8.2.2 Wadi Feiran

1) General Features of Basin

The Wadi Feiran area includes the area from the river mouth to Tarfa village through Oasis Feiran village.

Wadi Feiran is the largest wadi in the western part of South Sinai. It originates at the St. Catherine area in the central Sinai and discharges to the Suez Bay at approximately 150 km northwest of El Tur, collecting W. Sheikh, W. Akhdar, W. Rem, W. Romana and others. The total area of the basin is approximately 1,700 km^2.

The upper stream area from the Mokattab village are occupied by the Precambrian Basement Rocks while the Cretaceous and the Tertiary sedimentary rocks crop out in the down stream form the village. Neogene sediment, Feiran bed, appears in places in the wadi.

Groundwater in the wadi is exploited for irrigation use by dug wells between Redda and Tarfa, especially in Oasis Feiran area. Water for Mokattab Village is supplied from deep wells constructed on the down stream of the wadi.

2) Well Inventory

40 wells are listed as Quaternary wells in the inventory which is shown as Table 8.1.1-1 (2): 25 wells in Oasis Feiran and 15 wells in Tarfa. Location of wells is shown in Fig. 8.2.2-1.

No drilling data on the Quaternary aquifers are available in the wadi except deep wells drilled in the downstream of the wadi by WRRI.

Most wells are for irrigation use and a few wells are for domestic use.

3) Supplementary Geological Survey

Through all reaches of the W. Feiran, TEM survey was conducted by JICA Study Team, during 1st stage of the 2nd field study. The location of the survey area is shown in Fig. 6.2.3-8. Spacing of measurement station is approximately 1 km. Five (5) geoelectrical profiles were provided. The profiles were analyzed up to a depth of 350 to 400m depth.

The interpretation of the each geoelectrical profiles are as follows;

(1) Down Stream Section (Line-G and Line-H: Fig. 8.2.2-2)

Five (5) layered were identified from apparent resistivity. The existing wells, Feiran-1 and Feiran-2 are located at measurement station of G010 and G007 respectively. Their data were used as reference. Layers III and IV are considered as an aquifer correlated to the Lower Cretaceous Sandstone. The aquifer is divided by the two (2) lateral discontinuity of apparent resistivity between G008 and G007, and between G006 and G005. This discontinuity is also recognized in the drilling data between the wells. This lateral discontinuity is considered as fault. A similar lateral discontinuities are observed in the Line-H. Therefore it is considered that the depth to the main aquifer changes from place to place.

Following table shows summary of the interpreted relation between lithological formation and resistivity range.

Layer	Resistivity Rang (ohm-m)	Estimated Lithology	Hydrogeological Interpretation
(I)	20 - 70	wadi deposits at surface, limestone and dolomitic limestone at lower	Quaternary Wadi Deposits at upper, weathered limestone at lower
(II)	< 10	shale, partly intercalated with limestone	Upper Cretaceous formation
(III)	80 - 250	sandstone, partly intercalated with shale or limestone	expected aquifer, Lower Cretaceous Limestone
(IV)	10 - 40	sandstone, sometimes intercalated with shale	expected aquifer, Lower Cretaceous Limestone
(V)	> 1,000	plutonic rock	Pre-Cambrian Rocks

(2) Middle to Upper Stream Section (Line-D, E and F: Fig. 8.2.2-3)

In this profile, three (3) layers were identified from apparent resistivity. There is no existing well in this area. So that lithology of the each analyzed layer were estimated by geological situation.

Following table shows summary of the interpreted relation between lithological formation and resistivity range.

Layer	Resistivity Rang (ohm-m)	Estimated Lithology	Hydrogeological Interpretation
(I)	100 - 500	wadi deposit at surface and marl at lower	Quaternary Wadi Deposits at upper, Feiran Bed at lower
(II)	> 1,000	plutonic rock	Precambrian Rocks
(III)	10 - 40	plutonic rock	Precambrian Rocks

4) Configuration of Aquifer

(1) Down Stream Area

Line G and H are located at Mokattab Village and divide with El Qaa Plain respectively. In this area, Wadi Deposits vary its thickness from 50 m to 120 m in general and 20 m in minimum. It seems that groundwater appears at the depth more than 30m depth. Therefore, it is difficult to construct dug wells in the area.

(2) Middle to Upper Stream

Profiles are allocated Line D to downstream of Tarfa, and Line E and F to Oasis Feiran. In the Tarfa profile (Line D), the Wadi Deposits becomes thick, 170 m in maximum and 100 m in average. On the other hand, in the Oasis Feiran area, it is thin, generally 15 m to 25 m and 100 m in maximum.

5) Hydrogeological Characteristics of Aquifer

Most area of the basin is occupied by the Precambrian Rocks. The Pleistocene Feiran Bed and the Quaternary Wadi Deposits crop out overlying the Precambrian Basement Rocks in places along the wadi. As mentioned in Chapter V, a number of faults are concentrated in the Oasis Feiran area and many dykes of open cracks distribute in the area (Refer to Fig. 5.5-1: Geological Structure). Rain water precipitates on the Basement Rocks and infiltrates into the fissures, joints and faults in the Rocks. Then the water discharges to the aquifers in the Wadi Deposits. This recharge seems to be occurred in the area, upstream of Oasis Feiran.

The groundwater in the Wadi Deposits is exploited by dug wells. The rest of groundwater discharges to the Lower Cretaceous aquifers in the downstream area.

6) Groundwater Level

In the W. Feiran area, including El Tarfa area, the groundwater level are recorded at 30 dug wells and two (2) cased wells (See, Table 8.1.1-1(2). These data are described in Well Inventory. As for the dug wells, a range of groundwater level is 8.83 to 26.0

mBGL and a average level is 14.78 mBGL. On the other hand, as foe the cased well, a range of groundwater level is 41.58 to 41.91 mBGL, and a average level is 41.34 mBGL.

As shown as well inventory, a similar and narrow range of the groundwater level are observed in this area.

7) Groundwater Quality

(1) Obtained Data

As for chemical analysis data, there is no periodical measurement in this area. Available data is limited 1 or 2 in the year of 1994 and/or 1995 (See, Table below).

Availability of Water Quality Data (W.Feiran)

	Well Identification		Availability of water Quality Data		
Sr. No.	WRRI Code No.	Well Name	Periodical Measurement Since/To	Periodical Measurement Interval	Number of Data
	W. Feiran				
26	47CC-001	Mohamed Mansour	1/94, 1/95	12M	2
28	47CB-003	Mohamed Salem 2	1/94, 1/95	12M	2
31	47CB-007	Hassan Gebaly 1	1/94, 1/95	12M	2
33	47CB-008	Hassan Gebaly 2	1/95	one data	1
40	47CB-011	Fiteeh 2	1/95	one data	1
43	47CB-012	Mobark Emam	1/95	one data	1
47	47CB-017	El Hesswa	1/95	one data	1
	El Tarfa				
10	47CE-002	Eid Saleh Eid	1/94, 1/95	12M	2
15	47CE-005	Gomaa Khamis	1/94, 1/95	12M	2
18	47CE-010	Hassan Awad Mohane	1/94, 1/95	12M	2
21	47CE-013	Farha Slama	1/94, 1/95	12M	2
22	47CE-014	Raffe Salama	1/94, 1/95	12M	2
23	47CE-015	Mobarak Saleh 2	1/94, 1/95	12M	2
25	47CD-001	Sahab	1/94, 1/95	12M	2

Chemical analysis for the samples taken from 2 wells of M Salem-1 and Refaay in Wadi Feiran and a well of Gomma Khamis in El Tarfa Area have been carried out by JICA Study Team (1997). And a range of depth is 10m to 25m.

(2) TDS Distribution

A groundwater quality map of shallow aquifer in the area is provided as shown as Fig. 8.2.2-4. As a represented well in the area, Piper and Stiff diagram of well No. 47DE-008 is shown in Fig. 8.2.2-5 and Fig. 8.2.2-6 respectively. Generally, low TDS value of less than 800 mg/l is distributed in the entire area. Moreover, major component of ions are within the value of Egyptian drinking water standard. The TDS value is relatively high in north, and relatively low in south. The characteristic of the groundwater quality distribution of the area is uniform and stable distribution. No remarkable trend of seasonable variation is found in the area.

8) Groundwater Extraction

According to the data prepared by WRRI, total extraction reaches to 131 m^3/hour: Maximum discharge is 15 m^3/hour at El Mosalam Saleh well (47CB-015, Sr. No. 45) and average rate is 4.7 m^3/hour.

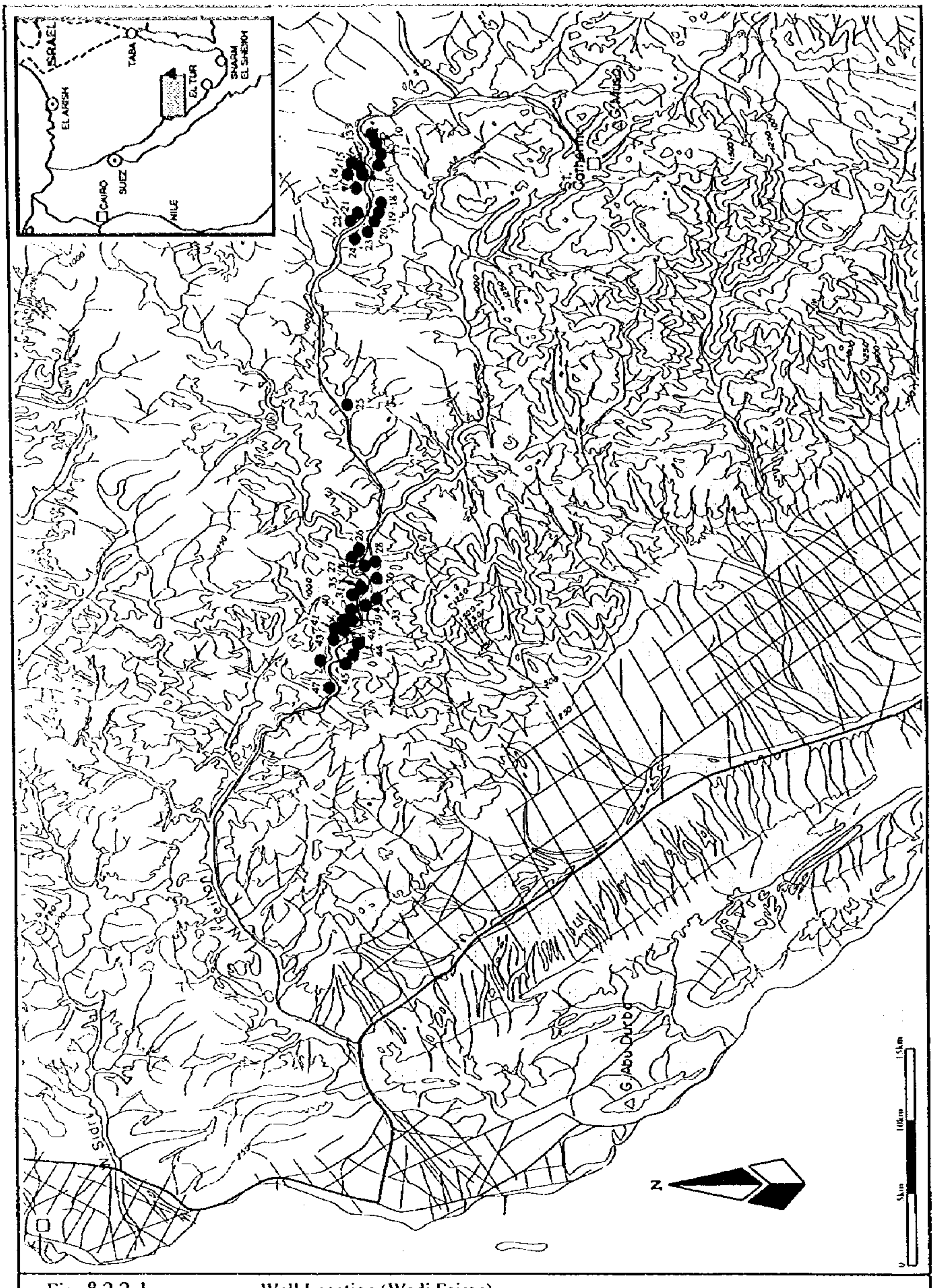

Fig. 8.2.2-1	Well Location (Wadi Feiran)

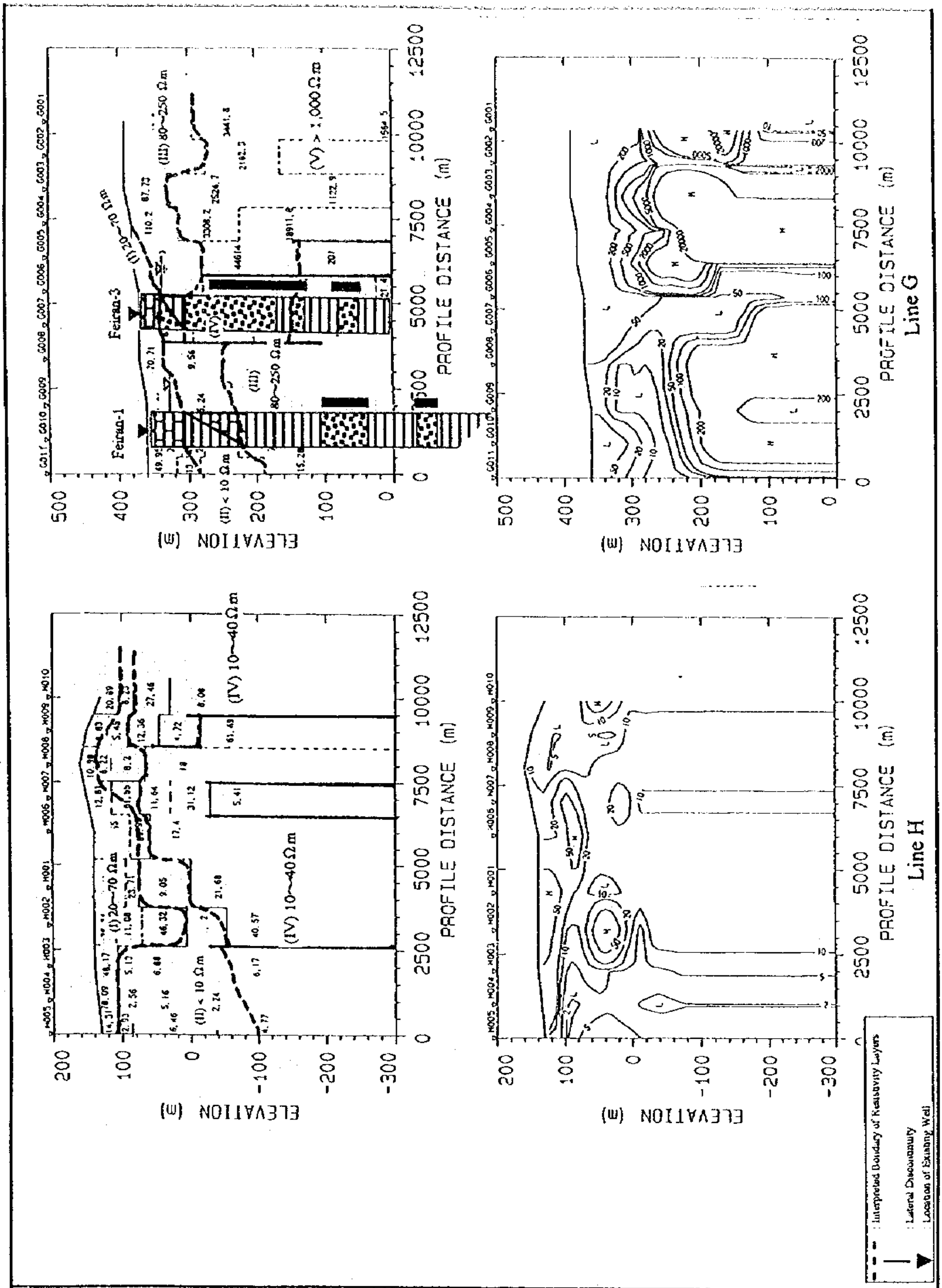

Fig. 8.2.2-2 Geoelectric Profile (Line G and H: Wadi Feiran)

