

# CAIRO SEWERAGE II WEST BANK

(USAID No. 263-0173)  
Cairo Wastewater Program

## 1991 INTERIM EVALUATION SUMMARY REPORT

Submitted to

US AGENCY FOR INTERNATIONAL DEVELOPMENT

OFFICE OF URBAN ADMINISTRATION  
AND DEVELOPMENT

ASCG

INCORPORATED

ENGINEERS • ARCHITECTS • SCIENTISTS • SURVEYORS



2200-0890-005

March 19, 1992

Office of Urban Administration and Development  
US Agency for International Development  
Cairo Center Building  
106 Kasr El Eini Street  
Garden City, Cairo

Attention: Mr. John Airhart

Subject: Submission of Final Report for the Interim Evaluation for  
Cairo Sewerage II (263-0173);  
Delivery Order No. 12, Contract ANE-0249-I-00-9022-00

Dear Mr. Airhart:

I am pleased to submit herewith, six (6) copies of our final report covering the above assignment. This work was authorized on September 26, 1991 by AID/Washington and completed per the Statement of Work issued by your office. Comments received from the review of the draft final report issued on 30 January 1992 have been incorporated in the final document.

The findings, conclusions and recommendations reflect information which the evaluation team was able to obtain in a limited period of time from available project reports, construction documentation and records, file information, site visits and observations, and interviews with people involved with various aspects of the project. Opinions and recommendations reflected in this document are those of the consultant.

ASGG, INC.

A handwritten signature in cursive script, appearing to read 'Fred C. Cooper'.

Fred C. Cooper, PE, PFD  
Team Leader

cc: H. Chen, Harza

# CAIRO SEWERAGE II WEST BANK

(USAID No. 263-0173)  
Cairo Wastewater Program

## 1991 INTERIM EVALUATION SUMMARY REPORT

Submitted to

US AGENCY FOR INTERNATIONAL DEVELOPMENT

OFFICE OF URBAN ADMINISTRATION  
AND DEVELOPMENT

January 1992

Prepared by

HARZA/ASCG  
in association with  
Dr. Ahmed Abdel-Warith  
Consulting Engineers

**TABLE OF CONTENTS**

TABLE OF CONTENTS . . . . .	i
LIST OF FIGURES AND TABLES . . . . .	v
GLOSSARY . . . . .	vi
EXECUTIVE SUMMARY . . . . .	vii
ACKNOWLEDGEMENTS . . . . .	xii
<b>CHAPTER 1.0 PROJECT BACKGROUND AND STATUS . . . . .</b>	<b>1</b>
1.1 PURPOSE OF AND PARTICIPANTS IN CAIRO SEWERAGE II . . . . .	1
1.1.1 Responsible GOE Agencies . . . . .	1
1.1.2 Scope of Cairo Sewerage II . . . . .	1
1.2 DESCRIPTION OF THE PROJECT AND SERVICE AREA . . . . .	2
1.3 INTERIM EVALUATION . . . . .	4
1.3.1 Identification of Project Objectives, Benchmarks, and Conditions Subject to Evaluation . . . . .	5
1.3.2 Project Objectives and Benchmarks . . . . .	5
1.3.3 Other Project Conditions and Performance Indicators . . . . .	6
1.4 HISTORY OF PROGRAM . . . . .	9
1.4.1 1978 Greater Cairo Sewer Master Plan . . . . .	9
1.4.2 Existing Sewer Rehabilitation Program . . . . .	9
1.5 CAIRO SEWERAGE II AUTHORIZATION . . . . .	9
1.5.1 1984 Project Paper . . . . .	10
1.5.2 Project Paper Amendments . . . . .	10
1.6 CURRENT PROJECT STATUS . . . . .	11
1.6.1 Project Assistance Completion Date (PACD) . . . . .	11
1.6.2 Project Completion Schedule . . . . .	11
1.6.3 Interim Operation and Maintenance of Completed Facilities . . . . .	11
1.6.4 East Bank Diversion . . . . .	11
1.6.5 Interim Sewage Bypassing . . . . .	11
1.6.6 Effluent Disposal to Drains . . . . .	12
1.6.7 System Load Review . . . . .	12
1.6.8 Institutional Support Services . . . . .	12
<b>CHAPTER 2.0 PROJECT IMPLEMENTATION . . . . .</b>	<b>13</b>
2.1 DESCRIPTION OF CONTRACTS AND ORIGINAL SCHEDULE . . . . .	13
2.2 WEST BANK SEWERED AREA . . . . .	13
2.3 STATUS OF CONTRACTS . . . . .	13
2.3.1 Sewage Collectors, Culverts and Pump Stations . . . . .	13
2.3.2 Laterals and House Connections - The FAR Program . . . . .	15
2.3.3 Other Collection System Adjustments . . . . .	16
2.3.4 Sewage Treatment Plants . . . . .	16
2.3.5 Effluent Disposal . . . . .	17

2.3.6	Sludge Disposal . . . . .	18
2.4	PROGRESS AND STATUS OF CONSTRUCTION . . . . .	18
	. . . . .	18
2.4.1	Completed Contracts . . . . .	19
2.4.2	Contracts in Progress . . . . .	19
2.4.3	Contracts Yet to be Started . . . . .	24
2.4.4	Work Unlikely to be Completed by the PACD . . . . .	25
2.5	CONSTRUCTION PROCUREMENT PRACTICES . . . . .	26
2.5.1	FIDIC Documents . . . . .	26
2.5.2	AID Commodity Procurement Requirements . . . . .	29
2.5.3	FAR Contracts . . . . .	29
2.5.4	CWO Contracting Procedures . . . . .	30
2.5.5	Bidding and Award . . . . .	30
2.6	CONSTRUCTION MANAGEMENT SERVICES . . . . .	30
2.6.1	Compliance with Standards and Specifications . . . . .	30
2.6.2	Quality Control and Assurance . . . . .	31
2.6.3	Cost Control & Variation Orders . . . . .	31
2.7	CONSTRUCTION SAFETY . . . . .	34
2.8	CONSTRUCTION ISSUES AFFECTING THE PACD . . . . .	34
2.8.1	Availability of Funding . . . . .	34
2.8.2	Program Changes . . . . .	35
2.8.3	Construction Conditions . . . . .	35
2.8.4	Reviews, Certifications, and Acceptance by CWO . . . . .	36
2.8.5	GOE Regulations . . . . .	37
2.8.6	Availability of Construction Materials . . . . .	37
2.9	FINDINGS AND CONCLUSIONS . . . . .	38
2.9.1	Adequacy of Facilities . . . . .	38
2.9.2	Commissioning of Facilities . . . . .	39
2.9.3	Project Assistance Completion Date . . . . .	40
2.9.4	Construction Program Management and Administration . . . . .	40
2.9.5	Construction Contractors and Suppliers . . . . .	41
2.9.6	Status of Present Construction . . . . .	42
2.9.7	Future Construction . . . . .	42
<b>CHAPTER 3.0</b>	<b>PROJECT OPERATION AND MAINTENANCE . . . . .</b>	<b>43</b>
3.1	PAST O&M PRACTICES . . . . .	43
3.2	CURRENT OPERATION OF FACILITIES . . . . .	43
3.2.1	Collection System . . . . .	43
3.2.2	Sewage Pumping Stations . . . . .	43
3.2.3	Zenein Wastewater Treatment Plant . . . . .	44
3.2.4	Screw Pump Stations . . . . .	47
3.2.5	Abu Rawash WWTP . . . . .	47
3.2.6	Sludge Handling and Disposal . . . . .	47

3.3	SAFETY PROGRAM . . . . .	48
3.4	TRAINING . . . . .	48
3.4.1	Siphon Pump Station Training Facility . . . . .	48
3.4.2	Zenein Training Facility . . . . .	48
3.4.3	Abu Rawash WWTP . . . . .	49
3.4.4	Screw Pump Stations Facility at Pyramids Pump Station . . . . .	49
3.4.5	Collection System . . . . .	49
3.5	AMBRIC POST CONSTRUCTION SERVICES (PCS) . . . . .	49
3.6	GOSD INSTITUTIONAL SUPPORT CONTRACT (ISC) . . . . .	50
3.7	WEST BANK FACILITY COMMISSIONING . . . . .	50
3.8	FINDINGS AND CONCLUSIONS . . . . .	51
3.8.1	Operations . . . . .	51
3.8.2	Maintenance . . . . .	51
3.8.3	Training . . . . .	52
3.8.4	Commissioning . . . . .	52
<b>CHAPTER 4.0</b>	<b>SOCIAL AND ENVIRONMENTAL IMPACTS . . . . .</b>	<b>53</b>
4.1	ADEQUACY OF RESOURCES . . . . .	53
4.1.1	Funding . . . . .	53
4.1.2	Engineering and Project Management . . . . .	53
4.1.3	Local Human Resources . . . . .	53
4.1.4	Local Construction Materials . . . . .	53
4.2	SOCIAL AND ENVIRONMENTAL FACTORS . . . . .	54
4.2.1	Population Growth . . . . .	54
4.2.2	Urbanization . . . . .	56
4.2.3	Street Flooding . . . . .	57
4.2.4	Transportation Access . . . . .	58
4.2.5	Sewage Bypassing . . . . .	58
4.2.6	Community Attitudes Towards the Project . . . . .	58
4.2.7	Public Health Objectives . . . . .	59
4.2.8	Water Quality . . . . .	59
4.2.9	Industrial Waste Discharges . . . . .	60
4.3	INSTITUTIONAL RELATIONSHIPS . . . . .	61
4.3.1	GOE Laws and Regulations Affecting the Project . . . . .	61
4.3.2	Other Public Services . . . . .	62
4.4	LOCAL ECONOMIC DEVELOPMENT . . . . .	62
4.5	REVENUE GENERATION AND SEWER TARIFFS . . . . .	63
4.5.1	Adequacy of Sewer Tariffs . . . . .	63
4.5.2	Tariff and Revenue Issues . . . . .	66
4.6	FINDINGS AND CONCLUSIONS . . . . .	68
4.6.1	Adequacy of Resources . . . . .	68
4.6.2	Social and Environmental . . . . .	68
4.6.3	Adequacy of Wastewater Revenues . . . . .	70

<b>CHAPTER 5.0</b>	<b>ORGANIZATION AND MANAGEMENT</b>	<b>71</b>
5.1	PROJECT OBJECTIVES IN ORGANIZATION AND MANAGEMENT	71
5.2	PROBLEMS AND CONSTRAINTS IN ACHIEVING PROJECT OBJECTIVES	73
5.3	ORGANIZATION OF KEY INSTITUTIONS INVOLVED IN THE PROJECT	74
5.3.1	CWO	74
5.3.2	AMBRIC	76
5.3.3	CDM	76
5.3.4	GOSD	77
5.3.5	USAID	78
5.4	PERFORMANCE OF KEY INSTITUTIONS INVOLVED IN THE PROJECT	78
5.4.1	CWO	78
5.4.2	AMBRIC	79
5.4.3	CDM	80
5.4.4	GOSD	80
5.4.5	USAID	80
5.5	PROSPECTS FOR ACHIEVING PROJECT OBJECTIVES IN ORGANIZATION AND MANAGEMENT BY THE PACD	81
5.5.1	Autonomous Organization	81
5.5.2	Modern Utility Practices	83
5.6	PROSPECTS FOR ACHIEVING PROJECT OBJECTIVES IN SUSTAINABILITY BY THE PACD	84
5.7	INSTITUTIONAL SUPPORT CONTRACT, SERVICES, AND PRIORITIES	85
5.7.1	Scope of Services	85
5.7.2	Resources and Priorities	89
5.8	SUMMARY OF PRINCIPAL CONCLUSIONS	90
<b>CHAPTER 6.0</b>	<b>RECOMMENDATIONS</b>	<b>92</b>
6.1	RECOMMENDED ACTIONS DURING THE FIRST SIX MONTHS OF 1992	92
6.2	RECOMMENDATIONS TO BE ADDRESSED DURING THE MID-1992 TO MID-1993 PERIOD	97
6.3	RECOMMENDATIONS TO BE ADDRESSED BETWEEN MID-1993 AND THE PACD	98

BIBLIOGRAPHY

APPENDICES

- A. SCOPE OF WORK FOR INTERIM EVALUATION
- B. MINUTES OF MEETING WITH GOSD
- C. AN ASSESSMENT OF WEST BANK POLLUTION LOADINGS ON WATER QUALITY OF THE ROSETTA BRANCH OF THE LOWER NILE
- D. ORGANIZATION CHARTS

## LIST OF FIGURES AND TABLES

### Figures

1.1	Cairo Sewerage II Project Major Sewerage Facilities . . .	3
2.1	Original West Bank Construction Contracts and Schedule .	14
2.2	Current West Bank Construction Contract Schedule . . . .	20
2.3	West Bank Contract Completion Status . . . . .	22
2.4	West Bank Contract Value Status . . . . .	23
2.5	Impact of Work Remaining on PACD . . . . .	27

### Tables

1.1	Summary of U.S. Funding for Cairo Sewerage II Project . .	2
2.1	Status of Facility Completion, Cairo Sewerage II Project . . . . .	21
2.2	Waivers to Source/Origin Requirements by Contract and by Value as of October 1991 . . . . .	28
2.3	Status of Facility Cost, Cairo Sewerage II Project, as of End of FY 91 . . . . .	32
2.4	Summary of Accident Data for West Bank Sewerage Project, 1986-1991 . . . . .	33
3.1	Zenein WWTP Performance Data for 1991 . . . . .	45
4.1	1983 GOPP Population Projection for Greater Cairo . . .	43
4.2	Census Data and Growth Rates for Greater Cairo . . . .	55
4.3	Growth Rates Proposed by AMBRIC for Greater Cairo . . .	55
4.4	AMBRIC 1991 Population Projection for the Cairo West Bank . . . . .	56
4.5	Comparison of Actual and Budgeted GOSD Revenues . . . .	64
4.6	Comparison of Actual and Budgeted GOSD Expenditures . .	65

## GLOSSARY

ABB/SUSA	Asea-Brown-Bovari/Sadelmi USA, Inc.
ACE	Arab Consulting Engineers (Moharram-Bakhoum)
AID	Agency for International Development (USAID)
AMBRIC	American British Consultants
APP	Project Paper, as amended
BOD	Biochemical Oxygen Demand
BVI	Black & Veatch International
CAOA	Central Agency for Organization and Administration (GOE)
CAPMAS	Central Agency for Public Mobilization and Statistics
CDM	Camp Dresser & McKee International
cmd	Cubic Meters per Day
CWO	Cairo Wastewater Organization (GOE)
DIR	Design Inception Report
FAR	Fixed Amount Reimbursable (FARA)
FIDIC	Federation Internationales des Ingenieurs Conseils
GOE	Government of Egypt
GOGCWS	General Organization for Greater Cairo Water System (GOE)
GOPP	General Organization for Physical Planning (GOE)
GOSD	Cairo General Organization for Sanitary Drainage (GOE)
ha	Hectare(s)
HDC	Higher Decision Committee (GOE)
ISC	Institutional Support Contractor
IWC	Independent Water/Wastewater Company
LE	Egyptian Pounds (currency)
M&I	Municipal and Industrial
mg/L	Milligram per Liter
MOU	Memorandum of Understanding
MPWWR	Ministry of Public Works and Water Resources (GOE)
MRNCHU	Ministry of Reconstruction, New Communities, Housing, and Utilities (GOE)
NOPWASD	National Organization for Potable Water and Sanitary Drainage (GOE)
NTP	Notice to Proceed
O&M	Operations and Maintenance
ODA	Overseas Development Administration (UK)
OJT	On-the-Job Training
OMT	Operations and Maintenance Training
PACD	Project Assistance Completion Date
PP	Project Paper
PS	Pumping Station
TA	Technical Assistance
SS	Suspended Solids
UAD	Office of Urban Administration and Development (USAID)
WWISP	Water and Wastewater Institutional Support Project
WWTP	Wastewater Treatment Plant

## EXECUTIVE SUMMARY

Mobilization preparations for this Interim Evaluation began in October 1991. Work was initiated on November 5, 1991 and continued through January 30, 1992 with a four week break during the year-end holiday period. The Harza/ASCG and A.A. Warith team members received orientation briefings from key staff of the involved agencies including USAID, CWO, GOSD, AMBRIC and CDM. This was followed by a coordinated fact finding period which involved extensive review and analysis of Project documents and interviews with officials and senior staff of the concerned agencies. A briefing covering preliminary conclusions and recommendations was conducted for USAID on December 11, 1991; additional briefings were conducted for GOSD, CWO, AMBRIC and CDM on January 29, 1992.

The statement of work for the Evaluation provided for the assessment of progress to date in the attainment of Project objectives and identification of problems and constraints which may inhibit attainment of such goals. The Team was also directed to determine how problems and constraints might be overcome and to assess, to the extent possible, the development impacts of the Project. Based on the findings and conclusions reached on these issues, the Team was directed to offer recommendations relative to future courses of action to be taken during the remainder of the Project period.

### I. Project Status

Due to delays experienced in the initiation of the Evaluation (caused by the Gulf War), the Evaluation was conducted nearly one year later than originally planned. The Project status therefore was somewhat advanced with approximately 70 percent of the work completed as of September 1991. The Zenein Treatment Plant had been completed in 1990 and the American contractor (ABB/SUSA) was nearing the mid-point of a two year operating and maintenance contract. This plant is now operating at its full capacity, with excess flows (estimated at 400,000 cmd) being bypassed. Similarly, screw pump stations which have been completed were under a 27 month maintenance contract assigned to another American contractor, AICI. Construction of the major collectors for the West Bank system has been completed, as well as many of the minor collectors and relief sewers. Total sewage treatment capacity, after completion of the Abu Rawash facility, is expected to be fully utilized by 1995 due to rapid urbanization and population growth in areas served by system components under construction. This issue was given careful consideration by the Team and recommendations are offered concerning strategies that might be employed in dealing with it.

## II. Conclusions

The conclusion concerning the attainment of Project objectives is generally positive. Design and construction was found to be of high quality and, while some delays have been encountered, overall performance in project implementation has been good, especially given the magnitude and complexity of the program. While significant problems and constraints were identified which must be overcome during the time remaining, the Team found that these issues were, in large measure, already being addressed by the responsible participating agencies. The Team reviewed these ongoing activities, concluded that the Project was moving ahead in an appropriate manner, and offered recommendations intended to enhance the overall effort.

## III. Recommendations

Recommendations were prepared and grouped according to the time period thought to be most appropriate. Three groups of recommendations were thus identified, those that should be considered for implementation during the first six months of 1992, those of a lesser urgency which can be considered for implementation during the mid-1992 to mid-1993 period, and another group which can be deferred for consideration to the later stages of the Project's duration. A summary listing of the actions recommended for consideration is presented below.

### **First Six Months of 1992**

For USAID, CWO, and GOSD - Consolidate all ongoing and future efforts for institutional strengthening under a direct contract with GOSD in order to maximize management, operation, and maintenance "on the job" training effectiveness and GOE commitment. Carefully coordinate all training efforts in the interim to optimize GOSD and consultant resources and to assure full readiness to commission major West Bank facilities.

For USAID and CWO - Review and renegotiate the Post Construction Services (PCS) efforts of AMBRIC to more closely match the scope of services to be provided by the Institutional Support Contractor. Modify PCS activities to 1) concentrate on immediate training of GOSD personnel to be assigned O&M duties on the West Bank, notably the new screw pump stations, treatment plants, and collectors; 2) assist in the implementation of the plan for commissioning new facilities; and 3) provide continuing technical assistance (TA) to GOSD for six to nine months after their personnel assume O&M responsibilities for the entire West Bank system.

For CWO - Do not extend the ABB/SUSA contract for operation of the Zenein WWTP beyond September, 1992 unless a need for

additional technical assistance services by ABB/SUSA can be demonstrated.

For USAID and CWO - Accelerate procurement and construction completion for Contract 33 (the Western Desert Sludge Disposal Facility) employing contractor incentive payments for early completion and/or other identified measures.

For USAID - Review the existing contract with ABB/SUSA for construction of the Abu Rawash WWTP with a view toward reducing the amount of time specified for full contractor operation, transferring full responsibility for operations to GOSD as early as possible, and modifying ABB/SUSA's role to one of providing technical assistance after GOSD assumes operational control of the plant.

For USAID, GOE, and CWO - Seek additional authorizations to Cairo Sewerage II and other sources of funding and initiate immediate actions necessary to complete the following work: a) add one to three years of institutional support services to GOSD; b) provide engineering studies, design, and expansion of the Abu Rawash Wastewater Treatment Plant; c) complete an update of the West Bank portion of the Greater Cairo Sewer Master Plan, and d) initiate a public education program on river pollution, sanitation, and the importance and proper use of sewerage facilities.

For GOE - Initiate a ministerial directive redefining GOSD as the "owner" and CWO as the "owner's representative" in the implementation process for sewerage projects in Cairo. Cooperate with involved parties, including USAID, in providing guidance concerning how the two organizations should interact on such matters as review of designs, contract documents, and change orders, and the involvement of GOSD operating personnel as on-site observers during construction.

For CWO and AMBRIC - Initiate discussions concerning ways and means through which institution building within CWO can be enhanced during the remainder of the Cairo Sewerage II Project. Prepare recommendations for the implementation of identified measures, including estimated costs, if any, for review and approval by the ministry and USAID.

For GOSD - Establish an internal policy directive applicable to all senior staff and department heads, requiring the participation of the ISC Team Leader and/or staff as appropriate in all significant decision making processes concerning any matter which has a relationship with the ISC scope of work.

For GOSD and USAID in Consultation with the ISC - Review the ISC scope of work to ensure that adequate provisions (i.e. tasks and resources) are included to address several areas which may have been inadvertently omitted, such as assistance in implementing the active reorganization plan, preparation of map books for sewer maintenance and repair field crews, and attention to project implementation functions.

#### **Mid-1992 to Mid-1993**

For GOE - Extend the Project Assistance Completion Date (PACD) through modification of the Grant Agreement for a period of at least two years. Expansion of the Rawash facility would add an additional three years.

For CWO and USAID - Intensify efforts to obtain full closeout of both American construction and Egyptian FAR contracts.

For CWO and USAID - Cancel and replace with other TA services the proposed contracting for limited period operation and maintenance of the new screw pump stations.

For USAID and GOE - Assess the industrial waste study for the West Bank, once completed, to provide the basis for a ministerial decree requiring pre-treatment and/or prohibiting discharge to sewers of toxic or other wastes which would interfere with treatment processes; include a companion study for the development of wastewater tariff surcharges applicable to high strength wastes.

For GOSD and USAID - Continue to review the results expected from the ISC. Recognize the likelihood that further ISC type efforts will be needed after 1994; establish priorities to provide guidance when decisions are needed concerning resource allocation during the contract implementation period.

For USAID - Conduct annual reviews of the performance of the Institutional Support contractor.

#### **Mid-1993 to the PACD**

For GOE - Conduct water quality monitoring and modeling of the River Nile to assist in assessing levels of wastewater treatment and options for effluent reuse.

For USAID - Eliminate study of the public health benefits of Cairo Sewerage II as part of the final Project evaluation.

For USAID - Make additional funding commitments contingent upon GOE actions to increase tariffs as necessary to meet the objective of full recovery of O&M costs from the sewer tariff based revenue.

For USAID - Initiate a final evaluation of the Cairo Sewerage II Project approximately six to nine months in advance of the PACD.

For USAID - Consider conducting the final evaluation as a joint effort with the British Overseas Development Administration (ODA).

For GOE and USAID - Incorporate the funding approach developed under the FAR concept into future sewer construction projects.

The Evaluation Team wishes to acknowledge the excellent cooperation and assistance received from the executives of all participating agencies who were open and candid in all discussions, made all requested documentation readily available, and were most generous in providing time from their busy schedules whenever it was requested. This report could not have been developed without such wholehearted assistance.

All comments, suggestions, and recommendations are offered in the spirit of good will which marks the Egyptian-USAID relationship. The Evaluation Team offers them with the sincere hope that they will prove to be beneficial in the pursuit of a successful Project completion.

## ACKNOWLEDGEMENTS

Team Composition. Team members provided through TECAID and their institutional affiliations are listed below according to area of responsibility.

1. Sanitary Engineering

Dr. Fred C. Cooper, Sanitary Engineer & Team Leader; Harza/ASCG (13 weeks)  
Salah Abdul Ghany, Civil Engineer & Assistant Team Leader; A.A. Warith (10 weeks)

2. Finance and Economics

Ray Bartlett, Economist; Harza/ASCG (7 weeks)  
Dr. Ahmed Ali, Financial Specialist; A.A. Warith (7 weeks)

3. Construction Management

William F. Johnson, Civil Engineer; Harza/ASCG (7 weeks)  
Abdel Rahman, Sanitary Engineer; A.A. Warith (10 weeks)

4. Operations and Maintenance

A.C Davanzo, O&M Specialist; Harza/ASCG (5 weeks)  
Salah Hamdi, O&M Specialist; A.A. Warith (7 weeks)

5. Organization and Management

James S. Baker, Management Specialist; Harza/ASCG (7 weeks)  
Reda Ibrahim, Management Specialist; A.A. Warith (11 weeks)

6. Public Health

Dr. Ahmed Akkad, M.D.; A.A. Warith (5 weeks)

Those individuals listed made written contributions to the Evaluation. Many others contributed by reviewing findings and assisting in defining/refining the scope of work and issues of central concern. The team wishes to express its appreciation for such assistance, especially to John W. Airhart, Charles McElroy, and Randall Parks of USAID for their interest and assistance.

## CHAPTER 1.0

### PROJECT BACKGROUND AND STATUS

#### 1.1 PURPOSE OF AND PARTICIPANTS IN CAIRO SEWERAGE II

The overall purpose of the project is to assist the Government of Egypt (GOE) by improving, expanding, and assuring the proper management of the wastewater collection and treatment system for the Cairo West Bank, thereby improving the urban environment and public health for a projected population of eight million people by 2020.

##### 1.1.1 Responsible GOE Agencies

On September 26, 1984, USAID executed a Grant Agreement with the Government of Egypt represented by two implementing agencies, the Organization for the Execution of the Greater Cairo Wastewater Project (CWO) and the General Organization for Sanitary Drainage for Greater Cairo (GOSD). CWO, which is attached to the Ministry of Housing and Reconstruction and administered by a coordinating committee, is responsible for all design and construction efforts. GOSD, which is part of the Governorate of Cairo, is responsible for sewerage system operation and maintenance.

##### 1.1.2 Scope of Cairo Sewerage II

The project scope was defined by a Project Paper developed in 1984 and later amended in 1985 and 1986. Total authorization for funding is \$816 million consisting of \$783 million in planned obligation and LE 107.5 million. U.S. funding has been matched by Government of Egypt funding. Total appropriations through FY 91 are \$679.7 million and LE 297.3 million. Total expenditures and appropriations are summarized in Table 1.1.

In addition to GOE matching funding for various lateral sewer and house connection contracts, direct capital funding is authorized through GOSD for design and construction of collectors and laterals in other West Bank unsewered areas. In 1991, approximately LE 41 million had been spent under the current five-year program; another LE 189 million is under construction and an additional LE 60 million is needed for construction of projects under design. GOSD has numerous sewer projects under design or construction in the Giza and El Ahram areas.

**TABLE 1.1 Summary of U.S. Funding for Cairo Sewerage II Project  
(U.S. \$ millions)**

Project Element	Through September 1991	Future	Planned
Construction	\$575.16	\$ 89.34	\$664.50
Engineering	85.80	9.40	95.20
Studies	1.70	0.60	2.30
Post Construction Support	7.00	0.00	7.00
Training & O&M Support	10.00	4.00	14.00
Totals	\$679.66	\$103.34	\$783.00

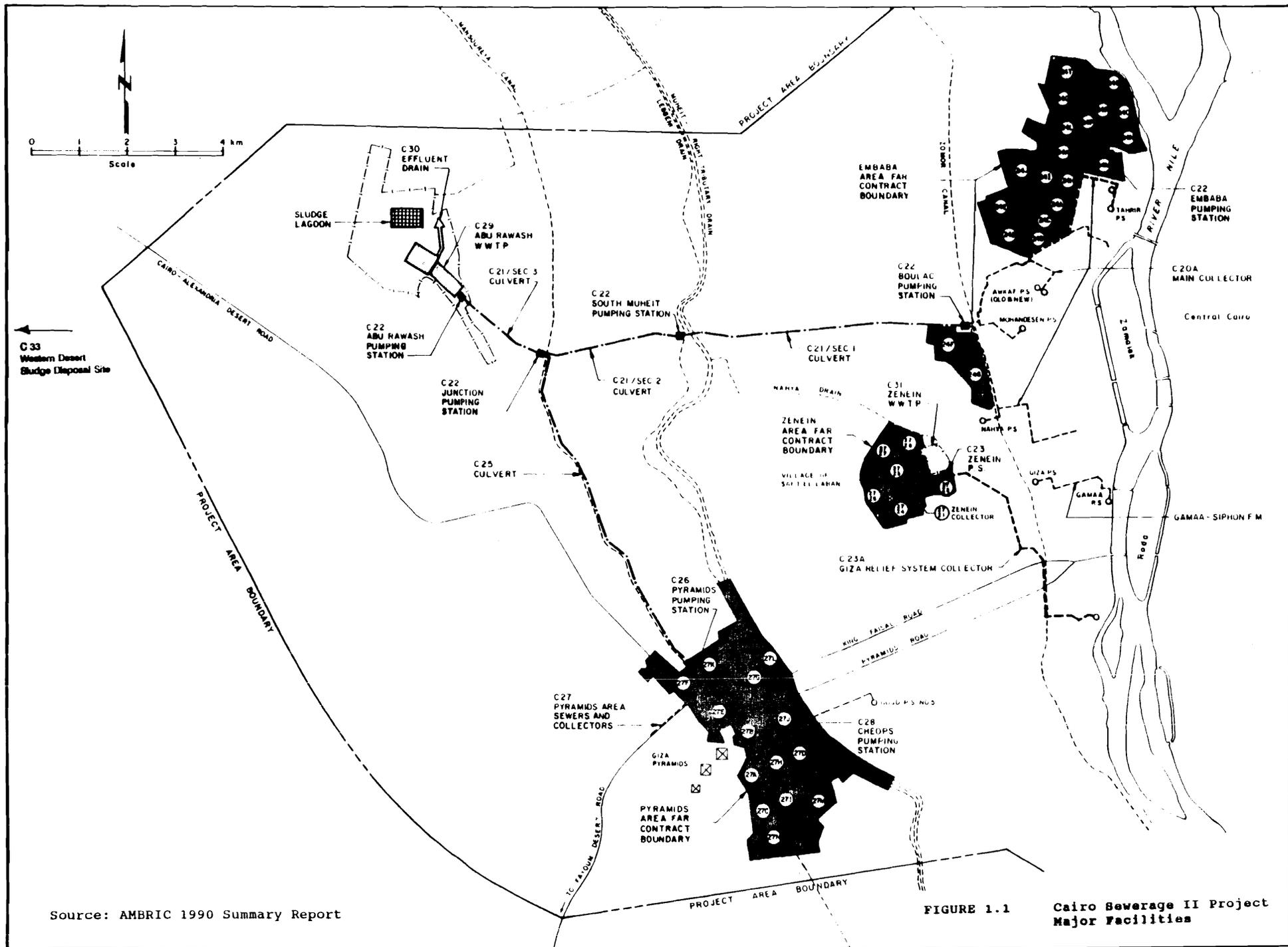
Source: UAD, USAID/Cairo  
(Amendment 5, Project Grant Agreement)

## 1.2 DESCRIPTION OF THE PROJECT AND SERVICE AREA

As extracted from the amended 1984 Grant Agreement (60\*), the Cairo Sewerage II Project is intended to .... "improve, expand and assure proper management of the wastewater collection and treatment systems on the West Bank of the City of Cairo. The Project will provide the basis for access to adequate wastewater disposal for the population on the West Bank, in turn assuring them of the provision of a basic human need and a guarantee of improved environmental health. Cairo Sewerage II will provide the core funding for the construction, design and construction management, and system operations, maintenance, management and training activities on the West Bank. This funding will assure the completion of a whole system, from household connections to final treatment adequate for both effluent and sludge reuse."

The West Bank sewerage system, located almost entirely within the Governorate of Giza, is depicted in Figure 1.1. Zamalek and Roda Islands, located in Cairo Governorate, are also served by the West Bank system, which encompasses a total of 9,293 hectares. As of 1990, the sewered area covered approximately 62.6 percent of the total, or 5,758 hectares, and the West Bank district housed an estimated 3.3 million residents; 58.5 percent or 1.93 million of these residents are presently served by sewers (14).

\* Numbers in parentheses are keyed to selected references listed in the attached Bibliography.



