NILE RIVER IRRIGATION SYSTEM REDESIGN, REHABILITATION AND IMPROVEMENT PROGRAM

Prepared for

U.S. Agency for International Development
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Appendices:

A. Scope of Work - Plan and Feasibility Report for Redesign, Rehabilitation and Improvement North Zifta District Irrigation and Drainage System (26 pages)

B. Scope of Work - Operation and Maintenance Project - Gharbiya Directorate (17 pages)

C. Ministry of Irrigation - Planning and Project Design Program (8 pages)

D. The Egyptian Irrigation Sector - Observations and Conclusions of Floyd E. Dominy, Commissioner (Retired), U.S. Bureau of Reclamation (4 pages)

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EXECUTIVE SUMMARY

Background

The Nile River irrigation system is the life blood of the Egyptian economy. It supports, indeed makes possible, the productive farming of an area covering some six million feddans (one feddan = 1.04 acres) extending some 1200 kilometers from Aswan to the Mediterranean Sea.

The operation of the system is a vast and complicated undertaking involving the storage, release, diversion and conveyance of some 56,000 million cubic meters of water per year through thousands of kilometers of canals and branches. Except for the absolute control of downstream releases made possible by completion of the High Aswan Dam in 1964, the water conveyance and delivery system is largely unchanged from that which evolved between 1861, when the first diversion barrage was built on the Nile, and 1954 when the existing barrage system was completed. The completion of the High Aswan Dam with its large storage and regulating capacity brought both benefits and challenges.

The Egyptian Government needs and desires to modernize and improve the irrigation system in order to increase food production on lands served by the existing system and conserve water for expansion of irrigated agriculture lands and other uses. The Agency for International Development Mission in Cairo (USAID) is interested in supporting such an endeavor and proposes to undertake a major assistance effort in the irrigation sector.

With the concurrence of the Ministry of Irrigation, (MOI), the USAID secured the services of a team of specialists (the authors of this report, the Scope Team) to examine the opportunities for improving the design, operation, and

effectiveness of the irrigation system serving the old lands and to define the initial steps of an action program for U.S. assistance.

Scope of Team's Assignment

The USAID's charge to the Team emphasized possible intervention in three areas--planning and project design, system redesign, and system operation and maintenance--but did not limit examination of other areas.

In particular, the USAID desired that the Team:

- define each of the three areas of activity within the Egyptian context,
- identify major issues to be resolved,
- determine where in the project design and implementation process each of the issues should be resolved,
- make recommendations to USAID on certain issues that needed resolution as a prerequisite to undertaking the projects design process, and
- develop the Scope of Work for undertaking design of recommended projects.

Team Activity

In the limited time that the Team had to familiarize itself with the Nile irrigation system, it had to rely on reports available and brief examination of selected areas that hopefully typified the system as a whole. Field trips were made to Gharbiya Governorate, to Minya Governorate, to Aswan and to El Fayoum.

Similarly, with respect to the organization and functioning of the Ministry of Irrigation, the Team had to rely on available reports and all too brief inquiries or discussions with officials at various levels in Cairo and in the field.

Nonetheless the Team is confident that its examination of the existing irrigation system and the functioning of the Ministry of Irrigation was sufficient to reach valid conclusions.

Assessment of Existing Water Conveyance and Delivery System

The present system has long supported an impressive effort in irrigated agriculture. However the condition of the waterways and related structures indicates that much maintenance has been too long deferred and is adversely affecting the ability of the system to make timely delivery of the proper amount of water to the farmer.

The basic design and operation of the system controls neither the timing nor the quantity of water taken from the delivery system by each farmer. As a means of discouraging over-use of water by the farmer, system design generally forces him to lift the water he uses from a header ditch (meska) lying below the level of his land. This imposes an unnecessary cost to both the farmer and the country where topography and appropriate system design could permit application by gravity. Further, application inefficiencies are inherent where low-capacity pumping provides the supply to the field.

Three other somewhat related aspects of the irrigation system stand out: (1) gravity (free energy) is not used to the extent feasible in the delivery of water to the farm plot, (2) water is generally applied to farms only during daylight hours while the delivery system runs full for twenty-four hours a day, almost guaranteeing substantial waste to drains during the nighttime hours, and (3) there is a "missing link" between the MOI conveyance system and the individual farm turnout. That is, the MOI responsibility ends when water is provided at the head of the meska; from that point management of the water and maintenance of the watercourse, which generally serves five to forty farm plots, are virtually out of control. Individuals look to their own interests; generally there are no meska "water users associations" to control timing or quantity of off-take or to maintain the watercourse in good operating condition. The single area where greatest efficiency in the overall system could be realized through change is better

design, management and operation at the meska and associated farm turnouts level.

Areas of Activity Recommended for AID-Assisted Action Program

The Team concluded that there are no "quick fixes" and infusions of money alone will not significantly deal with the problems perceived. The critical need is to initiate fundamental measures directed toward insuring the timely delivery of the proper amount of water to each farm turnout. Companion activities such as water use and management on the farm, along with other agricultural inputs, are necessary to increase crop yields. They can be brought into effective play, however, only if the water is there to apply as needed.

Accordingly two measures should be undertaken without delay: (1) deterioration of the existing irrigation system must be halted and it must be maintained in a reasonably effective operating condition until fundamental improvements can be made in system design and operation. That is, the existing system must in the first instance be kept going, and (2) a program of redesign, rehabilitation and improvement of the irrigation system in both physical and operational terms must be undertaken to more effectively serve the needs of currently irrigated areas and to conserve water for expansion of irrigated agriculture and other uses.

The system is so vast that any action program will have to be undertaken in stages, and it should be initiated on a manageable scale that would serve as a model for implementation throughout the system and would provide an opportunity to profit from lessons learned in the process. Such a modest beginning should in no way be interpreted as a lack of urgency in dealing with the problem throughout the country. Rather, it is a practical necessity to assure a sound, well-developed program to serve the needs of Egypt.

The Team recommends (1) that the system redesign and improvement program be initiated with a project covering

43,000 feddans in the Middle Delta--North Zifta Irrigation District of Gharbiya Governorate and (2) that the maintenance program to restore and preserve the existing system in effective operating condition be initiated with a project in Gharbiya Irrigation Directorate (one of 19 such directorates nationwide) covering some 400,000 feddans.

The first step in each of the projects is the preparation of a sound project plan. Detailed Scopes of Work for preparation of such plans by engineering and technical services firms (CONSULTANTS) are set forth in Appendices A and B. A follow-on phase of project execution would proceed after completion and MOI-USAID approval of the project plans.

A third area recommended for an action program by the Team concerns the capacity of the Ministry of Irrigation to plan and design system improvement projects internally. A detailed program for this activity involving assistance to the MOI by three highly qualified expatriates, in the first instance, is presented in Appendix C.

The Team also examined two other areas for possible inclusion in an action program: (1) a river flow metering and control system and (2) an MOI training center at the national level. It was concluded that while these activities had merit, an action program was not indicated at this time. The need and timing for such activities should be carefully re-examined when there is firm evidence that the irrigation system redesign and improvement program will be implemented. A note on each of the two activities is presented in Appendices E and F, respectively.

Timing and Cost of Activities Recommended

1. System Redesign, Rehabilitation and Improvement - North Zifta Irrigation District

Preparation of the Preliminary Plan and Feasibility Study is estimated to require eighteen months at a cost of some $2,600,000. Follow-on execution of the project might be of the order of $20,000,000.

2. Operation and Maintenance Project - Gharbiya District

Preparation of the Plan for structure and waterway rehabilitation and maintenance is estimated to require one year at a cost of about $1,000,000. Follow-on execution of the work might be of the order $10,000,000-$15,000,000.

3. Planning and Project Design - MOI

This is a technical assistance undertaking that might run two to four years. The cost is estimated at approximately $1,000,000 per year at the level of effort perceived for the first two years.

Issues Affecting the Improvement of the Irrigation System

The Team identified a host of issues--social, economic, technical, administrational and organizational, which impinge on improved design and operation of the system. The issues having major impact are concerned with change, and the will and capacity of the MOI to initiate or undertake such change: management of water all the way through the farm turnout; night irrigation; technical design and operational changes needed to raise the efficiency and cost effectiveness of the system; organized farmer participation in water allocation and scheduling for application; MOI organization, staffing, and funding to carry out its responsibility to provide and operate an effective irrigation system; interfacing between Ministry of Irrigation and Ministry of Agriculture for effective management of water both in the delivery system and on-farm use.

Satisfactory resolution of all the issues will be a long and difficult process. It is believed that an effective start at clearly defining the dimensions of the issues and devising finite steps toward their resolution will be provided in the process of designing and implementing the projects recommended by the Team in this Report.

NILE RIVER IRRIGATION SYSTEM
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I. Background

The irrigation system covering the Nile Valley and delta is unique. The water comes from a single source, the upper Nile, and its availability to the system controlled at a single point, the High Aswan Dam. However, the operation of the system is complicated in that it serves a vast area, six million feddans (one feddan = 1.04 acres) extending some 1200 kilometers (km) from Aswan through the delta.

The area has utilized the Nile waters in cultivation of crops from ancient times. Various control structures were built on the river beginning in 1861 to the effect that by 1952 some five million feddans were under irrigation and all the summer yield of the Nile was being used.

The installations on the River at that time consisted of six barrages and the old Aswan Dam. These structures were built to fulfill two main objectives: the first to guarantee basin irrigation in periods of low floods and the second to enable the conversion from basin irrigation to perennial irrigation to the extent possible. While effective for diverting river flow into the irrigation system, these structures had little storage capacity--one milliard (1,000 million) cubic meters at old Aswan when built in 1902, increasing to five milliards as the dam was strengthened and raised in 1912 and 1933.

A major change occurred some 16 years ago when completion of the High Aswan Dam enabled virtually complete control of the annual flow and year-to-year carry-over of unneeded water in its huge 164 milliard cubic meter gross capacity storage reservoir.

Up until that time perennial irrigation had been practiced but the amount of water available was geared to seasonal variation in the river flow--virtually run-of-the-river. The barrages raised water levels to provide head for

diversion into main canals but did not provide significant storage. Thus at the time of maximum demand for irrigation (in summer), the river could not provide the quantity needed; the flood stage on the Nile occurred somewhat later (August-September).

Upon completion of High Aswan Dam and filling of the reservoir to operating level, release of water downstream to the irrigation system could be made at any time to suit crop requirements. Surplus waters not needed for downstream purposes could be retained in the reservoir which has year-to-year carry-over capacity: live storage capacity of 90,000 MCM (million cubic meters) with annual downstream releases currently running about 56,000 MCM per year. This change which increased the amount of water available for irrigation and assured a year round supply to meet seasonal needs brought both benefits and problems.

With the concurrence of the Ministry of Irrigation of the Arab Republic of Egypt, USAID/Egypt secured the services of a team of specialists (the Irrigation Projects Scope Team) to examine the opportunities for improving the design, operation and efficiency of the system (old lands only) and to define the initial steps of an action program for U.S. assistance to such an undertaking; in particular, to write "Scopes of Work" for CONSULTANTS to prepare preliminary plans and feasibility studies for specific projects recommended by the Team. The findings of the Team's examination and proposed course of action follow.

II. General

A. Team Activity

In the limited time that the Scope Team had to familiarize itself with the irrigation system in Egypt it had to rely on reports available and brief examination of selected areas that hopefully typified the system as a whole in fundamental respects. This included field trips to the Gharbiya Governorate, to the Minya Governorate, to Aswan and to El Fayoum.

Similarly, with respect to the organization and functioning of the Ministry of Irrigation the Team, of necessity, had to rely on all too brief inquiries or discussions with the emphasis being on functional areas that were preliminarily identified as most likely to prove the basis for recommended action programs.

Nonetheless the Team is confident that its examination of the existing irrigation system, both the physical and organizational aspects, was sufficient to reach valid conclusions.

B. Working Premise

The design and operation of any irrigation system should be directed toward the timely delivery of the proper amount of water to each farm turnout. Proper delivery to the farm turn-out is fundamental to the practice of irrigated agriculture. Without it, water use and management on the farm along with other agricultural inputs will never get a proper chance to increase crop yields which is of course the ultimate objective. Clearly, upgrading the water delivery system without parallel attention to proper water use on the farm along with the other necessary inputs to increase yields would not be a sound proposition.

Thus a companion working premise is that the proper application and management of water on the farm together with associated agronomic practices is a vital function of the irrigation system lying within the purview of the Ministry of Irrigation.

C. Summary Assessment of the Existing Conveyance and Delivery System

Serving the irrigation system in the Nile Valley and Delta involves the release and management each year of billions of cubic meters of water from Aswan High Dam to the last farm turn-out over thousands of kilometers of canals, branches, laterals and header or farm ditches (meskas). There exists a system of constructed works to perform that function. Those works have not been and are not now operated and maintained to a minimal accepted standard for efficient conveyance of water or to serve the needs of modern irrigated agriculture.

The small farmer (95% of the farms in Egypt are five feddans or less) does not receive the correct amount of water to meet the evapotranspiration needs of his crop or needs for salinity control; there is excess at times, deficiency at others.

In sum, the conveyance system is wasteful of water and the farm delivery system is a significant constraint to proper on-farm water management necessary for high crop yields.

III. Areas of Activity for Action Program

Having come to the conclusion stated immediately above, the corollary is "what can be done about it", and in particular where might potential AID assistance be focused.

The solution in the Team's view requires two distinct but related approaches proceeding in parallel: one aimed at making a start on system redesign, rehabilitation and improvement, and the other at keeping the existing system maintained and operating in a reasonably effective state until the rehabilitation and improvement program can be accomplished throughout the system--perhaps a twenty-year undertaking.

A third area recommended for action by the Team impacts directly on the capacity of the Ministry of Irrigation (MOI) to plan and design system improvement projects as well as new lands projects or others to a level deemed sufficient for appraisal, without delay, by international financing agencies.

That is not to say that there are no activities other than the three described above that deserve attention or would be helpful. In particular, the Scope Team examined two other areas: River Flow Metering and Control System and a Training Center at the national level. The ordering of an action program for these two activities depends on a firm commitment and substantial start on the System Redesign and Improvement program discussed in detail below. Implementation of either of these activities in isolation, i.e. with the existing irrigation system remaining status quo, would be of dubious value. On the other hand, if the system redesign and improvement program is sucessfully implemented, significant benefits would accrue from a well designed training program and better monitoring and control of release of Nile waters both in the mainstream and the conveyance system. Notes on each of these two activities are included hereinafter as Appendices E and F.

The possible reconstruction or replacement of Nile barrages was not considered; we were advised that the World Bank had agreed to take the lead in examining this matter.

Following is a fuller exposition of the action approaches suggested above.

