existing wells were classified and the average TDS of the wells within each grid is shown in Fig. 8-2-7.

As shown in Fig. 8-2-7 the TDS of the groundwater, in most of the Wadi El-Arish plain area falls into categories of either being hazardous for salinity sensible crops or hazardous for most crops. The salinity of the groundwater is so high in the area on the eastern side of El-Arish town that the groundwater is hazardous even for certain salinity tolerance crops.

8-3 Water Use in Sheikh Zuwayid - Rafah

8-3-1 Historical Sketch of Water Use in Sheikh Zuwayid - Rafah

The oldest record of modern well construction in this area appears in the 1950s. By the end of the 1960s many wells were in operation in the area around Rafah town (Fig. 8-3-1).



1	Suitable for irrigation	< 750 ppm
2	Hazardous for salinity sensitive crops	750ppm-1,500 ppm
3	Hazardous for most of crops	1,500 ppm-3,500 ppm
4	Only for salinity tolerance crops	3,500 ppm-6,500 ppm
5	Hazardous for salinity tolerance crops	6,500 ppm-8,000 ppm

FIG. 8-2-7 TDS DISTRIBUTION AT EL - ARISH AREA IN 1988

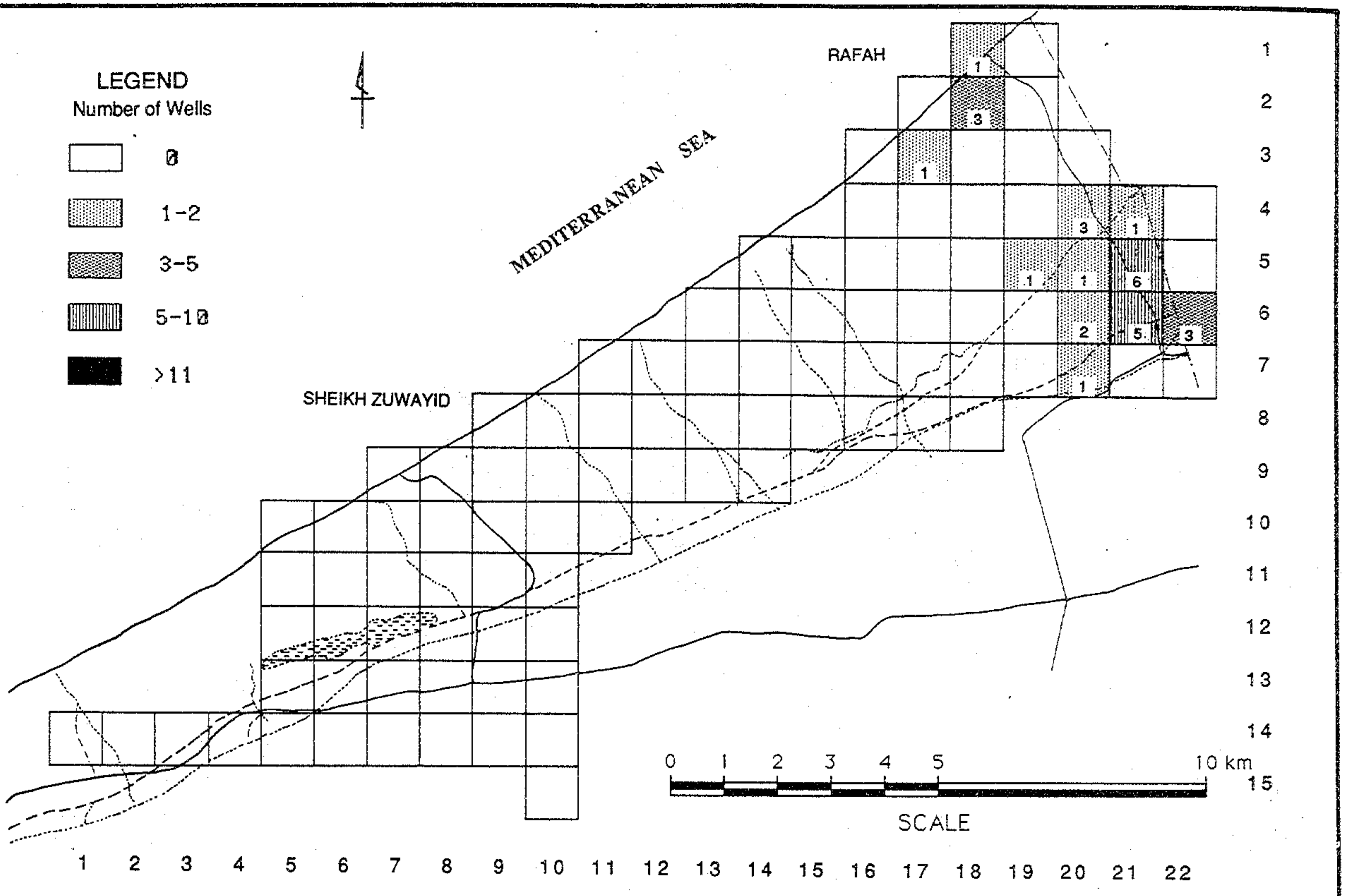


FIG. 8-3-1 WELL NUMBERS AT SHEIKH ZUWAYID - RAFAH AREA IN 1960s

During that time, the most intensive groundwater use was observed in grids Nos. 21-5 and 6. There were ten wells in this two square kilometer area. The total yield in these grids at that time was 2,400 m^3/day (240 m^3/day/well) (Fig. 8-3-2).

Other wells were also in use in the area around Rafah town. These well fields extends over 9 km^2 around Rafah including the grids Nos. 21-5 and 6 yielding 4,800 m^3/day (2 wells/km^2 and 250 m^3/well/day on an average).

8-3-2 Present State of Water Use in Sheikh Zuwayid - Rafah

Since the end of the 1960s, the well field around Rafah town expanded in a triangle zone, of which vertex extends from its base along the international border with Israel on the east of Rafah to the west for about 10 km. The well field around Rafah town now extends over 23 km^2 (Fig. 8-3-3).

The number of wells in the previous well field at the end of the 1960s (9 km^2) increased to 63. 24 wells are in operation in grids Nos. 21-5 and 6, yielding 5,700 m^3/day (2,850 m^3/day/km^2 and 226 m^3/day/well). The total yield within the previous well field was estimated to be 14,000 m^3/day (1,750 m^3/day/km^2 and 212 m^3/well/day) (Fig. 8-3-4).

There are 102 wells in operation in the expanded well field of the above triangle zone which is a part of the increment number of wells constructed during the 1970s and 1980s.

The total yield of this triangle zone around Rafah town in 1988 was estimated to be 26,100 m^3/day and there are 168 wells is 168 (1,100 m^3/day/km^2 and 155 m^3/day/well on an average) (Fig. 8-3-3).