Source: AMBRIC 1990 Summary Report

FIGURE 1.1 Cairo Sewerage II Project Major Facilities

The West Bank sewage works comprise three basic systems. The first system consists of the older sewerage areas or districts in South Giza and Boulac El Dakrour, with sewage conveyed to an existing treatment plant, now rehabilitated, at Zenein. The densely developed area around Zenein will also be served upon project completion. A new second system will serve the existing sewerage areas of Dokki, Agouza, Mohandessin, Awkaf, and Embaba, plus two newly sewerage areas in the northern area of Giza, Embaba Markaz and Boulac. Through a system of new relief sewers, collectors, and pump stations, sewage will be conveyed to the new Abu Rawash Treatment Plant. The third system is in southwest Giza and will serve the Pyramids vicinity. Sewage from this system will be pumped to gravity culverts and also treated at the Abu Rawash plant, and the El Ahrām area will be also served. Effluent from the Zenein and Abu Rawash treatment plants will be discharged to existing irrigation drains in a manner which allows flexibility for future reuse for land reclamation. Sewage sludge will also be dried and disposed of in a manner which allows reuse.

AMBRIC's 1981 Design Inception Report identified two stages of West Bank facilities construction. Cairo Sewerage II, as documented in the amended Project Paper, provides for the construction of Stage I collection, conveyance, and treatment facilities. Total treatment capacity will be 730,000 cubic meters per day (cmd): 330,000 cmd to secondary treatment standards and the remaining 400,000 cmd to primary treatment standards.

### 1.3 INTERIM EVALUATION

This interim evaluation report constitutes the first comprehensive evaluation of Cairo Sewerage II (Project No. 263-0173). The 1984 Cairo Sewerage II Project Paper (43) scheduled interim evaluations for mid-1986 and mid-1988 and the 1984 Grant Agreement (60) acknowledged the need for interim and final evaluations plus annual reviews to assist in identifying and overcoming any difficulties encountered and to facilitate Project implementation. The interim evaluations were administratively deferred, and annual reviews were discontinued after 1986.

A 1985 evaluation of Cairo Sewerage I (Project 263-091), completed as part of a sector assessment for water and sewer projects throughout Egypt, identified and commented on key issues affecting the Cairo Wastewater Program. While the evaluation pointed out some problems in management and training, the overall conclusion was that the project was proceeding in accordance with expectations and results were satisfactory.

The current interim evaluation is designed to:

- evaluate progress toward attainment of the objectives of the Cairo Wastewater Project;
- identify and evaluate problem areas or constraints which may inhibit such attainment;
- assess how such information may be used to help overcome any critical problems;
- evaluate, to the degree feasible, the overall development impact of Cairo wastewater project improvements on the West Bank; and
- advise on future courses of action for West Bank wastewater system improvements.

A final evaluation of the Cairo Sewerage II will be undertaken on completion of construction and prior to the Project Assistance Completion Date (PACD). Issues relating to the Project's impact may be more appropriately and thoroughly reviewed at that time.

#### 1.3.1 Identification of Project Objectives, Benchmarks, and Conditions Subject to Evaluation

The interim and final (end of project) evaluations are required to consider the original goals and objectives established for the Cairo Sewerage II Project. As objectives and various benchmarks for achievement evolved over a period of several years, a single list was prepared. The compilation and summary presented below was derived from three primary sources: (1) the Memorandum of Understanding (MOU) (74), signed in January of 1984; (2) the Project Grant Agreement (60), originally signed September 26, 1984 and amended on five occasions -- March 13, 1985, September 29, 1986, June 14, 1989, August 21, 1990, and September 24, 1991; and (3) the USAID Project Paper (PP) approved in September 1984 and amended in March 1985 and September 1986 (43). In addition to updating the project scope and grant obligations, these documents list various conditions and covenants, plus a set of long range benchmarks and performance indicators for the purpose of annual reviews and meeting specific project objectives.

#### 1.3.2 Project Objectives and Benchmarks

Key Project objectives addressed in this evaluation include:

- 1) Improvement in Living Conditions. "Improve living conditions (health, transit, aesthetic) for the population of the West Bank of Cairo." (PP 9/84, Annex J)
- 2) Elimination of Sewage Flooding. "Sewage flooding in the urbanized areas of the West Bank due to 1) surcharged sewers and 2) household vaults is to be eliminated. This would be accomplished by the design

and construction of relief sewers in several existing sewer areas and a network of new laterals and household connections in densely populated areas that are unsewered." (PP 9/84, Annex J)

- 3) Adequate Future Sewage Collection System Capacity. "By 1990 (or the PACD), the major collection system constructed for the West Bank will 1) have a minimum capacity to handle 480,000 cmd and 2) have begun a program to design and construct new lateral sewers and household connections to serve 8,000,000 people by 2020." (PP 9/84, Annex J)
- 4) Adequate Operation, Maintenance, and Management Capacity. "By completion of the project, the institutional capacity and capabilities within GOSD will be strengthened sufficiently to demonstrate operation, maintenance, and management of the West Bank system on a sustained basis." (1984 MOU and 1986 APP)

Key benchmarks, taken from the amended Project Papers, include:

- 1) Classroom and field training in priority operation and maintenance on existing collection and treatment facilities;
- 2) Technical assistance to develop a GOSD pump station O&M training and trouble shooting unit based at the Siphon Pump Station;
- 3) Classroom and hands-on training in O&M procedures for the staff of rehabilitated pump stations;
- 4) Development and application of pump station O&M checklists;
- 5) Development and implementation of a pump station O&M performance evaluation system;
- 6) Classroom and hands-on O&M training for pneumatic ejector pump station operations staff; and
- 7) Implementation of AMBRIC Work Order No. 4 for operations and management training, including the development of the Zenein Training Center.

### 1.3.3 Other Project Conditions and Performance Indicators

Other conditions and performance indicators defined by the Grant Agreement and amended Project Paper and addressed in this evaluation include:

- 1) Financing for Sewer Laterals and Hookups. "The Grantee agrees that adequate local currency financing for sewer laterals and household hookups is made available as needed to ensure implementation in a timely manner." (PP 9/84)

- 2) Operations and Maintenance Resources. "The Grantee agrees to utilize all necessary resources, including but not limited to tariff increases, to ensure the proper maintenance and operation of the wastewater system to be constructed or renovated under the Project." (PP 9/84)
- 3) Provision of Household Hookups. "The Grantee agrees that the provision of household hookups to the system will not be dependent exclusively on the house owner or resident's ability to pay for such hookups, but will be based on other factors agreed to by AID and the Grantee." (PP 9/84)
- 4) Discharge of Effluent to Drains. "The Grantee agrees that discharges into drains resulting from the Project construction are permitted under relevant law and regulation and that existing drains will be expanded, as necessary, to ensure sufficient capacity to accept increased flows." (PP 9/84)
- 5) Adequate Wastewater Revenues. "By 1990, sewer tariffs will be approved and implemented at the local level which are sufficient to cover 50 percent of the annual cost for operation and maintenance, debt service, and routine improvements for the wastewater system. Sewer tariffs will be sufficient to cover 100 percent of O&M costs by the PACD." (1984 MOU and 1986 APP, Table 2.1)
- 6) Annual Operation and Maintenance Cost Review. "The O&M budget for GOSD will be reviewed on an annual basis to assure an adequate level of national subsidy." (1986 APP, Table 2.1)
- 7) Annual Performance Reviews. "The parties agree to meet at least annually to review performance of the program during the previous year and anticipated performance during the following year .... The parties will further agree that these annual reviews will serve as a basis for determining the level of continuing AID funding for the Project, subject to the availability of funds." (PP 9/84)
- 8) Incentive Programs. "Programs will be developed within GOSD for 1) incentive pay or bonuses to wastewater employees and 2) wastewater operator certification." (1986 APP, Table 2.1)
- 9) Independent Wastewater Organization. "The establishment of an autonomous, local wastewater

organization with the authority to retain service revenues for its own operating needs." (1984 MOU)

- 10) Utilization of Construction Management Services. "The retention during the program of a construction management firm to ensure on-time completion of the projects." (Later clarified to identify AMBRIC as qualified to fulfill this responsibility.) (1984 MOU and Grant Agreement)
- 11) Comprehensive Training Program and Facilities. "A comprehensive training program will be developed for wastewater system management, operation and maintenance, and a regional training facility established at the Zenein Treatment Plant site." (PP 9/84, Annex J)
- 12) Elimination of Sewage from the Urbanized Area. "Construction of a system of conduits, pump stations, and wastewater treatment plants identified as First Stage facilities as planned and designed under Project No. 263-091 (Cairo Sewerage I) will eliminate untreated sewage in the urbanized areas." (PP 9/84)
- 13) Additional Sewage Treatment Capacity. "Treatment plants at Zenein and Abu Rawash will be fully functional and capable of providing a secondary treatment capacity of 770,000 cubic meters per day." (Authorization and funding of these facilities were not part of the original program but were added in 1986 to assure a fully functioning system.) (PP 9/84, Annex J)
- 14) Proper Effluent Disposal. "Sewage from the West Bank area would be treated to standards established by Egyptian law prior to discharge of the effluent to irrigation drains." (In the event of AID funding of the Abu Rawash WWTP, only primary treatment would be provided as a part of First Stage construction.) (PP 9/84, Annex J)
- 15) Compliance with AID Environmental Regulations. "Project must be in compliance with AID Regulation 16." While an Environmental Assessment was prepared in 1982 and a Negative Declaration approved for Project 263-0173 in 1984, the system for sludge disposal at Abu Rawash Treatment Plant was not yet identified. (PP 9/84 Annex I)
- 16) Source and Origin of Goods and Services. "Foreign exchange funding used to finance the costs of goods and services will exclusively have their source and

origin in the United States and Egypt except as otherwise agreed in writing. Local currency disbursements will be used exclusively for the costs of goods and services having their origin in the Arab Republic of Egypt." (1984 Grant Agreement)

- 17) Performance Review of Project Consultants and Contractors. "The Grantee, represented by CWO, will, in consultation with USAID, coordinate, support, and monitor the performance of the Project consultants and contractors." (1985 Amended Grant Agreement)
- 18) Acquisition of Facility Rights-of-Way. "Rights-of-way required for construction of each project shall be acquired by the Grantee prior to disbursement of construction funds by USAID." (APP 1986)

#### 1.4 HISTORY OF PROGRAM

##### 1.4.1 1978 Greater Cairo Sewer Master Plan

In late 1975, in recognition of a critical need to improve the existing Cairo sewer system, efforts were begun to prepare a master plan for immediate and long range development of sewerage facilities. Two British firms, John Taylor & Sons and Binnie & Partners, in association with the Egyptian firm of Dr. Ahmed Abdel-Warith, were awarded a contract by the Ministry of Housing and Reconstruction in late 1976 to design a wastewater facilities development plan for Greater Cairo. Their work was completed in late 1978 and has served as the basis for detailed engineering design and construction of various rehabilitation and first stage improvements to the East Bank and West Bank systems. AMBRIC has documented the latter in a Design Inception Report issued in 1981 (73).

##### 1.4.2 Existing Sewer Rehabilitation Program

Prior to 1980, less than 50 percent of the West Bank population was served by sewers. Unsewered households have historically utilized vaults or cesspits. Due to overloading and little or no maintenance, sewage flooding from both sewers and vaults was a daily occurrence at hundreds of locations. AMBRIC consultants assessed the flooding problems and developed a plan for rehabilitation for sewer areas. Sewer rehabilitation work for the West Bank consisted primarily of improvements to existing pump stations. This work was completed under Cairo Sewerage I.

#### 1.5 CAIRO SEWERAGE II AUTHORIZATION

The 1984 Project Paper as amended in 1985 and 1986 serves as the basis for this interim evaluation.

### 1.5.1 1984 Project Paper

The September 1984 USAID Project Paper (PP) specified the conditions of the Grant Agreement and defined the scope of the Cairo Sewerage II Project. This Project Paper, an important resource and background document, authorized and defined the initial construction program which focused on sewage collection. Treatment facilities were not part of the original scope and were left as future activities. The overall program cost and U.S. commitment were recognized to be near \$1.4 billion and \$800 million respectively, of which \$165.3 million was appropriated. Nearly all of the funded work was expected to be completed by late 1987.

It was assumed in 1984 that all of the 1990 West Bank population of 2.46 million would have new or improved sewer service by the time the project was completed, and that the basic collection system would be in place to serve nearly 10 million people by the year 2020. The PP recognized that there would always be a continuing need to extend sewer service to new unsewered areas and that sewer system and treatment capacity must keep pace with the expansion of the water system which was projected to grow at the rate of six percent per year. (Changes in population growth rates and the 1990 System Load Review of growth impact are discussed in Section 4.2.)

The Project Paper also recognized that extensive institutional support and training would be required. (The institutional support program is discussed in Section 5.7.)

Various analyses (technical, environmental, economic, financial, health and social issues) were included in the Project Paper, and the development of benchmarks and performance indicators for monitoring the overall program were also given important consideration. (See Section 1.3 above.)

### 1.5.2 Project Paper Amendments

The Project Paper was amended in March 1985 and again in September 1986 to update the authorized scope and estimated cost of the Project. Rehabilitation of the Zenein Treatment Plant and design/construction of the Abu Rawash Treatment Plant primary stage were authorized and increased funding appropriations were recommended: \$195 million in FY 85, \$61.5 million in FY 86, and an additional \$133.2 million proposed for FY 87. The amendments also described specific benchmarks for project evaluation required by the 1984 Project Paper.

## 1.6 CURRENT PROJECT STATUS

### 1.6.1 Project Assistance Completion Date (PACD)

The Project Assistance Completion Date is September 30, 1994. USAID is not authorized to obligate or reimburse any funds for work not completed before this date. Prospects for completion of the Project by the PACD are evaluated in Chapters 2.0 and 5.0.

### 1.6.2 Project Completion Schedule

The West Bank facilities were approximately 70 percent complete as of September 1991. Actual construction of all major facilities except the Western Desert Sludge Disposal Facility (Contract 33) should be completed by the PACD. Facility startup or commissioning, warranty periods on new construction, and operator training may not be completed by PACD. The status of each contract is discussed in Chapter 2.0.

### 1.6.3 Interim Operation and Maintenance of Completed Facilities

Since the completion of the Zenein Treatment Plant in 1990, it has been under a two year operations and maintenance contract with the American construction contractor, ABB/SUSA. This contract is due to terminate in September of 1992 with an option to be extended for one year. Similarly, screw pump stations which have been completed are under a twenty-seven month maintenance contract to AICI, a U.S. contractor. The selection of an American contractor to provide O&M services for new pump stations is on hold.

### 1.6.4 East Bank Diversion

Due to the unavailability of treatment and effluent disposal facilities on the East Bank, the East Bank relief system has not been put into operation and raw sewage is being diverted into the West Bank system via the Gamaa Siphon from Roda Island. This flow is estimated to be 292,000 cubic meters per day (14). This situation is expected to continue until early 1993, according to the commissioning plan for East Bank facilities.

### 1.6.5 Interim Sewage Bypassing

Currently, all raw sewage from sewerred areas on the West Bank, including the East Bank diversion, is pumped to the newly rehabilitated Zenein Wastewater Treatment Plant site. This plant is now providing full secondary treatment and operating at its design capacity of 330,000 cubic meters per day. Sewage flow in excess of its treatment capacity is bypassed. Estimates of present bypassed flow are in the range of 400,000 cmd. This flow receives preliminary treatment only, consisting of screening and grit removal, and is then discharged to the Nahya Drain which

empties into the South Muheit Drain and then into the Rosetta Branch of the Nile some 40 km below Cairo. The impact on sewage discharge on Nile water quality and downstream water users is reviewed in Appendix C and Chapter 4.0.

#### 1.6.6 Effluent Disposal to Drains

Stage I plans defined by the 1981 Design Inception Report call for the effluent from treatment facilities at both the Zenein and the new Abu Rawash Treatment Plants to be discharged to irrigation drains which enter the Rosetta Branch of the Nile below the diversion dam for the Raiyah El Beheira Canal.

#### 1.6.7 System Load Review

The available treatment plant capacity of 730,000 cmd is sufficient to serve an equivalent population of approximately three million. In 1990 AMBRIC prepared a system load review and compared it to projections utilized in the 1981 Design Inception Report. The 1990 System Load Review (73) concluded that the 1990 average daily flow for the West Bank will be 472,000 cmd, an increase of 4.2 percent. With the expansion of the system due to new collection systems under construction or design, sewage flows will reach the available treatment capacity by 1995 within two years of the date of full operation. Issues and options concerning the effect of future increased sewage flow on constructed facilities are discussed in Chapters 2.0 and 4.0.

#### 1.6.8 Institutional Support Services

The selection and award of a two year contract for institutional support to GOSD is due to be completed in early 1992. (Technical Assistance to increase the capabilities and self-sufficiency of GOSD/GOE personnel is addressed in Section 5.7.)

## CHAPTER 2.0

### PROJECT IMPLEMENTATION

#### 2.1 DESCRIPTION OF CONTRACTS AND ORIGINAL SCHEDULE

The construction of sewerage facilities began on the West Bank in 1985. New facilities to be constructed were defined by the Design Inception Report (DIR), prepared by AMBRIC in 1981, as first stage facilities. Figure 2.1 lists the original West Bank construction contracts as of September 1986. Principal features of the original plan are:

- All construction to be awarded in no more than 13 contracts.
- All work to be undertaken by American firms.
- Completion of Abu Rawash WWTP by early 1990.
- Effluent disposal system complete by mid-1990.
- No specific plan for sludge handling.
- All construction complete by early 1992.
- A two year period for warranty and project close out before the PACD.

#### 2.2 WEST BANK SEWERED AREA

The existing West Bank sewerage area lies predominately east of the Zomor Canal. Many of the existing sewers date back to the 1930s and 1940s. During the period 1982-86, the system was rehabilitated to reduce sewage flooding and bypassing. This work was funded as part of Project 263-091 (Cairo Sewerage I) and consisted primarily of sewer cleaning and pump station reconstruction. Relief sewers, either currently under construction or recently completed but not yet in operation, will eliminate surcharged or pressure conditions.

AMBRIC engineers have inspected existing sewers except where surcharged conditions could not be eliminated. These lines will have to be cleaned and inspected after the relief sewers are put into operation in late 1992. Significant clogging with silt and debris is likely. Some older existing sewers may also collapse once pressure conditions are removed resulting in a critical need for line repair or, in some instances, replacement.

#### 2.3 STATUS OF CONTRACTS

##### 2.3.1 Sewage Collectors, Culverts and Pump Stations

No significant adjustments have been made to the scope of Contracts 21 and 25, Culverts, or to Contracts 22 and 26, Pumping Stations, although some schedule slippage occurred. Contract 27, Pyramids Collector, was reprogrammed from an early 1990

Contract No.	Description	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
		20A	Embaba Area Collectors	—————							
21	Boulaq PS-South Mubeit PS, Junction Ps-Abu Rawash PS Culverts	—————									
22	Embaba PS, Boulaq PS, South Muheit PS, Junction PS, Abu Rawash PS	—————									
23	Giza Area Collectors, Zenein PS	—————									
24	Embaba Area Branch Sewers & House Connections Laterals		—————								
25	Pyramids PS - Junction Ps Colvert		—————								
26	Pyramids PS		—————								
27	Pyramids Area Collectors, Cheops PS			—————							
28	Pyramids Area Branch Sewers & House Connections Laterals				—————						
29	Abu Rawash WWTP			—————							
30	Abu Rawash WWTP Effluent Disposal System			—————							
31	Zeinin WWTP Rehabilitation		—————								
32	Sludge Handling		NOT SCHEDULED								

(C.WESTBAN2)

**FIG 2 . 1**  
**ORIGINAL WEST BANK**  
**CONSTRUCTION CONTRACT SCHEDULE**

SOURCE : Project Paper, Amend 2, Sept 1986

Figure 10,1

14

completion to about mid-1994. Cheops Pumping Station was removed from Contract 27 and made a stand-alone Contract 28.

Contract 20 was one of the very early contracts initiated. Notice to Proceed (NTP) was given in May 1986 with completion set for June 1990. The contract was terminated in September 1987. The work scope was reduced and re-bid as Contract 20A in August 1988. Award recommendations were forwarded to CWO in December 1988. NTP was finally issued in September 1989 with completion set for March 1992. The net change was a completion delay of 22 months and a cost increase of \$65 Million.

Contract 23, Giza Relief, was initially programmed as a project consisting of the Zenein Pump Station and a main collector leading to it. The Contract was awarded and NTP was issued in December 1985. Completion was scheduled for June 1988. The work on the pump station proceeded much as planned and a Certificate of Substantial Completion was issued in June 1988. Work on the collector portion of the job never got underway. That portion of the project was deleted from Contract 23 and awarded to an Egyptian public sector contractor. The present completion date for this work is March 1992, some 45 months after the programmed completion date.

#### 2.3.2 Laterals and House Connections - The FAR Program

The 1986 program included construction of laterals and house connections in two areas. Contract 24 in the Embaba area was one such contract. Contract 27 was originally programmed as laterals and house connections for unsewered sections of the Pyramids area. Contract 24 (Embaba) was to begin construction in mid-1987 and to be complete in January 1990; Contract 27 (Pyramids) was scheduled to start in March 1989 and to be in place by February 1992 when the second of two construction elements was finished.

Early in the program, a concern developed about the ability of U.S. contractors to effectively perform the sewers, laterals, and house connection work. This type of work requires close coordination with officials of various levels and day-to-day relationships with citizens, often in areas where standard excavation and other equipment is not effective and a very large local labor force is required. It was decided that the requirement for U.S. contractors would be waived and certain work would be done by Egyptian contractors.

An agreement between the Government of Egypt (GOE) and USAID known as the Fixed Amount Reimbursable Agreement (FARA) was executed. This is the procedure commonly used by USAID to deliver financial assistance to aid recipients on development programs.

The Fixed Amount Reimbursable (FAR) work was packaged into a total of 41 separate contracts. The original Contract 24 was subdivided into 20 contracts, designated 24A through 24T. Pyramids area laterals and house connection were designated as Contracts 27A through 27N, adding 14 more. A previously unsewered area immediately west of the Zenein treatment plant was also included as seven additional contracts, 27Z-1 through 27Z-7.

It was anticipated that these contracts would begin in mid-1989 to late-1992 with varying completion dates.

### 2.3.3 Other Collection System Adjustments

In 1988, the Sphinx suffered structural damage thought to be caused by increased development and attendant raising of ground water in unsewered areas. In response to this concern, three FAR contracts (27A, 27B, and 27C) were given priority and design and construction was accelerated.

Contract 27A began in December 1988 and was completed in November 1989. Contract 27B was completed in July 1991. Contract 27E construction work encountered materials of archeological significance. This work was suspended.

### 2.3.4 Sewage Treatment Plants

Treatment works have included rehabilitation of the 330,000 cmd Zenein Wastewater Treatment Plant (WWTP) to provide secondary treatment and construction of the new Abu Rawash WWTP to provide 400,000 cmd primary treatment.

Zenein WWTP Rehabilitation. Contract 31 included the mechanical and electrical rehabilitation of the existing plant which was originally constructed in 1972 and expanded in 1981-86. New construction was included, principally to provide preliminary treatment (grit and flotants removal), sludge pumping, chlorination facilities, and new labs, shops and stores buildings, plus a training center. The original schedule called for a two year construction period, January 1987 to January 1989.

Construction start slipped to September 1989 and the contract period was set for 30 months, making the revised completion date March 1990. The plant was substantially complete in September 1990.

For the most part Contract 31, Zenein WWTP Rehabilitation, was designed and constructed in accordance with the original scope and schedule. The contract was, however, used as a vehicle for added work including the electrical substation at Abu Rawash and an extended maintenance and operation period.

Abu Rawash WWTP. The Abu Rawash WWTP is designated Contract 29. This plant is the key facility of the Cairo Sewerage II Program and is designated in the 1978 Sewer Master Plan to serve all additional sewered areas for the West Bank.

The September 1986 Amendment to the Project Paper did not clearly outline a scope, schedule, and budget for USAID participation in Abu Rawash WWTP. Contract 29 is shown on the Project Plan schedule to be constructed between December 1987 and February 1990. This was based on the premise that the plant design was essentially complete, that the plant would be a secondary treatment facility, and that it would be jointly funded by U.S. and Japanese aid programs.

A major program adjustment was necessary when Japanese funding failed to materialize. Treatment was redefined as primary only. The facility procurement and delivery was changed to a (modified) Design-Construct procedure. The firm of Camp Dresser and McKee, International. (CDM) was retained by USAID to assist CWO in developing the Design-Construct contract documents and monitoring the selected contractor's performance. Abu Rawash WWTP was rescheduled for construction between April 1990 and October 1992, a program delay of nearly 2 years.

Further adjustments to the scope of facilities continued during construction dealing with effluent, interim sludge handling, and plant bypass issues. Interim sludge management and on-site effluent disposal facilities are being handled through variation orders to Contract 29; the bypass issue has not yet been resolved.

#### 2.3.5 Effluent Disposal

Zenein WWTP. The effluent from Zenein is discharged by gravity from the plant to the Nahya drain and thence to the South Muheit drain. No change to this concept or the facilities was made under Cairo Sewerage II.

Abu Rawash WWTP. A number of early studies including the 1978 Master Plan, 1980 and 1981 reports, and the 1985 "Effluent Drain Study for West Bank Drainage" (not issued) dealt with the issue of effluent disposal. When the Cairo Sewerage II Project Paper was amended in 1986, Abu Rawash effluent disposal was visualized as the construction or rehabilitation of an effluent drain for the removal of treated wastewater from the Abu Rawash treatment facility, or as a pumping facility and a drain to a desert reclamation project. The contract for these facilities was designated Contract 30 and was scheduled for construction between mid-1988 and mid-1990.

The issues involved in implementing the desert reclamation plan were substantial and compounded by the redefinition of Abu Rawash

as a primary WWTP. While the overall consideration of treatment requirements, water quality, reuse, diversion, and other issues continues, a program calling for the discharge of both Abu Rawash and Zenein effluent into the existing drainage system moves forward. Contract 30, now consisting of Part A, Drain Improvements, and Part B, Siphon, will be constructed using a direct order to a public sector Egyptian contractor with reimbursement to CWO using a FAR agreement. All work is scheduled for completion by late November 1992 concurrent with the completion of Abu Rawash WWTP.

#### 2.3.6 Sludge Disposal

Sludge from Zenein WWTP is pumped to Abu Rawash WWTP for disposal along with the primary sludge from Abu Rawash.

The 1986 Project Paper Amendment designated sludge handling as a separate contract, but technical issues, questions of beneficial use, and environmental issues had not been investigated. Consequently, there is no 1986 point of comparison for facilities, implementation procedure, cost, or schedule.

The current plan for sludge disposal calls for using a large remote area of evaporation ponds. It requires a pump station at Abu Rawash, 27 km of pipeline, and an area of 1500 ha for the construction of evaporation ponds or lagoons. The present schedule for Contract 33, The Western Desert Project, calls for the work to be constructed between March 1993 and December 1994. Interim sludge handling facilities must serve both Zenein and Abu Rawash until that time.

#### 2.4 PROGRESS AND STATUS OF CONSTRUCTION

When discussing the status of construction projects it is important to have a clear understanding of terms. The key stages of the construction process are:

- Beginning of construction means Notice to Proceed (NTP)
- Completion or complete means substantial completion as evidenced by the issuance of a Certificate of Substantial Completion
- Commissioning implies initial start up or placing in service
- Close out means final accounting

The Project Paper anticipated all work would be accomplished under thirteen actual contracts numbered, labeled, and scheduled as shown in Figure 2.1. As the program has moved forward, a number of factors have affected this plan which are discussed in Section 2.3. The program now includes a total of fifty-four (54) separate construction contracts.

The current schedule for the construction phase of these projects is provided in Figure 2.2. The completion dates represent substantial completion, either actual or planned. Each of the FAR area projects is shown as if it were one contract with a note indicating the number of actual contracts.

#### 2.4.1 Completed Contracts

Only Contract 23 for the Zenein Pump Station has reached the stage for final accounting. Ten other contracts have reached the substantial completion phase, which represents 19 percent of the total contracts awarded to date. From the standpoint of actual constructed work in place, the stage of overall project completion is approximately 70 percent as of the end of FY 91, as illustrated in Table 2.1.

It should be noted that only Contract 31, Zenein WWTP, is in service and providing benefit in the form of wastewater treatment. None of the completed screw pump stations are in service, so neither the Boulac to Abu Rawash or the Pyramids culverts are receiving or conveying any wastewater.

Contract 20 is shown in Figure 2.2 together with Contract 20A. This is only to show the time relationship of being terminated in 1988 and redefined and awarded as Contract 20A in 1989. Wastewater is being pumped to Zenein until completion of the Abu Rawash WWTP. At that time, wastes from the 20A service area will be routed to Abu Rawash through the new major screw pump stations and collectors.

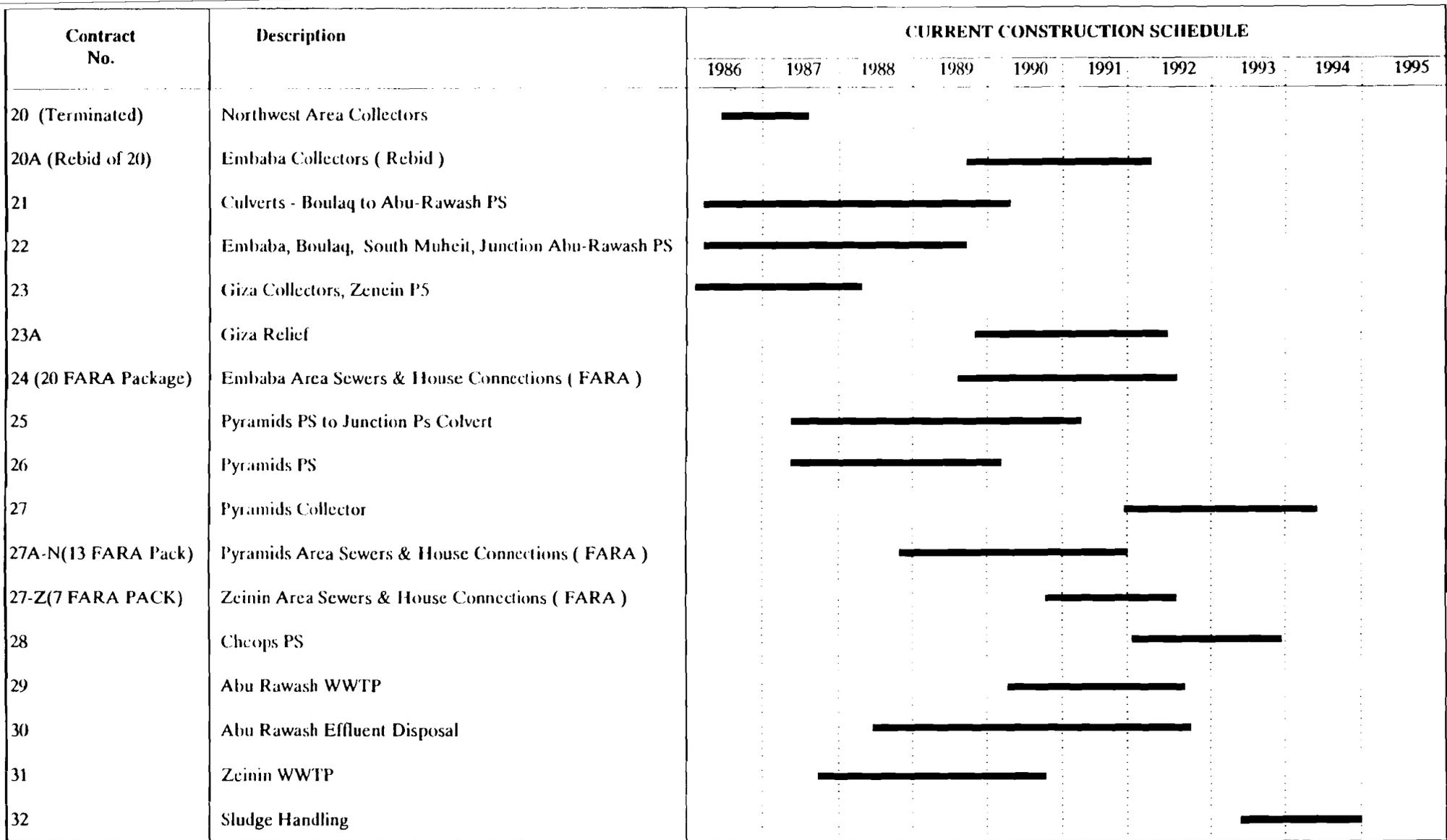
Work on five FAR contracts is now complete. Four of the initial contracts are in the Pyramids Area and were started early in 1988 to mitigate alleged groundwater problems with the Sphinx. Contracts 27A, B, and C were involved in this accelerated construction. Work on 27C encountered archeological materials. The contract was suspended, redesigned, and re-awarded as Contract 27N through a Variation Order to Contract 27C. The other FAR contract which has been completed is in the Embaba Area, Contract 24C.

