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PRELIMINARY EVALUATION AND RECOMMENDATIONS REGARDING GROUNDWATER CONDITIONS AT EL ARISH

JUNE 1981

SINAI DEVELOPMENT STUDY - PHASE I

PERFORMED FOR THE ADVISORY COMMITTEE FOR RECONSTRUCTION
OF THE MINISTRY OF DEVELOPMENT

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WORKING PAPER NO. 13

We offer this working paper for consideration by the Advisory Committee and for possible submission to the Governor of North Sinai for his action. The paper is based on available estimates and data, some of which were kindly provided by Mr. Paul Whincup, a hydrogeologist who visited the El Arish area with an Australian Government mission last month. The data and conclusions herein presented should be considered provisional and preliminary. More detailed evaluations of the groundwater conditions at El Arish will be performed after the Desert Institute submits the updated information on the hydrogeology of El Arish which was obtained by them during their field work this past March.

For the purposes of this working paper, we have collected information and summarized data that we feel are indicative of the groundwater conditions at El Arish now and that will provide the knowledge necessary to suggest courses of action to be taken to safeguard the aquifer against further quality deterioration.

The trend in the conductivity of well water at El Arish is presented in Table 1. The estimated pumpage from water wells in the El Arish area is presented in Table 2. Figure 1 provides a provisional water-table contour map for the area based on water-level measurments performed by REGWA in 1979. A contour map of equal conductivity of the groundwater for May 1981 is given in Figure 2.

The data given in Table 1 are based on government wells, not upon citizen wells, town council wells or military wells. In the area south of town and within about 1 Kilometer of Wadi El Arish, the groundwater quality is significantly better than in the area farther east and north. This is shown on Figure 2. For the purposes of Table 1, the wells have been divided into two groups. The waters from Group 1 wells (1 through 5,8,9,12 and 24) have significantly lower conductivities than those for the other wells. With the exception of Well 12, Group 1 wells are located within 1.2 Kilometers of Wadi El Arish, while wells in Group 2 are generally located a greater distance from the wadi, to the east. In May 1981, well group 1 averaged 3650 μmhos/cm, compared to 5000 μmhos/cm for well group 2. The difference between these two groups of wells may be a function of more efficient flushing of the aquifer close to the center of the wadi because of the possible existence of more permeable sand and gravel deposits there. Alternatively, it is possible that the wells on the east side through their pumping are inducing greater upward leakage into the Quaternary aquifer from underlying Pliocene or Miocene formations having relatively low quality water.

It is also seen in Table 1 that there was a significant increase in the conductivity of well waters from 1962 to 1980, particularly so along the eastern and northern side of the area (location of Group 2 wells). For well group 2, average conductivities rose from 3980 to 6080, μmhos/cm over this period. This dramatic increase or rising trend was followed over the course of the next year by a drop in the average conductivities.

We ascribe this drop in the conductivity values from May 1980 to May 1981 to the relatively large amount of rainfall and runoff received on the basin during the winter season of 1980-1981. This probably resulted in a significant degree of dilution within the aquifer. However, because such rainy seasons do not occur too frequently, we believe that the decline in groundwater quality is likely to continue, unless steps are taken now to limit groundwater pumping.

We believe that the water-table contours shown in Figure 1 provide an approximate picture of groundwater flow in 1981, even though they are based on 1979 measurements. There is a certain inaccuracy in the map because water levels were taken throughout 1979 as each well was drilled by REGWA, and so the measurements unfortunately do not apply to a particular week, or even month, in 1979. Moreover, there are uncertainties with respect to the locations of some of the wells and with respect to the ground-surface elevations or datum-point elevations at each well. Bearing these drawbacks in mind, we have a few comments to make relative to Figure 1.

The water table appears to be below sea level within the wadi as well as within one kilometer of the wadi on the nothern side. The figure also indicates that groundwater is flowing from east to the west toward the wadi. There is, moreover, a groundwater mound existing on the east side of the area shown, in the vicinity of wells 15 through 20. This apparent groundwater mound may represent:

1. Subsurface flow beneath Wadi Maazar flowing west toward Wadi El Arish;
2. Upward leakage, such as from an underlying Pliocene or Miocene formation; or,
3. Water levels associated with a different Quaternary aquifer tapped by the remainder of the wells. (Detailed cross sections will be prepared to examine this possibility.)