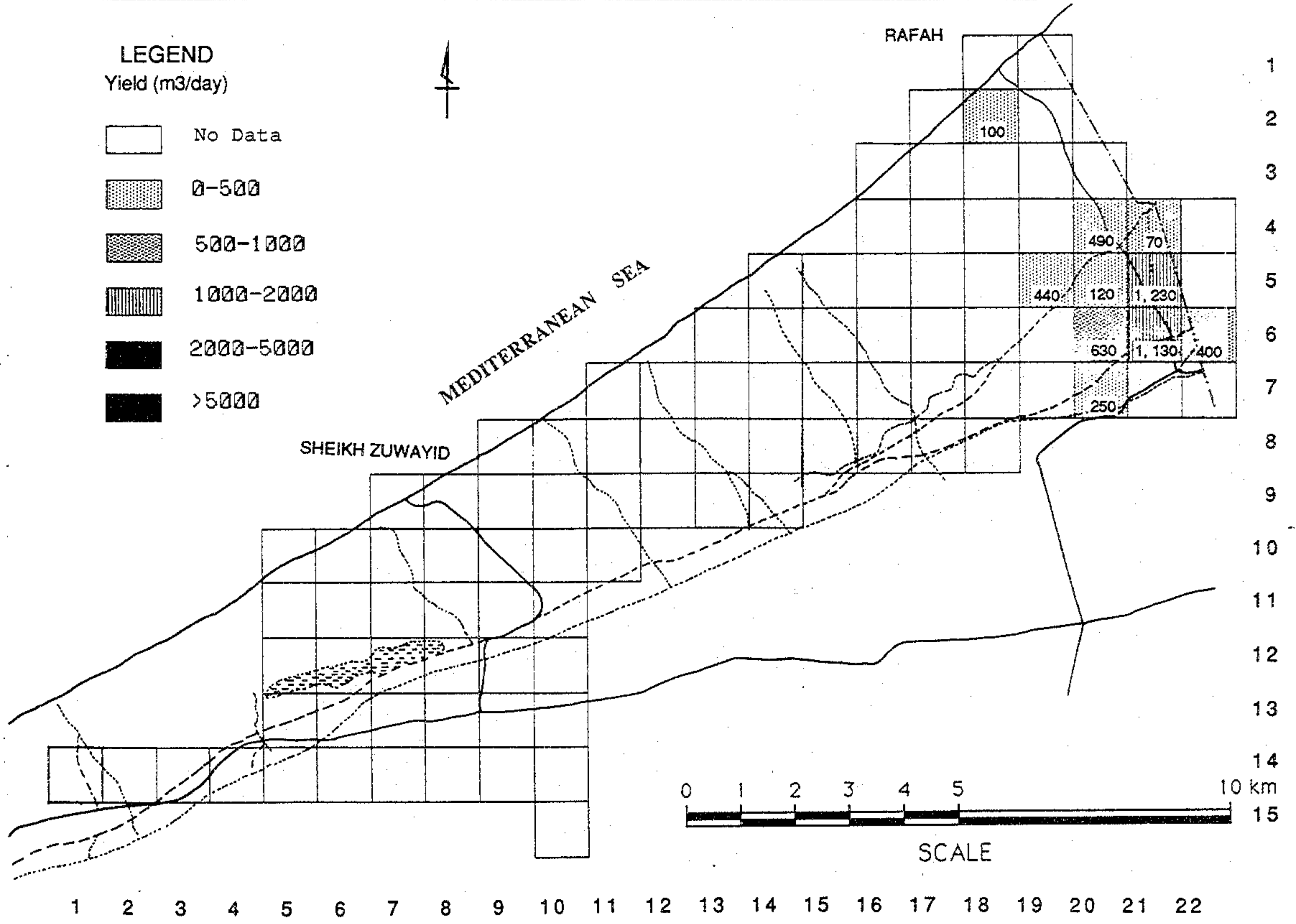


FIG. 8-3-2 PUMPAGE RATE AT SHEIKH ZUWAYID - RAFAH AREA AT THE END OF 1960s

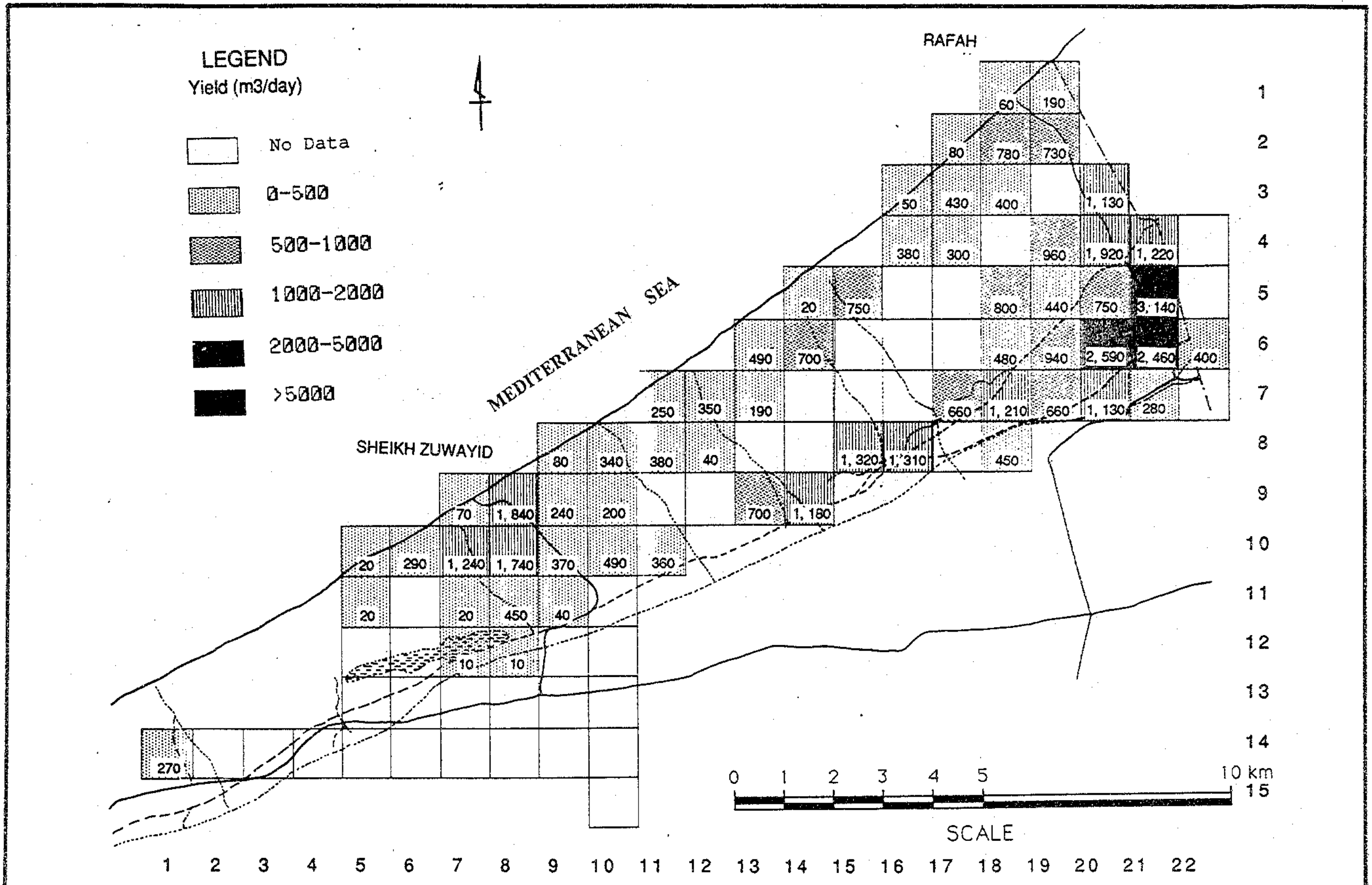


FIG. 8-3-3 PUMPAGE RATE AT SHEIKH ZUWAYID - RAFAH AREA IN 1988

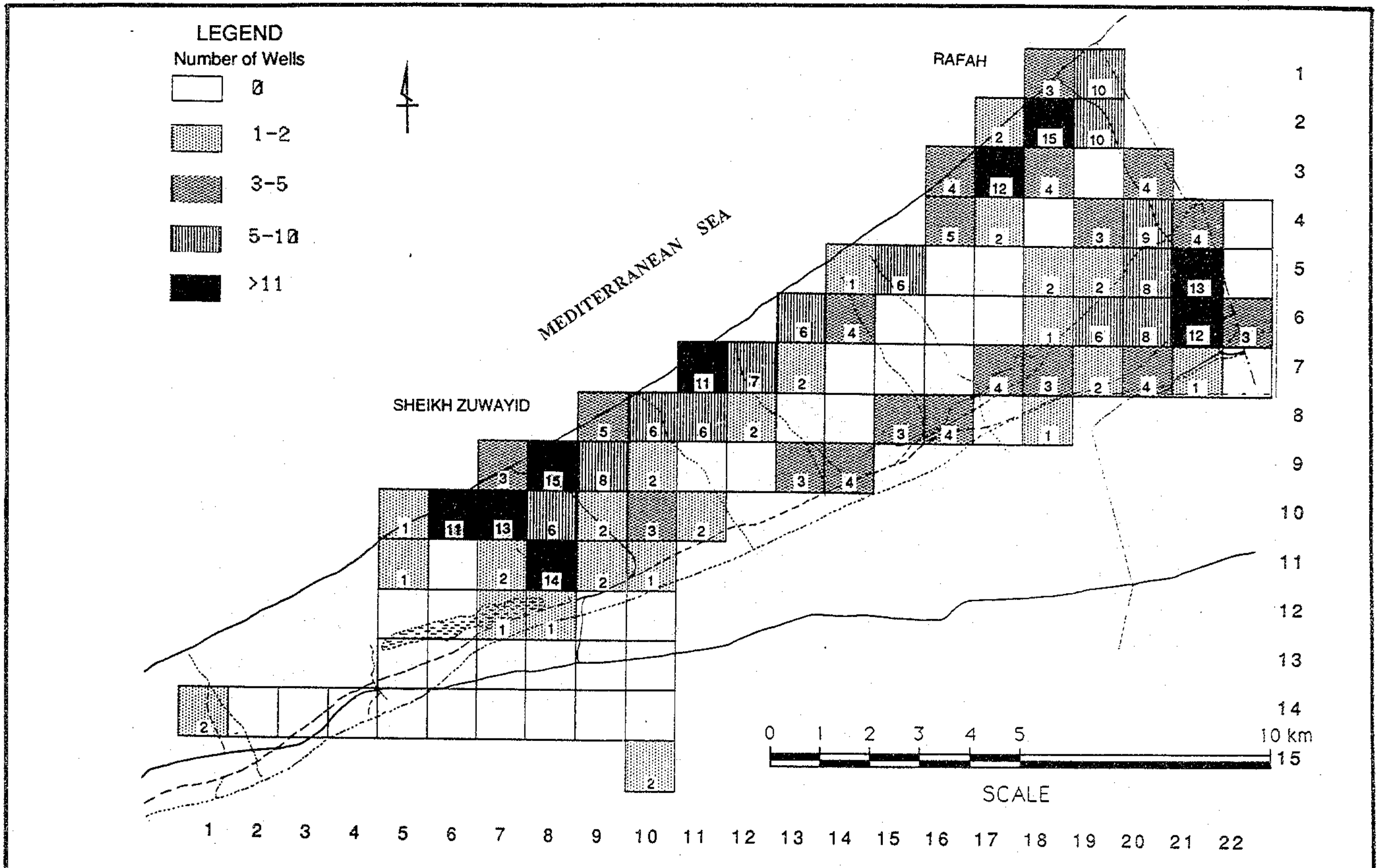


FIG. 8-3-4 WELL NUMBERS AT SHEIKH ZUWAYID - RAFAH AREA IN 1988

There were only two wells in grid No. 18-2 in the sand dune along the Mediterranean by the end of the 1960s. However, the well field extended over the sand dune from Sheikh Zuwayid to its eastern end in 1988. A very intensive extraction of groundwater was observed in the area around Sheikh Zuwayid and the eastern end of the sand dune.

In the area around Sheikh Zuwayid the density of wells is high at grids No. 6-10, No. 7-10, No. 8-9 and 11, and No. 11- 7, where there are more than ten wells within a single grid. In this fifteen square kilometer, well field there are 93 wells yielding 7,120 m^3/day (6.2 well/km^2, 77m^3/day/well and 475 m^3/day/km^2 on an average).

There is also intensive groundwater extraction from the coastal sand dune at the eastern end of the coast at grids Nos. 17-3, No. 18-2 and 19-1. There are 60 wells operating in this 10 km^2 well field. The total yield in this area is estimated at 3,000 m^3/day (6 well/km^2, 50 m^3/day/well and 300 m^3/day/km^2 on an average).

In the area between these two high intensive water use areas there are also many wells drilled on the sand dune. These total 43 wells in this 9 km^2, area that yield 3,170 m^3/day (5 well/km^2, 74 m^3/well and 352 m^3/day/km^2 on an average).

The total amount of groundwater used in the Sheikh Zuwayid and Rafah area during 1988 was estimated to be approximately 39,000 m^3/day. There were 364 wells in operation.

An average TDS value of all wells within each grid is plotted on the grid map and represent the salinity condition of each grid in a same manner made in Wadi El-Arish alluvial plain (Fig. 8-3-5).

As shown in Fig. 8-3-5, the potable and unharmful water for irrigating crops is available along the sand dunes (grids Nos. 7-10, 8-10, 9-9, 11-7, 14-5, 15-5, 16-4, 17-3 and 18-2) where the salinity of the

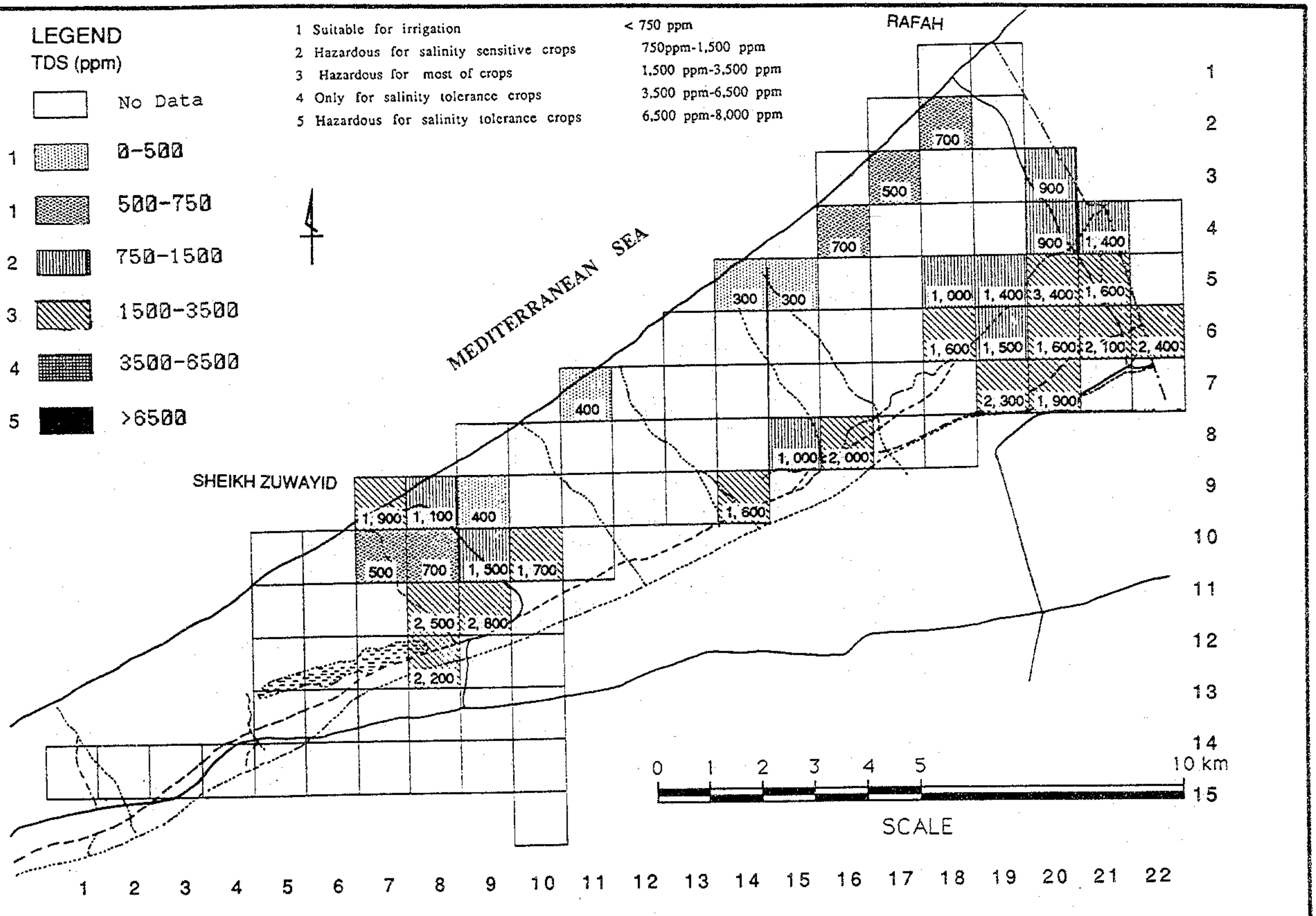


FIG. 8-3-5 TDS DISTRIBUTION AT SHEIKH ZUWAYID - RAFAH AREA IN 1988

ground water is less than 750 ppm. In the area around Sheikh Zuwayid there are some places where the salinity of the groundwater indicates a salinity hazard. Salinity sensitive crops would be damaged at grids No. 8-9 9-10 and most of crops at grids Nos. 7-9, 8-11 and 12, 9-11 and 10-10 would be seriously affected if the groundwater was used for irrigation.

In the triangular well field around Rafah there is no potable water having a salinity of less than 750 ppm. However, the groundwater in the northern half of the well field indicates that it is hazardous only when used for irrigating certain salinity sensitive crops. The salinity of the groundwater in the southern half of this well field is hazardous to most crops.

8-4 Consideration for Future Water Use

The high salinity of the groundwater in aquifers of the Quaternary is a prevailing problem in the study area. The water quality is characterized by high salinity caused by a high proportion of sodium content and a relatively higher concentration of magnesium than calcium (Section 4-3-2).

It seems unlikely that the high salinity of the groundwater is caused by sea water intrusion only (Section 4-2-6).

Although the current hydrometeorological conditions prevailing in the study area provide only a pessimistic outlook with respect to the recharge of the aquifers in the Quaternary. But the amount of groundwater being extracted is remarkably high (51,000 m^3/day in El-Arish and 39,000 m^3/day in Sheikh Zuwayid - Rafah).

Considering the size of the well fields in El-Arish and Sheikh Zuwayid - Rafah (approximately 53 km^2 and 62 km^2, respectively) the overall discharge is estimated to be 350 mm/year and 230 mm/year, respectively. Since the water level of most of the grids in both well fields is low due to the large discharge, the pumping rate obviously exceeds the recharge rate of these aquifers.

In order to estimate the recharge rate to the aquifers of the Quaternary the assumptions were made: The yield of the existing wells have been the same since 1980 and the recession of the water level was caused by over pumping over the past 8 years. Based on the assumptions, the pumping rate and the water level recession were found to be comparable at 16 grids in the well field of the Wadi El-Arish alluvial plain between the years 1980 and 1988 (Fig. 8-4-1). Grid No. 7-3 was blank; however, it was supplemented by the 1978 data (Fig. 8-4-1). As a matter of fact, the wells constructed during the 1980s in the well field of the Wadi El-Arish alluvial plain are distributed in an area further south (Fig. 8-4-1). Thus, an increase in the number of wells at these grids during that period is not significant.

Assuming the water balance in a single mesh, the following equations were formulated, where annual recharge rate of each grid is estimated as shown in Table 8-4-1;

$$8(Q_R - Q_Y) = h \times 10^6 \times 0.25$$

$$Q_R = (h \times 10^6 \times 0.25)/8 + Q_y \times 365$$

Where Q_R is annual recharge [$m^3/year/km^2$]
Q_Y is daily discharge [$m^3/day/km^2$],
Q_y is annual discharge [$m^3/year/km^2$],
h : is water level recession for 8 years,
and 0.25 is assumed effective porosity of aquifer.

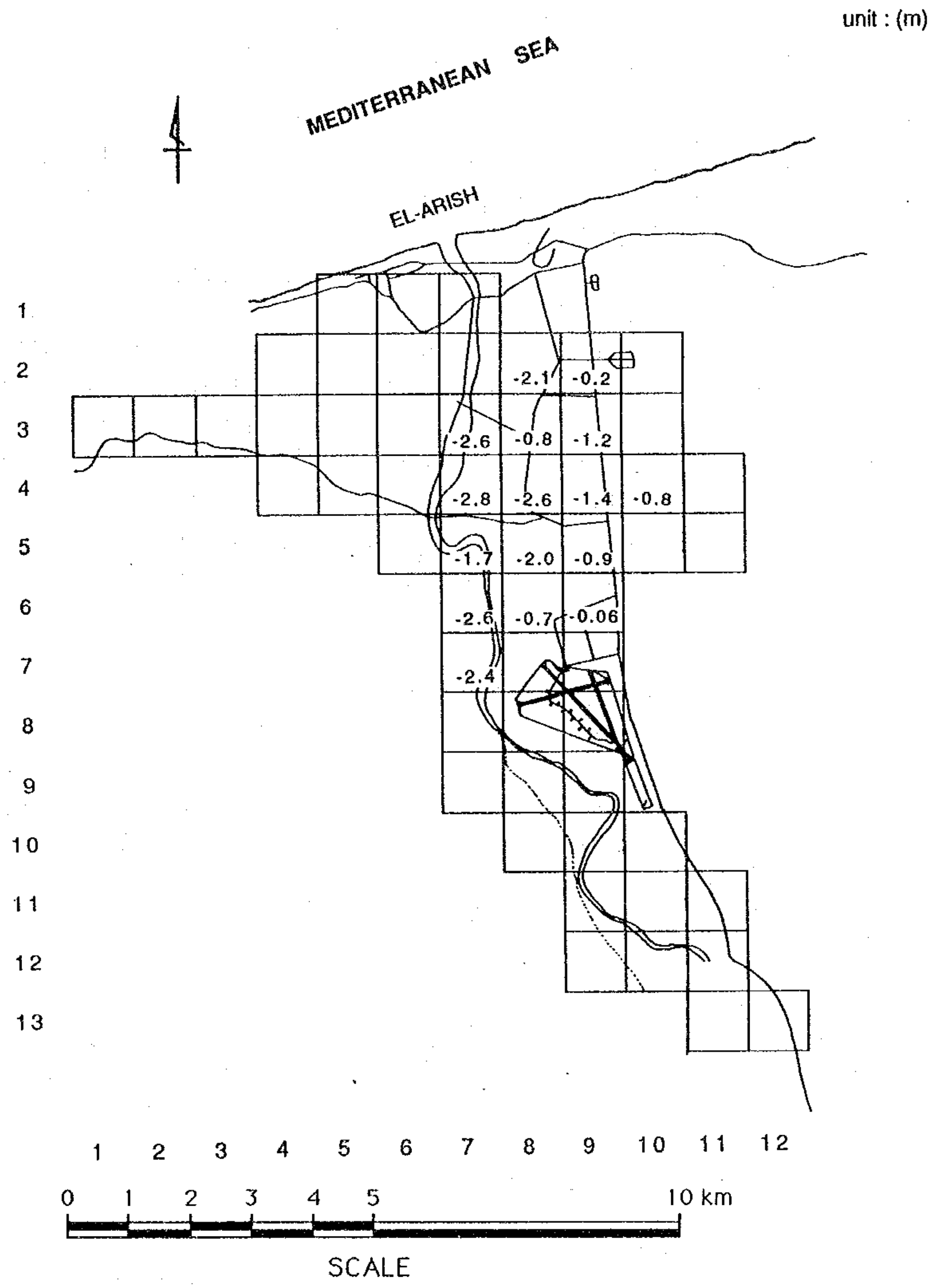


FIG. 8-4-1 CHANGE IN WATER LEVEL 1980 AND 1988 AT EL - ARISH AREA

Table 8-4-1 Annual Discharge

Grid No.	h (m)	Qy ($m^3/day/km^2$)	QY ($m^3/year/km^2$)	QR ($m^3/year/km$)	Re (mm/year)
7-3	-2.6	1,873	684,000	602,000	602
7-4	-2.8	1,334	487,000	400,000	399
7-5	-1.7	1,068	390,000	337,000	337
7-6	-2.6	1,002	366,000	294,000	294
7-7	-2.4	464	169,000	94,000	94
8-2	-2.1	2,575	941,000	876,000	876
8-3	-0.8	1,250	456,000	431,000	431
8-4	-2.6	2,206	805,000	724,000	724
8-5	-2.0	1,520	555,000	492,000	492
8-6	-0.7	798	291,000	269,000	269
9-2	-0.2	511	187,000	186,000	186
9-3	-1.2	2,490	909,000	871,000	871
9-4	-1.4	885	323,000	279,000	279
9-5	-0.9	1,274	465,000	437,000	437
9-6	-0.06	1,612	588,000	587,000	587
10-4	-0.8	565	206,000	181,000	181

Although the equation is static rather than kinetic and of rather crude estimation, it may present the general feature of the water balance of each meshed area. The estimated annual recharge rate varies from 94 mm/year to 876 mm/year within a small extent of the area. This may suggest that there is seepage of the groundwater from the old aquifers into the aquifer in the Quaternary depending on the spatial conditions of the hydrogeology and the pumping rate.