A. System Redesign, Rehabilitation and Improvement

The existing system encompasses some six million feddans under cultivation and 28,000 miles of unlined canals in fifty command areas. Water is provided from the main canals to the branches and laterals on a rotation system that alternates on-off time periods (for example, seven days "on" and seven days "off") which vary seasonally with cropping patterns. Water requirements are fulfilled not by measurement to a sub-system or farm but by maintaining water levels throughout the system from which the farmer may draw at will during the "on" period. This may result in over-application of water by the farmer and substantial waste to drains and seepage at night when the "on" sub-system is flowing full with little off-take by farmers. The costs and economic penalties associated with such a system include handling drainage water that runs through the irrigation system unused, losing cultivatable land through water-logging, draining lands water-logged through overuse of water or seepage from conveyance systems, and loss of unused water to the sea. Further, there are often considerable flows to sub-systems during the "off" periods due to leaky control structures, generally wooden stop-logs or worn slide gates.

In an attempt to limit the over-use of water by the farmer, the present system generally provides water in the farm or header ditch at a level below the adjacent farm plots so that the farmer must raise the water to his fields by pumping. This occurs even in areas where a system of gravity flow is topographically feasible. Such unnecessary pumping is done at considerable cost by farmers and is an economic drain on the country. It has been estimated that

only some 10% of farm off-take from the system is accomplished by gravity.

Clearly a two-pronged attack on waste needs to be mounted: (a) more efficient control and handling of water in the conveyance and delivery system and (b) better management of the water at the farm level. The former lies within the responsibility of the Ministry of Irrigation both as to physical works and operation of the system; the latter falls within the purview of the Ministry of Irrigation, the Ministry of Agriculture, and the farmers themselves, and is whence the major economic pay-off will come when combined with other well-managed farm inputs.

AID is presently funding an interdisciplinary project under the aegis of the Ministry of Irrigation, with the cooperation of the Ministry of Agriculture to improve on-farm water management. Pilot projects are underway at three locations.

A "missing link" in the existing system must also be included in the attack; that is, the management, operation and maintenance of the "meska" (the header or farm ditch from which the water is diverted directly to the individual farm plots; a meska may serve 5-40 farm families and an area of 25-200 feddans, sometimes more). This is believed to be the single area where greatest efficiency in the system could be realized through change.

At present the meskas, all unlined, belong to the farmers (even though some are reported to be as long as five kilometers) and the MOI's responsibility ends when water is delivered to the head of the meska. From that point on the operation is virtually out of control. Generally there are no farmer organizations, other than occasional ad hoc arrangements, to control quantity or timing of off-takes from the meska and no organized maintenance of the waterway. The result, physically, is that the meska is usually over-grown with grass and weeds and of uncertain cross-section and capacity. Operation is discriminatory: the farmer at

the upper end of the meska is in a superior position to secure his water requirement (quantity and timing) at will; the "tail-enders" at the downstream end of the meska get little or no water at all in peak requirement times until the upper-end users have had their fill. Then the supply must generally come through a tortuous, grass-choked channel. In an effort to move the water under such conditions, maximum head or even surcharging is used. This adds to the seepage problem and the quantity of water wasted during the non-daylight hours as it passes through the system unutilized when generally no one is irrigating (except in an emergency situation when a tail-ender has no choice).

In summary, a solution must be found to maintaining the meskas in reasonably efficient operating condition coupled with an operating procedure that is equitable and controllable; controllable in terms of off-takes to meet the needs of the farmers and significant reduction in water passing through the system unutilized. It is believed this can be accomplished through a combination of system redesign and operation (a change from the on-off rotation system to a demand system is not ruled out) and the establishment of some kind of "water users association" to operate and maintain the meskas serving the farms. Some sort of linkage between such an association and MOI operating officials would be essential.

Solutions will cut across social, economic, technical, and perhaps political lines and will not be easy. Rehabilitation and improvement of the entire system including redesign, physical implementation and operational modifications will be a massive undertaking extending over many years. However, a substantive beginning needs to be made now, both to initiate the process and to learn lessons to be applied as the process continues.

It is proposed here to begin with a single irrigation district of some 43,000 feddans in the Middle Delta--North Zifta district in the Gharbiya Governorate. Such an area is

believed to be both large enough to serve as a model replicable in other locations ar' typical of conditions encountered in the Delta lands while small enough to be reasonably manageable as a new departure. The action program proposed would be carried out in three phases:

1. Preparation of preliminary plans and feasibility study. (Upon approval, the second phase would be activated). The feasibility study would include examination in detail of the existing irrigation and drainage system, topography, present on-farm water management practices, cropping patterns, soil characteristics, seepage losses from canals and branches, water budget and water balance. Based on such examination and analysis of the existing system, options would be studied and preliminary plans developed for system redesign and improvement supported by careful technical, economic and financial soundness analyses. The feasibility study would also include the development of recommended social action programs and irrigation advisory services relating to water users organizations and improved on-farm water management considered necessary for effective utilization of the improved system.
2. Preparation of detailed engineering drawings and specifications, construction plans and bidding documents.
3. Awards of contract(s) and construction of the works.

The physical works described must be accompanied by development and implementation of operation and maintenance procedures to complement the improved system.

Equally, perhaps more, important to the success of the undertaking a parallel program must be developed by the Ministry of Agriculture, drawing on the work of the Egyptian

Water Use and Management Project, for better management of water at the farm level and improved agronomic practices.

It is realized that the proposal above covers less than one percent of the lands now irrigated by the Nile. However, if the system is to be improved--and the Team believes strongly that Egypt cannot long continue to enjoy the luxury of diverting more water to the sub-systems than needed for conveyance and use with reasonable efficiency--a start must be made. The Team believes it essential that issues be faced, finite plans and related feasibility studies made, costs and benefits established and work initiated for improvement of an area of sufficient size to (1) get something significant started; (2) show what can be done--not only in the specific area but also a model and guide for improving the remainder of the system; (3) to learn some lessons, even some negative ones perhaps, to apply on the other 99% of the system to be improved; and (4) begin development of a cadre of trained people needed for redesign and improvement of the system nationwide.

B. Operation and Maintenance

Independent of but related to a system redesign and improvement program as described above, the existing system throughout Egypt must continue to deliver water while the overall improvement program gradually spreads throughout the system--perhaps a 20-year undertaking.

On the basis of informed and experienced observation the Team feels strongly that the existing system is in danger of "falling apart", that its capacity to deliver water to the farms as needed is steadily diminishing. Though a fixed time cannot be projected, failure to replace worn-out structures and upgrade maintenance and operation of waterways will inevitably result in the inability to deliver water in sufficient quantity to major segments of the system.

There is a large backlog of deferred maintenance, some 43 million pounds (1 Egyptian pound = U.S. $1.30), for

structure repair/replacement alone according to a recent Ministry of Irrigation (MOI) survey. The condition of many of the waterways in the areas observed indicates recurring maintenance requirements have not been met. In addition to correcting these conditions on a priority basis, canals and laterals need annual attention--weed control, cleaning and/or reshaping to maintain design flow capacity.

Such maintenance of the system is a must. Else delivery to the farms will deteriorate, affecting crop yields, and the economic costs associated with an increasingly inefficient conveyance system must be borne. And as stated above, at some point in time the system will simply not be able to serve adequately all parts of its service area.

It is proposed to develop a plan and implement a program directed at overcoming problems which contribute to present and continuing deterioration of the system. The solutions are intended to enable maintenance of the existing system in effective operating condition until a comprehensive program of system redesign and improvement can be undertaken.

There are 19 Irrigation Directorates covering the irrigation system. It is proposed here to undertake as a first step a comprehensive program for improving maintenance and operation in a single Directorate. It would include not only rehabilitation of those segments of waterways and replacement/repair of structures needing priority attention, but also development of a system of planning, scheduling, budgeting, and implementing a sustained (annual) maintenance program to keep the facilities in a reasonable state of repair.

The program for the selected Directorate would be carried out in two phases:

1. Data collection and the development of a complete operational plan for structure and waterway rehabilitation and maintenance, both deferred and

recurring, for the existing irrigation and drainage systems in the Directorate. (Upon approval of this plan, the second phase would be activated.)

2. Preparation of detailed engineering drawings and specifications for specific replacements and repairs of structures, and for specific waterways rehabilitation, procurement of equipment and materials, and execution of the work in the field.

An effective program developed and proved operable in one Directorate could be rapidly replicated in the other Directorates. This approach is deemed more manageable and likely of success rather than attempting a country-wide program in a single step. (Execution of the program in other Directorates would not necessarily await completion of physical works in the selected Directorate. Replication could begin with adaptation of the approved operational plan developed for the initial Directorate.)

The Team recommends the Gharbiya Directorate for the initiation of the program as it is reasonably typical, accessible and there would be administrative advantages to undertaking the proposed operation and maintenance program in the Directorate also having jurisdiction over the proposed system redesign and improvement project in the North Zifta District.

C. Planning and Project Design

The Minister of Irrigation should have a Project Planning Organization responsible to him with the technical competence to consider and evaluate all activities proposed for agricultural production under irrigation using waters of the Nile, return flows, or ground water from wells.

This planning organization should have competence in Civil, Mechanical, Electrical and Agricultural Engineering, Soils, Geology, Economics, preliminary Cost Estimating for construction and for operation and maintenance, Agronomists

to determine in coordination with the Ministry of Agriculture soil classification, cropping patterns and water use, and Sociologists to work with the development of farmer organizations and irrigation advisory services.

At present, departments and sectors within the MOI, for example, irrigation, drainage, mechanical and electrical, perform planning functions that are coordinated at the Under Secretary level. Though such units have a place in overall planning, there is great need for a multi-disciplinary unit integrated into the mainstream of MOI functions for socio-economic analysis related to Egypt's development objectives, and to carry out comprehensive technical and economic studies to test the viability of projects proposed by various operating units or developed by the departments or sectors. The basic objective would be to give the MOI the capability to establish priorities, program activities, and prepare projects for system improvement or expansion with proven technical, economic and financial feasibility.

Such a unit would require personnel of a high degree of skill. The difficulty of attracting such personnel and retaining them is well known. Nonetheless, the need for such a Unit is so overriding that extraordinary effort should be made to establish it. An approach might be to identify personnel now employed by the Ministry suitable for establishment of a "core unit" to be supplemented by foreign expertise at the outset until recruitment and training (primarily on-the-job) could establish an effective, self-sustaining unit.

During the period of build-up it would likely be necessary to engage consulting firms to prepare some of the detailed feasibility reports generally required by international financial agencies for making investment decisions. The preparation of terms of reference, contract negotiations, monitoring of consultants activities and review of their work would be an important function of the planning and design unit.

IV. Major Issues Affecting Improvement of the System

A. Introduction

1. Major Egyptian Planning Objectives:

The long range objectives proposed for the Executive Authority for Water Planning are to enable the Government of Egypt to optimize the development and use of the nation's water resources and to reinforce the capability in water planning to help in attaining major socio-economic development objectives. Because of the impact of the waters of the Nile on the agricultural, transportation, industrial, and municipal development in Egypt, nearly all development policies and occurrences in Egypt influence and are influenced by the water resources of the Nile. For example, the pricing policy for electricity will have an impact on the water needed for future thermal power plants and the availability of agricultural credit will influence the water use efficiency at the farm level. In this sense, nearly all development policy issues are also water resource policy issues. While these overall interrelationships must both be recognized and dealt with, this report will concentrate on those issues which are principally related to the use and development of water resources in attaining major socio-economic development objectives. The design team (CONSULTANTS) must be given those objectives by the GOE and those objectives must be in operational form. The purpose of the next paragraph is not to specify what those objectives should be, but rather to illustrate the way in which those objectives need to be expressed if water resource programs are to be developed which will help in attaining the objectives. The objectives present are meant for illustrative purposes only, but they do reflect the Scope Team's current understanding of some of Egypt's goals and aspirations.

Egypt has established achievement of food sufficiency as an official development objective. Until 1975, Egypt was food sufficient but by then population levels (currently

increasing at the rate of 2.3% per annum) had resulted in food needs in excess of the production of Egypt's agriculture. Egypt's population is expected to increase to 65 million by the year 2000. "It has been estimated that to close the food deficit, agriculture must grow at the rate of 4% per annum for the next ten years, and parallel the population growth thereafter." (Gary P. Kutcher, draft of "The Agro Economic Model," Master Water Plan, Report 16, 1980, page 3). Since few developing countries have been able to sustain agricultural growth per unit area of 2% per annum over a long period, the magnitude of the task is considerable.

2. Differentiating Objectives and Alternatives:

Kutcher lists eight options to achieve such growth. The eight include three options which relate directly to water resource policy; intensified land reclamation, soil improvement through drainage, and a more efficient water delivery and application. Such options should not be formulated as discrete water policies but rather viewed as either alternative ways of achieving the objective of food sufficiency or activities which can complement one another in achieving food sufficiency. For example, in some cases more efficient water delivery and application may be an alternative to added investments in drainage. The feasibility of reclamation will greatly influence the amount of rehabilitation which can be justified in order to make more efficient use of water on existing lands. At some step in the decision-making process, these options need to be evaluated and the design team (engineering services CONSULTANT for system redesign, rehabilitation and improvement) must have a clear understanding of which are alternatives they need to evaluate and which options they can treat as stated policy objectives. As the result of the CONSULTANT's work, Egyptian water resource policy-makers may decide to review previously agreed upon policy objectives, but the CONSULTANT must be able to define its job in operational terms.

Therefore, the CONSULTANT must be given the relevant policy objectives and the general type of alternatives which they are to evaluate. However, it is important to make certain that relevant major issues are not eliminated from consideration by the CONSULTANT in the process of defining the objectives and alternatives to be considered.

The major issues affecting the improvement of the system may have several dimensions. However, for purposes of this report, issues will be classified under that dimension which appears to be most relevant.

B. Social Issues

1. Night Irrigation:

Night irrigation is generally not practiced in Egypt. No single change would probably have a greater impact on both the efficiency with which the present system is used and the required specifications of an improved system than the widespread adoption of night irrigation. Therefore, the reasons why night irrigation is not widely used must be understood. In Upper Egypt, concern about nighttime security is sometimes given as reason why night irrigation is not practiced. The process of irrigating small bunded areas may preclude efficient night irrigation. Social customs and family life patterns may mitigate against night irrigation. If night irrigation is not feasible on a widespread basis, it will greatly influence the required characteristics of an effective irrigation system. Therefore, it is critical that the feasibility of night irrigation be carefully studied by the CONSULTANT before the issue of water allocation rules and system design characteristics (farm application 12 hours or 24 hours per day) can be determined. It should be noted that night irrigation was once widely practiced in Egypt and that night irrigation is presently a general practice in the Fayoum area.

