AIRGRAM

DEPARTMENT OF STATE

PD-AAQ-629

UNCLASSIFIED

CLASSIFICATION

Reports U-520

1013

For each address check one ACTION | INFO

TO - AID/W TOAID A - 564 X

B263025 3007201

DATE REC'D.

DATE SENT 6/14/66

C-16 A-54

DISTRIBUTION

NEAEC 5

INFO.

[illegible] 2

[illegible] 1

[illegible] 1

[illegible]

[illegible]

WC 1

AGRIC C-15

CIA C-6

EARI C-2

STATE C-15

CARD 1013

A

OTHER AGENCY

FROM - Cairo

SUBJECT - Ground Water Investigations in the Western Desert - 263-11-120-253
Technical Assistance Project History and Analysis Report - U520

REFERENCE - AID-NESA (IC) - 36- 00

1. United Arab Republic (Egypt).
2. Ground Water Investigations in the Western Desert.
3. Project No. 263-11-120-253.
4. March 1960. (Date project initiated)
5. March 1967. (Planned termination date)
6. March 1960 - March 1966. (Period covered by this report)

CONTENTS	PAGE
1. Background Situation.	2
2. Project Targets and Goal Plan Objectives.	4
3. Project Results.	8
4. Resources Employed.	12
5. Major Factors Affecting Progress.	18
6. Appraisal of Results.	20
7. The Mission Acting Director's Comments and Evaluation of the Project	22

(9)

PAGE 1 OF PAGES 22

DRAFTED BY	OFFICE	PHONE NO	DATE	APPROVED BY:
RLCushman:md	Water Resources	249	6/9/1966	Kenneth S. Levick - Acting Director

AID AND OTHER CLEARANCES

Exec - _____ Cont - _____ Prog - [illegible]

UNCLASSIFIED

CLASSIFICATION

AID-5-39 (9-62) (Do not type below this line) PRINTED 3-63

1. Background Situation

Egypt needs more land under cultivation to feed her rapidly expanding population. The addition of new land requires a source of water to irrigate that land because Egypt is a country almost without rain. The country is relatively large, having an area of more than 380,000 square miles; but most of it (about 97%) is a hot, windblown, desert wasteland in which the only inhabitants (less than 50,000) are in scattered small oases. The supply of water in the Nile River is capable of irrigating only about 3 percent of Egypt - the area adjacent to the river. This small part of Egypt strives to feed the 27 million people residing in the Nile Valley. The population density in the Nile Valley is about 2,000 per square mile and is increasing. If ground water beneath the desert wasteland is suitable in quantity and quality for irrigation, some of the desert can be brought under cultivation as a measure toward solving the food and employment problems of Egypt.

For centuries ground water has been known to exist in the oases of the Western Desert (an area now termed the "New Valley"). The ancient Egyptians, the Persians, the Romans and the Greeks all built settlements there. The present inhabitants lend support to this knowledge by their use of ground water for irrigating their crops and making their livelihood. In more recent times (the past sixty years), several eminent geologists and other scientists have made broad generalized studies throughout the area in search of more definitive information. Conclusions, however, have not always been the same; and none has made adequate appraisal of the ground water potential. Basic data, in fact, did not exist on which adequate appraisal could be made. The unknown factors were and still are: the actual location of the water, its quality and quantity.

In July 1959, the United Arab Republic established the General Desert Development Authority 1/ and charged it with the responsibility and task of reclaiming desert areas by developing the natural resources of these areas. Any development in the desert depends on a supply of water; therefore the amount of development is controlled by the amount of water available. An evaluation of the water resources as to location, quantity and quality was given first priority in the activities of the Authority. A soil survey also was given high priority because it must be determined where the soil conditions are suitable for irrigated agriculture and what kind of crops could be grown. Studies about the economic and social aspects of relocating people from the Nile Valley to areas in the desert rounded out a broad integrated feasibility study of developing the desert. As soon as the feasibility studies showed what, how and where development could occur, then plans could be made to proceed with development.

1/ Name was changed to Egyptian General Desert Development Organization (EGDDO) in late 1961.