As shown in Table 4-2-12, there have been significant changes in water quality in many wells in this well field. At the same time, there are many wells where no remarkable change in the salinity was observed (Table 4-2-13).

These facts may suggest that there distributed patchy mosaics of fresh water lenses recharged recently in the environment of the old water bodies originated either from the kurkar aquifer or the up-coning or leakage from the Miocene aquifers. As over pumping goes on, the fresh water would be increasingly replenished by the water originated from the aquifers in the Miocene. The water originated from the aquifers of the Miocene may have different types of water quality than shown in Table 4-2-13. The salinity of the groundwater at the wells shown in the table remaine at the same level even under the heavy pumpage of the past 25 years, so it may suggest that the wells listed have been pumping the old water originated from Kurkar or the aquifer of either kurkar or the Miocene throughout this period.

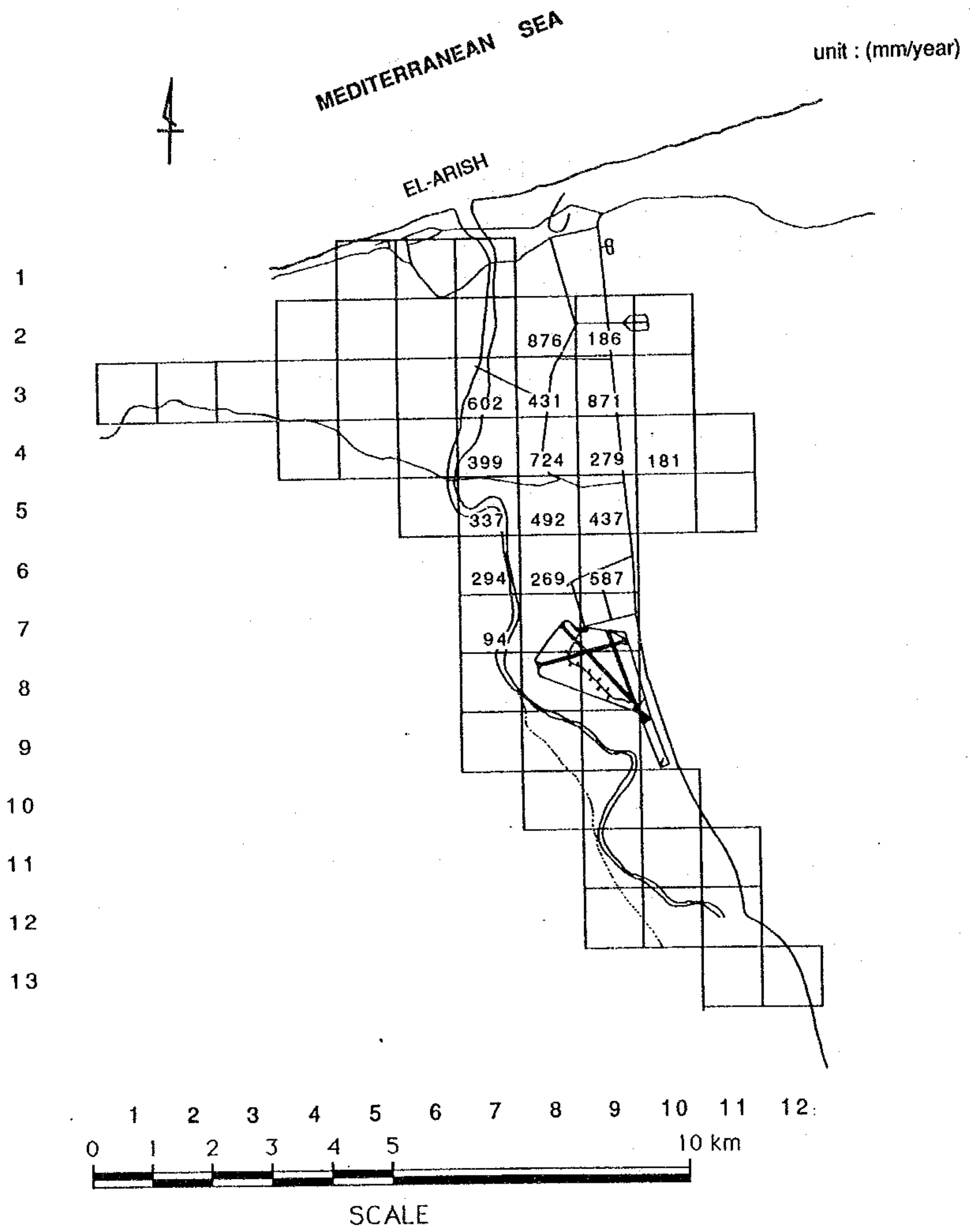


FIG. 8-4-2 ESTIMATED RECHARGE AT EL - ARISH AREA

Of course, locally occurring recharge under the current hydrometeorological conditions may influence the water quality to a certain extent since the age of the groundwater in the Quaternary aquifers varies from 1,000 to 8,000Y. BP (Chapter , Main Report).

By taking this influence of the environment into consideration, the water quality of each locality may become similar to the type caused by the supply from either kurkar aquifer or from an old aquifer. The quality of the water supplied from the old aquifer may differ from place to place since there must be different types of water qualities at different localities and lithofacies. The water supplied from either kurkar or from an old aquifer at grid No. 7-2 may have a salinity exceeding 4,000 ppm. The same situation was observed at grid No. 10-3. It is easily assumed that even moderate salinity of groundwater shown in Table 4-2-12 may reach the same level of the salinity as the water in the kurkar or in the related old aquifer in the Miocene sooner or later.

APPENDIX

Appendix - 1 QUATERNARY WELL LIST (1)

	Well No.	Well Name	Elevation	Drilling Depth		Water level		Water Quality		Top of Kurkar			Bottom of Quaternary		Other Quaternary		
			A.S.L(m)	B.G.L(m)	A.S.L(m)	B.G.L(m)	A.S.L(m)	TDS	※Aquifer	B.G.L(m)	A.S.L(m)	Thick.(m)	B.G.L(m)	A.S.L(m)	Thick. of gravel(m)	Thick. of sand (m)	Total(m)
1	J-1	JICA Test Well No.1	30.0	52.0	-22.0	-	-	-	-	-		-	43	-13.0	0	25	25
2	J-2	JICA Test Well No.2	30.0	100.0	-70.0	-	-	-	-	37	-7.0	11	48	-18.0	6	22	28
3	J-3	JICA Test Well No.3	55.0	80.0	-25.0	52.0	3.0	5562	K	55	0.0	14	75	-20.0	5	55	60
4	J-4	JICA Test Well No.4	139.0	100.0	39.0	-	-	-	-	-	-	-	35	104.0	20	9	29
5	J-5	JICA Test Well No.5	48.0	75.0	-27.0	39.9	8.1	4290	K+Gr	45	3.0	8	53	-5.0	12	26	38
6	J-6	JICA Test Well No.6	43.0	98.0	-55.0	38.1	4.9	4830	K	67	-24.0	27	94	-51.0	0	23	23
7	J-7	JICA Test Well No.7	50.0	120.0	-70.0	45.5	4.5	5560	K	78	-28.0	11	89	-39.0	0	38	38
8	J-8	JICA Test Well No.8	75.0	110.0	-35.0	69.8	5.2	2192	Ss	-	-	-	86	-11.0	0	82	82
9	J-9	JICA Test Well No.9	69.0	91.0	-22.0	68.3	0.7	3470	Gr	-	-	-	87	-18.0	0	36	36
10	J-10	JICA Test Well No.10	153.0	63.0	90.0	49.0	104.0	3622	K	43	110.0	13	56	97.0	2	36	38
11	J-11	JICA Test Well No.11	157.0	45.0	112.0	-	-	-	-	33	124.0	5	37	120.0	10	10	20
12	J-18	JICA Test Well No.18	45.0	65.0	-20.0	-	-	-	-	-	-	-	46	-1.0	15	26	41
13	1-63	GDDO No.9	20.2	60.0	-39.8	24.8	-4.6	1856	K	40	-19.8	>20	>60	↓-39.8	29	11	40
14	1-64	GDDO No.2	18.3	101.0	-82.7	17.6	0.7	2554	K	40	-21.7	>60	>100	↓-81.7	0	40	40
15	1-66	GDDO No.10	21.8	44.0	-22.2	23.3	-1.5	-	Gr	-	-	-	>44	↓-22.2	>30	14	44
16	1-75	GDDO No.4	18.8	56.0	-37.2	19.6	-0.8	-	Gr	-	-	-	>56	↓-37.2	>30	12	42
17	1-78	GDDO No.5	19.0	55.0	-36.0	19.8	-0.8	2238	K+Gr	42	-23.0	>13	>55	↓-36.0	30	12	42
18	1-83	GDDO No.22	14.7	60.0	-45.3	13.5	1.2	3460	K	25	-10.3	>35	>60	↓-45.3	8	17	25
19	1-84	GDDO No.8	20.3	55.0	-34.7	20.6	-0.3	2687	K	40	-19.7	>15	>55	↓-34.7	26	14	40
20	1-88	GDDO No.1	19.1	100.0	-80.9	18.4	0.7	2579	Sl	65	-45.9	>35	>100	↓-80.9	0	65	65
21	1-93	GDDO No.24	20.0	49.0	-29.0	19.4	0.6	3563	Gr	-	-	-	>49	↓-29.0	>15	34	49
22	1-100	GDDO No.7	26.3	48.0	-21.8	26.3	-0.1	2442	K	45	-18.8	>3	>48	↓-21.8	32	13	45
23	1-102	Test Well No.18	18.8	78.0	-59.2	19.0	-0.2	-	K	46	-27.2	30	77	-58.2	4	43	47
24	1-104	GDDO No.23	17.3	60.0	-42.7	16.1	1.2	3172	K	26	-8.7	>34	>60	↓-42.7	18	8	26
25	1-105	GDDO No.21	17.0	60.0	-43.0	16.1	0.9	-	K+Gr	44	-27.0	>16	>60	↓-43.0	4	26	30
26	1-106	GDDO No.26	17.7	55.0	-37.3	17.0	0.7	-	K	37	-19.3	>18	>55	↓-37.3	18	19	37
27	1-107	GDDO No.28	28.2	60.0	-31.8	26.9	1.3	3107	K+Gr	48	-19.8	>12	>60	↓-31.8	33	15	48
28	1-109	GDDO No.18	22.9	54.0	-31.1	20.1	2.8	3977	Gr	-	-	-	>54	↓-31.1	>35	19	54
29	1-110	GDDO No.31	20.8		20.8	19.7	1.1	3520	K	-	-	-	>60	↓-39.2	7	36	43
30	1-113	GDDO No.32	19.2	75.0	-55.8	18.3	0.9	-	K	27	-7.8	35	61	-83.6	0	26	26
31	1-115	GDDO No.11	28.6	60.0	-31.4	?	?	3679	K	45	-16.4	>15	>60	↓-31.4	27	18	45
32	1-119	GDDO No.17	23.4	60.0	-36.6	21.8	1.6	-	K	37	-13.6	>23	>60	↓-36.6	19	18	37
33	1-120	GDDO No.36	24.5	100.0	-75.5	23.5	1.0	3803	?	45	-20.5	5	51	-26.5	24	22	46
34	1-123	GDDO No.20	19.5	60.0	-40.5	18.0	1.5	2887	K	42	-22.5	>18	>60	↓-40.5	10	32	42
35	1-125	GDDO No.12	29.2	63.0	-33.8	37.6	-8.4	-	Sl	-	-	-	>63	↓-33.8	13	48	61
36	1-127	GDDO No.13	28.0	55.0	-27.0	25.9	2.1	4916	Gr	-	-	-	>55	↓-27.0	>46	9	55
37	1-128	GDDO No.25	20.6	35.0	-14.4	20.1	0.5	2752	K	31	-10.4	>25	>54	↓-33.4	13	16	29
38	1-129	GDDO No.29	22.9	52.0	-29.1	-	-	3809	Gr	-	-	-	>52	↓-29.1	>39	13	52
39	1-130	GDDO No.33	19.0	46.0	-27.0	?	19.0	3415	Gr	-	-	-	>46	↓-27.0	>40	6	46
40	1-131	GDDO No.6	30.0	66.0	-36.0	28.4	1.6	2691	K+Gr	39	-9.0	>27	>66	↓-36.0	27	12	39
41	1-134	GDDO No.30	19.0	73.0	-54.0	17.5	1.5	-	K+Gr	26	-7.0	>39	>73	↓-54.0	17	26	43
42	1-135	GDDO No.15	25.6	65.0	-39.4	23.9	1.7	2936	K+Gr	57	-31.4	>18	>65	↓-39.4	44	3	47
43	1-136	GDDO No.14	27.9	60.0	-32.1	25.7	2.2	5091	Gr	-	-	-	>60	↓-32.1	>43	17	60
44	1-137	GDDO No.16	24.4	65.0	-40.6	22.9	1.5	2773	K+Gr	53	-28.6	>12	>65	↓-40.6	42	11	53
45	1-138	GDDO No.34	20.3	95.0	-74.7	19.0	1.3	2860	Gr	49	-28.7	>40	91	-70.7	32	19	51
46	1-141	GDDO No.27	23.8	66.0	-41.2	22.4	1.4	1757	K+Gr	51	-27.2	>14	>65	↓-41.2	41	10	51
47	2-6	West Airport Pz	33.8	88.0	-54.2	33.1	0.7	-	Gr	-	-	-	60	26.2	30	30	60
48	2-17	(87-C)Lehfen	38.0	72.0	-34.0	?	38.0	-	S	-	-	-	49	-11.0	11	38	49
49	2-19	(87-E)Lehfen	40.0	57.0	-17.0	39.6	0.4	-	Gr	-	-	-	48	-8.0	18	23	41
50	2-21	(87-F)Lehfen	40.0	60.0	-20.0	39.6	0.4	-	S	-	-	-	48	-8.0	12	26	38
51	2-24	(87-B)Lehfen	41.0	68.0	-27.0	39.4	1.6	-	S	-	-	-	49	-8.0	16	33	49
52	2-25	(87-A)Lehfen	41.0	70.0	-29.0	39.6	1.4	-	Gr	-	-	-	57	-16.0	36	21	57
53	2-26	Borehole D "B"	41.3	75.0	-33.7	39.8	1.5	-	Ss+Ls	-	-	-	45	-3.7	36	9	45
54	5-1	Borehole H "A"	41.7	105.0	-63.3	41.0	0.7	1980	Gr	-	-	-	41	0.7	31	10	41
55	5-3	South Airport Pz	39.7	166.0	-126.3	41.4	-1.7	-	Ss+Ls	-	-	-	46	-6.3	17.5	21.5	39
56	5-5	Lehfen No.2 Pz	45.6	300.0	-254.4	43.9	1.7	-	Gr+Ss	-	-	-	48	-2.4	18.5	26	44.5
57	11-15	Sheikh Zuwayid No.8	23.9	50.0	-26.1	22.7	1.2	-	S	44	-20.1	>6	>50	↓-26.1	0	44	44
58	11-18	Sheikh Zuwayid No.9	24.5	48.0	-23.5	23.6	0.9	-	Ss	-	-	-	44	-19.5	0	44	44
59	11-20	Sheikh Zuwayid No.10	22.0	48.0	-26.0	?	22.0	-	S	46	-24.0	>2	>48	↓-26.0	0	30	30
60	11-23	Sheikh Zuwayid No.11	20.3	46.0	-25.7	19.2	1.1	-	Ss	-	-	-	>46	↓-25.7	0	41	41
61	11-26	Sheikh Zuwayid No.12	16.4	42.0	-25.6	15.4	1.0	-	Gr+Ss	38	-21.6	>4	51	-34.6	14	28	42
62	12-73	Sheikh Zuwayid No.1	20.0	36.0	-16.0	?	20.0	-	S	31	-11.0	>5	>36	↓-16.0	0	21	21
63	12-77	Sheikh Zuwayid No.2	9.2	62.0	-52.8	8.3	0.9	-	Ss	32	-22.8	>8	44	-34.8	0	34	34
64	12-90	South Sheikh Zuwayid Pz	46.0	124.0	-78.0	23.1	22.9	-	Ss	-	-	-	108	-62.0	3	103	106
65	12-91	Sheikh Zuwayid No.3	8.5	112.0	-103.5	7.6	0.9	-	Ss	35	-26.5	>11	46	-37.5	0	75	75