2. Farmer Participation at the Meska Level:

While the level of farmer participation in both the process of water allocation and scheduling from a meska (the ditch from which the farm off-take is made) and the performance of needed meska maintenance varies from location to location, there is less organized participation than is desirable if the system is to be used efficiently. The issue needs to be studied and either successful examples of farmer participation should be duplicated or new participation models developed.

3. Multiple Purpose of Canals:

Canal waters often serve multiple purposes. Even during off periods, minimum flows are sometimes required to be maintained in order to provide water for households and livestock. Either such flows should be regulated for those purposes or alternative sources of water need to be developed if canal water is tightly controlled.

4. Retention of Land in Agricultural Production:

Since the early 1950's about 600,000 feddans of prime agricultural land has been lost to urbanization. Generally, the land lost was of high quality and much of it was located near major urban areas. If proper land planning had preserved a major portion of this 600,000 feddans as agricultural land, Egypt's current ability to produce food would be 10-15 percent greater than it is at present. Estimates from the draft Master Water Plan (MWP) indicate that future losses of agricultural land in and around urban areas such as Cairo, Alexandria and the Canal Zone will amount to 15,000 feddans per year. In addition, there will be losses of agricultural land around other urban areas and villages. It seems ill-advised to make investments aimed at improving the irrigation system for land which will cease to be used for agriculture in the near future. Therefore, either improvements should be restricted to lands which have a high

probability of remaining in agricultural production or an active program for the preservation of agricultural lands needs to be developed.

5. Farm Size and Intensification:

The average size farm in Egypt is reported to be about 2.5 feddans and a considerable portion of the resources of small farms is devoted to subsistence agriculture. If one of the potential benefits from improving the irrigation system were to result from a significant intensification of agriculture, it is questionable that such intensification is likely to occur on subsistence farms unless the levels of both management and available credit are increased. This issue needs to be addressed and if it proves to be a serious problem, alternatives need to be considered.

C. Economic and Financial Issues

1. Economic and Financial Values Often Differ:

In a country where many prices are determined by administrative action, it is helpful to distinguish between what is often called the economic and the financial consequences. Financial issues relate to realized costs and revenues at the micro level; i.e. farm, project, Ministry, etc., while economic issues relate to true opportunity costs for the country as a whole. In a perfect market system, there would be little difference between the financial and economic costs. However, when many prices are administratively established, financial and economic analysis may yield different results. For example, a project may be economically advantageous for Egypt but financially impossible for a government organization because of budget constraints. Therefore, each alternative needs to be evaluated using at least two sets of accounts; the first in economic terms and the second in the financial terms which are relevant to either the public sector organization or the private unit in question. If the results of the analysis are different, methods need to be developed in order that the best economic alternatives can be implemented.

2. Value of Water Conserved:

The justifiable level of investment and operating costs incurred in the process of conserving water will depend on the value of the water saved. Determining the value of water conserved is a difficult task and will depend on the value of the water for other uses. The draft MWP (G. P. Kutcher, "The Agro Economic Model," MWP Report 18, page 33) estimates that the marginal value in 1978 of 1000 m^3 of water for consumptive use was L.E. 26.5. This figure could be used as a starting point for calculating the benefits of water conserving activities. Because of the uncertainty associated with this value, alternative values should be used as a basis for sensitivity analysis. To be of value, conserved water must increase the total amount of water which can be used for other purposes. For example, conserving water may result in more efficient use of other inputs such as fertilizer and the maintenance of water quality but the conserved water has no value if in the process the amount of drainage water which could be reused in the system is reduced by exactly the same amount.

3. Demand and Supply Schedules for Water:

Determination of a value of water implies the estimation of a single point on a demand schedule for water. The demand schedule shows how much can be paid per unit for different quantities of water. Ideally, at least the relevant portion of the demand schedule should be generated. As more water is supplied, the added water will probably be used for purposes which have lower net economic returns. For purposes of long-term planning, it would also be desirable to have some idea of the alternative ways of producing additional water for new uses and the costs associated with these alternative. In this sense, water supply schemes in the Sudan become possible substitutes for conserving water on old lands in Egypt. By ordering all the alternative sources of supply on the basis of cost of providing added water, an approximate supply schedule could be

built. While the issues are complicated by the dimension of time, it is in this general sort of framework that the macro water planning for water resources in Egypt should probably be done. The design team (CONSULTANT) mentioned earlier should not be responsible for generating such information, but such a team should be aware of the nature of this general issue. Ultimately, either explicitly or implicitly, the water resource planning in Egypt should be conducted within such a framework.

4. Water Pricing and Water Conservation:

If farmers pump water, pumping costs will tend to encourage farmers to use less water. The problem with this approach is that pumping costs constitute a significant drain on Egypt's economy. An alternative approach would be to encourage farmers to use water more efficiently by charging farmers for water delivery services. If the purpose of such charges were to encourage the conservation of water, as well as to recover a portion of the cost of operating the system, water must be priced to farmers on a per unit basis. However, simply applied, such a pricing policy could have an undesirable impact on agricultural intensification and reaching the objective of food sufficiency. An alternative pricing scheme that would contribute to both water conservation and food sufficiency would be to deliver a base quantity of water to the farmer at a base price. The base quantity would be determined by the consumptive needs for each of the crops grown by the farmer and a specified irrigation efficiency. If the farmer used in excess of the base amount, the price he would pay per unit of added water would be greater than the base rate.

A water pricing policy for water in Egypt is not a relevant issue until water can be delivered to the farmer on a volumetric basis. A modern irrigation system is therefore a necessary precondition before water pricing can be viewed as an operational alternative way of encouraging the conservation of water at the farm level. However, even a modern

irrigation system will not permit the use of water pricing as a means of conserving water unless the design of the system permits some flexibility in the amount of water which can be delivered. For example, if a Fayoum type system is designed to limit water delivery capacities to minimal water requirements, a pricing system is not likely to be a successful water rationing device. The water is rationed to farmers by a quantity allocation rather than by price. However, a market for water may exist among farmers at the meska level. The use of a quantitative allocation system for water, such as currently used in the Fayoum area, is more apt to be socially efficient if the allocations are calculated as a base quantity as discussed above rather than on the basis of area. If water charges based on area served are used in conjunction with a quantitative allocation system, a portion of operation and maintenance costs can be covered by the income generated. However, for a water charge system to encourage the conservation of water, water charges must be on the basis of units of water delivered.

D. Administrative/Organizational

1. Area served by Meska and Farmer Organizations:

One of the crucial water resource issues deals with the scheduling of water from the meskas to the farms. This scheduling could possibly be controlled directly by the MOI. However, such control is more likely to be successful if farmers are organized to accept much of the responsibility for scheduling the on-farm use of irrigation water from the meska. The rate and timing of use from the meska will have great impact on the required characteristics of the rest of the irrigation and drainage system. Therefore, the method used and the resulting organizational structure required for the allocation of water from the meska must be made explicit. In addition, the changes required to make such an organization operational must be specified. Such organizations are more likely to be successful if the number of

farmers involved is relatively small. Therefore, meskas presently serving large areas may need to be converted to MOI laterals and new meskas developed which serve smaller areas. The meska farmer organization will probably be more effective if it has some say in the operation of the branch canal and some influence at the district or sub-district level.

2. MOI Organization and Operating Units:

The lines of authority by sector (e.g. Irrigation, Barrages, etc.) are not likely to correspond exactly to the command needs for operating an irrigation and drainage system. If this occurs, either means must be provided for coordinating the involved sectors or the organizational structure must be changed to more closely correspond to the tasks to be done. The decentralization of authority to an MOI Undersecretary who operates at the Governorate level could ease the burden of coordinating the sectors involved in managing the irrigation and drainage system on a particular site.

3. Leadership Development in MOI:

One of the objectives of any organization with long-term responsibilities such as the MOI has, should be to develop the administrative leadership which will be required in the future. The future characteristics of the entire irrigation system in Egypt will be heavily influenced by the North Zifta system improvement project and the Gharbiya operations and maintainance project. Therefore, it is crucial that the cadre of people which will provide the future administrative leadership in the MOI need to become fully familiar with the projects as soon as possible. The career development plans for these people require that they become familiar not only with the physical developments but they also need to be able to understand the required organizational structure and provisions for coordination, which will often involve several ministries.

4. Provision of Adequate Staff:

The development of both an ideal organizational structure within the MOI and well motivated and trained future leaders within the MOI will not be enough unless the MOI has an adequate staff of people with the needed skills. It is understood that despite the best efforts by the MOI, only about half the allocated positions are filled. The demands for staff at the operational level would undoubtedly increase if a system such as that proposed for North Zifta were to be successfully operated. Therefore, the problems of recruiting and retaining the needed MOI staff must be dealt with in an adequate manner. There seems little doubt but that this would at least require (1) adequate starting salaries needed to attract good young people, (2) good working conditions, and (3) a promotion and salary program which would encourage desirable MOI people to regard the career development potentials in the MOI in a favorable way.

5. Interfacing of Ministry of Irrigation and Ministry of Agriculture

The water delivery system and on-farm use of water are intimately linked in the practice of productive irrigated agriculture. If responsibility is divided between Ministries then there must be a very close, results-oriented working relationship between them if the goal of increased crop production is to be attained. It is not at all clear that such a relationship now exists between the two Ministries in this crucial area of water delivery-water use. This issue must be squarely faced if substantial benefits are to accrue from an improved irrigation system.

E. Political Issues

The political realities of any society will have a great impact on what will be done and what will not be done. For example, in the case of Egypt, it appears that an irreversible political commitment has been made to develop

new lands. (Such commitment does not however minimize the importance of increasing production on old lands.)

Political reality as well as physical reality has to be recognized in project design. It is extremely difficult to develop an adequate political understanding of one's own society let alone an adequate understanding of another society. Nevertheless, it is important for the consultant to gain some understanding of the political limits imposed on acceptable alternatives for improving a system.

F. Physical Works and Present Operation of the System

1. Gravity Irrigation:

Perhaps the single most striking design feature of the existing system is the lack of utilization of gravity (a kind of free energy) in the operation of the system, particularly as it approaches the user on the farm. Outside of the Fayoum area which is a special case, only about 10% of off-takes out of the meska is accomplished by gravity. It is understood that forcing the farmer to pump water to his land is intended as a means of inducing some discipline against waste or overuse. This is a substitute for controlled releases to the farmer as a part of system operation. Main canals operate under gravity and their headworks at the barrages on the River cannot as a practical matter be changed.

2. Meska Operation:

In addition there are other inefficiencies and problems inherent in the system. For example, farmers generally are forced into inefficient irrigation practices by:

(1) lack of adequate administrative control at the meska level;

(2) insufficient flow to the field to cover land quickly enough to avoid excess application at the upper end in order for the water to reach the lower end of the "run";

(3) insufficient head in the meska to apply to fields by gravity;

(4) uncertainty of timely supply of water encourages over-application when water is available;

(5) haphazard maintenance of the meska creates inequitable burdens on those farmers at the lower end of the meska; and

(6) lack of a viable plan for scheduled releases at the farm turnout promotes daytime-only irrigation with water wasted to the drainage system at the end of the meska during the night.

3. Pumping Costs:

The Scope Team believes that enormous pumping costs, perhaps as much as L.E. 100 million per year are incurred each year as the result of lifting water from the meska to the field. Further, costs in pumping energy expended by the farmer place undue burdens on the farmer whose operations for several reasons, are marginally profitable at best, and the cost of energy is bound to increase significantly, jeopardizing the marginal profit of the farmer even more. Energy used by animals to turn sakias may mean less food available to the Egyptian consumer. Water wasted by inefficient on-farm irrigation practices and lack of control at the meska could be applied elsewhere, such as new land development, and to improve Egypt's ability to be self-sufficient in food production. Finally, water wasted to the surface drains and underground aquifer contributes to the cost of drainage borne by the Egyptian Government.

In sum, two intertwined issues must be faced and overcome in the implementation of a system redesign and improvement program: (1) the use of gravity to the maximum feasible extent in the conveyance of water in the system, particularly farm turnouts and (2) control of water at the meska level encompassing not only the amount of water diverted at the farm turnout but also the timing of offtakes

to include night irrigation, in order to secure more equitable access by the individual farmer and more efficient conveyance (less waste) in the system.

V. Resolution of Issues

When planning an intervention such as that proposed here in the irrigation sector, it is useful to not only identify significant issues but also to determine at what stage of the undertaking resolution is necessary. The USAID desired the Team to delineate (1) issues to be resolved before projects design; (2) during the design process; (3) during implementation (project execution); and (4) not to be addressed. With respect to the first category a number of specific questions were raised by the USAID. The following is keyed to the USAID request.

A. Issues to be Resolved before Design of Projects by Consultants

1. Whether activities should be undertaken in all three of the areas discussed in Section III above: As the arable land area is extremely limited in relation to the population, the importance of more efficient management of water in the delivery system and its application at the farm cannot be overestimated as a first step in improved agricultural production. Therefore, the Scope Team recommends that activities be undertaken in all three of the areas as they go to the heart of both improving the system and keeping the existing system going, i.e. System Redesign, Rehabilitation and Improvement, Operation and Maintenance, and Planning and Project Design.

2. Whether activities in all three areas should proceed simultaneously: Clearly the System Improvement and the Operation and Maintenance projects should proceed simultaneously as their objectives are closely related and a decision as to whether to proceed with these projects can likely be taken by the Ministry of Irrigation without long delay. The Planning and Project Design activity is more complicated to formulate as it is integral to the Ministry's internal operations. Therefore in practice, its development

and a decision as to whether to proceed will likely take a considerably longer time. Realistically then, implementation of the planning activity will lag behind the first two mentioned above.

3. The approximate level of effort in each area:

(a) The Preliminary Planning and Feasibility Study for the North Zifta District redesign, rehabilitation and system improvement project is estimated to require eighteen months of effort by a consulting engineering firm and may cost as much as $2,600,000 depending on the extent and difficulty of topographic surveying and mapping required in the area. Assuming there is a design and construction phase follow-on to the feasibility study, the cost may be of the order of $20,000,000 depending on the scale of construction decided upon and the difficulty of execution while keeping the system in operation.

(b) The planning for the operation and Maintenance Project will require about one year with some five men engaged in the field. They will require "home office back-up" so that the cost would likely range near $1,000,000. The cost of the follow-on execution phase might be in the range of $10,000,000-$15,000,000.

(c) The level of effort for the Planning and Project Design activity is difficult to gage pending further development of the scope of activity. Likely no more than two or three people would be engaged at the outset, growing to perhaps five if the unit proves viable with adequate staffing of Egyptian personnel to be trained on the job. If the activity develops into a meaningful operation, expatriate assistance might be required for up to four years; otherwise, it should be terminated after a year without substantial progress. The cost for the first two years is estimated at about $1,000,000 per year.