In 1959, the General Desert Development Authority, realizing the need for expert technical support in ground-water investigations, for modern drilling equipment and expert drillers, for multi-purpose aerial photographs and maps, and for magnetometer surveys, requested assistance from the United States and also the United Nations Education, Scientific and Cultural Organization (UNESCO). The UNESCO contribution has been limited to reviewing and commenting on the proposed project.

A project agreement was signed late in FY 1959 under the title "Ground Water Investigations in the Western Desert". The project became fully operational in FY 1961. AID entered into a participating agency agreement with the U.S. Geological Survey for furnishing technical assistance personnel, advice and direction of the program as set forth in PIO/T 263-12-253-2-10086.

2. Project Targets and Goal Plan Objectives

a. Long-range Objectives

The prime objective of the project is the evaluation of the ground-water resources of the New Valley area of the Western Desert as to quantity, quality and recoverability. It is anticipated that the results of the study will be used to plan the amount and kind of development that can be done in the New Valley within the limits of the ground-water resources. The addition of agriculture and industry and the exploitation of the mineral wealth of the New Valley through optimum use of ground water will assist Egypt in caring for its rapidly expanding population.

A secondary objective is to train a selected group of Egyptian engineers, geologists, chemists and well construction personnel in the methods and equipment used in making a quantitative evaluation of a ground-water system. Some Egyptian personnel are available who have experience in exploration for oil or experience in irrigation projects where surface water is the prime water supply. These personnel have a good background for learning about ground-water studies. It is anticipated that personnel trained during this project will be the nucleus of a group who can apply their knowledge to other ground-water problems in Egypt.

b. Short-range Objectives

These objectives are shown in the following outline of work for the project:

Type of Work	Scope of Work	Agency Responsible
1. Multi-purpose aerial photography	Photograph about 86,000 square miles of Western Desert.	Contract financed by U.S. funds.
2. Leveling for vertical control	Establish system of bench marks through project area necessary for piezometric and geologic control.	Survey Dept. of Egypt.
3. Airborne magnetometer survey	Fly 9,000 miles of traverses. Prepare magnetic map and relate it to the basement complex beneath the Nubian sandstone.	Contract financed by U.S. funds.
4. Surface geologic mapping	Map surface geology, detailed mapping in oases areas and reconnaissance elsewhere.	Geological Survey of Egypt.

Type of Work	Scope of Work	Agency Responsible
5. Sub-surface geologic mapping	a. Prepare contour maps showing tops of marker beds, used to delineate structure and to prepare maps showing thickness of principal aquifers (Isopachous maps). b. Prepare regional cross section and "fence" diagrams of oases areas. Show thickness, lithology and structure which can be used in location of wells. c. Prepare regional contour map of top of basement complex, correlating results of airborne magnetometer survey with data from test drilling.	GDDO-Ground Water Department.
6. Ground-Water Investigations	Collect, record, and evaluate data on well development, discharge, and pressures. Correlate data with geologic and hydraulic studies. Establish observation well program. Start work on determining chemical quality of water. a. Review and analyze all geological and hydrologic information available before project begins. Carefully record and evaluate information in a report. b. Geologic work both surface and subsurface as follows: (1) Detailed sub-surface geologic mapping in oases areas. (2) Electric logging. (3) Integrate information from regional photogeologic maps and detailed geologic maps of oases areas.	GDDO with American technical assistance and contract by GDDO.

Type of Work	Scope of Work	Agency Responsible
	(4) Gravimetric studies - recommended only in areas of other detailed studies as a further check on configuration of basement complex. (a) Regional (b) Detailed oases areas	
7. Carbon 14 Studies (optional)	Carbon 14, dating of artesian water in oases.	U.S. Geological Survey
✓ 8. Ground Water Hydrology	Describe hydrology of area as it relates to the development of ground water. a. Establish observation-well program in the oases. b. Compile an inventory giving pertinent data on all wells now used in the oases areas. c. Study and compile all subsurface data from the electric logs of the oases. d. Conduct pumping tests at pilot-development well locations. e. Quality of water work to consist of collecting samples of water from principal water-bearing zones throughout the oases for chemical analysis. Temperatures should be measured at the time the samples are collected. Special attention shall be directed to the corrosive properties of the water throughout the area. f. Locate existing old wells. Make recommendations for repair or plugging.	GDDO Ground Water Dept.