#### 2.4.2 Contracts in Progress

Figure 2.3 shows the status of all 54 construction contracts in the current program as of the end of the FY 91. Figure 2.4 summarizes the status by dollar value.

American contracts construction work is ongoing for 21 contracts.

Contract 29, Abu Rawash WWTP, began in April 1990 with a scheduled completion of October 1992. Work has been proceeding satisfactorily and is presently assessed as being 70 percent



(A: WESTBAN1)

SOURCE: Various Progress Reports  
AMBRIC & CDM

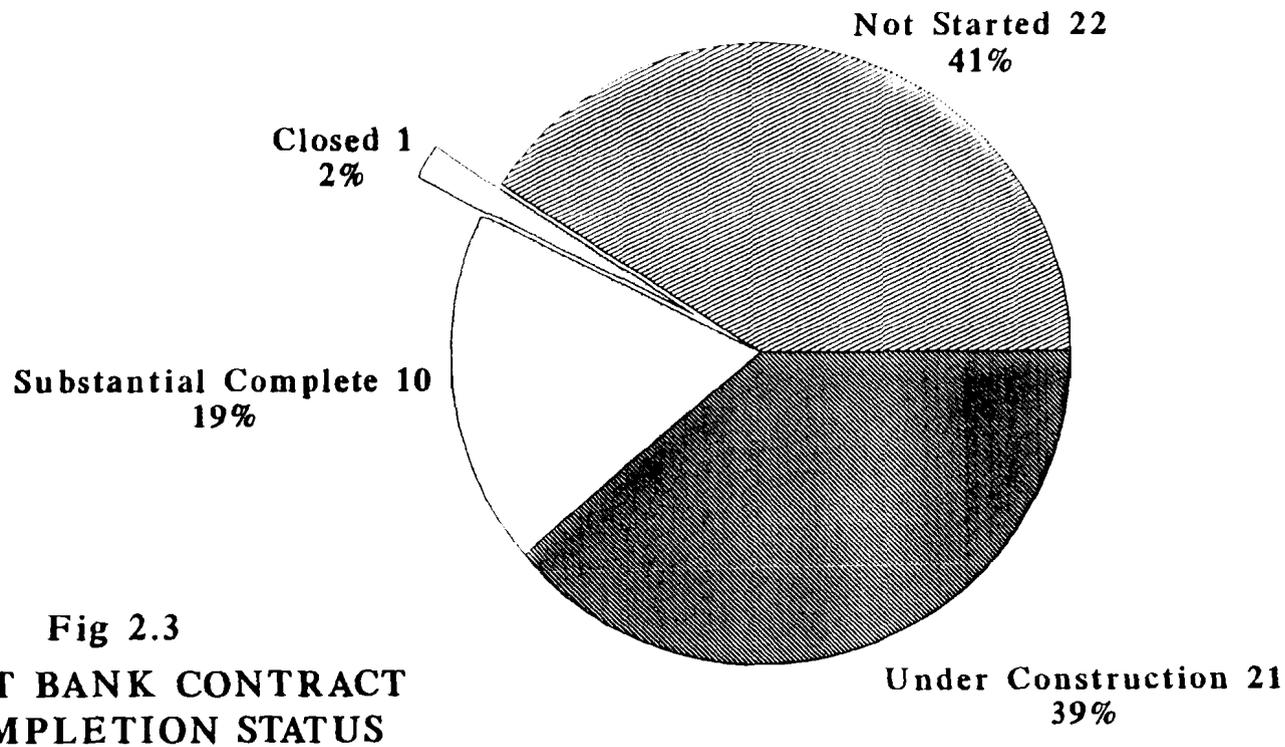
FIG 2.2  
CURRENT WEST BANK  
CONSTRUCTION CONTRACT SCHEDULE

20

**TABLE 2.1                      Status of Facility Completion, Cairo Sewerage II Project**

Type of Facilities	Total Contracts	Contracts Completed	% Completion as of End of FY91
Treatment Plants	2	1	84
Pump Station	4	3	98
Culverts	2	2	100
Collectors/Mains	3	0	81
Laterals/House	-	-	-
Connections	41	5	55
Effluent Disposal	1	0	0
TOTAL	53	11	70%

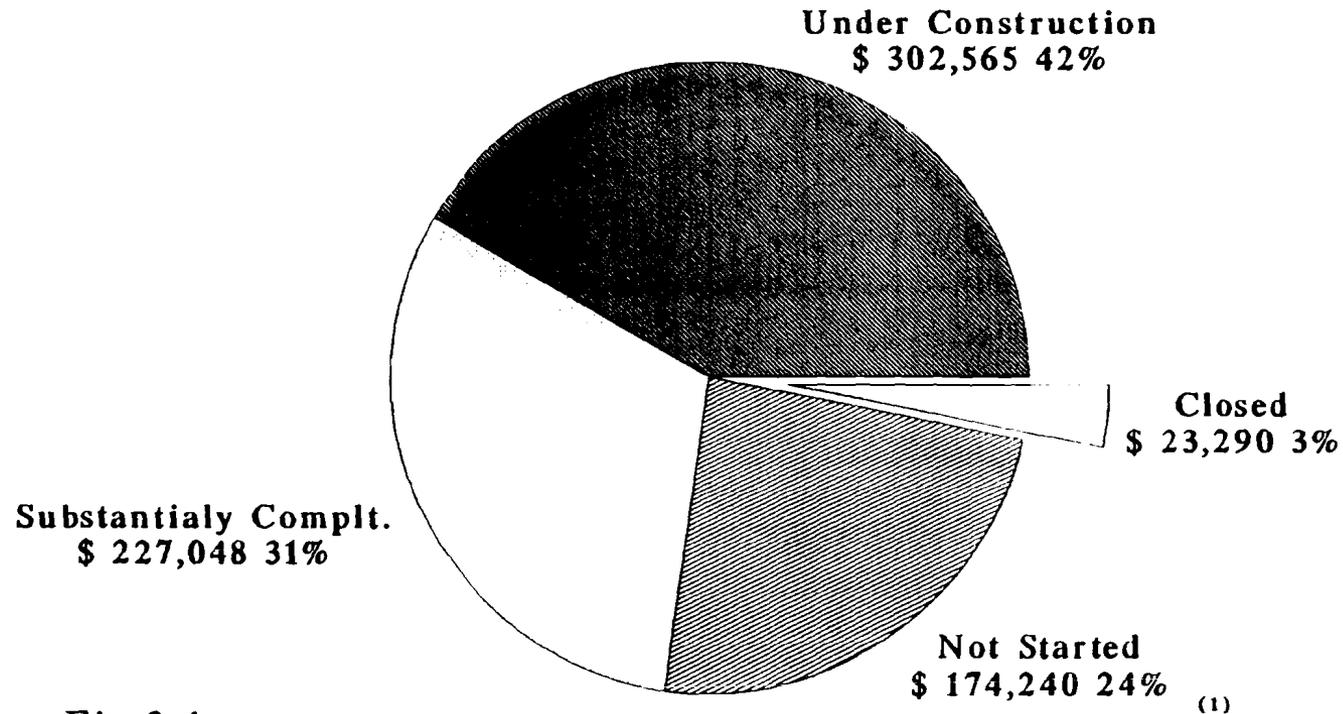
# Contract Completion Status



**Fig 2.3**  
**WEST BANK CONTRACT**  
**COMPLETION STATUS**

pie3

# Contract Value Status



**Fig 2.4**  
**WEST BANK CONTRACT**  
**VALUE STATUS**

plc4

Values in thousands of U.S. \$

(1) Estimated

complete by dollar value at approximately 67 percent of the allotted construction time.

Two substantial Change Orders are pending related to Contract 29 effluent disposal. These Change Orders, numbers 16 and 19, are expected to cost \$11 million, a substantial addition to the contract. As of September 30, these changes had not been approved but such notice is expected by late November 1991. No time extension is anticipated in the present contract schedule.

Work is also in progress on two major contracts for sewer collectors and laterals. On Contract 20A the work is almost complete and is projected to finish before year end 1991. Contract 23A is about 60 percent complete although over 80 percent of the contract time has elapsed. The contract is currently estimated to be completed by June 1992.

FAR Contracts. Thirty one FAR contracts have been awarded to 17 public sector contractors and 14 private sector contractors.

FAR program work is underway in three areas. In the Embaba area, ten of the proposed 20 contracts are under construction. Contracts 24A, 24B, and Contracts 24D through M are presently under construction. With one exception (Contract 24M), they are all behind schedule, some substantially. One is about 200 days or 97 percent over the contract period. In the Zenein area, all seven FAR contracts are under construction. None are complete, and all but one are behind schedule. Contract 27Z4 is less than 2 percent complete with about 45 percent of the contract time having elapsed. One other project is only 10 percent complete with 62 percent of the time utilized. Others are also behind schedule. In the Pyramids area, only one of the 14 scheduled FAR contracts is under construction. This is Contract 27N which is a Variation Order to Contract 27C. It is on schedule for completion.

#### 2.4.3 Contracts Yet to be Started

Major Facilities. The major works that have not begun construction include the Effluent Disposal Drains, Contract 30, and the Western Desert Sludge Disposal Facilities, Contract 33.

Contract 30 is expected to be awarded under a direct order to an Egyptian firm. There are two distinct work elements. Part A increases the capacity of the Abdel Rahman and Remel drains. This work must be completed concurrently with the Abu Rawash WWTP to provide effluent capacity for the initial plant flows. Part B is less critical to the early stages of the project but is needed to provide main additional capacity to the drainage system at a siphon under the Beheira Canal. The contract has been designed and negotiated. The necessary interagency permits and protocol are also in place. Contract signing and NTP await CWO final

review and approval. Initially these effluent works were to be in place by mid-1990. Studies and recommendations for an effluent disposal system were completed in 1985 but only recently has there been a decision made for an emergency system. Current plans for Contract 30 anticipate that work will be underway by November 1, 1991 and completed by November 1992. Delay in starting beyond January 1992 will affect start-up of the Abu Rawash WWTP.

The sludge disposal system, known as the Western Desert Sludge Disposal Facilities Project, Contract 33, is the second major facility not yet under construction. This project is under design with construction slated for April 1993 through December 1994, the latest completion date of any contract.

Contract 27 for the Pyramids Collector has been tendered and awarded. Notice to Proceed is scheduled for late November 1991, with construction starting in January 1992. Completion is scheduled for July 1, 1994.

The Cheops Pump Station, Contract 28, is expected to proceed on a similar schedule with construction starting in January or February 1992 and ending January 1, 1994.

FAR Projects. There are nine contracts in the Embaba Area FAR program not yet under construction. Two of these are signed but NTP has not yet been given. Six contracts have been awarded but have not been signed. One, Contract 24T, is awaiting CWO award approval.

In the Pyramids Area, where 14 FAR contracts are planned, nine are scheduled for procurement process starting in November 1991 through May 1992. Construction starts are scheduled between May 1992 and January 1993. Completion targets range from March 1993 through August 1994.

None of the uncompleted FAR projects are critical to West Bank facility commissioning.

#### 2.4.4 Work Unlikely to be Completed by the PACD

Contract 30 (Effluent Disposal), Contract 33 (Sludge Handling), and several FAR Contracts in the Embaba and Pyramids area will start in 1992. If they begin as scheduled, the completion dates would be as shown in Figure 2.2, subject only to conditions arising during actual construction work.

On Contract 30, a major element of the work involves tunneling to install a large siphon under a major irrigation canal. The contract is being awarded to a competent public sector Egyptian

firm. It is a very technical and difficult type of work and represents a potential delay to West Bank facility commissioning.

Contract 33, Sludge Handling, is basic civil works construction, except for lagoon liner installation, and should be completed as planned.

FAR projects have a history of time overruns. Of the five contracts completed, only one was finished as scheduled. The other four have averaged a delay of 5.3 months. Of the 18 FAR contracts under construction, four are on schedule and 14 are behind. Those behind schedule are projected to finish 3 to 14 months late.

The current program schedule shows all FAR construction work to be completed by September 1994, just before the PACD of September 30, 1994. Therefore, on September 30, 1994 many projects will still be in the normal one year maintenance warranty period.

In addition to the warranty and extended warranty maintenance periods, time is needed to close out administrative work and to prepare and settle final accounts.

Figure 2.5 sets forth the best estimate for the remaining work and activities which may not be completed until September, 1996.

## 2.5 CONSTRUCTION PROCUREMENT PRACTICES

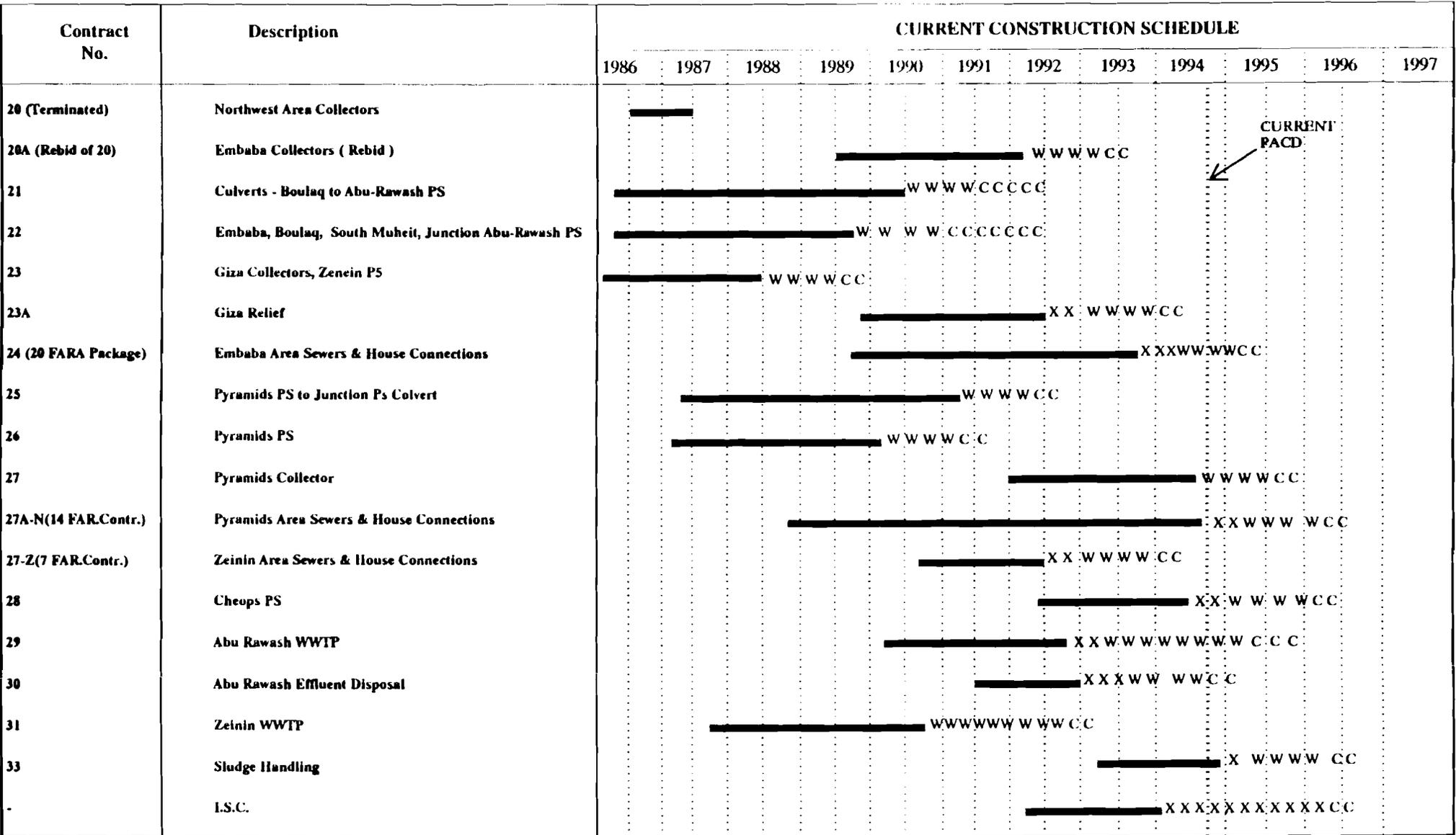
### 2.5.1 FIDIC Documents

During Cairo Sewerage I, the construction procurement and non-technical contract provisions of the Federation Internationales Des Ingenieurs Conseils (FIDIC) were selected for general use. When the East Bank work, funded by the UK, and the West Bank work, funded by USAID under Cairo Sewerage II, were made separate programs, the basic FIDIC procurement techniques were maintained.

Early in the program, all Cairo Sewerage II work was scheduled to be done by U.S. contractors, to U.S. standards, and paid for in U.S. dollars. On all contracts where these provisions apply, the FIDIC documents have been used for construction contracting and contract administration, amended to reflect U.S. construction practices and to meet USAID requirements.

Contract documents developed specifically for the FAR work are based on Egyptian construction contract law which is very similar to, and is patterned after, U.S. provisions.

For Contract 29, Abu Rawash WWTP, FIDIC was not used. Customized documents were prepared by CDM to reflect the modified Design/Construct approach to procuring and administering the contract.



CURRENT PACD

SOURCE: Various Progress Reports  
 AMBRIC & CDM

XXX Contract extension or overrun  
 WWW Warranty or OMT period  
 CCC Final accounting

FIG 2.5  
 IMPACT OF WORK REMAINING ON PACD

(C: WESTBA1)

27

TABLE 2.2 Waivers to Source/Origin Requirements By Contract and Value As of October, 1991

Contract Number	Item(s)	Value US \$	Total US \$
20A	Temp. Trench Shoring System	375,000	1,748,349
	Temp. Trench Shoring System	250,000	
	Trench Shoring System	295,000	
	Reinforcing Steel for Concrete Pipe		
	Trench Shoring System	395,000	
	Trench Shoring System	52,280	
	Trench Shoring System	375,000	
	Construction Equipment	6,069	
21	Radios	35,000	155,000
	Survey Equipment		60,000
	Equipment Spare Parts	60,000	
22	Radios	35,000	787,460
	Survey Equipment	60,000	
	Water Closets		
	WEBAC 157 (Foam)		
	Spare Parts	80,000	
	Type V Cement	600,000	
	Metal Lathe	10,000	
	Five (5) Lutz Drum Pumps	2,460	
23	Contract requested 3 waivers which were approved, but values are unavailable		
25	Temporary Materials		1,058,000
	Interim Statement 5	500,000	
	Spare Parts	100,000	
	H Piles	100,000	
	Portable Radios	8,000	
	Spare Parts	350,000	
26	Radios	20,000	
31	Concrete Mixing Trucks	110,000	503,450
	Spare Parts	90,000	
	Clarifier	200,000	
	Spare Parts	70,000	
	Deutz:Diesel (KHD)	25,000	
	Audio Visual Aids	2,450	
	Oil Breaker	6,000	
-	Survey Equipment (AMBRIC)	100,000	
Total US \$		4,372,259	

Source: AMBRIC, Waiver Status Report; memorandum from Eng. Mohsen to All SRE's, 2 November 1991.

The situation is somewhat unique because design documents had been previously prepared and CDM had been involved in the original design process. CDM has also been able to provide staff skilled and experienced in both design and field supervision and has developed working relationship with CWO which permit it to operate in a manner which approximates the traditional construction supervisory role.

### 2.5.2 AID Commodity Procurement Requirements

Source and origin requirements for goods and services are imposed by USAID in contracts that are awarded to U.S. contractors. U.S. contractors are required to obtain materials and equipment from American suppliers and manufacturers, unless provisions for requesting waivers are utilized.

To date, waivers have been granted in 33 instances. These are summarized by contract number in Table 2.2. The value of the waived goods is \$4.4 million and represents about 1.36 percent of the value of the U.S. contracts awarded to date.

### 2.5.3 FAR Contracts

The initiation of the FAR program in 1988 required the development of additional procurement documents. Work by Egyptian contractors under FAR format is done basically in accordance with Egyptian contracting law.

English and Arabic language contract provisions and terms were to be compatible with both GOE Law 9 and with the USAID FAR Agreement.

Technical specifications were modified to redefine certain requirements in terms of Egyptian standards, where they existed, while maintaining basic U.S. quality expectation comparable to the non-FAR work.

Some contract document translation and interpretation difficulty exists. When such issues surface, they are clarified within the framework of the individual FAR contract. The details and specific provisions are being fine tuned continuously.

One of the FAR program objectives is to utilize both public and private Egyptian contractors in approximately equal numbers. The documents and procedures for all FAR contracts are the same. Both public and private firms must pre-qualify in order to receive tender documents. Both submit tenders. AMBRIC makes award recommendations, generally based on the low price tender. The balance between types of contractors and any other GOE or local provisions are taken into account by CWO in the award process.

#### 2.5.4 CWO Contracting Procedures

The Cairo Wastewater Organization (CWO) serves as the owner and contracting agency for all FIDIC and FAR based contracts. The agency's procurement program must comply with numerous governmental policies for review.

#### 2.5.5 Bidding and Award

For the most part, the bidding and award process for construction contracts has been carried out smoothly. It does, however, take a long time. Some of the major contracts as well as FAR contracts, have taken a full year or more to be awarded once the bidding process starts.

### 2.6 CONSTRUCTION MANAGEMENT SERVICES

American British Consultants (AMBRIC), as a part of its consultancy, provides construction management services (CMS) for all of the Cairo Sewerage II construction work, except for Contract 29, the Abu Rawash WWTP. This project and the future Contract 30, Effluent Disposal, are handled by Camp Dresser & McKee International (CDM). Within AMBRIC, West Bank projects are administered and managed by an Assistant Project Director (see AMBRIC Organization Chart, Appendix D.) Activities are managed out of the West Bank Project Office located at the site of the Zenein WWTP. The office is staffed with management personnel, engineers, technicians, inspectors, and surveyors provided by AMBRIC's Cairo headquarters. There is design liaison with the home offices of the two U.S. firms which constitute the American portion of AMBRIC.

Construction management of the Abu Rawash WWTP is provided by CDM. CDM work is organized under a Project Manager, located at the plant site, along with a team of engineers, technicians, inspectors, and office support staff. The plant is being built under a design-construct agreement and, in theory, CDM monitors the work with less involvement CMS than normal.

In practice however, CDM has developed working relationships with CWO which permit it to function in a manner similar to that of the traditional construction management role.

When Contract 30, Effluent Disposal, goes into construction, CDM will provide the CMS as an extension of their design services.

#### 2.6.1 Compliance with Standards and Specifications

Compliance is obtained by review of submittals, review of contractor quality control program, by continuous on-site observation, and by specific acceptance testing by the Construction Manager.

Compliance should be routine and readily obtained. However, there are times when some level of enforcement is needed. The contract documents provide that the Construction Manager can enforce compliance by issuing directives, suspending or stopping work, deferring or withholding payment approval, or by not accepting work failing to comply with standards and specifications.

#### 2.6.2 Quality Control and Assurance

Quality control and quality assurance are used interchangeably in this report and are intended to mean the whole process of quality management.

AMBRIC Services. Tests, inspections, certifications, and the responsibility therefore are described in the technical specifications for individual types of materials, products, or construction. These specifications have both quality assurance and testing sections.

On-site observation, inspection, or test verification is done on each contract by the Resident Engineer's staff. Basic programs like factory testing and certification of items such as pipe are handled out of the West Bank office on behalf of all contracts.

This approach has been used throughout the project and both Construction Manager and contractors apparently find it satisfactory. Results are excellent.

CDM Services. At Abu Rawash, the contract documents require the contractor to prepare and submit a Contractor's Quality Control (CQC) plan for CDM approval. The plan contains detailed descriptions of the contractor's CQC organization, tests and inspections, and the forms for reporting. CDM monitors CQC plan compliance.

Since CDM staff have considerable skills and experience in design as well as field supervision, CDM's team has also been able to provide substantive inputs to the quality control program.

#### 2.6.3 Cost Control & Variation Orders

The total value of awarded contracts is presented for the major types of West Bank facilities in Table 2.3. Total value was \$436,471,164 as of the end of FY 91. There have been 686 variation orders approved by all parties (AMBRIC, CDM, CWO, and AID) amounting to \$41,836,640. Approximately one-third of the changes, resulting in 51 percent of the value of variation orders, were part of the rehabilitation of the Zenein WWTP. With the inclusion of work authorized with local currency, the percentage of change orders to contract award value is 9.0 percent. If the value of changes due to Zenein rehabilitation

**Table 2.3 Status of Facility Cost, Cairo Sewerage II Project as of End of FY91**

Type of Facility	Number of Contracts	Contract Price	No. of Variation Orders	Variation Order Cost	Percent of Contract
• Treatment Plants	2 (C29, C31)	\$ 187,223,346	223	\$ 21,280,230	11.3
• Pump Stations	3 (C22,C26,C23)	\$ 73,362,479	246	\$ 9,109,565	12.4
• Culverts	2 (C21,C25)	\$ 60,971,000	151	\$ 9,285,912	15.2
• Collector/Mains(FC) (LC)	2 (C20A,C23A)	[ \$ 114,914,339 LE 21,292,312 ]	49	[ \$ 2,160,933 LE 635,947 ]	1.9 3.0
• Laterals & House Connections (FAR)	23	LE 178,603,043	117	LE 9,791,248	5.5
<b>Totals</b>	<b>32</b>	[ \$ 436,471,164 LE 199,895,355 ]	<b>786</b>	[ \$ 41,836,640 LE 10,427,195 ]	<b>9.6 % (9.0 %) *</b>

\* Average of total cost at current exchange rate of 3.31 LE = 1.00 US\$.  
FC = Foreign currency; LC = Local currency

32

Table 2.4

Summary of Accident Data for West Bank Sewerage  
Project, 1986-1991 (39)

Date	Contr. No.	Type of Accident	Person Involved
24/09/86	C-23	Trench collapse; injury	Laborer
15/08/87	C-22	Falling blocks; death	Laborer
29/02/88	C-25	Electrical shock; one death, two injuries	Laborers
19/08/90	C-24-D	Collapsed cess pit; death	Laborer
14/10/90	C-24-D	Fall into manhole; injury	Site Engineer
14/01/91	C-27-Z	Fall into trench; injury	Public
5/02/91	C-24-E	Overtured Watertruck; injury	Laborer
13/02/91	C-27-Z	Equip. Installation; injury	Laborer
16/02/91	C-27-Z	Falling lumber; injury	Laborer
27/02/91	C-24-C	Fight; death	Laborer
09/05/91	C-24-A	Fight; injury	Site Engineer
13/05/91	C-24-B	Fall into manhole; death	Laborer
27/05/91	C-24-B	Electrical shock; death	Laborer
27/06/91	C-24-A	Vehicle accident; injury	Unknown
24/07/91	C-27-Z	Electric saw; injury	Carpenter
05/08/91	C-24-A	Sewer gas explosion; none	None
07/10/91	C-27-Z	Fall into manhole; injury	Public
15/10/91	C-24-J	Fall into manhole; injury	Site Engineer
20/10/91	C-27-Z1	Fall into trench; injury	Public
20/10/91	C-27-Z1	Fall into trench; injury	Public
04/11/91	C-27-Z3	Trench collapse; injury	Laborer
21/12/91	C-27-Z5	Lifting Equipment; injury	Laborer

Source: AMBRIC Accident Reports

are excluded, the percentage of changes drops to 4.8 percent. This is a very acceptable range given the type and size of the project and conditions under which work has been bid and performed.

Table 2.3 displays cost and variation history by functional category.

## 2.7 CONSTRUCTION SAFETY

There have been frequent construction-related accidents, including fatalities, on the project. Data compiled from AMBRIC project files for the period from 1986 to 1991 is summarized in Table 2.4. Accidents have involved construction laborers, site engineers, and the general public. Each construction contractor is responsible for safety during construction. He is also responsible for the means and methods of work, the supervision of employees and subcontractors, and site security.

FAR contractors have had more incidents involving the general public. They are required to "...take all precautions to prevent injury or death to laborers or any other persons during execution of the Works and to prevent damage to personal or government property..." Contractors are solely responsible for death, injury, and the like and all damages. No government standards are referenced and no safety equipment or procedures are specified by contract documents.

Few, if any specific safety procedures or programs seem to be employed by the various FAR contractors. Trenches are shored or sheeted but barricades, warning signs, flaggers, and safety clothing (shoes, hard hats, vests, etc.) were not observed.

AMBRIC has a safety coordinator who discusses these issues with FAR contractors and has apparently had some success in raising safety awareness with some of them.

## 2.8 CONSTRUCTION ISSUES AFFECTING THE PACD

To meet the PACD of September 30, 1994, all construction would need to be completed by mid-1992 in order to allow time for close out commissioning and warranty of the construction. Any factor causing construction to extend beyond that date has an impact on the approved PACD.

### 2.8.1 Availability of Funding

The major funding impact has been the loss of donor funding by the Japanese. Prompt funding would have allowed the Abu Rawash WWTP to be constructed as planned. By the time it was clear that this donor funding would not be available and the program was

readjusted accordingly, two years of slippage for Contract 29 had occurred.

### 2.8.2 Program Changes

Effluent disposal, sludge handling, and the FAR contracts are considered program changes. The length of time required to define and implement the Abu Rawash Effluent Disposal, Contract 30, has directly impacted the PACD.

Sludge Handling, Contract 33, is still in design. The study and approval of the sludge disposal scheme took a long time due to the review and decision process. Further delays were encountered in obtaining property rights for lagoons. This element of the work is scheduled for completion in December 1994, a date well beyond the mid-1992 completion required to meet the PACD. Sludge handling issues have had a major impact on the PACD.

Originally, all construction work was programmed to be undertaken by U.S. contractors. The program was dramatically changed with the inception of the FAR program. Lateral and house connection contracts had to be redefined, new bidding documents prepared, and new funding arrangements and payment provisions developed.

### 2.8.3 Construction Conditions

Conditions encountered during construction have had only minor effects on the PACD.

Existing Utility Conflicts. The utility situation has been a problem for contractors, particularly on collectors, sewers, laterals, and house connection contracts, because little or no information has been available on the location, size, or type of utilities. Utility associations often have no records and utility companies have been slow to respond to requests for temporary service and relocation. Contractors have generally solved the problem by making temporary arrangements and doing the restoration themselves. Utility issues, while extending completion times and causing variation orders, have not had a significant direct affect on the PACD.

Presence of Antiquities. Only one area of work has been affected by the discovery of items of archeological interest. Contract 27B was, in fact, stopped. Sewer lines were redesigned and included in 27E to be bid later this year.

Rights-of-Way. It is a GOE (CWO) responsibility to deliver the property or right-of-way to the contractor for construction. Some right-of-way issues were involved in the long culverts which crossed existing farmlands, but these were resolved with little to no impact on the project alignments or schedule. Property for pump stations was obtained. Construction of collectors, sewers,

and laterals generally is in streets or other public or community areas and does not require additional rights-of-way.

A general inquiry was made concerning the timely acquisition of rights-of-way and properties for constructed facilities. The Evaluation Team was satisfied that this condition has been adhered to during the project. The Western Desert Sludge Facility requires substantial rights-of-way for the proposed sludge force main and a large site consisting of approximately 1,500 hectares. While the Department of Defense has consented to the site acquisition, rights-of-way for pipeline alignment have not yet been obtained. This matter is critical to AID's approval of the award for construction on Contract 33.

Soils and Ground Water. The ground water conditions were well researched along with the soil conditions and the information was supplied to all contractors. Ground water control is a major element of the pipeline work and not all contractors handled it as well as they might have. Perched lenses of water were encountered in some areas requiring a localized water control scheme.

Some secondary effects of dewatering were experienced. Settlement of buildings occurred; some needed repair and, in one reported case, the demolition and rebuilding of a structure was required.

Overall, these conditions were known and were dealt with without directly affecting the PACD.

#### 2.8.4 Reviews, Certifications, and Acceptance by CWO

Delays in these activities are a continued source of concern. They have contributed to the slippage in awarding and close out of contracts, especially final acceptance and/or releases by other GOE agencies.

The bidding process for contracts involving U.S. contractors has typically required about four months to complete, sometimes longer. Tender evaluations, awards, and issuing Notices to Proceed are currently taking additional time, sometimes up to a year. Collectively these delays have had a significant effect on the implementation of the program.

The review, approval, and disbursement of interim payments continues to have a significant impact on the rate of progress of FAR work. Most contractors appear to require payments for their current contracts to enable continuation of work on those contracts. Delays in payment of five months after certification by AMBRIC are reported. Work is slowed and in some cases nearly stopped while awaiting payment.

When a construction contract is complete, AMBRIC issues a Certificate of (Substantial) Completion which authorizes the release of one half the ten percent retainage and starts the warranty or maintenance period.

Only Contract 23 has had the Final Accounting completed. Others that have been constructed are somewhere in this close out process. CWO appears to be avoiding acceptance until facilities are put in service.

Unless CWO finds a way to certify and accept present and future completed work in accordance with the contract terms, major delays in completing the Cairo Sewerage II program by the PACD may occur.