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K :Kurkar Gr:Gravel S:Sand
Ss:Sandstone Ls:Limestone

Appendix - 1 QUATERNARY WELL LIST (2)

	Well No.	Well Name	Elevation	Drilling Depth		Water level		Water Quality		Top of Kurkar			Bottom of Quaternary		Other Quaternary		
			A.S.L(m)	B.G.L(m)	A.S.L(m)	B.G.L(m)	A.S.L(m)	TDS	※Aquifer	B.G.L(m)	A.S.L(m)	Thick.(m)	B.G.L(m)	A.S.L(m)	Thick. of gravel(m)	Thick. of sand (m)	Total(m)
66	12-93	Sheikh Zuwayid Pz	18.0	74.0	-56.0	14.1	3.9	-	K	45	-27.0	>29	>74	↓-56.0	0	45	45
67	12-97	Sheikh Zuwayid No.14	17.8	42.0	-24.2	17.3	0.5	-	S	40	-22.2	>2	>42	↓-24.2	0	40	40
68	12-99	Sheikh Zuwayid No.5	22.9	42.0	-19.1	20.9	2.0	-	S	40	-17.1	>2	>42	↓-19.1	12	18	30
69	12-103	Sheikh Zuwayid No.6	29.2	46.0	-16.8	22.2	7.0	-	S	44	-14.8	>2	>46	↓-16.8	0	44	44
70	12-105	Sheikh Zuwayid	7.5	50.0	-42.5	?	7.5	-	S	42	-34.5	>8	>50	↓-42.5	0	39	39
71	16-2	Sheikh Zuwayid No.15	28.0	42.0	-14.0	?	28.0	-	Ss	-	-	-	>42	↓-14.0	0	42	42
72	16-4	Rafah CLI No.14	20.0	70.0	-50.0	27.2	-7.2	-	S	50	-30.0	>20	>70	↓-50.0	0	50	50
73	16-5	Rafah CLI No.13	25.0	42.0	-17.0	18.4	6.6	-	S	38	-13.0	>4	>42	↓-17.0	4	30	34
74	16-8	Rafah CLI No.1	20.0	46.0	-26.0	20.3	-0.3	-	S	44	-24.0	>2	>46	↓-26.0	0	36	36
75	16-10	Rafah CLI No.2	23.9	46.0	-22.1	?	23.9	-	Gr	-	-	-	>46	↓-22.1	8	38	46
76	16-11	Rafah CLI No.3	27.3	52.0	-24.7	?	27.3	-	S	50	-22.7	>2	>52	↓-24.7	6	44	50
77	16-12	Rafah CLI No.4	22.2	48.0	-25.8	?	22.2	-	S	44	-21.8	>4	>48	↓-25.8	26	11	37
78	16-20	Rafah CLI No.5	26.7	52.0	-25.3	25.3	1.4	-	Ss	48	-21.3	>4	>52	↓-25.3	20	20	40
79	16-24	Rafah CLI No.6	26.3	48.0	-21.7	25.1	1.2	-	S	46	-19.7	>2	>48	↓-21.7	0	42	42
80	16-34	Rafah CLI No.7	26.0	54.0	-28.0	30.5	-4.5	-	S	52	-26.0	>2	>54	↓-28.0	17	22	39
81	16-47	Rafah CLI No.8	35.9	92.0	-56.1	?	35.9	-	K+Ss	54	-18.1	20	80	-44.1	0	60	60
82	16-52	Rafah CLI No.9	30.0	62.0	-32.0	29.0	1.0	-	Gr	54	-24.0	6	>62	↓-32.0	6	44	50
83	16-73	Rafah CLI No.10	34.9	54.0	-19.1	34.4	0.5	-	Ss	50	-15.1	4	>54	↓-19.1	0	50	50
84	16-83	El-Meliety	12.5	42.0	-29.5	?	12.5	-	Ss	36	-23.5	>6	>42	↓-29.5	4	26	30
85	16-86	Rafah CLI No.11	18.5	42.0	-23.5	?	18.5	-	S	40	-21.5	>2	>42	↓-23.5	0	34	34
86	16-105	Rafah Pz	32.7	116.0	-83.3	?	32.7	-	S	-	-	-	95	-62.3	0	95	95
87	SR-1	Sheikh Zuwayid Site 1	5.2	24.0	-18.8	5.6	-0.4	-	Gr	32	-26.8	11	>24	↓-18.8	0	10	10
88	SR-4	Sheikh Zuwayid Site 4	7.5	30.0	-22.5	6.3	1.2	-	S	-	-	-	>30	↓-22.5	0	19	19
89	SR-5	Sheikh Zuwayid Site 5	31.7	96.0	-64.3	31.0	0.7	-	S	51	-19.3	15	66	-34.3	0	27	27
90	SR-6	Sheikh Zuwayid Site 6	15.6	62.0	-46.4	12.2	3.4	-	S	40	-24.4	16	60	-44.4	0	29	29
91	SR-7	Sheikh Zuwayid Site 7	20.1	94.0	-73.9	18.7	1.4	-	Ss	58	-37.9	10	68	-47.9	2	57	59
92	SR-8	Sheikh Zuwayid Site 8	20.0	64.0	-44.0	18.0	2.0	-	S	32	-12.0	14	52	-32.0	0	26	26
93	SR-9	Sheikh Zuwayid Site 9	21.4	100.0	-78.6	19.6	1.8	-	Ss	51	-29.6	25	76	-54.6	0	53	53
94	SR-10	Sheikh Zuwayid Site 10	29.7	103.0	-73.3	28.1	1.6	-	S	62	-32.3	10	82	-52.3	0	46	46
95	SR-11	Sheikh Zuwayid Site 11	45.8	106.0	-60.2	44.6	1.2	-	K	79	-33.2	10	89	-43.2	0	46	46
96	SR-12	Sheikh Zuwayid Site 12	64.0	101.0	-37.0	62.5	1.5	-	K	66	-2.0	5	71	-7.0	0	42	42
97	AR-1	El-Arish Site 1	5.1	47.0	-41.9	4.0	1.1	-	Gr+K	40	-34.9	>7	>47	↓-41.9	10	14	24
98	AR-2	El-Arish Site 2	5.2	65.0	-59.8	4.0	1.2	-	Gr+K	41	-35.8	6	62	-56.8	4	37	41
99	AR-3	El-Arish Site 3	15.2	99.6	-84.4	14.0	1.2	-	Gr+S	44	-28.8	17	61	-45.8	9	32	41
100	AR-5	El-Arish Site 5	21.27	70	-48.7	20.77	0.5	-	K	52	-30.7	18	>70	↓-48.8	8	19	27
101	AR-6	El-Arish Site 6	10.7	76.0	-65.3	10.1	0.6	-	S+Ss	47	-36.3	>3	65	-54.3	5	49	54
102	AR-7	El-Arish Site 7	19.8	88.0	-68.2	22.1	-2.3	-	Gr	56	-36.2	5	64	-44.2	13	29	42
103	AR-8	El-Arish Site 8	17.0	102.0	-85.0	18.3	-1.3	-	S+Ss	-	-	-	93	-76.0	4	65	69
104	AR-9	El-Arish Site 9	23.1	104.0	-80.9	24.2	-1.1	-	K	50	-26.9	12	65	-41.9	14	24	38
105	AR-10	El-Arish Site 10	51.2	90.0	-38.8	-	-	-	S	-	-	-	79	-27.8	1.5	64.5	66
106	AR-11	El-Arish Site 11	55.9	84.0	-28.1	56.7	-0.8	-	K	63	-7.1	9	72	-16.1	0	44.5	44.5
107	AR-12	El-Arish Site 12	52.4	106.0	-53.6	52.8	-0.4	-	S	64	-11.6	6	70	-17.6	0	64	64
108	AR-13	El-Arish Site 13	28.3	72.0	-43.7	30.0	-1.7	-	Gr	-	-	-	60	-31.7	16	34	50
109	AR-14	El-Arish Site 14	39.7	144.0	-104.3	28.7	11.0	-	K	-	-	-	84	-44.3	24	47	71
110	A	GDDO Test Well (A)	40.0	95.0	-55.0	?	?	-	-	50	-10.0	42	92	-52.0	32	18	50
111	B	GDDO Test Well (B)	29.1	98.0	-68.9	?	?	-	-	-	-	-	6	23.1	0	6	6
112	D	GDDO Test Well (D)	47.7	77.0	-29.3	?	?	-	-	41	6.7	3	44	3.7	36	5	41
113	E	GDDO Test Well (E)	19.5	100.0	-80.5	?	?	-	-	60	-40.5	31	92	-72.5	2	59	61
114	F	GDDO Test Well (F)	69.8	100.0	-30.2	?	?	-	-	12	57.8	41	90	-20.2	3	46	49
115	G	GDDO Test Well (G)	32.5	105.0	-72.5	?	?	-	-	46	-13.5	5	51	-18.5	24	22	46
116	H	GDDO Test Well (H)	32.5	107.0	-74.5	?	?	-	-	-	-	-	42	-9.5	32	10	42
117	O-1	Sultan-1	38.0	130.0	-92.0	?	?	-	-	52	-14.0	37	94	-56.0	0	57	57
118	O-2	Misri	96.8	258.5	-161.7	?	?	8990	-	-	-	-			0	0	0
119	O-3	Khabrai	160.0	3164.0	-3004.0	?	?	-	-	-	-	-	96	64.0	0	96	96
120	O-4	El-Barth	170.0	200.0	-30.0	?	?	-	-	0	140.0	23	23	147.0	0	0	0
121	O-5	El-Sirai	100.0	350.0	-250.0	?	?	-	-	-	-	-	48	52.0	8	40	48
122	O-6	El-Masura	71.0	115.0	-44.0	?	?	-	-	-	-	-	92	-21.0	0	92	92
123	O-7	El-Khabra	90.0	340.0	-250.0	?	?	-	-	-	-	-	100	-10.0	10	90	100
124	O-8	El-Goura	85.3	480.0	-394.7	?	?	-	-	0	85.3	31	30	55.3	0	-6	-6

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K :Kurkar Gr:Gravel S:Sand
Ss:Sandstone Ls:Limestone

Appendix - 2 QUATERNARY WELL LIST (1)