Type of Work	Scope of Work	Agency Responsible
9. Pilot Development and Test Wells	a. Drilling exploration tests and observation wells. b. Drilling pilot-development wells. c. Maintenance and repair of existing wells.	GDDO contract and GDDO drilling section with supervision by American well drillers.
10. Reference Library	Develop a library of the pertinent books and reports on the hydrogeology of arid areas. Obtain key books and reports outlining principles of geology, hydrology, and chemistry pertinent to the work of the Engineering and Ground Water Division of GDDO.	GDDO, USAID, and USGS
11. Reports	Prepare reports setting forth the results of the investigations.	GDDO with USGS technical review.

3. Project Results

a. Approximately 86,000 square miles have been covered by multi-purpose aerial photographs. Five sets of final contact prints at a scale 1:50,000 with suitable indexes (31,810 prints); and 10 sets each of 86 sheets of controlled photo-mosaics at scales of 1:500,000 have been delivered to the GUAR. The aerial photography has been completed and was financed by AID funds through a contract with an American company. The photos and prints are now available for all types of development and resource planning and investigation.

b. The determination of the altitude of a benchmark at each well in Kharga and Dakhla Oases has been 95 percent completed. Topographic maps at a scale of 1:25,000 have been completed for about two-thirds of the Kharga depression and all of the Dakhla depression. This mapping was done under a contract between the GUAR and a foreign company. In Farafra and Bahariya Oases vertical control work has been done by an American contractor from funds furnished by the GUAR.

c. The surface geologic mapping of the Dakhla area is complete, and a report has been published by the UAR Geological Survey and Mineral Research Department. Surface geologic mapping of the Kharga area is complete, and a report is in preparation by the UAR Geological Survey. Surface geologic mapping of Farafra and Bahariya Oases has been completed by an American contractor financed by GUAR.

d. Subsurface geologic mapping has been done in first draft for the Kharga area. An Arab Technical Committee is reviewing and revising the draft in accordance with all available geologic, geophysical, and drilling data. The first draft of the Dakhla subsurface geologic mapping is in preparation. Generalized regional cross-sections were made for the Farafra and Bahariya Oases by an American contractor financed by GUAR, but the data on which they were done were too scanty to use with certainty. More test drilling is needed in the latter cases to obtain better subsurface data.

In addition to the magnetic surveys of the depth to basement rock beneath the Nubian aquifer system, a resistivity survey was made by a foreign contractor financed by the GUAR. The first maps that were prepared showing interpretations of the magnetic and resistivity data are being reinterpreted and revised.

e. The data collection, integration and evaluation has been done with varying degrees of success. All of the existing data about the project area were not compiled and evaluated prior to the start of the project. Some of this information would be very helpful in analyzing data collected during the project. This collection, compilation, and evaluation of data known about the area prior to 1960 still should be done. Collection of geologic information is as complete as the drilling and surface mapping program permits; and the study and analysis

of the data is progressing, but a large amount of this activity remains to be done. Mechanical analyses were not made on the drill cuttings from all wells - this should be done. Permeability studies must be made on more cores and unconsolidated drill cuttings.

Collection of basic, routine information about water pressure and discharge of wells has been and is continuing to be done. The records are mediocre in quality and too small in quantity, but steps are being taken to increase the quality and number of pressure and discharge data in the future. Pressures are measured once or twice a year in 75 wells in the Kharga area and 50 wells in Dakhla. A pressure measurement should have been made on each well at the time the well was completed. A rough estimate of the pressure measurements that should have been made is as follows: Once a year on all wells; two-to-four times a year on 50 to 75 percent of the wells, monthly on at least 20 percent of the wells and continuously on a few key wells. The discharge rate is measured monthly or semi-annually on about 108 deep wells and 236 shallow native wells in Kharga and 102 deep wells and 627 shallow native wells in Dakhla.

Water samples have been collected and analyzed for 123 deep wells and 320 shallow native wells in Kharga and 85 deep wells and 100 shallow native wells in Dakhla. Water is analyzed periodically for about 30 selected wells in Kharga and 20 selected wells in Dakhla. A review of the analyses shows that more care must be taken in the future when making the analyses; errors are too numerous. The quality of the water chemistry program is being improved by better handling of the water samples and a more rigorous inspection of the analytical procedures in the laboratory.