As shown in Table 2, the total pumpage from wells in the El Arish area at this time is estimated to be a little more than 28,000 cubic meters/day, on an average annual basis. This figure is based on an estimated average area of 1000 feddans being regularly irrigated for one to two crops per year.

Although the annual average pumpage does not presently appear to exceed the figure of 30,000 cubic meters/day, which is the average rate of recharge to this aquifer estimated in 1963 by Dr. Farid Saad of the Desert Institute, the general declining trend of the groundwater quality gives cause for some concern. And this, together with the presence of below-sea level groundwater levels beneath Wadi El Arish, indicates that some action should be taken as soon as possible to reduce the likelihood of sea-water intrusion and to halt tha decline in groundwater quality.

Based on the foregoing preliminary evaluation, we would make the following recommendations for action in the El Arish area:

Recommendations for Action to be Performed Immediately

1. We recommend that for the present, no additional wells on the east side of the wadi, such as the new B-series wells, be commissioned or brought into production.
2. Increased rates of pumpage should not be permitted in any presently producing wells.

Recommendations for Action to be Taken in the Near Future

1. Implementation of the groundwater investigation and monitoring program posposed as one of the "Early-Action" projects submitted recently to the Advisory Committee. This is a 16-month program designed to evaluate in detail and monitor the groundwater conditions at El Arish with the aim of maximizing the quantity of usable groundwater that can be withdrawn on a long-term basis.

2. Drilling exploratory wells where there are few or no wells presently producing and where there is some likelihood of tapping good quality water.

   a. Drilling and testing of two 60-meter deep exploratory/production wells on the west side of Wadi El Arish. These wells should be located within one kilometer of the wadi on the west side, and from one to two kilometers south of El Arish town. The program should include the geophysical logging of both wells and their construction with durable casing and well screen. Following development of each well, they should be pump tested for a continuous 48-hour period at a constant pumping rate.

   b. Drilling and testing one exploratory well in the vicinity of Lahfan to tap the Nubian Aquifer. Expected depth would be within 500 meters. Logging, well construction and testing of the well would be performed as indicated above for the shallow wells. The well site should be located in the field by a hydrogeologist completely familiar with the geology of North Sinai.

3. Based on the final results of the Phase I study, to maintain acceptable groundwater quality, it may be necessary to recommend a clear reduction in the pumping rates of some of the existing producing wells at El Arish. But at this time, it is not possible to say whether or not this will be advisable.

TABLE 1

Trend in Conductivity of Well Waters from Government Wells in El Arish Area

Well Group	Average Conductivity (μmhos/cm at 25°C) October 1962	December 1979	May 1980	May 1981
1. Wells showing relatively low conductivity of water (Nos. 1-5,8,9,12,24)*	2860	3395	4540	3650
2. Wells showing relatively high conductivity of water (Nos. 6,7,11,13-17, 19,27,28)	3980	4850	6080	5000

* All but Well 12 are located within 1.2 kilometers of the center of Wadi El Arish.

NOTE: October 1962 readings were made by Geofizika, Enterprise for Applied Geophysics, Zagreb, Yugoslavia.

December 1979 readings were made by REGWA.