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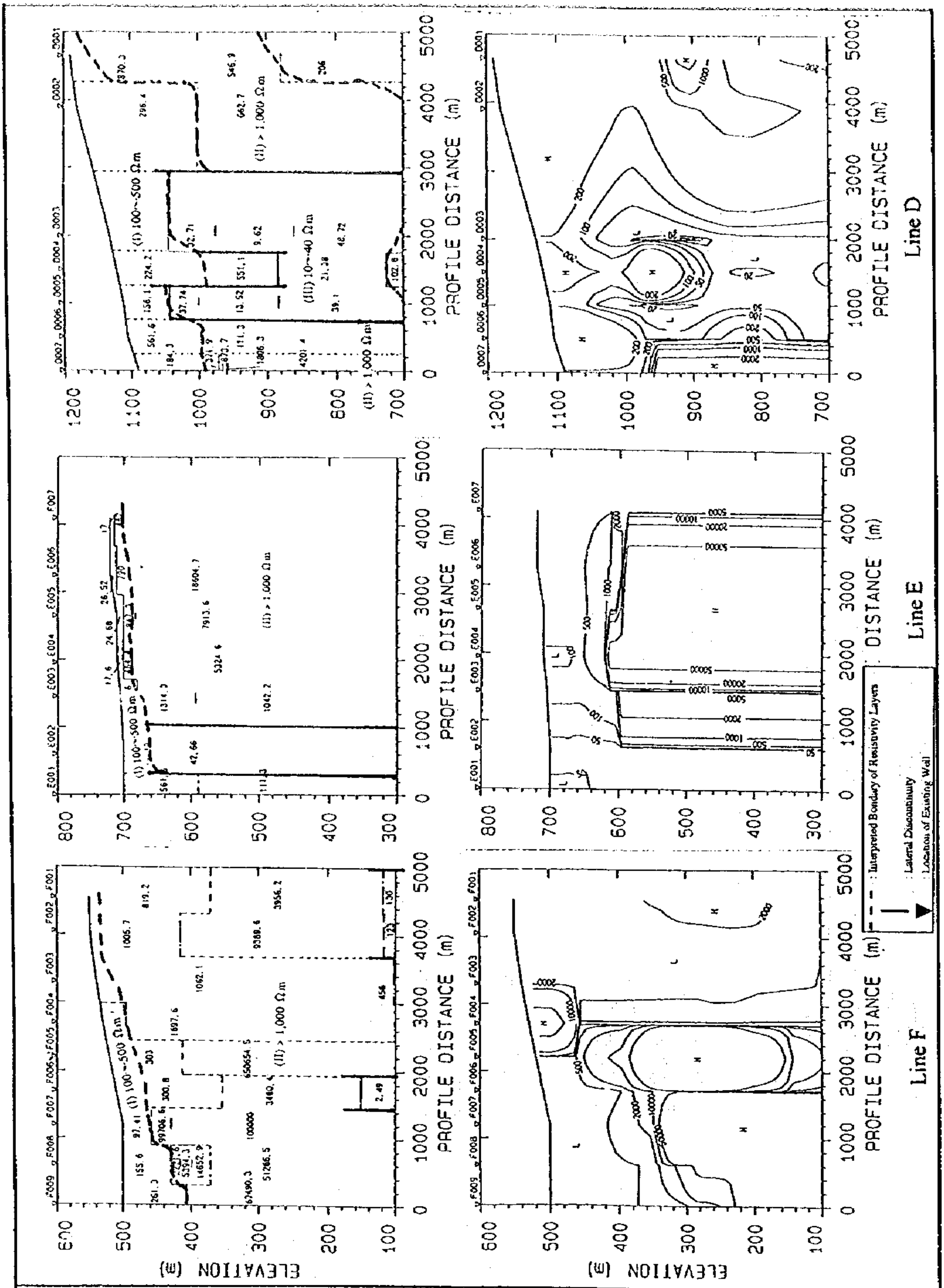


Fig. 8.2.2-3 Geoelectric Profile (Line D, E and F: Wadi Feiran)

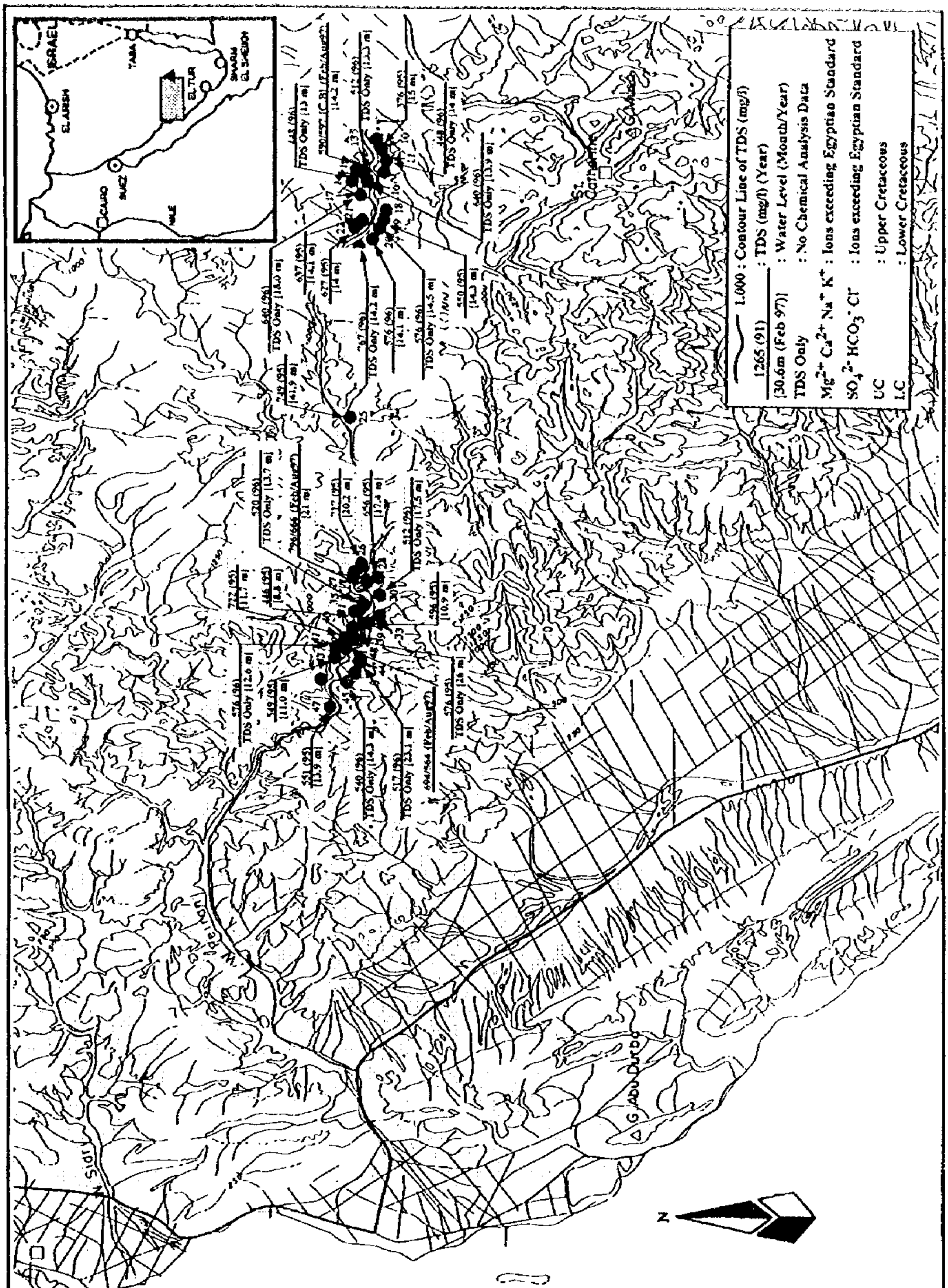
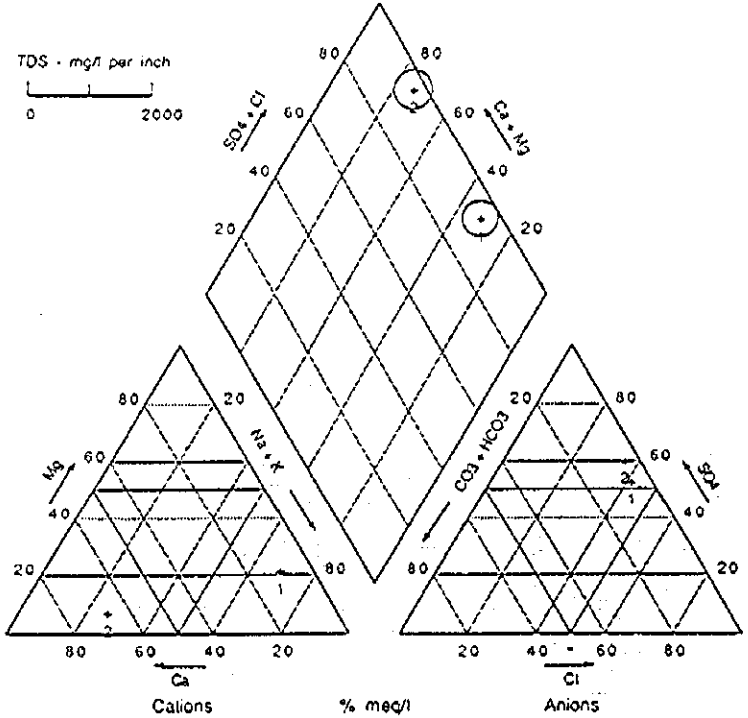


Fig. 8.2.2-4 Groundwater Quality (W. Feiran)



47DE-008					
No.	TDS	Sample	No.	TDS	Sample
1	637	Jan-94			
2	689	Jan-95			

Fig. 8.2.2-5 Piper Diagram (Well No. 47DE-008 : W. Feiran)

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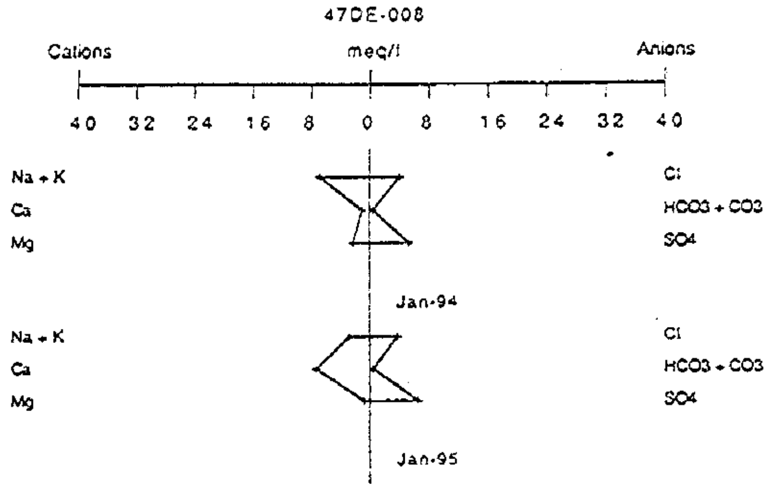

Fig. 8.2.2-6 Stiff Diagram (Well No. 47DE-008 : W. Feiran)

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8.2.3 St. Catherine and Wadi Sheikh

1) General Feature of Basin

The area is located in the central part of the Basement Plateau. Precipitation is about 60 mm/year. Wadi Sheikh originates from the highest point, Gebel Catherine (2,637 m ASL), and joins to the Wadi Feiran near Tarfa through Watia Pass.

The Precambrian Basement Rocks are widely distributed in the area.

Springs are occurred at some places such as El Rabba spring.

St. Catherine Town has a 4,600 of population (as of 1994) and is supplied domestic water from the wells (dug well and cased well) in the basin.

2) Well Inventory

There are 23 water points as listed in the Well Inventory (Table 8.1.1-1 (3)) All the production wells are dug wells, except 2 cased wells of Zaituna and Harouna. Location of dug wells are shown in Fig. 8.2.3-1.

3) Supplementary Geological Survey

Geophysical survey was conducted by WRRI in the Wadi Sheikh area to confirm the hydrogeological condition of the area and to select the location of a piezometer to be constructed.

Seven (7) station were allocated in the area. Three (3) layers were identified as the result. The first layer has a resistivity range between 240 to 750 ohm-m and considered to be dry. This layer is correlated to the Wadi Deposits. The resistivity of the second layer ranges from 150 to 240 ohm-m and the layer is considered as weathered granite which seems to be an aquifer. The third layer shows high resistivity ranging from 900 to 5000 ohm-m and considered as jointed granite.

Following table shows summary of the interpreted relation between lithological formation and resistivity range.

Layer	Resistivity Rang (ohm-m)	Estimated Lithology	Hydrogeological Interpretation
(I)	240 - 750	wadi deposits	Quaternary Wadi Deposits, dry
(II)	150 -240	weathered granite	Precambrian Rocks, expected aquifer,
(III)	900 - 5000	jointed granite	Precambrian Rocks, Basement

4) Configuration of Aquifer

Aquifer occurs in Weathered Granite and Quaternary Wadi Deposits. The distribution area of the aquifer is governed the shape of wadi. It distributes in the area from St. Catherine town to Watia Pass. Length of the section is approximately 18 km, and width is about 500 m in the upstream and 2 km in the downstream. Thickness of aquifer is about 30 to 80 m averaging 55 m.

Volume of the aquifer is roughly estimated to be 10 km^3.

5) Groundwater Level

In the St. Catherine area, the groundwater level are recorded for six (6) deep wells (more than 30m depth) and 11 shallow wells (less than 20m depth). These data are listed in the Well Inventory. As for the deep wells, a range of 29.7 to 48.8 mBGL with a average value of 38.14 mBGL of groundwater level is distributed. As for the shallow wells, a range of 2.4 to 14.4 mBGL with a average value of 7.67 mBGL is distributed.

Compared with W. Feiran area, relatively shallow water table is distributed both of shallow and deep Quaternary aquifer, spite of elevation of ground level is higher than W. Feiran area.

6) Groundwater Quality

(1) Obtained Data

As for St. Catherine area, the obtained data are 17 wells including JICA measurement. Chemical analysis for the samples taken from 2 wells of Harouna Well and Sowira-1 and a spring of El Rabba have been carried out by JICA Study Team (1997). A range of depth of Dug Wells is 10m to 40m.

(2) TDS Distribution

A groundwater quality map of shallow aquifer in the area is provided as shown as Fig. 8.2.3-3. Generally, low TDS value of less than 600 mg/l is distributed in the entire area. Major component of ions are within the value of Egyptian drinking water standard. No remarkable trend of seasonable variation is found in the area. The characteristic of the groundwater quality distribution of the area is uniform and stable.

5) Hydrogeological Characteristics of Basin

Aquifer is occurred in the Quaternary Deposits accumulated in the wadi. Considering the geological setting of the wadi, the groundwater seems to be derived from the present precipitation in the basin.

Water level is 43.2 m in the Zaituna well and 29.7 m in the Harouna well. Water quality is fresh.

6) Groundwater Extraction

Two (2) wells are used as production wells for water supply to St. Catherine town: They are Zaitouna well and Harouna well. Extraction rate of these well are 40 m^3/day and 300 m^3/day. Other dug wells show low yield ranging from 1 to 6 m^3/hour. Total extraction rate in the area reaches 124,100 m^3/year.

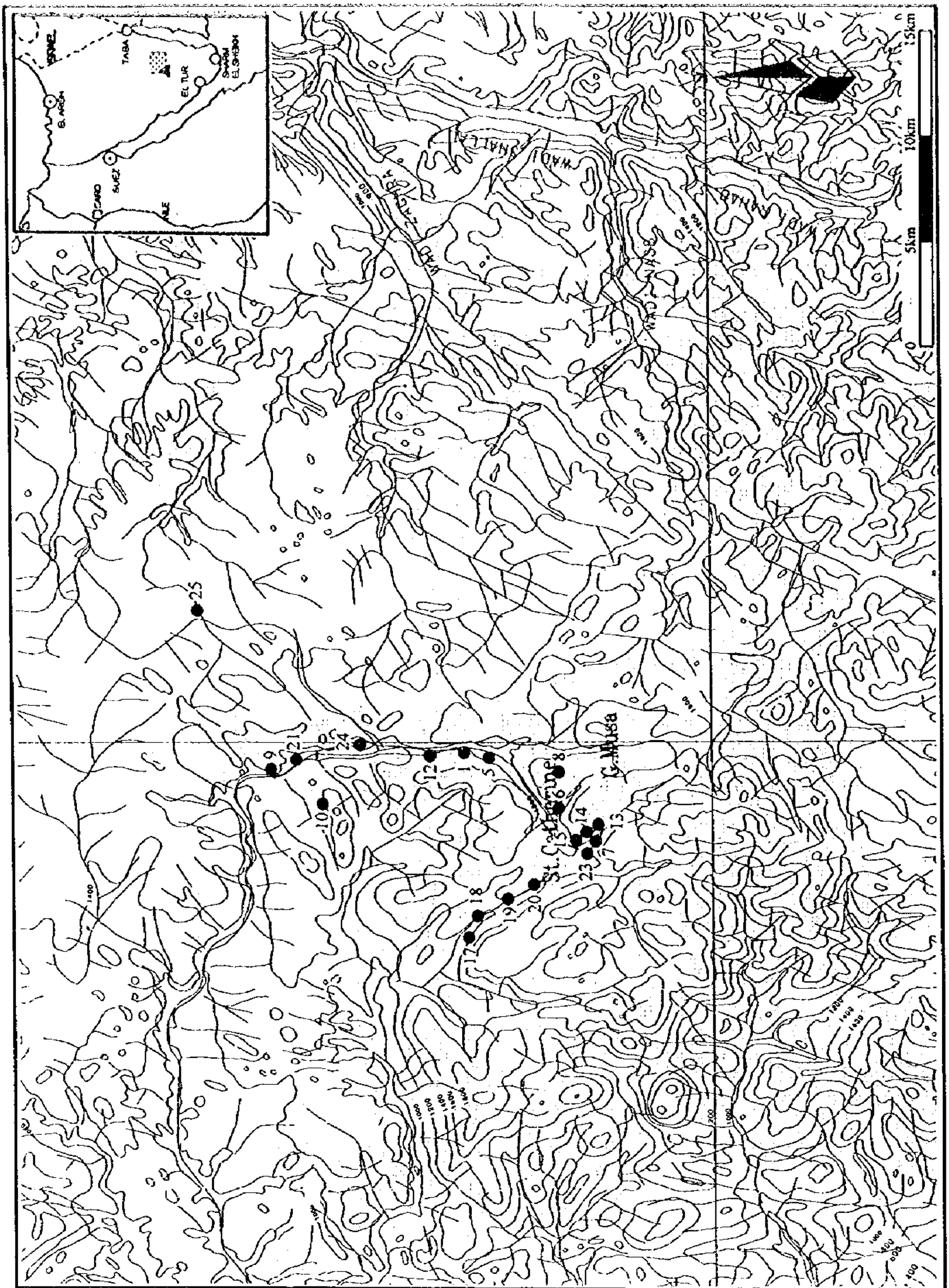

Fig. 8.2.3-1 Well Location (St. Catherine)