4. Coordination with other donor programs in irrigation and drainage: There is such a high level of interdependence in such programs in the Nile Valley and Delta that it is important to draw on mutual experience and to avoid duplicative effort; at worst, donors could be working at cross purposes. Irrigation and drainage is of such crucial importance to the nation that it is recommended that a qualified USAID staff employee, preferably one who can speak and read Arabic, be assigned the primary task of developing contacts in the Ministry and in the Governorates and following on a day-to-day basis developments in irrigation and drainage, both on-going projects and future plans. Such a person would become an informed mainspring for development of AID-assisted projects and for coordination with interested donors. As stated above, such a person should be on USAID staff rather than contract-hire as the depth of commitment to USAID, U.S. and Egyptian interests should be without question.

5. Suitability of the Collaborative Assistance Mode of intervention in the irrigation sector: The term "collaborative assistance mode" as used above refers to an approach whereby with the mutual consent of the partners, a suitable U.S. entity such as the Bureau of Reclamation, TVA, etc. establishes a long-term relationship with the host-government entity, under U.S. funding, to work closely with such entity (the MOI in the present instance) to develop programs and carry out project design and implementation efforts essentially on AID's behalf. In such a "mode" USAID's supervision of its "agent" would be minimal as the latter takes over many of the project development and implementation functions normally handled by AID staff.

After careful consideration it is concluded that the "collaborative assistance mode" of implementation is not indicated at this time. Almost by definition the "collaborative mode" implies the expectation of a long-term effort strongly slanted to the technical assistance side.

The System Redesign, Rehabilitation and Improvement Project here proposed is essentially a capital project and the direct participation of AID in reviewing and approving host-country contracts is inescapable. The Operation and Maintenance project proposed is technical-assistance oriented in the initial phase, moving toward capital assistance in the implementation phase. It should be packaged discretely and handled through a firm contract arrangement. The proposed Planning and Project Design activity is indeed a collaborative undertaking with the MOI; however, it is "project specific", not a broad programming exercise with the MOI in irrigation development. The "collaborative assistance mode" is not believed to be advantageous at this juncture and would relieve the USAID of little of its planning and implementation responsibilities in the proposed activities.

It is suggested that the opportunity for effective utilization of the "collaborative assistance mode" be examined further as the relationship between the USAID and the Ministry of Irrigation builds. (For example, if the structural changes proposed by the System Redesign, Rehabilitation and Improvement Project are to be successfully utilized, some non-structural developments will probably be needed in both the way the MOI operates the Irrigation District and the way in which water is scheduled along a meska. While these changes need not be implemented until the construction is underway, an MOI-AID effort needs to begin during the design stage so that potential problems can be identified and provisions for eliminating them can be developed. The selection of and bringing aboard the "collaborative" entity and its establishment of a productive modus operandi is itself a long-lead time process.)

It might be added that the activities here proposed are collaborative in the generic sense. All undertakings would be carried out through host-government contracts, the implementation of which would require close day-to-day working relationships with MOI staff.

6. As to the type of contracting arrangements and appropriate institutions for the activities proposed above:

(a) It is recommended that highly qualified engineering/technical services firms (CONSULTANTS) be selected for implementation of the System Redesign, Rehabilitation and Improvement and the Operation and Maintenance projects. The services would be provided under a conventional cost reimbursable, fixed fee contract with the Ministry of Irrigation presumably financed by AID.

(b) As to the Planning and Project Design activity to be implemented with the Ministry, either a highly qualified firm with a proven record of success as planning or training consultant to a large operating government agency, or a team put together by the Bureau of Reclamation might be used. Determination of the preferred approach should be based on the results of informal but substantive inquiry and appraisal of the depth of qualified personnel from appropriate firms and the availability, motivation and commitment of qualified personnel that might be supplied under an agreement with the Bureau of Reclamation.

(c) In either case, quality of personnel and strong back-up support from a "home office" of considerable resources and experience in overseas work is a must. Note that only the Bureau of Reclamation is suggested for consideration in the governmental or public agency category. Relevant experience in planning and design of <u>irrigation</u> activities is considered essential rather than more general water resources planning such as that practiced by TVA or the Corps of Engineers. Smaller agencies or authorities are not believed to have the depth of highly qualified people that would be spared for a long-term activity overseas.

7. Finally, the commitment of the Ministry must be ascertained to the utilization of expatriates in significant numbers in the execution of the suggested activities. The remuneration for such expatriates is costly, but must be borne to make an effective start on protection and improvement of a capital investment in the billions.

B. Issues to be Resolved during the Design Process:

1. The commitment of the Ministry of Irrigation to irrigation by gravity system to the extent proved technically and economically feasible.
2. The commitment of the Ministry of Irrigation, in coordination with the Ministry of Agriculture, to establish control of water to the meska and management at the farm turnout; to include not only the physical means but scheduling of releases, including night irrigation, and farmer participation (water users organizations?) in the process. (The commitment would in the first instance be with respect to North Zifta District system redesign and improvement. The results of the North Zifta experience would be considered in developing nation-wide policies regarding water control and management at the meska level.)
3. Productive interfacing arrangements between the Ministry of Irrigation and the Ministry of Agriculture in the critical area of water delivery and on-farm water management and use.
4. The commitment of the Ministry of Irrigation to upgrading its planning for and execution of recurring operation and maintenance requirements of the system, including careful, informed attention to funding and staffing requirements.
5. The relationship of the size area served by a meska to establishment of viable farm water-users organizations.

6. The differentiation between policy objectives, and alternatives for evaluation by the consultant. See Section IV A 2. above.
7. Evaluation of alternatives in both economic and financial terms. See Section IV C 1. above.

C. Issues to be Resolved during Project Execution

The issues presented under A and B above directly and significantly affect the activities proposed. Thus they must all be resolved before the project execution stage. It is in the latter stage that the depth of prior commitment to resolution of issues is demonstrated.

Although they may not be "resolved" during project execution, a number of the issues discussed in IV. above should be addressed on a continuing basis as they impinge on the broader scale improvement of the system of which the North Zifta effort is perceived only as a small but important beginning. These include:

- social issues: retention of land in agricultural production; farm size and its relation to intensification of agriculture
- economic and financial issues: the value of water conserved; demand and supply schedules for water; the relationship of water pricing and water conservation: crop production and the economic consequences of system failure.
- administrative/organizational: MOI organization with relation to decentralization of authority to field operating units; development of leadership in MOI; adequate staffing at the operational level to perform required functions.

D. Issues Not to be Addressed

Although political realities will have a great impact on what will be done and what cannot be done, resolution of

political issues is beyond the scope of activities proposed here. Nonetheless it is important that the CONSULTANTS be aware of the political limits imposed on acceptable alternatives for improving a system.

VI. Scopes of Work for Design Teams (CONSULTANTS)

A. System Redesign, Rehabilitation and Improvement - North Zifta Irrigation District

A detailed scope of work for this activity is presented in Appendix A. This scope covers the work to be done by an engineering and technical services firm (CONSULTANT) in preparing a complete preliminary plan and feasibility study for the redesign, rehabilitation and improvement of the irrigation and drainage system in North Zifta District.

The initial part of the work will be to make (to the extent not already available) a topographic survey of the area and hydraulic measurements at key control points so that the physical aspects of the system are definitely known. An accurate map would be prepared showing all facilities in the area that would serve as the physical base for succeeding tasks.

The CONSULTANT would then undertake an analysis of the system and consider various alternatives for improving the system from main canal to farm turnouts. These analyses would be made taking into account relevant technical, financial, economic and social aspects and would be aimed at raising the efficiency of both the conveyance system and application of water at the farm level. All viable alternatives including night irrigation and modification or change from the presently established on-off rotation system would be considered.

The plan as developed and presented in the feasibility study meeting the tests for technical and economic soundness, would constitute the basis for the expected follow-on phases: detailed design and rehabilitation/construction of improvement works, and detailed design of a program for operation and maintenance of the improved irrigation and drainage system when the works are completed.

The objective would be not only to provide a highly improved irrigation and drainage system--both physical and

operational--for the North Zifta District, but, more importantly, to break the trail--show what is involved, procedures, costs, operational results--toward rehabilitation and improvement of the 6,000,000 feddans under 50 canal commands.

B. Operation and Maintenance Project - Gharbiya Directorate

A detailed scope of work for the activity is presented in Appendix B. This scope covers the work to be done by an engineering and technical services firm (CONSULTANT) in preparing a complete Plan for structure and waterway rehabilitation and maintenance, both deferred and recurring, for the existing irrigation and drainage systems in the entire Gharbiya Directorate (less the North Zifta District in which a total system improvement including some redesign is contemplated). The Plan would be the prelude to moving into the detailed engineering and execution of works phase.

The initial part of the CONSULTANT's work would require data collection on the extent and condition of the irrigation and drainage system. This would include specific identification of (1) deferred maintenance requirements for both structures and waterways and (2) recurring (annual) maintenance requirements.

This would be followed by development of separate plans for execution of deferred maintenance works and for recurring requirements (some overlapping would of course occur). The plans would include non-structural aspects essential to the execution of the program such as organization and staffing, planning, programming and budgeting, and methods for execution of works.

The plan developed by the CONSULTANT in close consultation with the Directorate's staff would be expected to serve as the basis for development of the follow-on phase: detailed engineering drawings and specifications for replacements and repairs, procurement of equipment and materials, and execution of the work in the field.

The objective would be not only to assure that the existing irrigation and drainage systems in the Gharbiya Governorate would continue to provide acceptable service to the farmer, pending a more fundamental rehabilitation and improvement program, but also show the path leading to an acceptable standard of maintenance and operation in the existing systems of the other 18 Directorates.

C. Planning and Project Design

A detailed program for this activity is presented in Appendix C. The objective of this effort will be to strengthen the MOI planning and design capabilities for improvement and maintenance of the irrigation system.

The CONSULTANTS will work with the MOI in spelling out the methods of planning and design presently in use. Alternatives to present methods and procedures will be developed and evaluated in terms of the improved ability to (a) use water resources to achieve Egyptian development objectives and (b) meet the anticipated requirements of the Investment Bank and external financing groups such as AID and IBRD with respect to development and presentation of technically and economically sound projects.

The effort will be a collaborative effort with MOI with the goal to strengthen the planning and project design process within the MOI. Every reasonable attempt needs to be made to use the considerable capabilities which already exist within the MOI in this effort. Consultants will have to gain an understanding of the capabilities of the MOI and the evolving requirements of the Investment Bank. They will have to relate these understandings to the needs of external agencies.

APPENDIX A

Scope of Work
Plan and Feasibility Report
for
Redesign, Rehabilitation and Improvement
North Zifta District Irrigation and Drainage System

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Scope of Work
Plan and Feasibility Report
for
Redesign, Rehabilitation and Improvement
North Zifta District Irrigation and Drainage System

I. General

A. Nature of Services

The CONSULTANT shall prepare a comprehensive Plan and Feasibility Report for the redesign, rehabilitation and improvement of the irrigation system, including on-farm water management, in the North Zifta District of Gharbiya Governorate. This Plan is expected to constitute the basis for a follow-on phase of detailed design and construction of improvement works, and for the operation of the system, including on-farm water management, when the works are completed.

B. Project Area

The North Zifta Irrigation District is located about 80 kilometers (km) north of Cairo and 20 km west of Tanta, the administrative headquarters of Gharbiya Governorate.

The North Zifta District is one of the ten districts in the Gharbiya Governorate, and one of the five districts under the Inspectorate of Mahalla. All operate under the authority of the Ministry of Irrigation (MOI).

The District encompassing approximately 43,000 feddans (one feddan = 1.04 acres) is bounded on the West by the large canal known as Bahr Shebin from which approximately ten laterals serve the North Zifta District. On the North the boundary is the same canal as it bends to the east at the north end of the North Zifta District. The South boundary is the large feeder canal known as El Rayah El Abbasy which heads at the Nile River just upstream of the

Zifta Barrage. The East boundary is the Damietta Branch of the Nile River. See Attachment A for a schematic drawing of the boundaries as well as the canals and laterals serving the North Zifta Irrigation District.

II. The Existing System

The present system is composed of some 160 km of canals and laterals serving 43,000 feddans. None of the waterways are lined. The main canals are Omar Bey, approximately 13.7 km in length, serving 24,750 feddans with a capacity of approximately 1,000,000 cubic meters per day (m^3/day) at the head and Bahr Shershaba, approximately 500,000 m^3/day at the head.

The remainder of the canals are of much smaller size with laterals of various sizes and lengths. See Attachment B for details and specific names. Part of Bahr Shershaba serves the Santa Irrigation District which is not included in the Project. The area so served is about 3,200 feddans of land out of the total of 12,500 served by Bahr Sheshaba.

There are approximately 106 km of open drains in the North Zifta District, serving approximately 56,000 feddans. Some of these lands are outside of the district but the drainage passes through the district. See Attachment C for details and specific names.

The majority of the irrigation facilities have been in service for 35 to 75 years and are in need of physical improvement to adapt the system to present day conditions and requirements.

Present problems are the results of physical and economic changes which have taken place since original construction, causing the system to become inefficient with high maintenance cost and leading eventually to inability to deliver water as needed.

The present system is basically designed to operate below the level of adjacent land; however, some areas are served by a gravity system, or partial gravity system. All operate on a rotation system that may vary with the season: generally 4 or 7 days "on"--4 or 7 days "off". With the existing system there is virtually no ability to measure water discharges and therefore very little control can be exercised over the quantity passing through the system. The

control to the extent it is exercised is by water levels (stage) only. There are excessive water losses into the drainage system as 24 hour per day irrigation of farms is not practiced or required by system management. The canals and sub-systems continue to run 24 hours per day during the "on" period but the farmers generally discontinue irrigation during the nighttime hours. Consequently, large volumes of water end up in the drainage system contributing to additional maintenance costs, pumping costs, erosion of banks and seepage losses which contribute to waterlogging of some areas. The Ministry of Irrigation (MOI) is presently in a program of draining areas with high water tables, and those which are water-logged, by installing underground pipe drains.

The North Zifta district presently has 1,000 feddans in underground tile drainage with a program to install additional drains in 1980. There are plans to install additional pipe drains to 60,000 feddans in the Gharbiya area, some of which will be in the North Zifta district. The exact quantity for North Zifta is unknown at this time.

Additional present day problems with the operation of the system include the inability at times to make deliveries at the end of the laterals and canals as the upstream users utilize the majority of the water, leaving very little for the tail end of the system. This is mainly due to the daylight hours only irrigation practice on the farms.

With nc water control on the delivery system to the farmers and the daytime-only irrigation practice, the downstream users are usually without water at peak irrigation periods. This sometimes results in forcing night irrigation for those at the tail-end as it is the only time water is abundant there. It also has resulted in the District Engineer being required by the governorate to extend the "on" period to complete the irrigation of the farms that were unable to irrigate in the allotted rotation period.