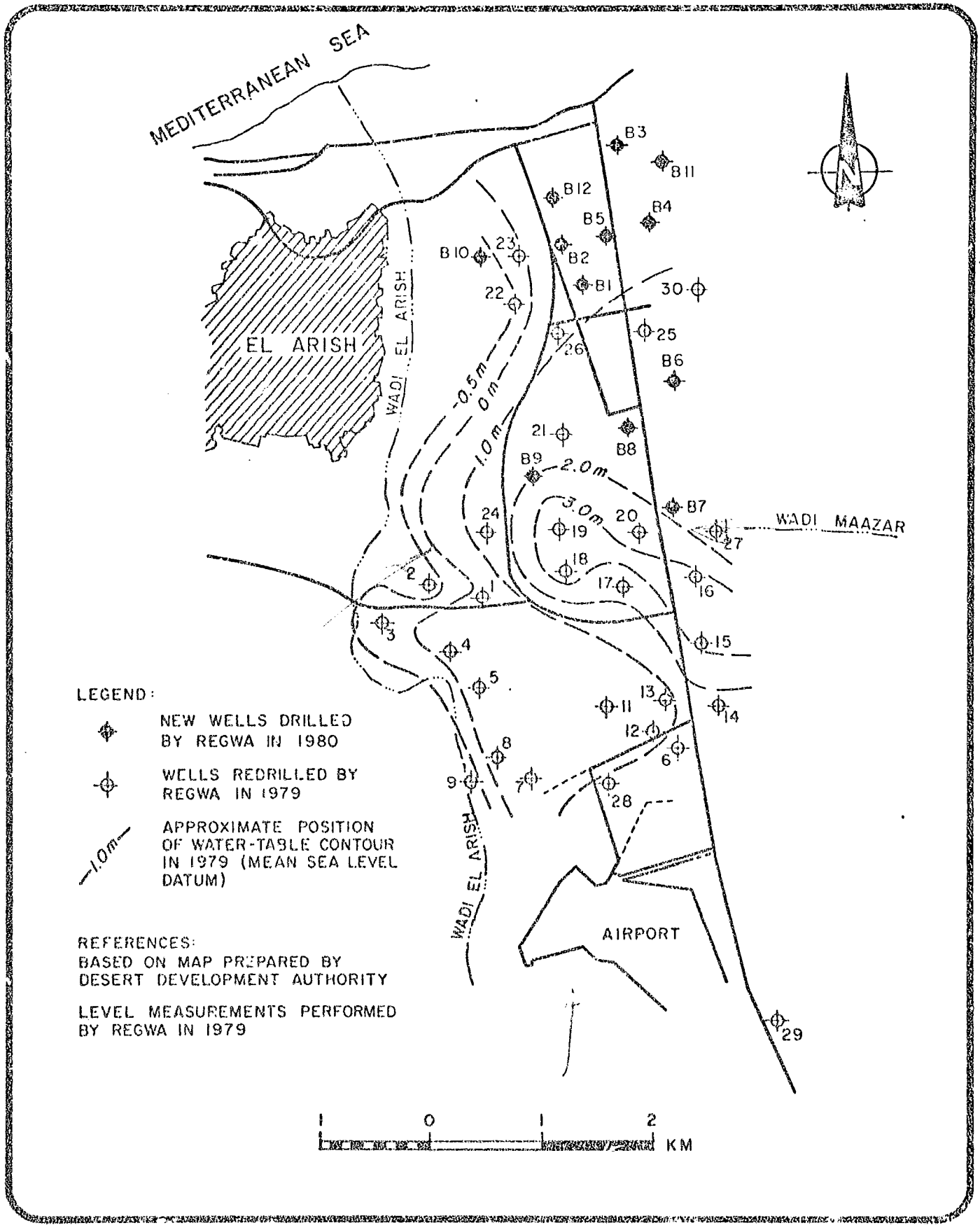
May 1980 readings were made by Ezzat Al Gamil, hydrogeologist with GORPAD.

May 1981 readings were made by Paul Whincup, Australian Government (ADAB) Mission.

TABLE 2

Estimate of Pumpage from Water Wells in the El Arish Area in Spring 1981

Type of wells	Approximate Pumpage (m^3/day)	Source of Information
Town Council Public Supply Wells	8130	El Arish Town Council (through Mr. Paul Whincup, Australian consultant)
Military Wells	3000	Officer Innajar, in command of pumping station, December 1980
Agricultural Wells --government wells and citizens wells	17,000	Estimated on the basis that the land presently irrigated is approximately 1000 feddans
Total	28,130 m^3/day	