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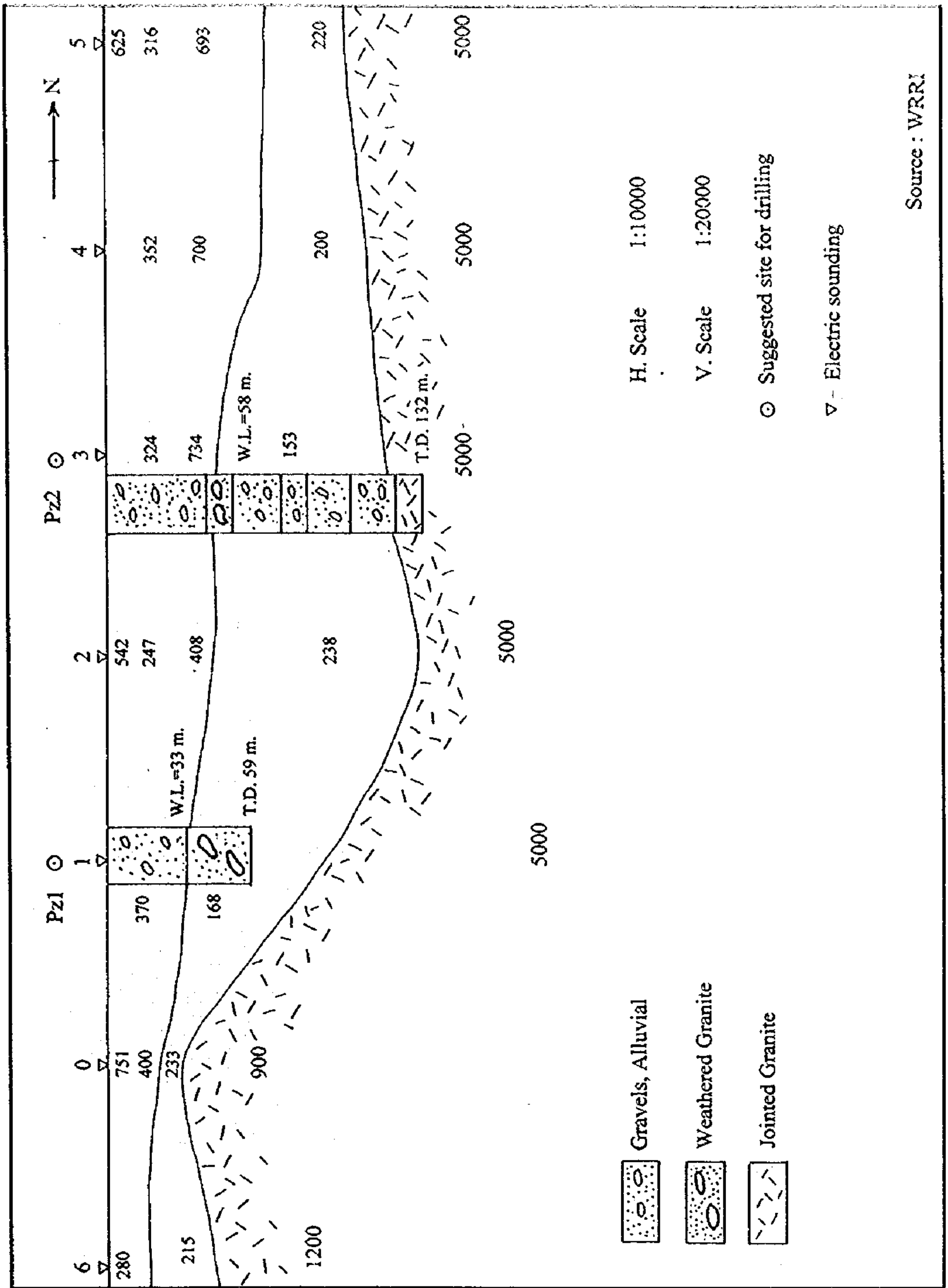

Fig. 8.2.3-2 Geoelectric Section (Wadi El-Sheikh)

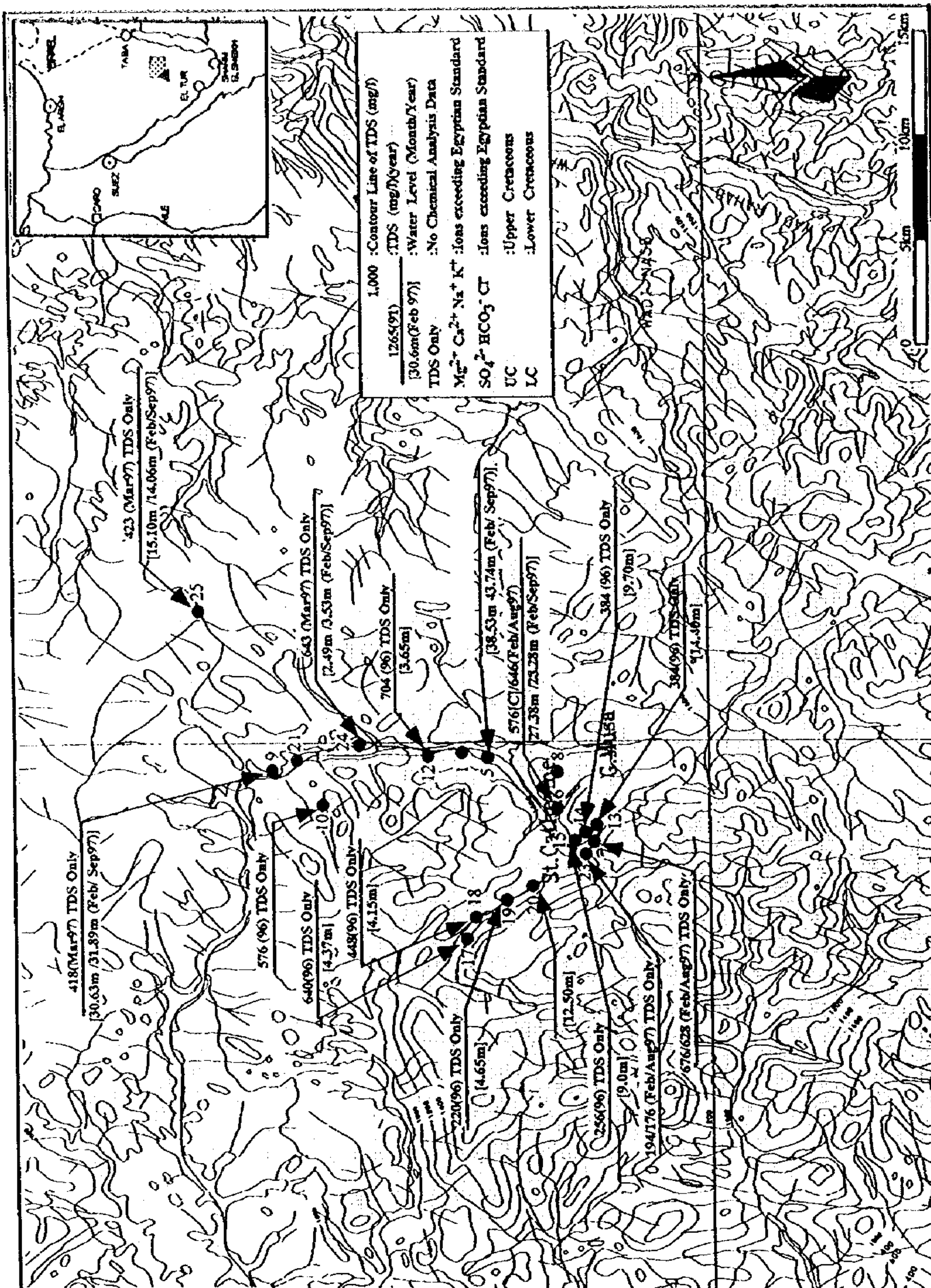

Fig. 8.2.3-3 Groundwater Level/Quality: St. Catherine (unit: mBGL)

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8.2.4 Wadi Garf and Wadi Babaa

1) General Feature of Basin

The basin is located on the north of Wadi Feiran area. Sheikh Nasba is the main village in the basin and is the entrance to a manganese mine which yields Turquoise.

Wadi Garf originates from the southwestern fringe of Egma Plateau and joins to the Wadi Babaa at Sheikh Nasba as shown in Fig. 8.2.4-1. Wadi Babaa outflows to Gulf of Suez: Its river mouth is between Abu Zenima and Abu Rudeis. Total area occupies 1,095 km^2. Precipitation in this area is about 20 mm/year.

In the upstream, the basin shows wide gentle slope developing between the Precambrian in the south and the sediment rocks from Paleozoic to Upper Cretaceous in the south. The stream flows in the narrow valley formed mainly in the Precambrian Basement Rocks. Wells in W. Garf concentrate in this area between Sheikh Nasba and about 8 km east of the village. In the downstream, the wadi changes the name to W. Babaa. Wells are also distributed in the downstream basin.

2) Well Inventory

There are 18 dug wells as listed in the Well Inventory (Table 8.1.1-1 (4)). Location of dug wells are shown in Fig. 8.2.4-1 for Wadi Babaa and Fig. 8.2.4-2 for Wadi Garf.

3) Groundwater Level

No water level data are available, therefore, the Study Team conducted water level measurement in March and September 1997 to compare seasonal change.

In March, static water level in Wadi Garf changes from 501 mASL at the well L (Sr. No. 10) to 389 mASL at the well M (Sr. No. 2). Gradient is about 12/1000. On the other hand, static water level changes from 524.5 mASL to 406.8 mASL at the same wells in September. Static water level decreases in Summer season compared with in winter season. Degree of decreasing is less than 1 m.

	Well Identification			March		Sep.		
Sr. No.	RWWI Code No.	Well Name	Elev. (mASL)	S.W.L (mBGL)	S.W.L (mASL)	S.W.L (mBGL)	S.W.L (mASL)	Change (m)
1		L	420	12.30	407.70	13.20	406.80	-0.90
2		M	400	11.08	388.92	16.7*	383.30	-5.62
3		N	405	14.79	390.21	15.7	389.30	-0.91
4		O	430	12.66	417.34	13.55	416.45	-0.89
5		P	440	10.68	429.32	11.52	428.48	-0.84
6		Q	450	7.52	442.48	9.55*	440.45	-2.03
7		R	480	8.64	471.36	8.73	471.27	-0.09
8		S	490	9.02	480.98	9.20	480.80	-0.18
9		T	500	10.4	489.60	10.6	489.40	-0.20
10		U	520	18.85	501.15	19.9*	500.10	-1.05
11		V	540	14.90	525.10	15.50	524.50	-0.60

*: measured after pumping

In Wadi Babaa, static water level is between 358.74m ASL and 332.98 mASL in March. In September static water level decreases in a degree less than 0.5 m as shown below.

	Identification			March		Sep.		
Sr. No.	RWWI Code No.	Well Name	Elev. (mASL)	S.W.L (mBGL)	S.W.L (mASL)	S.W.L (mBGL)	S.W.L (mASL)	Change (m)
1		1	370	11.26	358.74	11.43	358.57	0.17
2		2	365	11.41	353.59	11.87	353.13	0.46
3		3	360	5.91	354.09	-		
4		4	350	8.56	341.44	-		
5		5	350	9.62	340.38	9.94	340.06	0.32
6		6	340	5.88	334.12	-		
7		7	340	7.02	332.98	7.4	332.60	0.38

4) Groundwater Quality

(1) Obtained Data

JICA Study Team has carried out field water quality survey for nine (9) Dug Wells of which depth is 9 m to 20 m in the Wadi Garf and nine (9) Dug Wells of which depth is 6 m to 12 m in the Wadi Babaa.

(2) TDS Distribution

A groundwater quality map of Wadi El Garf is provided as shown as Fig. 8.2.4-3. A range of TDS value is 700 to 3000mg/l. Relatively low salinity is distributed on the up-stream of the wadi. No remarkable trend of seasonable variation is found in the area. A groundwater quality map of Wadi Babaa is provided as shown as Fig. 8.2.4-4. A range of TDS value is 1600 to 1,700mg/l. A similar value of salinity is distributed. No remarkable trend of seasonable variation is found in the area.

5) Hydrogeological Characteristics of Basin

Wadi Garf basin Aquifer is occurred in the Quaternary Deposits and weathered and/or jointed Precambrian Basement Rocks. Although annual precipitation is only 20 mm, groundwater is recharged by flood caused by this rainfall. As mentioned in 1) of this close, upstream of this wadi is wide and gently sloped basin and the stream flows into the narrow valley in the east of Sheikh Nasba. Therefore, it seems that rainfall and flood are collected in the upstream and infiltrate into the aquifer. Then, groundwater effectively concentrates into the valley.

6) Groundwater Extraction

All the wells are used for domestic and irrigation. According to the interview to owners, groundwater is extracted 1.0 m^3/day (= 20 liter/tank x 20 tanks). Since there are 18 dug wells, it is estimated total extraction as 18 m^3/day and 8,570 m^3/year.

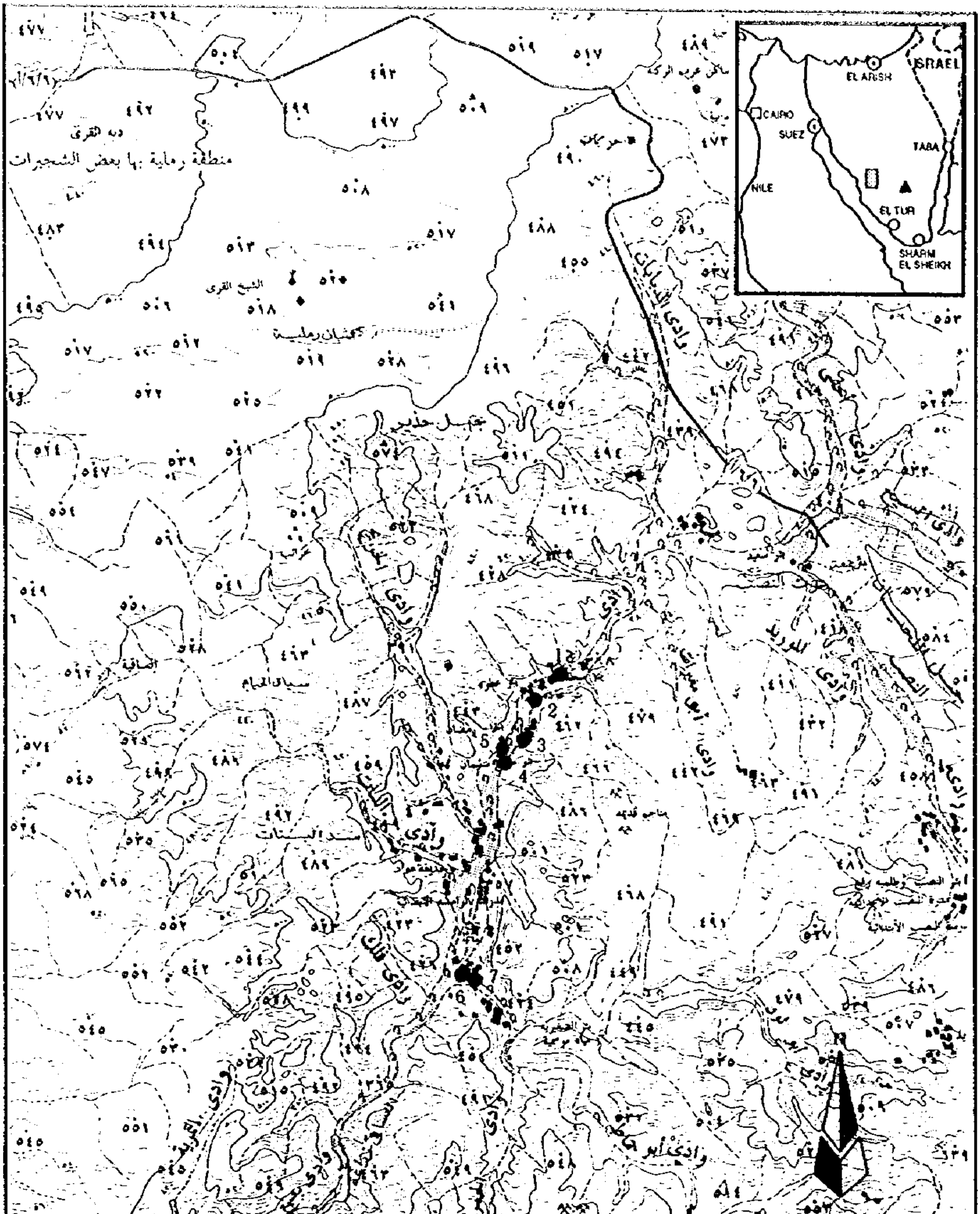

Fig. 8.2.4-1 Well Location (Wadi Babaa)

