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DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D.C. 20523

PROJECT PAPER

Proposal and Recommendations
For the Review of the
Development Loan Committee

EGYPT - IRRIGATION PUMPS

AID-DLC/P-2249

UNCLASSIFIED

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

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September 12, 1977

MEMORANDUM FOR THE DEVELOPMENT LOAN COMMITTEE

SUBJECT: Egypt - Irrigation Pumps

Attached for your review are recommendations for authorization of a loan to the Arab Republic of Egypt ("Borrower") in an amount not to exceed Eleven Million United States Dollars ($11,000,000) to assist in financing the foreign exchange costs of materials, equipment and services for the installation of irrigation pumps at 34 sites in Middle and Upper Egypt.

No meeting is scheduled for this loan proposal. However, please advise us of your concurrence or objections as early as possible, but in no event later than close of business on Wednesday, September 21, 1977. If you are a voting member, a poll sheet has been enclosed for your response.

Development Loan Committee
Office of Development Program
Review and Evaluation

Attachments:
Summary and Recommendations
Project Analyses
Annexes A - P

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PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A ADD, C CHANGE, D DELETE)

2. DOCUMENT CODE: PP 3

3. COUNTRY ENTITY: ARAB REPUBLIC OF EGYPT

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 263-0044

6. BUREAU OFFICE: A. SYMBOL: NE; B. CODE:

7. PROJECT TITLE (Maximum 40 characters): Irrigation Pumping

8. ESTIMATED FY OF PROJECT COMPLETION: FY 81

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 77; B. QUARTER 4 (Enter 1, 2, 3 or 4); C. FINAL FY 77

10. ESTIMATED COSTS $000 OR EQUIVALENT $1

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	11000		11000	11000		11000
GRANT						
LOAN	11000		11000			
OTHER U.S. 1						
OTHER U.S. 2						
HOST COUNTRY		3500	3500		7184	7184
OTHER DONOR(S)						
TOTALS	11000	3500	14500	11000	7184	18184

11. PROPOSED BUDGET APPROPRIATED FUNDS $000

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY GRANT	E. 1ST FY G. LOAN	H. 2ND FY GRANT	H. 2ND FY J. LOAN	K. 3RD FY L. GRANT	K. 3RD FY M. LOAN
(1) SA	120		064		11000				
(2)									
(3)									
(4)									
TOTALS					11000				

A. APPROPRIATION	N. 4TH FY O. GRANT	N. 4TH FY P. LOAN	Q. 5TH FY R. GRANT	Q. 5TH FY S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1)						11000
(2)						
(3)						
(4)						
TOTALS						11000

12. IN DEPTH EVALUATION SCHEDULED: MM 02 YY 82

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET DATA. 1 NO, 2 YES: 1

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14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Selig A. Taubenblatt

TITLE: Selig A. Taubenblatt, Director, NE/CD

DATE SIGNED: MM 09 DD 09 YY 77

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (11-78)

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EGYPT: IRRIGATION PUMPS

SUMMARY AND RECOMMENDATION

1. Borrower: Government of the Arab Republic of Egypt (GOE)
2. Implementing Agency: The Egyptian Ministry of Irrigation
3. Loan Amount: U.S. $ 11.0 million
4. Terms: To Government of Egypt - Repayment within 40 years including ten years of grace; 2 percent annual interest during the grace period and 3 percent annual interest thereafter.
5. Purpose: Increase irrigated agricultural productivity in the project area.
6. Project Description: Installation of irrigation water pumping facilities at 34 sites in Middle and Upper Egypt. The A.I.D. loan will provide funding for the necessary equipment and supplies for installation of new or replacement pumps.
7. Total Project Cost: Total cost of the pumps project, both foreign and local, is estimated at $ 18.2 million. The foreign exchange component is estimated at $ 11.0 million. The GOE will provide the balance of $ 7.2 million equivalent in local currency for installation and support costs.
8. Loan Application: The Government of Egypt has requested an A.I.D. loan of $11.0 million to cover the foreign exchange

costs of this project. The application is attached as Annex A.

9. Mission Views: USAID/Egypt has recommended authorization of the proposed loan.

10. Source of U.S. Funds: Fiscal Year 1977 Security Supporting Assistance.

11. Statuatory Requirements: All statuatory criteria have been met. See Annex D.

12. Recommendation: Authorize a $ 11.0 million loan to the Government of the Arab Republic of Egypt on terms and conditions set forth in the draft loan authorization in Annex B.

13. USAID Project Committee:

CDE:TRTifft

CDE:PSLEWIS

AGR:NDEMIK

LEG:STISA

ECON:JNORRIS

1. INTRODUCTION

1.01 The Government of Egypt has requested a loan of $11,000,000 to finance the foreign exchange costs of replacing or installing irrigation water supply pumping systems at 34 irrigated agricultural sites in Middle and Upper Egypt. Of these sites, 17 have existing pumping equipment which will be replaced and 17 without such equipment will have power-driven equipment installed. The project is expected to increase agricultural production substantially in these areas. The Ministry of Irrigation selected the sites, which represent about three percent of the pumping stations in Egypt, on the basis of condition of equipment, their importance to production of key export crops and the desires of farmers for publicly-operated water delivery systems.

1.02 This project will complement other A.I.D. assistance to the Egyptian agricultural sector. Several capital and technical assistance projects are underway: PVC Drainage Pipe Plant (Loan 263-K-034), Water Use and Management Studies (263-0017), Agricultural Development Systems (263-0041), Poultry Improvement (263-0060) and Managing Planning in Agriculture and Rural Development (TAB-0209). Commodity import assistance totaling approximately $41 million is being provided to increase agricultural production, including tractor units, soybean seed and innoculants, deep well pumps, electrical parts for pumping stations, and herbicides. Future project and commodity import assistance to the agricultural sector are planned.

1.03 A feasibility study of this project was completed in Mid-1977 by the firm of Louis Berger International under Contract AID/afr-c-1132. The study, reviewed by USAID and the Ministry of Irrigation, serves as the basis for this Project Paper.

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II. BACKGROUND

A. General

2.01 Egypt is largely desert country with a total land area of approximately 1 million km^2. The populated area is 35,850 km^2 (3.6%) and the cultivated area approximately 28,120 km^2 (2.8%). The cultivated area per capita was estimated to be .76 feddans in 1960 and now is only about .70 feddans per person.

2.02 The entire country of Egypt lies in the temperate zone between 22° and 32° north latitude. It is part of the vast desert belt that extends in Northern Africa from the Atlantic Coast eastward through Saudi Arabia. It is a dry, arid country with subtropical temperatures prevailing throughout the land. The Nile, flowing from the southern region to the Mediterranean, forms the ribbon of life for the country. People and crops are confined to the eastern and western edges of this strip of water. The deserts on both sides to the Nile Valley provide a warm and rainless climate with pronounced diurnal changes.

2.03 The project area is located in Upper and Middle Egypt. The average rainfall is highest in the northern part of that region. Beni Suef Governorate, in the north averages about 11.3 millimeters, most of which comes in the winter period. In the southern area, Aswan Governorate, the average rainfall is negligible, amounting to only 1.5 millimeters a year. Although the average rainfall is practically nil, occasional "storms" can cause severe erosion.

2.04 Egypt has an estimated population of 40.0 million (1977) with a current population growth rate of 2.5% per annum. About 96% of the country is uninhabitable. The remaining 4%, located mainly in the Nile Delta and the Nile Valley, is densely populated, estimated to have over 1,000 persons per km^2. The per capita GNP for the country in 1970 was U.S. $210 and for agriculture the per capita GNP in the same year was only U.S. $100. In 1974, the per capita GNP for the country was U.S. $280. The relative poverty level in rural areas of the country is estimated to be U.S. $58 per capita.

2.05 Food import costs over the last few years have risen sharply from less than LE 100 million to over LE 500 million annually. Government subsidies to supply basic foods in urban areas at low prices and certain production inputs such as fertilizers and pesticides to farms at fixed prices have also risen from about LE 50 million to nearly LE 500 million. In spite of this, food prices have risen about 60% since 1967.

B. Agriculture

2.06 The agriculture sector is critical to the life and economy of Egypt. It involves 57% of the population, provides employment opportunities for 46%, generates 31% of the GNP and is responsible for approximately 75 to 85% of export earnings. It is the basis for the present study and establishes the broad justification for the pumps under consideration. The Nile, flowing northward, provides two distinct agricultural regions: The Nile Delta, an alluvial fan, and the Nile Valley, formed by alluvial soils deposited annually on the east and west banks of the Nile. In general, agriculture is more advanced in the Nile Delta than in the Nile Valley. The irrigation pumping project is located in the Nile Valley, referred to as Middle and Upper Egypt.

2.07 Due to its mild and temperate climate and available water, the Nile Valley enjoys a year-round growing season. New crops are planted as quickly as old ones are harvested. Traditionally, the agricultural year begins in November and is divided into three periods: winter, summer and "nili" (the fall season, named after the Nile flood). The major winter crops are wheat, barley, Egyptian clover or berseem, broad beans, lentils, winter vegetables, winter onions and flax. These crops are usually planted during October through December and harvested from April through June. The major summer crops are cotton, maize, sorghum, millet and summer vegetables. They are generally planted from March through June and harvested from August through November. The nili crops include maize, sorghum and vegetables which are planted in July and August and harvested from October through December. Sugar cane is perennial and is usually planted in January and February and harvested about 15 months later. The subsequent ratoon cuttings are harvested a year apart afterwards. An array of fruits such as oranges and other citrus, mangoes, grapes and bananas are grown in permanent groves. Dates, the second most important fruit after oranges, are found scattered around villages and cultivated fields and along canals.

2.08 C. Farm Practices

The general practice is a 2 or 3 year rotation. In addition the land usually supports a variety of crops throughout the year, giving a cropping ratio of close to 1.9. The areas devoted to sugar cane and cotton are regulated by the Government and tend to be farmed in relatively large consolidated blocks. The other crops are distributed in small plots. In the two year rotation, the land is divided into two approximately equal blocks. One block is planted to clover in the winter and after about two cuttings, the summer cotton crop is planted. The second block is divided into two equal parts, one of which is planted to clover and the other to wheat and barley. These two blocks are

subsequently planted with summer crops such as maize, sorghum, summer vegetables or millets. In the second year, the respective crops are planted in the opposite plots in the same distributions. In the three year rotation, the land is divided into 3 equal blocks. Block one is planted to clover from which two cuttings may be obtained before planting the field in March to cotton. Block two is planted in winter to clover or beans and the third block to wheat or barley. The latter two blocks are subsequently planted with summer crops. This sequence of crops is rotated among the three blocks in the second and third year to complete the rotation. On farms where cane is grown, the sugar cane remains in the same plot for at least three years. The balance of the farmer's land is divided into plots in which winter, summer and nili crops are cultivated. As a consequence, the calculation of water requirements and pump sizes is a complex problem.

2.09 All farm plots in the project area engage in perennial irrigation made possible by the commissioning of the Aswan High Dam. Farmer's fields are provided water distributed through a vast network of irrigation and drainage canals operating under gravity. In the majority of cases, water is lifted out of the main canals to the plots by means of traditional water wheels, shadoofs, and screws. Since there is no water charge to the farmer, it is said that there is a tendency to over-irrigate, although water discipline is improving with the Ministry of Irrigation's recent efforts to match supply from the dam to actual crop production needs.

2.10 The major source of power on the farm is the buffalo and cattle. These animals are used to carry out land preparation, threshing of grain, lifting of water and in transporting goods and people. Machinery is being used to an increasing extent in some agricultural operations needing draft power such as plowing for sugar cane areas, pumping machines for irrigation and motor sprayers for pest control on cotton. The donkey is very common and is used primarily to transport goods and people. Sheep of the fat tailed, coarse wool type, and goats are found in the area, usually in herds controlled by nomads. Sheep and goat milk is used primarily for making cheese and their flesh provides the occasional meat component of the rural Egyptian's diet. The raw wool produced is used mainly for making carpets. Poultry are common, securing their food by scavenging the cultivated fields. Organic and chemical fertilizers are used extensively and farmers are fully aware of their benefits.

III. THE PROJECT

3.01 This project involves the replacement of 17 existing pump stations in Aswan and Qena Governorates and the installation of 17 new stations in Beni Suef, Minia and Sohog Governorates. The locations of these 34 stations are shown on the maps presented in Annex E. An illustration of a typical pump station in relation to irrigation canals and irrigated fields is shown in Annex F.

3.02 All of the existing pumps in the system were designed and installed for operation and cultivating conditions that were quite different from current conditions. For example, the stations were established when there was an 8-meter annual variance in the Nile River level, prior to construction of the High Dam as compared with the present 2.5-meter variance. The stations were also designed to serve cropping patterns that were substantially different from those found in Egypt today. Since they were built, approximately 10 to 15% more land area has been brought under cultivation and high water demand crops such as sugar cane and sorghum have been added to the crop distribution in the project areas. Because of these factors, and the age and condition of the pumping units, the peak water demands at the stations is on the average about 50 percent greater than the pumps are capable of supplying while serviceable spare units for emergencies are retained. Almost all of the pumps and prime movers have operated well beyond their useful life. Of the 17 existing sites, 10 utilize equipment manufactured in 1931-33, 4 use equipment manufactured in 1949-54, and 3 use equipment units made in 1965-67, as detailed in Annex G.

3.03 Water supply at sites without pumping stations also show a substantial water deficit since most water supplied at present is by traditional means such as draft animal and hand-operated water wheels and shadoofs (counterpoise sweep). The effect of this deficiency is a substantial loss in crop yields which could be recovered by investment in more efficient mechanical delivery systems.

3.04 This project also provides transport equipment for pump station installation and maintenance and shop equipment to upgrade the maintenance and rebuild capability of existing shops. Funding is also being provided for consulting engineering services required for finalization of bidding documents, review of bids, award recommendations and monitoring of procurement and project implementation.

IV. TECHNICAL ANALYSIS

A. Pumping Stations

1. Water Requirements

4.01 Water is supplied to the irrigation system of Egypt through daily discharges from the Aswan High Dam. The dam, commissioned in the early 1960's, was designed to generate hydroelectric power, control Nile River floods and provide water for irrigation and navigational purposes. It is estimated that some 82% of the annual Aswan discharge or 46 million gallons is used directly for irrigation purposes. Water requirements throughout the irrigation system from Aswan to the Mediterranean are monitored daily by stations along the Nile. Discharges from the High Dam and related elements of the water supply system are regulated continuously by the Ministry of Irrigation according to onsite assessments of the demand based on growing season, crops to be irrigated and the actual state of land preparation in each area.

4.02 May through September are the critical months for irrigation water demand, July being the peak demand month. The demand may be calculated from an interaction analysis of key variables: crop transpiration rates by plant growth stage; water surface evaporation; air temperature; soil percolation; wind velocity; crop distribution and water user practices. Primary determinants of these variables are soil topography, climate, cropping patterns, and management of local water supply. Considerable research on the interaction of these variables for each major crop, by cultivation cycle and agro-geographic region, has been conducted since 1962 in nine selected locations throughout Egypt.

4.03 Results of these experimental investigations have been empirically tested under the actual crop production environment in Egypt during the past several years, resulting in quantification of actual water requirements for normal cultivation conditions. Using these data, the water demand level for each station was determined by aggregating the water requirements for each cropping area by peak month.