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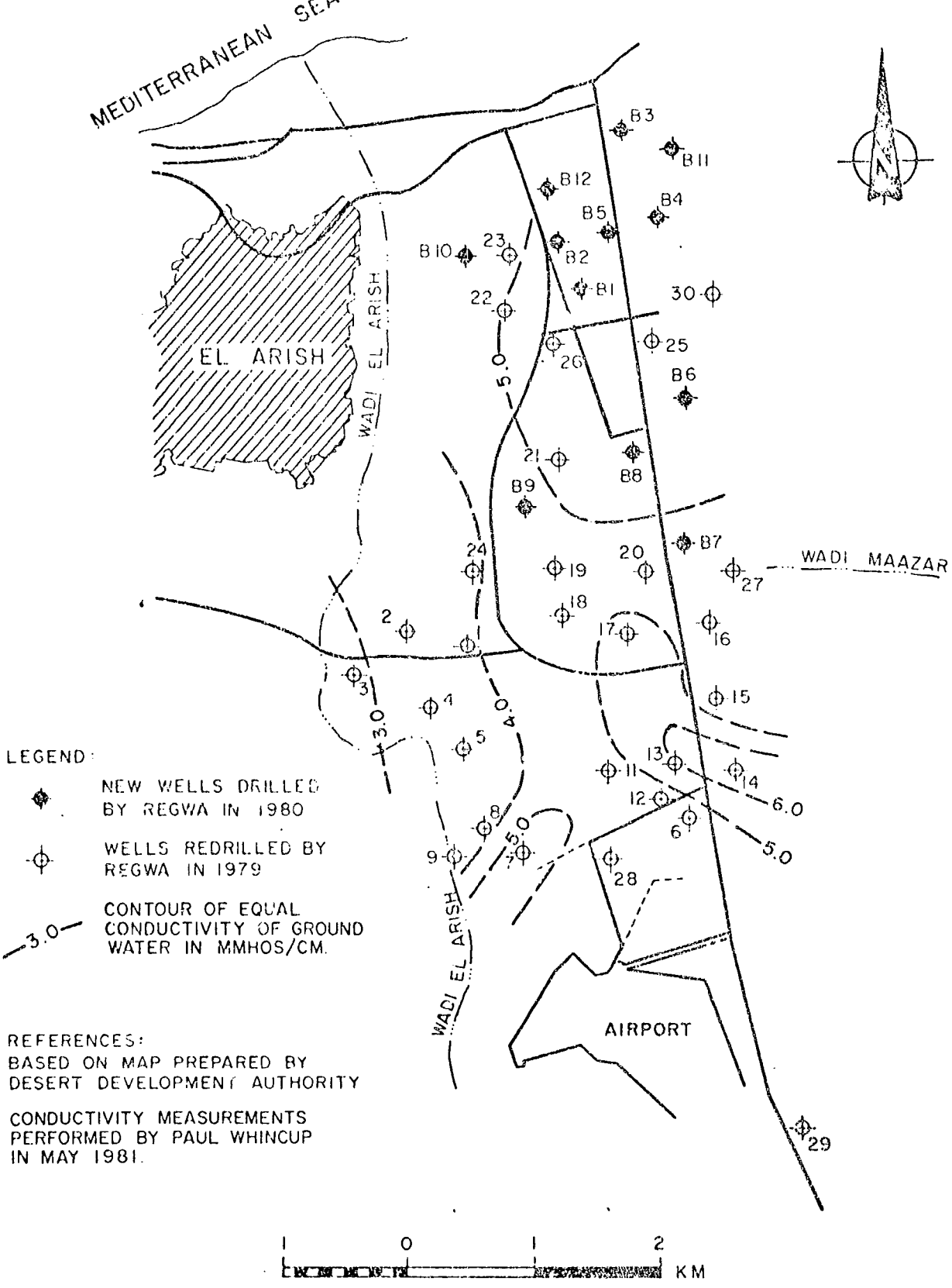
PROVISIONAL WATER-TABLE CONTOUR MAP FOR EL ARISH AREA

FIGURE 1



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CONDUCTIVITY CONTOUR MAP FOR GROUNDWATER IN EL ARISH AREA

FIGURE 2