#### 2.8.5 GOE Regulations

GOE regulations have had only moderate impact on contract progress.

The long process of resolving the Abu Rawash effluent system was in part due to GOE regulations. This involved several jurisdictions and laws dealing with water quality and discharge to the drains and the Nile River. (See Section 4.2.8.)

U.S. contractors report difficulty dealing with the social insurance issue. The construction contracts require the contractor to pay these premiums to the collecting agency. Premiums are to be reimbursed by CWO. Calculation of premiums seems to be inconsistent.

The recently initiated ten percent tax on certain goods has had an impact on the work of the FAR contractors. Suppliers have raised certain prices by 10 percent. Contractors feel they should have their contract price raised accordingly. Requests have not been acknowledged. Some claims have been filed, but no action has been taken by CWO.

#### 2.8.6 Availability of Construction Materials

Availability of construction materials from U.S. suppliers has been good.

Some short term shortages of Egyptian produced materials have occurred. Concrete pipe, pre-cast concrete structures, vitrified clay pipe, and Type V cement have not always been available when needed.

This issue concerning Type V cement was handled at the project level by accepting other types of cement for non-critical construction and by minor adjustments to schedules. No PACD impact was noted.

A significant shortage of Blue Brick occurred in 1987. Quality of the finished product was really the issue, but it led to a quantity and delivery problem. The Blue Brick issue is well documented (75). The overall impact to Contracts 21, 22, 25, and 26 was time extensions of varying lengths and increased contract costs of \$2.1 million. Given the time frame and contracts involved, no real effect on the PACD is evident.

There are some unique and special construction materials needed in the work not yet started. On Contract 30, Effluent Disposal, special equipment and material is needed for tunneling and a large amount of stone is required for drainage system bank protection. On Contract 33, Sludge Handling, 27 km of sludge piping will be needed along with construction of 1500 ha of sludge lagoons. While no specific problems have been identified, the special nature and huge quantity of materials involved has the potential to become an issue which could further affect the PACD.

## 2.9 FINDINGS AND CONCLUSIONS

A general assessment and evaluation of the construction of the West Bank facilities under Cairo Sewerage II is given below. Findings and conclusions are grouped in a series of construction topics or issues.

### 2.9.1 Adequacy of Facilities

- 1) Abu Rawash WWTP is projected to be operating by the third quarter of 1992.
- 2) Abu Rawash must have increased capacity by early 1995 if the planned flow of 208,000 cmd from Al Ahram pressure main is to be accommodated; otherwise, alternatives must be found and implemented.
- 3) Major screw pump stations are projected to reach their installed capacity in 2 to 5 years after placing Cairo Sewerage II facilities in service.
- 4) Culverts, collectors, sewers, and laterals are adequate for the ultimate planned capacities.
- 5) There is no bypass at Abu Rawash to handle peak loads or to be used for isolating the plant in an emergency.
- 6) During the first year of operation, deficiencies in chlorination, sludge transfer, and secondary clarifier sludge collection equipment are evident at the Zenein WWTP (see Chapter 3.0).
- 7) Interim sludge handling facilities at Abu Rawash will not have sufficient capacity needed for both Zenein and Abu Rawash sludge production. The Western Desert Project (Contract 33) needs to be in service as soon as possible.

- 8) The adequacy of facilities, storage space, and handling systems for the sludge accumulation at the Western Desert sludge disposal site cannot be assessed at this time. The Design Report submission is behind schedule.
- 9) Quality control programs, construction management personnel, and contractor efforts are producing high quality work and finished facilities.
- 10) The modified design-construct approach used under Contract 29 has been successful. This success should be considered a direct result of the unique nature of the situation (existence of a design previously prepared by CDM and the experience of CDM field staff); it is unlikely that a design-construct procurement approach would normally be satisfactory due to the risks of bidding public works projects in Egypt.

#### 2.9.2 Commissioning of Facilities

- 1) Completion of individual facilities, acceptance testing, and start up, where appropriate, are being adequately handled under individual construction contract terms.
- 2) Zenein and Abu Rawash construction contracts have Operation, Maintenance, and Training (OMT) work elements covering the individual facility.
- 3) An OMT contract planned for the screw pump stations (Contract 32) is not necessary.
- 4) A separate interim maintenance contract covers periodic exercising of the large screw pump stations.
- 5) A commissioning plan, describing how the various individual facilities are put in service and balanced to operate as an effective system, is being prepared by AMBRIC.
- 6) Completion of a commissioning plan is necessary and must include coordination with East Bank activities to avoid new system overload and to coordinate the efforts of all of the organizations involved.
- 7) Only one construction contract is closed.
- 8) The percentage of authorized change orders and variation orders is good with the recognition that nearly 50 percent have been for justifiable additions, particularly in regard to rehabilitation of facilities and critical supporting infrastructure.
- 9) Contract acceptance procedures are being followed by AMBRIC and certifications of Substantial and Final Completion are being issued but there is inadequate follow through by the GOE. Consequently, facilities are not being transferred to GOSD.

- 10) GOSD management and staff must be part of the commissioning plan and commissioning process.
- 11) Without a detailed commissioning program agreed to by all responsible parties, the ability of the system to provide the intended service will be negatively affected.

#### 2.9.3 Project Assistance Completion Date

- 1) In order to meet the Cairo Sewerage II PACD, all construction work would need to be substantially complete by early 1992 to provide time for completion of all post construction activities prior to September 30, 1994.
- 2) Some construction is currently scheduled to extend beyond the 1994 PACD.
- 3) Construction could be delayed; a reasonable amount of time must be allowed for closing the services contracts and final accounting.

#### 2.9.4 Construction Program Management and Administration

- 1) The original program, plan, and schedule were well conceived and progress is good, although some unforeseen changes have occurred.
- 2) The construction management approach and the construction documents are appropriate and have served the program well, both technically and procedurally.
- 3) CWO's performance in construction procurement and administration is satisfactory but could be more effective with additional technical assistance.
- 4) Delays in acknowledging completion of construction has put several projects in a suspended state of completion.
- 5) Mechanisms for acceptance from the contractors by the GOE and the transfer of facilities from CWO by GOSD are required for the timely completion of Cairo Sewerage II.
- 6) The utilization of CDM for specific construction management tasks and the use of the modified design-construct approach at Abu Rawash WWTP have been reasonably well integrated into the West Bank program.
- 7) The West Bank construction management program has been well organized, staffed, and managed. It continues to provide very professional level services to the official client, CWO, and secondarily, to construction contractors, Cairo citizens, and USAID.
- 8) It is not clear how records management programs and equipment being developed for CWO will benefit GOSD or be used to operate and maintain the system.

## 2.9.5 Construction Contractors and Suppliers

- 1) American contractors experienced some difficulty early in the Project (1985, 86) and Contracts 20 and 23 had to be rebid or restructured.
- 2) Since then, the selected U.S. contractors have performed well.
- 3) Most U.S. contracts were completed on schedule or within approved time extensions.
- 4) Variation orders and claims have been nine percent of tender costs to date. This is considered an average ratio, but if change orders of rehabilitation in Zenein WWTP are disregarded, the ratio would be considered excellent.
- 5) Compliance with Source and Origin requirements has been well documented; only 30 waivers have been approved at a value of \$4,400,000.
- 6) Based on early experience and success, several U.S. contractors have obtained additional contracts, thereby continuing to use key staff and equipment.
- 7) FAR contractor performance varies considerably from contract to contract.
- 8) It is reported (but not substantiated) that private sector FAR contractors are more responsive to requirements and instructions than public sector firms.
- 9) Nearly all FAR contractors report satisfaction with plans, specifications, and construction management practices.
- 10) Private sector FAR contractors are concerned about slow payment by CWO and lack of response to their claims for contract price increases due to the recent 10 percent sales tax.
- 11) Since the start of the program, FAR contractors have improved their performance in the area of scheduling, submittals, quality control, and documentation.
- 12) At the completion of the FAR work, good as-built, horizontal and vertical location information on sewer lines and appurtenances will exist. A system for integrating this data into the information management system is being developed by AMBRIC for GOSD/CWO.
- 13) A program to map existing sewers is needed.
- 14) Suppliers who had or were able to develop management, production, quality control, and delivery performance were rewarded with direct business from the program and an improved position for future local and perhaps export work.

#### 2.9.6 Status of Present Construction

- 1) Of the 54 construction contracts in the present program, 32 are complete or under construction and 22 have not started.
- 2) The most critical contract to complete is Abu Rawash WWTP.
- 3) Until Abu Rawash starts up, about \$500 million worth of completed facilities will remain idle.
- 4) Contract 30 (Effluent Drain) is critical to operations but does not appear to present a schedule problem unless construction start is delayed beyond January 1, 1992.
- 5) Western Desert Sludge Disposal, Contract 33, which is in design, is scheduled for completion in December 1994. Acceleration of this project is desirable.

#### 2.9.7 Future Construction

- 1) Adding facilities to the Cairo Sewerage II program would affect the current PACD.
- 2) Studies have identified several additional village areas that could be served by the Cairo II facilities and designs are being prepared for four such villages. None are actually scheduled for construction and should not be bid until treatment capacity is available.
- 3) Abu Rawash WWTP will need to be expanded in the near future and the commissioning plan should defer connection of the Al Ahram force main.
- 4) Abu Rawash, Junction, and Pyramids pump stations will be the next facilities to be overloaded.
- 5) An update of the 1978 Master Plan or a West Bank facilities plan is needed to prioritize future sewer construction.
- 6) Future construction of the collectors, sewers, and house connections could be done by local contractors.
- 7) The local Egyptian engineering community has the capability for the design and construction management and local suppliers and construction companies are capable of placing the construction.

## CHAPTER 3.0

### PROJECT OPERATION AND MAINTENANCE

The methodology employed to evaluate operation and maintenance practice has been to conduct extensive site visits and interviews with GOE officials and project consultants to note levels of training, capabilities, and deficiencies.

#### 3.1 PAST O&M PRACTICES

Operation and maintenance practices by GOSD's predecessors prior to 1984 could not be confirmed; in fact, maintenance of West Bank Facilities appears to have been practically non-existent. Reports of pump station failures and streets flooded with sewage because of equipment breakdowns (mostly submersible pumps), sediment clogging and surcharging of sewers, installation of illegal bypasses by neighborhood associations, and lack of collection system maintenance have been confirmed through personal interviews, historic photographs, and engineering reports (10).

#### 3.2 CURRENT OPERATION OF FACILITIES

##### 3.2.1 Collection System

The new West Bank conveyance system will not be placed into service until late 1992, except for minor portions of some FAR projects in the Embaba and Pyramids areas. The existing collection system is maintained on a demand basis. Some parts of the system appear to have received some preventive cleaning at known trouble spots. Sewer cleaning vacuum trucks are employed, as well as dragging machines and hand rodding. All maintenance equipment is dispatched from a central location resulting in delayed response and excessive travel time for work required on the West Bank.

Cairo collection system maintenance is severely hampered by problems with locating sewers and manholes in areas where no accurate maps exist and where garbage or other fill material has covered the area. Manholes are often lost, or badly damaged due to the heavy loads of Cairo traffic.

##### 3.2.2 Sewage Pumping Stations

The existing pump stations visited by the team were of the submersible type with the pumps placed in both wet pit and dry pit configurations. Ejector pumps are utilized at some locations, but were not visited. Frequent maintenance problems result from heavy debris load and lack of screens or sedimentation chambers. High grit and trash content in sewage

flow result in excessive downtime for pumps and significant impeller wear. GOSD has an annual program to replace or rehabilitate older pumps. Maintenance checklists have been developed by AMBRIC for pump station operation, but their use by GOSD pump station staff is not consistent.

### 3.2.3 Zenein Wastewater Treatment Plant

Constructed in 1962 and remodeled in 1982-86, the Zenein WWTP has a capacity of 330,000 cmd average daily flow. Influent is pumped to the headworks followed by three primary and secondary treatment modules of 110,000 cmd each. The plant has been completely rehabilitated and has been in full operation since early 1990 providing treatment to acceptable effluent standards. Only flow that can be treated at Zenein is taken into the plant. The excess is diverted to separate preliminary treatment facilities consisting of screening and grit removal before bypassing to the Nahya Drain. No flow measurement is provided for bypassed flow. Average monthly plant flow during 1991 varied from 300,000 to 342,000 cmd.

The plant operates under relatively constant organic (BOD) and solids loadings. Daily peaks are dampened by the large service area and connected population as well as the bypassing. Large quantities of septage are dumped into the sewers by tank trucks servicing vaults in the unsewered areas. This loading constitutes a high strength source of BOD and suspended solids. The impact of large industrial flows cannot be observed under present operations. Seasonal changes in BOD have occurred and are unexplained. The plant also has high primary solids removal which is also unexplained.

The Zenein plant was designed with roughing bio-filters preceding a conventional activated sludge process. However, recent operating experience has shown that a better effluent can be achieved by bypassing the bio-filters due to excessive nitrification and poor settling in the final clarifiers and operating the activated sludge process at a relatively low mixed liquor suspended solids (MLSS), in the range of 1040-1350 mg/L. One hundred percent of the secondary sludge is returned to the plant headworks.

Average year-to-date effluent data for 1991 shown in Table 3.1 are 32 mg/L BOD and 22 mg/L suspended solids resulting in average removals of 89.2 percent and 94.0 percent respectively. Data for the months of October-December 1991 showed very good results with removal percentages of 92.7 percent for BOD and 96.3 percent for suspended solids.

While chlorination equipment was included in the rehabilitation contract, use of the equipment is not part of current operations due to equipment deficiencies under power failure. Leaks of

Table 3.1 Zenein WWT Performance Data for 1991. (ABB/SUSA, Inc. December, 1991 Report)

MANAGEMENT INDICATOR	NOTE	1991												MONTHLY DATA				YEAR TO DATE DATA				CRHMT YEAR TARGET		
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	% DIFF FROM LAST MONTH	SAME MO. LAST YEAR		TARGET		THIS YEAR	LAST YEAR			TARGET	
		AMT.	% DIFF	AMT.	% MET	AMT.	% DIFF	AMT.	% DIF															
<b>INFLUENT</b>																								
BOD		311	348	384	361	311	295	260	292	255	242	241	273	11.7	310	(11.9)			298	331	(10.0)			
Suspended Solids		443	422	444	347	360	351	340	320	332	348	338	364	7.1	483	(24.6)			367	402	(8.7)			
Volatile																								
Suspended Solids		287	296	276	239	247	233	218	209	219	219	223	241	8.1	297	(18.8)			242	274	(11.6)			
Total Solids		1372	1387	1359	1211	1211	1165	1151	1135	1160	1235	1205	1326	10.0	1308	1.3			1243	1009	23.1			
Volatile Total Solids		486	489	473	423	402	392	355	355	358	383	375	407	8.5	451	(9.7)			408	346	17.9			
Settleable Solids		6.2	5.3	5.8	5.6	5.6	5.7	5.2	5.5	5.2	5.6	5.0	4.4	(10.7)	5.4	(18.5)			5.4	5.6	(3.5)			
pH		7.3	7.4	7.3	7.3	7.3	7.3	7.3	7.5	7.5	7.5	7.4	7.5	1.3	7.4	1.3			7.4	7.5	(1.3)			
<b>PRIMARY EFFLUENT</b>																								
BOD	A	141	164	163	172	140	146	131	137	121	123	123	143	16.3	159	(10.1)			142	142	-			
Suspended Solids	A	124	102	92	92	89	72	69	70	77	71	72	89	23.6	143	(37.7)			85	107	(20.5)			
pH		7.5	7.4	7.4	7.4	7.4	7.4	7.4	7.6	7.6	7.6	7.5	7.6	1.3	7.5	1.3			7.5	7.5	-			
<b>FINAL EFFLUENT</b>																								
BOD	A	28	50	46	40	39	41	22	32	25	20	17	18	5.9	29	(37.9)	30		32	32	-	30		
Suspended Solids	A	41	41	29	23	22	19	16	19	19	11	12	16	33.3	43	(62.8)	30		22	37	(40.5)	30		
Volatile																								
Suspended Solids	A	27	31	22	18	17	14	13	14	14	9	9	13	44.4	27	(51.9)			17	27	(37.0)			

NOTES: (A) Average of values from Module I, II & III

5

Table 3.1 (continued)

MANAGEMENT INDICATOR	NOTE	1991												MONTHLY DATA				YEAR TO DATE DATA				CRRNT YEAR TARGET		
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	% DIFF FROM LAST MONTH	SAME MO. LAST YEAR		TARGET		THIS YEAR	LAST YEAR			TARGET	
															AMT.	% DIFF	AMT.	% MET		AMT.	% DIFF		AMT.	% DIF
Total Solids	A	939	966	916	850	837	802	804	798	811	843	836	901	7.8	974	(7.5)			859	827	3.8			
Volatile Total Solids	A	203	178	153	132	122	111	109	104	105	105	108	120	11.1	198	(39.4)			129	133	(3.0)			
Settleable Solids	A	1.3	0.1	0	0.4	0.1	0.5	0.1	0.7	0.1	0	0	0	-	-	-			0.3	0.4	(25)			
pH	A	7.8	7.7	7.8	7.7	7.6	7.6	7.5	7.7	7.8	7.9	7.9	7.9	-	7.8	(1.3)			7.7	7.7	-			
Chlorine Residual		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-			
Total coliform		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-			
Turbidity (FTU)	A	26	44	32	26	23	23	18	20	23	17	19	24	26.3	29	(17.3)			25	27	(7.4)			
MLVSS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	722	-			
MLSS	A	1352	1144	1244	1325	1141	1120	1132	1123	1059	1039	1085	1128	4.0	1995	(43.4)			1158	901	28.5			
F/M ratio		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-			
<b>EFFICIENCY</b>																								
BOD		91.0	85.6	88.0	88.9	87.5	86.1	91.5	89.0	90.2	91.7	92.9	93.4	0.5	90.6	3.1			89.2	90.3	(0.9)			
Suspended Solids		90.7	90.3	93.5	93.4	93.9	94.6	95.3	94.1	94.3	96.8	96.4	95.6	(0.8)	91.1	4.9			94.0	90.7	3.6			
# Samples collected		324	316	380	368	386	328	444	444	428	449	572	473	(17.3)	228	107			4912	849	827			
# Analyses perform		1536	1588	1753	1755	1831	1963	2440	2358	2314	2462	3089	2521	(18.3)	1034	144			25610	5335	380			
# Chlorine used		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-			
Flow (avg)		300	300	300	300	300	300	301	326	324	329	340	342	0.5	150	128			314	113	178			

NOTES: (A) Average of results from Module I, II & III

454

Table 3.1 (continued)

MANAGEMENT INDICATOR	NOTE	1991												MONTHLY DATA				YEAR TO DATE DATA				CRRNT YEAR TARGET		
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	% DIFF FROM LAST MONTH	SAME MO. LAST YEAR		TARGET		THIS YEAR	LAST YEAR			TARGET	
															AMT.	% DIFF	AMT.	% MET		AMT.	% DIFF		AMT.	% DIF
<b>ELECTRICAL</b>																								
KWH X 1000		2100	1882	2086	2438	2686	2646	2598	2498	2442	2230	2144	2228	(3.9)	1890	17.8			27978	5106				
# of outages		1	0	3	2	-	2	3	3	1	0	0	0	-	0	-			15	110				
Minimum minutes		-	-	4	4	-	4	60	5	24	-	-	-	-	-	-			4	1				
Maximum minutes		-	-	40	30	-	13	263	13	24	-	-	-	-	-	-			263	348				
<b>TRAINING-CLASS</b>																								
# Trainees		23	7	14	21	23	33	22	15	26	71	41	32	(21.9)	9	256			215	97	122			
Trainee-hrs		131	91	140	60	68	91	35	61	172	640	265	222	(16.2)	18	1133			1976	3646	(45.8)			
<b>TRAINING-OJT</b>																								
# Trainees		18	17	29	21	56	79	49	57	75	89	94	74	(21.2)	18	311			236	75	215			
Trainee-hrs		1009	1042	534	658	833	637	755	1241	1092	900	830	998	20.2	902	9.6			10529	6496	62.0			
<b>MAINTENANCE</b>																								
# Work orders exec.				232	364	238	333	280	338	401	695	393	641	63.1	-	-			3915					
Man-hrs					509	342	1068	1025	1866	3279	6104	2169	7427	242	-	-			23789					
Back log				190	397	428	173	312	3606	9851	861	3657	1517	(58.5)	-	-								

45B

chlorine gas pose a hazard to plant operator personnel and area residents because existing structures are not able to contain escaped chlorine. The existing chlorine storage building is accessible to vandalism. Emergency preparedness to handle accidental leaks is unknown and lack of security poses a serious threat to public safety.

The new screw pump intermediate transfer station has functioned efficiently although some minor deficiencies have been noted with lower bearing lubrication and hydrogen sulfide corrosion.

The standby generators are currently being replaced with units of American manufacture under a Variation Order.

Maintenance problems have been noted with the sludge ejector pumps and strainers, the secondary clarifier sludge collector mechanisms, air compressors (vibration problems), and the chlorination system.

Some maintenance equipment and facilities for plant mechanics were noted as insufficient, such as hand tools, work benches, vices, lockable storage cabinets, shelving, drill motors, and vehicles for transporting components back to the shops (which is undersized). Training facilities with equipment and tools abound as do needed items in stores, but very little is available to GOSD plant mechanical maintenance staff at this time. Electrical maintenance appears to be in somewhat better shape but sufficient shop space is not available for assigned tasks.

Security of the plant area was generally regarded as poor with too many site entrances; access from adjacent residential areas is unrestricted.

ABB/SUSA, under an OMT contract Variation Order, is providing O&M services at Zenein. This effort includes training of assigned GOSD personnel in all operating needs, including sampling and laboratory testing. A 30 day demonstration period, during which GOSD staff will assume full control, is scheduled for early 1992. A GOSD organizational chart for Zenein is included in Appendix D.

ABB/SUSA is providing very competent and professional services, as demonstrated by the plant operating results, level of maintenance, prompt attention to repairs, and, particularly, to the level of classroom and on-the-job training for GOSD plant personnel. Total contact hours for training, shown in Table 3.1, exceeded 12,500 person hours for 1991, or an average of 38.7 hours for each assigned employee. The contractor has noted, however, that employees frequently fail to attend training or do not complete training sessions (38).

#### 3.2.4 Screw Pump Stations

Seven of the eight planned screw pump stations are completed and ready for commissioning. All seven facilities are under an interim maintenance contract with AICI, an American contractor. They are operated for a minimum of 15 minutes each month by expatriate and Egyptian crews. The crews are the contractors' employees and do not include any GOSD O&M personnel at this time.

#### 3.2.5 Abu Rawash WWTP

Currently there are no operations at Abu Rawash except the GOSD operated sludge drying beds described below. The construction of the new primary plant is not yet complete and contract documents call for the contractor to start up these facilities and operate them for two years with an option to renew for an additional one year period.

#### 3.2.6 Sludge Handling and Disposal

Sludge collected from the primary and secondary clarifiers at the Zenein WWTP is conveyed through a dual forcemain to the Abu Rawash site for drying. This method was selected because the Zenein site has no space for such facilities. The pumping station uses centrifugal units and is able to pump 20,000 cmd of sludge at 0.6 percent solids content daily, which is sufficient for plant operations. The original primary clarifiers at old Abu Rawash are now used as sludge thickeners. Sludge is distributed to the drying beds from four thickeners with an underflow concentration which averages 3.25 percent solids (2.5 to 4.0 percent).

Two sets of drying beds are available, one set of small square cells constructed with the original plant and a second set of rectangular beds with 56 cells constructed at the site in 1962. Currently the second set of beds -- which had been designed for hand cleaning with the sludge loaded into small tracked carts which were pushed to the end of the bed and moved to nearby stacking sites -- is under rehabilitation, modification, and expansion as part of the new Abu Rawash construction and is not available for service. Since the original beds were not sized to handle the sludge volumes from Zenein, an emergency lined lagoon was constructed as part of the plant project to hold excess sludge until the drying bed project is completed. The sludge which is dried is removed by hand and sold to local farmers for land application.

The rehabilitated beds and the new beds under construction at Abu Rawash have been designed for mechanically assisted mixing and removal operations. The beds will be mixed utilizing seven vehicles with front mounted rotating screw devices (augers) known as "Brown Bears." Dried sludge will be removed utilizing twelve

small front end loaders (Bob Cats) and hauled to ultimate offsite using trucks. The sludge will be placed in stacking areas for distribution to farmers. The number of trucks is yet to be determined and purchased. Tests are currently being conducted to determine dried sludge production tonnages taking into account four variables: evaporation, enhanced evaporation utilizing mixing, percolation, and decanting. Sufficient land is available at the plant site for interim stacking areas should ultimate disposal be delayed, although odor problems may develop.

### 3.3 SAFETY PROGRAM

The Evaluation Team reviewed available records for construction safety (see Section 2.7), but was unable to obtain any statistics on work-related accidents and fatalities for sewer workers. Unofficial reports obtained in discussions with AMBRIC staff indicated that incidents occur with regularity, largely due to the number of unskilled, uneducated GOSD employees.

There is no active training program for safety at work sites. AMBRIC has recently provided technical assistance to GOSD under its PCS group addressing policies, organization, training, and equipment which should be of great value to GOSD activities.

For projects under construction, site safety is the responsibility of the contractor. Special training in safety programs for laborers to develop increased safety awareness appears inadequate.

### 3.4 TRAINING

#### 3.4.1 Siphon Pump Station Training Facility

For several years, GOSD has operated a training facility at a site adjacent to the Siphon Pump Station on Roda Island consisting of a prefab metal building which houses the trainers and a computer lab with five work stations. Another temporary building which provides a classroom, a training laboratory, additional trainer offices and three other classrooms is utilized by GOSD trainers. By the end of 1991 this facility will be closed and all equipment and personnel moved to the new facility constructed at the Zenein WWTP.

#### 3.4.2 Zenein Training Facility

A new 3,000 square meter training facility has recently been completed and dedicated at Zenein to house most future West Bank training operations. The facility provides classrooms, offices, and a large training laboratory. Also located at Zenein are on-the-job (OJT) facilities for electrical and diesel training and space for submersible pump OJT plus other future OJT needs.

### 3.4.3 Abu Rawash WWTP

There are to be no elaborate training facilities at the Abu Rawash Plant. Included in the plant construction contract as part of the Lab & Administration Building will be a small training laboratory, as well as a conference room which can be used as a training room. A large room in the plant maintenance building will serve as a combination lunch and training room. Audio/visual equipment is to be provided as part of the plant construction contract, as well as software for a maintenance management program.

### 3.4.4 Screw Pump Stations Facility at Pyramids Pump Station

Currently no facility exists to train GOSD O&M personnel in screw pump O&M procedures. Plans are underway to convert the Pyramids Pump Station into an interim training center. Plans call for the contractor, AICI, to build a bulkhead in the incoming box culvert, construct a recirculation system for the clean water which will be used, and provide security and housekeeping services during interim use as a training facility. Training manuals have been prepared by AMBRIC.

### 3.4.5 Collection System

No training of collection system laborers is currently being conducted.

## 3.5 AMBRIC POST CONSTRUCTION SERVICES (PCS)

An Action Plan for training operators for major West Bank facilities was formulated by reviewing the findings, conclusions, and recommendations of studies conducted under AMBRIC Work Order 4A. However, the Action Plan is not merely a summation of these studies but was meant to be used in conjunction with them. These studies consisted of The Systems Management Plan (SMP), The Systems Operations Plan (SOP), and The Comprehensive Training Plan (CTP). In addition to the deliverables mentioned above, services were intended to include training. This work was initiated in March of 1988 between AMBRIC and CWO.

Work Order 4B, signed in April 1989, is a continuation of the services provided under Work Order 4A but concentrates primarily on the maintenance requirements of GOSD. Officially entitled "Pump Station O/M Services," its start was delayed until September 1989 and was scheduled to be completed by February 1991, but was extended to June 1991 when the final report was completed.

Work Order 7 provides for the continuation and consolidation of previously authorized work under Work Orders 4A and 4B and is officially known as "Post Construction Support Services."

Assigned AMBRIC staff are currently implementing the 1991-1992 Work Plan submitted to USAID and CWO.

Current training programs under Work Order 7 include the 20 or so courses proposed under Work Order 4A (15) plus the continuation of a computer course using equipment purchased under an earlier project phase. Five GOSD employees attend the computer course each week.

### 3.6 GOSD INSTITUTIONAL SUPPORT CONTRACT (ISC)

This program is an attempt to address the problems discovered under Work Orders 4A and 4B. The terms of reference for the ISC and supporting documentation were reviewed. Although the contract's objectives appear ambitious, they have the full support of the Evaluation Team as necessary steps to remedy GOSD training deficiencies, well known since the project began. The scope of the ISC is discussed more extensively in Chapter 5.0.

### 3.7 WEST BANK FACILITY COMMISSIONING

A detailed commissioning plan as such has not been prepared. The screw pump stations appear to be less of a problem since they are operated monthly unless problems occur under full load with raw sewage.

Of particular concern is specific details for the commissioning of the conduits. This plan must consider time for a final inspection for, and removal of, debris since the screw pumps are not protected by screens.

Preparation of a commissioning plan for Abu Rawash is specified in an addendum to the construction contract but has not yet been initiated. Commissioning is tentatively set for early October 1992 and a full staff of contractor operations personnel are expected to be on-site three months prior to that date to prepare for start-up operations of the various units. Contractor operations personnel must also submit various reports and begin to collect information for O&M manuals and the required maintenance management program as described in the addendum. No GOSD operations staff have yet been identified. It is not known when such selections will be made, the quality and quantity of staff, how housing and/or transportation problems will be addressed, and when actual training of these people can begin.

The contractor is obligated to operate Abu Rawash for two years with an option to extend for a third year. The contractor is confident that GOSD staff will be assigned and commissioning will take place as scheduled.

### 3.8 FINDINGS AND CONCLUSIONS

#### 3.8.1 Operations

- 1) Since the formation of GOSD and the provision of new sewer cleaning equipment and training initiated by USAID, West Bank sewer collection system O&M practices are about as good as can be expected until the new relief sewers and screw pump stations are placed in service.
- 2) O&M takes place in response to problems rather than on a preventive maintenance basis or regular maintenance schedule.
- 3) System mapping must continue to be updated and utilized by sewer maintenance personnel.
- 4) New facilities, pump stations, or conveying system cannot be tested and operated under full load until the completion of the Abu Rawash Wastewater Treatment Plant and the Western Desert Sludge Facility.
- 5) The Zenein WWTP operation yields good results and is being well operated under Contract 31.
- 6) Older pumping stations operate with traditional tools and equipment and receive little or no preventive maintenance. GOSD has a continuing program for pump replacement.
- 7) While the GOSD has an Industrial Safety position, there is little evidence of employee education as to proper protective measures or work safety practices.
- 8) Responses to requests for maintenance and repair equipment for West Bank work orders are delayed due to excessive travel time and dispatching from a central location on the East Bank.

#### 3.8.2 Maintenance

- 1) Adequate preventive cleaning of old collecting system and equipment continues to be a problem.
- 2) Adequate maintenance care has been given to new pump stations but none to the conveyance system.
- 3) Zenein Wastewater Treatment Plant has no maintenance workshops, fabricating workshop, or transportation (busses or trucks).

### 3.8.3 Training

- 1) Good documentation of project O&M procedures and manuals exists.
- 2) Training instructions and manuals are written for appropriate level of education.
- 3) Training center at siphon pump station is small and will be transferred to Zenein.
- 4) Training center at Zenein is expected to be occupied by the end of 1991 and will include laboratory, computer, mechanical, and electrical training activities, as well as classrooms.
- 5) The Zenein training center will provide on-the-job training for electrical, diesel, and submersible pumps.
- 6) The training center of Abu Rawash will be small but adequate on-site laboratory, maintenance, and management training.
- 7) Plans for a training center at the Pyramids Pump Station are underway for 1992.
- 8) Present training programs carried out under contract through CWO to train GOSD staff result in attendance problems.
- 9) New GOSD Institutional Support Contract has raised expectations that known training deficiencies will be remedied.

### 3.8.4 Commissioning

- 1) Commissioning of all new facilities is dependent on the commissioning of Abu-Rawash.
- 2) Assurance of final inspection plans for conduits.
- 3) Key GOSD personnel, such as superintendent, chief engineer, and senior operators have not been named for pump stations or Abu Rawash WWTP. It is not known when such selections will be made, the quality and quantity of staff, or when actual training of these people can begin.

## CHAPTER 4.0

### SOCIAL AND ENVIRONMENTAL IMPACTS

#### 4.1 ADEQUACY OF RESOURCES

There are four types of resources necessary for the project. These are funding, both U.S. and Egyptian; professional services in terms of engineering and project management; local manpower resources for construction and O&M; and local construction materials and services availability.