There are no deep well pumps operated in the MOI system for supplementary water or to allow for flexibility of operation. It is reported that a few individual farmers utilize wells.

The majority of farmers are required to pump from the "meska" (the farm or header ditch) by means of sakias (water wheels), tambours (Archimedean screw), dip buckets, electric, diesel or gasoline pumps, as the meska generally lies below (usually less than a meter) the level of the field it is to irrigate. This lack of gravity delivery at field turn-outs causes operational problems as it slows down the ability of the system to deliver water; each farmer requires a long period to irrigate his land, thereby making the common ditch (meska) unavailable to downstream users, or reducing the flow in it for long periods. Additional water is also required in the application as the farmer irrigates small basins successively due to the lack of sufficient head to move the water across his land in a short period of time. The general lack of land-leveling also contributes to this problem.

III. The Project Plan

The Project Plan will include all aspects of improving the physical works of the irrigation and drainage system, including redesign or replacement where so indicated; the operation of the improved system down to the farm turn-outs; on-farm management of water and land shaping; and a maintenance plan for the improved system.

The design and operating criteria for the system will be coordinated with the Ministry of Agriculture and the Egyptian Water Use and Management Project with respect to water demand and use at the farm level.

The objective is to improve the efficiency and effectiveness of the water conveyance system and to enable more efficient use of water at the farm level. The plan will be developed through consideration of all logical alternatives and supported by detailed analysis of technical, economic, financial and social aspects.

The Plan shall demonstrate technical and economic soundness and shall include a computation of costs and benefits made insofar as practicable with the procedure set forth in the Memorandum of the President (U.S.) dated May 15, 1962, with respect to such computations. (NOTE: Required under the U.S. Foreign Assistance Act for land and water related projects to be financed by the United States). A Project Plan and Feasibility Study will be submitted to the Ministry of Irrigation in suitable report style covers (soft) eighteen months after effective date of contract. Copies of a working draft edition will be submitted for review and comments prior to preparation of and printing the final copies.

IV. CONSULTANT's Tasks

Performance of the services required for preparation of the Project Plan and Feasibility Study as described above shall include, but not be limited to, the specific tasks outlined below. The description of the tasks are not intended to limit or restrict the CONSULTANT to the items contained therein--the CONSULTANT shall perform these tasks and such other tasks as may become apparent during the progress of the work.

The CONSULTANT will maintain continuous contact with Inspectorate and District personnel responsible for operation of the present system so that Egyptian staff will be involved in the entire process of plan development.

A. Data Collection and Review

The CONSULTANT shall familiarize himself with all available information pertinent to the work. The MOI shall provide the CONSULTANT or assist him in obtaining copies of all studies, reports, data, etc. from governmental agencies and other sources within Egypt pertinent to the work. Although the MOI will provide such assistance to the CONSULTANT, it shall be the CONSULTANT's responsibility to ascertain what is relevant and to initiate requests and inquiries.

B. Topographic Surveys and Mapping

The CONSULTANT shall conduct topographic surveys as necessary to map the North Zifta Irrigation System. The map will be used as a base for all studies and, reduced to appropriate scale, included in the Report. (It may be possible for the CONSULTANT to utilize the services of the MOI's surveying section in completing this task.) NOTE: The Egyptian General Survey Authority operates under the direction of the Ministry of Irrigation. Mapping of the Nile Delta has been reported done at a scale of 1/25,000; two kilometers each side of the Nile River at 1/10,000 with

contours at one-half meter intervals; and cadastral maps of agricultural lands at a scale of 1/2500. It is recommended that prospective consultants satisfy themselves as to the availability of relevant maps of the North Zifta District prior to submittal of technical proposals.

C. Hydraulic and Hydrological Surveys

The CONSULTANT shall measure flows at key control points in the existing system and construct discharge rating curves as necessary to analyze flows in the system. (It may be possible for the CONSULTANT to utilize the services of the MOI's hydraulic section in completing this task.)

D. Ground Water Survey

A review of all existing data and reports will be conducted to determine ground water depth and relationship to the irrigated land. Recommendations for remedial measures will be made, including any necessary surveys, in conjunction with the need to provide supplemental water and more flexible operation of the system.

E. Water Management and Farm Practice Survey

The CONSULTANT shall make a survey of present on-farm irrigation and related agronomic practices. Socio-economic data shall be gathered on farmer organizations, credit availability, fertilizer use, cropping practice, and crop yields, etc. as necessary to develop a sound operational basis for the system improvement project and provide a valid base for computation of benefits accruing from the system improvement project.

F. Irrigation System Plan

Utilizing the elements of the existing irrigation system to the extent practical, a gravity system for the entire area will be studied as one of the alternatives. This will include main, secondary, branch canals and laterals, header ditches (meskas) as well as structures,

pumping plants necessary to create a head for gravity irrigation, and farm delivery turnouts.

Other logical alternatives shall be studied, to include but not limited to change from a rotation system of operation to a demand system; lined or elevated meskas, pressure system, etc. for delivery to the farm.

The alternatives studied as well as the recommended plan will be presented in the Feasibility Report. Such alternative designs will depict characteristics such as location, size, elevations, capacities, etc. as necessary for understanding of the components of the system.

The recommended plan shall be complete with conceptual drawings, implementation plan and schedule, cost estimate, and operations plan for the improved system, including on-farm water management.

1. Main and Branch Canals

The main canals will be analyzed and evaluated for rehabilitation or improvement to meet system requirements. This might include modifying of gate structures to enable operation for regulation, control and measurability of water flow. Motorization of gate controls should be evaluated as to need and practicality.

2. Laterals

The lateral system will be analyzed and evaluated for rehabilitation and/or redesign. This will include the feasibility of converting all or part of the system to gravity, concrete lining, pumping plants, structures, gates, etc., to provide control of and measurability of water in the improved system.

3. Header Ditches (Meskas)

The CONSULTANT will investigate the present system of delivering water to the farmers and the ability of the MOI to control, monitor and deliver adequate water in necessary quantities.

The CONSULTANT will evaluate the different alternatives that are practical for the purpose of improving operational control to the farm plots or units. This will include consideration of including some or all of the meskas under MOI operational and maintenance responsibility; water users organizations to operate and maintain the meskas; elevating meskas to provide sufficient gravity head to deliver water efficiently to the farm plots. The feasibility of concrete lining of meskas or pressure pipe system should be considered.

The CONSULTANT should evaluate alternatives for MOI systems based on delivery of water to meskas serving not more than (100±) feddans. These "short" meskas might be maintained and operated by the farmers. Such a farmer delivery system would be similar to the present meska system but meskas would be reduced in size and length to the extent feasible.

4. Operation and Maintenance

A comprehensive plan shall be prepared for operation and maintenance of the improved irrigation system with particular attention to problems in operation and maintenance of the existing system including the meskas.

5. Organization

The existing organizational structure will be analyzed as to its capability to operate and maintain the improved irrigation system. Problems discovered in the existing organizational and functional structure will be addressed and appropriate reorganization will be recommended. Consideration should include farmer input into the operation and maintenance program.

6. Budgeting for Operation and Maintenance

The budgeting and funding procedure for operation and maintenance of the North Zifta system will be analyzed. Problems discovered in existing fiscal management and budget

administration by the MOI and the Ministry of Finance that would mitigate against the improved North Zifta system receiving ample funds for recurring operation and maintenance will be addressed. Procedures to accomplish the desired end compatible with the budgeting system of the Government shall be developed.

7. Training

Organization and procedures will be recommended for the training of personnel required to operate and maintain the improved irrigation system, including on-farm management of water.

G. Drainage

The existing drainage system will be studied and evaluated as to its adequacy and its compatibility with the improved irrigation system and farming operations. Both surface and subsurface drainage requirements and facilities will be analyzed and included in the recommended plan. Utilization of drainage water for downstream irrigation will be considered.

1. Operation and Maintenance

A comprehensive plan shall be prepared for operation and maintenance of the improved drainage system with particular attention to problems in operation and maintenance of the existing system.

2. Organization

The existing organizational structure will be analyzed as to its capability to operate and maintain the improved drainage system. Problems discovered in the existing organizational and functional structure will be addressed and appropriate reorganization will be recommended.

3. Budgeting for Operation and Maintenance Report

The budgeting and funding procedure for operation and maintenance of the North Zifta drainage system will be

analyzed. Problems discovered in existing fiscal management and budget administration by the MOI and the Ministry of Finance that would mitigate against the North Zifta drainage system receiving ample funds for recurring operation and maintenance will be addressed. Procedures to accomplish the desired end compatible with the budgeting system of the Government shall be developed.

4. Training

Organization and procedures will be recommended for the training of personnel required to operate and maintain the drainage system.

H. Conjunctive Use of Water

Review the need for, and feasibility of, Well Pumps to be installed in the North Zifta Irrigation District for the purpose of providing supplemental water, system operation flexibility, and drainage of high water table. Consideration must be given to the present tile drainage system installed in the area or to be installed in the area under an on-going drainage project.

I. Construction Procedures and Plans

The CONSULTANT will develop construction plans and procedures necessary to execute the system redesign and improvement program. The program shall take into account the desirability of keeping the present system in operation during the execution of construction and improvement works.

J. Implementation and Construction Schedule

The CONSULTANT will develop an implementation schedule showing essential items of work from detailed engineering to completion of improvement and construction works envisaged in the recommended plan. The Construction Schedule shall be broken down by discrete major work items.

K. System Redesign, Rehabilitation and Improvement Cost Estimate

1. A detailed cost estimate for the redesign, rehabilitation and improvement project will be prepared presenting total capital costs broken down into U.S. dollars and Egyptian pounds components. This estimate will also include the cost of any land shaping recommended to be accomplished other than by individual farmer effort. The total cost estimate shall include engineering design and construction supervision as well as physical and price contingencies.

2. An estimate will be made to show the initial cost of training facilities for improved operation and maintenance, and the staffing of an organizational structure to support the operation and maintenance of recommended improved system.

3. An estimate will be made of annual recurring costs to the MOI for operations, maintenance, training, etc. to support the continued effective operation of the improved system.

L. Land Leveling

The CONSULTANT shall assess the feasibility of re-leveling lands irrigated by the system to the new concept of "dead level". (See reports by Soil Conservation Service, Phoenix, Arizona written by Leonard Erie.) The purpose of this investigation is twofold:

1. To provide fill material for raising waterways as necessary in the proposed gravity system; that is, putting laterals and header ditches into embankment, if so determined.

2. To improve the flow characteristics on the individual farms and improve irrigation efficiency.

M. Plans, Analyses, Estimates and Schedules

The preliminary designs, outline drawings, descriptions, cost estimates and analyses developed for the Report

shall be prepared in such a manner that detailed design for construction of the project can proceed expeditiously (by separate contract). The preliminary designs produced shall include but not be limited to:

1. Plan and profile, showing location, hydraulic gradients, dimensions and elevations of the proposed system, adequate to provide a basis for a reasonably firm estimate of cost.

2. Description of system, capacities, structures, lining, gates, etc., of major facilities.

3. Location of electric power lines necessary to operate the improved system.

4. Conceptual drawings of major structures and facilities.

5. Conceptual layout of any new facility that may be necessary to physically support the new system, i.e. centralized office for operations and maintenance, maintenance yard, etc.

6. Description and cost estimate of material and equipment to support the improved system.

7. Total cost estimate for the redesign, rehabilitation and improvement project.

These preliminary designs and outline drawings, layouts, cost estimates, etc., shall clearly and absolutely convey the intent, general features and specify and describe the basic performances and sizes of the improved irrigation system. Appendices shall contain information on survey data, aerial photography (if used), investigations, tests, conceptual design details and other supporting material and data supplementary to the main text.

N. Environmental Assessment

Preparation of an Environmental Assessment of the proposed project in accordance with the AID environmental procedures published as AID Regulation 16 in the Federal Register on June 30, 1976. The purpose of the Environmental Assessment is to provide the MOI and USAID with a comprehen-

sive understanding of the reasonably foreseeable environmental effects of the modified system and its reasonable alternatives, if any, so that the expected project benefits can be weighed against any adverse short or long-term impacts upon the environment. Briefly, the Environmental Assessment shall include:

1. Discussion of the environmental effects, including effects on air and water quality as well as land use of the proposed system.

2. Description of the various feasible alternatives which might avoid some or all of the adverse environmental effects during rehabilitation and construction.

O. Field Controls

During the initial survey, controls will be established that are suitable as a base for subsequent construction staking. The controls shall be sufficient so that the project portrayed on the final plans can be built as shown. Control elevations and locations will be shown on the plans.

V. Technical Soundness

The redesign, rehabilitation and improvement project will be considered technically sound if all pertinent technical aspects have been considered in the analyses, if the project is designed in accordance with accepted engineering standards and practices, and the estimated cost is as low as any other reasonably available alternative which would produce the intended results.

The technical aspects listed below and others necessary to demonstrate technical soundness shall be considered:

1. Principal engineering features of the project as to type, capacity and characteristics of major facilities or units.

2. Justification of the scope of improvement of the project.

3. Design objectives, criteria, standards, and specifications of new facilities and equipment in relation to the existing system and the quality of service to be provided.

4. Preliminary investigations and surveys sufficient to identify the significant technical problems, establish locations and fix general criteria and standards.

5. Justification of the criteria, standards, location and extent of the facilities proposed as compared with other available alternatives.

6. Conceptual designs and outline plans for all facilities, sufficiently complete to provide a basis for reasonably firm estimates of work quantities and costs.

7. Special construction problems foreseen such as keeping existing canals in operation during construction, availability of materials and equipment, manpower requirements and availability--skilled and unskilled.

8. Project execution in sufficient detail for cost estimating purposes and construction scheduling; identification of constraints and measures to deal with them.

9. Operation and maintenance of the completed project--operating plan, recurring maintenance plan organization, availability of trained operating personnel and required facilities and equipment.

VI. Financial Soundness

The financial aspects listed below and others necessary to demonstrate financial soundness shall be considered.

1. Estimated capital cost of land, engineering and construction in U.S. dollars and local currency. Estimated average cost per feddan of land benefitted.

2. Maintenance and operating cost, labor, supervision, equipment and supplies, training and administration. Estimated annual cost per feddan benefitted.

3. Estimated overall annual costs to include annual depreciation and interest on total project investment on estimated life of project. Total annual cost and average annual cost per feddan benefitted.

4. Estimated returns: Total annual benefit to landowners and average benefit per feddan; total annual benefit from handling reduced amount of unused (waste) water enabled by the improved system; total annual benefit of water conserved.

VII. Economic Soundness

The economic aspects listed below and others necessary to demonstrate economic soundness shall be considered:

1. Present agricultural production - crops and acreages, yields per feddan and total income received, deduction for farms input costs, net agricultural yield.