	Well name	Grid	Elevation (m)	Lat.	Long.	Drilling Depth		Water Level		Water Quality		Top of Tertiary			Top of U.C			Top of L.C			Top of Pre C.	
						B.G.L(m)	A.S.L(m)	B.G.L(m)	A.S.L(m)	TDS	Aguifer	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)
1	Darag No.1	G5d	446	29°51'26"	33°46'26"	844	-398	183	263	1,490	L.C		-----	-----		-----	-----	810	-364	34		-----
2	Nakhl1	G5c	450	29°55'45"	33°42'41"	1,696	-1,246	181	269	1,635	L.C		-----	-----	59	391	812	871	-421	247	1,118	-668
3	Nakhl2	G5d	470	29°54'30"	33°45'40"	1,083	-683	210	260	1,200	L.C	25	445	76	101	369	769	870	-400	213		-----
4	Bir Guraid	G6c	505	29°48'29"	34°11'26"	340	165		-----				-----	-----	127	378	213		-----	-----		-----
5	El Themed	G6b	630	29°40'11"	34°18'34"	760	-130		-----	3,500	L.C~Cen.		-----	-----	24	606	530	554	76	206		-----
6	Sheira Well 1	H3c	760	29°57'52"	34°34'21"	804	-44	340	420	1,575	L.C		-----	-----	20	740	544	564	196	246	810	-50
7	Sheira Well 2	H3c	760	29°57'52"	34°34'21"	300	430	81	679	1,100	U.C(Tur)		-----	-----			-----		-----	-----		
8	Naqb 2	H4a	700	29°38'34"	34°41'45"	160	540		-----	Dry			-----	-----		-----	-----	18	682	102	120	580
9	Naqb 3	H4a	690	29°39'38"	34°39'35"	608	82	400	290	35,000~40,000	U.C(Tur)		-----	-----	114	576	494		-----	-----		-----
10	Bir El Abd	J6b	20	30°57'30"	34°21'30"	306	-286		-----			62	-42	244		-----	-----		-----	-----		-----
11	Quitia Well No.1	J6d	25	30°55'	32°45'	350	-325	20	5	12,000~15,000	Q. 25m/H.	247	-222	103		-----	-----		-----	-----		-----
12	South Shohat	J6c	25	30°51'37"	32°37'35"	345	-320		-----			240	-215	105		-----	-----		-----	-----		-----
13	P1 Gifgafa	K1c	298	33°13'26"	30°26'	850	-552	219	79	3,500	U.C(Cen)		-----	-----	20	278	830		-----	-----		-----
14	Abu Ghazala	K1c	320	30°25'	33°07'	1,322	-1,002	219	101		L.C		-----	-----		-----	-----	1,225	-905	97		-----
15	No. 68 El Hagaib	K1c	312	30°24'58"	33°10'32"	186	126		-----				-----	-----	33	279	153		-----	-----		-----
16	No. 69 Wadi Umm Zroub	K1c	339	30°22'30"	33°10'35"	160	179		-----				-----	-----	19	320	141		-----	-----		-----
17	No. 70 Wadi El Maleiz-1	K1d	395	30°16'05"	33°18'34"	293	102	97	298	8,480	U.C(Sen)		-----	-----	0	395	293		-----	-----		-----
18	No. 71 Wadi El Baha-1	K1a	450	30°13'	33°13'	276	174		-----				-----	-----	6	444	270		-----	-----		-----
19	Sadr El Heitan	K1a	475	30°01'04"	33°13'18"	1,025	-550	270	205	1,246	L.C		-----	-----	0	475	790	790	-315	202	992	-517
20	Bir Hasana	K2d	260	30°28'	33°47'	875	-615	118	142	1,500	U.C(Cen)		-----	-----		-----	-----		-----	-----		-----
21	El Monshareh No.1	K2c	290	30°17'40"	33°44'45"	300	-10		-----			6	284	294		-----	-----		-----	-----		-----
22	El Resha No.1	K2c	358	30°17'35"	33°37'48"	150	208		-----				-----	-----	6	352	144		-----	-----		-----
23	No. 49 El Arish Well No.14	K2c	247	30°29'	33°44'	210	37	140	107	2,200	U.C(Sen)		-----	-----	0	247	210		-----	-----		-----
24	No. 50 El Arish Well No.15	K2d	229	30°27'15"	33°51'35"	295	-66	190	39	7,000	U.C(Tur)		-----	-----	0	229	295		-----	-----		-----
25	No. 57A El Arish Well No.19	K2c	331	30°19'14"	33°40'25"	502	-171	162	169	2,740	U.C(Cen)		-----	-----	0	331	502		-----	-----		-----
26	No. 61 El Bruk No.1	K2a	304	30°14'12"	33° 16' 42	300	4		-----			6	298	38	44	260	256		-----	-----		-----
27	No. 62 El Bruk No.2	K2a	315	30°16'20"	33°43'36"	306	9		-----				-----	-----	77	238	229		-----	-----		-----
28	No. 65 El Menshera2	K2a	342	30°17'40"	33°44'45"	300	42		-----				-----	-----	0	342	300		-----	-----		-----
29	No. 66 Umm Gholam No.1	K2c	309	30°21'30"	33°41'15"	300	9		-----				-----	-----	6	303	294		-----	-----		-----
30	No. p18 Egyptian Army Hasana	K2c	345	30°18'07"	33°39'	1,060	-715	185	160	1,500	L.C		-----	-----		-----	-----	860	-515	200		-----
31	P4 El Hasana	K2d	235	30°28'	33°47'	1,038	-803	172	63	4,120	U.C(Cen)		-----	-----		-----	-----		-----	-----		-----
32	Talet El Badan	K3c	240	30°26 '31'	34°01 '14	651	-411	168	72	5,360	L.C		-----	-----		-----	-----	316	-76	335		-----
33	No. 46 El Arish Well -11	K4b	270	30°41'17"	33°16'55"	251	19	60	210	3,600	J(Mas)		-----	-----		-----	-----		-----	-----	37	233
34	No. 47B El Arish Well -12	K4b	255	30°43'25"	33°18'58"	200	55	104	151	1,650	J(Mas)		-----	-----		-----	-----		-----	-----	106	149
35	No. 51B El Arish Well-16	K4b	320	30°41'15"	33°29'59"	200	120		-----		J(Mas)		-----	-----		-----	-----	4	316	141	145	175
36	No. 52A El Arish Well -17A	K4b	270	30°45'30"	33°26'30"	249	21	123	147	3,450	J(Mas)		-----	-----		-----	-----		-----	-----	47	223
37	No. 53A El Arish Well -18	K4d	260	30°45'35"	33°28'18"	158	102	28	232	3,810	J(Mas)		-----	-----		-----	-----		-----	-----	43	217
38	No. 54A El Fath Well -4	K4b	280	30°45'15"	33°26'25"	249	31	113	167		J(Mas)		-----	-----		-----	-----		-----	-----	33	247
39	No. 55 El Massajid Well No.4	K4b	277	30°41'35"	33°23'29"	300	-23	115	162	2,800	J(Mas)		-----	-----		-----	-----		-----	-----	6	271
40	No.5 Coal Mine	K4b	334	30°40'45"	33°19'41"	215	119	29	305	4,140	J(Saf)		-----	-----		-----	-----		-----	-----	0	334
41	No.6 Coal Mine	K4b	330	30°40'38"	33°19'22"	217	113	29	301	7,300	J(Saf)		-----	-----		-----	-----		-----	-----	0	330
42	No.8 Coal Mine	K4b	329	30°40'38"	33°18'49"	331	-2		-----	7,455	J(Saf)		-----	-----		-----	-----		-----	-----	0	329
43	No.WX2 Coal Mine	K4b	277	30°44'08"	33°23'05"	200	77	120	157	2,700	J(Mas)		-----	-----		-----	-----		-----	-----	25	252
44	Baghdad No.1	K5a	135	30°39 '55'	33°41'26"	993	-858		-----			0	-----	92	92	43	901		-----	-----		-----
45	El Hemma	K5a	220	30°36'58"	33 °32'10	120	100		-----				-----	-----		-----	-----		-----	-----		-----
46	No. 41 El Arish Well No.6	K5c	166	30°47'15"	33°34'28"	153	13		-----			25	141	128		-----	-----		-----	-----		-----
47	No. 42 El Arish Well No.7	K5d	104	30°49'	33°51'10"	100	4		-----			3	101	97		-----	-----		-----	-----		-----
48	No. 43 El Arish Well No.8	K5c	100	30°45'30"	33°44'30"	128	-28		-----			0	-----	128		-----	-----		-----	-----		-----
49	No. 45A El Arish Well No.10	K5a	210	30°37'20"	33°31'45"	290	-80	22	188	5,200	T(Mio)	2	208	288		-----	-----		-----	-----		-----
50	No. 48 El Arish Well No.13	K5b	195	30°39'	33°45'	98	97		-----			0	-----	98		-----	-----		-----	-----		-----
51	No. 60 Gebel Halal Well No.1	K5d	148	30°46'14"	33°57'20"	300	-152		-----				-----	-----	0	148	300		-----	-----		-----
52	No. 63A Gebel Libni No.1	K5d	190	30°45 '32	33°48' 34'	300	-110	132	58	4,500	U.C(Sen.)	0	-----	60	60	130	240		-----	-----		-----
53	No. 63C Libni Well No.3	K5b	190	30°43'46"	33°48'14"	231	-41	132	58	4,500	U.C(Sen.)		-----	-----		-----	-----		-----	-----		-----
54	No. 64 Libni No.4	K5d	130	30°43'	33°49'	282	-152		-----			6	124	84	90	40	192		-----	-----		-----

QUATERNARY WELL LIST (2)

	Well name	Grid	Elevation (m)	Lat.	Long.	Drilling Depth		Water Level		Water Quality		Top of Tertiary			Top of U.C			Top of L.C			Top of Pre C.	
						B.G.L(m)	A.S.L(m)	B.G.L(m)	A.S.L(m)	TDS	Aguifer	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)
55	El Girai	K6c	85	30°57'30"	34°21'30"	350	-265		-----			48	37	302		-----	-----		-----	-----		-----
56	Misri 1	K6c	97	30°57'38"	34°02'45"	259	-162	27	70	10,450	T(Mio)	16	81	243		-----	-----		-----	-----		-----
57	No. 58 El Rawafal	K6c	100	30°49'55"	34°08'11"	300	-200		-----				-----	-----		-----	-----		-----	-----		-----
58	No. 76A Wadi El Amro No.2	K6d	200	30°52'29"	34°21'50"	226	-26	203	-3			6	194	79	85	115	141		-----	-----		-----
59	No. 76B Wadi El Amro No.1	K6d	200	30°52'29"	34°21'50"	62	138		-----			6	194	56		-----	-----		-----	-----		-----
60	P16 El Amro	K6d	210	30°52'50"	34°22'15"	980	-770	35	175	4,000	U.C(Cen)	0	-----	52	52	158	928		-----	-----		-----
61	Abu Raty	K6a	205	30°32'33"	34°22'15"	268	-63		-----				-----	-----	0	205	268		-----	-----		-----
62	El Halal Israeli Well	K6a	185	30°41'15"	34°07'43"	900	-715	161	24	1,410	LC.		-----	-----		-----	-----		-----	-----		-----
63	El Monbateh Well2	K6a	200	34°11'	30°40'	1,004	-804	124	76	3,200	U.C(Cen)		-----	-----	0	200	604	604	-404	400		-----
64	No. 78 Wadi El Husseiny	K6a	205	30°44'54"	34°14'04"	257	-52		-----				-----	-----	8	197	249		-----	-----		-----
65	No. 79 El Merterah	K6a	185	30°39'	34°09'	290	-105		-----				-----	-----	6	179	284		-----	-----		-----
66	No. 82 El Gorour	K6a	220	30°35'	34°14'37"	234	-14		-----				-----	-----		-----	-----		-----	-----		-----
67	Ain Gudeirat	K6b		30°38'23"	34°25'40"					1,440	T(Eoc)											
68	No. 80A El Quseima	K6b	310	30°29'20"	34°21'23"	293	17		-----				-----	-----		-----	-----		-----	-----		-----
69	No. 81 El Gouderate	K6b	350	30°38'31"	34°24'06"	148	202		-----				-----	-----		-----	-----		-----	-----		-----
70	No. 83 El Mewaleh Well -1	K6b	280	30°41'17"	34°21'45"	170	110	23	257		T(Eoc.)	3	277	146	149	131	21		-----	-----		-----
71	No. 84 El Ghifi	K6b	215	30°36'28"	34°15'19"	210	5		-----				-----	-----	16	199	194		-----	-----		-----
72	El Magdaba	K6c	90	30°53'34"	34°02'28"	978	-898		-----	2,500			-----	-----		-----	-----		-----	-----		-----
73	Umm Shihan	K6c	140	30°49'33"	34°10'31"	1,003	-863	115	25				-----	-----		-----	-----	800	-660	203		-----
74	El Barth (B)	K6d	170	31°58'	34°20'	196	-26		-----	3,720	LC(L.S)	24	146	172		-----	-----		-----	-----		-----
75	El Khabra	K6d	160	30°55'18"	34°15'14"	340	-180	160	0			100	60	240		-----	-----		-----	-----		-----
76	Kuntilla	H4c	580	29°46'10"	34°39'35"	645	-65		-----				-----	-----	56	524	441	497	83	148		-----
77	El Goura Well No.1	O2a	90	31°07'03"	34°09'17"	482	-392		-----			60	30	422		-----	-----		-----	-----		-----
78	No. 5-5 Lehfin Well No.2	O2b	45	31°01'53"	33°51'15"	300	-255		-----			50	-5	250		-----	-----		-----	-----		-----
79	Abu Hamth	G5c	423	29°57'57"	33°38'47"	2,174	-1,751		-----			0	-----	4	4	419	765	769	-346	1,405		-----
80	Manna-1	J6d	20	31°00'17"	32°57'47"		-----		-----			277	-257	-277		-----	-----	2,225	-2,205	-2,225		-----
81	Sheh-1	J6c	34	30°54'	32°37'30"	2,990	-2,956		-----			370	-336	2,620		-----	-----	1,950	-1,916	1,040		-----
82	Katib	J6b	256	30°30'45"	32°51'20"	1,000	-744		-----				-----	-----		-----	-----	80	176	30	110	146
83	Khabra-1	K6d	151	30°55'18"	34°15'14"		-----		-----				-----	-----	103	48	627	730	-579	976	1,706	-1,555
84	Bougaz-1	N3b	0	31°08'50"	32°48'38"		-----		-----				-----	-----		-----	-----	3,090	-----	-3,090		-----
85	Rommana-1X	N3a	9	31°01'04"	32°30'39"		-----		-----			564	-555	-564		-----	-----		-----	-----		-----
86	Gofer-1	O1b	4	31°01'37"	33°17'01"	2,042	-2,038		-----			245	-241	1,797		-----	-----	895	-891	1,147		-----
87	Pelusion	O1a	14	31°04'49"	33°03'43"		-----		-----			550	-536	2,650	3,200	-3,186	-3,200		-----	-----		-----
88	Slav-1	O1b	14	31°04'01"	33°25'03"		-----		-----			400	-386	-400		-----	-----	1,065	-1,051	25	1,090	-1,076
89	Arish-1	O2b	50	31°04'33"	33°55'		-----		-----			0	-----	260	260	-210	115	375	-325	865	1,240	-1,190
90	Haruvit-1	O3c	10	31°14'44"	34°05'22"		-----		-----			146	-136	-146		-----	-----	1,903	-1,893	-1,903		-----
91																						
92	JNo.1 El Medan	O2b	30	31°03'19"	33°34'55"	52	-22					43	-13	9			-----		-----	-----		
93	JNo.2 El Tawil	O2b	30	31°04'41"	33°53'54"	100	-70					72	-42	28			-----		-----	-----		
94	JNo.3 El Tawil	O2b	50	31°06'50"	33°58'19"	80	-30	47	3.0	5,562	Q	75	-25	5			-----		-----	-----		
95	JNo.4 Rawafa Dam	K6c	139	30°46'28"	34°07'13"	100	39					35	104	65			-----		-----	-----		
96	JNo.5 El Kharoba	O3b	48	31°08'19"	34°00'40"	73	-25	39.9	8.1	4,290	Q	53	-8	20			-----		-----	-----		
97	JNo.6 El Sheikh Zuwayed	O3c	43	31°10'45"	34°02'42"	98	-55	38.1	4.9	4,830	Q	94	-51	4			-----		-----	-----		
98	JNo.7 El Sheikh Zuwayed	O3c	50	31°10'15"	34°08'22"	120	-70	45.5	4.5	5,560	Q	89	-39	31			-----		-----	-----		
99	JNo.8 El Massora	O3c	75	31°12'38"	34°13'20"	110	-35	69.8	5.2	2,192	Q	86	-11	24			-----		-----	-----		
100	JNo.10 Barth	K6d	157	30°58'14"	34°17'58"	63	94	53	104	3,622	Q	56	101	7			-----		-----	-----		
101	JNo.11 Barth	K6d	157	30°56'44"	34°18'32"	45	112					32	125	13			-----		-----	-----		
102	JNo.18 Lehfen	K5d	57	30°59'25"	33°52'58"	64	-7					46	11	18			-----		-----	-----		
103	JNo.9 El Massora	O3c	78	31°09'35"	34°11'34"	91	-13	77.3	0.7	3,470	T(Mio)	6	72	85			-----		-----	-----		
104	JNo.12 Minsherah	K2a	380	30°17'41"	33°39'35"	300	80	182	198	2,973	L.C		-----	-----		-----	-----	4	376	296		-----
105	JNo.13 Falig	K1d	355	30°23'34"	33°16'42"	403	-48	288	67		L.C		-----	-----		-----	-----	0	355	403		-----
106	JNo.14 Halal	K6a	320	30°37'46"	34°01'52"	300	20		-----				-----	-----		-----	-----	0	320	300		-----
107	JNo.15 Naqb	H3c	850	29°28'07"	34°39'54"	400	450		-----				-----	-----	0	850	295	295	555	105		-----
108	JNo.16 El Bruk-1	K2a	355	30°11'32"	33°12'22"	799	-444	152	203	2,318	L.C		-----	-----	0	355	493	493	-138	223	716	-361

Appendix - 2 QUATERNARY WELL LIST (3)

	Well name	Grid	Elevation (m)	Lat.	Long.	Drilling Depth		Water Level		Water Quality		Top of Tertiary			Top of U.C			Top of L.C			Top of Pre C.	
						B.G.L(m)	A.S.L(m)	B.G.L(m)	A.S.L(m)	TDS	Aguifer	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)	Thich.(m)	B.G.L(m)	A.S.L(m)
109	JNo.17 El Bruk-2	K2a	355	30°11'32"	33°12'59"	188	167	132	223	5,628	U.C(Cen)		-----	-----	0	355	188		-----	-----		-----
110	JNo.19 Arif El Naga	K3d	455	30°16'53"	34°29'04"	900	-445	296	159	3,008	L.C		-----	-----	0	455	556	556	-101	166	722	-267
111									-----				-----	-----			-----		-----	-----		

TECHNICAL REPORT

II

FOSSIL ANALYSIS

TABLE OF CONTENTS

1 INTRODUCTION

In order for determination of the hydrogeological structure of the study area, geological field surveys were undertaken at various outcrops and some test holes were also drilled. For interpretation of data obtained it is inevitable to determine the age of strata, especially in the study area where limestones with similar type of lithology encounter from various strata.

For this reason, fossil analysis was undertaken in many samples obtained through geological field survey and slime samples from test well drilling.

The stratigraphy in North Sinai has been studied and published by some authors. Among these a detailed stratigraphy established by Farag and Shata (1954) at Minshera is regarded as a standard stratigraphy in the study area since the sequence of stratigraphy is confirmed by the result of detailed fossil analysis.

Results of fossil analysis obtained by the study team were carefully interpreted referring to the above mentioned standard stratigraphy.

Almost two hundred samples were analyzed through cooperation with RIWR. Some other results of fossil analysis were also provided by RIWR.