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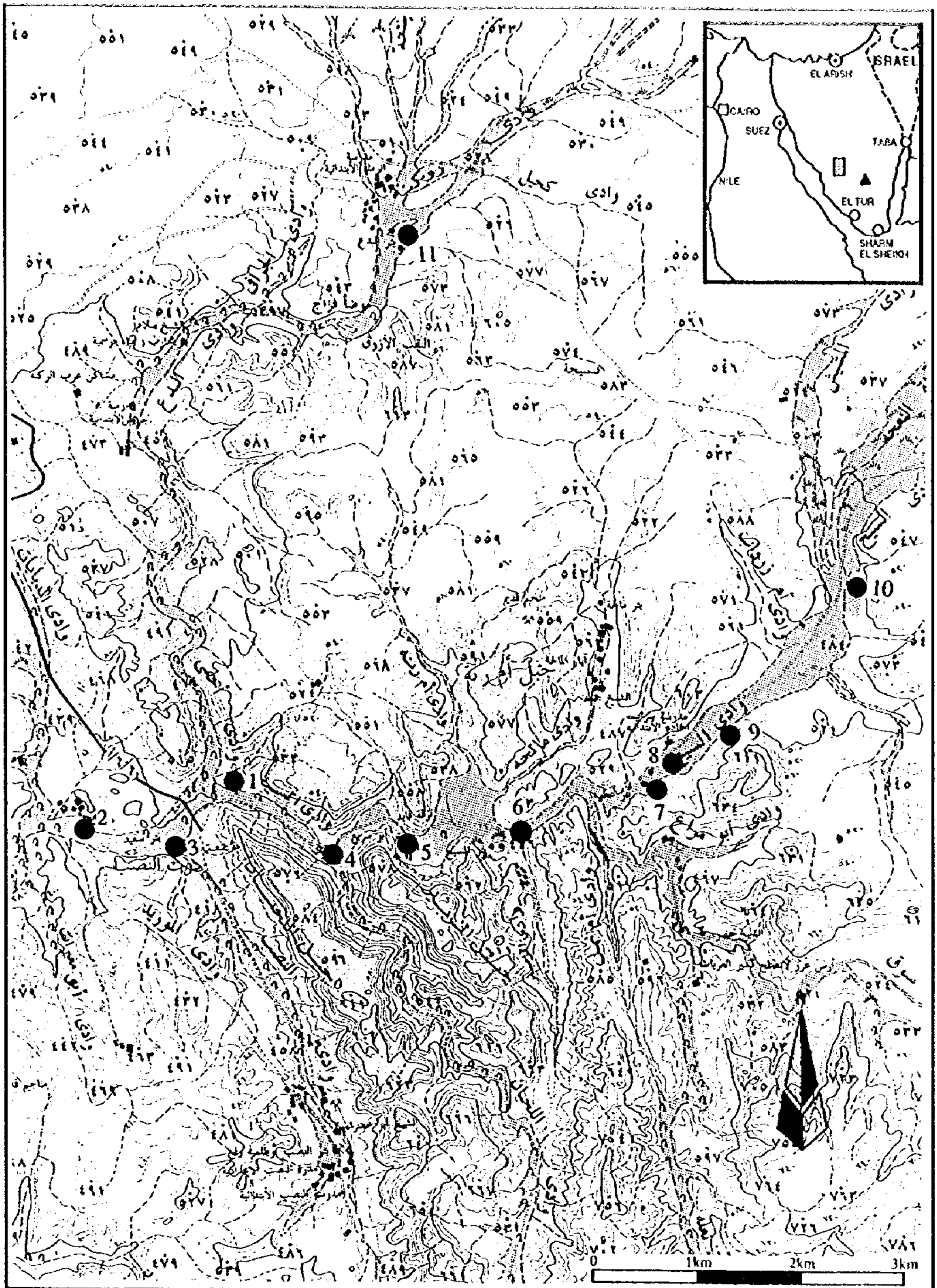

Fig. 8.2.4-2 Well Location (Wadi El Garf)

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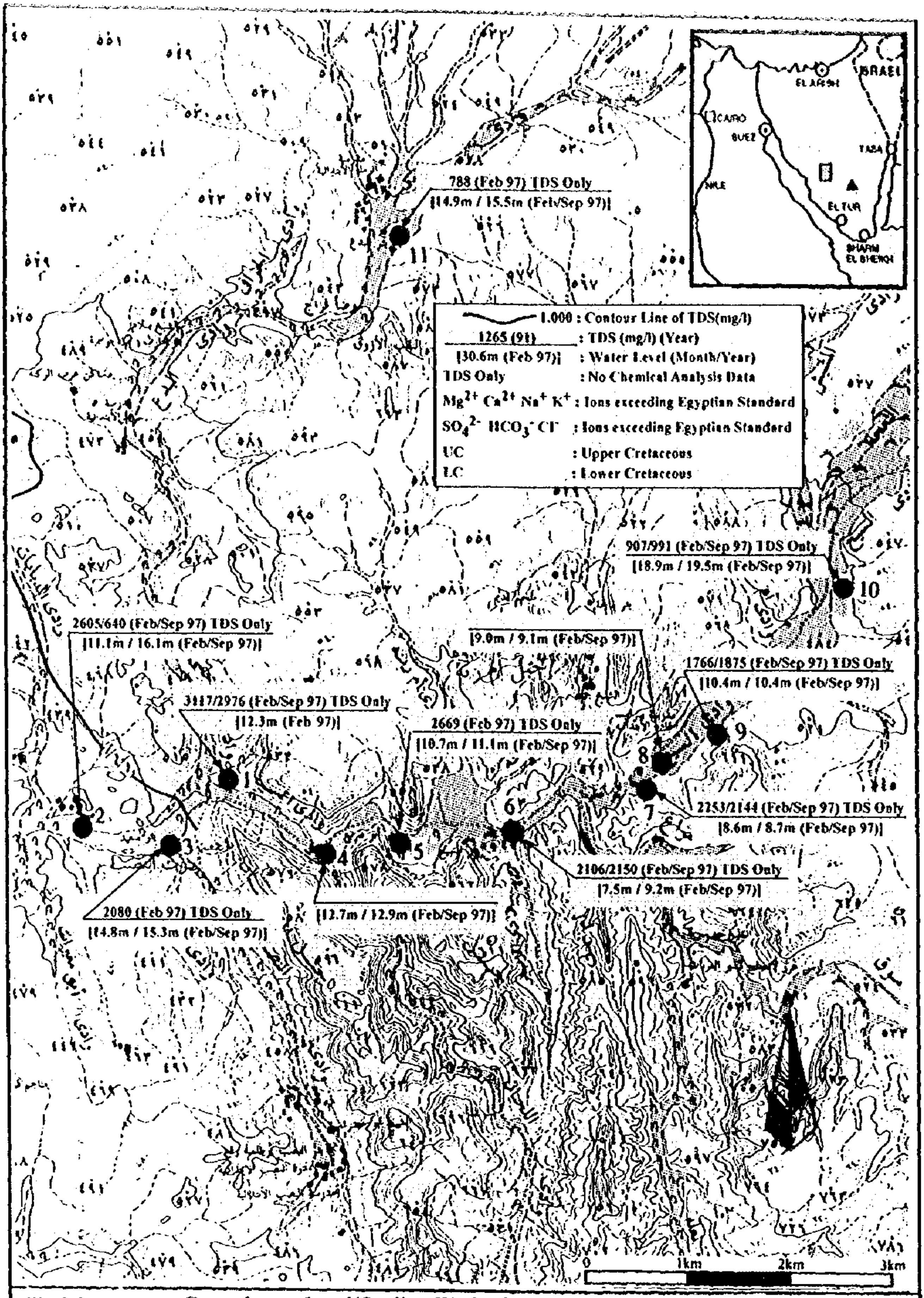

Fig.8.2.4-3 Groundwater Level/Quality: W. Garf (unit: mBGL)

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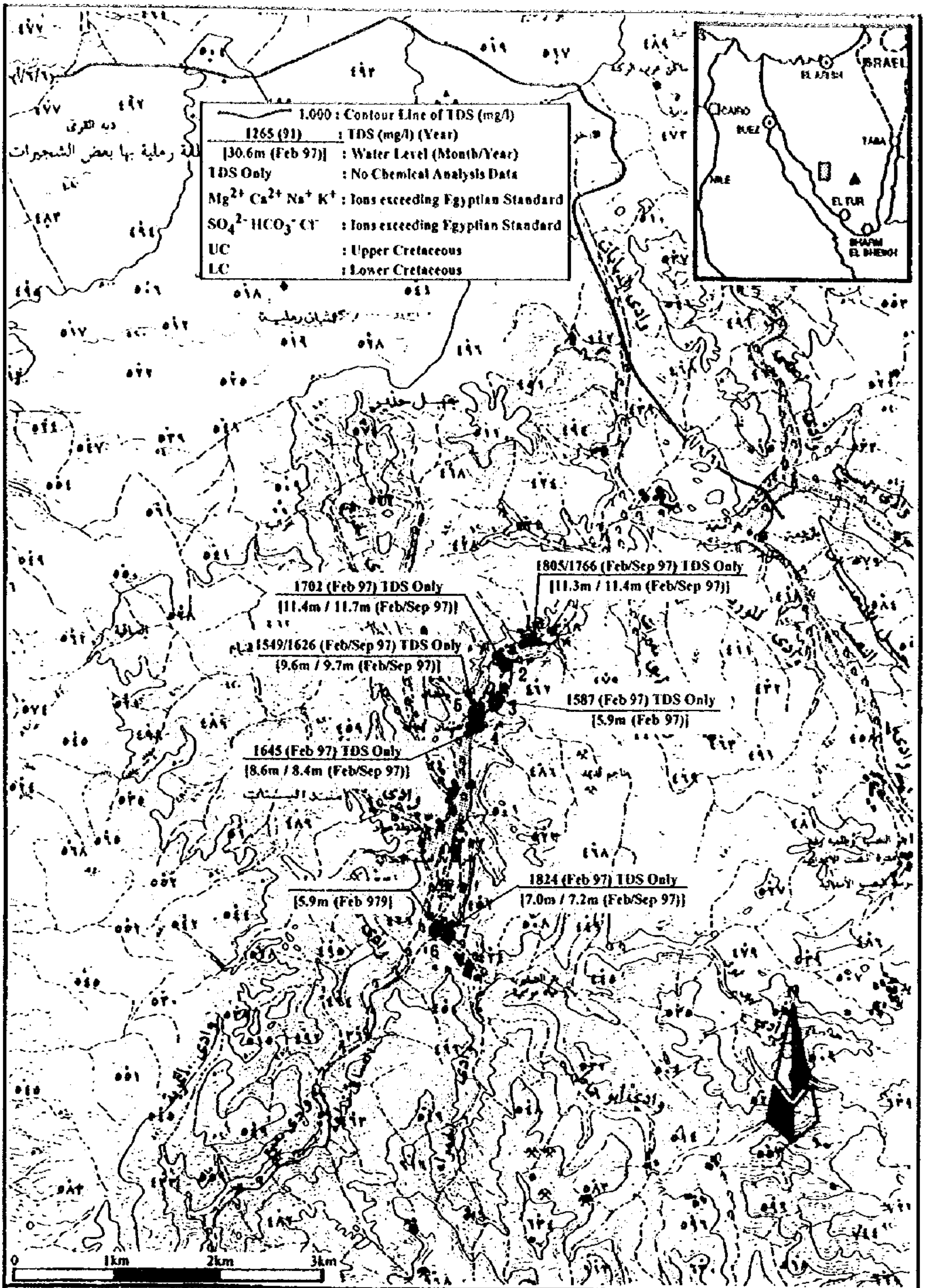

Fig.8.2.4-4 Groundwater Level/Quality: W. Babaa (unit: mBGL)

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8.2.5 Wadi Gharandal

1) General Features of Basin

Wadi Gharandal is one of the main basins and is located in the southwestern part of the Sinai Peninsula. The wadi originates in the western edge of the El Tih Plateau and flows into the Suez Bay at the area near Abu Zenima, approximately 130 km from El Tur, collecting W. Gaada and other small wadis (Fig. 8.2.5-1). The wadi generally flows toward west and it suddenly changes direction to southeast at about 21 km point from the river mouth. In some case, the wadi is called as Wadi Gharandal and Wadi Gada in the upstream, however, the Wadi Gharandal is used as the generic name of whole wadi in this report.

The Cretaceous formations are distributed at the eastern part of the basin consisting of shale and limestone. These are overlain by the Palaeocene and Eocene formations.

In the western part of the basin, the wadi is surrounded by the Miocene formations.

The wadi is covered by the Quaternary Deposits composed of silt and sand with gravel. The thickness reaches to 50 m. Many dug wells are constructed in the deposits.

2) Well Inventory

RIWR drilled three (3) deep wells penetrating into Pre-Quaternary aquifers: Gharandal-1 to Upper Cretaceous, Gharandal-2 to Lower Cretaceous and Gharandal-3 to Paleozoic. Apart from these deep wells, all the dug wells in the wadi were confirmed through the Study. There are 12 dug wells and three (3) springs tapping groundwater from the Quaternary aquifers.

Inventory of those are shown in Table 8.1.1-1 (5).

3) Supplementary Geological Survey

Along the W. Gharandal, TEM survey was conducted by JICA Study Team, during 1st stage of the 2nd field study. The location of the survey area is shown in Fig. 6.2.3-11. A total of two (2) geoelectrical profiles are provided. The profiles are compiled with an interval of approximately 1 km measuring station and analyzed depth of 250 to 350m depth.

In the W. Gharandal, a total of two (2) profiles of Line-I and Line-J were established as shown as Fig. 8.2.5-2. An existing well of Gharandar-1 is located 2,600m east of the last measurement station of J009.

Three (3) layered model is applied except area between measurement station I001 and I006. A total of four (4) major lateral discontinuity is observed in profile line J. The layer is divided by this discontinuity. However, it is considered as a same Upper Cretaceous formation. The difference of the range of resistivity is probable due to the difference of predominance of the shale content. In this profile, aquifer of the Lower Cretaceous Sandstone is not observed.

The interpretation of the each geoelectrical profiles are as follows;

Layer	Resistivity Rang (ohm-m)	Estimated Lithology	Hydrogeological Interpretation
(I)	20 - 50	wadi deposit at surface and chalky limestone or marly limestone at lower	recent quaternary wadi deposit at upper, weathered upper cretaceous formation at lower
(II)	10 - 20	silt stone or shale	upper cretaceous formation
(III)	< 5	shale	upper cretaceous formation
(III')	10 - 60	limestone	upper cretaceous formation

4) Configuration of Aquifer

The first dug well (Well A: Sr. No. 1) is located about 16 km and the last one (Ain Higiya Well : Sr. No. 15) is about 62.5 km from the river mouth. The down stream section from the first well to the river mouth is not suitable for construction of dug wells because the width of the wadi becomes wider so that groundwater level decreases in this section. Therefore, the area of the Quaternary aquifer seems to be almost same as distribution of dug wells and springs.

The aquifer is composed of silt and sand containing gravel of which thickness is generally 10 to 30 m (maximum 50 m).

5) Groundwater Level

No periodical data are available in the area, therefore, water level and water quality were measured by the Study Team in February and September 1997. Results are shown in Fig. 8.2.5-3.

		Feb. 1997			Sep. 1997			Change	
Sr. No.	Well No	TDS (mg/l)	S.W.L (mBGL)	S.W.L (mASL)	TDS (mg/l)	S.W.L (mBGL)	S.W.L (mASL)	S.W.L (m)	TDS (mg/l)
1	A	dry			dry				
2	B	dry			dry				
3	C	1208	13.00	117.00	1208	13.05	116.95	0.05	0
4	D	dry			dry				
5	E	613	24.65	255.35	545	25.61	254.39	0.96	68
6	F	2624	19.22	300.78	1275	18.95	301.05	-0.27	1349
7	G	1038	18.45	301.55	723	19.95	300.05	1.50	315
8	H	529	23.85	316.15	376	23.78	316.22	-0.07	153
9	I	445	31.49	388.51	400	31.50	388.50	0.01	45
10	J	-	17.74	482.26	dry				
11	K	1337	15.17	504.83	442	15.16	504.84	-0.01	895
12	Spring 1	2944			dry				
13	Spring 2	1708			dry				
14	Spring 3	1014			dry				
15	Ain Higiya	834	1.12	668.88	852	1.86	668.14	0.74	-18

Compared with winter and summer seasons, water level generally decreases except some wells. Dug well G (Sr. No. 7) showed the highest recession of 1.5 m and that of others are less than 1 m. On the other hand, water level raised a little in dug wells F, H and K.

Gradient of static water level is 12/1000.

6) Groundwater Quality

(1) Obtained Data

As for Wadi Gharandal, JICA Study Team has carried out field water quality survey for 12 Dug Wells (1997). No chemical analysis were carried out. A range of depth of Dug Wells is 11m to 32m.

(2) TDS Distribution

A groundwater quality map of shallow aquifer in the area is provided as shown as Fig. 8.2.5-3. A low salinity zone showing of less than 500 mg/l TDS is distributed in the mid-stream of Wadi. Major component of ions are within the value of Egyptian drinking water standard. The TDS value is relatively high in the right bank, and relatively low in the left bank of the Wadi. The TDS variation indicate that low on February and high on September at all the wells measured.

7) Hydrogeological Characteristics of Basin

Upper Cretaceous Limestone widely distributes in the upstream of the wadi and Tertiary Limestone is predominant in the downstream. The Tertiary is in contact with the Upper Cretaceous and the Tertiary were cut by many faults extending for NNW-SSE direction. Northeast trending faults are also observed.

The Quaternary Deposits filled the valley formed in these formations. Facies of Quaternary aquifer consists of sand and gravel.

The aquifer of the basin seems to be recharged by local precipitation judging from the location and the geological setting.

Static water level is generally deep, between 18.5 and 31.5 mBGL. TDS of groundwater is between 445 mg/l at Well K (Sr. No. 11) and 1944 mg/l at Spring 1 (Sr. No. 12), averaging 1,300 mg/l in winter and 728 mg/l in summer..

8) Groundwater Extraction

Use of groundwater is for mainly domestic and small scale of irrigation. Irrigation water is supplied from deep wells exploiting groundwater from Pre-Quaternary aquifers. All the dug wells are not equipped engine pumps to extract groundwater. Therefore, groundwater extraction rate is negligibly small. Provided that extraction rate is same as that of the Wadi Babaa and Garf area, total extraction rate is estimated to be 11 m^3/day in winter and 8 m^3/day in summer.