4.04 To arrive at aggregate pump discharge capacities at each station, peak water demands were further adjusted by appropriate factors to compensate for the following:

a. Losses in distribution canals. A canal efficiency coefficient of 0.9 for Upper Egypt and 0.85 for Middle Egypt, as recommended by the Research Institute of the Ministry of Irrigation, GOE, were utilized

b. Irrigation rotation periods. A rotation factor was derived from information on irrigation practices in

Egypt, provided by the Ministry of Irrigation, as shown in the following table:

TABLE 1

ANALYSIS OF CROP ROTATION

Region	Crop	Rotation Period	Rotation Factor
Middle Egypt	Rice	4 days wet; 4 days dry	2
	Vegetables	4 days wet; 4 days dry	2
	Cotton	5 days wet; 10 days dry	3
	Other	7 days wet; 7 days dry	2
Upper Egypt	All Crops	7 days wet; 7 days dry	2

c. Daily periods of pump operation. Pump operating time coefficients were determined from the data provided by Irrigation Water Districts as shown below:

TABLE 2

Pump Operating Times

Location	Hours/Day	Coefficient
Beni Suef	18	1.33
Minia	18	1.33
Sohag	16	1.50
Qena	16	1.50
(Derb)	24	1.00
Aswan	19	1.26

4.05 The aggregate station discharge requirements in cubic meters per second are shown in Annex II.

2. Static Lift

4.06 Utilizing data provided by the Egyptian Research Institute for the Study of High Dam Effects, an independent investigation was used to verify the accuracy of site static lift data provided by the Ministry of Irrigation and presented in Annex H.

4.07 In determining static lift, the possible future effects of construction of a proposed barrage at El Silsila, 71 kms downstream from Aswan, were not considered. The issues of the barrage project are under discussion within the Ministry. However, no one can predict the decision or when it may be made. If the dam is built, increased water levels upstream will reduce the static lifts at related stations. Rather than size motors on a tenuous prediction of a future situation, size recommendations were based on existing conditions.

3. Electric Power

4.08 Twelve of the existing pump stations are presently electrified.

It is proposed that all of the existing diesel-driven stations and all of the new pump stations similarly be electrified. An economic analysis of electric vs. diesel driven is presented in Chapter VI.

4.09 The primary determinant of the desirability of electrifying a pumping station is the distance between the station and an 11 KVA line. This is the level of power at the last terminal point before step down reduction for distribution throughout the local area served by the electrical network. The existing 11 KV terminal points throughout Egypt are shown on the maps in Annex E. According to data furnished by the Rural Electrification Authority, Ministry of Electricity, a terminal point has the capacity to serve a pumping station when the station is located within a radius of 15 to 25 kilometers of the terminal outlet. To demonstrate the serviceability of the project stations by the existing power network, a dotted circle showing power terminal area coverage has been drawn on the maps presented in Annex E. All stations are within the range of an 11 KV power distribution point, and, therefore, can be electrified at moderate cost.

4. Pump and Motor Sizing

4.10 Based on water demand, static head, dynamic head, etc., pump capacity and horsepower requirements were determined by standard engineering computation methods. These calculations, together with recommended pump and motor sizes, are presented in Annex I. Pumps will be of the vertical shaft, direct drive, single stage mixed flow type. In selecting pump and motor sizes, high priority was given to standardizing the equipment at each station and providing for a significant degree of standardization in the total equipment procurement. For the 104 motors and pumps selected for

33 of the stations (excluding Derb, Station 23), the following list shows the number of different sizes determined for the main equipment components:

TABLE 3

Shaft and Bearing Diameters	2
Pump Bowl Sizes	3
Motor Speeds	3
Impeller Sizes	6
Motor Sizes (HP and Speed)	12

4.11 The electric motors selected are within the permissible maximum of 500 HP, thereby allowing them to be of the same voltage (380v), hertz ratings (50 cycles) and phase (triple). When final specifications are written, motor sizes may be further reduced to 7 or 8 if intermediate sizes covering the requirements of the widest range of pumps are selected. This point will be considered in final specification of equipment requirements.

4.12 Spare pumps will be supplied for each station. The spare units will permit repair of a deadlined primary unit without disruption of the required water supply and will insure an emergency reserve during peak demand periods when failure to deliver enough water for as little as one of two days can substantially reduce crop yield. Operation of the spare unit is to be rotated with the other units to prolong the useful economic life of all units. Spare parts will be provided amounting to about 15 percent of pump costs and 10 percent of motor costs.

5. Installations

4.13 All pump stations, except El Derb (Site 23), will consist of fixed concrete platforms extending from the river bank, supported by reinforced concrete piles. A sketch of a typical installation is shown at Annex J. The initial cost of such a platform (LE8,500) is only 14% of the initial cost of the floating barge platforms currently in use at some pump stations in Egypt. Further, the fixed concrete platforms require no maintenance, while costs of barge maintenance are considerable. The type of construction is simple and poses no problem to medium-to-large local construction companies.

4.14 Pump stations will be sited at locations on the river where sedimentation or erosion are minimal. If the El Silsila barrage is eventually built, the increase in water level will reduce the static head at adjacent upstream stations. It is not expected

that changes in river regimen caused by construction of the barrage would adversely affect operation of adjacent pump stations. However, this factor will be fully assessed during the detailed field investigation of station sites.

4.15 The El Derb pump station, the largest and most modern of the sites investigated, is presently housed in a concrete building, with a suitable intake structure, that will adequately accommodate the new equipment. The existing pumps will be removed and replaced sequentially to avoid interruption of irrigation water flows.

4.16 The project budget includes dollar and local currency funds to cover all costs of site improvement, station construction, and related electrical transmission lines and connections.

6. Data Collection

4.17 The absence of an adequate pumping data collection system was noted during investigation of the project. Recommendations were made by the consultant to initiate recordkeeping by station operators relative to pump operating times, frequency of repairs, electric power consumption and actual water delivery. It was recommended that weirs be installed at pump stations to measure discharge quantities. Although the project budget includes local currency for weir construction, further investigation will be made of more economical ways by which to measure discharges prior to expenditure of funds for this purpose.

B. Support Equipment

1. Maintenance

4.18 The Mechanical and Electrical Departments of the Ministry of Irrigation maintain three permanent workshops and three floating workshops in Upper Egypt. These shops are under separate managers and are specialized by the type of work. The Aswan shop maintains diesel pumping stations; the Komombo shop is set up to maintain electric pumping stations; the Naga Hammadi installation is a much larger shop and performs all types of work on diesel pumps, electric pumps, deep well pumps and floating pumps. The three floating workshops, attached to the Aswan shop, are assigned throughout Upper Egypt as needed to, principally, service equipment which cannot be readily moved to the main shops.

4.19 Based on existing inventories of shop equipment, comprehensive packages of additional shop equipment and tools are being provided to upgrade the capabilities of the three main shops and the floating workshops. Major equipment items include air compressors, grinding machines, floor cranes, lubrication units, presses, welders, etc. Electrical testing and motor re-winding equipment is also provided.

2. Transport Equipment

4.20 To improve the capability of the Mechanical and Electrical Departments to install and service the new pumping stations, transportation equipment, including pick-up trucks, flatbed trucks, personnel carriers, mobile shops and crew boats, will be provided to the three main shops.

3. Communications Equipment

4.21 Project investigations have indicated that improved communications between the various operational elements of the Ministry of Irrigation would serve to increase the efficiency and effectiveness of repair and maintenance efforts. The recommendation of the study consultant to establish a radio communications network between the new pump stations and related shops and Ministry offices has been given serious consideration. As we recognize that the telecommunications problem is endemic to all civil government operations in rural Egypt, we do not believe that the problem can be satisfactorily addressed by providing radio communication facilities to the relatively few pump station sites included in this project. The number of sites included represent only about three percent of the prime irrigation stations in Egypt, and, after project completion, these will be less likely to require emergency repair services than any other stations in country. At the present time, a U.S. consultant, Continental Telephone Corporation, is preparing a nationwide telecommunications improvement plan under an AID-funded contract with the Ministry of Communications. The opportunity will be provided all GOE ministries, including the Ministry of Irrigation, to express their requirements and have such needs incorporated into the national master plan. We believe this approach will result in a more comprehensive solution to the communications problem.

C. Consultant Services

4.22 The services of a U.S. consulting engineering firm will be provided to assist the Ministry prepare the final specifications and invitations for Bid (IFB), evaluate bids, contract for equipment procurement, monitor procurement, and supervise the installation and testing of equipment. The consultant shall assist the Ministry in planning and supervising site preparation, which includes the construction of pump platforms, access road, electrical hook-up and discharge pipe installation. These services are considered essential to ensure timely project implementation.

D. Capital Costs

4.23 Dollar cost estimates for U.S.-procured equipment are based on manufacturers' estimated 1977 costs. Local currency import duties are indicated. Total project costs are summarized in the following table.

CAPITAL COST ESTIMATE

Item	Foreign Exchange (U.S. $)	Local Currency (L.E.)
A. Pumping Stations		
Pumps	2,151,186	331,280
Pump Spare Parts	322,678	30,490
Motors	3,510,913	334,070
Motor Spare Parts	351,090	33,180
Transformers & Switches		341,470
Transformer Mounting		24,090
Discharge Pipe		486,880
Transmission Line		1,481,700
Submarine Cable	694,048	65,560
Pump Platforms		280,500
Site Access Roads		51,000
Measuring Weirs		85,000
Sub-Total	7,029,915	3,545,220
B. Support Equipment		
Transport Equipment	867,100	312,590
Spare Parts	130,065	12,290
Shop Equipment	306,665	28,980
Electrical Testing Equipment	74,855	7,070
Sub-Total	1,378,685	360,930
C. Consultant Services	350,000	117,000
D. Equipment & Service Sub-Total	8,758,600	4,023,150
E. Contingencies		
Physical 10%	875,860	402,320
Price 15%	1,365,540	603,430
F. Total Project Costs	11,000,000	5,028,900

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V. FINANCIAL ANALYSIS

A. Financing Plan

1. Capital Costs

5.01 Capital costs are estimated at $11,000,000 and LE 5,028,900. Total project cost expressed in dollars at the parallel market rate is $18,184,000, of which approximately 60% represents foreign exchange cost and 40% represents local currency cost. The entire amount of foreign exchange cost is to be provided under this loan. All local currency costs are to be provided by the Ministry of Irrigation from its budget from the Government of Egypt.

2. Operating Costs

5.02 Costs of operation and maintenance are estimated at LE 1,360,000 ($1,904,000) per annum after project completion. All costs will be paid by the Ministry of Irrigation from its annual budget allocations.

B. Ministry of Irrigation

5.03 The Ministry is a government agency, not a profit making enterprise. Its only source of funds is allocations from the Government budget. The level of annual investment in new projects for the past 5 years has ranged from LE 20-30 million and capital costs of this project should not impose a financial burden. We will obtain our customary assurance that sufficient local currency will be available for this project.

C. User Charge

5.04 There will be no direct cost recovery which can be directly attributed to the project because farmers do not pay a user charge for water. The Ministry of Irrigation has no present plan to institute such a charge, claiming that such a procedure violates traditional practices. There has been some recent discussion regarding subsidies, including user charges; however, in the immediate period, there is no chance they will be instituted. This issue will have to be dealt with as a longer term and more broadly based matter. It should be noted that farmers contribute heavily to national revenues through the administrated prices for key agricultural products, which are considerably lower than international or true economic prices. For example, the controlled farm gate price of sugar cane averages LE 7 while the international price, assuming a transformation ratio of 13 tons of cane to 1 ton of refined sugar, is LE 9.20. For cotton, the price difference is even higher, with LE 140/MT paid to the farmer and an international price of LE 722.70/MT. For these reasons, we recommend against requiring the Ministry of Irrigation to impose any user charges as a condition of financing this project.

D. Debt Servicing Capability

5.05 Egypt's external debt amounted to about $12 billion at the end of 1976. Of this, roughly one-third was to Eastern European countries and primarily for past military equipment imports; the $8 billion balance includes almost $2 billion in deposit liabilities of the Egyptian Central Bank to the various Arab OPEC countries.

5.06 It is estimated that about $950 million in principal payments on medium and long-term debt were made in 1976. An amount estimated at $1.4 billion was owed on short-term bank credit facilities at the end of 1976. In 1977 Egypt received a loan of $1.5 billion from GODE which is being used to substantially reduced its current short-term debt problem.

5.07 Debt service requirements in the future depend heavily on the extent to which new short-term debt can be avoided. Over the near term, we expect the debt service ratio (including short term debt) to move between 25 and 30 percent of export and service earnings.

5.07 In view of Egypt's heavy debt burden, A.I.D.'s normal concessional loan terms are proposed -- 40 years, including a 10 year grace period, with an interest rate of 2 percent per year during the grace period and 3 percent per year thereafter. With these terms, particularly the 10 year grace period, repayment prospects for this $11 million loan appear reasonable.

VI. ECONOMIC ANALYSIS

A. Least Cost of Diesel vs. Electric Motors

6.01 The method of evaluation used to select the optimum prime mover for the pumping stations was to compare economic costs of the two options: diesel and electric. For this comparison, a cost analysis of each alternative was calculated for a single site: Site 22 at Sawada Gabel El Teir. this site was selected because it lies within the intermediate range of peak discharge requirements (6.05m^3/sec) and shows a typical distribution of crops within the project areas. The total dynamic head at the site is approximately 7.11 meters and the Consultant has selected 3 pumps of equal size (2.02m^3/sec) to meet the total peak discharge requirement.

6.02 The cost comparison analysis shows electric power is cheaper to operate and maintain. Discounted at 15%, the net present value of the electric option is LE 306,362 and of the diesel option, LE 345,640. The discounted cost comparison is shown in Annex K. Initial investment costs are slightly higher for the electric option; however, lower maintenance costs of electric pump motors demonstrate the desirability of electric prime movers over diesel.

6.03 In addition, diesel engines operating in Egypt must be replaced after 15 years. Electric motors, on the other hand, have a useful life of up to 30 years. This long economic life of electric motors in Egypt is attributed to the highly developed motor rewinding skills of Egyptian electricians working in the Mechanical and Electrical Department, the low price paid for this skilled labor, and the local capacity to manufacture most spare parts for electrical equipment. Also, recently purchased modern electric motors and pumps for other sites, outside of the study area, have developed local maintenance capabilities, whereas similar capabilities for maintaining modern diesel-engines are not developed. Egyptian contractors have gained experience installing modern electrical pumping equipment in many areas of the Nile Delta, while there is no similar experience in installing modern diesel-driven pumps. For all of these reasons, electrically driven pumps should be installed in preference to diesel-powered pumps.

B. Cost-Benefit Evaluation

6.04 The economic rate of return on this project is favorable at nearly 30%. Sensitivity analyses are also favorable as shown below:

Assumption	Return Obtained
Estimated Basic Costs: Benefit Flows	29.7%
Benefits Decrease 20%	22.8%
Costs Increase 20%	24.1%
Costs Increase 20%, Benefits Decrease 20%	17.7%

1. Economic Costs

6.05 Economic costs include capital, installation, operations and maintenance, and annual replacement costs; import duties are excluded. A summary is given below.

Project Cost Summary

	$US	LE	Total LE (Rounded)
Capital Costs*	10,382,685	3,300,764	10,870,000
Installation	-	-	281,000
O&M		51,433,000	51,433,000
Replacement (Annual)		369,000	14,760,000
		TOTAL	77,353,000

2. Economic Benefits

6.06 Quantification of benefits from investment in a single component of an irrigated agricultural system is tricky and requires considerable care if overstatement of the investment impact is to be avoided. An attempt has been made to isolate the impact of one variable, water supply, from the combined impact on agricultural production of all other input variables (land, labor, seeds, fertilizers, etc.) so as to evaluate only those benefits directly related to water supply in comparison with

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* This figure is from the original cost estimate which has been increased. This change will have a small effect on the economic analysis and is adequately covered by the sensitivity analysis.

the costs of supplying water.