2 SAMPLES

2-1 Rock Samples

Rock samples were collected through geological field survey as shown below;

	Location	Sample Number
1	North Maghara	4
2	South Maghara	5
3	Gebel Risan Aneiza	4
4	Gebel Libni	4
5	Gebel Yelleq	5
6	Gebel Minshera	2
7	Wadi El Giddi	2
8	Gebel El Hamra	3
9	Gebel Arif El Naga	5
10	Naqb North (G. Alada)	3
11	Naqb South(East to Wadi Watir)	5
12	Naqb West	1
Total		43

2-2 Slime Samples of Quaternary Test Holes

For determination of the age of strata following samples were collected from slime of the Quaternary test holes;

Location	Sample Number
J No. 1	1
J No. 2	7
J No. 3	4
J No. 4	13
J No. 5	4
J No. 7	5
J NO. 8	4
J No. 9	4
J No. 10	6
J No. 11	6
J No. 12	1
Total	55

2-3 Slime Samples of Pre-Quaternary Test Holes

Samples obtained from slime of the Pre-Quaternary test holes are summarized as shown below;

	Location		Sample Number
1	J No. 6	El Sheikh Zuwayid	4
2	J No. 12	Minshera	4
3	J No. 13	Falig	26
4	J No. 14	Halal	17
5	J No. 15	Naqb	3
6	J No. 16	El Bruk-1	55
7	J No. 17	Arif El Naga	56
Total			165

3 RESULT

The results of fossil analysis are summarized in the Attachment. These are referred to determine the age of strata of geologic columns observed through field survey.

These results obtained from the fossil analysis of slime samples of test wells were referred to for determination of the age of strata in the test well profile, however, some results of fossil analysis were discarded which were obviously contaminated in the mixture of slime with different strata in the test well.

ATTACHMENT

RESULT OF FOSSIL ANALYSIS

North Maghara

- Sample NMG-1

Lithology : Hard brown limestone.

Microfacies : Dolomitized slightly argillaceous micrite, with presence of some arenaceous index forams *Trocholina* sp.?

Age : probably Upper Jurassic

- Sample NMG-2

Lithology : Brownish hard limestone.

Microfacies : Quatzitic dolostone, with presence of skeletal shell remains, *Kurnubia* sp.?, *Nautiloculina* cf., N. *oolithica* (mohler).

Age : probably Middle Jurassic?

- Sample NMG-3

Lithology : Hard brown limestone.

Microfacies : Dolostone, partly argillaceous, with presence of deformed skeletal shell remains due to dolomitization, Fe and Mn stains are also present in the matrix.

Age : ?

- Sample NMG-4

Lithology : Brownish hard limestone.

Microfacies : Foraminiferal biomicrite, with presence of rather abundant shell remains (sponge-spicules, gastropoda, echinoid spines, ...) *Nautiloculina circularis* (Said & Barakat), *Miliolidae, Tectulariidae, Trocholina intermedia* ? Henson

Age : probably Upper Jurassic

South Maghara

- Sample C_1sp. 15

Lithology : Compact light brownish white fine-grained calcareous sandstone.

Residue : Highly sandy, rarely fossiliferous with some macro-inverterate fragments and *miscellanea* sp.?

Microfacies : Sandy biomicrite, with sand grains fine to medium sized, angular to subrounded in outline, with presence of *Miscellanea* cf., *M. miscella* (d'Archiac & Haime), with presence also of some relics of shell fragments.

Age : Mostly Landenian or Lower Eocene.

- Sample C_1sp. 18

Lithology : Calcarenite, compact, yellowish white, banded, rather medium to coarse-grained.

Washed residue : Limestone and chalky fragments with some fragments of *Nummulites* sp.

Microfacies : Nummulitic biomicrite, with presence of *Nummulites* cf., *N. atacicus* leym., *Numm*. cf., *N. subatacicus* Douvillé, *Discocyclina* sp., shell remains.

Age : Mostly Lower Eocene.

- Sample C_1F_1

Lithology : Yellowish brown hard massive limestone.

Washed residue : Dolomitic fragments, devoid of any micro-organic remains.

Microfacies : Dolostone, with the whole groundmass consisting of rather medium-sized dolomite rhombs, without presence of any organic remains.

Age : ?

- Sample C_1F_4

Lithology : Massive hard yellowish brown dolomitic limestone.

Washed residue : Dolomite fragments with presence of some pyrite debris.

Microfacies : Dolostone, very fine grained with the groundmass entirely consisting of dolomite rhombs, patces of iron oxides are present, devoid of any micro-organic remains.

Age : ?

- Sample C_1F_7

Lithology : White compact chalky limestone.

Washed residue : With *Heterohelix globulosa*, *Gyroidina girardana*, *Globotruncana arca*, *G. rosetta*, *Rugoglobigerina* sp., *Ventilaberella* sp., *Nodosaria* sp., ..

Microfacies : Biomicrite, with abundant presence of planktonic and some benthic forams and other micro-organic remains embedded in a finely crystalline groundmass.

Age : Mostly Maastrichitian.

Risan Anciza

Sample R 11

Lithology	:	Light brown, hard massive limestone.
Microfacies	:	Oobiosparite, with abundant oolites, calcareous algal remains, valves of ostracoda, *pseuocyclammina* sp. and other various indefinite micro-organic remains.
Age	:	Probably Upper Jurassic or Lower Cretaceous.

Sample R 12

Lithology	:	Reddish brwon, massive limestone with casts of pelecypoda.
Microfacies	:	Oligostegina? biomicrite, with presence of *Orbitolina* cf., *O. conoave* (Lamarck).
Age	:	Probably Aptian (Lower Cretaceous) or Cenomanian.

Sample R 13

Lithology	:	Pinky white, massive hard limestone.
Microfacies	:	dolomitic biomicrite, with presence of some indefinite organic remains, shell debris, highly dolomitized.
Age	:	?

Sample R 17

Lithology	:	Light yellowish brown, hard massive limestone.
Microfacies	:	biosparite, with presence of *Nummulites* cf., *N. beaumonti* d'Archiac, some shell fragments.
Age	:	mostly Middle. Eocene.

Gebel Libni

- Sample LBN-1

Lithology	:	Greyish to reddish brown hard limestone.
Microfacies	:	Dolomitized biosparite, with presence of some indefinite skeletal shell particles, probably *lithothamnium* sp.?
Age	:	May be Eocence?

- Sample LBN-2

Lithology	:	Whitish hard limestone.
Microfacies	:	Dolostone, fine grained, without index microfossils, probably due to dolomitization.
Age	:	??

- Sample LBN-3

Lithology	:	Yellowish brown massive hard limestone.
Microfacies	:	Biomicrite, with some indefinite skeletal shell particles *Orvitoides*?, Fragments of *Operculina* sp.?
Age	:	Probably Eocene

- Sample LBN-4

Lithology	:	Light brown chert.
Microfacies	:	Micrite, fine-grained, with presence of a single Nummulites sp.? and a single *Operculina* sp. fragment
Age	:	Probably Lower Eocene

Gebel Yelleq

- Sample Y-1

Lithology	:	Brown to yellowish light brown hard massive limestone.
Washed residue	:	Calcareous crystalline fragments, devlid of free index fossils.
Microfacies	:	Dolomicrite, with most of the rock consisting of euhedral small dolomite rhombs, with presence of some skeletal particles also highly dolomitized, probably molluscan?.
Age	:	?

- Sample Y-2

Lithology	:	Hard light brown massive crystalline limestone.
Washed residue	:	Highly crystalline fragments, devoid of free index fossils.
Microfacies	:	Dolomicrite, with most of the groundmass consisting of euhedral small to medium-sized dolomite rhombs, with presence of void spaces, probably due to dissolved organic skeletal particles, the rare present shell fragments are also highly dolomitized, no index fossils.
Age	:	?

- Sample Y-3

Lithology	:	Light brown massive limestone.
Washed residue	:	Calcareous recrystallized fragments, devoid of free index microfossils.
Microfacies	:	Dolomicrite, with most of the rock formed of euhedral small-sized dolomite rhombs, with presence of some shell remains also highly dolomitized.
Age	:	?

- Sample Y-5

Lithology	:	Hard light brwon limestone.
Washed residue	:	Calcareous crystalline fragments, devoid of free index forams.
Microfacies	:	Oodolosparite, with most of the rock consisting oolitic particles, rounded, subrounded, ovoidal, some of which probably algae ?, some shell debris embedded in dolomitized groundmass, index microfossils not clear.

Age : ?

- Sample Y-6

Lithology : Light greyish brown hard massive limestone.

Washed residue : Calcareous crystalline fragments.

Microfacies : Micrite, with most of the rock groundmass formed of lime mud recrystallized, slightly dolomitized with some relics of organic debris, no index forams.

Age : ?

Gebel Minshera

- Sample MNS-1

Lithology	:	Light yellowish white limestone
Microfacies	:	Dolomitized biosparite, with presence of rather coomon skeletal particles probably *Macroporella* sp.?
Age	:	Probably Lower Cretaceous or Upper Jurassic

- Sample MNS-2

Lithology	:	Dark grey spotted hard limestone.
Microfacies	:	Oolitic algal biosparite, with *Chofatella* sp., *Triporella* sp. ? and other skeletal shell particles.
Age	:	Probably Lower Cretaceous or Upper Jurassic

Wadi El Giddi

- Sample GID-1

Lithology : Buff reddish white hard limestone.

Microfacies : Oobiosparite, with presence of various oolitic forms, some *miliolidae*, *textulariidae*, calcareous algal remains.

Age : Probably Cenomanian or may be older

- Sample GID-2

Lithology : White to yellowish white hard limestone.

Microfacies : With *Nummulites* cf. *N. gizehensis* Forkal, *Fabularia* sp., calcareous algal remains.

Age : Middle Eocene

Gebel El Hamra

- Sample HMR-1

Lithology : White moderately compact chalk.

Washed residue : With presence of valves of ostracoda, rather abundant planktic and benthic assemblage, among which are: *Globotruncana aegyptiaca* Nakkady, *G. fornicata* Plummer, *G. gagnebibi* Tilev, *G. arca* (Cushman), *Rugoglobigerina rugosa* Plummer, *Abathomphalus mayaroensis* (Bolli).

Microfacies : Foraminiferal biomicrite, with fine matrix with presence of planktonic forams : *Heterohelix* sp., *Globotruncana* sp.

Age : Maastrichtian

- Sample HMR-2

Lithology : Hard light brownish white limestone.

Microfacies : With presence of *Nummulites* cf., N. *gizehensis* Forskal, *Alveolina* sp.

Age : Middle Eocene

- Sample HMR-3

Lithology : Yellowish brown hard limestone.

Microfacies : Algal foraminferal dolo-intraclastic biosparite, with presence of various shell debris, vernulinidae, *Trocholina* sp., *Pfenderina sp. ?*

Age : Probably Upper Jurassic

Gebel Arif El-Naga

- Sample AN-1

Lithology : Massive hard light greyish white crystalline limestone.

Washed residue : Calcareous crystalline fragments, devoid of free index microfossils.

Microfacies : Shelly biomicrite, with abundant presence of skeletal particles including molluscan, echinoid and other macro-invertebrate remains, some smaller forams, *Gavelinella* sp. ?, partly dolomitized in some parts.

Age : Probably Turonian or may be slightly younger.

- Sample AN-2

Lithology : Hard grayish white to light brwon massive dolomitic limestone.

Residue : Calcareous dolomitic fragments, devoid of free index microfossils.

Microfacies : dolo, biomicrite, with presence of various skeletal particles including some shell remains, calcareous algae?, *Actinoporella* sp., valves of ostracoda, largar forams, *Orbitolina* sp.?, some other index smaller forams.

Age : Probably Cenomanian

- Sample AN-4

Lithology : Massive hard light greyish limestone white brown spots.

Residue : Calcareous highly crystalline fragments, devoid of free index microfossils.

Microfacies : Dolomicrite, with most of the groundmass formed of dolomite rhombs equigranular, with presence of some ghost structures of dissolved micro-organic fragments.

Age : ?

- Sample AN-5

Lithology : Light brwon hard massive limestone.

Washed residue : Calcareous finely crystalline fragments, devoid of free index forams.

Microfacies : Biomicrite, with presence of a considerable amount of skeletal particles including : some macro-invertebrate shall fragments, *Guneolina* sp.? *Orbitolina* sp.? and other debris of index, small forams.

Age : Probably Cenomanian or may be younger.

- Sample AN-7

Lithology : Compact fine-grained limestone.

Washed residue : Calcareous slightly chalky recrystallized fragments, devoid of free index microfossils.

Microfacies : Dolomicrite, with the whole groundmass consisting of equigranular dolomite rhombs, with presence of some relics skeletal particles, highly dolomitized also.

Age : ?

- Sample NN-1

Lithology : Hard massive greyish crystalline limestone.

Washed residue : Calcareous fragments, devoid of free index microfossils.

Microfacies : Dolomicrite, with the groundmass consisting mainly of equigranular small dolomite rhombs with rare presence of shell fragments also dolomitized.

Age : ?

- Sample NN-2

Lithology : Farthy brown massive limestone.

Washed residue : With rare shell fragments, mostly molluscan, rare pyrite, devoid of free index microfossils.

Microfacies : shell biomicrite, with abundant presence of skeletal particles including : mollusca, valves of ostracoda, some larger forams as *Orbitolina* sp.? These skeletal particles are also highly dolomitized, the groundmass formed of small-sized dolomite rhombs.

Age : Probably Cenomanian or probably older i.e Lower Cretaceous.

- Sample NN-3

Lithology : Light yellowish white slightly chalky limestone.

Washed residue : Calcareous recrystallized fragments with rare ostracoda, *Paracypris* sp., *Oytherella* sp.?, very rare planktics, *Hadbergella* sp.?

Microfacies : Biomicrite, with presence of some forams, *Charentia* cf., S. *cuvilleri* ?, rare *textularlidae*, some calcareous algae probably *Thyrosporella* sp.? embedded in a groundmass of lime mud, dolomitized in some parts.

Age : Probably Turonian.

Naqb (East to Wadi Watir)

- Sample NS-1

Lithology	:	Hard, fine-grained yellowish white limestone.
Washed residue	:	Calcareous crystalline fragments, very rare valves of ostracoda.
Microfacies	:	Dolomitized biomicrite, with the presence of various skeletal particles, most of which are highly dolomitized leading to deformation of its internal structure. These skeleatl particles include : molluscan shell fragments, some small index forams, larger forams?, *Edomia* sp., calcareous algae, *Aoioularia* sp.?
Age	:	Probably Lower Cretaceous or may be younger, Cenomanian?

- Sample NS-2

Lithology	:	Earthy yellow to pale yellowish marly moderately compact limestone.
Washed residue	:	With presence of some echinoid spines and *Cyphosoma baylei* Cotteau.
Microfacies	:	Biomicrite, with the groundmass consisting of lime mud with some macro-invertebrate debris.
Age	:	Probably Turonian

- Sample NS-3

Lithology	:	Compact, yellowish brwon fine-grained limestone.
Washed residue	:	Calcareous finely crystalline fragments, devoid of free index microfossils.
Microfacies	:	Dolostone, with the groundmass entirely formed of rater small-sized rhombs, non-fossilif.
Age	:	?

- Sample NS-4

Lithology	:	Hard yellowish brwon dolomitic limestone.
Washed residue	:	Highly dolomitic fragments, devlid or freee index micro-fossils.
Microfacies	:	Micrite, fine grained, groundmass formed of recrystallized calcite, with veinlets of sparry calcite, some patches in the rook dolomitized in iron rich

dolomite rhombs, dissolved organic index remains appear as ghost structures, devoid of index micro-fossils.

Age : ?

- Sample NS-5

Lithology : Massive greyish white dolomitic limestone.

Washed residue : Calcareous crystalline fragments, devoid of free index microfossils.

Microfacies : Biomicrite, with presence of some forams, including *Nezzazata* cf., *N. conica* (Smout)?, *Cuneolina* ? cf., *C. pavonia* d'Orb., *Textulariidae* and some other shell remains.