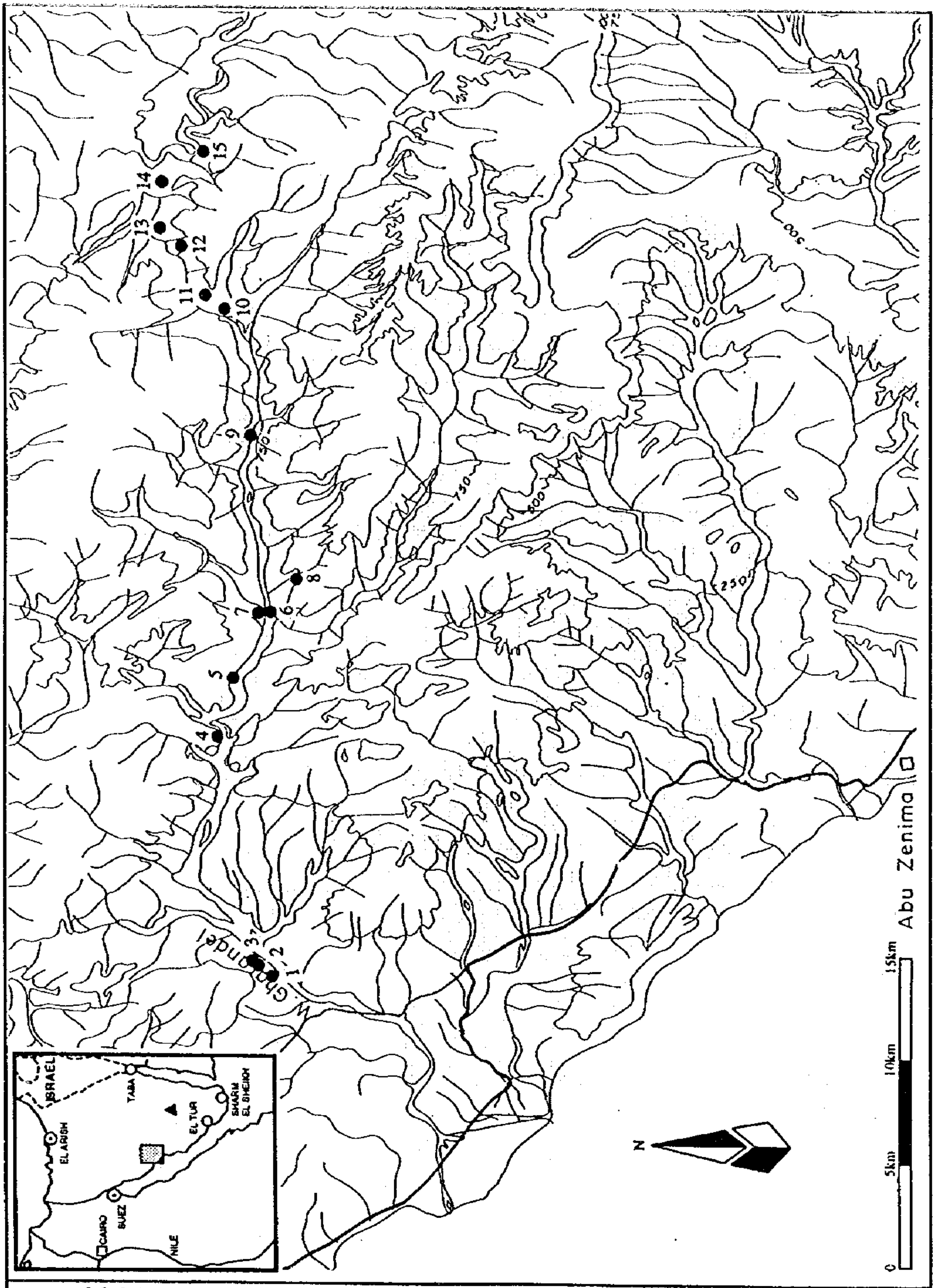

Fig. 8.2.5-1 Well Location (W. Gharandal)

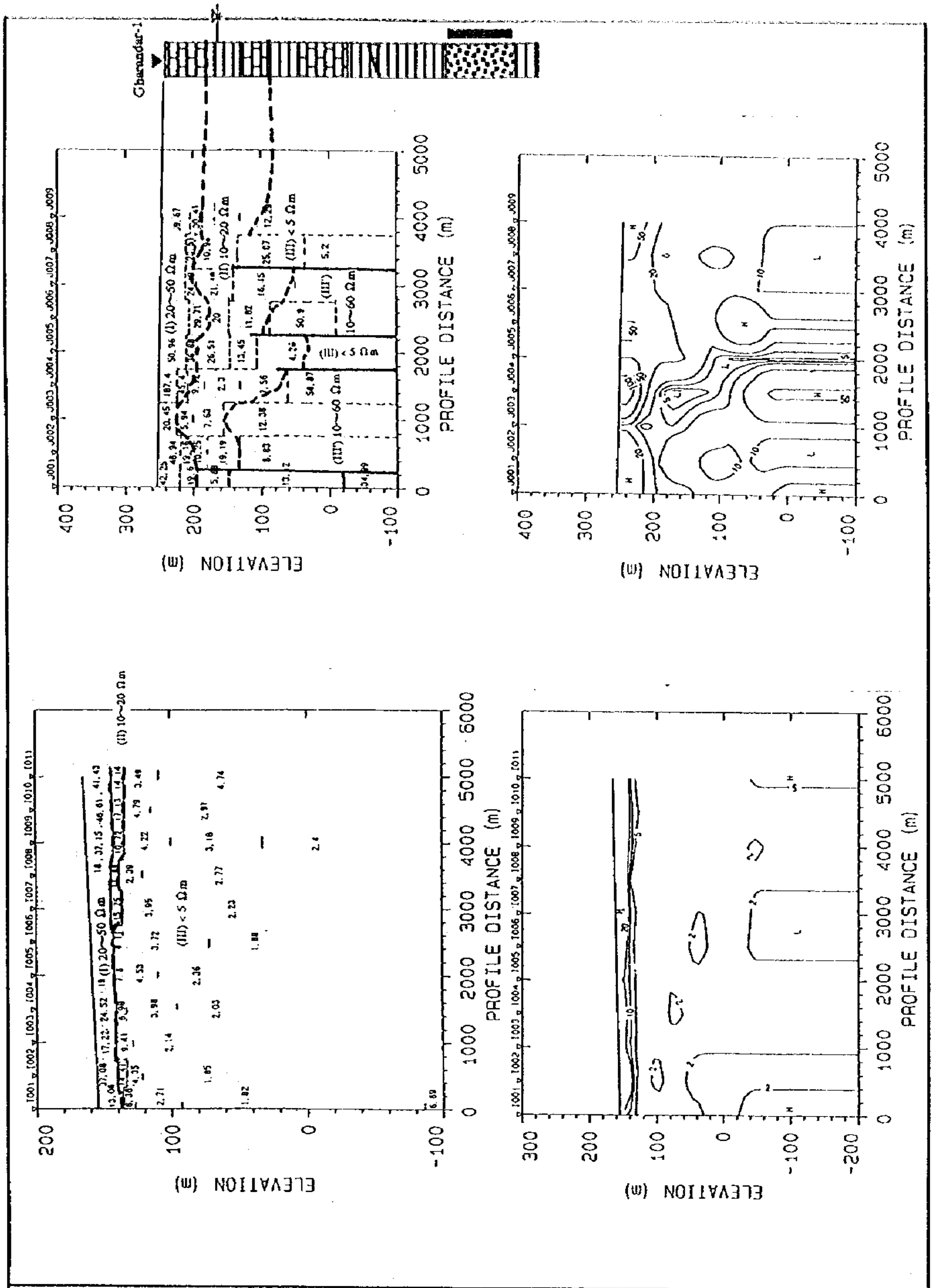

Fig. 8.2.5-2 Geoelectric Profile (Line I and J: W. Gharandal)

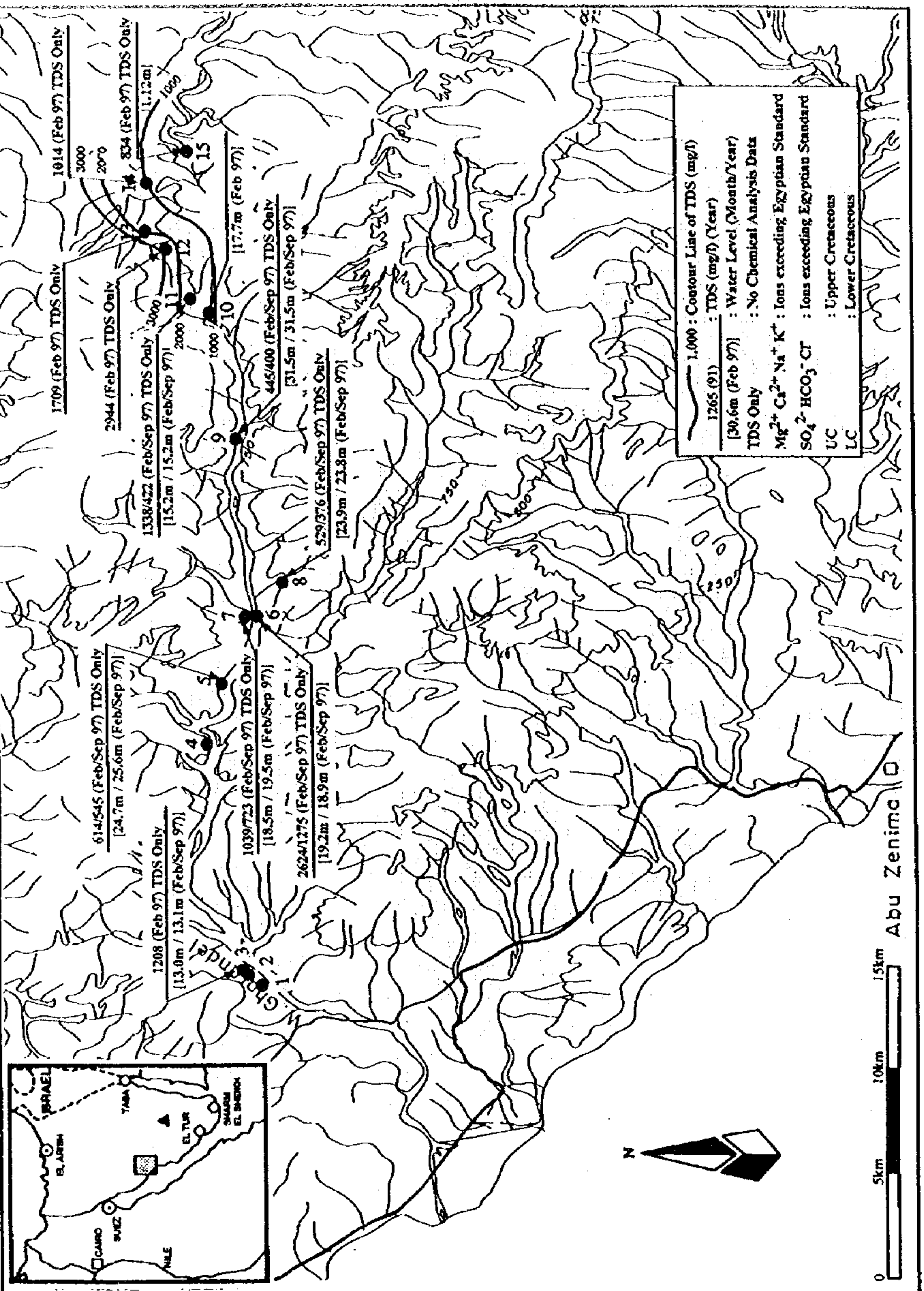

Fig. 8.2.5-3 Groundwater Level/Quality: W. Gharandal (unit: mBGL)

8.2.6 Ras Sudr Area

1) General Features of Basin

Ras Sudr is located on the coastal plain formed by the Wadi Sudr and faces to the Gulf of Suez. The area is approximately 40 km southwest from Suez City. The Wadi Sudr originates in the western edge of the El Tih Plateau (north of Gebel Somar) and flows into the Suez Bay. The coastal plain was formed by the Wadi Sudr on the west of El Tih plateau.

Ras Sudr area is one of the oil field in Sinai Peninsula and many wells are yielding oil from the Tertiary formations.

There are some resorts along the coast in the area. In addition to these, a lot of new development of tourism are going on spreading to the north and south of the area.

2) Well Inventory

There are 35 dug wells in the area. Among them, 29 dug wells are listed in the WRRI's data base system. The location of wells are shown in Fig. 8.2.6-1 and the well inventory in Table 8.1.1-1 (6). All the wells are for irrigation use of private sector spreading in the north of Ras Sudr City area.

3) Configuration of Aquifer

Dug well field is concentrated in the down stream area of the Wadi Sudr located in the north of the city area. Shape of the field is a oval elongated to N-S direction. No drilling data are available to confirm the thickness of aquifer. So far the area is close to the sea and formed on the coastal plain, thickness of aquifer seems to be thin.

4) Groundwater Level

Based on the available data provided by WRRI, a map was prepared for static water level (depth from ground surface) as shown in Fig. 8.2.6-2. Static water level in the area is in a range from 3.2 to 13.84 mBGL averaging 6.91 m BGL. Depth to water level increases to the east. Contour line of 6 mBGL runs slightly east of the topographic contour line of 10mASL and 10 mBGL of line is almost along the 20 mASL of topographic contour line. Judging from this fact, static water level is generally less than 10 mASL.

5) Groundwater Quality

(1) Available Data

In the Ras Sudr area, a total of 45 wells are newly identified during 1st stage of 2nd field study, as listed in the well inventory. Among these water points, chemical analysis data of the groundwater quality were obtained from 33 wells. The available data for these wells are listed below.

Availability of Water Quality Data (Ras Sudr)

Sr. No.	Well Identification		Availability of water Quality Data		
	WRRI Code No.	Well Name	Periodical Measurement		Number of Data
			Since/To	Interval	
3	25CC-003	El Queany 3	2/95	one data	1
5	25BC-025	Awoda-Darebg	2/95	one data	1
6	25CE-001	Atia Abou Ashba	2/95	one data	1
7	25BC-002	Slama Zayed	2/95	one data	1
9	25BC-004	Alian Zedan	2/95	one data	1
11	25BC-006	Desert Iustitule	2/95	one data	1
12	25BC-007	Sowelam M Zayed	2/95	one data	1
13	25BC-008	Sowelam Salama Sowelam	2/95	one data	1
14	25BC-009	Abdel Karem Khames	2/95	one data	1
15	25BC-010	Khalefa Werdang	2/95	one data	1
16	25BC-011	Dabes Khames	2/95	one data	1
17	25BC-012	Soliman Hamed	2/95	one data	1
18	25BC-013	F Msaid Ali	2/95	one data	1
19	25BC-014	Msaid Ali	2/95	one data	1
21	25BC-016	Owdah Qreny	2/95, 12/95	10M	2
22	25BC-017	Aed Khames Mefkrag	2/95, 12/95	10M	2
23	25BC-018	Salman Zedan	2/95, 12/95	10M	2
25	25BC-019	Salem alg Salem	2/95, 12/95	10M	2
27	25CC-004	Saf Rowe Dy	2/95, 12/95	10M	2
28	25BC-021	Aed Slem Saba	2/95	one data	1
29	25BC-022	Salman Mesalam Zayed	2/95, 12/95	10M	2
30	25BC-023	Moner Abou Bakr	2/95, 12/95	10M	2
31	25CC-005	Ahmad Mostafa Geaemy	2/95, 12/95	10M	2
32	25BC-024	Hag Talat	2/95, 12/95	10M	2
33	25CC-006	Mohamed Abou Reza	2/95, 12/95	10M	2
34	25BC-025	Salah Dein Selem	2/95, 12/95	10M	2
35	25CC-007	Ahamad Mostafa Awad	2/95, 12/95	10M	2
37	35AB-001	Ain Desa	2/95, 12/95	10M	2
38	35AB-002	Spring	2/95, 12/95	10M	2
39	35AB-003	Ain Resha	2/95, 12/95	10M	2
40	35AB-004	Ain Abou Regem	2/95, 12/95	10M	2
43	35AB-006	Thanlah Sareya	2/95	onw data	1
45	35BB-001	Umm Garf	2/95	one data	1

The data sources are mainly from the CRONO database, and partly unfilled data from the local office. Apart from these data, chemical analysis for the samples taken from a dug well of Abdel Karem Khames and a spring of Ain Abou Regem have been carried out by JICA Study Team (1997).

(2) Groundwater Quality in Ras Sudr City Area

A groundwater quality map of shallow aquifer in the area is provided based on the TDS value of the 24 dug wells (See, Fig. 8.2.6-3). The range of depth of these dug wells are approximately 5m to 15m.

Relatively high TDS value of more than 3,000 mg/l is observed at most of dug wells. The contour lines of 3,000, 4,000 and 5,000 (TDS value mg/l) suggest that directing groundwater flow towards the coastal line, as shown in Fig. 8.2.6-6. It is expected that the groundwater recharge of the aquifer is from Wadi Sudr

In the almost of wells, three (3) ions of Ca, Cl and SO_4 exceeds a value of Egyptian drinking water standard. Therefore, it is considered that most of dug wells in the Ras Sudr City area is not suitable for potable water supply.

As a represented well in the area, Piper and Stiff diagram of well No. 25BC-019 is shown in Fig. 8.2.6-4 and Fig. 8.2.6-5 respectively.

6) Hydrogeological Characteristics of Aquifer

Fig. 8.2.6-6 shows micro-topography of Ras Sudr area. Wadi Sudr flows into coastal plain from the east. The wadi eroded old fans and formed new fan between old fans as shown in the figure. Sabkha are formed at the front of new fan where is close to the shoreline. Dug well field is distributed backward of Sabkha at the elevation between 10 and 20 mASL, traversing the channel of the Wadi Sudr.