6.07 Experimental data provided by the Ministry of Irrigation shows a very high correlation between water supply and agricultural yield in Egypt, due to the virtual lack of rainfall and high solar intensity that causes extensive water evaporation from soils and transpiration from growing plants. Crop distribution patterns also influence the high correlation between water supply and yield. Major crops grown in Egypt such as sugar cane, cotton, clover and vegetables have the highest water requirements of any crops. When all of the effects of climate and types of crops are taken into consideration, the water factor may be considered the most important production factor, in conjunction with land, seeds and labor.

6.08 This observation is supported by actual production data from some of the project sites. For example, in Minia and Beni Suef Governorates, sites without existing pumping stations have a cropping ratio of only 1.0 compared to the Governorate's average of 1.8. At these sites, farmers supply their own water from the Nile or secondary canals by traditional means and, because of insufficient water, grow only one crop per year. In contrast, three or four crops per year are grown on mechanically-irrigated land under the same climate and soil conditions. At other sites, where pumping stations now exist, cropping ratios are higher than at the non-mechanically-supplied sites, but yields were lower than the averages for the entire Governorate. At such sites, where application of other agricultural inputs were consistent with Governorate averages, lower crop yields are attributed to the inadequacy of water from the existing pumping stations.

6.09 Two methods were used to quantify water supply benefits:
(1) In the case of existing stations, benefits were derived by a tested mathematical formula defining the correlation between water supply and crop yield. Assuming all other agricultural inputs are supplied in constant amounts, the water deficiency accounts for the present low yields. Calculations of optimum yields, with adequate water supply, were made using parameters based on Ministry of Irrigation data from some 150 multi-year experiments. The difference between optimum and present yield was calculated and multiplied by farm gate prices or international prices (for export crops) to find monetary value of yearly benefits that would accrue to the national economy if the project were implemented.
(2) In the case of sites without existing stations, benefits were assumed to be the value of the marginal increase in production to be obtained by installing pumps. Gross marginal benefits were obtained by subtracting current yields at each site from average district yields and multiplying this difference by farm gate or international prices. From these gross marginal

benefits were subtracted the additional on-farm costs of supporting the additional crops to be grown on the same plots of land. The result is net marginal benefits attributable to the project.

6.10 Total annual benefits amount to LE 6,515,000 ($9,121,000) per year. Over the project's 40-year life span, benefits total LE 246,417,000 (including LE 790,000 scrap value of equipment) compared to total costs of LE 77,353,000. A discounted cash flow is attached as Annex L.

VII. SOCIAL ANALYSIS

A. Income Effect on Rural Poor

7.01 The average of the 39,000 farm families in the Upper and Middle Egypt project area does not have much land or much income. Average farm size is 3.4 feddans but 75% of farm holders till less than 3 feddans and 40% till less than 1 feddan. Of total farm land, about 34% is owner-operated and average size is 3.1 feddans; 38% are renter-operated and average size is 1.7 feddans; the remaining 28% are mixed (owner and renter-operated) and average size is 5.4 feddans. With relatively small land holdings, only relatively low annual incomes can be expected.

7.02 As a result of this project, farm family income may jump 25% for owners and 55% for renters. Present annual net farm incomes in this area, after deduction for taxes and charges, is estimated at about LE 291 ($407) for owners and LE 131 ($185) for renters, by a recent World Bank Report. Project benefits accruing to each family will be approximately LE 73 ($102) from the estimated value of increased production, at farm gate prices. This increase will raise owners' annual net incomes by 25% to LE 364 ($510) and renters annual net incomes by 55% to LE 205 ($287). Without this project, farm family incomes can be expected to decline progressively as existing pump stations become more inefficient.

B. Role of Women

7.03 This project is not designed to substantially alter the social role of women in rural Egypt. Nevertheless, some changes can be expected in project areas where new pumping stations are to be added, as a result of increased agricultural productivity resulting in a higher standard of living. Such benefits will include improved health, more and better food, and improved nutrition, which will become available to all people in the project area including women.

VIII. ENVIRONMENTAL ANALYSIS

A. Project Description

8.01 This project consists of the installation of electric motor-driven pumps at 34 locations to lift Nile River water for irrigation use. New pumping stations will be built at 33 locations, together with access roads as needed. Project coverage represents about three percent of the primary pumping stations in Egypt.

B. Land Use

8.02 The pump stations included in this project serve about 128,000 feddans (133,000 acres) spread throughout Upper and Middle Egypt, ranging about 800 linear miles along the Nile River from 29° latitude at Beni Suef to 22° latitude at Aswan. All of the 34 agricultural sites served by the project are currently under irrigated cultivation but all are deficient in irrigation water. The project, therefore, is instituting no change in current land use; it is making available adequate irrigation water to optimize agricultural outputs. The irrigation of land does not preempt its future use for alternate purposes.

8.03 At 33 of the sites, new pump stations will be constructed, together with access roads where needed and, at 22 of the sites, new electric distribution lines will be erected. [illegible] siting of each station will be determined by detailed surveys (now underway). Efforts will be made to [illegible]mize the length [illegible] required access roads and to establish [illegible]gments compatible with current land use. Road surfaces will be compacted but not paved. Land clearing for site and access roads will be minor and localized. Water sprinkling will be used to ameliorate dust conditions during clearing if adjacent to residential areas. Erection of electric power lines will, during the construction phase, temporarily disrupt agricultural activities in a very narrow corridor.

8.04 Pump stations will consist of reinforced concrete platforms, supported by concrete piles, extending from the river bank. Natural ground cover will be disturbed or destroyed during construction operations. Disruption of normal river flows adjacent to the station, caused by piling and pump intakes, may result in accelerated, localized river bank erosion. Bank protection, in the form of riprap or slope paving, will be provided where necessary.

8.05 The productivity of agricultural lands in Egypt has stagnated since 1965 because of the twin effects of waterlogging and salinity. This situation has become more critical since construction of the High Dam at Aswan as water has been made available for perennial irrigation. A high priority has been accorded

to improving drainage conditions by the GOE. The Egyptian Public Authority for Drainage Projects (of the Ministry of Irrigation) has launched with IBRD financing two field drainage projects, using concrete tile pipe, covering 950,000 feddans in the Nile Delta and 300,000 feddans in Upper Egypt. In addition, the EPADP is presently initiating a second drainage project, jointly funded by IBRD and AID (Loan No. 263-K-034) involving the installation of PVC perforated underdrain pipe in 500,000 feddans (520,000 acres) of agricultural land in Upper and Middle Egypt, as well as the construction or remodelling of related main and branch drains. All but five of the agricultural sites served by the new pump stations are located in areas in which drainage will be improved. As the EPADP is planning to extend the coverage in Upper and Middle Egypt by follow-on PVC pipe drainage projects, ultimately all of the irrigated lands will be served by improved drainage systems. The installation of field drains is expected to raise present crop yields per feddan by 12 to 25 percent.

C. Water Quality

8.06 Nile River water, being low in saline and alkaline concentrations, is ideally suited for irrigation of the crops actually produced in Egypt. Water from Aswan to Cairo rates low in salinity hazard for most of the year and is rated at medium hazard during occasional periods in fall and winter. In this regard, Nile River water quality is superior to that of other rivers in the region, such as the Tigris and Euphrates Rivers in Iraq, the Karun and Dez Rivers in Iran, and the Indus River in Pakistan. Nile River water also rates low in alkalinity hazard. However, as noted above, some soils in Egypt have undergone salinity buildup in the absence of a regular leaching maintenance program and, under the new regimen of perennial irrigation, rising water tables have aggravated the waterlogging problem. Field drainage will correct these conditions.

8.07 Insofar as the availability of adequate irrigation water increases the number of cropping cycles per year, accompanied by the increased use of fertilizers and pesticides, drainage water returning to the Nile will carry traces of such substances in increased amounts. Due to the size of the Nile (average annual flow at Aswan of 84 billion cubic meters), no measurable change in river water quality will result from this project.

8.08 Five of the existing 17 powered pumping stations included in the project have diesel engines as prime movers. These engines will be replaced by electric motor-driven pumps, thus eliminating the present hazard of pollution of water and land by fuel oil spills and leakage.

D. Atmospheric

8.09 Construction activities at each of the 33 sites where new pump platforms and access roads are to be built will cause temporary and minor air pollution in form of dust. If near residences, shops, etc., dust abatement by water sprinkling will be practised.

8.10 Noise levels at construction sites will rise but be tolerable and temporary. Noise levels in vicinity of existing diesel-driven pump stations will be reduced as these units are eventually phased out of service. No excessive noise levels will be caused by the electric-driven pumping units to be installed.

E. Natural Resources

8.11 Nile River water resources used in agricultural irrigation are perpetually restored by the natural hydrological cycle of evaporation and precipitation. The magnitude of Nile River flow as regulated by the High Dam at Aswan permits concurrent use of this resource for irrigation and the maintenance of river stages for navigation purposes from Aswan to the Mediterranean Sea.

8.12 Those nutrients removed from the soil by intensive cultivation require replacement through application of suitable natural or chemical fertilizers if crop yields are to be increased or maintained at present levels.

F. Cultural

8.13 This project introduces no elements detrimental to the cultural heritage of the Egyptian people. Careful site selection will preclude damage to or destruction of any existing archeological or historical site, building or antifacts.

G. Socio-Economic

8.14 Socio-economic impacts are assessed in Chapter VII, Social Analysis.

H. Health

8.15 Bilharzia, or schistosomiasis, is the most important endemic disease in Egypt. Existing since the time of the Pharaohs, it continues to affect an extremely large portion of the population. The highest prevalence rates reported are 53.5 percent in the 5-14 year age group and 48.5 percent in the 15-20 year age group. School children and farm workers are highly susceptible because of their more frequent contact with water.

8.16 The type of irrigation (basin vs. perennial) has an important bearing on the rate of infection. Data from the Ministry of Health indicates that for Asyut, Sohag and Qena Governorates, the overall prevalence rate for areas with perennial irrigation was 63.9 percent, whereas it was only 16.2 percent in the basin-irrigated areas. Commissioning of the High Dam at Aswan has led to a shift from basin to perennial irrigation throughout Egypt. It is recognized that, to the extent that this project encourages perennial irrigation, it correspondingly increases the hazard of bilharzia infection.

8.17 An integrated snail control program, coupled with chemotherapy for infected people, has been launched by the GOE covering over a billion feddans in Upper Egypt. It is expected that this program will continue to expand and eventually cover all agricultural lands in Egypt. The most effective control measure is elimination of the vector snail by use of molluscicides. Experiments in El Fayoum, using the molluscicide Bayluscide for Spring, Summer and Autumn application yearly in the Bahr Youssef Canal, dropped the overall prevalence rate from 45.7 percent in 1968, to 23.3 percent in 1971, and to 9.1 percent in 1974. *

8.18 Although Bayluscide may kill some fish in the water when first applied, the effect is temporary and the fish population should restore itself. The fish can be eaten by humans without harmful effects. Bayluscide is biodegradable, and when compared to other molluscicide such as copper sulfate and sodium pentachlorophenate, it creates a minimum alteration to the ecological balance (microflora and microfauna) of a fresh water habitat.

8.19 Although this project does not include physical alteration of the delivery/feeder/lateral canal distribution system, if such alteration takes place because of this project, engineering measures for the control of bilharzia will be considered. Such measures include maintenance of water velocities in canals, canal cleaning and lining, control of vegitation, etc., all of which are designed to create a water environment unfavorable to snail vectors.

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* It is recognized that these experiments were performed under controlled conditions not replicable throughout rural Egypt.

IX. PROJECT IMPLEMENTATION

A. Implementing Agencies

1. Ministry of Irrigation

9.01 The Ministry of Irrigation is the agency of the Egyptian Government which will implement this project. This Ministry is responsible for all matters relating to Egypt's irrigation systems. An organization chart for this Ministry is attached as Annex M.

9.02 Renovation of the pump stations included in this project is under the jurisdiction of the Mechanical and Electrical Department of the Ministry of Irrigation. The Department is organized by administrative levels corresponding to the geographic regions of the country. The central level is primarily concerned with policy formulation, interregional coordination and financial support of field operations. The lower levels--directorate, inspectorate and district--have virtually autonomous authority for the installation,operation, and maintenance of the pumping stations. The key echelon in the vertical management structure is the District, supervised by a Chief Engineer and assisted by a highly specialized staff for operations, mechanical and electrical engineering and administrative support. The charts presented in Annex N show the organization of the geographic regional officer and the work flow of the entire vertical organization, respectively.

2. Other Agencies

9.03 To carry out this project, the Ministry will require assistance from the Rural Electrification Authority (REA)(in preparing detailed site studies and in installing 11 KV distribution lines to the sites) and from the Ministry of Transport's Roads and Waterways Authority (in providing access roads to the sites). The Ministry of Irrigation traditionally works with these two Authorities in preparing pumping station sites, and no unusual problems are expected to develop in the course of implementing this project. As one of the conditions prededent to this loan, we are requiring, prior to the disbursement of funds for pumps and other equipment, that the Ministry of Irrigation provide evidence that satisfactory arrangements have been made with REA for the installation of distribution lines and with the Ministry of Transport for provision of suitable access roads.

B. Implementation Plan

1. Detailed Site Studies

9.04 Under its contract (No. AID/Afr-C-1132) for study of this project, the contractor, Louis Berger International, Inc., prepared related equipment specifications to the extent possible without the

accomplishment of the final design for the specific pumping station sites. Prior to finalizing specifications for pumps and motors, a detailed physical survey of each of the sites will be conducted to determine optimum location of the pumping stations, verify cropping patterns and water discharge requirements, and prepare final designs of station platforms, access roads and utility connections. The Ministry has signed a contract, utilizing its own funding sources, with the firm of Louis Berger International, Inc., for engineering services which include these required detailed site surveys. This task is scheduled for completion in early 1978.

2. Consultant Services

9.05 The Ministry will contract for additional consulting engineering services to be funded under this project. Services will include assistance to the Ministry in preparation of final equipment specifications and IFB, evaluation of awards, contract execution, monitoring of procurement, supervision of site preparation, and installation and testing of pumping unit. The consultant will also assist in improving warehousing procedures relative to equipment spare parts.

9.06 The Ministry of Irrigation has indicated its desire to utilize the firm of Louis Berger International for the above engineering services. The firm worked very closely with the Ministry in preparing the initial study of this project (and the Canal Maintenance Project) under Contract No. AID/Afr-C-1132 (Egypt) and is now engaged in a more detailed study of the sites under a contract directly funded by the Ministry. In accordance with the provisions of Section 1B2K of AID Handbook 11, Country Contracting, AID will review the Ministry's desire to select Louis Berger International for these services.

3. Procurement

9.07 The Ministry will procure all equipment from U.S. suppliers utilizing AID approved IFBs and Handbook 11 procedures. All pumps and motors will be procured under one IFB; however, equipment deliveries (and installation) will be sequenced to reflect pump station priorities. The stations have been divided into three priority groups as follows:

a. Group 1: includes 11 of the sites serving the largest and most water deficient agricultural areas. Also included in this procurement package will be all shop and transport equipment.

b. Group 2: includes 12 remaining stations of intermediate size (serving 1,000-2,000 feddans).

c. Group 3: includes 11 of the smallest stations (250-1,000 feddans), both existing and planned.

Pump stations included in each of these groups are shown in Annex P.