2. Factors expected to increase production:

a. Changes in farm sizes (if any).

b. Water availability and improved irrigation to present farmers.

c. New crops and modified rotation and cropping patterns.

d. Interactive effect of improved water management on other agricultural inputs (fertilizer, seeds, agronomic practice).

3. Agricultural production after completion of project--crops and yields, value at anticipated prices, deductions for farm input costs, net agricultural yield.

4. Benefits to farmers--gain in total agricultural production, annual net benefits to farmers.

5. Annual benefits from handling reduced amount of unused (waste) water enabled by the improved system.

6. A schedule of estimated benefits of conserving water will be developed which will include:

a. value of conserved water in other uses,

b. impact on net value of agricultural production,

c. decreased drainage costs, and

d. reduced pumping costs if the plans call for gravity flow.

VIII. Report Format

The Final Report in bound form (soft covers) shall be prefaced by a summary which shall provide an overview of the proposed project and contain location maps indicating the project boundaries and working system.

The summary shall present briefly, the CONSULTANT's major findings and conclusions relative to the technical and economic soundness of the project and indicate related costs.

The body of the Report shall set forth in appropriate detail the CONSULTANT's findings, analyses and conclusions. Statistical data, conceptual drawings, maps, preliminary specifications, etc., shall be bound as appendices with the body of the Report.

One set of reproducible drawings of conceptual plans, maps, etc., shall be provided to the MOI upon submittal of the Final Report.

IX. Report Submissions

1. Interim Action Reports

To ensure prompt and timely review of project elements, the CONSULTANT shall submit Interim Action Reports covering completed studies or investigations of the main items of work for advance review and approval. These Reports are intended to assist the CONSULTANT by enabling him to submit recommendations for early approval thereby permitting the subsequent interrelated tasks to proceed expeditiously.

Interim Action Reports, when submitted, shall be straightforward working documents, complete and fully detailed to permit timely review, evaluation and decisions.

A preliminary schedule of interim action reports anticipated by the CONSULTANT shall be furnished the MOI within three months after the effective date of contract.

2. Draft Final Report

It is anticipated that the CONSULTANT will be prepared to issue a Draft of the Final Report within 15 months after the effective date of the contract. The Draft Report shall be submitted in twenty (20) copies to MOI, and ten (ten) copies to USAID/Cairo for review and comment.

3. Final Report

The CONSULTANT shall issue the Final Report within thirty (30) days after receipt of MOI and USAID comments.

Such comments shall be provided to the CONSULTANT within sixty (60) days after receipt of the Draft Report. The Final Report in bound form (soft covers) shall be submitted in fifty (50) copies to the Ministry of Irrigation.

X. Level of Effort and Estimated Cost-Preliminary Plan and Feasibility Report

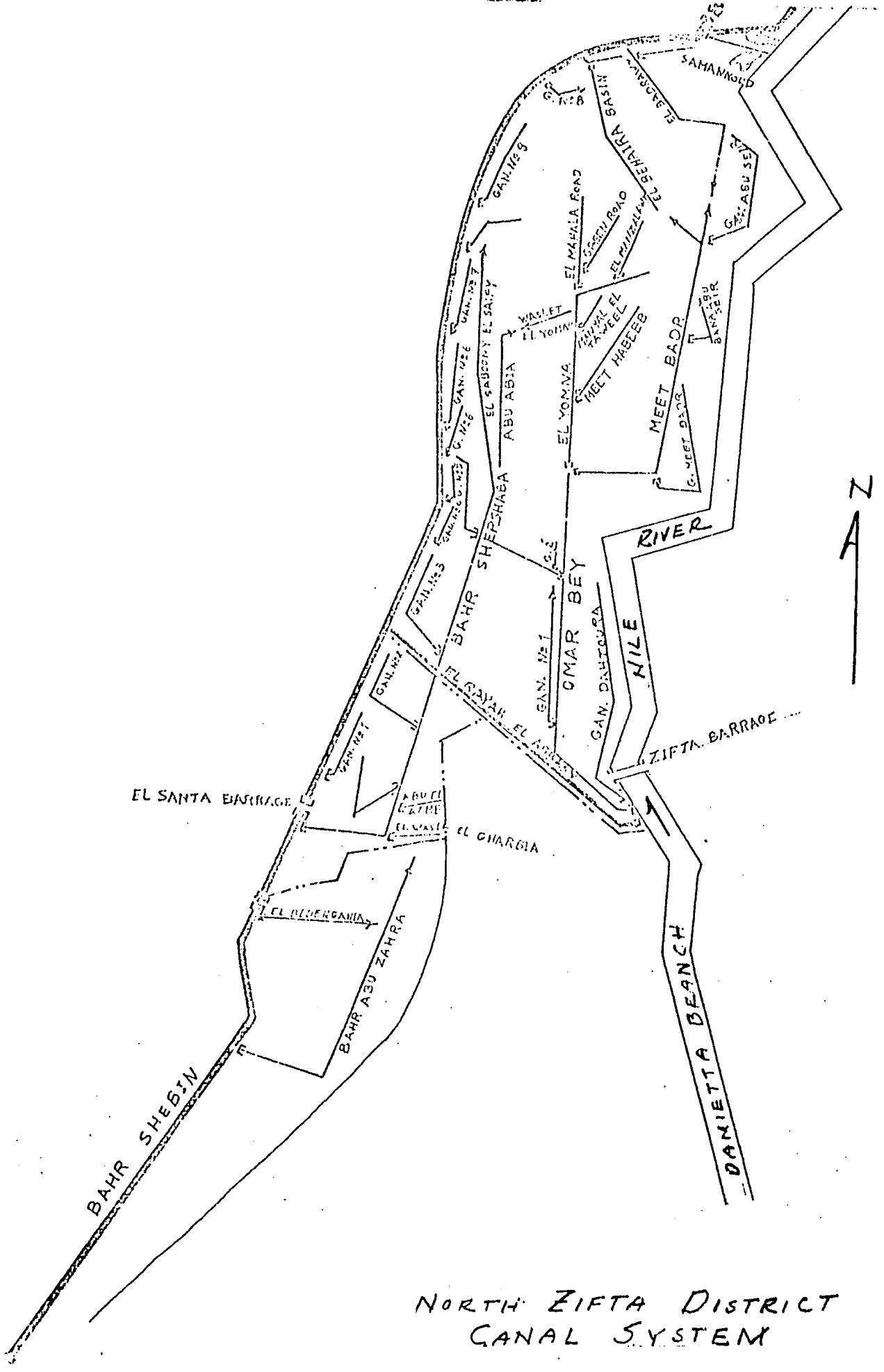
Field Staff:

Project Manager - Civil Engineer	18 months
Engineer - Irrigation System Design	15
Engineer - Surveying and Mapping	6
Engineer - Hydraulics	4
Engineer - Hydrology	4
Engineer - Construction	4
Engineer - Agricultural	6
Engineer - Drainage	4
Operations and Maintenance Specialist	4
Agricultural Economist	6
Agronomist	6
Social Scientist	4
Cost Estimator	4
Total	83 months
Say 7 man years	

Estimated Cost:

Field Staff, 7 years @ 150,000/yr*	$1,050,000
Home Office Effort (2/3)	700,000
Direct Costs--Travel, local staff, local expenses, etc.	250,000
Total	$2,000,000

*Includes salary, fringe benefits, overhead and profit.



NORTH ZIFTA DISTRICT
CANAL SYSTEM

CANALS

APPENDIX A

Canal	Length (km)	Area Served (feddan)	Maximum Discharge (m^3 / day)
Omar Bey	13.730	24,750	1,000,000
Canal No. 1	3.60	2,050	120,000
Al Saboni (El Nili)	5.54	2,000	120,000
Canal No. 2	.97	300	1,500
Al Yamany	10.36	8,250	400,000
Meet Habeeb	3.84	1,300	70,000
Manual Altawel	3.00	1,000	50,000
Waslet El Yamni	1.40	300	15,000
El Mahalla Road	3.74	1,750	85,000
Samanoud Road Canal			
El Manzalawi	2.50	1,760	85,000
Dahtoora	9.50	2,000	120,000
Meet Badr	12.31	8,200	400,000
G. Meet Badr	4.60	1,200	50,000
Bana Abu Seir	1.76	370	20,000
G. Abu Seir	3.78	1,200	60,000
Abu Seir Bana	2.62	1,500	70,000

CANALS

Canal	Length (km)	Area Served (feddan)	Maximum Discharge (m^3 / day)	
Bahr Shershaba	18.35	12,500	500,000	
West Waslan	1.46	400	20,000	Santa District
Abu El Azm	1.10	500	25,000	Santa District
Al Tagabia	2.87	550	30,000	Santa District
G_1	2.50	750	40,000	Santa District
G_2	4.58	950	50,000	Santa District
G_3	4.75	550	30,000	Santa District
Halk El Gamal				North Zifta from Shershaba
Abu Obayah	4.31	1,800	90,000	North Zifta from Shershaba
Al Saboni				North Zifta from Shershaba
El Sify	7.10	3,000	150,000	North Zifta from Shershaba
G_4	2.28	200	10,000	North Zifta from Shershaba
G_5	1.60	150	10,000	North Zifta from Shershaba
G_6	1.75	450	30,000	North Zifta from Shershaba
G_7				North Zifta from Shershaba
G_8	1.330	600	30,000	North Zifta from Shershaba
G. Momtaz	4.90	1,700	85,000	Bahr Shebeen
G. Mokhtar	3.97	1,000	50,000	Bahr Shebeen
Woud El Behira	4.60	2,040	50,000	Bahr Shebeen
Al Badrawy	5.79	2,400	120,000	Bahr Shebeen
Kafr Higazy	1.98	570	300,000	Bahr Shebeen

Attachment C

APPENDIX A

DRAINS

Drain	Length (km)	Area Served (feddan)	Maximum Discharge (m^3 / day)
Zifta	20.60	10,500	
Omar Bey 2.	14.00	21,000	
Kafr Higazy	2.20	600	
Shoubra Babel	2.60	1,200	
El Manzalawi	3.00	630	
Abu Seir Bana	2.00	770	
Bana Abu Seir	2.80	600	
Meet Habib	4.50	200	
Meet Badr	4.70	1,450	
Kafr Fialah	10.00	3,850	
Sheshta	5.55	1,500	
Kafr Al Gezira	3.90	2,400	
Senbat	9.40	3,000	
Drain 3			
Omar Bey Al Bahary	5.50	5,400	
Gouhar	3.65	700	
Kafr Higazy 2	3.30	1,300	
Meet Al Nasara	4.60	2,900	
Al Badrawy	2.20	630	
Samanoud	3.00	300	
	105.50	56,000	

N.B. This system will change when new drains are finished

APPENDIX B

Scope of Work

Operation and Maintenance Project - Gharbiya Directorate

A-27

APPENDIX B

APPENDIX B

Scope of Work
Operation and Maintenance Project - Gharbiya Directorate

I. General

A. Nature of Services Desired

1. Consultant services are needed to examine the water conveyance and drainage systems of the Gharbiya Directorate, excepting the North Zifta District, to develop a plan for accomplishment of deferred maintenance on structures and waterways in the system, and to develop an annual maintenance and operation plan designed to maintain the existing system in an operating condition that will meet water conveyance requirements with reasonable efficiency until such time as a more comprehensive system redesign, rehabilitation and improvement project can be undertaken.

2. These services shall include an examination of the organizational structure within the Ministry of Irrigation (MOI) down to the Directorate and District levels for Operations and Maintenance (O & M), and the planning and budgeting process for recurring O & M requirements. A plan shall be developed delineating recommended improvements in organization and staffing, planning, programming and budgeting, and method of execution of works.

B. Project Area

The project area consists of all lands covered by Gharbiya Directorate, except those in the North Zifta District.[1] This includes about 400,000 feddans of irrigated land (one feddan = 1.04 acres) served by some 1,400 kilometers of canals. The project area is located in the Nile Delta about 80 kilometers north of Cairo. The city of Tanta is the administrative headquarters of the Gharbiya Governorate.

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[1] A separate comprehensive redesign, rehabilitation and improvement project is proposed for the irrigation and drainage system in North Zifta District.

C. Description of Present Operations and Maintenance

1. Canals and Laterals

The operations, maintenance and replacement functions on canals and laterals (all unlined) are performed as a responsibility of the Ministry of Irrigation as these facilities are owned by the Arab Republic of Egypt. Water diversions are controlled at the headworks at major barrages (diversion dams) on the Nile River to satisfy irrigation water requirements of canals and laterals and for navigation. Diversions at the major barrages and to secondary canals and laterals are loosely administered, largely because of the abundance of water and lack of flow measuring devices. Releases to secondary canals and laterals are made on the basis of the elevation of the water level (gage height) rather than by amount of flow as elevations must be maintained to accommodate diversions. (It was reported that discharge rating curves were generally available but that calibration needed updating to represent present waterway and structure conditions.)

Maintenance is the responsibility of the Ministry of Irrigation. Evidence of lack of weed control and bank dressing indicates inadequate funding, and insufficient organization and execution resources for accomplishing the work. Replacement of antiquated, inadequate or deteriorated structures have been deferred for many years.

A recent MOI survey indicates that in Gharbiya Directorate there is a need for replacement of 27 tail escapes, 46 gates for head regulators, 73 bridges and 48 head regulator structures at a total estimated cost of over five million Egyptian pounds (1 L.E. = U.S. $1.30). For the irrigation systems in the whole of Egypt (19 Dictorates) the estimated cost is some 43 million Egyptian pounds.

Attachment A shows a physical breakdown by Districts in Gharbiya of structure requirements.

Attachment B shows a cost breakdown by Districts of structure requirements.

A breakdown of estimated costs for deferred waterway maintenance was not available.

2. Meskas (farm or header ditches)

Operation, maintenance and repair functions on meskas are in general performed by the farmers without benefit of organized efforts. The meskas are not owned or operated by the Government of Egypt as an integral part of the distribution system.

Operations are haphazard without supervision by any effective authority. This results in confusion and controversy with much inherent discrimination. It also results in a great amount of water waste and contributes to waterlogging and drainage problems.

Maintenance of meskas is grossly neglected. Generally, individual farmers maintain the meska only to the extent of accomplishing his diversion. This provides a distinct advantage to the farmers on the upper reaches of the meska co the distinct disadvantage of farmers in the lower reaches. This in practice is discriminatory and provides little or no real maintenance. The conditions of the meska reflect this lack.

Replacement is not a problem for structures since there are virtually none, except through-the-berm open pipe offtakes poorly constructed and uncontrolled to sakias (water wheels). Diversion by gravity, when possible, is accomplished by breaking the bank of the meska.

Periodic re-establishment of the meska cross section and improvement of alignment rarely occurs.