Considering the above situation, it is concluded that the aquifer can be exist under subtle balance between surface water of the Wadi Sudr and sea water.

7) Groundwater Extraction

Most wells are in use for irrigation. Daily extraction rate is in a range between 25 and 70 m^3 averaging 52 m^3. Total extraction reaches 1,610 m^3/day (about 590,000 m^3/year).

8) Estimated Recharge to Basin

Groundwater in the area is mainly recharged by flood water of the Wadi Sudr happens to occur in winter season.

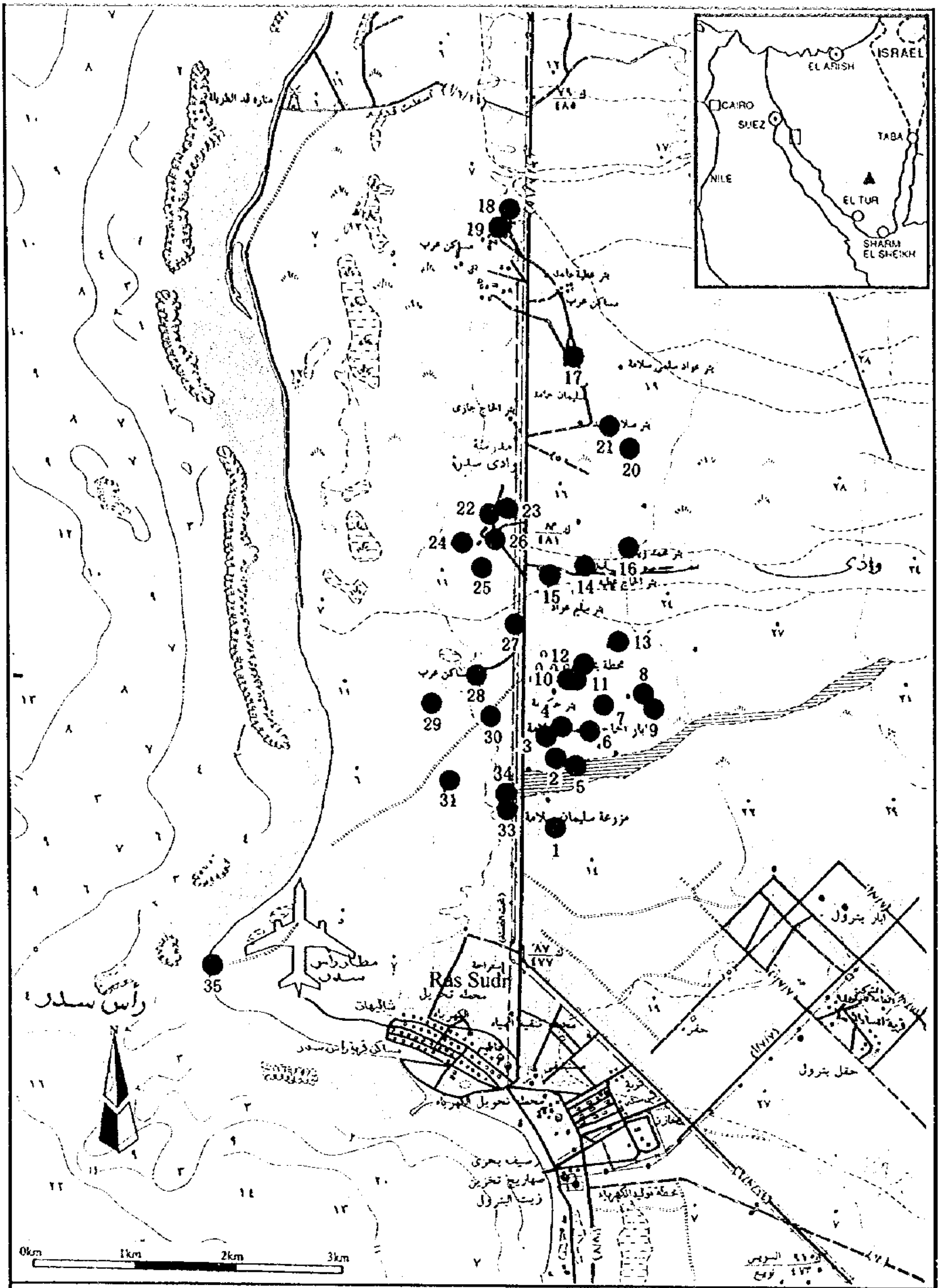

Fig. 8.2.6-1 Well Location (Ras Sudr)

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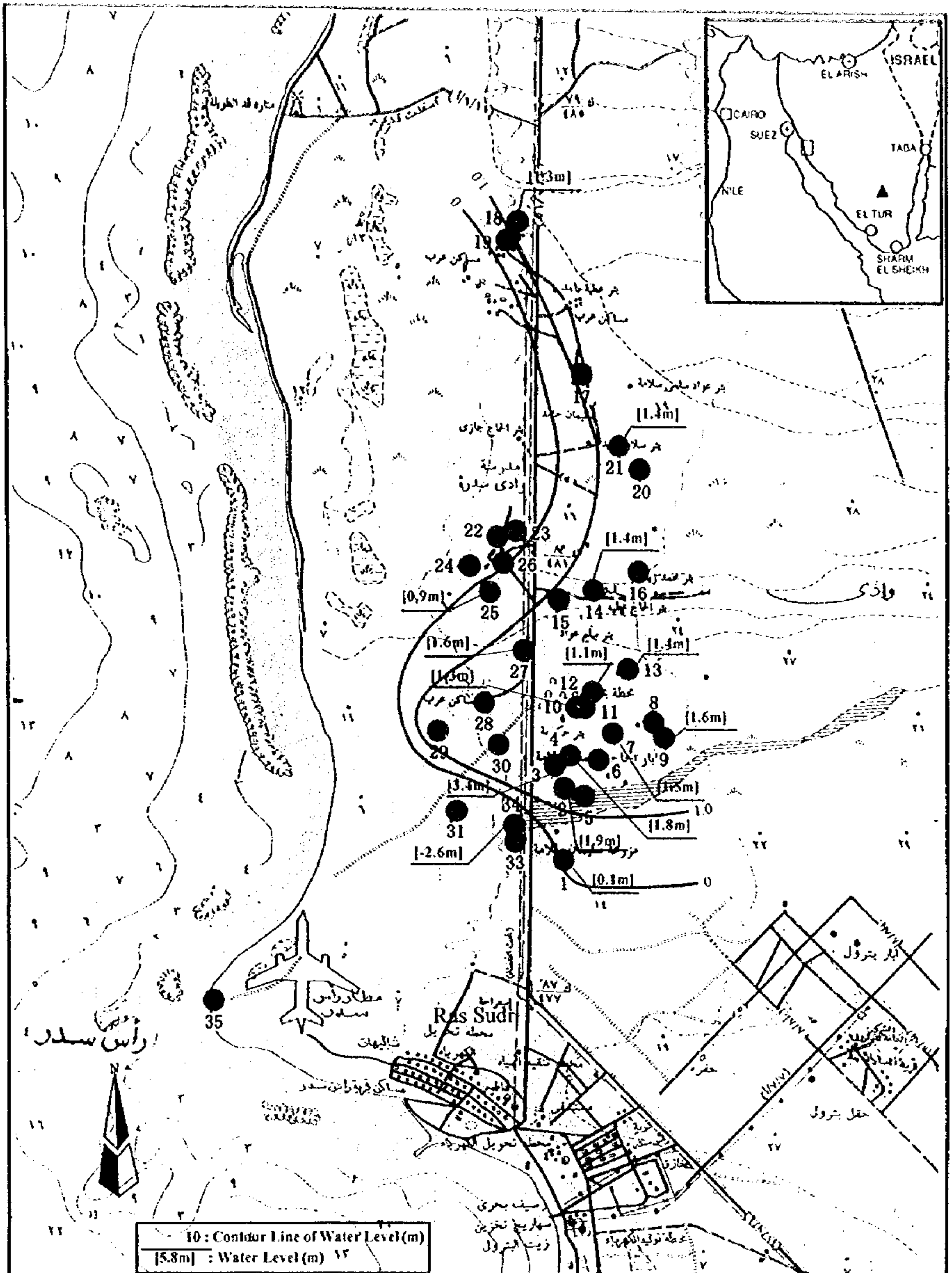


Fig 8.2.6-2 Groundwater Level: Ras Sudr (unit: mASL)

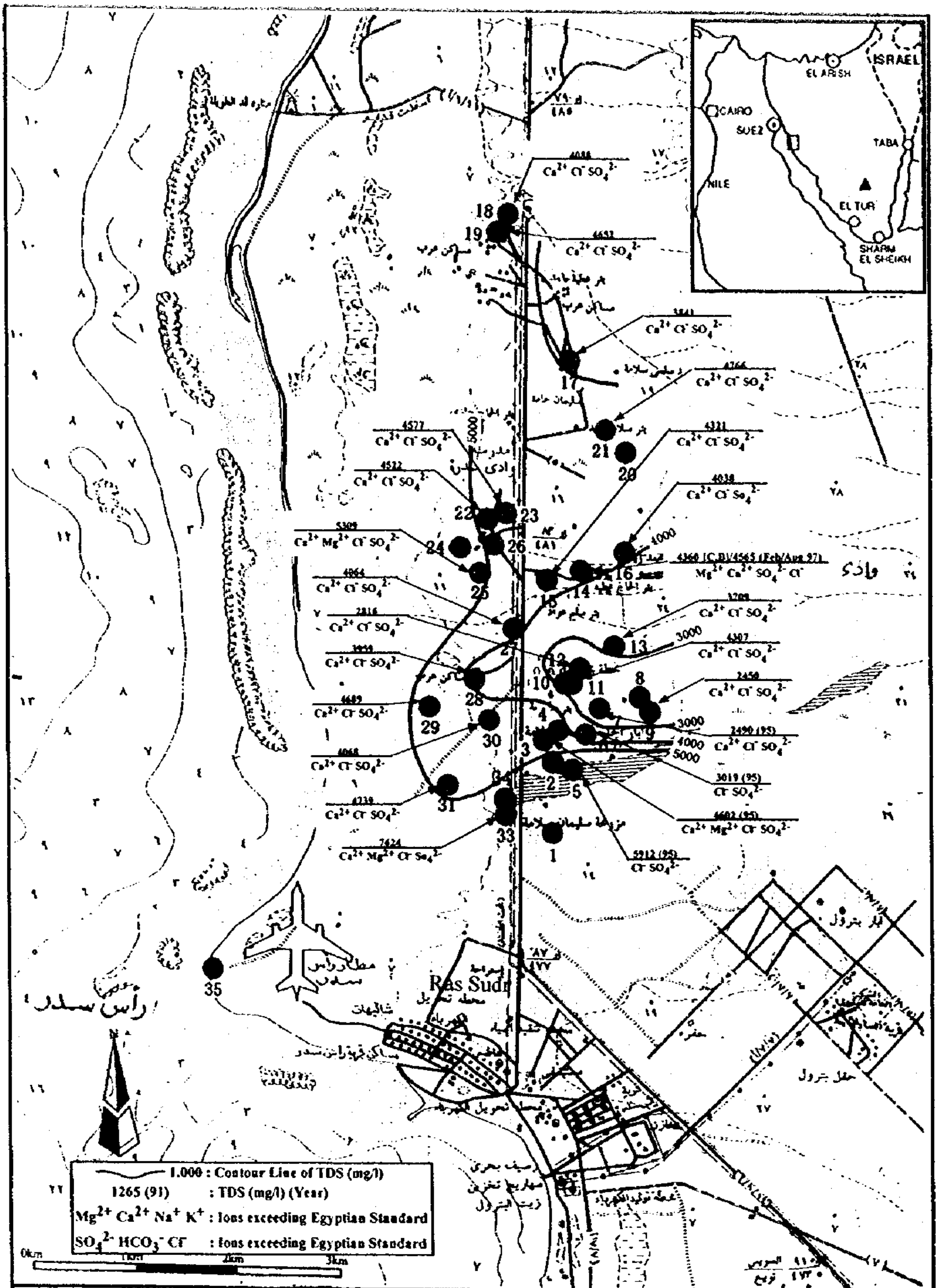
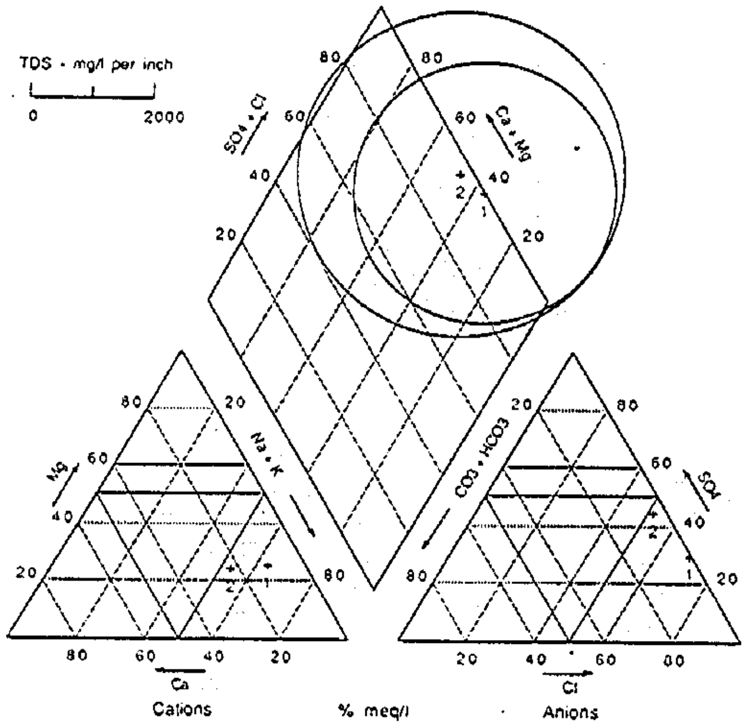


Fig. 8.2.6-3 Groundwater Quality: Ras Sudr



25BC-019					
No.	TDS	Sample	No.	TDS	Sample
1	4254	Feb-95			
2	5309	Dec-95			

Fig. 8.2.6-4 Piper Diagram (Well No. 25BC-019: Ras Sudr)

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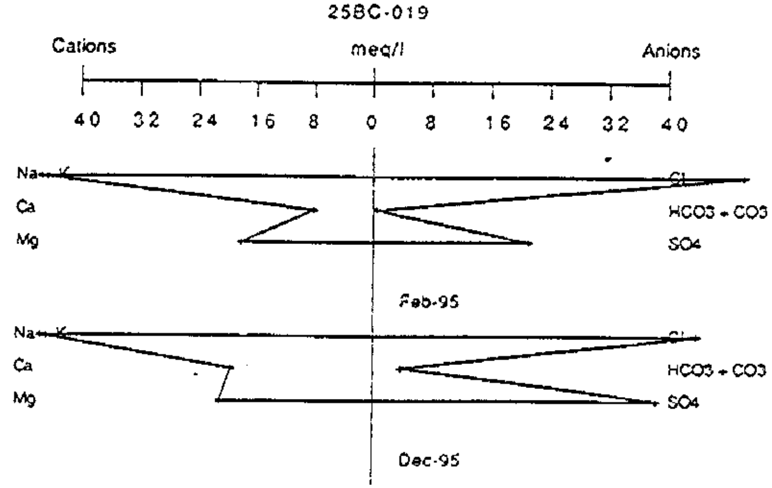

Fig. 8.2.6-5 Stiff Diagram (Well No. 25BC-019: Ras Sudr)

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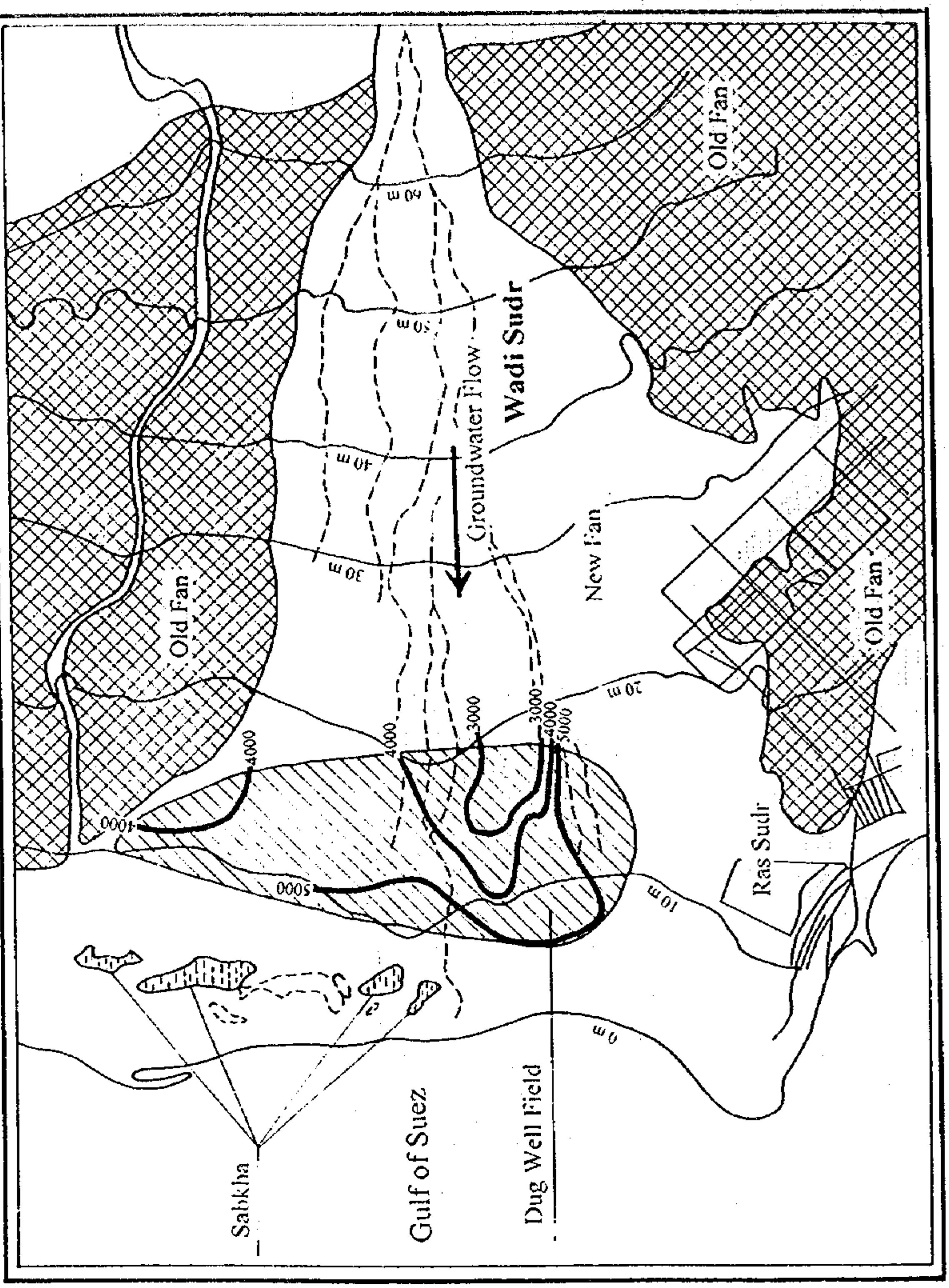

Fig. 8.2.6-6 Micro-Topography (Ras Sudr)

8.2.7 Wadi Sudr

1) General Feature of Basin

The Wadi Sudr is one of the main wadis in South Sinai. It originates from northwestern area of El Tih Plateau and flows into Gulf of Suez. The wadi is about 55 km in length and occupies 712 km^2 of catchment area. Several springs are occurred in the area, such as Ain Desa, Ain Sudr and so on. The upstream area of the wadi is discussed in this clause, separating the downstream area as Ras Sudr coastal plain (Refer, 8.2.6).