##### 4.1.1 Funding

In 1984, the integrated program of design, construction, O&M support, and training was estimated to require \$816 million. Since initial authorization, \$679 million has been appropriated and 70 percent of construction completed.

The availability of U.S. or GOE funding has not had any significant impact on scheduled completion. Approval to expend U.S. funds was administratively withheld in 1991 thereby delaying award of construction contracts. This was due to failure of the GOE to show progress meeting grant conditions (see Section 1.3).

##### 4.1.2 Engineering and Project Management

Adequate technical resources have been made available to the project by the GOE, consultants, and USAID. A discussion of each project participant is provided in Chapter 5.0.

##### 4.1.3 Local Human Resources

There have been a sufficient number of construction firms with resources to bid West Bank projects. Projects for American contractors have produced excellent bidding results with a number of projects being significantly below the engineers' estimates. Early in the project, American contractors experienced problems locating local subcontractors and labor skilled in certain sewer laying tasks. These difficulties were resolved by setting aside lateral sewers and house connections for Egyptian sewer contractors. Dewatering efforts also posed problems which were resolved by importing Egyptian well drilling crews from Upper Egypt. Egyptian public and private sector projects have had sufficient response to requests for bids and have produced good results in developing construction capabilities.

##### 4.1.4 Local Construction Materials

Some shortages of local construction materials, such as high strength cement and blue bricks for sewer lining, have been

encountered. These shortages resulted in rationing and slowed the completion of some projects. Imported products and equipment have also been slowed due to delays resulting from port handling, customs clearance, and highway shipment from Alexandria. Further discussion is provided in Section 2.8.

## 4.2 SOCIAL AND ENVIRONMENTAL FACTORS

### 4.2.1 Population Growth

Egypt suffers from explosive population growth. Forty-four percent of the population live in urban areas where the population growth rate is around 3.6 percent per year. Historical population records show that actual population growth rates are exceeding all projections and expectations drawn from the 1976 and 1986 censuses, the 1983 General Organization for Physical Planning (GOPP) projection, and water supply planning for studies portions of the East Bank completed in early 1990 (funded by USAID).

The population of the Greater Cairo Region, according to data from the 1976 census utilized in the 1978 Master Plan, was:

West Bank	2.13 million
East Bank	6.14 million
Total Population	8.27 million

GOPP made forward projections of population in Greater Cairo to the year 2000. The trends established by GOPP in 1983, based on 1976 census data, are summarized in Table 4.1 below. The Central Agency for Public Mobilization and Statistics (CAPMAS) conducted a second census in 1986. GOPP made available a comparative tabulation, prepared in 1989, based on 1976 amended data and 1986 corrected data. The revised population data is summarized in Table 4.2 below.

**Table 4.1 1983 GOPP Population Projection for Greater Cairo (14)**

	1976 (Millions)	2000 (Millions)	Geometric Annual Rate %
West Bank Population	1.97	3.46	2.6
East Bank Population	5.31	12.53	3.6
Total Population	7.28	15.99	3.3

=

**Table 4.2 - Census Data and Growth Rates for Greater Cairo (14)**

	1976 (Millions)	1986 (Millions)	Geometric Annual Rate %
West Bank Population	2.13	3.31	4.4
East Bank Population	6.14	7.76	2.4
Total Population	8.27	11.07	3.0

As presented in the preceding tables, the actual rate of annual West Bank population growth rate, 4.4 percent, was almost double GOPP's 1983 estimate. The West Bank population in 1986 almost equaled GOPP's year 2000 estimated population. The East Bank growth rate was only 2.4 percent, or about two-thirds of GOPP's projected rate established in 1983.

For the purpose of updating population projection to the year 2010 for sewerage study data, the annual percentage growth rates shown in Table 4.3 were proposed by AMBRIC (14).

**Table 4.3 - Growth Rates Proposed by AMBRIC for Greater Cairo**

	1986-1990	1990-2000	2000-2010
West Bank	4.6	4.2	3.6
East Bank	2.8	2.8	1.5
Total	3.3	3.3	2.4

Accordingly, the pattern of actual urban development differs somewhat from that anticipated in the master plan of 1978. Projected growth for the West Bank summarized in Table 4.4 below exceeds previous expectations. The need for an updated sewer master plan and the acceleration of Stage II facility design and construction were thus strongly endorsed in the 1991 AMBRIC System Load Review (14) as well as other reports.

**Table 4.4 AMBRIC 1991 Population Projection for the Cairo West Bank (14)**

KISM	1990	2000	2010	SATURATION
Zamalek	22,900	25,900	25,900	36,600
Roda	22,000	23,800	24,700	38,000
Embaba	561,600	710,000	710,000	718,300
Agouza	195,500	220,100	220,300	278,800
Dokki	108,900	151,100	170,000	211,100
Giza	276,000	320,000	386,000	483,600
Boulac				
El Dakrour	738,600	677,900	1,004,300	1,986,500
El Ahrām	342,000	363,800	700,900	1,617,600
Embaba Markaz	941,900	1,416,000	2,139,000	3,789,700
Giza Markaz	149,500	300,000	600,000	883,800
<b>TOTALS</b>	<b>3,358,800</b>	<b>4,208,600</b>	<b>5,981,000</b>	<b>10,044,000</b>

#### 4.2.2 Urbanization

The General Organization for Physical Planning (GOPP) published a master scheme in 1983 for the Greater Cairo Region (GCR) for the year 2000. It shows the extent of the Cairo urban area. No corresponding planning has been done by GOPP for the period 2000 to 2010. The basic land development policies embodied in the GOPP planning were:

- Decentralization through the development of new towns and new communities, and
- Protection of agricultural land from urban encroachment.

The policy of developing new towns and new communities has been adopted mainly to reduce informal urban development within the GCR, and to mitigate residential densities in central Cairo. To achieve these objectives, cheap serviced (basic infrastructure) plots is also an alternative.

Informal urban development is, in essence, informal housing provided through the private sector for low income groups. In contrast to the planned new towns and new communities, ad hoc towns and communities lack the basic infrastructure supplied by public sector.

Most of this informal housing is located in the West and North of Cairo (especially in Embaba Markaz, Giza Markaz, and Kism Giza) at the expense of the agriculture land. Population densities in these informal areas tend to be high. In addition, the projected population (14) for this sector is enormously increasing. Embaba

Markaz, Giza Markaz, and Kism El Ahram (where most of the informal housing is built) have projected population increases by year 2010 of 127 percent, 300 percent, and 104 percent respectively. According to the AMBRIC 1991 System Load Review (14):

- Urban growth will continue to occur within the project area in parallel with development of new towns and new communities.
- Informal housing development will continue beyond 2000.
- Despite the legal controls on urbanization and agricultural land, urban encroachment in agricultural areas will continue.

Clearly, the 1978 master plan must be updated in order to assess properly the sewerage system load, especially in the West Bank.

#### 4.2.3 Street Flooding

Flooding of streets from raw sewage continues to occur in both the existing sewered areas and in unsewered areas. Flooding in the latter is due mainly to lack of maintenance of installed sewage vaults. The rehabilitation of the existing Cairo sewer system as a part of Project 263-0091 included an investigation by AMBRIC engineers of sewage flooding incidents. Flooding was a very serious situation in over 195 locations, 46 of which were located in the West Bank area. Principal causes of flooding in sewered areas are inadequate sewer capacity, flat gradients, siltation, sewer abuse, and inappropriate relief pumping systems. Nine areas of the West Bank system were prioritized in 1981 for rehabilitation by reconstruction of existing lines, relief sewers, and new pumping stations: El Awkaf City, Sanadiely Street, Block Nasr, El Munira, Tahrir and Ommal Cities, El Aalam City, Abu Horeira and Sakeit Mekki.

Until the Giza and other relief interceptors are completed and put into operation, the full impact of flooding relief can not be determined. Periodic flooding occurs regularly in some areas due to surcharged laterals and pump station failures. GOSD is reportedly making improvements to prioritized areas and new problem areas as a part of its annual capital construction program. AMBRIC resident engineers working in the FAR project areas report almost daily street flooding in unsewered areas from vaults.

The Evaluation Team has been unable to verify that any records are maintained of flooding incidents and locations. No records were available for the amount of annual sewer cleaning accomplished with GOSD personnel and equipment.

#### 4.2.4 Transportation Access

One of the objectives of the project has been to improve access and public transit in the developed areas of the West Bank. Inadequate sewage disposal frequently interferes with access by resulting in flooded streets which create traffic jams and detours (see section 4.3). The Evaluation Team found little direct relationship between the improvements being made to the sewerage system and transportation access, other than the elimination of flooding.

#### 4.2.5 Sewage Bypassing

Bypassing of raw sewage is largely an indirect measure of the effectiveness of the system to handle and treat all sewage received. No provisions exist for bypassing to surface waters at any of the new pump stations or at the Abu Rawash Plant. Since the Zenein Plant was put into full operation, a substantial volume of raw sewage is bypassed to the Nahya Drain. Because there are no capabilities to measure bypassed flows, only estimates are available. Estimates put this flow in the range of 300,000 to 400,000 cmd. A significant portion of this flow is the 292,000 cmd of sewage (14) temporarily diverted to the West Bank from the East Bank system.

As new facilities are brought on line, particularly the Saft El Laban and Zenein FAR projects, the amount of bypassed flow is expected to continue to increase. With elimination of the East Bank flow and startup of Abu Rawash as proposed, bypassing at the Zenein Plant should cease for a period. Recent flow allocations prepared by AMBRIC show that Zenein will have about 138,000 cmd in excess capacity after the Abu Rawash Plant commences operation. However, within two years of full operation, the capacity of Abu Rawash will probably be exceeded; by the end of 1995, Abu Rawash will have to bypass up to 185,000 cmd under average flow conditions and 420,000 cmd under peak flow conditions. There is currently no bypass channel constructed at Abu Rawash. The component for system commissioning which will have the biggest impact on the plant's capacity will be the addition of the El Ahram District. The principal cause of excess flow and resulting bypassing is due to 1) the unanticipated growth in existing sewered areas and 2) the additional connections for new sewered areas such as El Ahram added to the original plan for first stage service.

#### 4.2.6 Community Attitudes Towards the Project

To fully assess how the general population perceives the Project would require a survey of residents in various sewered areas. It is obvious that due to difficult construction conditions, the construction of collector sewers and house connections has had a considerable impact on activities in developed areas in terms of

inconvenience and travel. On a relative basis, however, such inconveniences have been no worse than the problems associated with sewage flooding or other construction work such as water, roads, bridges, communications, etc.

Through questioning of resident engineers and observations of the public in areas of construction, it was apparent to the Evaluation Team that there is very good support for the installation of sewers. Once sewers are installed, residents quickly complain if there are stoppages or odors.

#### 4.2.7 Public Health Objectives

Sewerage of an urbanized area is clearly an important factor in the prevention and control of health hazards. At this stage, however, any attempt to assess public health improvements brought about by the sewer improvements in the West Bank area under the Cairo Sewerage II Project would constitute speculation. Time must pass following construction before such differences can be detected, and adequate baseline data concerning public health statistics prior to sewerage is also needed in order to make a significant comparison.

However, a brief epidemiological survey of the West Bank service area was conducted as part of this evaluation. It consisted of field visits for data collection and a review of historical data to define significant parameters. Information was obtained from the Ministry of Health, the Giza Health Department (GHD), the Embaba Fever Hospital, Endemic Diseases Control Department, the Malaria and Filariasis Control Section/GHD, and the Communicable Diseases Control Section/GHD.

Epidemiological and admittance statistics which may bear some relationship to sewerage improvements were reviewed, including data related to infant mortality rates, diarrheal diseases in children, typhoid, paratyphoid, hepatitis, dysentery, poliomyelitis, filariasis, and malaria. However, the Evaluation Team found that the availability of data was inadequate for any level of statistical analysis at this time.

#### 4.2.8 Water Quality

By virtue of the USAID/GOE grant agreement, the West Bank Project will utilize the Nahya-Muheit-Rahawi irrigation drain network for all effluent discharge. Upon completion of the project, effluent flow will make up the bulk of the flow in the upper reaches and approximately 50 percent of the flows in the lower reach influencing water quality characteristics of the drain system as it discharges into the Nile below Cairo.

The West Bank scheme for treatment and disposal of effluent has been planned and implemented in stages which can ultimately

comply with current GOE water quality regulations for either direct discharge to irrigation drains which flow to the Nile or for irrigation reuse.

The rehabilitated Zenein WWTP provides secondary treatment, and sampling for the first year of operation demonstrates an ability for the plant effluent to meet or exceed criteria for discharge to fresh waters.

Present construction of treatment facilities at Abu Rawash will provide primary treatment but will not bring this part of the project into compliance for discharge to irrigation drains. CWO is currently considering ways to enhance primary treatment at Abu Rawash by chemical addition to the primary clarifiers. This process is known to benefit both the level of treatment and hydraulic capacity. Such practices can result in removals in the range of 60 percent BOD and 80 percent SS. Use of the process will not meet the required drain discharge criteria and the only benefit derived will be to assure additional primary treatment capacity on an interim basis.

Only minimal attention has been given to the water quality impact of sewage discharges on the River Nile below Cairo. Historically, sewerage planning and facility construction has focused on removing raw sewage from the urban environment and offering some degree of treatment within available funding resources. Nevertheless, there is some risk in shifting public health issues further downstream. The lower Nile remains an important fishery resource as well as being a source of diversion for both domestic and irrigation uses. Some baseline water quality data exists for the period of 1979 to 1982 for the Rosetta Branch in the vicinity of the Muheit Drain system discharge. Other data is available on the Nile below Cairo.

Utilizing available water quality information and five different scenarios for sewage treatment and discharge, the impact on the lower Nile was projected utilizing a simplified dissolved oxygen model. The methodology and results are provided in Appendix D. Based upon limited water quality data and continued regulated flow conditions in the Rosetta Branch, the distance for recovery of dissolved oxygen levels below the drain discharge are affected very little for average summer flows, but are significantly affected during low winter flows.

#### 4.2.9 Industrial Waste Discharges

As a part of Contract 4A, AMBRIC engineers conducted a survey of industrial waste generators for the Cairo area, including 30 industries located on the West Bank. Work is continuing to develop more detailed information for industrial wastes generated and discharged to the East Bank, West Bank and Helwan systems under other donor funding. The importance of such studies is

threefold: 1) to identify sources and quantities of discharges of toxic chemicals which may be harmful to the conveyance system or upset biological treatment facilities; 2) to quantify high volume and high strength waste discharges and determine their impact on the conveyance system and waste treatment plant operations; and 3) to assess use of additional tariffs for high strength discharges based upon equivalent connections to offset disproportional use of treatment capacity and associated operation and maintenance costs.

#### 4.3 INSTITUTIONAL RELATIONSHIPS

##### 4.3.1 GOE Laws and Regulations Affecting the Project

The primary law governing (municipal and industrial) M&I sewage treatment operation and discharges is Law No. 48 which was last revised in 1982. Law 48/1982 classifies waterways of the country into two groups from the standpoint of pollution control. These are 1) fresh waters, primarily the River Nile and primary irrigation canals, and 2) non-fresh or non-potable waters -- drains, lakes and ponds, bodies of water which largely consist of return flows. Governed largely by the tradition that the Nile is the source of all water, no domestic sewage, untreated or treated, is permitted to be discharged directly to the Nile. Discharge can only be to non-potable waters, most commonly to drains.

Ministerial Decree No. 8 (28), issued in 1983, further stipulates standards for wastewater treatment based upon effluent criteria and stream standards. For Egypt, streamflow is lowest during the winter and therefore winter is the most critical period for monitoring in-stream conditions and definition of mixing zones for point discharges.

The effluent criteria for treated sewage discharge to irrigation drains, according to current GOE regulation MD No. 8, Article 66, is: BOD < 60 mg/L and SS < 50 mg/L. Article 67 of the decree further requires the capability to treat the effluent with chlorine.

Law 48/1982 is administered principally by two ministries, the Ministry of Health and the Irrigation Department of the Ministry of Public Works and Water Resources (MPWWR). The responsibility for issuing permits and monitoring construction activities for discharges to canals and drains has recently been transferred to the MPWWR. The Ministry of Health monitors discharges and water quality of receiving waters.

There is also an Egyptian environmental agency which is responsible for coordination and monitoring of environmental issues of national scope. An agency representative is assigned to each governorate, including that of Giza. Environmental

quality regulations are neither monitored nor enforced. No evidence of effluent or in-stream water quality monitoring was found, even though this is required by Law 48/1982.

Although a protocol has been executed between CWO and MPWWR acknowledging the need for compliance with the provisions of Law 48/1982 by West Bank treatment facilities, no permit or license is considered necessary at this time.

#### 4.3.2 Other Public Services

Public services such as electrical distribution, communications, and water supply have been expanded significantly since 1984. In many areas of the West Bank, other infrastructure improvements have resulted largely from new development and without the benefit of master planning. Water system improvements have been studied for Giza City, but the remainder of the West Bank project area is greatly in need of infrastructure planning. Significant problems encountered in the implementation of Cairo Sewerage II include:

- the need to upgrade high voltage electrical transmission lines and install electrical substations for new major facilities;
- lack of adequate or accurate utility mapping to avoid utility conflicts;
- illegal expansion of small water distribution systems in residential areas constructed without permits and using extremely poor construction practices; and
- lack of coordination between utility design and construction.

The impact of other public services on construction is presented in Section 2.8.

#### 4.4 LOCAL ECONOMIC DEVELOPMENT

In the long run improved public health and environmental quality will result in economic benefits which cannot be measured until after completion of the project. However, Cairo Sewerage II has increased business and personal income and has contributed to the long-term development of some elements of the construction and manufacturing industries, including the labor market.

Since most funding comes from donor countries, construction costs have a positive impact on Egypt's economy, particularly in the Greater Cairo region. Wages paid locally to labor, both expatriate and domestic, have had and continue to have direct, indirect, and induced benefits to the local and national economies. Demand for locally produced goods (e.g., food and clothing) and services (e.g., transportation) have no doubt stimulated Egypt's economy. How much, is beyond the scope of

this evaluation, but generally, the multiplier for labor wages exceeds 2.5. That is, every LE 1 paid in wages generates over LE 2.5 in direct, indirect, and induced benefits.

After the construction project ends, GOSD will increase the amount of labor used to operate and maintain the sewerage system. GOSD will also continue to construct new elements of the collection system. Beyond these immediate and obvious economic benefits, the project has resulted in the formation of new businesses, expansion of existing businesses, and training for businesses in contracting for construction projects.

The business impacts are in two primary industry groups: construction and manufacturing. In construction, 43 of the 54 construction contracts completed, underway, or pending are directed to Egyptian Contractors. AMBRIC has provided training to improve the management capacity and performance of FAR contractors. During the course of construction, FAR contractors have become more proficient in the execution of work. In the future, these firms should be able to bid on and perform similar contracts both in Egypt and in other countries. Using Egyptian firms to complete construction contracts in Egypt also enhances the country's economy.

The manufacturing sector was affected especially in the areas of brick and pipe manufacturing. Cairo Sewerage II used exclusively Egyptian brick and pipe and Egyptian firms have expanded production to meet this demand. Also, and perhaps more important, AMBRIC's quality control standards (see Section 2.6.2) have forced manufacturers to improve the quality of their materials and, one would expect, to become more efficient in production. This is an important economic benefit as some Egyptian manufacturers are now in a position to bid on contracts outside of Egypt.

#### 4.5 REVENUE GENERATION AND SEWER TARIFFS

##### 4.5.1 Adequacy of Sewer Tariffs

To meet its obligations under the MOU, the GOE began in 1985 to assess a sewer tariff that will eventually be increased to a level that will cover total annual costs of the sewerage system. The MOU requires that the tariffs be increased to 50 percent of this level by 1990, and to 100 percent by the end of construction, which is currently scheduled for 1994. The 50 percent level was not reached in 1990, and it is unlikely that the 100 percent level will be reached by 1994; however, if the PACD is extended, this obligation will be extended.

Annual sewer revenues by source and expenditures by type are presented in Tables 4.5 and 4.6. There are two sources of local revenue for the GOSD, wastewater tariffs and miscellaneous

**Table 4.5 Comparison of Actual and Budgeted Revenues for GOSD (1,000 LE)**

		1985	1986	Fiscal Year Ending June 30,			1990	1991
				1987	1988	1989		
<b>REVENUES</b>								
Tariff	Budget	NA	NA	1,200	1,200	1,200	4,500	4,600
	Actual	NA	NA	550	4,247	4,670	6,141	7,083
Other Revenue	Budget	NA	NA	800	1,800	4,000	4,500	1,000
	Actual	NA	NA	1,013	2,779	678	2,600	6,022
GOE	Budget	112,242	108,482	108,426	119,198	165,908	146,994	159,459
	Actual	62,837	97,417	107,912	115,112	162,282	132,874	150,047
Total	Budget	112,242	108,482	110,426	122,198	171,108	155,994	165,059
	Actual	62,837	97,417	109,475	122,138	167,629	141,615	163,153
Tariff as a Percent of Total Cost				0.5%	3.5%	2.8%	4.3%	4.3%
Tariff as a Percent of Total O&M Cost				1.7%	11.4%	11.8%	15.2%	14.0%

**Table 4.6 Comparison of Actual and Budgeted Expenditures for GOSD (1,000 LE)**

		Fiscal Year Ending June 30,						
		1985	1986	1987	1988	1989	1990	1991
<b>EXPENDITURES</b>								
Wages	Budget	24,726	26,330	27,570	27,803	30,488	33,067	36,434
	Actual	24,178	26,076	26,791	29,932	31,553	33,855	36,468
Goods & Services	Budget							
	Interest	NA	NA	NA	2,095	3,790	1,687	2,025
	Parts	NA	NA	NA	915	1,086	1,363	2,200
	Other	NA	NA	NA	2,414	2,373	3,467	10,495
Total		7,216	6,699	5,589	5,423	7,249	6,517	14,720
Actual	Interest	NA	NA	NA	2,095	2,283	1,149	1,587
	Parts	NA	NA	NA	584	921	578	1,721
	Other	NA	NA	NA	4,499	4,873	4,740	10,926
	Total	4,061	5,944	5,900	7,178	8,077	6,467	14,234
Projects	Budget	66,000	65,000	67,100	80,555	92,424	110,462	107,488
	Actual	26,501	46,412	63,814	75,441	80,671	96,048	107,240
Debt Service	Budget	14,300	10,453	10,167	8,417	40,947	5,948	6,417
	Actual	8,097	18,985	12,970	9,587	47,328	5,245	5,211
TOTAL	Budget	112,242	108,482	110,426	122,198	171,108	155,994	165,059
	Actual	62,837	97,417	109,475	122,138	167,629	141,615	163,153

Source: 1985-1989 Budget and 1985-1988 Actual, [13, Vol. 2, p.39].  
1989 Actual and 1990-1991, GOSD Financial Records (translated).

revenue (i.e., wastewater connection fees and the sale of sludge).

Wastewater tariffs are assessed as a percentage of water tariffs. The General Organization for Greater Cairo Water Supply (GOGCWS) performs the billing and collection services for GOSD. From fiscal year 1986 until 1991, the wastewater tariff equalled 10 percent of the water tariff. In 1991 it was increased to 20 percent for domestic (housing) users and 50 percent for non-domestic users. 1991 tariff revenues for sewers amounted to LE 7.1 million, only 4.3 percent of total expenditures. In 1992, tariff revenues should increase to about LE 19.5 million, or 38.5 percent of current O&M costs. Based on an earlier study of water customers (31), approximately 75 percent are domestic users who have incurred a doubling of rates from 10 percent to 20 percent. The remaining 25 percent are non-domestic users who have incurred a five-fold increase from 10 percent to 50 percent.

Since 1987, miscellaneous revenues have fluctuated from a 1989 low of LE 678,000 to a 1991 high of LE 6 million. These revenues depend heavily on new building activity and are very difficult to forecast; in the long term they will amount to only a small fraction of total annual revenue.

While wastewater tariffs and local sources of revenue will become increasingly important to the GOSD, it presently relies entirely on budget appropriations from the GOE. Local revenues are, in fact, passed on to the GOE and the GOE authorizes total annual budget requirements for GOSD. The GOE subsidies net of local revenues are shown in Table 4.5. Until tariffs are increased to meet total annual costs, the GOE will need to continue to subsidize GOSD operations substantially.

Since 1985, expenditures have increased an average of 17.2 percent per year. Wages for all GOSD employees have only increased at 7.1 percent. Goods and services (which include interest payments on a long-term loan from Holland and spare parts and other operating supplies) increased 12.6 percent per year. Capital projects, which includes major repairs, expansion of existing sewerage facilities, and the construction of new collection systems, has increased at an average annual rate of 26.2 percent. This capital investment is separate from West and East Bank works. Debt service for GOSD is composed of principal payments on a loan from Holland for work on the East Bank.

#### 4.5.2 Tariff and Revenue Issues

To control costs, the GOSD must better define and project its O&M and capital project costs.

In 1989, AMBRIC developed a forecast of the physical needs of operating the complete East and West Bank sewerage system (9). A

later report (58, 59) estimated high and low O&M costs for all new West and East bank facilities. AMBRIC estimated that additional wages and goods and services would increase by LE 24.9 million to LE 31.2 million in fiscal year 1992, and that by 1993, these costs would range from LE 63.1 million to LE 101.9 million. For the low range, GOSD's O&M costs will increase by 124 percent. However, these figures are only preliminary and are not adequate for establishing wastewater tariffs for total cost recovery.

A study to improve the definition of GOSD annual expenditures and forecasting of annual costs is scheduled for 1992-93. Until this study is completed, the level of revenue required to achieve sustainable operations will remain unknown. Other problems with forecasting costs are: 1) GOSD currently enjoys subsidized electricity tariffs and lower than private sector wage rates, and 2) GOSD suffers from over staffing, high turn-over in critical job categories, and a shortage of basic office and management systems and equipment to assist management in making informed decisions.

Two separate reports, one completed in 1978 (26) and one in 1989 (9) by AMBRIC, came to several key conclusions: GOSD lacks the basic accounting tools and methods to adequately measure its costs and to establish wastewater tariffs. The 1989 AMBRIC report recommended that GOSD obtain the necessary computer hardware and accounting software and technical training to prepare GOSD for the day when it has to become financially self-sufficient. The recommendation is only now being made possible with funding under the proposed Institutional Support Contract (32). In the interim, GOSD personnel and consultants selected to help with tariff studies will have to work with non-computerized records. GOSD's training needs will be burdened by having financial training occurring during the same period as O&M.

About 75 percent of Egypt's 500,000 sewer customers are domestic users. The personal income of the majority of domestic customers is at poverty level. The current tariff structure is largely based on perceptions concerning the users' ability to pay, and to a lesser extent, on the cost of service. While the MOU is indifferent as to the structure of the tariffs, it is important to recognize that problems do exist with the billing and collection of tariffs. According to studies (33, 31), many households in lower-income neighborhoods of Greater Cairo are not known to be connected to the water system, do not receive or pay monthly bills, and do not have a water meter. The billing agency underestimates household water consumption, and leaking water fixtures go unfixed. These studies also conclude that GOGCWS does not have a definitive program for meter placement, maintenance, or replacement (33). Overall, "studies indicate that as much as 40 percent of all water produced and distributed is not billed (31)."

Interviews with GOGCWS indicate that at least some of these problems are being addressed, and progress appears to have been made in the billing process. GOGCWS has developed and is using a computerized billing system that tracks customer billings and payments using a minimum one-year history. At the time of the evaluation, GOGCWS had increased its billings by 15,000 to 20,000 per year over the last three years to reach its current total of more than 500,000 customer accounts.

#### 4.6 FINDINGS AND CONCLUSIONS

##### 4.6.1 Adequacy of Resources

- 1) Financial, manpower, and management resources were all deemed adequately available for the project. Significant technical assistance has been provided in the areas of engineering design, construction management, and O&M Training.
- 2) Transportation problems due to sewage flooding have largely been eliminated. Periodic stoppages in small diameter sewers still occur resulting in flooding of localized areas but have no impact on transportation or other means of travel.

##### 4.6.2 Social and Environmental

- 1) The population growth rate for the West Bank area was found in 1991 to be higher than the growth rates utilized in the original 1978 sewer master plan. Accordingly, the fact that future population projections exceed previous projections has raised two concerns: a) the sewer master plan has become outdated and b) the construction of new sewers and treatment plant capacity, in particular, needs to be accelerated.
- 2) Informal housing development with the proper extension of infrastructure has been extensive in some areas of the West Bank resulting in sewerage problems that were not anticipated in the 1981 Design Inception Report. AID funding of local sewers through the FAR program has been able to assist with this problem for the village of Saft El Laban near Zenein due to lower than anticipated construction costs. GOSD construction projects, funded by the GOE, are addressing other rapidly developing areas, but available annual funding is not adequate.
- 3) Adequate public health baseline data for reliable statistical analyses of health improvements brought

about by Cairo Sewerage II is not available at this time.

- 4) In the West Bank area, the rate of incidence of several diseases of public health importance may be affected by sewerage improvements. These include Infant Diarrhea, Dysentery, Infectious Hepatitis B, Typhoid, Paratyphoid, and Poliomyelitis
- 5) A comprehensive public health survey of fecal-oral related diseases of the West Bank area is needed, but is not feasible as a part of the Cairo Sewerage II process due to timing and budget.
- 6) Water quality in the lower Nile is seriously degraded as a result of inadequately treated sewage from the West Bank Area.
- 7) While a protocol between CWO and the Ministry of Public Works and Water Resources has been developed which recognizes the long range objectives of compliance with GOE environmental laws, no licenses are considered to be required at this time.
- 8) All sewage from the West Bank area will require secondary treatment in order to reduce pollutant loadings on the Lower Nile and meet effluent and instream water quality criteria.
- 9) Bypassing of raw sewage to irrigation drains on the West Bank is due primarily to sewage diverted from the East Bank and delays in commissioning West Bank facilities.
- 10) A comprehensive water quality study of irrigation drains and the Rosetta Branch is needed.
- 11) The inventory and identification of West Bank industries and their waste discharges should be assessed for impact on hydraulic and organic treatment capacity of existing plants. Such information is essential to identify risk of upsets, expansion needs for treatment plants and to establish policies for pretreatment.
- 12) The construction and manufacturing sectors of the Egyptian economy have been improved by the existence Cairo Sewerage II which has developed public and private sector capabilities for sewer construction projects and for supplying locally procured construction materials, particularly cement, pipe, and brick.

- 13) Opportunities have been provided for the development of small construction contractors through the use of the Fixed Amount Reimbursable (FAR) Contract program.
- 14) Public education in the use and abuse of sewer systems is inadequate. Refuse and other materials are frequently disposed of in sewer manholes, just as they have been in open drains.

#### 4.6.3 Adequacy of Wastewater Revenues

- 1) Annual expenditures for wastewater are subsidized by the Government of Egypt; 1990 and 1991 sewer tariffs equal only 4.3 percent of total annual cost and 14 percent of O&M costs.
- 2) Adequate financial data to identify O&M costs for GOSD is not available; however, projections by AMBRIC indicate that upon commissioning of new sewerage facilities, the cost of labor, goods, and services could be double current levels.
- 3) Sewer tariff increases have already been approved for 1992 and will have to continue to be increased significantly every year until the PACD in order to meet the MOU objective of 100 percent recovery of O&M costs.
- 4) Modernization of the accounting system through use of a computer based system is badly needed in order to provide data for internal management reports, annual budgeting, and reports required by the Ministry of Finance. The ISC will assist GOSD with this effort and with the necessary training of finance personnel.

## CHAPTER 5.0

### ORGANIZATION AND MANAGEMENT

Project implementation and the ultimate operation and maintenance of the Cairo Sewerage II facilities continue to present new challenges to the GOE. Now that much of the construction work is completed or well underway, attention is shifting toward preparing for operations start-up and the assumption of operating responsibilities by GOSD. The critical issues to be addressed now are largely institutional in nature. They relate to 1) preparing GOSD to assume O&M responsibility in the near term, 2) supporting and assisting GOSD as it continues to build its capabilities in the medium term, and 3) incorporating the necessary ingredients in GOSD's institutional development plan to assure long term sustainability.

#### 5.1 PROJECT OBJECTIVES IN ORGANIZATION AND MANAGEMENT

In broad terms, the objectives of the Project related to organization and management are to assure 1) proper management on a 2) sustainable basis of wastewater collection and treatment systems on the West Bank. As a practical matter, proper management and sustainability as achieved by GOSD must relate to all geographic areas under its jurisdiction.

AID has sought the attainment of these objectives through a combination of approaches. The first method was through grant conditions. Under covenanted terms in the Grant Agreement and stipulations of the Memorandum of Understanding (MOU), the GOE agreed to a number of key points (see Section 1.3). The main provisions relating to organization and management are summarized below (clarifying language added):

- To provide tariff increases as necessary to increase operating revenues so as to achieve coverage of O&M costs, debt service, and funds for routine improvements. This requirement was subsequently relaxed to only require coverage of O&M costs by the PACD (1994). It is also stipulated that O&M funding must be increased by an amount, unspecified, that would be adequate to the need.
- To provide (adequately staffed and funded) training facilities and programs for management, operations, and maintenance personnel.
- To establish incentive compensation systems sufficient in impact to permit recruitment and retention of qualified staff.