Under the irrigation law, the MOI can intervene and do maintenance work on a meska at a charge to the farmers if there are complaints and disagreement by individuals on performing necessary maintenance and repair themselves. This procedure is seldom invoked.

D. Project Objective

The objective of this project is to develop a plan for design and for implementation of solutions to problems which contribute to the continuing deterioration of the existing system. The solutions are intended to enable maintenance of the existing system in an operable condition until a more comprehensive system redesign, rehabilitation and improvement program can be undertaken.

The Plan developed for the Gharbiya Directorate is expected to constitute the first phase of an action program, i.e. in Gharbiya Directorate there would be a follow-on project of maintenance and repair works as set forth in the Plan, and the Plan developed for Gharbiya Directorate would serve as a model for maintenance and repair programs in the 18 other Directorates throughout the country.

II. Content of the Operation and Maintenance Plan

A. General

The Project Plan will include all aspects of a comprehensive program to meet maintenance and repair needs to keep the existing system operating with reasonable efficiency and capable of providing required water to its service area.

B. Structure Rehabilitation and Replacement

In particular, the Plan shall identify structures to be rehabilitated or replaced and shall present plans and cost estimates for execution of the work. The Plan shall differentiate between treatment of priority items (deferred maintenance) and the normal recurring replacement that must be programmed on a continuing basis.

C. Water and Drain Maintenance

The Plan shall identify reaches of waterways and drains requiring priority measures (deferred maintenance) to restore acceptable operating characteristics. Plans and cost estimates for execution of this work shall be presented separately.

The Plan shall also address normal recurring system maintenance that must be planned and programmed on a continuing basis.

D. System Operation -- Water Measurement and Control

An analysis and appraisal of the existing system of measurement and control of water and record keeping on waterways, including drains, shall be presented. A plan shall be submitted for additional facilities and modified operating procedures, as indicated, to improve the efficiency of water conveyance in the system.

E. Organization and Function Plan

An organizational, staffing and functional plan shall be presented to include planning and programming of

maintenance works, budgeting for such works, and execution of such works on a continuing basis in each Irrigation District of the Gharbiya Directorate.

F. Training Plan

A Training Plan for Directorate and District personnel shall be developed to the extent necessary to implement the organization and function plan described above.

The items described in A through F above are to be included in the Plan but are indicative, not exclusive. The CONSULTANT will establish the order of presentation and be responsible for the sufficiency of the Plan based on the results of his examination and analysis of problems to be overcome in planning, managing and executing a program to maintain the existing system in a reasonably efficient operating condition.

III. Consultant's Tasks

Performance of the services required for preparation of the Operations and Maintenance Plan as described above shall include, but not be limited to, the specific tasks outlined below. The descriptions of the tasks are not intended to limit or restrict the CONSULTANT to the items contained therein--the CONSULTANT shall perform these tasks and such other tasks as may become apparent during the progress of the work.

A. Data Collection and Review

The CONSULTANT shall familiarize himself with all available information pertinent to the work. The MOI shall provide the CONSULTANT or assist him in obtaining copies of all maps, studies, reports, data, etc. from governmental agencies and other sources within Egypt pertinent to the work. Although the MOI will provide such assistance to the CONSULTANT, it shall be the CONSULTANT's responsibility to ascertain what is relevant and to initiate requests and inquiries.

B. Maps

To the extent not already available, maps of each District shall be prepared under the direction of the CONSULTANT showing all waterways and drains in the system with head regulators, gates, tail escapes, etc. identified.

C. Reconnaissance of the System

A reconnaissance of waterways will be made in each Irrigation District to (1) identify and locate structures to be replaced or rehabilitated and returned to reasonable operating condition and (2) to identify waterways and drains in urgent need of cleaning or rehabilitation. Areas of waterlogging and need for emergency drainage will be identified and located.

D. Deferred Structure Rehabilitation and Replacement

After completion of the identification phase described above the CONSULTANT shall draw up, in consultation with Directorate and District operating officials, an execution program for rehabilitation/replacement of structures giving due priority to items more seriously affecting the efficient operation of the system. The program will include engineering plans and cost estimates and procedures for execution of the work.

E. Deferred Waterway Maintenance

After completion of the identification phase described in C above, the CONSULTANT shall draw up in consultation with Directorate and District operating officials an execution program for cleaning and rehabilitation of waterways, including drains. This program shall give due priority to those waterways in reaches more seriously affecting the efficient operation of the system.

F. Development of Plan for Recurring (Annual) Maintenance

Companion to the efforts described above to overcome operational problems connected with deferred maintenance, the CONSULTANT shall develop plans and procedures for forecasting and executing annual maintenance work. This shall be a comprehensive undertaking covering identification of needs, planning, programming, budgeting, execution of work and include organization and staffing reasonably needed for implementation of the Plan. (The starting point will, of course, be thorough appraisal of the Directorate's and Districts' current organization, staffing, and procedures for carrying out the system maintenance and repair function.)

G. Physical Works and Mode of Accomplishment

The Plans described for work in D, E and F above shall give particular attention to the constraints on construction

and repair imposed by the demands of an operating system. Further the mode by which various items of maintenance and repair work are to be physically accomplished--by contractors or by departmental forces--will significantly affect scheduling and staff requirements.

H. Water Measurement and Control

Water measurement in terms of flow and systematic recorded data is essential for efficient operation of the system and providing data for water conservation plans or design modifications to the system.

An important part of the Consultant's task is an analysis of the system of control and measurement and record keeping on waterways, including drains, and recommending additional facilities and operating procedures that will improve the effectiveness of the measurement and control functions.

The flow of information to higher echelons and the decision-making process on water releases will be examined and recommendations made.

I. Implementation Schedule

The CONSULTANT will develop an implementation schedule showing essential items of work from detailed engineering to completion of the rehabilitation/replacement of structures, gates, etc. and rehabilitation of waterways and drains included in the program recommended to overcome the effects of long deferred maintenance.

The CONSULTANT will develop a model implementation schedule for planning, programming, budgeting, and executing annual recurring system maintenance.

J. Cost Estimates

1. A detailed cost estimate shall be prepared for the rehabilitation/repair/replacement of structures, gates, etc. included in the program recommended to overcome the effects of long-deferred maintenance.

2. A detailed cost estimate shall be prepared for rehabilitation of waterways and drains included in the program recommended to overcome the effects of long deferred maintenance.

3. A detailed estimate shall be prepared of annual recurring costs for maintaining the system in a reasonable state of efficiency. Estimated annual cost per feddan will be computed.

4. All costs will be broken down into U.S. dollars and Egyptian pounds components. The estimates shall include engineering design and construction supervision (as applicable) as well as price and physical contingencies.

K. Training

The CONSULTANT will maintain continuous contact with Directorate and District personnel charged with operation and maintenance of the system so that Egyptian staff will be involved in the entire process of plan development.

To the extent needed to support the O & M Plan recommended, a training program for Directorate and District personnel shall be developed.

IV. Technical Soundness

The Operation and Maintenance Project will be considered technically sound if all pertinent technical aspects have been considered in the analyses, if repair/ replacements and maintenance procedures conform with accepted engineering standards and practices, and the estimated cost is as low as any other reasonably available alternative which would produce the intended results.

V. Financial and Economic Soundness

The necessity for operating the irrigation and drainage system is a "given". The financial and economic soundness of the project will be demonstrated by cost-effective solutions to arresting system deterioration and operating and maintaining it in a reasonable state of efficiency.

VI. Report Format

The Final Report shall be prefaced by a summary which shall provide an overview of the proposed project and contain location maps indicating the project boundaries and working system. The summary shall present briefly the CONSULTANT's major findings and conclusions relative to the project and indicate related costs.

The body of the Report shall set forth in appropriate detail the CONSULTANT's findings, analyses and conclusions. Data, conceptual drawings, maps, etc. shall be bound as appendices with the body of the Report.

One set of reproducible drawings of conceptual plans, maps, etc. shall be provided to the MOI upon submittal of the Final Report.

VII. Report Submissions

1. Interim Action Reports

To ensure prompt and timely review of project elements, the CONSULTANT shall submit Interim Action Reports covering completed studies or investigations of the main items of work for advance review and approval by MOI and USAID/Cairo. These Reports are intended to assist the CONSULTANT by enabling him to submit recommendations for early approval, thereby permitting subsequent interrelated tasks to proceed expeditiously.

Interim Action Reports, when submitted, shall be straightforward working documents, complete and fully detailed to permit timely review, evaluation and decisions.

A preliminary schedule of interim action reports anticipated by the CONSULTANT shall be furnished the MOI within three months after effective date of contract.

2. Draft Final Report

It is anticipated that the CONSULTANT will be prepared to issue a Draft of the Final Report within 12 months after the effective date of the contract. The Draft Report shall be submitted in twenty (20) copies to MOI, and ten (10) to USAID/Cairo for review and comment.

3. Final Report

The CONSULTANT shall issue the Final Report within thirty (30) days after receipt of MOI and USAID comments. Such comments shall be provided to the CONSULTANT within sixty (60) days after receipt of the Draft Report. The Final Report in bound form (soft covers) shall be submitted in fifty (50) copies to the Ministry of Irrigation.

VIII. Level of Effort and Estimated Cost-Project Plan

Field Staff:	
Project Manager - Irrigation Engineer	12 months
Engineer - Surveying and Mapping	6
Operation and Maintenance Specialists	
- Structures	12
- Waterways	12
- Organization and Management	4
- Training	4
Cost Estimator	4
Total	54 months
Say 4½ man years	

Estimated Cost:	
Field Staff, 4½ years @ $150,000/yr*	$675,000
Home Office Effort (1/3)	225,000
Direct Costs--Travel, local staff, local expenses, etc.	100,000
Total	$1,000,000

*Includes salary, fringe benefits, overhead and profit.

LIST OF IRRIGATION WORKS FOR THE SHORT-TERM DEVELOPMENT OF IRRIGATION SYSTEM
WITHIN THE 5-YEAR PLAN (1980/1984) in EGYPT
THE GENERAL DIRECTORATE OF: GHARBIYA

IRRIGATION DISTRICT	Tail Escapes			Gates for Head Regulators			Bridges			Head Regulators		
	New	Rep.	Total	New	Rep.	Total	New	Rep.	Total	New	Rep.	Total
Gharbiya Insp.												
Tanta District	-	-	-	-	1	1	6	1	7	2	4	6
Santah District	-	1	1	-	6	6	5	-	5	-	4	4
Kafer El Zaiat Dist.	-	11	11	-	26	26	-	31	31	-	7	7
Kotor District	-	-	-	-	-	-	4	-	4	-	9	9
Basione District	-	10	10	-	6	6	-	9	9	-	2	2
Total	-	22	22	-	39	39	15	41	56	2	26	28
Mahala Kobra Insp.												
Upper Zifta Dist.	-	1	1	1	5	6	5	1	6	3	3	6
East Mahala Dist.	-	2	2	-	-	5	2	-	2	5	-	5
West Mahala Dist.	-	-	-	-	2	2	-	2	2	1	-	1
Bashbish Dist.	-	2	2	-	-	-	4	-	4	-	5	5
Samanode District	-	-	-	-	-	-	1	2	3	1	2	3
Total	-	5	5	1	7	13	12	5	17	10	10	20
GRAND TOTAL	-	27	27	1	46	52	27	46	73	12	36	48

COST OF REHABILITATION/ REPLACEMENT

of

IRRIGATION STRUCTURES IN: GHARBIYA

IRRIGATION DISTRICT	Tail Escapes	Gates For Head Regulator	Bridges	Head Regulator
Gharbiya Insp.				
Tanta District	-	5,000	190,000	200,000
Santah District	5,000	55,000	75,000	1,015,000
Kafer El Zaiat	60,000	91,000	565,000	185,000
Kotor District	-	-	75,000	290,000
Basione District	-	21,000	385,000	160,000
Total	115,000	172,000	1,290,000	1,850,000
Mahala Kobra Insp.				
Upper Zifta Dist.	5,000	12,000	65,000	310,000
East Mahala Dist.	10,000	10,000	40,000	200,000
West Mahala Dist.	-	4,000	135,000	75,000
Bashbish Dist.	13,000	-	135,000	150,000
Samanode District	-	-	175,000	925,000
Total	28,000	26,000	550,000	1,660,000
GRAND TOTAL	143,000	198,000	1,840,000	3,510,000

*Values are in
Egyptian Pounds

APPENDIX C

Ministry of Irrigation
Planning and Project Design Program

C-1

Ministry of Irrigation
Planning and Project Design Program

I. Objective

The objective of the program is to strengthen the Ministry of Irrigation's (MOI's) planning and project design capabilities so that it may be better prepared to specify the requirements, organization, alternatives and recommended activities for water resource planning and project design in Egypt. The unit charged with such responsibilities should function in the main stream of MOI activities and have close ties with MOI officials charged with operational responsibilities down to and including at least the Directorate level.

II. Background

A. The planning and project design activities within the MOI are presently coordinated by a Committee of First Undersecretaries in the process of establishing budget priorities. Budgets for MOI activities are coordinated by the Undersecretary for Planning. With these exceptions, the planning and project design activities are presently decentralized and are largely the responsibilities of the various departments and sectors (Drainage, Barrages, Irrigation, etc.)

Each sector has been authorized to establish a planning group. Each planning group develops studies for projects proposed within its sector. Some of those in-house studies such as "Nile Water Conveyance to Suez-Sinai; August, 1979" have considered alternative approaches and appear to be well done. While improvements in such studies undoubtedly could be made, this study demonstrates that the MOI currently does have in-house capability to do acceptable feasibility work. We do not know either the amount of work of this quality being done or number of staff capable of doing such work. Such information needs to be gathered.

B. The MOI has long term plans which serve as the basis for generating annual budgets. A document has been prepared in English by the Minister's office, "Egypt Irrigation Systems Management Improvement and Implementation Project" (undated). This report lists eleven projects and a summary study for each project. One project is the "Nile Water Conveyance to Suez-Sinai" and a four page summary of the larger study, mentioned earlier, is included in the report. The summary states, "...the total cost of the project will be recovered from the project revenue after 20 years." It is not as apparent that a great deal of economic analysis has been done on the other projects presented in this document. The drainage project which is included does propose an economic evaluation of drainage projects (as was

reportedly done for a previous drainage project). However, it is interesting to note that the proposed economic evaluation will compare alternate drainage methods but will not consider alternatives from other sectors such as changes in the water delivery system, to reduce the quantity of waste water to be handled, as alternatives to drainage projects. However, in the general introduction to the document the relationship between water delivery and drainage is noted.

C. While it is recognized that the MOI planning and project design system is not fully understood, [the MOI has obvious capabilities in this area] it appears to be highly sector-oriented. Therefore, there may be a tendency for sectors to neglect alternative solutions which involve responsibility of other sectors.