Age : Probably Cenomanian or Turonian.

Naqb (West)

- Sample Naqb W N-2

Lithology	:	Hard massive, yellowish brown dolomitic limestone.
Washed residue	:	Dolomitic limestone fragments, with rare chart debris, devoid of index microfossils.
Microfacies	:	Shelly biosparite, with presence of macro-invert-ebrate shell remains, gastropoda and other molluscan debris calcareous algae?, with presence of some ill-preserved forams probably *Trocholina* sp., *Pfenderina* sp., *Nautiloculina* sp., embedded in sparry calcite groundmass.
Age	:	Probably Upper Jurassic.

- Sample, depth 29-30m

Lithology	:	Dark greyish brown clay.
Residue	:	Fine, sandy, non fossiliferous.

- Sample , depth 20-21m

Lithology : Yellowish sandy clay.

Residue : Highly sandy with chert fragments with presence of *Streblus beccarii* (Linné), rare reworked planktics.

Age : Probably Pliocene or Pleistocene

- Sample , depth 50-51m

Lithology : Yellowish brown clay.

Washed residue : With chert fragments, coral and other fossil shell remains, rare ostracoda (*Hemicythere* sp.), *Elphidium victoriense* Cushman, *E. crispum* (Linné), E. *mcellum* (Fich. & Moll), *Quinqueloculina bicarinata d'Orb.*, Trilloculina sp., *Streblus beccarii* (Linné)

Age : Probably Pliocene

- Sample , depth 59-60 m

Lithology : Yellowish brown, moderately compact marl.

Washed residue : With presence of chert fragments, *Textularia agglutinans* d'Orb., *Operculina* cf, *carpentri* Silvetri. *Uro cythereis* sp. cf., *U. farosa* (Roemer), *streblus beccarii* (Linné), and some other badly preserved benthics.

Age : The interval from depth 50 - 60 m probably may be assigned to Miocene or may be younger.

- Sample , depth 80-81m

Lithology : Yellowish white marly limestone.

Washed residue : With limestone fragments, chert debris, fossil shell remains, *Nummulites* cf., *N. exilis* Douvillé, *Operoulina* sp.

- Sample , depth 91-92m, 98-99m

Washed residue : In both samples with presence of *Nummulites* cf. *N. fraasi* de la Harpe, *Operoulina* sp.

- Sample , depth 99-100 m

Lithology : Yellowish brown, moderately compact marl.

Washed residue : limestone fragments, chert debris, with *Nummulites* cf., *N. planulatus* (lamarck), rare valves of ostracoda.

Age : The interval from depth 80-100 could be probably assigned to Lower Eocene

- Sample , depth 40-41 m

Lithology	:	Brown clay.
Residue	:	Fine sandy with few chert debris, non-fossiliferous.

- Sample , depth 58-59 m

Lithology	:	Hard greyish white argillaceous chalk.
Residue	:	With chert remains, rare benthic forams : *Elphidium* sp., *Streblus beccarii* (Linné) and other indefinite micro-organic debris.

- Sample , depth 76-77 m

Lithology	:	Dark grey sandy clay
Washed residue	:	Gravels, chert debris, abundant fine quartz and size residue, non-fossiliferous.

- Sample , depth 79-80 m

Lithology	:	Dark grey clay.
Residue	:	Sandy with chert fragments, rare benthic forams, *streblus beccarii* (Linné).
Age	:	Probably Plicene?

- Sample , depth 39-40 m

Lithology	:	Light brwon, rather compact clay.
Washed residue	:	With chert debris, some planktonic foraminiferal species as : *Globoratalia* cf., *G. abundocamrata* Bolli, *G. velascoensis* (Cushman), *Globorotaloides* cf., *G. suteri* Bolli.

- Sample , depth 44-45 m

Lithology	:	Clay, light brown moderately compact.
Washed residue	:	With chert debris, some planktonics as *Globigerina triloculinoides* Plummer, *Globorotalia pentacamerata* Subbotina, *G. convexa* Subbotina, *Globorataloides suteri* Bolli.

- Sample , depth 45-46 m

Lithology	:	Light brwon, rather compact clay.
Washed residue	:	With chert debris, *Globoratalia* cf., *G. simulatilis* (Schwager), *G. varianta* (Subb.), *G. velascoensis* (Cush.), *G. colligera* (Schwager), *G. rex* Martin, *Globoquadrina yeguaensis* (Wein. & Applin), *Globigerina triloculinoides* Plummer.

- Sample , depth 49-50 m

Lithology	:	Clay, moderately compact, light brown.
Washed residue	:	With chert debris, *Globorotalia esnaensis* (Le Roy), *G. crassata* (Cushman), *Bulimina* sp., *Robulus* sp., *Globigerina pseudoeocaona conpacta* Subbotina.

- Sample , depth 50-51 m

Lithology	:	Light brown, rather compact clay.
Washed residue	:	With chert debris, rare planktics *Truncorotaloides rohri* Bronn. & Berm., *Globorotalia pentacamerata* Subb., *Nonion* sp., *Gaudryina* sp.

- Sample , depth 69-70 m

Lithology	:	Greyish light brown compact clay.

Washed residue : With chert fragments, *Globorotalia aequa*, *G. esnainsis* (Le Roy), *G. colligera* (Schwager).

- Sample , depth 70-71 m

Lithology : Greyish brown clay.

Washed residue : Chert fragments, rare benthic & planktic forams : *Globorotalia crassata* (Cushman).

- Sample , depth 79-80 m

Lithology : Grey rather compact clay

Washed residue : With chert debris, *Rugoglobigerina* sp., *Globotruncana* sp.

- Sample , depth 80-81 m

Lithology : Moderately compact grey clay

Washed residue : With chert debris, *Heterohelix ultimatumida* (White), *Globotruncana gansseri* Bolli, *Rugoglobigerina rugosa* Plummer.

- Sample , depth 89-90 m

Lithology : Yellowish, greyish brown sandy clay

Washed residue : With chert debris, *Rugoglobigerina macrocepnala* Bronn., *R. rugosa* Plaummer, *Heterohelix* sp., *Bolivina incrassata*. *Palmula* sp., *Bolivinoides draco* Marson.

- Sample , depth 90-91 m

Lithology : Grey to yellowish brwon moderately compact clay.

Washed residue : With chert debris, valves of ostracoda, *Rugotruncana ganssori* (Bolli), *Rugoglobigerina* sp., *Heterohelix globulosa* (Ehrenberg), *Gyroidina* sp., *Spiroplectammina* sp.

- Sample , depth 94-95 m

Lithology : Chocolate grey rather compact clay

Washed residue : With chert debris, valves of ostracoda, *Heterohelix reussi* (Cushman), *Rugoglobigerina* sp., *Globotruncana* cf., *G. arca* (Cushman), *R. jerseyensis* Olcaon, *Abathomphalus mayaroensis* Bolli.

- Sample , depth 95-96 m

Lithology : Dark brown greyish clay.

Washed residue : with chert fragments, valves of ostracoda, *Bolivinoides draco* Marson, *Rugoglobigerina macrocephala* Bronn., *R. rugosa* Plummer, *Globotruncana esnaensis* Nakkady.

For Well J NO. 4 the interval from 39.0m to 71.0m could be assigned to Paleocene/Lower Eocene. While the interval from 79.0m to 100m to Maastrichtian.

<u>J No. 5 El Kharoba</u>

<u>- Sample , depth 9-10 m</u>

Lithology	:	Yellowish soft clay.
Residue	:	Sandy with small gastropoda, reworked Middle Miocene planktics (*Orbulina* sp.), no other index fauna.
Age	:	Probably Pliocene or Pleistocene?

<u>- Sample , depth 49-50 m</u>

Lithology	:	Sandy yellowish limestone.
Residue	:	With common chert fragments, *Streblus beccarii* (Linné), *Quinqueloculina* sp.
Age	:	Probably Pliocene

<u>- Sample , depth 69-70 m</u>

Lithology	:	Greenish grey clay.
Residue	:	With chert fragments, some planktics and benthic assemblage including : *Anomalina* sp., *Robulus* cf., *R. macrodiscus* Reuss, *Nodosaria* sp., *Dentalina* cf., *D. scripta* d'Orb., *Globigerina trilocularis* d'Orb., *Orbulina suturalis* Bronnimann, *Globigerina bulloides* (d'Orb.), *Dentalina* cf., D. *elegans* d'Orb., *Siphogenerina bononiensis* (Forasini), *Stilostomella soluta* (Bronermann), *Loxostomum Limbatum* (Brady), *Elphidium crispum* (Linné).
Age	:	Most probably Middle Miocene

<u>- Sample , depth 70-71 m</u>

Lithology	:	Dark gray clay.
Washed residue	:	With presence chert fragments, dwarged gastropoda, planktic and benthic forams : *Lingulina costata* d'Orb., *Frandicularia* sp., *Siphogenerina bononiensis* (Fornasini), *Amphistegina* sp.?, *Bolivina spathulata* (Williamson), *Robulus lucidus* Cushman, *Globigerina trilocularis* (d'Orb.), *Nodosaria* sp., *Globigerina bulloides* (d'Orb.).
Age	:	Most probably Middle Miocene

J No. 6 El Sheikh Zuwayid

- Sample , depth 29-30 m

Lithology	:	Brwon argillaceous sandstone.
Residue	:	Sandy with some shell debris, rare forams, *Streblus beccarii* (Linné).
Age	:	Probably Pliocene or Pleistocene?

- Sample , depth 59-60 m

Lithology	:	Soft brwon clay.
Residue	:	With some shell debris, sandy, with some valves of ostracoda, rare planktics, Orbulina suturalis Bronn., *Cassigerinella chipolensis* (Cush & Ponton), calcareous algae.
Age	:	Probably Miocene.

- Sample , depth 85-86 m

Lithology	:	White fragile limestone
Residue	:	Sandy some shell debris, chert fragments, absence of index microfossil.

- Sample , depth 19-20 m

Lithology	:	Soft dark brown clay.
Residue	:	Sandy, rare ostracoda, rare reworked planktics, *Globorotalia* sp.
Age	:	Probably Pliocene or Pleistocene

- Sample , depth 65-66 m

Lithology	:	Soft brown clay.
Residue	:	Sandy with some valves of ostracoda, *Elphidium crispum* (Linné), *Globigerina* sp. cf., *G. bulloides* (d'Orb.), *Streblus beccarii* (Linné).
Age	:	Probably Miocene.

- Sample , depth 84-85 m

Lithology	:	Greyish brown sandy friable clay.
Residue	:	With abundant chert fragments and nearly the same assemblage as before (depth 65-66m).

- Sample , depth 109-110 m

Lithology	:	Greenish grey soft clay
Residue	:	Sandy with pyrite concretions, *Robulus* cf. R. *macrodiscus* Reuss, *Globigerina trilocularis* (d'Orb.), *G. bulloides* (d'Orb.), *Streblus beccarii* (Linné).
Age	:	Probably Miocene.

- Sample , depth 80-81 m

Lithology	:	Yellowish friable sandstone.
Residue	:	Sandy with Elphidium macellum var E. granulosum (Side Bottom), *E. crispum* (Linné), *Streblus beccarii* (Linné), *Globigerina bulloides* (d'Orb.), *G. trilocularis* (d'Orb.), *Globorotalia* sp.
Age	:	Probably Miocene.

- Sample , depth 89-90 m

Lithology	:	Yellowish clay
Residue	:	With chert fragments, sandy, nearly with the some assemblage as before (depth 80-81m).

- Sample , depth 105-106 m

Lithology	:	Chalky white limestone
Residue	:	Non-fossiliferous

- Sample , depth 39-40 m

Lithology	:	Dark brown clay.
Residue	:	Sandy with rare chert fragments, rare *Streblus beccarii* (Linné).
Age	:	Probably Pliocene.

- Sample , depth 65-66m

Lithology	:	Friable sandy clay.
Residue	:	With rare chert fragments, sandy, with Asterigerina sp., *Sphaeyoidinellopsis* sp.
Age	:	Probably Pliocene.

- Sample , depth 71-72 m

Lithology	:	Light yellowish clay.
Washed residue	:	Sandy, rare valves of ostracoda, rare dwarged gastropoda, no index microfossils.

- Sample , depth 74-75 m

Lithology	:	Soft brown clay.
Residue	:	With chert fragments, highly sandy, with nearly the same assemblage as before (depth 65-66m).

- Sample , depth 29-30 m

Lithology	:	Brown sandy clay.
Residue	:	With rare rewarked planktic and benthic assemblage : *Rugotruncana gansseri* (Bolli), *Abathomphallus mayaroensis* (Bolli), *Cibicidoides* cf., *G. howelli* (Toulmin).

- Sample , depth 50 m

Lithology	:	Yellowish brown sandy clay.
Washed residue	:	Sandy, quartz pebbles, chert debris, with no free index microfossils.

- Sample , depth 50-51 m

Lithology	:	Light yellowish brown clay.
Residue	:	With some badly preserved Neogene planktics, rare benthics *Elphidium macellum* (Fich. & Mol).

- Sample , depth 54-55 m

Lithology	:	Yellowish brown clay.
Washed residue	:	Calcareous sandstone, gravels, chert debris, fine sandy residue, non-fossiliferous.

- Sample , depth 59-60 m

Lithology	:	Yellowish white clay.
Residue	:	With *Nonion boveanum* (d'Orb.), *Orbulina suturalis* Bronnimann, *Glovigerinoides primordius* Blow & Banner, *G. immaturus* Leroy, *Streblus beccarii* (Linné).
Age	:	Probably Miocene.

- Sample , depth 61-62 m

Lithology : Yellowish brown clay.

Washed residue : Sandy with chert debris, some pebbles, *Elphidium crispum* (Linné), *E. macellum* (Fich & Moll), *Nodosaria scalaris* (Batsoh), *Nonion scaphum* (Fichtel & Moll), *N. gateloupi* (d'Orb.), *Robulus* sp., *Streblus beccarii* (Linné), *Cibicides* sp., *Eponides repandus* (Fichtel & Moll).

This sample could be probably assigned to Pliocene. The above other two samples are hard, if not impossible, to determine their age, owing to their absence of any index microfossils.

- Sample , depth 10-11 m

Lithology : sandy brwon clay.

Residue : Sandy with small gastropoda, rare benthics *Streblus beccarii* (Linné).

- Sample , depth 24-25 m

Lithology : Soft brown clay.

Residue : with *Anomalina* sp., *Rotalia* sp., *Globorotalia* sp., *Globigerinoides trilobus* immaturus Leroy.

- Sample , depth 33-34 m

Lithology : Brown coarse sandstone, slightly argillaceous.

Washed residue : Highly sandy, with chert debris, rare planktonic forams : *Globorotalia pasionensis* (Bermudez), *G. broedermanni* Cushman & Bermudez.

- Sample , depth 35-36 m

Lithology : Brown sandstone.

Washed residue : With limestone fragments, chert fragments, rare valves of ostracoda, *Chilogumbelina* cf., *C. wilcoxensis* (cushman & Ponton), *Globigerina triloculinoides* Plummer.

- Sample , depth 40-41 m

Lithology : White argillaceous limestone.

Residue : With rather common planktic assemblage not very well preserved, among which are : *Orbulina suturalis* Bronnimann.

Age : Probably Miocene

- Sample , depth 41-42 m

Lithology : Chalky white friable clay?

Washed residue : Limestone fragments, with chalky benthic and planktic foraminiferal assemblage : Globigerina inaequispira Subbotina, *Globorotalia esnaensis* (Le Roy), *G. pentacamerata* (Subbotina), *Nummulites* sp.

The interval from depth 33-42m could be probably assigned to Lower Eocene.

- Sample , depth 290m

Lithology : Dark grey friable shale.

Washed residue : With some shell debris, no index microfossils.

- Sample , depth 292m

Lithology : Dark grey shale.

Washed residue : Pyritic, rare lagenidae : Robulus sp., rare ostracoda, small gastropoda.