Data to determine the water-yielding characteristics of the wells and water-bearing rocks are of low quality. This might be the result of insufficient guidance or a careless attitude toward the work. Well and aquifer tests have been made on about 50 wells in Kharga and 27 wells in Dakhla. The data are insufficient in quantity and quality. Prior to 1965 it was thought that the quantitative hydrology data were being obtained in a careful and adequate manner. All of the data were in Arabic and not easily available for the American advisor to inspect and assess. Translation of the data into English has shown the poor quality and quantity of this essential data. Steps are being taken in Calendar Year 1966 to intensify and upgrade the quality of the hydrologic data collection program. The deficiencies in the hydrologic data have caused the project to be reduced in areal scope; the project will be concentrated solely on Kharga and Dakhla for remaining project life.

The study of the corrosive effects of the ground water on various metals used in well construction is about complete. Samples of mild steel, stainless steel, incoloy, aluminum, monel and wood have been tested for corrosion in 8 wells

in Kharga and 6 wells in Dakhla. The work remaining to be done on this subject is a one-year test of two turbine pumps - one is epoxy coated and the other is a standard untreated pump. The standard pump was installed in its well about February 18, 1966.

f. Well construction is complete in the Kharga-Dakhla areas except for 5 wells to be drilled at selected points 30 to 50 kilometers from the center of the oases. The number of wells drilled in Kharga and Dakhla are summarized by years as follows:

1960	4
1961	25
1962	50
1963	73
1964	62
1965	15
1966	2

The deepest well is 1,232 meters; the shallowest is 80 meters; the average depth is about 550 meters.

About 15 deep test holes have been drilled in or near Farafra Oasis.

Casings were installed in all new wells in the New Valley in the section of the hole above the water-bearing beds. Screens of various metals and some wood were placed in most of the holes to finish the well. One aspect of well construction that did not receive sufficient experimentation was a study to learn if the well bores would collapse without screens, thus testing the possibility of eliminating a large expenditure for screens. The preparation of casing and screen logs is complete for all wells that were drilled during the project.

g. The reference library in Kharga, though still small, is growing. The GUAR has purchased several standard textbooks on various subjects in the fields of geology, hydrology, hydraulics and soils sciences. The library has been added U.S. Geological Survey publications and some State Government reports.

h. Three reports have been written about the nature of the study problems in the New Valley; these were presented at international meetings concerned with arid zone development problems. Each or every other year Mr. P.E. Laforeaux, the principal planner of the project work outline, has written a summary of

his impressions about the progress of the program. Five reports have been written about the corrosion of metal when exposed to the ground water of the New Valley. Two reports have been written summarizing the progress of the chemistry part of the program. One report has been written that presents some qualitative information about the geology and hydrology of the Kharga area; it is basically a progress report. A first draft of a similar report on Dakhla has been prepared and is under review and revision as of March 1966. A report summarizing the basic data of the Dakhla area, without interpretation, is about 75 percent complete.

4. Resources Employed

a. U.S. Resources Employed

(1) U.S. Funds (net obligations)

	Dollar	U.S.-owned Local Currency (Sec. 402) (dollars equivalent)
Total (FY 1959-CY 1965)	$2,178,000	$223,000
Programmed for second half FY 1966	40,300	-
Programmed for FY 1967	60,000	-

The total funds obligated include $46,000 paid to a U.S. contractor for aerial photography of 35,000 square miles of the Western Desert and 9,000 miles of aerial magnetometer surveys. The results obtained from this contract have been and are being used by activities in the desert other than the water-study program; therefore this expenditure resulted in multiple benefits to the GUAR.