D. Once projects are developed, they are channelled through the Undersecretary for Planning for budget review while the technical review is largely the responsibility of other sectors. It does not appear that projects are always examined in detail from the standpoint of economic feasibility. If the newly established Investment Bank operates as planned, the MOI would have to place greater emphasis on economic evaluation of projects at both the sector and inter-sector level.

E. During 1980, (Decree 113 for 1980) the Master Water Plan Project (MWP), which was earlier established for the planning, development and use of water resources was attached to the Water Research Center. The Director of the Project was also appointed as an Undersecretary and plans were to be made for the continuation of the MWP after termination of external financing. Presumably, under this reorganization of the MWP it will also be assigned broad planning responsibilities.

F. It is obvious that the MOI has an existing framework and a capability for planning and project design. However it appears that economic evaluations, particularly at the inter-sector level, are of limited scope.

III. Program Implementation

A. It is proposed to secure a three-man team (CONSULTANT) which will work closely with the MOI in establishing a strong planning and project design unit at the Ministerial level. Such a team would report to the Minister or his designee and consist initially of three persons: (1) a senior engineer with proven performance in the planning of water resource development programs in general and irrigation development projects in particular, (2) an agricultural economist/planner with a proven record of developing and evaluating programs with interdisciplinary aspects and with agriculture/irrigation orientation, and (3) a senior irrigation design engineer with a proven record of design of irrigation systems from river headworks to farm turnout. The assignment would be for not less than two years in the first instance with the expectation of extension as the program "builds".

B. Initial activity would be directed toward developing alternative formats for planning within the MOI, evaluation of those alternatives and finally presenting recommendations. Since the purpose would be to help the MOI establish and institutionalize a process rather than merely developing a planning program, it is crucial that the project be highly collaborative in nature and that in the beginning the CONSULTANT emphasize development of the planning process rather than the development of specific projects.

The MOI planning unit should have at least the following three characteristics:

1. The unit should be in the mainstream of the decision-making process and not isolated.

2. Planning will require that appropriate technical skills be available and this requires recruitment and retention of people with some skills, such as economics or agriculturists, not usually sought by the MOI.

3. Some of the staffing slots in such a unit need be available for the temporary assignment of people who are likely to have command and non-planning leadership roles within the MOI in the future.

C. Following the development and organization of the planning process, activity would be directed toward staffing the planning unit with the requisite skills and developing operating procedures. The desired end product is a functioning unit with the capability to:

1. Develop preliminary plans that reflect intersectoral considerations and multi-disciplinary evaluation--economic, technical, social, etc.

2. Prepare specific project feasibility reports that meet the tests of technical, financial and economic soundness necessary for an investment decision either by the Egyptian Government alone or in concert with international financing agencies.

IV. Consultant Tasks

A. The first task will be the preparation of a detailed description of the present process for planning and project design within the MOI. This description should include the number and disciplines of the people involved, the tasks they perform, the equipment and other resources available for planning and design.

On the basis of limited information, it appears that the process is complex, multi-faceted and therefore difficult to understand. Accordingly there may be a tendency to under-estimate present in-house planning and project design capabilities within the MOI. The process for planning appears to be in flux and much planning is undoubtedly performed as part of other on-going work.

B. Once the present planning and project design system is understood, alternative methods of strengthening the existing planning and project design efforts should be developed. Once the alternatives are developed, they need to be evaluated and recommendations made as indicated for strengthening the planning and design process.

It appears that one aspect which could beneficially be strengthened is evaluation of the inter-sectoral planning and project design efforts. In project design, alternatives involving more than one sector need to be considered more often than is apparently the case now. In project evaluation, more consideration should be given than is apparently the case at present to the technical and economic feasibility of accomplishing the objectives through inter-sectoral activity. If after studying the present system in detail these conclusions hold, at least four ways of strengthening and improving the effectiveness of MOI's planning and project design efforts should be considered.

1. Provide adequate staff to work with the existing Committee of First Undersecretaries within MOI which is charged with coordinating planning efforts.

2. Strengthen the capabilities of the office of the Undersecretary for Planning for evaluation of proposed irrigation development activities.

3. Assign the Master Water Plan the responsibility and staff for coordinating project configuration and evaluation.

4. Develop a new organization for centralized planning and design which would have responsibilities at the Ministerial level rather than at the sector level.

C. In addition to inter-sector planning and design, it is important to have strong sector level planning and design capabilities. It was not possible to evaluate those efforts for each sector, but it is apparent that considerable strength does exist in at least some sectors. The CONSULTANT should carefully evaluate planning and design capability existing in each of the sectors with a view toward strengthening where so indicated within the sectors. Of crucial importance is development of working procedures for interfacing the work of sector designers with the Ministerial level planning and design organization.

D. With the planning process and related organization established the CONSULTANT would have the day-to-day task of working with the Egyptian staff in the development and evaluation of conceptual plans (the broad area) and in the preparation of project designs and related feasibility studies (project specific area).

It is to be expected that a large element of on-the-job training would be involved in these activities and the assistance of additional expatriate personnel might be required in establishing a viable planning unit that would become self-sustaining.

V. Level of Effort and Estimated Cost-Project Planning and Design Team

First Year: Two men	
Irrigation Engineer - Program Planning	$150,000*
Agricultural Economist	150,000*
Home Office Back-up	150,000
Travel and Local Costs	50,000
Equipment (vehicles, design and office equipment, computers, etc.)	200,000
Training	100,000
Total	$ 800,000

*Includes salary, fringe benefits, overhead and profit.

Second Year: Three men	
Irrigation Engineer - Program Planning	$150,000
Agricultural Economist	150,000
Irrigation Engineer - Project Design/ Feasibility Studies	150,000
Home Office Back-up	150,000
Travel and Local Costs	75,000
Equipment (vehicles, design and office equipment, computers, etc.)	200,000
Training	100,000
Total	$ 975,000

Note: If services are furnished by a non-profit agency, e.g. Bureau of Reclamation, the above costs may be reduced by about ten percent.

APPENDIX D

The Egyptian Irrigation Sector
Observations and Conclusions

by
Floyd E. Dominy, Commissioner (Retired)
U.S. Bureau of Reclamation

The operation of any irrigation project should be directed toward the timely delivery of the proper amount of water to the farm turn-out. In the Nile Valley this involves the release and management of water from Aswan Dam to the last turn-out over thousands of miles of canals, laterals, sub-laterals and meskas.

There exists a system of constructed works to perform that function. Those constructed works have not been and are not now operated and maintained to a minimal acceptable standard. It is of vital and urgent importance that the Minister of Irrigation have the organization, authority and financial resources to upgrade substantially, both in technical competence and in numbers, the organization responsible to him for proper operation and maintenance of this Nile Valley Irrigation System of such great continuing importance to the people of Egypt.

At the present time the Irrigation Department considers its task completed when water is supplied in the sub-lateral serving the meskas. To assure the timely delivery of the proper amount of water to each field served by a meska the Irrigation Department should extend its operation, maintenance and control of water to include the meska.

Each District Engineer should have available to him the necessary staff, the necessary equipment, the necessary funds and authority to properly maintain that portion of the project assigned to him. He should be held responsible for the timely delivery of water in the proper amount to every field turn-out in every meska within his assigned area.

A well-directed operation and maintenance program properly performed on a continuing basis from the barrage, through the canal system to the last field turn-out on a meska will result in much improved irrigation efficiency and will result in greatly improved crop yields.

To make sound judgments as to when, where and to what extent new lands should be incorporated into the Egyptian Irrigation System requires consideration of many factors.

The Minister of Irrigation should have a Project Planning Organization responsible to him with the technical competence to consider and evaluate any and all areas proposed for agricultural production under irrigation using waters of the Nile, return flow water or water from wells.

This Planning Organization must have competence in Civil, Mechanical, Electrical, and Agricultural Engineering, Soils, Geology, Economics, preliminary cost estimating for construction, for operation and maintenance, and Agronomists to evaluate type of crops best suited to soil and water to be supplied.

The Planning Organization must have the competence to evaluate the several projects that may be proposed and establish a valid cost/benefit ratio for each as an aid to final project selection for construction.

It would be desirable to make a major commitment of resources to a pilot area of sufficient size to demonstrate system rehabilitation and improvement and first class operation, maintenance, control and delivery of water to the farm.

Any program of rehabilitation and improvement wherever instituted on the project should--wherever physically possible--deliver the water from the meska to the land by gravity.

It is beyond question that substantially more water is introduced into the canal system than is required for the irrigation plus evapo-transpiration on six million feddans.

Excess water must be introduced in some sections because lack of adequate maintenance has resulted in aggregation of the lower reaches and excess water must be introduced to make irrigation possible.

Excess water causes costly drainage construction and pumping costs that otherwise would not be needed.

To limit excess use on the farm a system should be provided to:

a) Measure water delivered.

b) Limit each application to amount needed to saturate root zone of crop being watered.

c) Some charge for delivery of water to farmer as added incentive to conserve.

d) Irrigate on 24-hour schedule to reduce seepage and waste water from delivery system.

Much more resources--both public and private--need be devoted to operation and maintenance and in some areas modernizing the existing project.

The arable land area is extremely limited in relation to the population. More efficient management of water in the delivery system and its application at the farm cannot be over-estimated as a first step in improved agricultural production. Without that first step being accomplished improved agronomic practices cannot succeed.

The Ministry of Irrigation, in order to properly operate and maintain the existing irrigation system and bring new lands into production as economically justified, must have a strong position in the policy-making councils of government.

In Egypt the major long-run food security issue is how to provide a secure food supply--over time--for its increasing population. Management and expansion of irrigation is the single most important element.

There is strong justification to modernize and improve the operation and maintenance of the vast Nile Irrigation System--it is in fact the life blood of the Egyptian economy.

In fact--though a fixed time cannot be projected--failure to replace worn out structures and to do an upgraded job on operation and maintenance--will inevitably result in the inability to deliver water to major segments of the existing project.

APPENDIX E

Note on
River Flow Metering and Control System

The Scope Team's recommended action program for AID assistance does not include expanding the Ministry of Irrigation's telemetry program for water measurement and control at this time.

Nonetheless the Scope Team recognizes the utility of a centralized control center where instant communication with critical points on the River and the main canal conveyance system and knowledge of the water discharge at those points can be maintained. This would require discharge measurement capability at structures, trained staff and telemetry equipment.

The value of a centralized control center is twofold (1) control of the system resulting from real time knowledge of the flow at critical points will enable immediate response to changes in operation at any point in the system, thereby more accurately matching upstream releases, including hydropower, to downstream demands and (2) establishment of real time flow discharge records will provide for more accurate determination of travel time, channel losses, channel storage, and effect of operational changes for any set of parameters such as river stage, power releases, temperature, cropping patterns, and downstream demands.

The usefulness of a center for coordinated control and automatic recording of flows in the river at the High Aswan Dam and each of the barrages on the Nile, at main canal off-takes in each reach of the River, and at the mouths of the two branches discharging to the Mediterranean Sea is hardly questionable. Because hydropower generation is subordinate to irrigation demands, the center will provide the data base and real time information of river discharges needed to optimize hydropower production and also meet irrigation demands.

Such a mainstream system would be valuable, indeed essential at a point in time when more precise control of bulk flows is perceived as a real need by the Ministry of Irrigation. However, the Team believes that the greatest opportunity now for significant improvement of the irrigation system lies in the delivery sub-systems rather than the mainstream.

As improvement of the delivery sub-systems proceeds, the need for flow measurement, telemetry and more precise control will increase. An analysis will be needed to determine both the value and the appropriate timing for installation of a control system. Premature implementation of such a control system will mean the needless commitment of scarce MOI staff and budget. Therefore, it is recommended that at an appropriate time in the future, a team of two or three experts in telemetered hydraulic measurement and control systems make a detailed analysis and feasibility study of a River Flow Metering and Control System on the Nile including the parameters of the system needed and the time schedule for installation and phasing in segments of the system.

APPENDIX F

Note on
Training Programs for Irrigation Development

The Scope Team's recommended action program does not include AID assistance for the Ministry of Irrigation (MOI) to establish a Training Center at this time. However, if the system redesign and improvement project is successfully implemented, significant benefit would accrue from a well designed training program. Therefore, the Scope Team recommends that when there is evidence that the system redesign and improvement program will be successfully implemented, planning should begin on developing a responsive training program. Such a program needs to be based on both a realistic image of the kind of irrigation system which can exist for Egypt in the future and the resultant specific training needs which must be met if such a system is to be operated so as to be of the greatest benefit to the Egyptian people.

The Scope Team recognizes that training has an important role to play in the optimum development of the water resources in Egypt. Based on the Scope Team's experience with other natural resource development programs and the Team's perception of the stage of water resource development in Egypt, we believe the emphasis now should be directed to training of people for the specific projects and programs that are recommended in this report. Once the proposed projects are implemented, it is important to develop training programs which will improve the skills of the newer staff and continuing education programs for more senior staff.

The engineers in the MOI are apparently well grounded in engineering principles and are therefore well prepared to gain from specialized training designed to meet the needs of the programs for redesign, rehabilitation and improvement of

the irrigation system. This is especially true if the training is related to pilot programs which are designed to emphasize specifically the kinds of changes which will take place in the entire system in the future.

In the short time the team had for this mission we were not able to examine in depth the available man power, the level of their skills and the need for a national level Training Center. Many in the MOI believe such a Training Center is needed to train technicians, (gate keepers, stream gagers, etc.); provide direction to on-the-job training; provide short courses, video tape courses and other continuing education programs for people to improve their skills while working; provide management training; test and select persons to take further academic training to improve their skills and to provide focus and direction to a training program for the Ministry to develop the manpower base needed to improve and operate the delivery system. They contend that the Ministry is presently understaffed by 40 to 50 percent and that new staff will need specialized training that in the past was provided by on-the-job training.

Some of the MOI personnel have considerable skill in planning, project design and operations. As the MOI is understaffed we believe it would be counter-productive at this time to relieve such people of operational responsibility in order for them to work in a formal training situation until the training needs can be made very specific. The need for and content of such training programs should be examined during the design phase of the pilot projects in connection with organization and staffing. While we believe this is not the time to commit large amounts of resources to a formally established Training Center, considerable use could be made of training programs located on-site as the pilot projects develop. As both the training needs become more specific and training can be related to pilot project facilities and organizations, a Training Center could

have an important role to play in the overall training program for the Ministry.

When there is evidence that the recommended system redesign and improvement program will be implemented, a special team could examine the training needs and the need for a Training Center. If this team determined there was a need for a Training Center, they should also develop the detailed training program. A special team to examine training needs should consist of people from action agencies, consulting firms and industry training programs in addition to university people. These people should have knowledge and experience in irrigation, engineering and economics as well as continuing education.