- Sample , depth 296m

Lithology : Grey friable shale.

Washed residue : With rare *Lenticulina* sp., *Nautiloculina circularis* (Said & Barakat).

- Sample , depth 298m

Lithology : Dark grey friable shale.

Washed residue : With valves of ostracoda, slightly pyritic, *Nautiloculina circularis* (Said & Barakat).

For Well J No. 12 the interval from 290-299 may be assigned to Callovian stage.

- Sample , depth 24-25m

Lithology : Friable light voilet sandy clay.
Washed residue : Sandy, with Fe stains (hematitic), non-fossiliferous.

- Sample , depth 25-26m

Lithology : Light violet friable sandy clay.
Washed residue : Sandy, rare shell remains, absence of index forams.

- Sample , depth 49-50m

Lithology : Yellowish calcareous clay.
Washed residue : Sandy, some shell debris, absence of indx forams.

- Sample , depth 50-51m

Lithology : Clay, yellowish slightly calcareous.
Washed residue : Sandy, non-fossiliferous.

- Sample , depth 100-101m

Lithology : Dark grey compact clay.
Residue : sandy highly pyritic, non-fossiliferous.

- Sample , depth 147-148m

Lithology : Buff friable calcareous clay.
Washed residue : Sandy, non-fossiliferous.

- Sample , depth 148-149m

Lithology : Reddish brown calcareous clay.
Washed residue : Sandy, non-fossiliferous.

- Sample , depth 149-150m

Lithology : Buff friable clay.
Washed residue : Sandy, non-fossiliferous.

- Sample , depth 150-151m

Lithology : Brownish to reddish clay.
Washed residue : Sandy, non-fossiliferous.

- Sample , depth 199-200m

Lithology : Light grey friable clay.

Residue : Sandy, highly pyritic, non-fossiliferous.

- Sample , depth 248-249m

Lithology : Grey griable shale.

Washed residue : Pyritized, with lignite debris, with *Ammosphaeroidina* sp.?

- Sample , depth 249-250m

Lithology : Grey shale.

Washed residue : With few lignite remains, pyritized, *Ammosphaeroidina* sp.

- Sample , depth 250-251m

same as before in lithology and faunal content.

- Sample , depth 300-301m

Lithology : Dark grey friable clay.

Residue : Pyritic with Globigerina - like concretions, absence of index microfossils.

- Sample , depth 345-400m taken every 5m (12 samples)

The microscopic investigation for these samples proved the presence of a rather similar results for all of them, which included the presence of pyrite, chert and dolomite fragments, glauconite pellets, other miscellaneous rock debris, shell remains, some valves of ostracoda with some small forams as : *Lenticulina subalata* (Reuss), *L. munsteri* Roemer, *Ammobaculites glaessneri* (Said & Barakat), *Pseudocyclammina jaccardi* (Schrodt), P. *ammobaculitiformis* Mayne, *Kurnubia jurassica* (Henson), *K. palestinensis* Henson, *K. bramkampi* Redmond, *Nautiloculina circularis* (Said & Barakat), *N. oolithica* (Mohler) and others.

Upper Jurassic age could be safely assigned to this interval, i.e. from depth 345 - 400m, according to the presently recorded microfaunal assemblage.

The washed residue of these samples also contained some reworked Upper Cretaceous forams including : *Gaudryina* sp., *Buccicrenata* sp., *Charentia* sp., *Coxites* ? sp., *Pseudotextulariella* sp., and others. Which probably assign Cenomanian to Lower Cretaceous age for the pre Upper Jurassic interval presently determined.

- Sample , depth 40m

Lithology : Reddish brown compact fine sandy clay.

Washed residue : With shell fragments, rare *Marsonella* sp.

- Sample , depth 41m

Lithology : Yellowish brown sandy clay.

Washed residue : With some shell debris, rare arenaceous forams, *Trochanmmina* sp., rare calcareous, *Robulus* sp.

- Sample , depth 60m

Lithology : Dark grey clay, rather compact.

Washed residue : With some arenaceous forams including : *Ammobaculites* sp., *Trochamminoides* sp. and fragments of *Orbitolina* sp.?

- Sample , depth 80m

Lithology : Greyish brown friable clay.

Washed residue : Sandy, non-fossiliferous

- Sample , depth 95m

Lithology : Buff rather compact clay.

Washed residue : sandy, non-fossiliferous

- Sample , depth 100m

Lithology : Brownish to buff rather compact clay.

Washed residue : With *Conicospirillina* sp.?

- Sample , depth 149m

Lithology : dark grey rather compact clay.

Washed residue : With rare *Trochammina* sp.

- Sample , depth 150m

Lithology : Greyish to yellowish brown sandy clay.

Washed residue : With some small rounded concretions, absence of index microfossils.

This interval from depth 40 - 150m may be assigned to Lower Cretaceous.

- Sample , depth 199m

Lithology : Grey friable shale.

Washed residue : With abundant small gastropoda, small pelecypoda *Pseudocyclammina* sp.?

- Sample , depth 200m

Lithology : Shale, greyish friable.

Washed residue : Pyritic with small gastropoda, *Cyclammina* sp.

- Sample , depth 201m

Lithology : Shale, friable grey.

Washed residue : With small gastropoda, some smaller forams, *Feurtillia* sp.?, *Valvulinella* sp.

- Sample , depth 250m

Lithology : Dark grey compact shale.

Washed residue : Pyritic, carbonaceous, with small gastropoda.

- Sample , depth 251m

Lithology : dark chocolate moderately compact shale.

Washed residue : Carbonaceous, pyritic with small gastropoda.

- Sample , depth 279m

Lithology : Grey friable shale.

Washed residue : Dwarfed gastropoda, some algal ? remains, no index microfossils.

- Sample , depth 280m

Lithology : Friable shale, greyish.

Washed residue : Pyritic, small gastropoda, rare shell remains.

- Sample , depth 281m

Lithology : Grey friable shale.

Washed residue : Partly carbonaceous, with small gastropoda.

- Sample , depth 300m

Lithology : Dark grey friable shale.

Washed residue : Pyritic, dwarfed gastropoda.

The interval from depth 180-300m may be assigned to Upper Jurassic.

- Sample , depth 50-51m

Lithology	:	Chalky white friable limestone.
Residue	:	Rare shell debris, small gastropoda, rare ostracoda, no index microfossils.

- Sample , depth 150-151m

Lithology	:	Dark grey friable clay.
Residue	:	With rather common ostracoda, rare arenaceous forams : *Haplophrgmoides* sp., some shell debris.
Age	:	Probably Cenomanian.

- Sample , depth250-251m

Lithology	:	Dark grey friable clay.
Residue	:	With small gastropoda, rare shell fragments, rare planktics : *Heterohelix* sp., fragments of *Thomasinella* sp.
Age	:	Probably Cenomanian.

The present study deals with the microscopic investigation of 55 ditch samples provided from well J No. 16 El Bruk-1. In the following, a brief account is given for each of the provided samples with the results obtained.

- Sample , depth 49-50m

Residue : With some molluscan shell fragments.

- Sample , depth 50-51m

Residue : With Rare echinoid shell remains.

- Sample , depth 51-52m

Residue : Non-fossiliferous.

- Sample , depth 52-53m

Residue : With rare shell debris.

- Sample , depth 99-100m

Residue : With fragments of *Thomasinella punica* Schlumb., *Nezzazata* sp., *Charentia cuvillieri* Neum., various shell fragments, valves of ostracoda as : *Bairdia* sp., *Cytherella ovata* (Roemer), *Dolocytheridea atlasica* Bass. & Dam., *Cythereis magherebensisi* Bass. & Dam

- Sample , depth 100-101m

Residue : Nearly with the same foram: assemblage as depth 99-100m

- Sample , depth 101-102m

Residue : With shell fragments, valves of ostracoda : *Cytherella ovata* (Roemer), *Cythereis magherebensis* Bass. & Dam.

- Sample , depth 102-103m

Residue : With molluscan and other shell fragments, *Thomasinella punica* Schlumb., pyrite remains, valeves of ostracoda : *Cythereis magherebensis* Bass. & Dam., *Cytherella ovata* (Roemer), Bairdia sp., *Planileberis pustulata* Rosenfeld.

- Sample , depth 121-122m

Residue : With shell remains, *Thomasinella punica* Schlumb., *Pseudocyclammina* sp., valves of ostracoda : *Cytherella oveta* (Roemer).

- Sample , depth 122-123m

Residue : With pyrite remains, valves of ostracoda : *Cytherella ovata* (Roemer).

- Sample , depth 123-124m

Residue : With shell fragments, pyrite remains, ostracoda : *Cytherella ovata* (Roemer), *Dolocytheridea atlasica* Bas. & Dam.

- Sample , depth 124-125m

Residue : With presence of shell fragments, valves of ostracoda : *Cythereis magherebensis* Bas. & Dam., *Cytherella ovata* (Roemer), pyrite remains, *Cyclammina* sp.

- Sample , depth 152m

Residue : Dolomitized, with some shell fragments.

- Sample , depth 154-55m

Residue : With presence of rare shell fragments, rare valves of ostracoda.

- Sample , depth 155-156m

Residue : With various shell fragments, pyrite debris, *Thomasinella* sp., ostracoda as *Metacytheropt-eron berbericum* (Bas. & Dam.), *Dolocytheridea atlasica* Bas. & Dam., *Cytherella ovata* (Roemer).

- Sample , depth 156-157m

Residue : Dolomitized, with pyrite debris, ostracoda as *Cythereis magherebensis* Bas. & Dam., *Cytherella ovata* (Roemer).

- Sample , depth 157-158m

Residue : Mica flakes, molluscan and other shell fragments, pyrite remains, fragments of *Thomasin*. ostracoda as *Cytherella ovata* (Roemer).

- Sample , depth 252-253m

Residue : With ostracoda as Metacyther-*opteron berbericum* (Bas. & Dam.), *Cythereis magherebensis* Bas. & Dam., *Cytherella ovata* (Roemer).

- Sample , depth 253-254m

Residue : With rare presence of valves of ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth 254-255m

Residue : With some shell fragments, pyrite remains, rare ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth 255-256m

Residue : With pyrite remains, shell fragments, valves of ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth296-297m

Residue : with rare shell fragments.

- Sample , depth 297-298m

Residue : Non-fossiliferous.

- Sample , depth 298-299m

Residue : With valves of ostracoda, *Dolocytheridea atlasica* Bas. & Dam.

- Sample , depth 299-300m

Residue : With presence of shell debris, *Charentia* sp.

- Sample , depth 303-304m

Residue : With ostracoda, *Cytherella ovata* (Roemer), *Dolocytheridea atlasica* Bas. & Dam. also forams as *Charentia* sp.

- Sample , depth 304-305m

Residue : With presence of some micro-organic debris, small gastropoda, some ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth 305-306m

Residue : Pyritic, molluscan and other shell fragments, benthic forams as *Flabellammina alexandei* Cushman, valves of ostracoda, *cytherella ovata* (Roemer).

- Sample , depth 306-307m

Residue : With ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth 349-350m

Residue : With presence of molluscan shell fragments, ostracoda : *Cytherella ovata* (Roemer).

- Sample , depth 350-351m

Residue : Pyritic, shell fragments, *Nezzazata* sp., valves of ostracoda, *Dolocytheridea* sp.

- Sample , depth 351-352m

Residue : Shell fragments, valves of ostracoda, *Cytherella ovata* (Roemer).

- Sample , depth 352-353m

Residue : With abundant shell fragments, valves of ostracoda, *Cytherella* sp.

- Sample , depth 384-385m

Residue : With rare valves of ostracoda *Cytherella ovata* (Roemer).

- Sample , depth 385-386m

Residue : Glauconitic, rare shell fragments, rare ostracoda.

- Sample , depth 386-387m

Residue : With rare *Cyclammina* ? sp.

- Sample , depth 387-388m

Residue : Non-fossiliferous.

- Sample , depth 414-415m

Residue : Sandy, pyritic, glauconitic, some shell fragments, rare reworked ostracoda.

- Sample , depth 415-416m

Residue : Highly pyritic, sandy, glauconitic, some shell fragments.

- Sample , depth 416-417m

Residue : Sandy, glauconitic, pyritic, non-fossiliferous.

- Sample , depth 417-418m

Residue : With rare shell debris, reworked, sandy, glauconitic, pyritic, no index forams.

- Sample , depth 466-467m

Residue : Sandy, glauconitic, pyritic with some reworked shell fragments, and ostracoda.

- Sample , depth 467-468m

Residue : Sandy, with pyrite remains, reworked molluscan and other shell fragments, rare forams, *Haplophragmium* sp.?

- Sample , depth 467-468m

Residue : with pyrite remains, molluscan and other shell fragments, sandy, glauconitic, tiwh *Pseudotextulariella* sp., rare ostracoda.

- Sample , depth 469-470m

Residue : With some shell debris, sandy; non-fossiliferous.

- Sample , depth 716-717m

Lithology : Dark grey, sandy clay.

- Sample , depth 728-729m

Lithology : Dark brown sandy clay.

- Sample , depth 750m

Lithology : Grey sandy clay.

- Sample , depth 756m

Lithology : Sandy calcareous clay.

- Sample , depth 765m

Lithology : Brown sandy clay.

- Sample , depth 775m

Lithology : Light grey sandy clay.

- Sample , depth 781m

Lithology : Grey clay.

- Sample , depth 789m

Lithology : Sandy grey clay.

- Sample , depth 791m

Lithology : Brownish argillaceous sandstone.

- Sample , depth 789m

Lithology : Grey clay

Turonian, Cenomanian and Lower Cretaceous stages could be safely assigend respectively for the stratigraphic sequence of J No. 16 El Bruk-1.

According to the presently provided samples, the Turonian could be assigned from depth 49-53m, and is represented by light coloured rocks of limestones, marly limestone and chalky limestone with macrofossil shell fragments. While, Cenomanian from depth 99-388m? and is represented by dark coloured grey and bluish clays with minor limestone or marly intercalations with abundant presence of macrofossil shell fragments, ostracoda and some foraminiferal species. Lower Cretaceous, from depth 414-470m is represented by sandy, glauconitic, slightly pyritic rocks, with rather rare foraminifera, ostracoda and macrofossil content.

The washed residues of these samples proved the presence of some reworked shell remains, some valves of ostracoda, glauconitic, pyrite fragments, some carbonaceous debrisin a clastic sandy interval.

It is evident that this interval represents the continuation of Risan Aneiza or Malha Formation of Lower Cretaceous age, which started as proved from 414m.

The whole well could be summerized, as compiled from the previously examined samples in preceeding reports, to be as follow.

0 m	:	Quaternary cover and Wadi Deposits.
49-53m	:	Wata Formation. Turonian stage, this interval is characterized by light coloured, non-clastic rocks with some shell remains.
99-382m	:	Galala or Halal Formation. Cenomanian stage, this interval is represented by argillaceous rocks with minor intercalations of limestoneand marl, with presence of valves of ostracoda and foraminiferal species including : *Thomasinella punica, Charentia cuvilleri, Pseudocyclammina* sp., *Flabellammina alexanderi, Cytherella ovata, dolocytheridea atlasica, Cythereis magharebensis, Bairdia sp., Planileberis pustulata, Metacecytheroppteron berbericum.*
414-798m	:	Risan Aneiza or Malha Formation of Lower Cretaceous age, characterised by glauconitic clastic rocks, pyrite and carbonaceous fragments, with presence of reworked shell remain, valves of ostracoda.

J No. 18 Lehfen

- Sample , depth 50-51m

Lithology : Yellowish brown clay.

Washed residue : Sandy, gravels, chert debris, some reworked planktics,: *Globorotalia spinulosa* Cushman, *Globigerina soldadensis angulosa* Bolli, *Globorotalia* cf., *G. spinuloinflata* (Bandy).

Age : Probably Eocene ?