- To establish autonomous local water and wastewater organizations with authority to retain the revenues generated from their operations.

The second method has been for AID to provide a significant level of support to the GOE in several of these areas. AID has funded "Post Construction Services" through AMBRIC: studies of O&M requirements, preparation of training manuals, curriculum development, and classroom training programs provided directly to GOSD staff are illustrative. AID is also funding a major Institutional Support Contract for GOSD which will be administered directly by GOSD. Sector-wide institutional support and training services have also been provided by an AID funded project for NOPWASD over the past three years. Though not specifically directed at GOSD, the products developed under this program (Water and Wastewater Institutional Support Project - WWISP) are in many instances, applicable in the efforts to strengthen GOSD as an effective institution. AID policies in support of institutional development are also illustrated by the funding of capital projects which include 1) funding of the Zenein training facility, 2) provision for contractor operations and training of GOSD O&M staff during a two year phasing in period (one year with an optional one year for pumping stations), and 3) the provision of five years worth of spare parts for each major operating facility.

The GOE, on the other hand, has been slow in initiating actions aimed at meeting the agreed upon targets. At the insistence of AID, some progress has been made in the area of tariff increases (see Section 4.5.1), but the delay in getting started makes it difficult, if not unlikely, that the target for 100 percent coverage of O&M costs by the PACD can be met. The proposed GOSD reorganization plan, while incorporating some important improvements, makes no provision for autonomy which is a precondition to the establishment of effective performance based incentive compensation measures.

Based on the assessment of the progress of the Project presented in Chapter 2.0, it is reasonable to conclude that "proper management" has been employed in the conduct of Project activities up to this interim stage. This must be attributed, however, to the massive infusion of consultant and contractor resources and the fact that operations and maintenance responsibilities have not yet been transferred to GOSD. The goal of sustainability no doubt remains to be achieved. Given the extent of the resources being applied to preparing GOSD to take over completed facilities, a measure of success can be expected in the medium term. Institution building must be continued over an extended period and long term sustainability will remain an elusive target until GOSD can gain the financial strength and institutional autonomy envisioned in the Grant Agreement and MOU.

## 5.2 PROBLEMS AND CONSTRAINTS IN ACHIEVING PROJECT OBJECTIVES

Most of the problems and constraints which tend to inhibit the achievement of Project objectives are endemic within the context of GOE management systems. They have been cited in numerous evaluations and reports dealing with the water and wastewater sector dating back to the 1970s. A representative sampling is provided below:

- General tendency toward over staffing, particularly at lower levels, attributable largely to GOE full employment policies.
- Inability to recruit and retain qualified employees due to low salary and benefit programs. Tendency of qualified employees to be lost to jobs in the private sector in Egypt or abroad.
- Low levels of employee performance due to a variety of reasons including lack of incentives and, in some instances, disincentives for employees to improve their capabilities through training.
- Personnel system which stresses seniority as the key criterion for advancement, is lacking in career development programs, and lacks effective measures for dealing with absenteeism and/or disciplinary problems.
- Tendency toward excessive centralization of authority (minimal delegation).
- Excessive concern over the security of property (i.e., tools, spare parts, even scrap materials or dysfunctional equipment); strong punitive measures which tend to stifle employee initiative and inhibit the attainment of the full benefits of tools, parts, and equipment made available under the Project.
- Inadequate budgetary support for operations and maintenance, with annual appropriations based on prior year allowances rather than an objective assessment of funding requirements needed to properly operate and maintain the utility plant.

These and other related constraints to the improvement of organizational performance are inherently associated with government systems, procedures, and policies. Recognizing this, many observers of the situation, including AID, have focused on the need to remove wastewater and other sector organizations from the government arena. The solution most frequently proposed, as stipulated in the Grant Agreement and MOU, is through the

creation of autonomous or semi-independent utility organizations. Once removed from the framework of government systems and procedures, the utility organizations would be free to implement more effective and efficient management systems.

The theory is sound but realization of many of the benefits of such autonomy is dependent upon achieving a state of financial independence. As long as subsidies from government are required, government will impose its rules, procedures, and regulations on the recipient. Hence a further constraint is the lack of operating revenue in sufficient amount to cover basic operating and maintenance needs.

The prevailing "wisdom" among GOE officials seems to be that too many Egyptians are too poor to afford wastewater tariffs at the level required to achieve financial independence for the utility organization. Wastewater tariffs are, after all, starting from a very low base and must be increased in rather large increments in order to overtake an upward moving target. There is reason to believe, however, that affordability can be achieved through careful tariff planning including pricing policies which take full advantage of cross-subsidization opportunities.

The GOGCWS is reported to have achieved financial self-sufficiency, a situation that not long ago many would have thought to be impossible (72). A greater emphasis on cross-subsidization approaches in the wastewater tariff plan than is present in the water tariff plan will likely be needed to achieve affordability. This can be achieved in part, for example, through the use of industrial wastewater tariff provisions which account for wastewater strength as well as volume.

AID has consistently recognized the importance of revenue enhancement in Grant Agreement covenants. It has also provided funding for institutional support measures for revenue system and tariff design which are included in a forthcoming tariff study and the ISC Scope of Services.

### 5.3 ORGANIZATION OF KEY INSTITUTIONS INVOLVED IN THE PROJECT

The institutions playing key roles in the Project can be grouped into three categories: those dealing with implementation of the Project (CWO and consultants), the organization to be charged with operations and maintenance responsibility (GOSD, the ultimate "owner"), and the donor agency, USAID. Organizational arrangements, roles, and relationships are reviewed in the following paragraphs.

#### 5.3.1 CWO

The Cairo Wastewater Organization (CWO) was created in 1981 when the former General Organization for Sewerage and Sanitary

Drainage (GOSSD) was reorganized, transferring the planning, design, and construction management responsibilities for the Cairo Wastewater Projects to the new entity. CWO is an agency of the Ministry of Reconstruction, New Communities, Housing, and Utilities (MRNCHU) and was established by Ministerial Decree No. 497/81. It is an ad hoc organization with a life tied to the life of the Cairo Sewerage Project. No close-out date or criterion for determining a close-out date is provided in the Decree. Thus the date for closing CWO operations is subject to interpretation.

Several of the key staff, including the Chairman of the former GOSSD, were transferred into CWO at the time of its creation; the Chairman, in fact, became Chairman of both the new CWO and the reorganized GOSD, and held both positions for a period of three years. Salary scales within GOSD and CWO are the same, so there is no monetary incentive to move from one organization to the other.

Under the direction of the Chairman, the organization consists of a large staff agency (Office of the Chairman) and three central departments: Planning and Projects, Construction and Finance, and Administration. The Central Department for Construction is organized on a regional basis with General Departments covering the West Bank, East Bank, and Helwan.

CWO's authorized staffing provides for a total of 486 positions, with about 57 percent of the positions classified as temporary. At the time of the evaluation, however, 141 positions were vacant. Several key positions are occupied by individuals seconded to CWO from private construction firms. The Chairman's Office includes 114 positions, Planning and Projects has 43 positions, Construction staffing allowance is 118 positions (17 of which are retained under special contract), and the Finance and Administration functions are allotted 211 positions. Organization charts depicting the details of CWO's structure are presented in Appendix D.

CWO's principal role has been as a contracting agency representing the GOE. Its duties include performing the contract administration functions required within the GOE framework such as contractor pre-qualifications, processing of contract documents for tendering, bid evaluation, contract award, processing of change orders, payment processing, and contract close-out. In all these matters CWO relies heavily on the services of the Project consulting team, AMBRIC. CWO's relationships with AMBRIC are described in detail in the consulting agreement. Its office and field engineering staff act primarily in a liaison or facilitative capacity and do not participate directly in project management functions.

CWO's external relationships for contract procurement (tendering and award decisions) are primarily with the Higher Decision Committee of the Ministry (MRNCHU). After receiving the necessary approvals, CWO provides authorizations to AID concerning contractor payments to be made in U.S. dollars. It deals with GOE agencies through the normal LE funding processes for LE payments. This involves the Ministries of Planning and Finance, the National Investment Bank, and the Central Bank. CWO has also entered into an agreement with the Ministry of Public Works and Water Resources concerning improvements to be made to drainage networks (and associated pumping facilities) which will receive treated effluent from the Zenein and Abu Rawash treatment plants. The agreement includes transferability provisions at the time the facilities are transferred to GOSD which would obligate GOSD to the same terms.

### 5.3.2 AMBRIC

AMBRIC is a multi-national organization of American, British, and Egyptian engineering firms retained by the GOE to provide the technical services required in the implementation of Cairo Sewerage II. The organization is divided into four groups including top management, Central Services, Technical Services, and Construction Services. The Construction Services Group is divided into two sections, one each for the East and West Banks. Organization charts providing further detail on the make-up of AMBRIC's organization are provided in Appendix D.

AMBRIC is staffed by a total of 451 persons (as of 30 September 1991) which includes 82 expatriates. The Construction Services Group is the largest including a total of 262 persons (102 in the East Bank Section and 160 in the West Bank Section). Of its total of 58 employees, the Technical Services Group includes 26 persons for Post Construction Services, 29 in Study/Design, and three for Information Services. The extent to which AMBRIC has become involved in administrative detail is indicated by the staffing of the Central Services Group. Of the Group's total staff of 82, 58 are listed under Administration and Personnel and a staff of 12 is shown under a "Coordination" heading.

### 5.3.3 CDM

Construction management services are being provided for the Abu Rawash Treatment Plant under special arrangements, due to the unique circumstances of the project (see Section 2.3.4). The firm of Camp Dresser & McKee (CDM) is being retained to assist CWO under direct contract with USAID. Although its capacity can be described as being more than that of a liaison team, CDM's role in this assignment falls short of the traditional role in construction management for the major portions of the work. CDM is also providing design services in connection with the emergency effluent drain project.

CDM's monthly report for July 1991 showed a total staff of 18 assigned to this work. CDM is also providing a significant level of home office support and inputs from short-term specialists.

#### 5.3.4 GOSD

The Cairo General Organization for Sanitary Drainage (GOSD) is responsible for the operation and maintenance of the wastewater collection and disposal systems serving Greater Cairo, which includes the Governorate of Cairo, portions of the Governorates of Giza and Kalioubia, and the city of Helwan. The present organization structure consists of three central departments: Operations and Maintenance, Finance and Administration, and Projects. Two other units report to the Chairman, including a General Department for Research and a Training Department. Details of the existing organization structure are presented in Appendix D.

GOSD is staffed by a total of 10,399 employees, with 9,495 being assigned to Operations and Maintenance, 530 to Finance and Administration, 221 to Projects, 25 to Research, 24 to the Training Department, and 104 to the Chairman's Office. The existing organization plan is unsatisfactory and a revised plan has been prepared, approved by the GOSD Board of Directors, and submitted to the Central Agency for Organization and Administration (CAOA) for final approval. The principal difference between the existing and proposed plans is that the proposed organization includes a Vice Chairman for O&M and three central departments for O&M in the East Bank, West Bank, and Helwan. Details of the proposed organization are also presented in Appendix D.

GOSD functions as a general organization under the direction of the Governor of Cairo and is subject to all standard GOE personnel, budgetary, and procurement procedures and regulations. Its primary responsibilities lie in the area of operations and maintenance of existing operating facilities. These cover the full range of activities including neighborhood sewers, collectors, major conveyance conduits, pumping stations, siphons, treatment plants, and sludge handling facilities.

Although responsibilities for planning, design, and construction supervision for Cairo Sewerage II were transferred to CWO, GOSD continues to perform those functions for projects not considered to be within the scope of the Cairo Sewerage II program. Projects in this category include the Berka Treatment Plant and the tributary Nasr City Collector and the Shobra El Khema Treatment Plant and its tributary Shobra Collector.

GOSD has had minimal involvement in any aspect of the Cairo Sewerage II project (except the original 1978 master plan) and only recently has been actively participating in training

programs designed specifically to prepare its staff to assume operating responsibilities for the new facilities. GOSD staff, for example, have not participated in the design review process nor has there been any GOSD staff "presence" at construction sites. GOSD staff are now actively participating in a wide range of training programs prepared and offered by AMBRIC (in coordination with GOSD's Training Department) and in contractor conducted training at the Zenein Treatment Plant.

#### 5.3.5 USAID

USAID maintains an oversight role, must approve all major procurement actions and proposed change orders and act on all requests for commodity procurement waiver requests. AID staff attend all regularly scheduled progress meetings for projects under construction including quarterly Donor Liaison meetings.

### 5.4 PERFORMANCE OF KEY INSTITUTIONS INVOLVED IN THE PROJECT

#### 5.4.1 CWO

CWO appears to have functioned reasonably well within the framework and context of the GOE bureaucracy. However, considering the fact that it was created to improve upon normal levels of performance, the record is somewhat disappointing. Based on a review of the processing times for ten major contracts fully funded by AID, the average time required between receipt of tenders and CWO award is nearly 5.5 months, with a high of 7.0 months and a low of 3.5 months. An additional average processing duration of 2.0 months was required between the date of award and issuance of the notice to proceed. The records indicate that tender evaluation normally requires no more than 10 to 20 days, and funding approval by AID is typically achieved in about 14 days. One might reasonably expect that contracts of the magnitude and importance of those being processed for the Project would be handled much more expeditiously.

Based on a review of a sampling of FAR contracts, the processing time appears to be slightly shorter, averaging about 4.0 months between bid opening and award and slightly less than 2.0 months for signing and notice to proceed. Where competitive bidding is involved, there appears to be no difference in processing times between the selection and award of contracts to private vs. public sector companies. Under certain conditions for GOE funded projects, however, contracts can be awarded by "direct order" to public sector companies. The conditions for such awards would include 1) urgent requirement to proceed, 2) lack of budgeted funds, and 3) willingness of contractor to finance the work until funding can be made available. This process avoids the bidding and tender evaluation processes and greatly reduces the overall time required to initiate work after completion of the design.

There appears to have been very little in the way of coordination between CWO and GOSD. Routine procedures in these matters call for the review of all designs and contract documents by the designated operating agency, and at least an observer's role for the operating agency during construction. Arrangements along these lines have been virtually absent in Project activities to date. This is somewhat puzzling considering the fact that the two organizations were headed by the same individual during the first years of CWO's existence. Furthermore, GOSD's Chairman holds a seat on CWO's Board of Directors, as do the General Secretaries of the Governorates of Cairo, Giza, and Kalioubiya. Surely such coordinating arrangements were achievable if pursued by the concerned Board members.

CWO also appears to have had an "arms length" relationship with AMBRIC which has severely limited the opportunities for technology transfer or institution building within GOSD. As a result, CWO does not appear to have developed any significant capability to assume, in the future, much if any of the project implementation work (design, supervision, inspection, etc.) now conducted by AMBRIC. To the extent that this situation is attributable to the terms of the agreement between AMBRIC and CWO, it represents a significant lost opportunity in the design of the Project. Even though CWO is an ad hoc organization with a limited life, the development of construction management skills by CWO staff would have had lasting benefits to the GOE and the organizations to which staff members will ultimately be transferred.

Although CWO, with the assistance of AMBRIC, has performed with a reasonable degree of effectiveness, the Evaluation Team found a significant amount of dissatisfaction with the present division of responsibilities. Support was expressed in favor of the integration of CWO and/or its functions into GOSD. There is no clearly defined date for the completion of its mission nor any plan for the transfer to, or the development of capabilities within GOSD to carry-out the duties now performed by CWO.

#### 5.4.2 AMBRIC

The overall view of the Evaluation Team is that AMBRIC's performance has been highly professional and technically competent. The magnitude and complexity of the organization, however, has resulted in a significant, possibly excessive, level of bureaucracy. This appears to have affected neither AMBRIC's performance with respect to the quality of its products, project documentation, and project control, nor its ability to meet schedules.

#### 5.4.3 CDM

The nature of CDM's assignment is such that it must work closely with CWO staff; its role is therefore highly integrated into CWO's operations. In addition, and on its own initiative, CDM offers periodic training sessions for CWO and other interested staff. As a result, a significant amount of institution building appears to be taking place. Overall, CDM appears to be performing at a high level of professionalism and competency.

#### 5.4.4 GOSD

Among those involved with the Project, including GOSD officials, there is universal agreement that GOSD's overall management capabilities are weak and in need of a comprehensive upgrading. Notwithstanding this situation, the decision to remove the planning and construction management functions from the former GOSSD and create a new agency to perform them, now seems ill-advised. For most of the seven years of project implementation to date, GOSD has been virtually uninvolved and only recently has there been a concerted effort to strengthen the organization and prepare it to assume its operating responsibilities.

As previously noted, GOSD performs project implementation functions for projects not included within the scope of Cairo Sewerage II. GOSD employs both the competitive bidding and direct order processes for contracting. Processing times required under the competitive bidding system employed by GOSD appear to be significantly shorter than those for CWO. Based on a sampling of GOSD contracts, the average time required between bid opening and award is only about 1.5 months with an additional month for contract signing.

GOSD's operational performance with respect to the facilities being provided under the Project has yet to be tested. At the present time, there appear to be few opportunities to build institutional capability beyond those presently being addressed.

#### 5.4.5 USAID

AID operates within its own set of regulations and requirements which are associated with the expenditure of funds appropriated by the United States Congress. These requirements are considerable and AID missions around the world are closely monitored and frequently audited for conformance. Despite these requirements, AID processing of required approvals is generally achieved in an expeditious manner and has no adverse impact on project implementation.

AID can and has deliberately withheld approvals of specific contracts (i.e., Contracts 27 and 28 in 1991) to promote GOE actions regarding agreed upon conditions, such as tariff

increases. Although the associated delays in project implementation are not desirable, there are few options available which would produce the desired result.

AID is required by law to assure that funds provided by the United States are properly applied to defined project purposes. This has resulted in an emphasis on the use of funds for West Bank purposes only, an approach that could be considered shortsighted in terms of the overall goal of improving GOSD's ability to operate as a competent public utility. For example, concerns were expressed to the Evaluation Team about apparent limitations placed on the use of the Zenein Training facility for the training of only West Bank facilities staff. It will be particularly important for AID to avoid any unnecessary restrictions on the application of funds with respect to the services, materials, and equipment being provided under the ISC.

#### 5.5 PROSPECTS FOR ACHIEVING PROJECT OBJECTIVES IN ORGANIZATION AND MANAGEMENT BY THE PACD

Since a large part of the Project's objectives in the area of organization and management cannot yet be fully tested at this interim stage of project completion, it is important to assess the prospects for achieving these objectives by the date of project completion.

The ability to employ modern utility practices in managing the wastewater functions in Cairo is heavily dependent (though not totally) upon achieving the status of an autonomous wastewater organization. Setting aside for the moment the important consideration of financial independence, the prospects for achieving such an autonomous status are reviewed first.

##### 5.5.1 Autonomous Organization

Although the concept has been discussed for many years, there is only limited experience in Egypt with the establishment of independent water and wastewater companies (IWCs). An evaluation of the concept as it applies in Egypt prepared in 1990 under the Water and Wastewater Institutional Support Project (72), identified the following key points:

- 1) Privately owned and operated companies provided water services in Cairo and Alexandria for nearly 100 years until their nationalization in 1956 and 1961. The services provided were reportedly adequate and the companies earned sufficient profits to enable payment of dividends to shareholders.
- 2) Enabling legislation exists (Law 97/1983 and Law 48/1978) which provides the basis for the establishment of public sector IWCs. Such

organizations have been formed in three governorates: Beheira (1983), Kafr El Sheikh (1985), and Damietta (1986). At the time of the evaluation, however, these organizations had failed to take advantage of the opportunities available for becoming fully independent.

- 3) Realization of the intended benefits of creating an IWC is dependent upon, among other things, a) appointment of a permanent chairman and board of directors and b) development of revenues sufficient to avoid operating subsidies for the central government. These steps had generally not yet been taken among the three IWCs.
- 4) Employee benefits and incentives designed to recognize good performance had not been implemented; employees of IWCs received about the same level of compensation as the staff of general organizations and other GOE agencies.
- 5) Tariffs had not been designed specifically to meet the needs of each organization. All three IWCs continued to use standard tariffs set by NOPWASD.
- 6) Operation and maintenance of utility assets (pipelines, pumping stations, and treatment plants) remained inadequate.
- 7) Problems of over staffing remained as the IWCs had yet to take advantage of the provisions of Law 48 which permit transfer of employees between sectors when conditions of over staffing exist.

The evaluation (72) also describes an alternative approach to the formation of independent water and wastewater companies which was being considered in South Sinai Governorate. This approach involves a combination of public and private ownership under existing enabling legislation, Law 159/1981 which deals with the various types of shareholder companies. The scope of the undertaking includes both water and wastewater. A wide variety of supplemental activities would also be authorized including the sale of treated effluent and the mining and sale of bottled mineral water. Under the proposal, a group of ten entities would purchase 50 percent of the initial shares issued. Of these, nine are public sector companies and one is a private firm. Many of the founding shareholders would appear to have a business interest in the activities of the proposed entity. The largest shareholder, for example, is a public sector contracting firm (Egyptian Contracting Enterprises), another shareholder is involved in groundwater development (REGWA Company), and the only

private shareholder specializes in maintenance services (Care Services Company).

Recent and serious discussions are reported to have been held at high levels of government concerning the establishment of independent/autonomous water and wastewater agencies in Cairo and Alexandria. Details concerning the proposed arrangements under discussion are confidential, but are said to involve, for Cairo, the following basic concepts: 1) combined water and wastewater functions, 2) separate operating entities for the West and East Banks and Helwan, 3) private sector involvement as investors and/or as contract operators, 4) a central holding company with ultimate control over all three operating entities, and 5) a tentative implementation schedule providing for a transitional period in the range of 2 to 5 years. The Evaluation Team was unable to confirm these points. There remains only one official reorganization proposal for GOSD which is now before the CAO and which, if implemented, would fall far short of the goals of organizational autonomy.

Experience with the three existing IWCs indicates that the formation of such organizations is relatively straightforward, but that taking the necessary additional steps so that the desired results can actually be achieved is a much more difficult task. Furthermore, while the existing enabling legislation has provided a satisfactory base for the initial formation of the three existing IWCs, the situation in Cairo may be sufficiently complex/unique to require enactment of specific legislation. The associated policy dialogue and debate could easily continue for several years before the initial implementing steps could be taken. Full implementation of all the measures required to gain an autonomous status will require still more time. Therefore, the prospects for achieving full organizational autonomy prior to the current PACD are, at best, only fair.

#### 5.5.2 Modern Utility Practices

All indications point to a virtual total lack of modern utility management practices within GOSD at the present time. Although it could be argued that some beginning steps are being taken through AMBRIC resources (i.e., O&M training, records system development, etc.) and contractor training, such measures will have no lasting benefit in the absence of a sound utility management framework. The scope of the ISC in itself, which has been established with the concurrence of GOSD, is indicative of the comprehensive nature of the improvement program that is needed.

Given the sheer magnitude of the task and the obstacles to be overcome, the Evaluation Team questions the feasibility of achieving a comprehensive upgrading of GOSD's management systems and capabilities by the current PACD. The resources being made

available through the ISC and the enthusiasm being displayed by key GOSD officials, however, open the real possibility that significant improvements can be achieved. This is especially so with respect to areas of management wherein attainment of organizational autonomy and/or financial self-sufficiency are not required prerequisites. Further discussion of the program of management improvements included in the Institutional Support Contract (ISC) is provided in paragraph 5.7 below.

#### 5.6 PROSPECTS FOR ACHIEVING PROJECT OBJECTIVES IN SUSTAINABILITY BY THE PACD

True financial self-sufficiency is the single most important factor in the drive to achieve overall institutional sustainability for GOSD. This is achieved when 1) operating costs are realistically defined in a manner that recognizes the level of costs needed for proper management, operations and maintenance, and supporting services, 2) salaries and benefits are realistically set so as to retain qualified staff, 3) management has the ability to implement measures aimed at optimizing operational efficiency, and 4) operating revenues are sufficient to cover operating expenses thus defined and there is reasonable assurance that revenue enhancements can be implemented as needed to keep pace with inflation. There are obvious interdependencies with organizational autonomy; realization of the full range of benefits to be gained from organizational autonomy, for example, is dependent upon eliminating the need for annual operating subsidies from the national treasury. Conversely, the ability to implement personnel management improvements is dependent on gaining organizational autonomy. When both organizational and financial independence are achieved, the prospects for maintaining long term sustainability are greatly enhanced.

There are a number of factors which give rise to optimism concerning the prospects of gaining financial self-sufficiency for GOSD, not likely by the PACD, but closely following thereafter. The more important of these are:

- 1) Recent actions by the GOE providing for an increase in wastewater tariffs and an implied willingness to continue such increases to meet agreed upon targets.
- 2) Task assignment under the ISC providing for the preparation of five year forecasts of the level of funding required to support proper management and control, as well as necessary amounts for operating and maintenance activities.
- 3) Task assignment under the ISC and a separate, but coordinated tariff study to design a program of revenue enhancements aimed at meeting projected

financial requirements, emphasizing affordability considerations and a public awareness program as required to facilitate implementation.

- 4) Other tasks under the ISC which contribute to GOSD's overall ability to successfully manage and sustain operations at optimum levels on a long-term basis.

Thus, there is a reasonable expectation that financial self sufficiency will be within view by the date of the PACD and achievable soon thereafter. This will provide a major impetus to subsequent actions which can then be implemented in terms of full organizational autonomy and the corresponding management prerogatives which become available. Although sustainability is not likely to be gained by the PACD, most of the underlying elements necessary to achieve it should be in place at that time.

## 5.7 INSTITUTIONAL SUPPORT CONTRACT, SERVICES, AND PRIORITIES

### 5.7.1 Scope of Services

Throughout this chapter, numerous references have been made to the ISC and the anticipated improvements in institutional performance projected to be gained by GOSD as a result of ISC based efforts. It is appropriate to give closer examination to this effort which is so important in the overall plan for the successful implementation of the Cairo Sewerage II Project.

The ISC constitutes a comprehensive program designed to assist GOSD in the improvement of its management, support functions, and operating and maintenance procedures. The work is organized under 15 major task areas as follows:

- 1) GOSD Management Capability - involving the identification and training of the existing cadre of top level managers; establishment of an ongoing management training program, possibly including a Master degree program; and evaluation of the potential benefits of a program of secondment of qualified managers from public sector companies as an element of the management training effort.
- 2) Computerized Data Management Systems - evaluation of GOSD's needs for computer hardware and software and assistance in procurement of approved items; assist in establishing computer capabilities of GOSD managers and their ability to establish computerized records systems and computer generated reports on key management topics and to effectively benefit from such reports.

- 3) Financial Control Systems - accounting system development including chart of accounts with responsibility centers covering all GOSD activities and meeting its needs for utility based accounting information; training of financial managers in computerized accounting and reporting systems and assistance in procurement of software required for computerization of all basic financially oriented systems.
- 4) Maintenance Management Procedures - development of a controlled maintenance system covering the need for maintenance on a preventive basis, planned and scheduled repairs, and emergency situations; provide training of GOSD staff in work order preparation and the various computerized components of the system.
- 5) Inventory Control and Stores Management - including the reorganization of the GOSD Stores Department to provide for improved performance in materials management; streamlining of systems and procedures and development of computerized materials management system; and identifying procurement lead times and reorder levels.
- 6) Procurement of Equipment and Spare Parts - assist GOSD in the preparation of lists of equipment (i.e., training equipment, computers and software, safety equipment, and office equipment) and spare parts and procure the approved items; identify opportunities for import substitution through the development of local enterprises.
- 7) Financial Viability - preparation of a comprehensive analysis of revenue requirements through use of zero based budget forecasts covering a five year period; evaluation of optional sources of revenue; preparation of tariff analysis and community awareness program to support the needed revenue enhancements.
- 8) Organizational Effectiveness - in conjunction with the involved governorates and GOE agencies, evaluate prior and current proposals concerning reorganization, particularly with respect to the establishment of semi-autonomous public sectors companies serving the West and East Banks and Helwan; identify optimum organizational arrangements and an action plan for implementation of the agreed approach.

- 9) Policies and Procedures - assist in the updating of all existing policies and procedures and in the documentation of additional policies as required; recommend procedures for periodic review and updating and in measuring compliance; prepare a policy and procedures manual for distribution and assist in disseminating its contents throughout the organization.
- 10) Personnel Capability Improvement and Training - establish system for the assumption and/or control of all training for GOSD personnel including the assignment of trainees, evaluation of training efforts, and selection of training resources; establish library of applicable training materials from other sources within Egypt and abroad; give special emphasis to the establishment of an effective laboratory training program.
- 11) Internal Training Capability - assist in the assumption of responsibilities for the training functions at the Zenein Training Center and in the overall strengthening of the GOSD Training Department; emphasize the training of trainers so as to assure continuous availability of qualified training staff; assist in identifying training equipment needs and carry out subsequent procurement tasks.
- 12) Personnel Management Practices - prepare comprehensive recommended personnel management system incorporating the principles of merit based appointments and advancement and performance based rewards; develop compensation plan designed to retain qualified staff and a certification program establishing a career ladder for operators and other personnel.
- 13) Safety Practices and Procedures - review prior recommendations concerning safety program policies and the elimination of safety hazards and modify as appropriate under current conditions; assist the Safety Department in development of internal training programs and preparing data in justification of the strengthening of the Department's staffing, funding, and equipment resources; conduct safety training in both general safety awareness and as related to specific hazardous work areas; establish emergency response teams and train staff in emergency response procedures.

- 14) Sewer Cleaning Department - provide for the overall upgrading of the performance of the Sewer Cleaning Department including reorganization, staff training (covering such areas as supervision, use of specialized cleaning and monitoring equipment, and safety), rehabilitation of equipment, and procurement of a five year supply of critical spare parts; develop a program for locating and rehabilitating manholes that have been paved over and/or damaged.
- 15) Twinning Relationship - assist in the formation of a twinning relationship between GOSD and an appropriately constituted U.S. wastewater utility organization including the development of evaluation criteria, selection processes, negotiation of agreement, and providing guidance to the twinning partner.

The task descriptions contained in the Terms of Reference are well constructed and provide a sound basis for the development of GOSD's overall management capabilities. Several areas were noted by the Evaluation Team, however, which are offered for further consideration by AID:

- 1) GOSD will most likely be going through transitional stages during the term of the ISC which will affect the nature of the consulting products, particularly those systems which will at least temporarily need to be interfaced with standard GOE systems and procedures. The transitioning will occur as GOSD moves from i) the current situation, on to ii) an independent wastewater organization which still requires operating subsidies, and then iii) achieves financial self-sufficiency. Until phase iii is reached, it will be necessary to employ interfacing mechanisms between the utility based systems to be developed under ISC and the standard GOE systems still in use (i.e., budgeting, accounting, etc.). Even then, there will likely be some GOE procedures applicable in the area of capital improvement programming, budgeting, and fund management since cost recovery goals under the current agreement do not extend beyond the recovery of recurrent costs.
- 2) There is a need to identify actions which could be taken to provide for a closer integration of CWO's activities within GOSD's functions. One possible approach would be to employ the resources of ISC under the "Intermittent" category to conduct such an analysis. This would also provide an opportunity to identify steps that could be taken to streamline contract processing activities.

- 3) The project implementation functions (planning, design, and construction management) do not presently appear to be addressed among the tasks. Even though CWO is currently assigned responsibility for most of those tasks, GOSD continues to undertake a smaller, but still significant, program which likely requires attention. Furthermore, if CWO is to be eventually phased-out, it will be necessary at some point to develop a plan for building the required capabilities within GOSD. AID may therefore wish to consider this area as an item to be addressed under the ISC.
- 4) Under Organizational Effectiveness, there appears to be no recognition of the proposed reorganization of GOSD that has been presented to the CAO for approval. Is it understood that this proposal is to be held in abeyance until the situation can be addressed under the ISC?
- 5) Under the Sewer Cleaning Department task, it may be useful to specify that the consultant assist GOSD in employing the microfilm maps prepared by CWO/AMBRIC to develop "map books" for use in the field by sewer cleaning and repair crews.

#### 5.7.2 Resources and Priorities

GOSD was instrumental in the selection of the successful consulting team which is expected to begin work in March 1992. GOSD will provide a Project Manager from within its staff as well as counterparts to work with the consultants in each of the 15 task areas. Most consulting efforts are to be implementation oriented with little effort needed to refine and prepare recommended procedures and systems submitted previously (e.g., numerous AMBRIC reports) for almost immediate implementation. Where the potential for overlapping of assignments between task areas exists, the consultant team is to provide assurance that careful coordination of work efforts is achieved.