4. Site Preparation

9.08 This activity consists of platform construction and installation, electrical hookup, access road construction (300 meters per site of graded earth surface), and installation of discharge pipes. For each group of pumps, eight months have been allowed for site preparation. Site preparation will be done by the mechanical and Electrical Department with assistance from the Roads and Waterways Authority of the Ministry of Transport and the Rural Electrification Authority.

5. Testing and Installation of Pumps and Motors

9.09 Eight months have been allocated for the testing and installation of pumps and motors for each of the three priority groups. Proper advance planning is required prior to delivery of the new pumping equipment. The Mechanical and Electrical Department will test equipment upon arrival at port and be responsible for its delivery to site, installation and testing.

C. Implementation Schedule

9.10 The implementation schedule is shown in bar chart form in Annex O. Key dates will be as follows:

Loan Authorization	Sept 1977
Loan CPs Met	Jan 1978
Site Studies Complete	Feb 1978
Consultant Start Services	Mar 1978
Equipment Contract Awarded	Aug 1978
Group 1 Installations Complete	Sept 1979
Group 2 Installations Complete	June 1980
Group 3 Installations Complete	Jan 1981

D. Monitoring

9.11 USAID/Cairo will monitor this project by maintaining close liaison with the Ministry of Irrigation, its Mechanical and Electrical

Department, its consulting engineer, and by frequent field trips to pump station sites. Monthly reporting will be required from the Ministry, covering project activities, progress and problems.

E. Terminal Dates

9.12 The terminal date for meeting conditions precedent will be 120 days after the date of signing of the loan agreement.

9.13 The terminal date for requesting the opening of letters of commitment will be January 31, 1980. The terminal date for disbursements will be July 31, 1981.

F. Evaluation

9.14 The GOE is undertaking a wide range of projects in irrigation drainage and general water management for agricultural lands. Initial indications support the thesis that water supply is not the single major constraint but it is an important one to increased production and that the lack of proper water management is also a major problem. The GOE/USAID Project 263-0017 Water Use and Management will address the problem of proper water management. Major projects for improved field drainage in the Nile Delta and Upper Egypt are underway and others are being planned. The Irrigation Pumps Project 263-0044 is a discrete activity which will renovate and expand the existing irrigation system in Egypt. As such, it assumes that whatever problems are identified concerning water management in Egypt, there still remains a need to get increased amounts of water on the land, and in doing so, if other cropping improvement practices are undertaken, an increase in production will result.

9.15 The evaluation of this project will be undertaken one year after the installation of the third group of pumps. The Ministry routinely collects data on sites serviced by their pumping stations. At that time, the third group will have one year of production data, the second group will have 19 months of data, and the first group will have had 29 months of data on production changes resulting from increased pumping capacity. A team composed of Ministry of Irrigation officials and the USAID/Cairo Mission economist, food and agriculture officer, agriculture engineer and the Mission evaluation officer will analyze the production data which has been collected by the Ministry of Irrigation. Based on this analysis, an assessment will be made of the agricultural impact of the pumping station improvements.

X. RECOMMENDATION, CONDITIONS AND COVENANTS

A. Recommendation

10.01 Subject to the conditions and covenants listed below, we recommend that A.I.D. authorize a loan to the Government of Egypt in the amount of $11.0 million for procurement of equipment and services for installation of irrigation pumps at 34 irrigation sites in Middle and Upper Egypt. We further recommend that the loan terms to the GOE be that the loan principal be repaid in 40 years, including a ten-year grace period, with interest at two percent (2%) per annum during the grace period and at 3 percent (3%) thereafter. Procurement of equipment and services shall be of United States source and origin.

B. Conditions Precedent to Disbursement

10.02 Prior to the first disbursement or to the issuance of the first Letter of Commitment under the loan, the GOE shall furnish to A.I.D. in form and substance satisfactory to A.I.D.:

a. An opinion of the Egyptian Ministry of Justice or other legal counsel to A.I.D. that the loan agreement and the corresponding reloan agreement have been duly authorized and ratified by, and executed on behalf of, the GOE and is a valid and legally binding obligation in accordance with its terms.

b. The names of the persons who will act as the representatives of the GOE and the Ministry of Irrigation, together with evidence of their authority and the specimen signature of each.

c. Prior to the disbursement of any funds for pumping, shop or transport equipment, the Ministry of Irrigation shall have:

(1) executed a contract approved by AID with a U.S. consulting engineering firm acceptable to AID for project related services;and

(2) provided evidence of satisfactory arrangements with the Rural Electric Authority for installation of distribution lines and with the Ministry of Transportation for provision of access roads to the project sites.

C. Covenants

10.03 The GOE and the Ministry of Irrigation will be required to covenant:

a. Execution of the Project

(i) To carry out the project with due diligence and

efficiency, and in conformity with sound engineering, construction, financial and administrative practices.

(ii) To cause the project to be carried out in conformance with all the plans, specifications, contracts, schedules, and other arrangements, and with all modifications therein approved by A.I.D. pursuant to this agreement.

(iii) To submit for A.I.D. approval prior to implementation, issuance, or execution, all plans, specifications, construction schedules, bid documents, documents concerning soliciation of proposals relating to eligible items, contracts, and all modifications to these documents.

b. Funds and Other Resources to be Provided

(i) To make available on a timely basis any Egyptian currency and any foreign currency in addition to the loan, for the punctual and effective carrying out of construction, maintenance, repair and operation of the project.

c. Operation and Maintenance

(i) To operate, maintain and repair the project in conformity with sound engineering, financial and administrative practices and in such manner as to insure the continuing and successful achievement of the purposes of the project.

d. Management

(i) To provide qualified and experienced management for the project and to train such staff as may be appropriate for the maintenance and operation of the project.

e. Continuing Consultation

(i) To cooperate fully with A.I.D. to assure that the purpose of the loan will be accomplished. To this end, the GOE, the Ministry of Irrigation and A.I.D. shall from time to time, at the request of any party, exchange views through their representatives with regard to the progress of the project, the performance of the GOE and the Ministry of Irrigation of its obligations under the loan agreement, the performance of consultants, contractors and suppliers engaged on the project, and other matters relating to the project.

ANNEX- A

MINISTRY OF ECONOMY
AND ECONOMIC COOPERATION

Mr. Donald S. Brown
AID Director
U.S.A. Embassy
Cairo.

Cairo, 5 Sept. 1987.

Dear Mr. Brown,

One of the problems Egypt is facing is the declining water flow in the irrigation canals caused by canal silting and weed growth. If the 26,000 miles of canals and drains are not continually maintained this will cause a serious decline in food production.

Our government has, therefore, established irrigation canal maintenance as one of its priorities and is replacing and rehabilitating dredging, earth moving and similar equipment.

This requires substantial foreign exchange expenditures. An AID-funded study, "Agricultural Canal Maintenance Study", completed in June of this year, recommended the purchase of approximately $29 million worth of equipment and related services.

In order to implement this Agricultural Canal Maintenance Project we request a loan for $26 million from the Agency for International Development to finance the foreign exchange costs of the project. Other funds will be obtained from other sources to finance the remaining foreign exchange expenditures.

The Government of the Arab Republic of Egypt will supply the estimated LE 3.1 million required to meet the local cost expenditures of this project.

Sincerely yours,

G. El-Hazer

GAMAL EL-HAZER
Deputy Chairman
For Investment Authority
In Charge of Economic Cooperation

LOAN AUTHORIZATION

EGYPT: IRRIGATION PUMPS

Provided from: FAA Section 532 ("Security Supporting Assistance Funds")

Pursuant to the authority vested in the Administrator, Agency for International Development ("A.I.D.") by the Foreign Assistance Act of 1961, as amended, ("the Act") and the delegations of authority issued thereunder, I hereby authorize the establishment of a loan ("the Loan") pursuant to Part 2, Chapter 4, Section 532, Security Supporting Assistance, of said Act to the Arab Republic of Egypt ("Borrower") of not to exceed Eleven Million Dollars ($11,000,000), such funds to be made available to the Ministry of Irrigation ("the Ministry"), a Ministry of the Borrower, to assist in financing the foreign exchange costs of materials, equipment and services for the installation of irrigation pumps at 34 sites in Middle and Upper Egypt.

1. Terms of Repayment and Interest Rate. The Borrower shall repay the Loan to A.I.D. in United States Dollars within forty (40) years from the date of the first disbursement under the Loan, including a grace period of not to exceed ten (10) years from said date. The Borrower shall pay to A.I.D. interest in United States Dollars at the rate of two percent (2%) per annum during the grace period and three percent (3%) thereafter on the outstanding balance of the Loan and on any due and unpaid interest.

2. Source and Origin. Equipment, materials, and services financed under the Loan shall have their source and origin in the United States.

3. Conditions Precedent to Disbursement. Prior to the first disbursement, or to the opening of a letter of commitment under the Loan Agreement, the Borrower shall furnish, in form and substance satisfactory to A.I.D.

   (a) A legal opinion of the Egyptian Minister of Justice, or other legal counsel satisfactory to A.I.D., that the Loan Agreement has been duly authorized or ratified by, and executed on behalf of the Arab Republic of Egypt, and that it constitute valid and legally binding obligation

thereof in accordance with its terms.

(b) The names of the persons who will act as the representatives of the Borrower and the Ministry for the Project, together with evidence of their authority and specimen signatures of each.

(c) Prior to the disbursement of any funds for pumping, shop or transport equipment, the Ministry of Irrigation shall have:

1. Executed a contract approved by AID with a U.S. consulting engineering firm acceptable to AID for project related services; and

2. Provided evidence of satisfactory arrangements with the Rural Electrification Authority for installation of distribution lines and with the Ministry of Transportation for provision of access roads to the project sites.

4. The Loan will be subject to such other terms and conditions as A.I.D. shall deem appropriate.

_____

Administrator

_____

Date

ANNEX C

EGYPT - IRRIGATION PUMPS PROJECT

CERTIFICATION PURSUANT TO SECTION 611 (e) OF THE

FOREIGN ASSISTANCE ACT OF 1961 AS AMENDED

I, Donald S. Brown, the Principal Officer of the Agency for International Development, Egypt, having taken into account, among other things, the maintenance and utilization of projects in Egypt previously financed by the United States, do hereby certify that in my judgment Egypt has both the financial capability and human resources capability to effectively maintain and utilize the capital assistance to be provided for irrigation pumping facilities at thirty-four agricultural sites.

Donald S. Brown
Director, USAID/Egypt

August 31, 1977
Date

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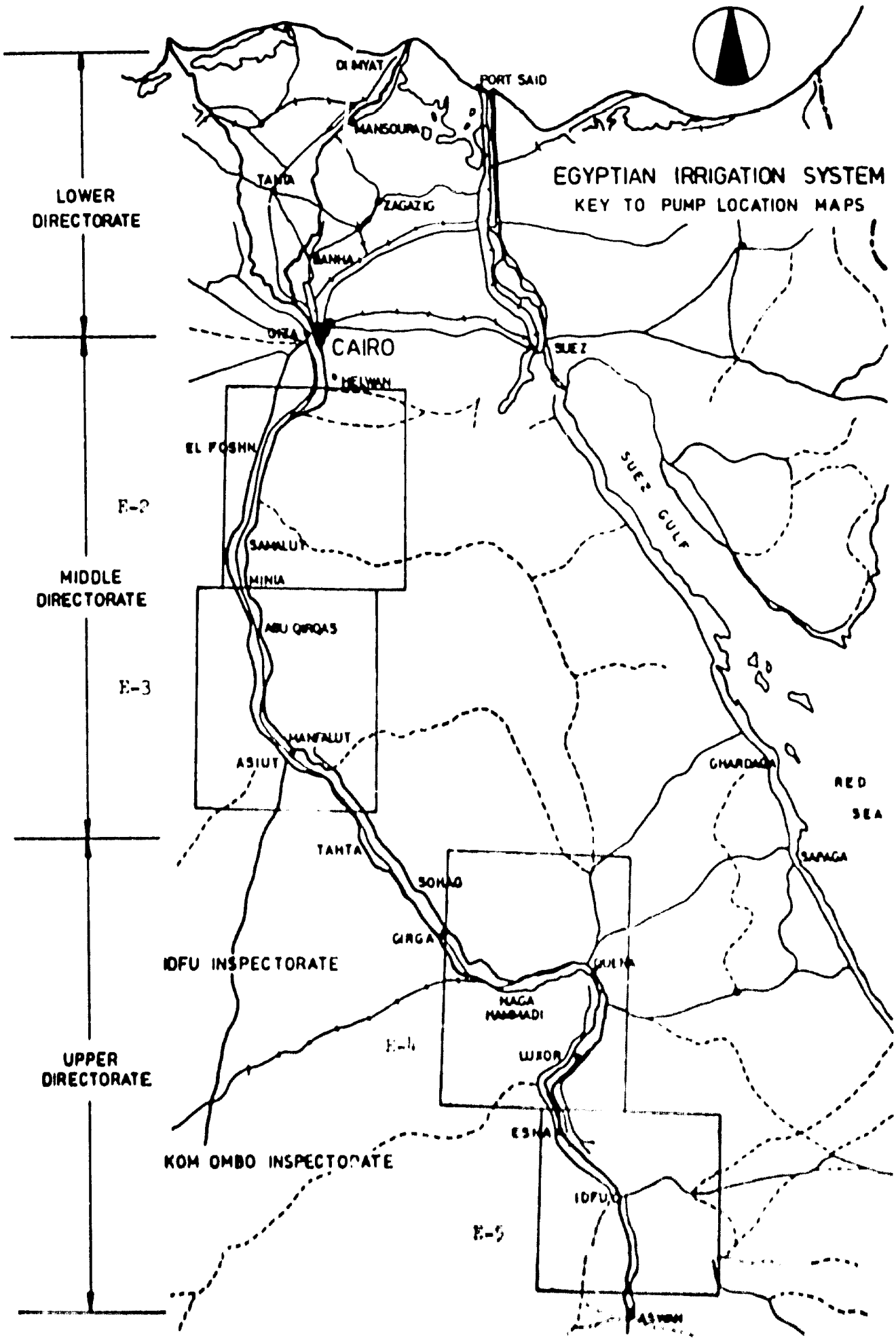
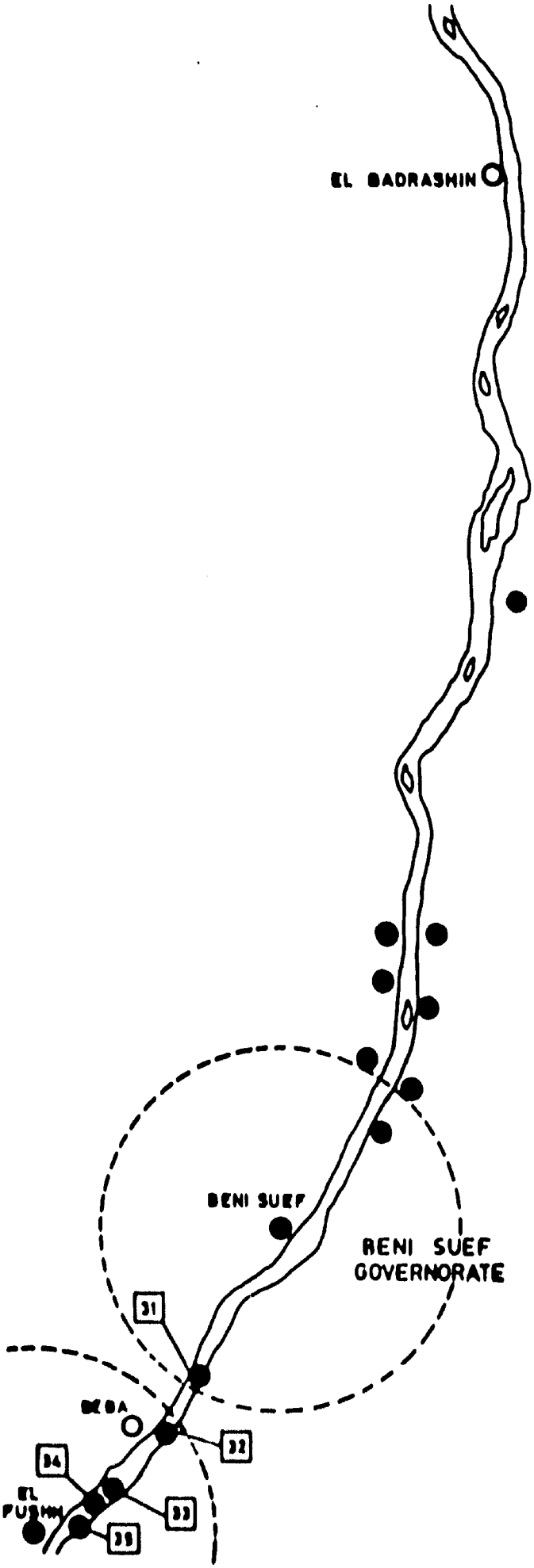
NO. Annex D