(2) Resources by Type

(a) U.S. Technicians:

A senior ground-water hydrologist (PASA) as full-time Chief Project Advisor to the EMDDO and the U.S. AID Mission to advise on all aspects of the project and to provide general supervision of the Americans working on the project. 60 man-months

A ground-water geologist or junior hydrologist (PASA) full-time to assist the technical advisor. 40 man-months

Three experienced water-well drillers, on direct AID hire, to train Egyptian personnel in water-well construction. 120 man-months

A heavy machinery maintenance specialist, on direct AID hire, to train Egyptian mechanics on maintenance of project machinery and to give technical advice on major mechanical problems. 24 man-months

Quantitative hydrologists on TDY (PASA) to advise on quantitative aspects of the study, data collection, and analysis. 5½ man-months

Corrosion specialists on TDY (PASA) to advise on problems of corrosion of materials used in well construction and pump equipment. 3½ man-months

Photogeologist on TDY (PASA) to train Egyptian geologists in principals of photo-interpretation for geologic mapping. 4½ man-months

Agricultural engineer on TDY, direct AID hire, for consultation in irrigation layout practice. 1 man-month

Chemist on TDY (PASA) to train Egyptian chemists in laboratory techniques and equipment used in making chemical quality of water analyses and to advise on the construction and equipping of a water chemistry laboratory. 4 man-months

Analog model specialist on TDY (PASA) to train Egyptian engineers in the layout and construction of an analog model of the New Valley's ground-water system. 2½ man-months

Report writing specialist on TDY (PASA) to advise Egyptian personnel on the preparation of technical reports about water-resources studies. 1½ man-month

Topographic survey specialist on TDY (PASA) to advise Egyptian engineers on a program of establishing a vertical and horizontal control network as a basis for a topographic survey. 1 man-month

(b) Participants (all U.S.-trained):

Fiscal Year	Number	Man-Months	On project 3/1/66	Field of Training
1961	1	7	No 1/	Photogeology
1962	5	35	No	Photogeology (1), Groundwater Hydrology (2), Groundwater Geophysics (2)
1963	3	16	Yes	Well-drilling, Groundwater Hydrology, and Soil Classification
1964	3	20½	Yes	Groundwater Hydrology, Groundwater Geology, Water Geochemistry
1965	1	6	Yes	Groundwater Hydrology
1966	4	23½	Yes 2/	Groundwater Hydrology
	17	108		TOTAL

The six participants trained in FY 1961-62 have left the project and are not working on ground-water projects elsewhere. The participants still with the project are applying their learning, but they seemingly do not give their fellow workers the benefit of their training. Training is a personal possession.

1/One man left the project in March 1966

2/ Training scheduled for early FY 1967

(c) Commodities:

4	Rotary drilling rigs, 1 well-cementing unit, power tools for a small workshop, and spare parts for above equipment to drill test wells and train Egyptian drill crews	$837,600
3	Trucks, oil-field type to serve drilling operations	75,700
10	House trailers and portable generators for field living quarters for drilling crews and field technicians	42,000
2	Pick-up trucks, 2 sedan carryalls (all 4-wheel drive), and spare parts to transport drilling advisors and other U.S. technicians	16,900
	Scientific instruments - well logger for electric logging of wells, automatic recorders to obtain data about pressure changes in wells, chemical laboratory equipment for analyzing water samples, permeability and mechanical analysis equipment for geologic laboratory, well-exploration equipment for studies inside wells	42,700
3	Deep-well turbine pumps for corrosion studies	34,100
	TOTAL	$1,049,000

Costs are given in terms of funds obligated. Some of this amount, however, remains unliquidated and a small portion will not be expended because of minor overestimating on costs at the time of fund obligation.

(d) U.S.-owned Local Currency: A total of $223,000 equivalent of Sec. 402 L/C was used to finance local costs of an aerial photogrammetric survey conducted in 1960-1962 by Aero Service Corporation, an American firm under contract to A.I.D.

b. Cooperating Country Resources Employed

(1) Total Value (Dollars Equivalent)

Exact estimates of the host country's contribution to the study program cannot be obtained because the EGDDO has not separated cost of the study program from the cost of work that constitutes water-production and development and which is not pertinent to the study. The magnitude of the Cooperating Country contribution can be estimated through their cost breakdown of the well-construction program. Approximately 230 wells were constructed at a cost to them of about 9 million dollars. Manpower, transportation, office space and other expenses would make their contribution at least 10 million dollars.

2) Commodities and services

At least 130,000 meters of casing and screen for the test wells.

At least 6 drilling rigs and crews on contract with domestic and foreign contractors.

At least 20 vehicles including several heavy-duty trucks.