The duration of the project is for an initial period of 24 months with an optional additional period of twelve months. The extension would be justified only on the basis of additional work elements which come to light during the initial 24 month period, and would not be considered for continuation of unfinished portions of the initial scope of work. The consulting resources being made available include a long term expatriate staff of twelve persons, seven assigned for the full 24 month period and five for a period of 18 months. Additional expatriate resources are available for up to 50 person-months of short term specialists and 72 person-months of home office support. Personnel resources provided by local associates are allowed up to a total of 500 person-months.

AID is clearly making available a massive task force backed up with supplemental funds for procurement of critical materials, supplies, parts, and equipment. If the project objectives are not achieved, it will not be due to any lack of material resources.

The following tasks are suggested for inclusion as top priorities for the near term:

- GOSD Management Capabilities
- Maintenance Management
- Inventory Control and Stores Management
- Organizational Effectiveness
- Personnel Capability Improvement and Training
- Internal Training Capability

Initiation of work under the ISC marks the most significant effort to date to assure the long-term sustainability of the assets provided under the Project. AID and the GOE are clearly well focused in this effort.

#### 5.8 SUMMARY OF PRINCIPAL CONCLUSIONS

- 1) A policy decision should be made concerning CWO's tenure as the principal project implementation agency for Cairo wastewater projects. If its temporary nature is confirmed, a date, or project related milestone, should be established to define the point in time at which its mission would be considered complete. This would permit the development of plans concerning how best to prepare GOSD for the assumption of the functions currently performed by CWO.
- 2) CWO's current role should be redefined to one in which it acts as more of an "owner's representative" on behalf of GOSD; GOSD for example, should review all designs prior to finalization, all contract documents prior to tendering, and all change orders prior to approval. GOSD should also place observers at all construction sites.
- 3) Steps should be taken to reduce the contract approval processing time through CWO and the Higher Decision Committee (HDC), particularly for projects on the "critical path."
- 4) Steps should also be taken by CWO and AMBRIC to identify ways and means through which institution building within CWO can be enhanced during the remainder of the Cairo Sewerage II Project.

- 5) In order to optimize the benefits to be derived from the ISC, GOSD should fully integrate the ISC team into all of its internal management functions, including those that might be considered confidential. ISC team members, for example, should be included in high level policy discussions such as those related to tariff increases or the establishment of an independent wastewater company. This will be dependent upon the ability of the ISC Team Leader to establish himself in a way that gains the full trust and confidence of the Chairman and other senior staff of GOSD.
- 6) The scope of work of the ISC should be reviewed to provide assurance that adequate attention is given to
  - a) the practical requirement that systems and procedures developed through the ISC include interfacing mechanisms with the applicable standard GOE systems until such time as GOSD achieves both financial and institutional autonomy,
  - b) defining the requirements of the ISC with respect to assisting in the implementation of the organization proposal which is currently awaiting approval by the CAO, c)
  - d) development of map books for use of field crews for sewer cleaning and repair, utilizing the microfilm records prepared by CWO/AMBRIC, and
  - e) the project implementation functions including interim measures to involve GOSD more directly in CWO decision making, identifying steps to streamline project processing activities within CWO, and upgrading GOSD's project implementation capabilities for its ongoing workload.
- 7) AID and the GOE should reevaluate and scale down their expectations concerning the results to be achieved through the ISC within the initial contract period. A revised approach to institution building through the ISC should provide for a significantly lengthened time horizon for the full range of tasks to be covered and recognition of the likelihood that project extensions will be required well beyond the initial two year period. Priorities should also be identified to guide GOSD and the ISC when decisions concerning resource allocation arise during the course of the work.

## CHAPTER 6.0

### RECOMMENDATIONS

The Cairo Sewerage II Project is proceeding successfully in providing an efficient sewerage system for the West Bank area of Cairo. It has been an outstanding civil engineering and public works achievement implemented under very difficult construction conditions. Since its inception, the Project has also been an excellent example of multinational cooperation in achieving a broad range of objectives to improve the quality of life in Egypt's most heavily populated area.

The recommendations presented below are based on the findings and conclusions of the Evaluation Team and address the issues identified in the USAID Statement of Work for the interim evaluation of the Project. These include project implementation and construction procurement, operation and maintenance, institutional strengthening, social and environmental impacts, and organization and management of the participating agencies. Recommendations are addressed to the agency or agencies having primary responsibility for implementation. They are prioritized and grouped in sequence, according to the following criteria: 1) matters needing attention during the first six months of 1992, 2) issues which can be dealt with between mid-1992 and mid-1993, and 3) other items which can be addressed after mid-1993 and prior to the current PACD.

#### 6.1 RECOMMENDED ACTIONS DURING THE FIRST SIX MONTHS OF 1992

- 1) USAID, CWO, and GOSD - Initiate consolidation of all ongoing and future efforts for institutional strengthening under a direct contract with GOSD in order to maximize management, operation, and maintenance training effectiveness, as well as GOE commitment. Carefully coordinate all training efforts in the interim to optimize GOSD and consultant resources and to assure full readiness to commission major West Bank facilities: AMBRIC -- pump stations and treatment plants; ABB/SUSA -- treatment plants at Abu Rawash and Zenein.
- 2) USAID and CWO - Review and renegotiate the Post Construction Services (PCS) efforts of AMBRIC to more closely match the scope of services to be provided by the Institutional Support Contractor. Modify PCS activities to: a) concentrate on immediate training of GOSD personnel to be assigned O&M duties on the West Bank, notably the new screw pump stations, treatment plants, and collectors; b) assist in the implementation of the plan for commissioning new

facilities; and c) provide continuing technical assistance (TA) to GOSD for six to nine months after their personnel assume O&M responsibilities for the entire West Bank system.

Comment. These services appear to have some potential to be reduced significantly for 1993 and beyond. However, the role of the PCS staff is critical to the commissioning of West Bank facilities, especially the operation and maintenance of new pump stations, collectors, and culverts. A date for changing AMBRIC's PCS role from training to technical assistance cannot be determined at this time. The earliest date appears to be mid-1993, assuming 180 days of TA are required after major facility commissioning.

- 3) CWO - Do not extend the ABB/SUSA contract for operation of the Zenein WWTP beyond September, 1992 unless a need for additional technical assistance services by ABB/SUSA can be demonstrated.

Comment. This need should be evaluated for AID by AMBRIC based on monitoring the 30 day period of GOSD operation. It is possible that any additional TA services could be provided from other sources, either the PCS staff of AMBRIC or the new ISC staff. The latter may not be sufficiently staffed in time to assume this role at Zenein.

- 4) USAID and CWO - Accelerate procurement and construction completion for Contract 33 (the Western Desert Sludge Disposal Facility).

Comment. This project is critical to the operation of the Abu Rawash WWTP. Estimates of the time typically required for CWO tendering and contract award seem long. Steps need to be taken to minimize addenda during bidding and to encourage "fast track" contract approvals by CWO, the Higher Decision Committee, and USAID. Shortening the construction period is also paramount; offering an incentive to the contractor for early completion should, therefore, be considered.

- 5) USAID - Review the existing contract with ABB/SUSA for construction of the Abu Rawash WWTP with a view toward reducing the amount of time specified for full contractor operation, transferring full responsibility for operations to GOSD as early as possible, and modifying ABB/SUSA's role to one of

providing technical assistance after GOSD assumes operational control of the plant.

Comment. The time allowed for initial operation should reflect a reasonable period for shakedown of the unit processes and equipment followed by a transition to full operation by GOSD personnel similar to the procedures utilized to transfer operation of the Zenein WWTP. Once the plant is operating satisfactorily and meeting primary effluent criteria, ABB/SUSA responsibility should consist of technical assistance only. If GOSD personnel to be assigned to the Abu Rawash WWTP receive advance training at the new Zenein Training Center, it is reasonable to assume that ABB/SUSA's operation and TA activities should cease about the same time as the warranty period, or one year after commissioning.

- 6) USAID and CWO - Pending completion of the facilities plan for Abu Rawash and the update of the West Bank Master Plan, undertake a study of interim treatment modifications at Abu Rawash WWTP as a way to resolve the interim capacity problem, as well as the potential long term use of partial treatment coupled with effluent reuse for land reclamation.

Comment. Presently under consideration is a CDM proposal to evaluate chemical treatment of raw sewage at the Abu Rawash WWTP using a process known as "enhanced primary treatment" (EPT). Such application at Abu Rawash, on an interim basis, is advocated as a means of increasing the hydraulic capacity of the primary treatment system. However, it will not solve the peaking capacity problem without some means of flow equalization. On an interim basis, the use of culvert capacity should also be explored as a means of flow equalization, but should not be allowed to jeopardize the culverts' structural integrity. The Evaluation Team does not endorse the use of EPT for long term application at either Zenein or Abu Rawash WWTPs, as it strongly supports facility and sewer master planning which are included in Recommendations 7c and 7d below.

- 7) USAID and GOE - Provide the required funding and initiate the actions necessary to complete the following elements deemed important to the success of the project and, when appropriate, initiate procurement activities employing sole source or variation order approaches to expedite implementation:

- a) Design and construction of a bypass pipeline or channel at the headworks of the Abu Rawash WWTP.

Comment. This work is required to prevent peak flows in excess of plant hydraulic capacity from affecting plant operations and efficiency.

- b) Three years to five years of institutional development support services to GOSD.

Comment. The scope of services under the ISC contract is ambitious and, given the reorganizational steps to be taken with GOSD, additional time will be needed for GOSD to achieve self-sufficiency in operation and management responsibilities.

- c) Preparation of a new facility plan for the expansion of the Abu Rawash Wastewater Treatment Plant.

Comment. The new facility plan should be based upon the results of the 1991 System Load Review, which identified a serious need for additional treatment capacity for this facility, and other data presently being collected on sludge handling, wastewater characteristics, and facility operations. The Abu Rawash Plant should be immediately designed for expansion and upgrading to provide a minimum of 200,000 cmd primary treatment capacity and 600,000 cmd secondary treatment capacity.

- d) Update of the West Bank Portion of the Greater Cairo Sewer Master Plan.

Comment. The current plan was completed in 1978 and has been substantially affected by rapid urban growth, expansion of unsewered areas, and increased water consumption. All future work on major facilities and unsewered areas for the West Bank system should be guided by an update of the 15 year old plan.

Certain elements of the West Bank Sewerage Program, which have been deferred due to lack of donor funding, should now be planned, designed and constructed to assure: (1) the capacity of present facilities is not exceeded; (2) an environmentally sound program is implemented to protect public health and enhance water quality of the lower Nile; and (3) the long term viability of an

important element of urban infrastructure on the West Bank.

- 8) GOE - Initiate a Ministerial directive redefining GOSD as the "owner" and CWO as the "owner's representative" in the implementation process for sewerage projects in Cairo; cooperate with involved parties, including USAID, in providing guidance concerning how the two organizations should interact on such matters as review of designs, contract documents, and change orders, and the involvement of GOSD operating personnel as on-site observers during construction.
- 9) CWO and AMBRIC - Initiate discussions concerning ways and means through which institution building within CWO can be enhanced during the remainder of the Cairo Sewerage II Project. Prepare recommendations for the implementation of identified measures, including estimated costs, if any, for review and approval by the Ministry and USAID.
- 10) GOSD - Establish an internal policy directive applicable to all senior staff and department heads requiring the participation of the ISC Team Leader and/or staff as appropriate in all significant decision making processes concerning any matter which has a relationship with the ISC scope of work.
- 11) GOSD and USAID, in Consultation with the ISC - Review ISC scope of work to ensure that adequate provisions (i.e., tasks and resources) are included which:
  - a) recognize the need to provide, as part of the utility management systems to be developed, interfacing mechanisms with standard GOE systems on a transitional basis until financial and organizational is achieved.
  - b) assure implementation of the organization structure currently before the CAO, if it is approved.
  - c) permit the preparation of map books, using the microfilm records prepared by CWO/AMBRIC, showing the locations and pertinent details of sewerage facilities, for the use of field maintenance and repair crews.
  - d) address the issues related to the project implementation functions, namely to: involve GOSD more directly with CWO in decision making, review

and streamline contract processing functions within CWO, and make improvements to GOSD's current project implementation functions.

- 12) CWO with Assistance from AMBRIC and GOSD - Complete a detailed commissioning plan for West Bank facilities.

## 6.2 RECOMMENDATIONS TO BE ADDRESSED DURING THE MID-1992 TO MID-1993 PERIOD

- 1) USAID and GOE - Extend the Project Assistance Completion Date (PACD) through modification of the Grant Agreement for a period of at least two years.

Comment. Extension of the PACD for two years will allow completion of the following:

- Construction contracts which have just been awarded or will be awarded in the next twelve months: Pyramids Sewers, Cheops Pump Station, and Western Desert Sludge Disposal Facility.
- All construction warranty periods.
- An interim period of operation of the Abu Rawash Wastewater Treatment Plant and transition of facility operation to GOSD personnel.
- Close out of a significant number of completed construction contracts by CWO and AMBRIC.
- Extension of Institutional Support Contractor (ISC) services in order to establish a suitable level of training and capacity in management, operation, and maintenance skills for GOSD personnel.
- An "end of project" final evaluation.

If the Project Paper can be amended to include further expansion of the Abu Rawash WWTP and additional funding can be authorized for Cairo Sewerage II, the PACD should be extended by four years.

- 2) CWO and USAID - Intensify efforts to obtain full close out of both American construction and Egyptian FAR contracts.

Comment. During the remainder of the project, a "stepped up" effort is required by CWO. Action should be taken by AID to assure full close out of American and FAR contracts which have been completed but not administratively closed out.

- 3) CWO and USAID - Cancel and replace with other TA services the proposed contracting for limited period

operation and maintenance of the new screw pump stations.

- 4) USAID and GOE - Assess the industrial waste study for the West Bank, once completed, to provide the basis for a ministerial decree requiring pre-treatment and/or prohibiting discharge to sewers of toxic or other wastes which would interfere with treatment processes; include a companion study for the development of wastewater tariff surcharges applicable to high strength wastes.
  
- 5) GOSD and USAID - Continue to review the results expected from the ISC. Recognize that further ISC type efforts will be necessary up to the PACD. Establish priorities to provide guidance when decisions are needed concerning resource allocation during the contract implementation period and any extensions approved thereto.
  
- 7) USAID - Conduct annual reviews of the performance of the Institutional Support contractor.

Comment. Such action is strongly recommended due to the importance of this phase of the project and the need to assess a) the performance and effectiveness of the ISC and b) the impact of changes in Project needs on the current ISC scope of services.

### 6.3 RECOMMENDATIONS TO BE ADDRESSED BETWEEN MID-1993 AND THE PACD

- 1) GOE - Conduct water quality monitoring and modeling of the River Nile to assist in assessing levels of wastewater treatment and options for effluent reuse.

Comment. With the completion of construction of the treatment plants on the West Bank, effluent will be discharged to the Nile well below Cairo, but will continue to affect downstream water use both for in-stream fishery and potable water withdrawal. No definitive water quality study has been undertaken on the Lower Nile since 1982 when some work was completed by the University of Michigan.

- 2) USAID - Eliminate study of the public health benefits of Cairo Sewerage II as part of the final Project evaluation.

Comment. While area health statistics show trends of general improvement, no conclusive evidence exists at

this time which would attribute these results to sewerage programs. Baseline public health data is inadequate and the period for post project analysis would be too long for accurate assessment as a part of final Cairo Sewerage II evaluation.

- 3) USAID - Make additional funding commitments contingent upon GOE actions to increase tariffs as necessary to achieve full recovery of O&M costs from the sewer tariff based revenue.

Comment. Additional USAID funding commitments should be tied to renewed commitments by the Egyptian government to both increase tariffs and control expenditures for sewerage system O&M.

- 4) USAID - Initiate a final evaluation of the Cairo Sewerage II Project approximately six to nine months in advance of the PACD.
- 5) USAID - Consider conducting the final evaluation as a joint effort with the British Overseas Development Administration (ODA).

Comment. The ODA is currently considering a final evaluation of the Cairo Wastewater Project. If feasible from the point of view of completion and commissioning schedules for East Bank and West Bank contracts, some elements of evaluation should be conducted jointly. Possible shared elements include improvement in public health, water quality of the lower Nile, and the capabilities of governmental agencies to sustain operation and maintenance of facilities.

- 6) GOE and USAID - Incorporate the funding approach developed under the FAR concept into future sewer construction projects.

Comment. The FAR (Fixed Account Reimbursable) program developed by USAID for design and construction of lateral sewers and house connections in unsewered areas of the West Bank should be continued in order to assist in meeting the objective of sewer availability to the existing population.

Future donor funding for FAR projects should be entirely in local currency to further encourage development of local private sector capabilities in design and construction management as well as public and private sector construction.

- 7) GOE and USAID - Preclude sewerage and connecting additional areas of West Bank until such areas have been prioritized by an updated sewer master plan and the expansion of the Abu Rawash Plant has been initiated.
- 8) GOE - Conduct a public education program on the use of sanitary sewers to prevent improper use for disposal of refuse and toxic wastes.
- 9) GOE - Make additional improvements to the Zenein Wastewater Treatment Plant which include: a) storage and use of chlorine for effluent disinfection, b) plant maintenance operations, and c) plant security.
- 10) GOE - Improve the GOSD system of maintaining records of new sewer connections and reporting such information to the GOGCWS.

## BIBLIOGRAPHY

- 1 AMBRIC, Greater Cairo Wastewater Project, Rehabilitation and Expansion of the Cairo Wastewater System, Work Order No. 1, Investigations of Flooding Incidents. Cairo, December 1981.
- 2 AMBRIC, FAR Work History, A collection of letters and memoranda: 4 February 1985 to Robert Cook; 9 March 1988 to Salama A. Salem; 17 April 1988 to Salama A. Salem; 13 August 1988 from Robert M. Dundy; 22 September 1988 to Salama A. Salem (2).
- 3 AMBRIC, Greater Cairo Wastewater Project, Monthly Reports for Periods Ending:  
March 31, 1986  
March 31, 1988  
September 30, 1989  
March 31, 1990  
September 30, 1990  
August 31, 1991  
September 30, 1991  
October 31, 1991
- 4 AMBRIC, Greater Cairo Wastewater Project, Unsewered Areas Demonstration Project, Final Report. Cairo, October 1987.
- 5 AMBRIC, Rehabilitation and Expansion of the Cairo Wastewater System, Review Statement. October 1987, April 1989.
- 6 AMBRIC, Greater Cairo Wastewater Project, West Bank Project Contract No. 28 Cheops Pumping Station,  
Volume 1, 2, and 3. Cairo, September 1989.
- 7 AMBRIC, Greater Cairo Wastewater Project, System Management Plan,  
Volume 1 Report and Volume 2 Appendices, Cairo, October 1989.
- 8 AMBRIC, Greater Cairo Wastewater Project, Comprehensive Training Plan, Volume I and II, draft. Cairo, October 1989.
- 9 AMBRIC, Greater Cairo Wastewater Project, System Operations Plan, Volume I and II, draft. Cairo, October 1989.
- 10 AMBRIC, "Report on Sphinx Ground Water Study." Cairo, September 1990.
- 11 AMBRIC, Greater Cairo Wastewater Project, Financial Review, Quarterly, Period Ending 30 September 1990, and 30 September 1991.
- 12 AMBRIC, Greater Cairo Wastewater Project, Review Statement, for the 4th Quarter 1990.

- 27 Arab Republic of Egypt, Agreement between GOSSD and AMBRIC, Work Order No. 1. Cairo, 7 August 1980.
- 28 Arab Republic Of Egypt, Law No. 48 for the year 1982 re Protection of the River Nile and Waterways from Pollution. Official Gazette - issue No. 25. Cairo, 26 June 1982.
- 29 Camp Dresser & McKee International, Inc. Abu Rawash Wastewater Treatment Project, Contract No. 29. Invitation for Bids Volume 1, Bidding, Contract and General Requirements. Cairo, December 1988.
- 30 Arab Republic of Egypt, GOSD, Financial Data: Annual Budget 1989-90, 1990-91, 1991-92 Budget; 1981-88 through 1990-91 List of Projects (BAB 3); 1987-1988 through 1990-91 Revenue by Source. (in Arabic).
- 31 Arab Republic of Egypt, National Organization for Potable Water and Sanitary Drainage, SR-3 Tariff and User Charges Study, Volume 2, Draft Version. Cairo, June 1990.
- 32 Arab Republic of Egypt, NOPWASD, Report CG-6 Development of an Economic Analysis Capability, Final Report, Cairo, September 1990.
- 33 Arab Republic of Egypt, National Organization for Potable Water and Sanitary Drainage, Report CG-9 Local Revenue Generation, Final Report, Cairo, February 1991.
- 34 Arab Republic of Egypt, Ministry of Defense, Agreement Letter with CWO for Sludge Disposal. March 28, 1991.
- 35 Arab Republic of Egypt, Protocol between Ministry of Public Works and Water Resources, and Organization for Execution of G.C.W.P. concerning reinforcement and expansion of the drainage networks that will receive treated effluent from Zenein and Abu Rawash Wastewater Treatment Plants and construction of two Pumping Stations. (Translated by Adalat 23 July 1991).
- 36 Arab Republic of Egypt, General Organization for Sanitary Drainage, Arab Republic of Egypt Institutional Support Contract (ISC) Request for Proposals, Part Two Terms of Reference, Solicitation Number: 263-0173-01. Cairo, undated.
- 37 Quality Control Plan Abu Rawash Wastewater Treatment Project. ABB/ SUSA, Inc. : 1990.
- 38 ABB/SUSA, Inc., Zenein Wastewater Treatment Plant Operation, Maintenance and Training Report for December, 1991.
- 39 AMBRIC, Project Files, Accident Reports, 1986-1991.

- 53 AMBRIC, Sample Plans/Specifications/Documents - C 240; August 1990.
- 54 Stanley Consultants, Environmental Assessment, Greater Cairo Wastewater System, West Bank; 2 Volumes, September 1982.
- 55 USAID Request for Proposal for Institutional Support Contractor Part 2, Solicitation No. 263-0173-0.
- 56 Arab Republic of Egypt, Ministry of Reconstruction, Housing and Land Reclamation, Ministerial Decree No. 497/1981, Establishing the Agency for Execution of the Greater Cairo Wastewater Project (CWO).
- 57 Contract 24D Sewers & House Connections  
Vol 1 Contract Requirements - Aug 1991  
Vol 2 Specifications - Aug 1990  
Vol 3 Geotechnical Information (2 books) April 1989  
Plans - July 199
- 58 AMBRIC, Greater Cairo Wastewater Project, Effluent Drain Study from West Bank Wastewater Treatment Plant Facilities, Draft. Cairo: March 1986.
- 59 Project Grant Agreement between the Arab Republic of Egypt and the United States of America for Cairo Sewerage (II). September 26, 1984; First Amendment, March 13, 1985; Second amendment, 29 September 1986; Third Amendment June 14, 1989; Forth Amendment August 21, 1990; Fifth Amendment 24 September 1991.
- 60 AMBRIC, Operating and Maintaining the New West Bank Facilities. Cairo, May 1990.
- 61 AMBRIC, Updating and Maintaining the New East Bank Facilities. Cairo, May 1990.
- 62 AMBRIC, Unpublished forecast of "GOSD New Works Facilities, 1991-1992 O&M Budget (in LE)".
- 63 Engineer Saad Eldin Eldeeb, Chairman of GCWW letter to Mr. Moenes Edward Youannis, USAID Re: Water Tariff Structure Re-adjustment. 1 December 1991.
- 64 Boyle/NEC, Annual CDT/DTC Training Report, 1990-1991 (NOPWASD Central Department Training, Damanhour Training Center), August 1991.
- 65 Boyle/NEC, Damanhour Training Center Master Training Plan, 1991.

# APPENDIX A

## APPENDIX A

### CAIRO SEWERAGE II (260-0173) SCOPE OF WORK FOR INTERIM EVALUATION

#### A. ACTIVITY TO BE EVALUATED

Project	Cairo Sewerage II
PACD	September 30, 1994
Implementing Agencies	CWO, GOSD
Primary Contractors	AMBRIC Camp Dresser & McKee
Period to be Evaluated	1984 - 1990
Project Purpose	To improve, expand and assure proper management of the wastewater collection and treatment system on Cairo's West Bank. This will result in access to adequate wastewater disposal for approximately 8 million people by the year 2020, in turn assuring them a basic human need and improved health.

#### B. PURPOSE OF THE EVALUATION

This interim evaluation of the Cairo Sewerage II project is in accordance with Article 5.1 of the Cairo Sewerage II grant agreement signed jointly by the GOE and USAID on September 16, 1984 which specifies that the GOE and USAID will establish an evaluation program as part of the project. The Program will include:

- a) Evaluation of Progress toward attainment of the Objectives of the Project,
- b) Identification and Evaluation of Problem Areas or Constraints which may inhibit such attainment,
- c) Assessment of any such Information that may be used to help Overcome such Problems and
- d) Evaluation to the Degree Feasible of the Overall Development Impact of the Project.

- Does it meet project and GOE standards?
- What were difficulties experienced by contractors then and now?
- Are there any difficulties experienced by contractors and how?
- Are there any difficulties or problems than can be solved?
- What are the advantages/disadvantages of using Egyptian contractors and FAR agreements in difficult locations?
- How well are GOE contracting procedures related to FAR contracting and implementation?
- To what extent have commodities been procured under AID rules?

**The Contractor shall:**

- 1 - Assess the implementation progress of contract activities, and analyze the implication for timely completion of the project and achievement of project goals and objectives.
  - 2 - Identify those contracts whose implementation progress is behind schedule. Determine why progress has slowed and the effect on the PACD and the degree to which project goals and objectives may be compromised due to implementation difficulties.
  - 3 - Assess the impact of the project on private Egyptian contractors and suppliers.
  - 4 - Identify those elements of construction which impact onto other construction elements such as effluent discharge and sludge disposal from one plant site to another or from one contract to another.
  - 5 - Assess commodities procured under the project and extent of procurement under source/origin requirements.
2. What problems and constraints have slowed implementation or otherwise prevented the accomplishment of project goals and objectives?
- Have technical, human and financial resources been adequate?
  - Have there been any managerial problems or decisions involving implementing agencies which have had adverse effect on implementation?
  - Have the general effects of GOE management techniques on implementation of the AID project been sufficient for the purpose?

3. Review O & M plans for project constructed facilities to determine whether adequate resources, personnel and procedures will be in place to assure sustainability.
4. Review the adequacy of training provided under the project and the placement of trained employees to determine whether such training has contributed to adequate O & M.
5. Evaluate the adequacy of budgets and tariffs established by CWO/GOSD and Ministry for O & M purposes.
6. Recommend actions to be made by AID and GOE to assure maximum O & M sustainability.
4. How has the management structure of the project affected implementation and issues of O & M sustainability?
  - Has CWO provided adequate management of the project?
  - Has AMBRIC, the consultant to CWO, provided adequate management and services?
  - Has USAID played it's role effectively?
  - What are the reasons that contributed to delay in project construction?
  - How can the system be changed to allow for accelerated progress?
  - Have there been any disputes or procedural difficulties in management?
  - Has AMBRIC or BVI/CDM been efficient?
  - What has been the effect of AMBRIC being an indirect consultant to GOSD?
  - Has the relationship between CWO and GOSD been beneficial to the project?
  - What is the effect of changing from CWO/GOSD to a composite organization?
  - Has AID provided adequate inputs for O & M sustainability?

**The Contractor shall:**

1. Assess the capability and capacity of CWO in their Host Country management.
2. Assess the capability and capacity of GOSD in their O & M functions.
3. Assess the capability and capacity of AMBRIC and BVI/CDM in their consultant functions.
4. Assess the capability and capacity of consultants to GOSD.

5. Review O & M budget costs for the project, compare these costs with responsible GOE Agency budget and analyze/evaluate the impact of the present tariff on the budget. Investigate GOE delay in compliance with MOU and conditional requirements of Grant Agreement Amendment No. 4
6. Review capacity and capability of Abu Rawash WWTP, to determine if primary capacity is adequate for the near future and whether secondary treatment is needed for effluent discharge.
7. Review status of sludge disposal sites and systems, to determine their economic, environment and efficient operation.
8. Recommend actions to be taken to ensure progress toward project goals and objectives is being modified and met?

**E. TEAM COMPOSITION**

		<b>Estimated Level of Effort</b>
1	Team Leader	10 weeks
1	Engineer Construction & Sanitary	6 weeks
1	O & M Specialist	7 weeks
1	Management Specialist	7 weeks
1	Economist	7 weeks
1	Local Egyptian Support 5 persons for	7 weeks

**QUALIFICATIONS**

**Team Leader**

Should have a broad based public administration background with experience in government and utilities. Minimum 10 years experience, with some experience in Arab/African countries.  
Public Administration degree.

**Engineer**

Should have a broad based background in construction of municipal utilities systems and its operation. Minimum 10 years experience with some experience in Arab/African countries.  
Engineering degree.

**G. REPORTING REQUIREMENTS**

All reports shall be submitted in six English copies to the USAID Project Officer.

1. A work program shall be submitted to the USAID Project Officer within 4 days of commencement of the evaluation.
2. An outline report of work done and work to be done midway through the evaluation. All work done shall be submitted for initial review.
3. A draft final evaluation report to USAID/DR/UAD 6 weeks after commencement of work. USAID shall provide general comments one week after receipt and shall provide detailed comments in the following week. The final report shall take these comments into consideration.
4. The final evaluation report to USAID one week after receipt of USAID detailed comments. This final report shall incorporate comments, respond to questions posed in the Statement of Work, conclusions and recommendations.
5. The format for the report should be as follows:
  - **Executive Summary** in narrative form not to exceed three single spaced pages to be provided in English and Arabic.
  - **Listing of Major Conclusions and Recommendations.**  
This Section shall briefly summarize the most important conclusions and recommendations in the evaluation in bulletired format (USAID can provide examples).
  - **Main Report**, i.e. information and evidence on which conclusions and recommendations are based. The information obtained through the required tasks, described above, shall be qualitatively and quantitatively analyzed, and integrated to respond directly to the key questions in the Statement of Work. The report should not exceed fifty double-spaced or twenty five single-spaced pages.
  - **Annexes**, as appropriate, including the evaluation **Scope of Work**, a bibliography of documents consulted, a list of individuals interviewed and their agency affiliation, and other information considered appropriate by the team.

**BACKGROUND PAPER  
CAIRO WASTEWATER PROJECTS**

May 1990

The Cairo sewerage system was initially installed between 1915 and 1920. Over the years, the capacity of the system was expanded to keep pace with the increasing size of the service area. However, around the end of World War II and through the period of Middle East conflicts, it started to show serious signs of neglect. A major effort was made beginning in 1979 through British, I.S. and GOE financing to upgrade and expand the system. While the British effort is confined to improve the system on the East Bank of the Nile, the AID financed program involves major projects on both sides of the Nile, but mainly the West Bank.

Cairo Sewerage I is complete and through a \$129 million grant helped to return Cairo's existing sewerage system to its design capacity and provided a detailed plan for the expansion of the system. The project consisted of three main elements:

- 1) Rehabilitate approximately 100 pumping stations, construct six new pumping stations, replace various sections of old gravity sewers and force mains throughout Cairo - on both sides of the Nile.
- 2) Procure sewer cleaning and rehabilitation equipment.
- 3) Furnish engineering services and training.

The sewer cleaning and rehabilitation equipment (\$11 million) was provided to the General Organization for Sanitary Drainage (GOSD). Two major construction contracts were awarded, one to joint venture of Howard Harbert Sadelmi, (\$53 million) and the other to Sadelmi-New York (\$14 million). Both contractors performed well under difficult conditions and completed their work in 1986.

Since the time when the two AID financed contractors completed their work, Cairo has not experienced any major sewage flooding incident due to system failure.

Cairo Sewerage II is ongoing and through a \$816 million grant (\$531.8 million obligated through FY 89) provides for construction, engineering services and training for large scale sewerage projects on the West Bank. These projects will relieve pressure on the existing system and provide for the expansion of the system into presently unsewered areas. The initial work is shown on the accompanying maps and includes:

- (10) **Contract 27: Giza Collectors** - Construction of main collector sewers in Pyramids area. This future contract is estimated at \$70 million and is waiting to go out to bid.
- (11) **Contract 28: Cheops Pump Station** - Construction of a screw lift station in Pyramids area. This contract is estimated at \$8 million and is waiting to go out to bid.
- (12) **Contract 30: Abu Rawash Effluent Drain** - Construction of headwork, siphons, channel modification for discharge of effluent from Abu Rawash. This series of works valued at about \$10 million.

#### **FAR Program**

**Contract 24, 27 and 27A: Sewers and Collectors** - Construction of sewers in the unsewered areas of Embaba (North Giza) Pyramids and Zenein areas. The net works will be connected to the above mentioned conveyance system. The work is divided into 41 small contracts and will use local contractors. The work has been completed on the first Contract 27A at the Nazlet El Semman (near the Sphinx). Work has started on Contracts 24A, 24B, 24C, 24D and 27B, 27C, 27D. Tenders have been issued and bid for 14 other contracts.