The Upper Cretaceous and Tertiary formations are distributed in the upstream area.

Floods sometimes occur in winter season. Following four (4) floods were observed during the survey period:

(1) 23 January 1997

(2) 2 March 1997

(3) 3 December 1997

(4) 11 February 1998

2) Well Inventory

Nine (9) springs are known in the wadi and they are listed in the WRRI's data base. Inventory and location are shown in Table 8.1.1-1 (7) together with Ras Sudr area, and Fig. 8.2.7-1 for Key Map and Fig. 8.2.7-2 (1) to (3) for detailed location maps.

All the springs yield groundwater from Upper Cretaceous Limestone. Although their aquifers shall be considered as Pre-Quaternary, they are listed here to understand the characteristics of the Wadi Sudr. No dug well and spring in the Quaternary are known. Therefore, the Quaternary aquifer occurs in the downstream of the wadi (Ras Sudr Coastal Plain).

3) Groundwater Quality

Three (3) groundwater quality map of Wadi Ras Sudr were provided based on the TDS value of the 9 springs as shown in Fig. 8.2.7-3 Piper and Stiff Diagram for a spring (34AB-003) are shown in Fig. 8.2.7-4 and 8.2.7-5 respectively.

Springs (Sr. No.41, 42, 44 and 45) show low TDS value between 704 and 1,181 mg/l. Other springs show high TDS value between 3,894 and 5,650 mg/l.

The aquifer of these springs is Upper Cretaceous limestone. TDS value show a gradual increase to the down stream. Relatively high TDS value of approximately 4,000 mg/l is observed in the middle stream of wadi area, where serial No. 37 to 41 are located. In the springs of Serial No. 37 to 39, the ions of Cl^- and SO_4^{2-} are exceeding the Egyptian drinking water standard.

4) Hydrogeological Characteristics of Basin

Geological Survey was executed along the Wadi Sudr by WRRI using the resistivity survey method. According to the result, the Quaternary Deposits in the wadi is very thin. Therefore, no groundwater resources in the wadi is expected.

According to the report prepared by WRRI, the Lower Cretaceous Sandstone is considered as the most important aquifer and supplies groundwater to the area an amount of 5×10^6 m^3/year through faults and fractures.

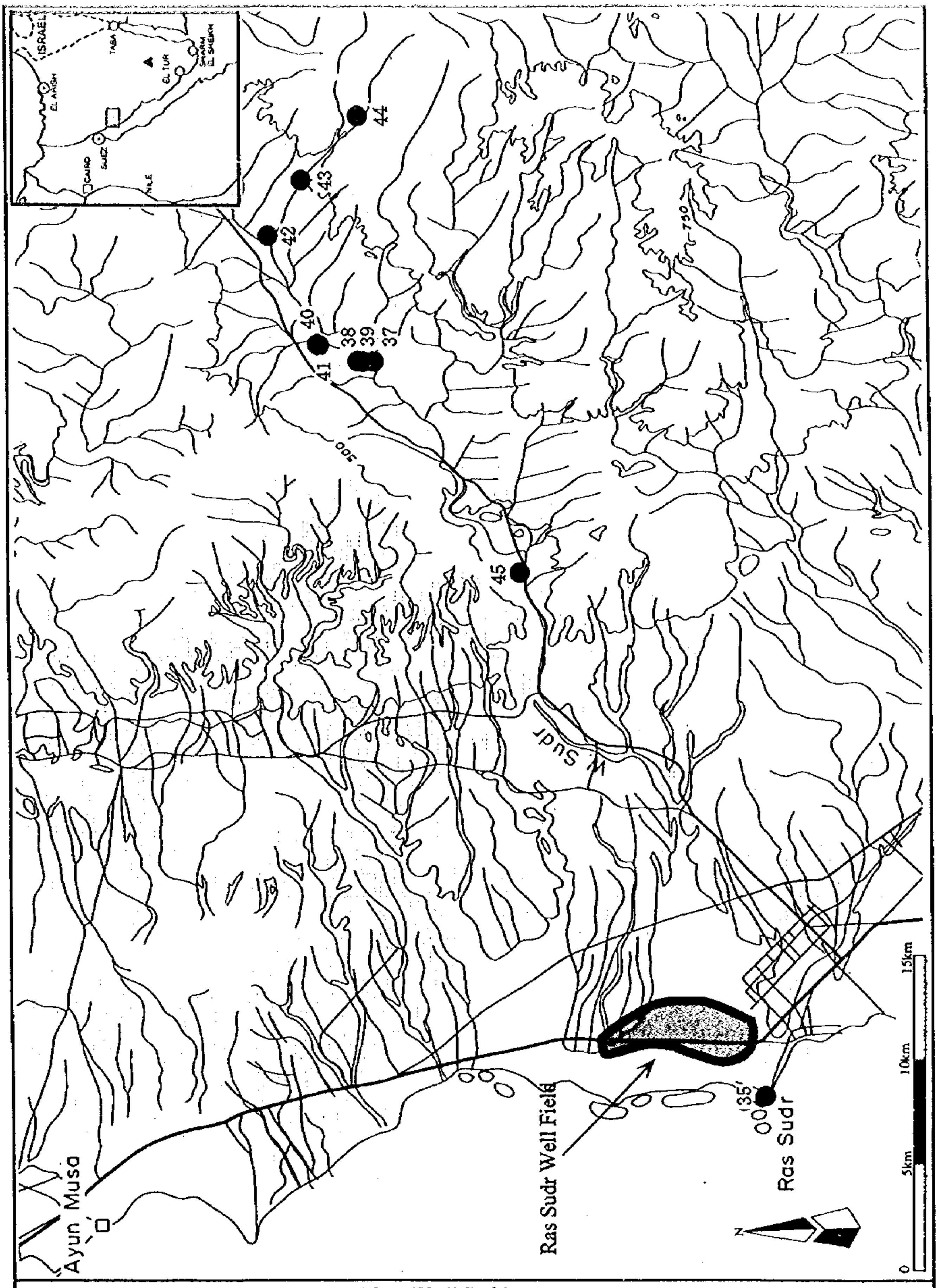

Fig. 8.2.7-1 Well Location (Key Map: Wadi Sudr)

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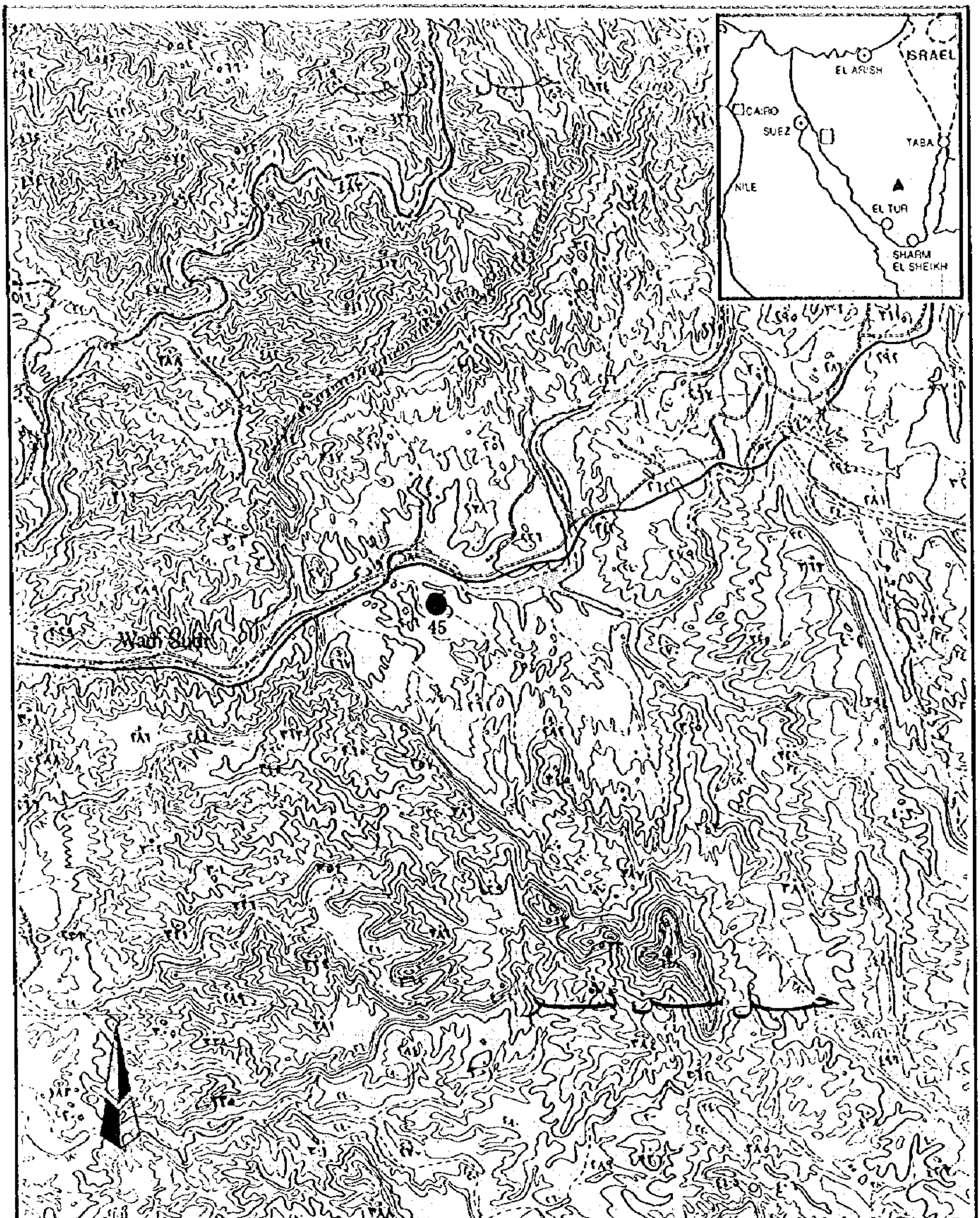

Fig. 8.2.7-2 (1) Well Location (Wadi Sudr)

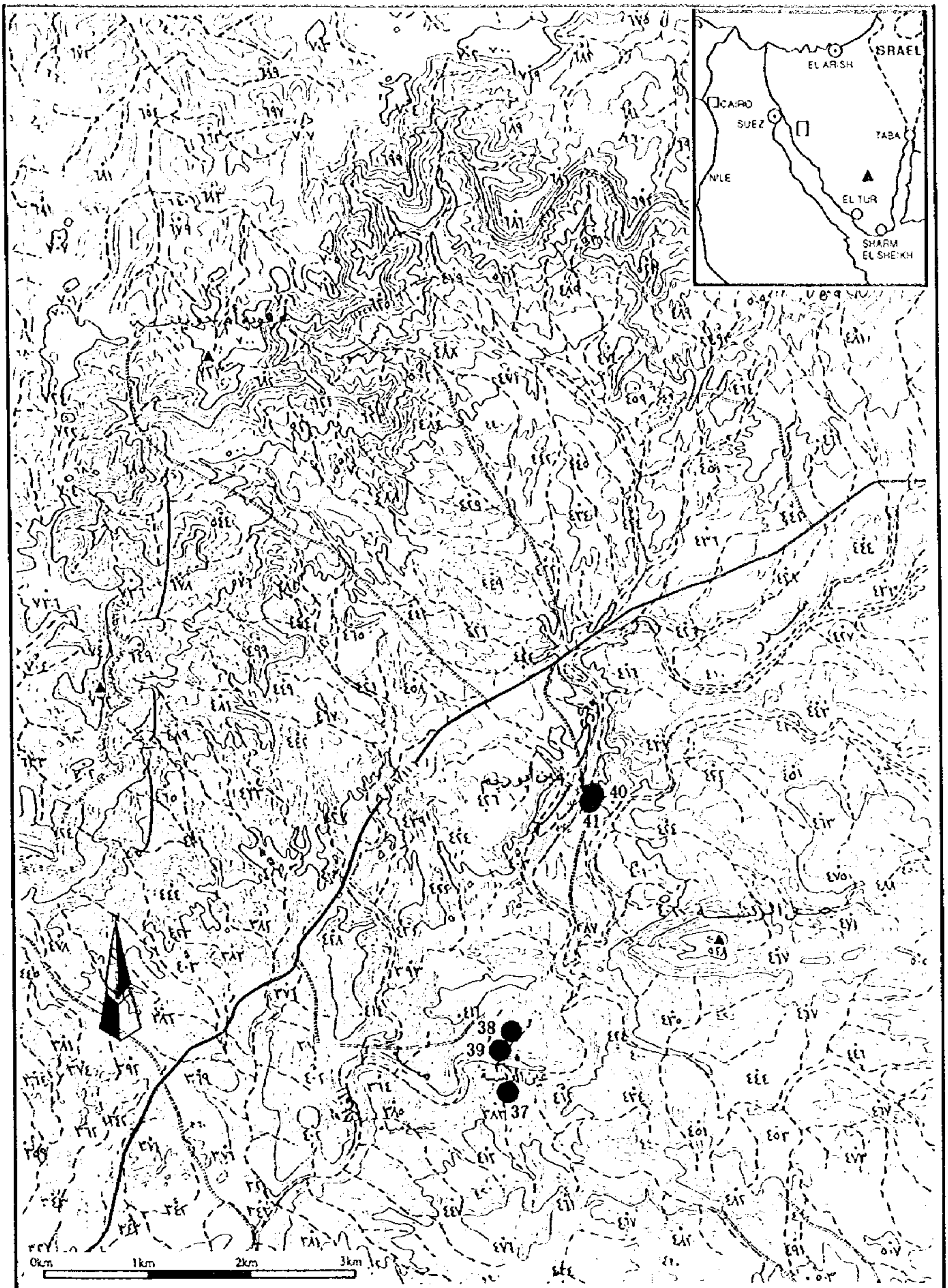

Fig. 8.2.7-2 (2) Well Location (Wadi Sudr)