Resthouse for U.S. technicians at Kharga.

Air and rail transportation of local as well as U.S. technicians between Cairo and Kharga.

Fuel and maintenance on all mechanical equipment.

Geologic and topographic mapping by contract with the Survey of Egypt.

Gravimetric survey by contract with a foreign contractor.

Preparation of topographic maps of New Valley by contract with a foreign contractor.

(3) Technical Personnel

Engineers	58 man-years (*)
Geologists	30 man-years
Chemists	26 man-years
Drillers and assistants	118 man-years

(*) Estimated by U.S. AID that only about 30 man-years were by professional engineers, the balance was by sub-professionals.

5. Major Factors Affecting Progress

a. Cooperating Country Performance

The host country showed a high level of interest in the project. The EGDDO proved to be a dynamic organization and tried to provide enough facilities, manpower and finances to make the project effective. They were handicapped by having no one who had been previously engaged in a comprehensive ground-water evaluation. This may have contributed to one of the major problems of the project because no one could explain to high-ranking government officials in their own language all of the elements necessary to make a comprehensive quantitative evaluation of a large ground-water system.

The major problem plaguing the project has been that the prime objective of the project - study and quantitative evaluation of the ground-water resources of the New Valley - became subservient to actual production and use of the ground water. The latter activity was undertaken while the study was in progress rather than waiting until study results were available with which to plan a development consistent with proven resources. The project was slowed, and the quality and quantity of the hydrologic data collected were poor because the project's test-wells were used to supply water for irrigation before the hydrologic studies of the wells were completed. The EGDDO was the agency responsible for the study as well as for the ultimate production schemes. Pressure was exerted on EGDDO from higher government sources to show visible efforts for solving the shortage of crop acreage. The EGDDO abandoned the basic idea that the study results should dictate when, where and how much development of the water resource should be undertaken. The slow-down of the project because of increased difficulty in getting good quantitative data has required project goals to be lowered to include only the appraisal of the Kharga and Dakhla areas by termination of the GUAR-USAID joint effort in FY 1967.

Certain parts of the study program were accelerated because of the interest in water production. Drilling of wells was given excellent support. The rapid well-construction program made information about the subsurface rocks available to the geologists quickly so they could keep actively engaged on the subsurface geology. Aerial photography and mapping of the New Valley was well supported because that information was essential to the positioning of well sites and the layout of the agricultural areas.

The ability of EGDDO to provide the necessary transportation was overestimated. Lack of an adequate supply of vehicles to put the technical men on the job slowed the project.

b. U.S. Performance

The project was well planned by U.S. personnel and was flexible enough to compensate for some field operation difficulties. The project was adequately financed on the U.S. side, and the GUAR bore the largest share of project costs. A slight change in the U.S. staffing pattern might have resulted in overcoming the problem of rapid conversion of test wells to production wells. If one full-time quantitative hydrologist had been added and assigned to the field he could have shown what testing was required during the early life of each well. Some of the cost of this additional man could have been covered by eliminating the services of the TDY quantitative consultants. Depending on Egyptian personnel to carry on with too little guidance resulted in inadequacies in quantity and quality of data.

The guidance of the project was seriously disrupted when the chief advisor and the junior hydrologist ended their tours of duty in August and June 1964, respectively; and it was March 1965 before their replacements arrived at post. This gap was caused by a major illness of the man who was to be the new chief advisor, and another man had to be found for the job. It took from about September 1964 to mid-February 1965 to get clearances for the new chief advisor.

Planning was inadequate in some cases to assure that the specialist sent to the project on TDY could be used effectively. Timing the arrival of a technician on TDY often cannot be done accurately with the consequence that some of the time of a specialist is wasted in waiting for the opportunity to work. The need for the specialist and timing his arrival on TDY should be discussed thoroughly between the USAID Mission and the host country so that each side does its share in making the TDY of the specialist worthwhile.

The project might have benefitted if the background and experience of all the drilling advisors had been entirely in water-well construction. There is a difference between an oil-well driller's approach to drilling and that of a water-well driller. In addition, there is a difference between drilling for a study program and drilling for a production program. More attention should have been given to studying how to make better wells rather than how to drill wells faster.