ANNEX E-1


EGYPTIAN IRRIGATION SYSTEM
KEY TO PUMP LOCATION MAPS
LOWER DIRECTORATE
MIDDLE DIRECTORATE
UPPER DIRECTORATE
E-2
E-3
E-4
E-5
DIMYAT
PORT SAID
MANSOURA
TANTA
ZAGAZIG
BANHA
GIZA
CAIRO
SUEZ
BENIWAN
EL FOSHN
SAMALUT
MINIA
ABU QIRQAS
MANFALUT
ASIUT
TAHTA
SOHAG
GIRGA
QUENA
NAGA HAMMADI
LUXOR
ESNA
IDFU
ASWAN
SUEZ GULF
GHARDAGA
RED SEA
SAFAGA
IDFU INSPECTORATE
KOM OMBO INSPECTORATE

MIDDLE EGYPT DIRECTORATE
SOUTH OF DELTA INSPECTORATE

Station No.	Site Name	Floating	Stationary	Diesel	Electric	Existing	Planned	Feddans Irrigated
31	SAHEL SENOR	•			•		1	1000
32	SAHEL GHIADA	•			•		1	500
33	GEZIERAT BEBA	•			•		1	500
34	SAHEL BANI OKBA	•			•		1	1250
35	GEZIERAT SAHEL EL-HIBA	•			•		1	1050



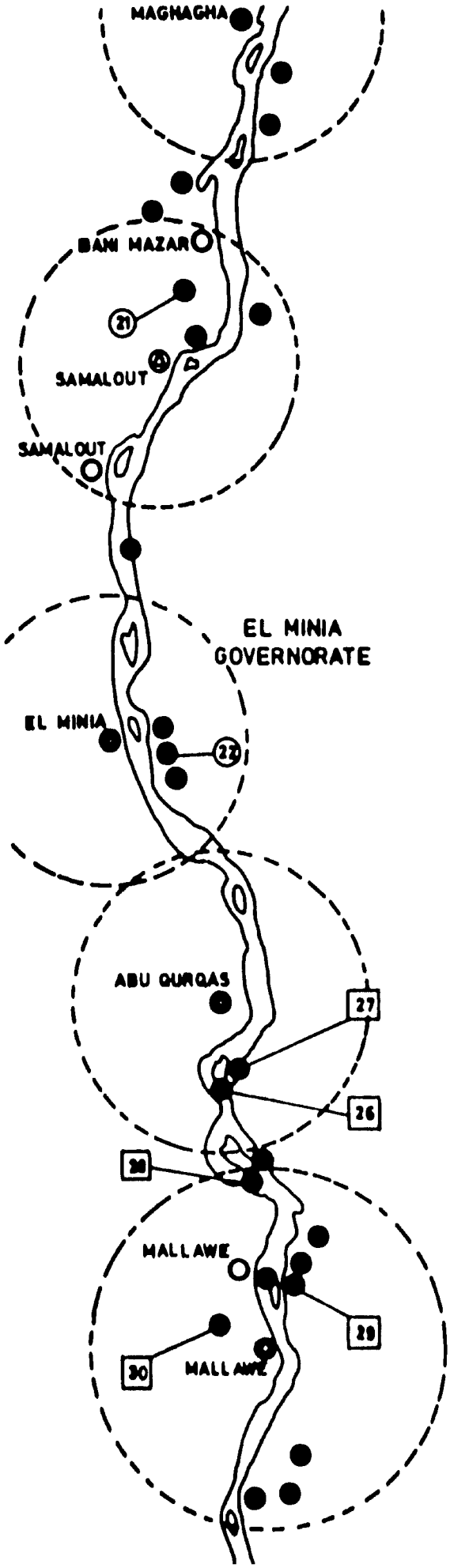
11 KV DISTRIBUTION POINT

EXISTING PUMPS EXCLUDED FROM PROJECT

EXISTING PUMPS INCLUDED

31 PLANNED PUMPS INCLUDED

MIDDLE EGYPT DIRECTORATE
EL MINIA INSPECTORATE



Station No.	Site Name	Floating	Stationary	Diesel	Electric	Existing	Planned	Feddans Served by Station
21	EL SHEIKH FADEL, AND,		•	•		3		12250
	SHAROWNA		•	•		4		
22	SAWADA GABEL EL TEIR		•	•		6		8600
28	GEZIERAT SHIEBA	•					2	2000
29	SAHEL EL BORSHA	•					2	4000
30	GEZIERAT EL BORSHA	•					2	2000
26	GEZIERAT EL SHEIKH TOMAI	•					2	2000
27	SAHEL EL SHEIKH TOMAI	•					2	1500

(21) 11 KV DISTRIBUTION POINT

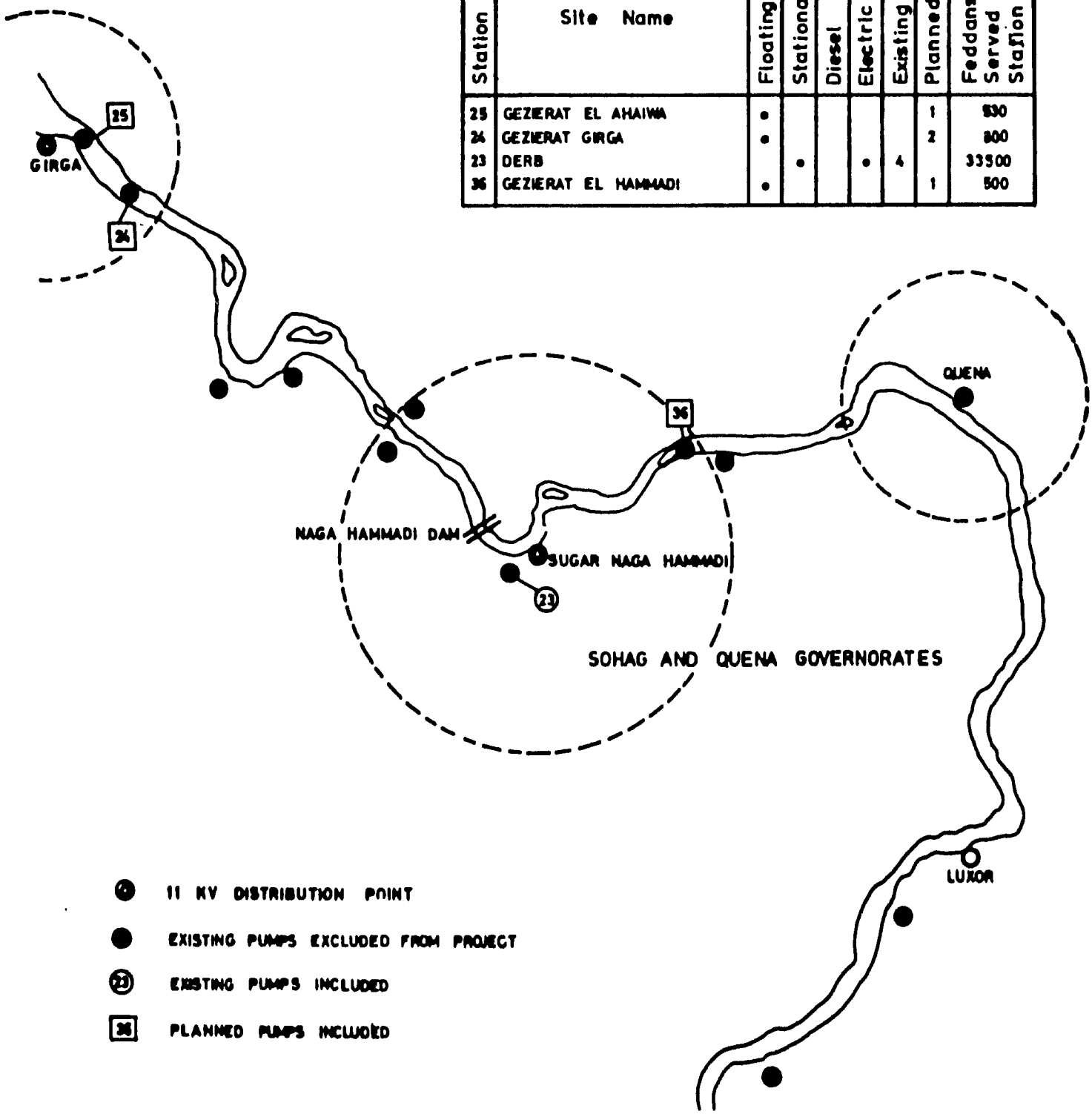
● EXISTING PUMPS EXCLUDED FROM PROJECT

(22) EXISTING PUMPS INCLUDED

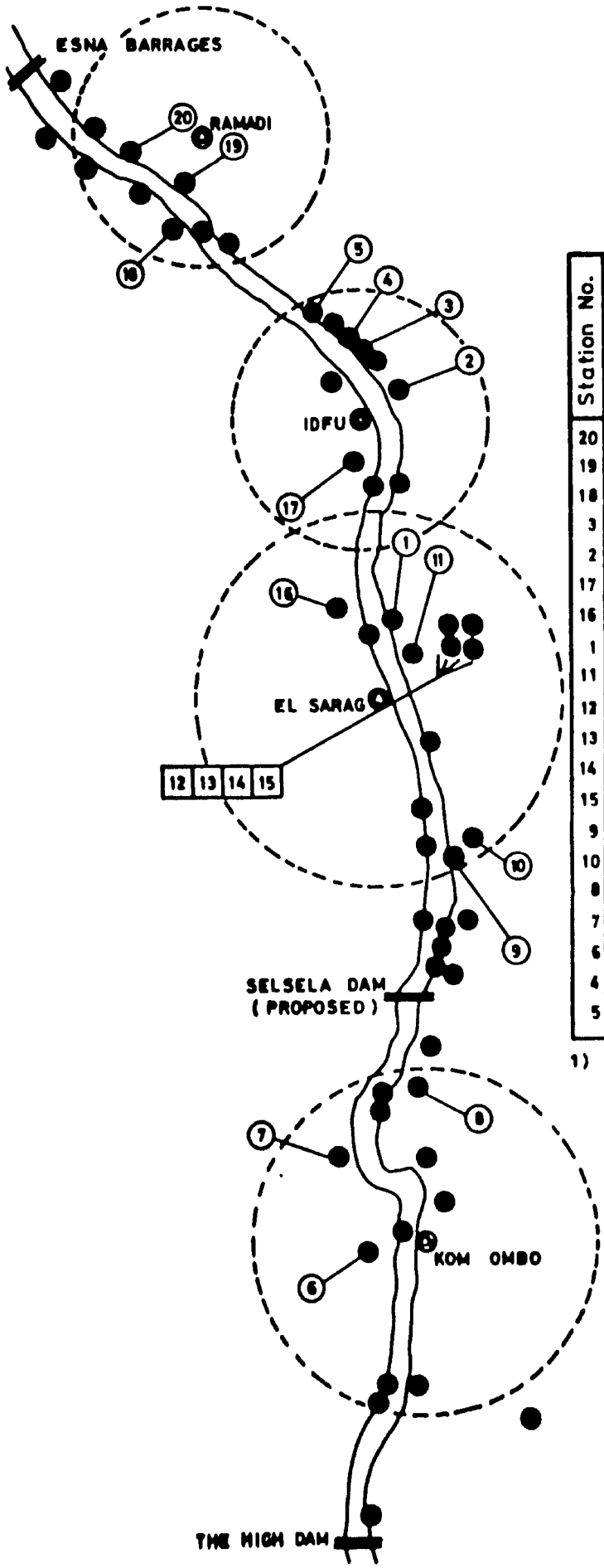
[30] PLANNED PUMPS INCLUDED

MIDDLE EGYPT DIRECTORATE
NAGA HAMMADI INSPECTORATE

Station No.	Site Name	Floating	Stationary	Diesel	Electric	Existing	Planned	Feddans Served by Station
25	GEZIERAT EL AHAIWA	•					1	830
24	GEZIERAT GIRGA	•					2	800
23	DERB		•		•	4		33500
36	GEZIERAT EL HAMMADI	•					1	500