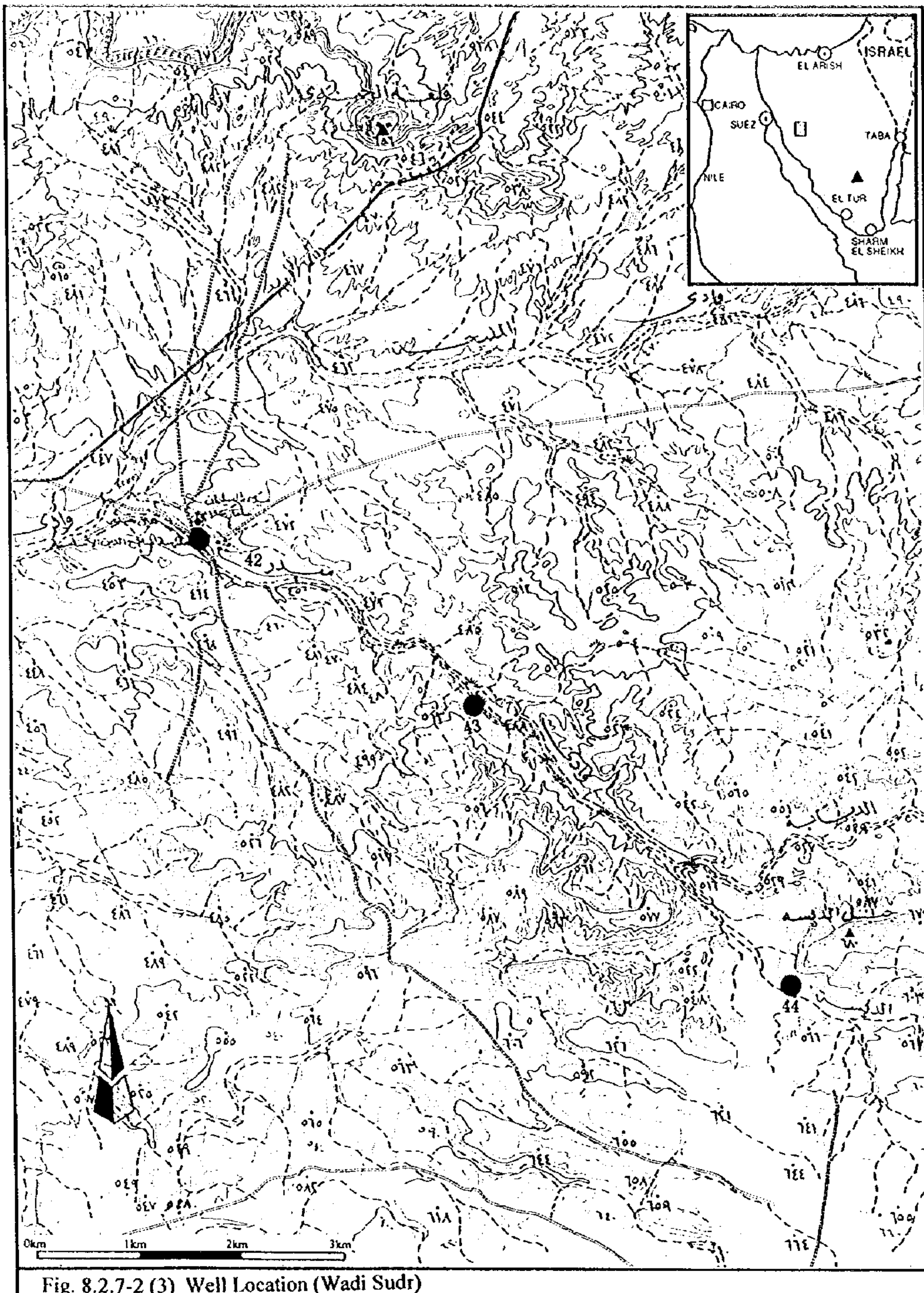

Fig. 8.2.7-2 (3) Well Location (Wadi Sudr)

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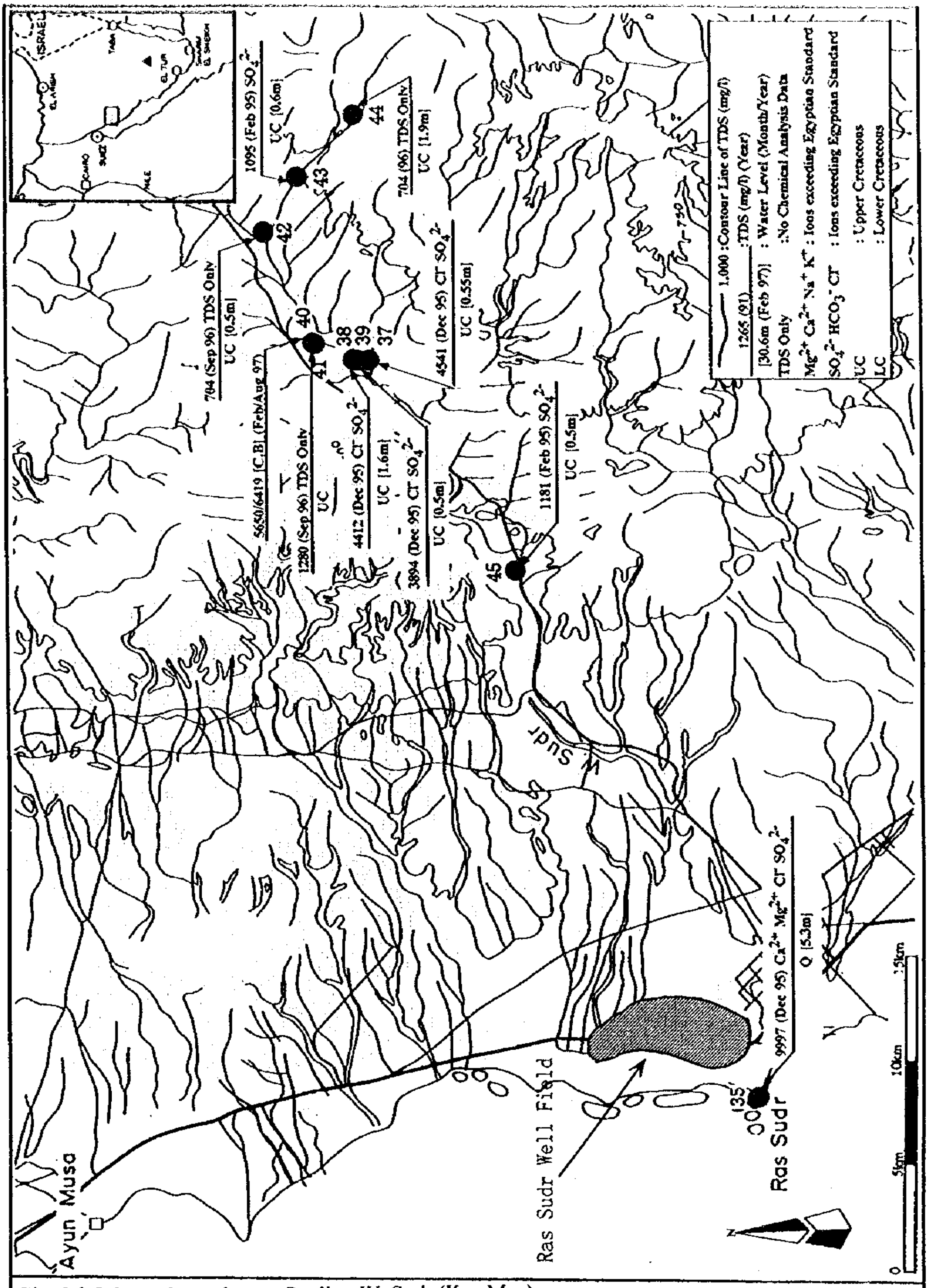

Fig. 8.2.7-3 Groundwater Quality: W. Sudr (Key Map)

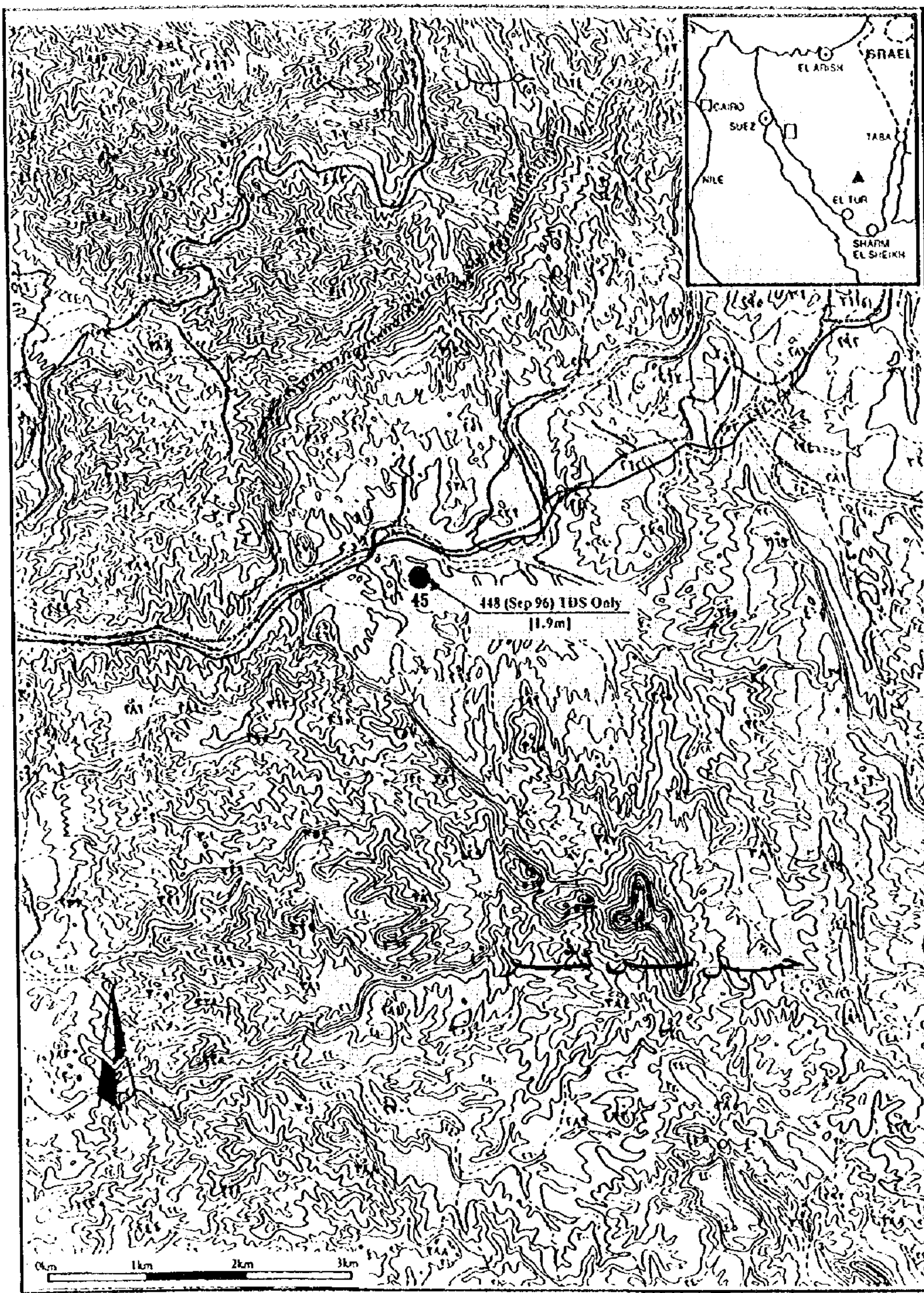

Fig. 8.2.7-4 (1) Groundwater Quality: W. Sudr

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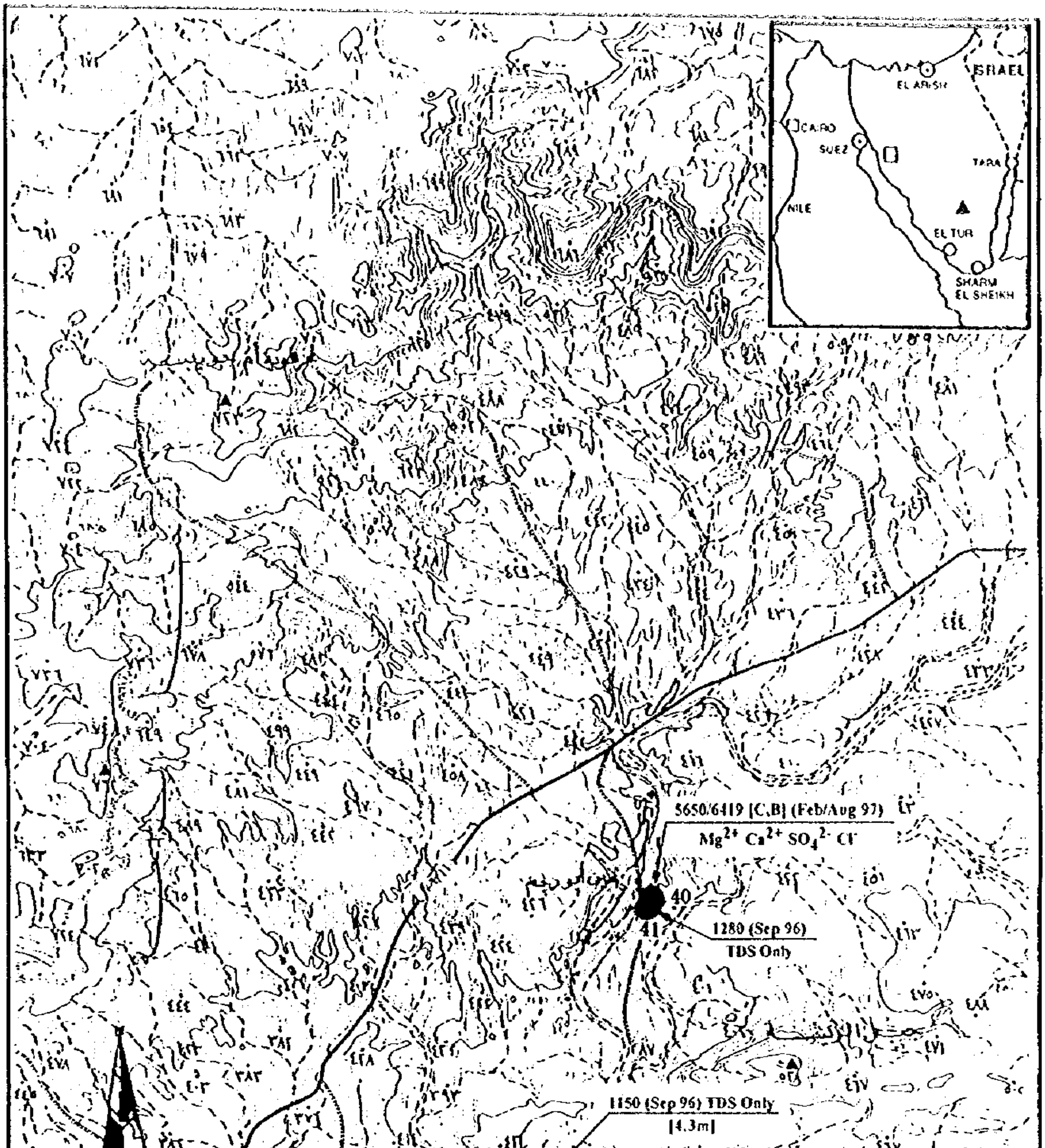

Fig. 8.2.7-4 (2) Groundwater Quality: W. Sudr

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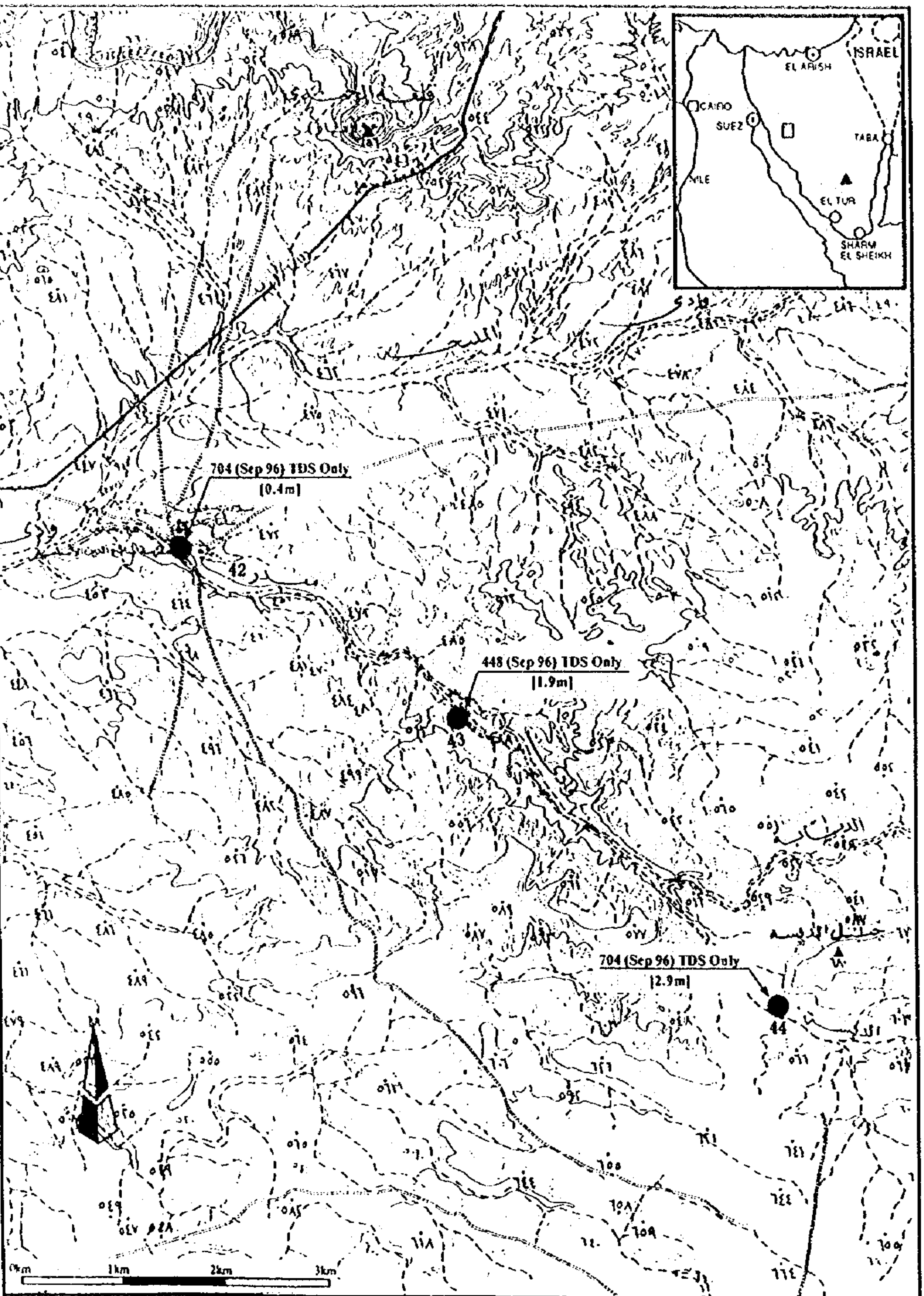

Fig. 8.2.7-4 (3) Groundwater Quality: W. Sudr

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