6. Appraisal of Results

The case study report on the Ground-Water Investigations in the Western Desert presents a realistic description of a fascinating and challenging operation in learning about underground water in a desert area. Artesian water flowing from wells in a desert is a spectacular sight, particularly in an area where the average rainfall is less than one inch in ten years.

The underground water studies project was started in 1960, its major objective being the determination of the availability of underground water beneath the New Valley of the Western Desert. The test wells of the study project were too good; their discharge rates were sufficient for irrigation of land. The major activity which developed as a result of these high-yield wells was the rapid reclamation of new land on which the "surplus" water from these wells could be used for productive purposes. As a consequence, more emphasis was placed by the GUAR on preparing land, getting it leveled, etc., than on studies of the actual water resource.

The actual rate of progress has been much slower than expected because of the decreased emphasis on the study program and the diversion of effort and equipment to production schemes. The goal of studying all of the New Valley by 1967 had to be dropped, and the remainder of the project's life is scheduled solely for concluding the evaluation of the water resources of the Kharga and Dakhla areas; Farafra, Bahariya and Siwa oases have and can receive only token effort.

One of the major problems in many newly developing countries is the desire of higher officials to show new land areas which have been rapidly developed or partially reclaimed and to have a large number of wells drilled rather than to follow the more conservative approach to efficient land development; namely water resources evaluation, soil survey, study of irrigation practices, adequate leaching, and experimentation to determine the crops best suited for the area. The desire of officials to report visible progress rather than the dull statistics of sound study and planning has introduced an element of confusion and a lack of teamwork among the EGDDO departments associated with the project.

The objective of the project is good and, if carried to completion within its original plan, will provide Egypt with information that can help toward, but not totally solve, the problem of feeding and employing the people of Egypt. The ground water of the Western Desert can support some irrigation of land. What data are available have been interpreted to indicate that withdrawal of water from the ground is a "mining" operation. The extraction of this resource is complicated by the "narrow" entrance to the "mine" - the economic depth of water withdrawal is within the lower parts of the depressions which comprise the New Valley. The ground water is stored under most of the Western Desert, but the economically feasible points

of extraction are limited to the New Valley depressions. The resource is fluid and some will move slowly from outside the oases areas to replace the water that has been withdrawn. Previous qualitative studies of the Western Desert have "estimated" the gross amount of water in storage but have ignored the fact that it is not feasible to obtain for use much of the stored water.

Until the GUAR proves a capacity to adhere to a study program, any attempt study other ground-water problems in Egypt probably will not succeed.

7. The Mission Acting Director's Comments and Evaluation of the Project

My contact with this project has been limited to the last year; I first visited the field operation only in April 1966 after assuming responsibilities as Acting Director a few months previously. I believe that this report correctly describes the progress and problems of the activity. The GUAR recently, to some extent since the above analysis was drafted, has shown increasing recognition of the necessity to complete the water investigation. We now are assured that no further production will be undertaken until studies are completed. This has resulted partly from the Government's difficulties with declining production from both shallow village wells and EGDDO deep wells. Some land once put under production by EGDDO already has returned to desert.

Apart from routine obstacles encountered in technical assistance generally, the GUAR's insistence on beginning agricultural use of water from exploratory wells in the New Valley has been the only significant problem. No satisfactory method was found of attacking this problem until reduced well flow convincingly underlined the warnings of the USGS technicians. The fascination which flowing water in the desert understandably has for water-conscious Egyptians was too strong to be overcome through any avenue open to the Mission. We cannot now be sure that earlier USAID personnel were fully awake to the seriousness of the diversion of EGDDO's attention from investigation to agriculture. The project record does not make clear that proper warning and the firm stand which subsequent experience has justified were adequately conveyed to GUAR authorities. The gap in the presence of a senior advisor, from August 1964 to March 1965, was most unfortunate in this regard.

While experience to date has been disappointing in the most important aspect of project activity, the USAID feels that it may yet prove advisable to extend the project by some months beyond the previously planned termination date. Should recent favorable developments continue, consideration will be given to such a recommendation. The project is so near to being highly successful; it would be appropriate to devote perhaps two additional man-years to it if this would give reasonable assurance of accomplishing the key objective of establishing a sound water study background and capability in the UAR.