UPPER EGYPT DIRECTORATE
ASWAN, IDFU & KOM OMBO INSPECTORATES

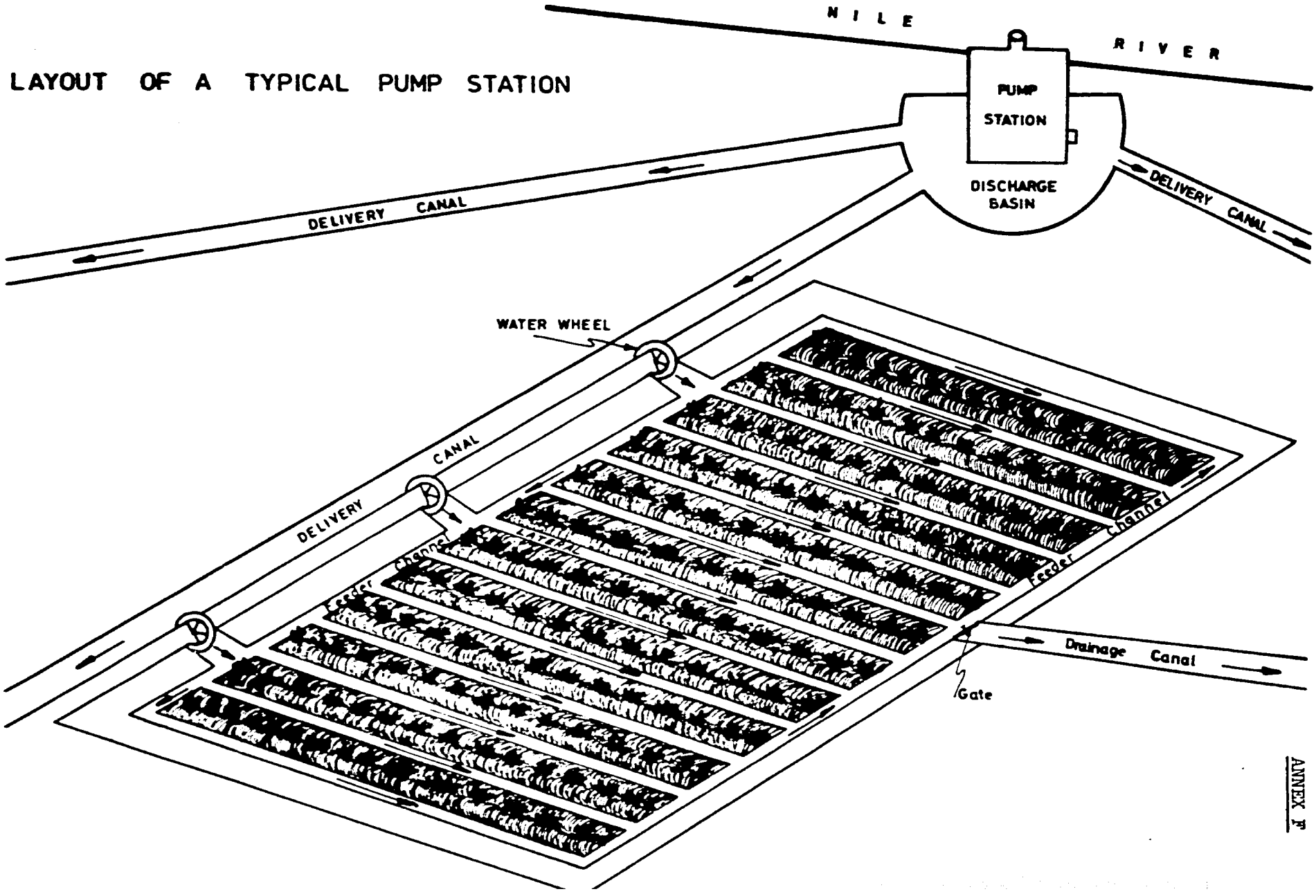


Station No.	Site Name	Floating	Stationary	Diesel	Electric	Existing	Planned	Feddans Served by Station
20	EL SIBAIA		•		•	5		5785
19	GEZIERAT EL HIGZ		•		•	3		2050
18	EL BOUSILLIA		•		•	4		4400
3	MOKASSIFAT EL ATWANI 1)	•		•		2		580
2	BLUKHAR		•	•		2		2000
17	EL KELH		•		•	6		11315
16	EL RAMADI		•		•	6		9785
1	GEZIERAT EL MALKIA	•		•		2		650
11	EL RADISSIA		•		•	4		4600
12	EL RADISSIA NORTH 1		•				1	500
13	NORTH 2		•				1	250
14	SOUTH 1		•				1	250
15	SOUTH 2		•				1	250
9	SELWA KIBLI		•		•	3		1450
10	SELWA BAHARI		•		•	3		2050
8	IKLIT		•		•	3		2075
7	GEZIERAT EL MANSOURIA		•		•	4		1125
6	BENBAN		•		•	4		4120
4	EL DAMARIA 1)	•		•		2		550
5	SAHEL EL KILH SHARK 1)	•		•		2		220

1) STATIONS 4 & 5 TO BE COMBINED WITH STATION 3.

- 11 KV DISTRIBUTION POINT
- EXISTING PUMPS EXCLUDED FROM PROJECT
- (5) EXISTING PUMPS INCLUDED
- [12] PLANNED PUMPS INCLUDED

LAYOUT OF A TYPICAL PUMP STATION



ANNEX F

INVENTORY OF EXISTING PUMPS

Site No	Station No.	Pump Station	Year of Mfr.	Pump Make	Country of Origin	Rated Capacity[1)]	Type	Prime Mover	HP	RPM	Fuel
1	1	Gezieret El Malkia	1954	Sulzer		2 x 1.35	Bohn Kholer	Diesel	600	500	Diesel
2	2	Blukhar	1966	Sulzer		1 x 2.00 1 x 1.00	Bohn Kholer	Diesel	210 140	500 900	Diesel
3	3	Mukassifat El Atwani	1951	Andrinz		2 x 0.75	Bohn Kholer	Diesel	150	600	Diesel
	4	El Domaria	1954	Sulzer		2 x 1.35	Bohn Kholer	Diesel	600	500	Diesel
	5	Sahel El Kilh Shark	1949	Shanzline		2 x 0.25	Skoda	Diesel	67.5	750	Diesel
4	6	Benban	1930	Borsing	W. Germany	1 x 1.00 3 x 0.60	Siemens	Electric	151 92	588 734	Elec.
5	7	Gezieret El Mansouria	1933	Borsing	W. Germany	3 x 0.34	Siemens	Electric	61	980	Elec.
6	8	Iklit	1933	Ganz	Hungary	2 x 0.60 1 x 0.35	Ganz	Electric	135 80	2075	Elec.
7	9	Selwa Kibli	1933	Ganz	Hungary	2 x 0.60 1 x 0.35	Ganz	Electric	135 80	975	Elec.
8	10	Selwa Bahari	1933	Ganz	Hungary	2 x 0.60 1 x 0.35	Ganz	Electric	135 80	975	Elec.
9	11	El Radissia	1931	Borsing		3 x 0.60 1 x 1.00	Siemens	Electric	107 172	458 354	Elec.

Site No.	Sta No.	Pump Station	Year of Mfr.	Pump Make	Country of Origin	Rated Capacity[1]	Type	Prime Mover	HP	RPM	Fuel
10	16	El Ramadi	1931	Borsing	W. Germany	2 x 0.60	Siemens	Elec.	107	456	Elec.
						1 x 1.00			172	354	
						3 x 2.00			336	251	
11	17	El Kelh	1931	Borsing	W. Germany	3 x 2.00	Siemens	Elec.	336	251	Elec.
						2 x 1.00	Siemens		172	354	
						1 x 0.60			108	356	
12	18	El Bousillia	1931	Borsing	W. Germany	3 x 1.00	Siemens	Elec.	173	354	Elec.
						1 x 0.60			108	456	
13	19	Gezieret El Higz	1931	Borsing	W. Germany	3 x 0.35	Siemens	Elec.	61	602	Elec
14	20	El Sibaia		Borsing	W. Germany	2 x 0.60	Siemens	Elec.	108	456	Elec
				Borsing	W. Germany	2 x 1.00			133	354	
				Borsing	W. Germany	1 x 2.00			338	251	
15	21	El Sheikh Fadel & Sharowna	1951	Sulzer	Switzerland	1 x 3.80	Sulzer	Elec.	525	330	
				Sulzer	Switzerland	2 x 1.35	Bohn Kholer		600	500	
				Reston	England	2 x 0.50	Sulzer	Diesel	156	230	Diesel
				Bohn Kholer	W. Germany	2 x 0.35			150	600	
16	22	Sawada Gabel El Tier	1965	Wander		2 x 0.50	Wander	Diesel	150	440	Diesel
						2 x 0.39				500	
			1967	Magyar	Hungary	2 x 0.75	Magyar	Diesel	200	400	Diesel
17	23	Derb	1955	M.A.N.	W. Germany	4 x 7.50	Siemens	Elec.	630	235	Elec.

1) Rated capacity only; does not reflect current delivery capacity

Source: Ministry of Irrigation, February 1977

PUMP DISCHARGE AND STATIC LIFT REQUIREMENTS

STATION NAME	DISTANCE FROM ASWAN DAM	AREAS SERVED IN FEDDANS	AREA OF MAX. DELIVERY IN A SINGLE IRRIGATION PERIOD	REQUIRED DISCHARGE (M^3/SEC)	DISCHARGE LEVEL (METERS ABOVE SEA LEVEL)	THE NILE LEVEL IN M.			STATIC LIFT IN M.	
						CONDITION	MIN.	MAX.	MIN.	MAX.
Beni Suef Gov. Sanel Senor (21)	799	1,000	1000	1.11	30.60	Present	24.2	26.9	3.7	6.4
Sahel Shiada (22)	791	500	500	0.56	30.70	"	24.6	27.3	3.4	6.1
Sezierat Beba (24)	784	500	500	0.56	31.00	"	24.84	27.54	3.46	6.16
Sanel Bani Okba (25)	755	1,250	1,250	1.39	31.30	"	25.47	28.17	3.13	5.83
Sezierat El Hiba (26)	763	1,050	1,050	1.17	32.20	"	25.95	28.65	3.55	6.25
Minia Gov. El Sheikh Fadel (21)	747	12,250	6,750	8.00	37.15	"	29.28	31.90	5.25	7.87
Sawada Gabel El Tier (22)	694.5	8,600	5,400	6.05	40.30	"	34.14	36.41	3.89	6.16
Sezierat Shieba (28)	658	2,000	2,000	2.24	42.90	"	37.06	39.44	3.46	5.84
Sanel El Boraba (29)	641.75	4,000	4,000	4.48	44.40	"	38.35	40.79	3.61	6.05

PUMP DISCHARGE AND STATIC LIFT REQUIREMENTS

STATION NAME	DISTANCE FROM ASWAN DAM	AREAS SERVED IN FEDDARS	AREA OF MAX DELIVERY IN A SINGLE IRRIGATION PERIOD	REQUIRED DISCHARGE (M^3/SEC)	DISCHARGE LEVEL (METERS ABOVE SEA LEVEL)	THE NILE LEVEL IN M.			STATIC LIFT IN M.	
						CONDITION	MIN	MAX.	MIN.	MAX.
Minia Gov. Gezierat El Borahn (30)	645	2,000	2,000	2.24	43.7	Present	38.09	40.52	3.18	5.61
Gezierat El Sheikh Tomai (26)	668	2,000	2,000	2.24	42.1	"	36.26	38.61	3.49	5.84
Sahel El Sheikh Tomai (27)	665.5	1,500	1,500	1.54	42.5	"	36.45	38.82	3.68	6.05
Sohag Gov. Gezierat El Ahaiwa (25)	436.5	530	530	0.92	62.89	"	55.89	58.09	4.80	7.00
Gezierat Girga (24)	415	800	800	1.39	62.25	"	57.25	59.45	2.80	5.00
Qena Gov. Dera (23)	350	33,500	16,750	19.38	69.1	"	64.05	66.60	2.50	5.05
Gezierat El Hammadi (36)	335	500	500	0.87	69.45	"	64.45	66.45	3.00	5.00
Aswan Gov. El Sibaia (20)	141.5	5,785	3,270	4.70	82.8	"	75.5	78.95	3.85	7.30
Gezierat El Higr (19)	139	2,050	1,150	1.66	82.45	"	75.65	78.95	3.50	6.83

PUMP DISCHARGE AND STATIC LIFT REQUIREMENTS

STATION NAME	DISTANCE FROM ASWAN DAM	AREAS SERVED IN FEDDANS	AREA OF MAX DELIVERY IN A SINGLE IRRIGATION PERIOD	REQUIRED DISCHARGE (M^3/SEC)	DISCHARGE LEVEL (METERS ABOVE SEA LEVEL)	THE NILE LEVEL IN M			STATIC LIFT IN M.	
						CONDITION	MIN	MAX.	MIN	MAX.
Aswan Gov. El Boustilia (18)	131	4,400	2,220	3.22	83.30	Present	76.00	79.10	-.40	7.50
Moukassifat El Atwani* (3)	118	1,350	1,350	1.96	84.80	"	77.04	79.55	5.25	7.76
Shukar (2)	116	2,000	1,000	1.45	86.30	"	77.36	79.73	6.57	8.94
El Kelh (17)	112	11,315	5,860	8.52	84.50	"	76.90	79.85	4.65	7.60
El Ramadi (16)	102.6	9,785	5,400	7.80	85.60		77.50	80.85	-.75	8.10
Gezierat El Malkia (1)	102	650	650	0.94	84.85	"	77.73	80.20	4.55	7.12
El Radissia (11)	99.5	4,600	2,685	3.87	86.00	"	77.70	81.00	5.00	8.30
North 1 (12)	99.50	500	500	0.72	91.50	"	84.50 Suction Lev.		7.0	

* SEKES EL DEMARIA AND SAHEL EL KILA SHARK COMBINED WITH MOUKASSIFAT EL ATWANI

PUMP DISCHARGE AND STATIC LIFT REQUIREMENTS

STATION NAME	DISTANCE FROM ASWAN DAM	AREAS SERVED IN FEDDANS	AREA OF MAX. DELIVERY IN A SINGLE IRRIGATION PERIOD	REQUIRED DISCHARGE (M^3/SEC)	DISCHARGE LEVEL (METERS ABOVE SEA LEVEL)	THE NILE LEVEL IN M.			STATIC LIFT IN M.	
						CONDITION	MIN.	MAX.	MIN.	MAX.
Aswan Gov. North 2 (13)	99.50	250	250	0.36	94.00	Present	91.45 Suction Lev.		2.55	
South 1 (14)	99.50	250	250	0.36	90.50	"	84.50 Suction Lev.		6.00	
South 2 (15)	99.50	250	250	0.36	90.50	"	84.45 Suction Lev.		6.05	
Selum Kibli (9)	76.00	1,450	1,450	2.09	87.20	"	78.90	82.50	4.70	8.30
Selum Bahari (10)	86.00	2,050	2,050	2.95	86.50	"	78.60	81.90	4.60	7.85
Idlit (8)	62.30	2,075	1,180	1.65	88.50	"	79.66	81.81	6.69	8.84
Gezierat El Mansouria (7)	53.00	1,125	1,125	1.62	89.15	"	80.44	82.71	6.44	8.71
Benban (6)	44.50	4,120	2,350	3.38	89.30	"	80.80	83.15	6.15	8.50

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DERIVATION OF DYNAMIC HEAD AND HORSEPOWER REQUIREMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
25	14,584	1x14584	22.97	183.74	8.72	1.40	192.46	2.69	1.70	.60	27.96	150	18,000	15,000
18	51,043	3x16962	24.61	196.86	11.67	0.54	208.53	1.13	1.00	.34	27.08	200	18,000	54,000
1	14,901	1x14901	23.36	186.89	10.10	0.426	196.99	0.84	0.70	.27	25.17	150	15,000	15,000
32	8,877	1x 8877	20.01	160.12	9.86	1.39	169.98	2.36	1.40	.60	24.37	75	8,900	8,900
33	8,877	1x 8877	20.21	161.69	9.86	1.39	171.55	2.38	1.40	.60	24.59	100	10,000	10,000
34	22,034	2x11017	19.13	153.03	10.36	0.81	163.39	1.32	1.00	.36	21.81	100	12,000	24,000
35	18,547	2x 9273	20.51	164.05	9.86	1.60	173.91	2.78	1.90	.63	25.82	100	10,000	20,000
24	22,034	2x11017	16.41	131.24	8.72	0.81	139.96	1.13	1.00	.36	18.90	75	11,500	23,000
9	33,131	2x16645	27.23	217.86	13.81	0.54	231.67	1.25	1.00	.34	29.82	200	17,500	35,000
10	46,763	3x15535	25.76	206.05	12.83	0.50	218.88	1.09	1.00	.34	28.19	150	15,700	47,100
8	26,156	2x13078	29.00	230.03	8.55	1.12	238.53	2.70	0.60	.50	32.80	150	13,500	27,000
7	25,680	2x12840	28.55	228.36	8.95	1.10	237.31	2.61	0.60	.50	32.26	150	12,900	25,800
23	357,000	3x119000	DYANAMIC HEAD CALCULATION MADE BY U.S. MANUFACTURER									35.00	1500	119,000	357,000
6	53,580	2x26790	27.89	223.11	9.71	0.46	232.82	1.07	1.30	.40	30.66	300	28,000	56,000
11	61,347	2x30674	27.23	217.86	12.83	1.65	230.69	3.80	1.00	.35	32.38	350	31,000	62,000
13	5,707	1x 5707	8.37	66.93	Cascade	0.81	66.93	0.44	0.60	.27	9.68	50	6,300	6,300
14	5,707	1x 5707	19.69	157.49	Cascade	0.65	157.49	1.02	0.60	.27	21.58	50	6,750	6,750
15	5,707	1x 5707	19.85	158.80	Cascade	0.65	158.80	1.03	0.60	.27	21.75	50	6,500	6,500
3	31,070	2x15535	25.46	203.69	10.24	0.538	213.93	1.15	1.00	.43	27.95	200	17,800	35,600
2	22,985	2x11493	29.33	234.66	9.28	0.87	243.94	2.04	1.10	.38	32.85	150	11,500	23,000
17	135,059	4x13765	24.94	199.49	11.68	0.65	211.17	1.35	1.00	.34	27.63	350	34,000	136,000
16	123,646	4x30911	26.58	212.61	12.99	0.55	225.60	1.26	1.50	.60	29.92	350	32,100	128,400
14	13,633	1x13633	16.41	131.24	8.70	1.20	139.94	1.68	1.40	.60	20.29	125	14,500	14,500
20	75,404	2x37252	23.95	191.61	13.32	0.76	204.93	1.62	2.00	.70	28.27	400	38,100	76,200
19	17,532	1x 8766	22.41	179.27	11.83	1.40	191.10	2.68	1.30	.40	26.99	100	9,500	19,000
29	71,017	2x35509	19.85	158.80	10.01	0.80	168.81	1.35	1.60	.60	23.40	300	36,000	72,000
22	95,905	3x32021	20.21	161.69	9.45	0.95	171.14	1.01	1.50	.60	23.32	300	32,100	96,300
31	17,596	2x 8719	21.00	167.99	9.86	1.40	177.85	2.50	1.00	.60	25.10	100	9,500	19,000
21	126,816	4x31704	25.82	206.57	10.60	0.63	217.17	1.17	1.40	.60	29.10	400	38,000	152,000
12	11,413	1x11413	22.97	183.74	Cascade	0.81	183.74	1.49	1.00	.38	25.84	125	11,800	11,800
26	35,509	3x11731	19.16	153.28	9.21	1.12	162.49	1.82	1.20	.42	22.60	100	12,900	38,700
28	35,509	3x11731	19.16	153.28	9.31	1.12	162.54	1.82	1.20	.42	22.60	100	12,900	38,700
30	35,509	3x11731	18.41	147.25	9.47	1.12	156.72	1.76	1.20	.42	21.79	100	12,800	38,400
27	24,412	3x 8132	19.85	158.80	8.78	1.25	167.58	2.10	1.20	.50	23.65	75	8,750	26,250

DERIVATION OF DYNAMIC HEAD AND HORSEPOWER REQUIREMENTS

EXPLANATION OF CALCULATIONS

Col. 1 : Station number

Col. 2 : Total peak discharge requirement in GPM, converted from metric discharge requirements shown in Table III-7

Col. 3 : Number of pumps and rated pump discharge requirements in GPM

Col. 4 : Static head in feet converted from max. static lift in Table III-7

Col. 5 : Discharge pipe lengths in feet from pump flange to delivery canal (provided by M.E. Dept.)

Col. 6 : Total length of the pump column in feet from underside of the platform to the lowest controlled level of the Nile in the area of the pump station

Col. 7 : Friction loss in feet per 100 linear feet of discharge pipe of stated diameter delivering known quantity of water per minute (Col. 3) (Source: Fairbanks Morse Hydraulic Data Book)

Col. 8 : Total length of discharge pipe plus pump column (sum Cols. 5 and 6)

Col. 9 : Pipe friction loss in feet of total shown in Col. 8 and figure in Col. 7 divided by 100

Col. 10 : Velocity head as gallons per minute of discharge against the velocity head-feet taken from a U.S. manufacturer's charts

Col. 11 : Elbow friction loss in feet taken from the same manufacturer's charts

Col. 12 : Total dynamic head as the total of Cols. 4, 9, 10 and 11, representing the total head in feet that water must be lifted. With this figure and water discharge requirements from Col. 3, the performance curves and B.H.P. required were obtained from a U.S. manufacturer together with the bowl and impeller size, pump efficiency, of the most suitable pump.

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Col. 13 : The final derived theoretical B.H.P. required to drive the pump after all friction losses, pump efficiency, etc. have been taken into account. As a check on the validity of the derived H.P. requirements, some of the B.H.P. values were calculated directly from the formula:

$$H.P. = \frac{Q \times H \times S.G.}{3960 \times Eff.}$$

Where:

H.P. = Required horsepower

Q = Discharge in gallons/minute

S.G. = Specific gravity of water (=1)

Eff. = Pump efficiency

The derived value was then raised 10-15% for pump coupling and shaft losses. The nearest standard size to theoretical B.H.P. was selected. This independent calculation was used as a check on the manufacturer's curve values and because there may be variations in different manufacturer's calculations. The formula gives the fairest budget estimate of the capital costs.

Col. 14 : Total water supply from each pump (the nearest standard size to requirement, Column 4).

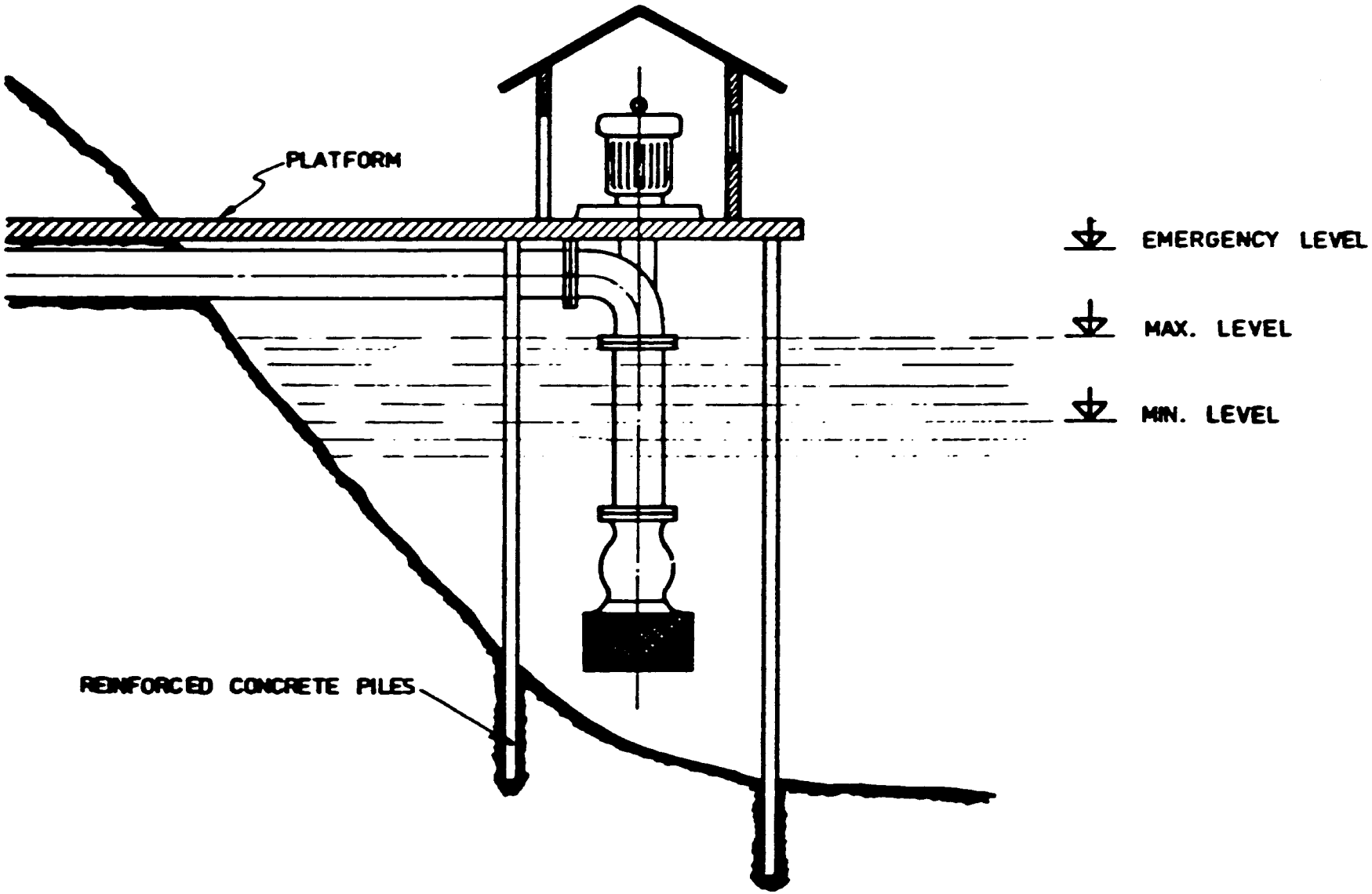
Col. 15 : Total supply from all pumps (slightly in excess of requirement in Column 4, for safety margin).

The following table shows the recommended pump and horsepower sizes for each of the stations using the above methods of derivation.

CONSULTANT'S PUMP RECOMMENDATIONS

Station Number	Number of Pumps		Pump Model and Bowl Diameter (inches)			Stage	Motor and Pump Speed (RPM)	Discharge Flange Size (inches)	Pump Efficiency % Efficiency less 1%thrust of shaft	B.H.P.	U.S. Gallons per minute Delivered per pump	Total Dynamic Head (feet)
25.	1	x	24	M	x	1	730	24	84	150	15,000	27.96
18.	3	x	24	M	x	1	730	30	79	200	18,000	27.08
1.	1	x	24	L	x	1	730	30	82	150	15,000	25.17
32.	1	x	20	P	x	1	730	20	82	75	8,900	24.37
33.	1	x	20	P	x	1	730	20	82	100	10,000	24.59
34.	2	x	24	M	x	1	585	24	82	100	12,000	21.81
35.	2	x	20	P	x	1	730	20	82	100	10,000	25.82
24.	2	x	24	M	x	1	585	24	80	75	11,500	18.90
9.	2	x	24	M	x	1	730	30	81	200	17,500	29.82
10.	3	x	24	M	x	1	730	30	82	150	15,700	28.19
8.	2	x	24	M	x	1	730	24	79	150	13,500	32.80
7.	2	x	24	L	x	1	730	24	84	150	12,900	32.26
23.	3	x	70	L 70	x	1	325	60	81	1500	119,000	35.00
6.	2	x	36	L	x	1	490	36	81	300	28,000	30.66
11.	2	x	36	L	x	1	490	36	84	350	31,000	32.38
13.	1	x	20	L	x	1	585	20	81	50	6,300	9.68
14.	1	x	20	P	x	1	585	20	80	50	6,750	21.58
15.	1	x	20	P	x	1	585	20	79	50	6,500	21.75
3.	2	x	24	M	x	1	730	30	79	200	17,800	27.95
2.	2	x	24	L	x	1	730	24	79	150	11,500	32.85
17.	4	x	36	L	x	1	490	42	83	350	34,000	27.63
16.	4	x	36	L	x	1	490	36	83	350	32,100	29.94
36.	1	x	24	L	x	1	730	24	82	125	14,500	20.29
20.	2	x	36	L	x	1	585	36	81	400	38,100	28.27
19.	3	x	20	P	x	1	730	20	82	100	9,500	26.99
29.	2	x	36	L	x	1	490	36	79	300	36,000	23.40
22.	3	x	36	L	x	1	490	36	81	300	32,100	23.32
31.	2	x	20	M	x	1	730	20	82	100	9,500	25.10
21.	4	x	36	L	x	1	585	36	81	400	38,000	29.10
12.	1	x	24	L	x	1	730	24	82	125	11,800	25.84
26.	3	x	24	L	x	1	730	24	82	100	12,900	22.60
28.	3	x	24	L	x	1	730	24	82	100	12,900	22.60
30.	3	x	24	L	x	1	730	24	82	100	12,800	21.79
27.	3	x	20	M	x	1	730	20	82	75	8,750	23.65

PROFILE OF PROPOSED PUMP STATION



ANNEX 1

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Diesel and Electric Cost Comparison for Site 22

(LE 000)

	DIESEL					ELECTRIC				
Yr	Cap.	Repl.	Main.	Opn.	Total	Cap.	Repl.	Main.	Opn.	Total
1	133.4	-	-	-	133.4	149	-	-	-	149.0
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	38.8	38.8	-	-	-	39.5	39.5
5	-	-	-	38.8	38.8	-	-	-	39.5	39.5
6	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
7	-	-	-	38.8	38.8	-	-	-	39.5	39.5
8	-	-	46.7	38.8	85.5	-	-	2.4	39.5	41.9
9	-	-	-	38.8	38.8	-	-	-	39.5	39.5
10	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
11	-	-	-	38.8	38.8	-	-	-	39.5	39.5
12	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
13	-	-	33.4	38.8	72.2	-	-	2.4	39.5	41.9
14	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
15	-	133.4	-	38.8	172.2	-	13.8	-	39.5	53.3
16	-	-	-	38.8	38.8	-	-	-	39.5	39.5
17	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
18	-	-	-	38.8	38.8	-	-	2.4	39.5	41.9
19	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
20	-	-	33.4	38.8	72.2	-	-	-	39.5	39.5
21	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
22	-	-	-	38.8	38.8	-	-	-	39.5	39.5
23	-	-	13.3	38.8	52.1	-	-	2.4	39.5	41.9
24	-	-	-	38.8	38.8	-	-	-	39.5	39.5
25	-	-	46.7	38.8	85.5	-	-	-	39.5	39.5
26	-	-	-	38.8	38.8	-	-	-	39.5	39.5
27	-	-	13.3	38.8	38.8	-	-	-	39.5	39.5
28	-	-	-	38.8	38.8	-	-	2.4	39.5	41.9
29	-	-	-	38.8	38.8	-	-	-	39.5	39.5
30	-	133.4	-	38.8	172.2	-	92.6	-	39.5	132.1
31	-	-	-	38.8	38.8	-	-	-	39.5	39.5
32	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
33	-	-	-	38.8	38.8	-	-	-	39.5	39.5
34	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
35	-	-	33.4	38.8	72.2	-	-	2.4	39.5	41.9
36	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
37	-	-	-	38.8	38.8	-	-	-	39.5	39.5
38	-	-	13.3	38.8	52.1	-	-	-	39.5	39.5
39	-	-	-	38.8	38.8	-	-	-	39.5	39.5
40	-	-	46.7	38.8	85.5	-	-	2.4	39.5	41.9

Net Present Value of Diesel Cost Stream = LE 345,640 when discounted at 15%
Net Present Value of Electric Cost Stream = LE 306,362 when discounted at 15%
During the 11th year, the cumulative NPV of Diesel option surpasses the NPV of the electric option, which is higher for the first 10 years.

ECONOMIC COST AND BENEFIT FLOWS

(LE 000)

		COSTS					BENEFITS		
Project Year	Calendar Year	Investment	Installation	O&M	Replacement	Total	Total Benefits	Net Cash Flow	N.P.V. at 29.742%
1	1979	9233	232	-	369	9834	-	(9834)	(7579.66)
2	1980	1646	43	-	369	2064	-	(2064)	(1226.16)
3	1981	-	-	1199	369	1568	4880	3312	1516.52
4	1982	-	-	1274	369	1643	6202	4559	1608.97
5	1983	-	-	1360	369	1729	6515	4786	1301.88
6	1984	-	-	1360	369	1729	6515	4786	1003.43
7	1985	-	-	1360	369	1729	6515	4786	773.41
8	1986	-	-	1360	369	1729	6515	4786	596.11
9	1987	-	-	1360	369	1729	6517[1]	4788	459.65
10	1988	-	-	1360	369	1729	6515	4786	354.13
11	1989	-	-	1360	369	1729	6515	4786	272.95
12	1990	-	-	1360	369	1729	6515	4786	210.38
13	1991	-	-	1360	369	1729	6515	4786	162.15
14	1992	-	-	1360	369	1729	6518[1,2]	4789	125.06
15	1993	-	-	1360	369	1729	6515	4786	96.33
16	1994	-	-	1360	369	1729	6515	4786	74.25
17	1995	-	-	1360	369	1729	6515	4786	57.23
18	1996	-	-	1360	369	1729	6655[3]	4926	45.40
19	1997	-	-	1360	369	1729	6517[1]	4788	34.01
20	1998	-	-	1360	369	1729	6515	4786	26.20
21	1999	-	-	1360	369	1729	6515	4786	20.20
22	2000	-	-	1360	369	1729	6515	4786	15.57
23	2001	-	-	1360	369	1729	6515	4786	12.00
24	2002	-	-	1360	369	1729	6515	4786	9.25
25	2003	-	-	1360	369	1729	6518[1,2]	4789	7.13
26	2004	-	-	1360	369	1729	6515	4786	5.49
27	2005	-	-	1360	369	1729	6515	4786	4.23
28	2006	-	-	1360	369	1729	6515	4786	3.26
29	2007	-	-	1360	369	1729	6515	4786	2.52
30	2008	-	-	1360	369	1729	6515	4786	1.94
31	2009	-	-	1360	369	1729	6517[1]	4788	1.50
32	2010	-	-	1360	369	1729	6515	4786	1.15
33	2011	-	-	1360	369	1729	7155[3,4]	5426	1.01
34	2012	-	-	1360	369	1729	6515	4786	0.68
35	2013	-	-	1360	369	1729	6515	4786	0.53
36	2014	-	-	1360	369	1729	6515	4786	0.41
37	2015	-	-	1360	369	1729	6518[1,2]	4789	0.31
38	2016	-	-	1360	369	1729	6515	4786	0.24
39	2017	-	-	1360	369	1729	6515	4786	0.19
40	2018	-	-	1360	369	1729	6515	4786	0.14
		10,879	281	51,433	14,760	77,353	246,417	169,064	0

[1]includes scrap value of transport equipment [2]includes scrap value of communications equipment

[3]includes scrap value of transformers and switch panels [4]includes scrap value of pumps and motors

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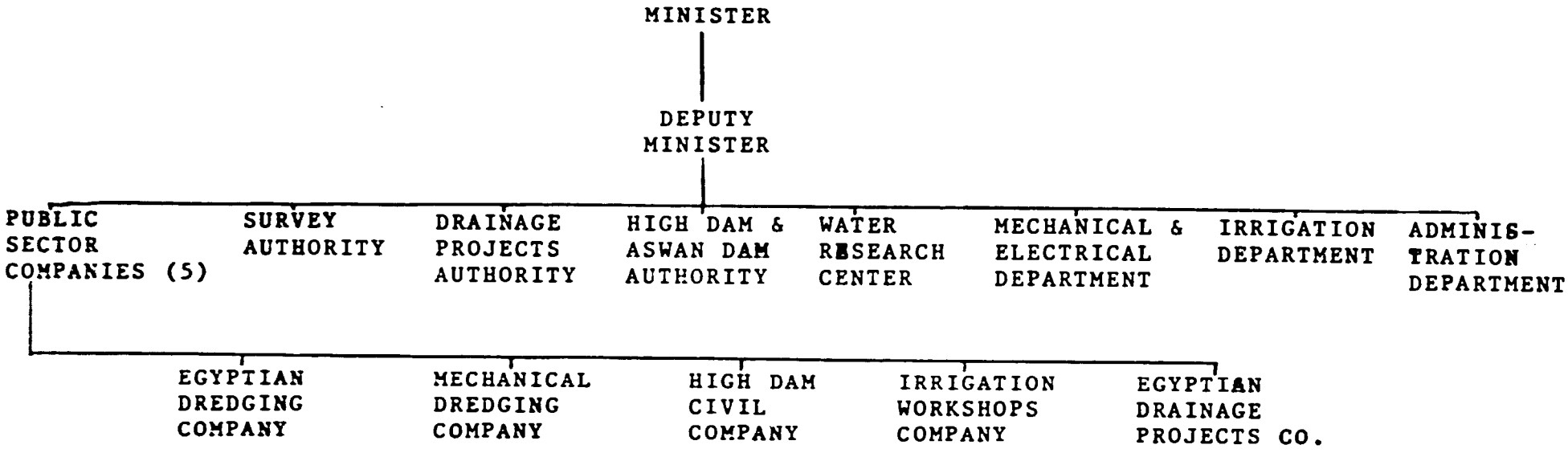
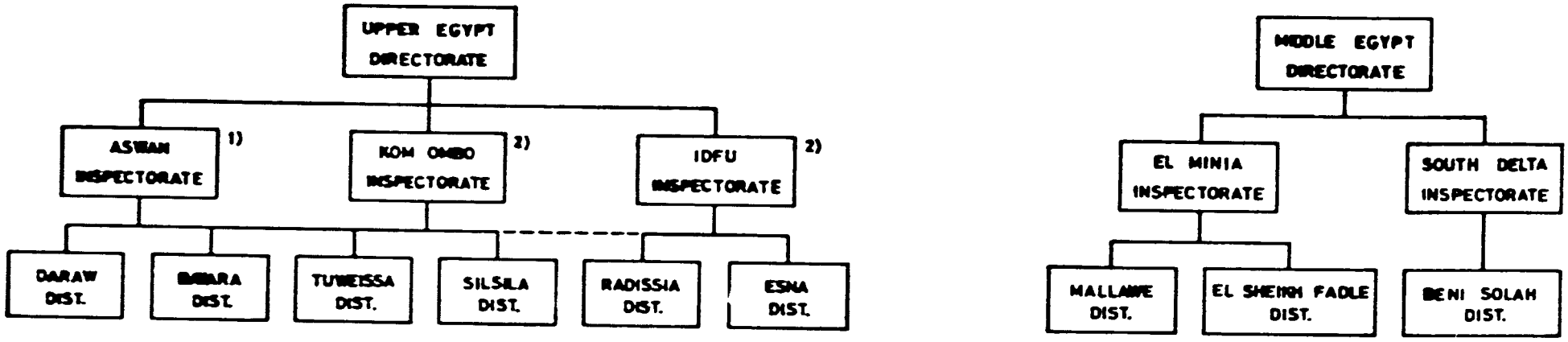
ANNEX 1.

MINISTRY OF IRRIGATION



ANNEX M

IRRIGATION ORGANIZATION AT THE OPERATIONAL LEVEL

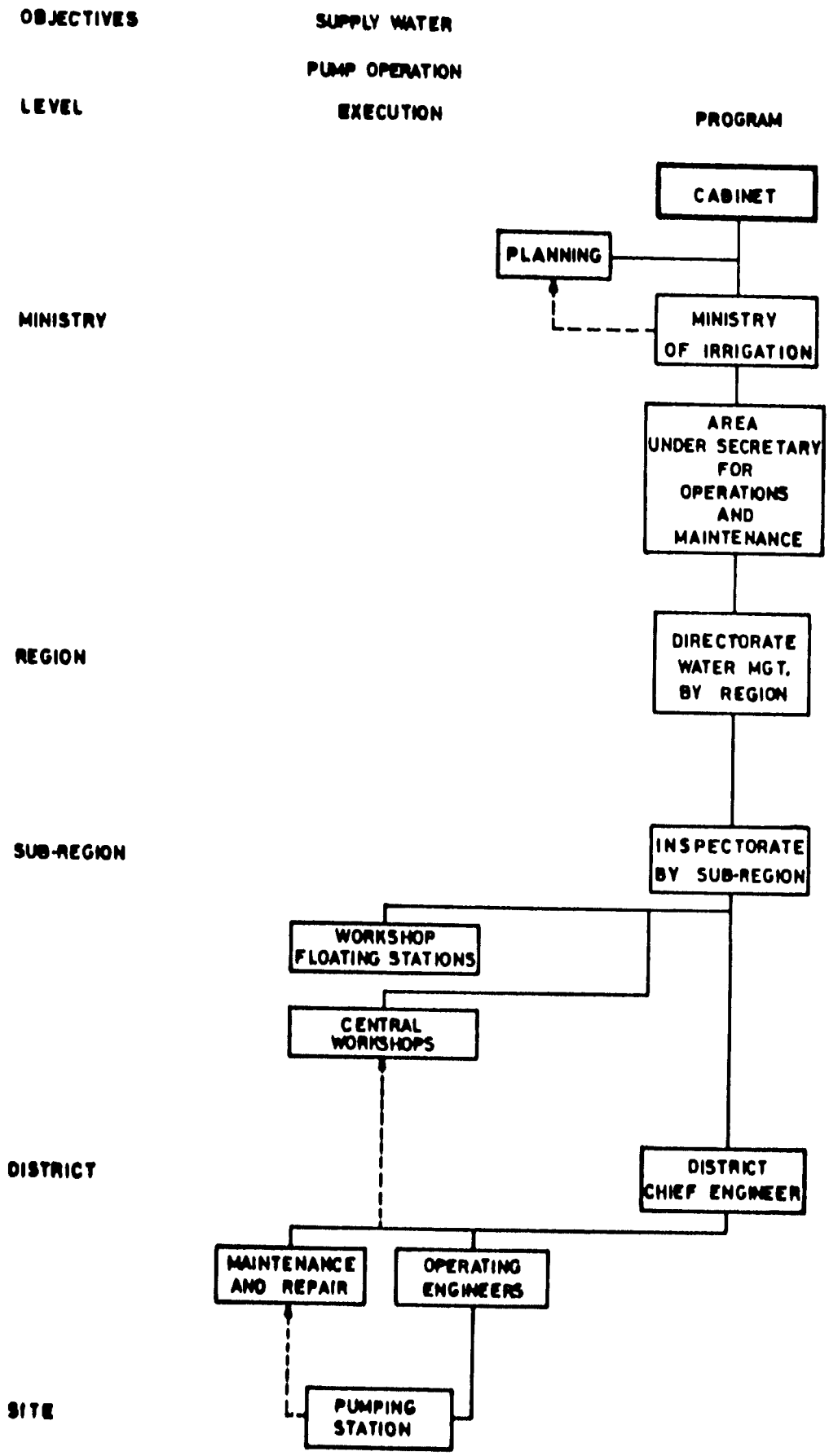


1) ASWAN SUPERVISES ALL DISTRICTS FOR FLOATING STATIONS.

2) STATIONARY PUMP SITES ARE MANAGED BY KOM OMBO AND IDFU INSPECTORATES.

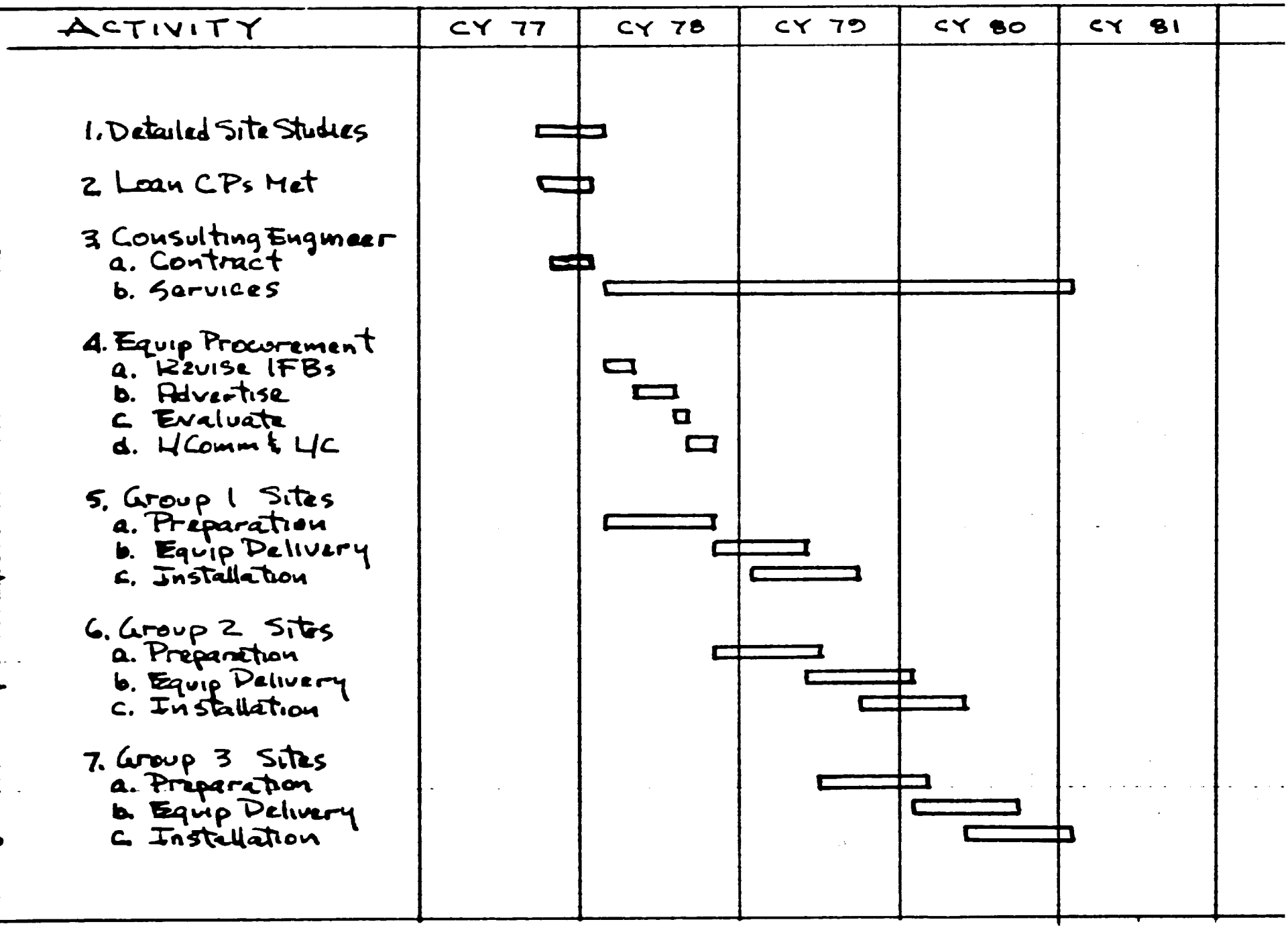
ANNEX N-1

WORK FLOW FOR IRRIGATION MANAGEMENT



Annex O

Irrigation Pumps - Implementation Schedule



PRIORITIES FOR PUMP INSTALLATION

Group 1

21 El Sheikh Fadel
22 Sawada Gabel El Teir
23 Derb
20 El Sibaia
18 El Bousillia
17 El Kehl
16 El Ramadi
6 Benban
11 El Radissia
26 Gezierat El Sheikh Tomai
10 Selwa Bahari

Group 2

19 Gezierat El Higz
3 Moukassifat El Atwani
2 Blukhar
9 Selwa Kibli
8 Iklit
7 Gezierat El Mansouria
34 Sahel Bani Okba
30 Gezierat El Borsha
27 Sahel El Sheikh Tomai
28 Gezierat Shieba
35 Gezierat El Hiba
29 Sahel El Borsha

Group 3

31 Sahel Senor
32 Sahel Ghiada
33 Gezierat Beba
25 Gezierat El Ahaiwa
24 Gezierat Girga
36 Gezierat El Hammadi
1 Gezierat El Malkia
12 Radissia North 1
13 Radissia North 2
14 Radissia South 1
15 Radissia South 2