All FAR type contracts with the exception of Contract 27A are reimbursed by USAID at 79% of contract amount. Contract 23A is paid at 100% contract amount.

#### **Operation and Maintenance Program - GOSD**

GOSD personnel are being trained under Work Orders \$A, 4B and 4D to maintain and operate collection sewers, pump stations and treatment plants. The first challenge will be to operate the Zenein treatment plant which will be commissioned in August 1990.



# APPENDIX B

## APPENDIX B

### MINUTES OF MEETING

**PLACE** : GOSD Head Office - Ramsis St., Cairo  
**DATE** : November 10, 1991  
**SUBJECT** : GOSD PRESENTATION ABOUT THEIR ACTIVITIES

#### Attendants :

Mr. Chuck McElroy                    USAID  
Mr. John Airhart                    USAID Project Officer  
Mr. Omar                              USAID  
Evaluation Team  
GOSD Staff                            (See attached sheet)

#### Research - Engineer Khairy

1. Engineer Khairy started the presentation by presenting GOSD's role regarding Cairo Sewerage II project. He continued by mentioning challenges encountered: solving wastewater problems for unsewered area, operation and maintenance of the existing systems, and management (operation and maintenance) of new projects, etc. Managing new projects will necessitate changes in GOSD performance and attitude.
2. To face such challenges, the organization chart for GOSD will require new positions for Maintenance Training, Spare Parts Requirement Planning Policies and Performance Improvement Plans.
3. GOSD is moving in three directions to realize the previously mentioned objectives:
  - a. Institutionalize into an autonomous wastewater organization to follow the new trend of privatization.
  - b. Establishment of training programs to acquire necessary employees with the new skills required for adequate performance.
  - c. Manpower evaluation and development of a new organization chart.  
CAOA must ratify the proposed organizational structure -
4. GOSD organization is split into three main geographic sectors, East, West and Helwan.

5. The new structure emphasizes the importance of the training, operation and maintenance systems.
6. Each sector will have a complete autonomous operational capability.
7. New departments for sludge treatment and screw pumps will be established.
8. Manpower Evaluation - The present work force is classified into the following categories and number of current employees:

Category	Number
Engineers	316
Administrative	195
Chemists	16
Clerk	881
Tech. Assistants	656
Lab. Assistants	18
Tech. Labours	5049
Mech. Labours	1010
Elec. Labours	838
Labourers	340
Car Mech. Lab.	176
Driver	636
Workshop Tech.	330
	-----
TOTAL	10094
	-----

A significant number of, the labour and low skill positions are staff with government placed people who cannot read.

9. New manpower requirements for new West Bank projects, as assessed by GOSD, according to AMBRIC reports are:

Class	Requirement (by number)
Engineer (Elec. & Mech)	82
Instrumentation Engineer	4
Chemist	12
Lab. Technician	10
Technical Assistant	264

## II Project Management - By Eng.

1. The master plan should be updated every two years.
2. It is important to eliminate the small pump stations and use gravity disposal methods.
3. It is important to eliminate the sewage ( 300,000 CMD) Conveyed to Zenein TP from the East Bank through siphons.
4. GOSD's point of view is that loosening some the construction specifications a little bit may help expand collection systems (FAR) to include some unsewered areas by reducing construction costs.
5. Technical preparation of technicians needs to be stressed. GOSD, with AMBRIC, developed a program to include orientation programs and specialized programs.

## III Training

1. The Training Department will move soon to the new Zenein Training Center from the old Syphon Pumping Station site.
2. There are several training programs that have been taking place for the time being.
  - a - Specific training programs developed in coordination with AMBRIC.
  - b - Renewal training programs include: Operation, Maintenance, Computer and New Employees Program.
3. Operation Training Programs -
  - The plan proposed includes the following training programs: Orientation, screw pump stations, operation management and on-the-job training (OJT)
  - There are two forms of training proposed: in-class and OJT.
  - South Muheit Pump Station is proposed to provide the screw pump station training programs, both in-class and OJT.
  - Training for treatment activities will take place both at Zenein and Abu Rawash WWT's.
  - There is a special program for chemists, to train them to conduct routine chemical tests and analysis. It includes sample collection from 14 different points all over Cairo.

- Only in-class training programs are started. There are difficulties in starting the OJT. Difficulties are due to either lack of equipped places or debating about using one of the treatment stations as a training facility.
- 4. Maintenance Training Programs - The plan includes the following training programs: Diesel Engine, power supply (Electricity) and submersible pumps. There is no training activities for screw pumps.
- 5. Computer Training - The plan includes several programs: Orientation; languages (Basic), and standard software.  
  
This will help GOSD develop reliable procurement, inventory and payroll systems.
- 6. New Employees - A new policy is being followed. The Training Departments responsible for distributing new comers (after studying their capabilities, skills and interests) to different departments of GOSD, including the West Bank.

#### IV Administration

- a. GOSD legal staff asserts that some Egyptian Laws and regulations curb its ambitious plans, for instance Law 9 for Tendering.
- b. There are not enough financial grades in GOSD structure to employ (recruit) qualified technicians.
- c. The current promotion scheme is awful and restricted by a limited budget.
- d. There is no management information system.
- e. Centralization, especially for inventory and procurement, needs to be studied..
- f. Incentive pay has been a fixed amount for almost eight years despite an increase of manpower force.
- g. The authorized budget for training is only L.E. 1500 a year (L.E. 500 is the minimal cost for an in-class training program). However, GOSD has access to approximately L.E. 553,00 in training funds or needed.
- h. The new organizational structure is four folds than old on??

i. GOSD is seeking a revenue generation plan to reach some financial autonomous status. (WW tariff and extra money for house connections)

**CWO STAFF WHO ATTENDED THE MEETING SUNDAY, NOVEMBER 10, 1991**

Eng. Salama A. Salem	Chairman
Eng. M. M. Taalat Abu Saada	Deputy Chairman
Eng. M. Farag	Head of Construction Department
Eng. M. Fathy El Shaarawy	Abu Rawash TP Advisor
Eng. O. Abu Aouf	Manager of Technical Office
Eng. Sharaf El Din Orabi	Change Order Advisor
Eng. Asaad Shahien	Internal Auditor
Eng. Z. Talaat	Head of the Central Dept. of West Bank
Eng. M. Said Osman	Financial Auditor
Eng. Ismail Farag	Project Management Advisor
Eng. Refky Hassan	Rehabilitation Manager
Acc. Galal Abd El Aziz	Head of the Central Dept. of Finance

**GOSD EMPLOYEES PRESENT AT MEETING HELD ON 10 NOVEMBER 1991**

<b>NAME</b>	<b>TITLE</b>
Eng. Khairy Morsy	Head for the Central Department of Research
Eng. M. A. Abdel Rahman	General Manager of PS and Workshop
Mr. Said Aiad	G. Manager for Financial Dept.
Mr. M. Ahmed	G. Manager of Administration Dept.
Mr. Yousry El Mousalmy	G. Manager of Orgn. and Admin.
Mr. N. Rizkallah	Head of Central Dept. of Legal Affairs
Mrs. Loulou Salama	G. Manager of the Information Center
Eng. M. S. Khafaga	G. Manager of Training Dept.
Eng. A. A. Moustafa	Manager of Zenein TP
Eng. Abdel Kader Hamdy	G. Manager of Follow-up and Performance Evaluation
Eng. M. A. Zaid	G. Manager of Ele. and Mech. Dept.
Eng. S. A. Hassan	Assistant Chairman for East Bank
Eng. M. S. Khalil	Assistant Chairman for West Bank
Eng. M. Khattab	Assistant Chairman for Cairo II Project
Mr. Hussein Helmy	Manager of Admin. Dept.
Eng. M. A. El-Shourbagy	Training Coordinator

## **APPENDIX C**

## APPENDIX C

### AN ASSESSMENT OF WEST BANK POLLUTION LOADINGS ON WATER QUALITY OF THE ROSETTA BRANCH OF THE LOWER NILE

Fredrick C. Cooper, PhD

The Lower Nile is an important water resource for irrigation and municipal supply in the Delta area of Egypt. The Delta Barrage, situated approximately 30 kilometers (km) below Cairo near El-Kanater, diverts part of the river flow into the Raiyah El-Beheira Canal and part into the west branch of the Nile, known as the Rosetta Branch. Regulated streamflow in the Rosetta Branch is entirely utilized in the 200 km reach below the dam with only a negligible release to the Mediterranean Sea. Excess flow is diverted by another barrage into El-Berolos Lake east of Alexandria. The system is very complex both from the aspects of hydrogeology and water quality in this reach of the Nile. Flow is highly regulated throughout the year. A significant amount of inflow from subsurface sources is known to occur [1], estimated as high as 50 percent of total flow during the main irrigation season. There are also numerous irrigation drains and withdrawals. The city of Kafr El-Zayat, with a population of over 250,000 and located 145 km below Cairo, treats water from the Nile as does the City of Alexandria. A vicinity map is presented in Figure 1.

The most extensive studies on water quality of the Nile was completed by Dr. Gohary of the Egyptian Ministry of Health and the University of Michigan in the late seventies [3,4]. This work demonstrated that the Nile has a considerable assimilative capacity for organic wastes. However, poor water quality in recent years due to uncontrolled industrial development and heavy population growth in major urban areas without adequate sewage treatment has dramatically affected both instream uses and downstream withdrawals. This paper reviews the impact of increased sewage flow from the West Bank of Cairo and various levels of treatment for effluent discharged to irrigation drains and ultimately into the Rosetta Branch. Compliance is assessed as to standards established by the Government of Egypt for domestic effluent quality and instream water quality for the Nile through the issuance of Law 48 and Ministerial Decree 8 [7].

The classic Streeter-Phelps equation was utilized for assessing the impact of biochemical oxygen demand (BOD) loading on assimilative capacity of the river and resulting dissolved oxygen deficiency. It was modeled with the assistance of Dr. Ahmed El Ahwany of the University of Cairo using an IBM compatible PC. The impact of other chemical parameters, such as heavy metals, was not assessed.

Streamflow Conditions. River flow in the Rosetta Branch of the Lower Nile is highly regulated due to irrigation use and withdrawals for the Beheira Canal [1]. There is little variation in discharge from March through September with an average flow for 1990-91 of 11.62 million cubic meters per day (mcmd). The average flow in winter months was 4.42 mcmd. Peak flows in the Rosetta Branch can reach 72 mcmd [2]. During the month of

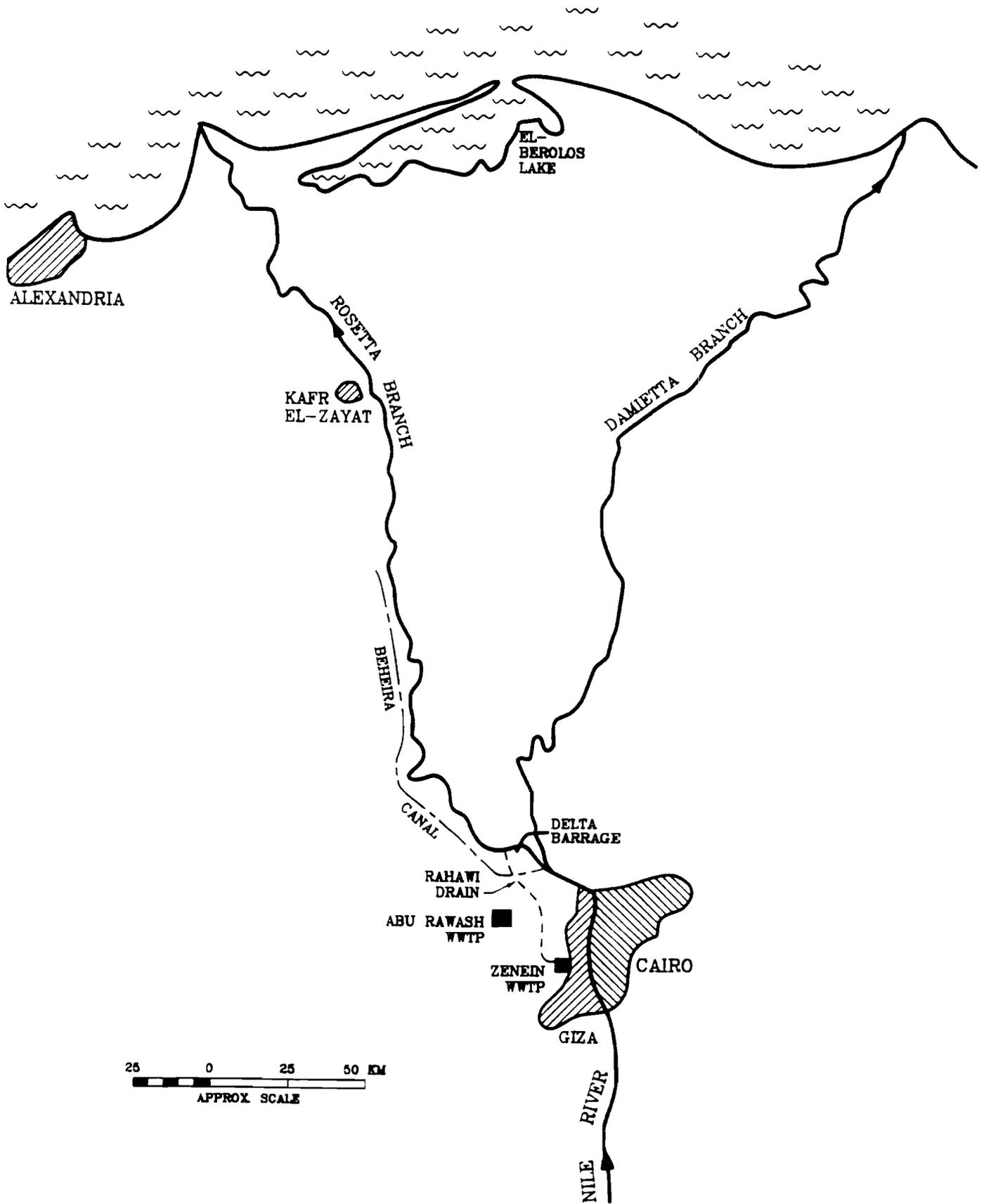


FIGURE 1  
VICINITY MAP

December, releases at the upper barrage can cease entirely. For purposes of the dissolved oxygen sag analysis, the average summer and winter conditions were selected for modeling.

**Sewage Discharges.** Construction of this project, known as the Cairo Sewerage II Project, is currently being completed, under joint funding by the United States (USAID) and the Government of Egypt [6]. The initial stage of construction will serve an estimated three million people with the rehabilitated Zenwin WWTP providing secondary treatment 330,000 cubic meters per day, average daily flow (ADF), and the new Abu Rawash WWTP providing primary treatment for another 400,000 cubic meters per day. Untreated sewage in excess of treatment capacity is bypassed at the Zenein plant site. All untreated sewage and effluent are discharged to the Rahawi irrigation drain system which enters the Rosetta Branch just below the Delta Barrage.

Treatment and discharge scenarios with resultant flows and BOD loadings are presented in Table 1 below.

TABLE 1. VARIOUS SCENARIOS FOR TREATMENT AND EFFLUENT DISPOSAL TO THE LOWER NILE FOR THE CAIRO WEST BANK SEWERAGE SYSTEM.

Scenario	ADF, in mcmd	BOD, in mg/L	BOD, in tpd x 1000
A - Present Condition			
Zenein WWTP	330,000	20	5.0
Abu Rawash WWTP	0	-	-
Bypassed Raw Sewage	300,000	330	98.9
B - 1993 Operation Plan			
Zenein WWTP	330,000	20	5.0
Abu Rawash WWTP	400,000	190	76.0
C - 1993 Operation Plan w/EPT			
Zenein WWTP	330,000	20	5.0
Abu Rawash WWTP	400,000	150	80.0
D - 1996 Operation Plan w/EPT			
Zenein WWTP	330,000	20	5.0
Abu Rawash WWTP	600,000	150	90.0
E - 2020 Plan			
Zenein WWTP	330,000	20	5.0
Abu Rawash WWTP	1,600,000	20	32.0

mcmd - million cubic meters per day  
kpd - kilos per day  
EPT - enhanced primary treatment

The quantity and quality of effluent were established with the intention of relative comparison for different treatment scenarios to current conditions. Data for present plant effluent and bypassed flow are considered too unreliable to extrapolate to the modeling.

Treatment Alternatives. The present condition is represented by temporary measures involving the bypassing of untreated sewage to the Nahya Drain before the headworks of the Zenein WWTP. This flow is unmeasured but estimated to be over 300,000 cmd. Most of the flow is from the East Bank and to be eliminated when other facility construction on the East Bank is completed and put into operation in early 1992. The Zenein WWTP is a secondary treatment plant with a very high quality effluent.

The Abu Rawash WWTP is expected to be completed in late 1992 and will provide conventional primary treatment only. The use of enhanced primary treatment (EPT) to improve BOD and SS removal efficiencies and offer a 50 percent increase in hydraulic capacity has been considered. BOD removal could improve with use of EPT from 35 percent to 50 percent. With flow equalization, this method of operation would allow an increase in treatment plant capacity from 400,000 cmd to 600,000 cmd on an interim basis extending the available capacity of the plant by several years.

Water Quality Modeling. Utilizing a simple assimilation model based upon the Streeter-Phelps equation [5] and calibrated for Nile water quality data collected by the University of Michigan [3], predictions were made as to: 1) dissolved oxygen deficiency and 2) mixing requirements to meet GOE instream standards for several development and treatment scenarios for the West Bank wastewater project. Effects of solids sedimentation, algal respiration and benthic oxygen demand were assumed to be accounted for in the model calibration. Effect of the residence time and dilution from return flow in the Rahawi irrigation drain were ignored and the effluent considered to be combined as a point discharge where the drain enters the river. The reduction in Rosetta Branch flow and effects of other point discharges and withdrawals were assumed to be linear along the 200 km reach below the drain discharge point. Velocity for summer conditions was assumed to be 0.5 m/s. Winter flow velocity was reduced in proportion to the streamflow. Due to the reaeration action of the Delta Barrage, the Rosetta Branch was assumed to have zero oxygen deficit above the Rahawi drain. Other sources of BOD loading were also ignored.

Results for Summer Conditions. BOD concentrations in the Rosetta Branch and dissolved oxygen deficiencies for the five modeled scenarios are presented in Figures 2 and 3 respectively. Except for Scenario E, full secondary treatment of all sewage is required in order to meet GOE instream water quality standards. For other scenarios, excessively very long mixing zones are required. Dissolved oxygen deficiency never exceeds 3 mg/L resulting in a worst case condition of Scenario A at 86 kilometers downstream where the DO drops to 7.4 mg/L before recovering.

Secondary treatment for all West Bank sewage results in no DO sag after initial dilution. Because of the 6:1 dilution ratio, the length of the mixing zone is not measurable.

Results for Winter Conditions. When average flows are reduced during the winter, Figures 3 and 4 show significant water quality deterioration occurs under all scenarios, except E, for both instream BOD and DO deficiency. The latter results in the DO falling below 4.0 mg/L required for most macro-invertebrate populations. This condition under scenarios A, B and D and would exist for over 115 kilometers having a serious impact on instream fishery and the withdrawal for the City of Kafr El-Zayat. High BOD loading due to sewage bypasses may account for this reach of the river being reported to have poor fishing conditions at the present time. Current conditions result in zero oxygen levels occurring for a distance of 50 km below the discharge of the Rahawi Drain.

Instream BOD levels, presented in Figure 4, show the need for a 15 km mixing zone for scenario E to achieve a concentration under 6.0 mg/L. None of the other scenarios achieve this objective within the first 70 km.

Findings and Conclusions. Except under secondary treatment levels, effluent disposal into the Rosetta Branch will affect instream water quality, particularly during the winter months when the flow is low, averaging only 2.2 million cubic meters per day. Dissolved oxygen levels will be significantly depressed; recovery above 4.0 mg/L does not occur for 85 km downstream.

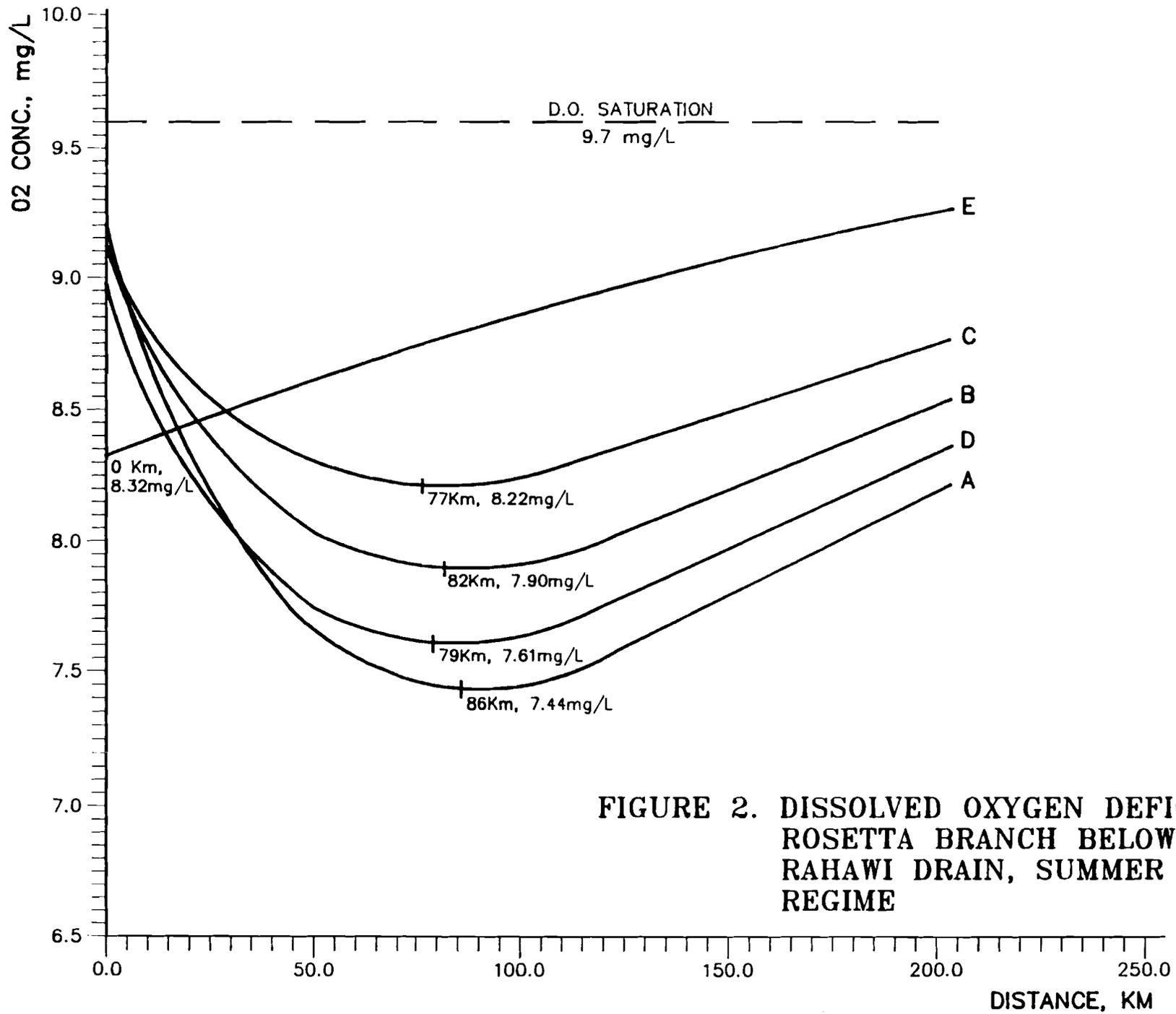
While enhanced primary treatment helps assure reasonable water quality during summer months, winter conditions remain poor for flows over 730,000 cmd. Enhanced primary treatment provides an improvement in dissolved oxygen deficiency of 11 percent in summer and 63 percent in winter.

Secondary treatment satisfies all requirements for long range flow conditions with the provision for a 15 km mixing zone for instream BOD levels higher than the allowable GOE standard of 6 mg/L.

#### References:

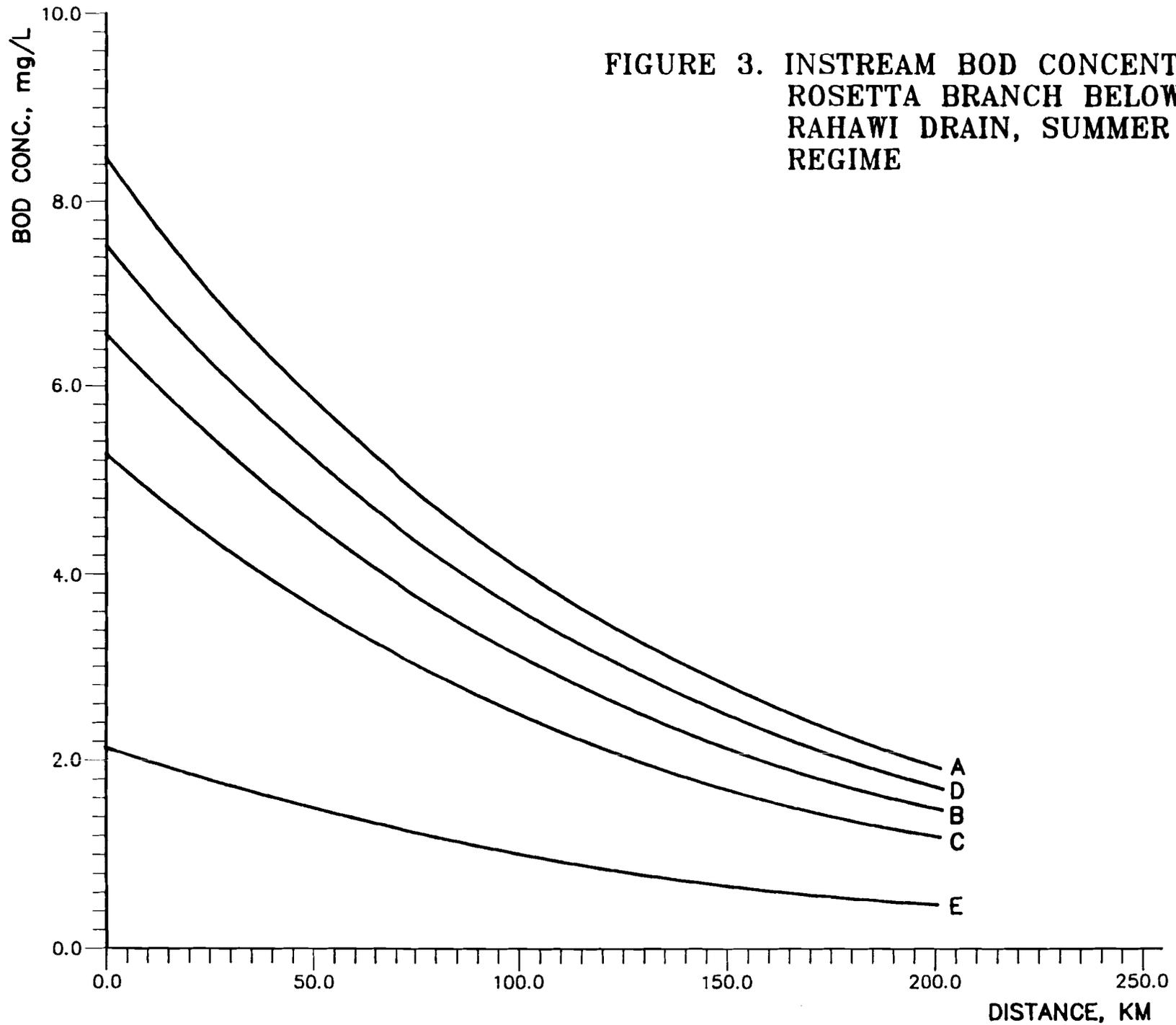
1. "Pollution Control of Industrial Effluents in Rosetta Branch Water Course, Report No. 1;" USAID Project No. 263-0140.1; Science & Technology Corporation; 1990.
2. "Environmental Assessment for the Cairo Wastewater Program;" Stanley Consultants, 1982.
3. "Water Quality of the River Nile;" University of Michigan; 1979.
4. "Water Quality Changes in River Nile and Impacts of Waste Discharge;" Fatma El-Gohary; Ministry of Health, 1981.
5. "Wastewater Engineering: Collection, Treatment and Disposal;" Metcalf & Eddy, Inc.; McGraw-Hill; 1982.
6. "Cairo Wastewater Program - Periodic Report;" American British Consultants (AMBRIC); 1990.
7. "Law 48, as amended in 1982, and Ministerial Decree No. 8, dated 1984;" Government of Egypt.

125



**FIGURE 2. DISSOLVED OXYGEN DEFICIENCY  
ROSETTA BRANCH BELOW THE  
RAHAWI DRAIN, SUMMER FLOW  
REGIME**

FIGURE 3. INSTREAM BOD CONCENTRATION  
ROSETTA BRANCH BELOW THE  
RAHAWI DRAIN, SUMMER FLOW  
REGIME



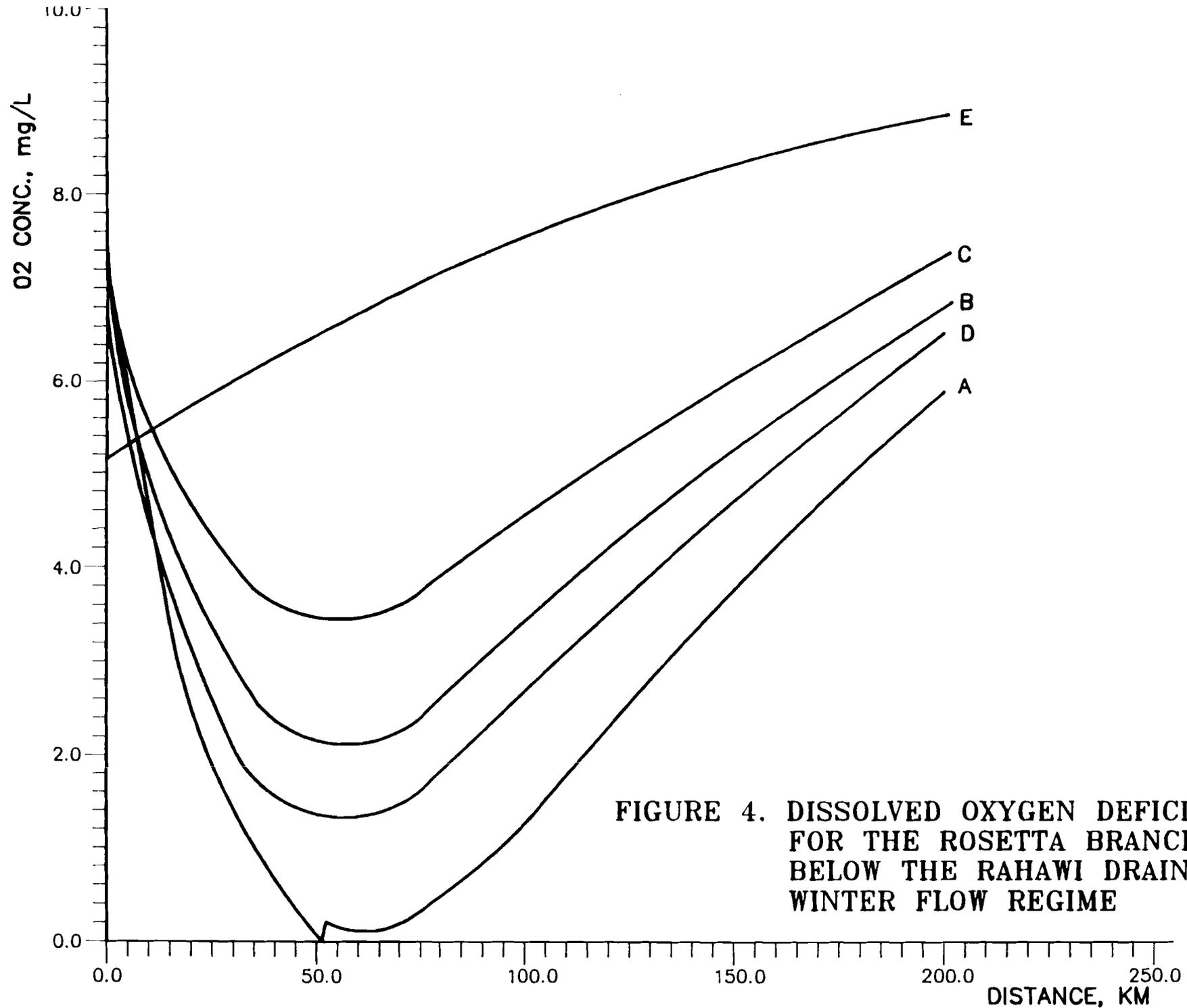
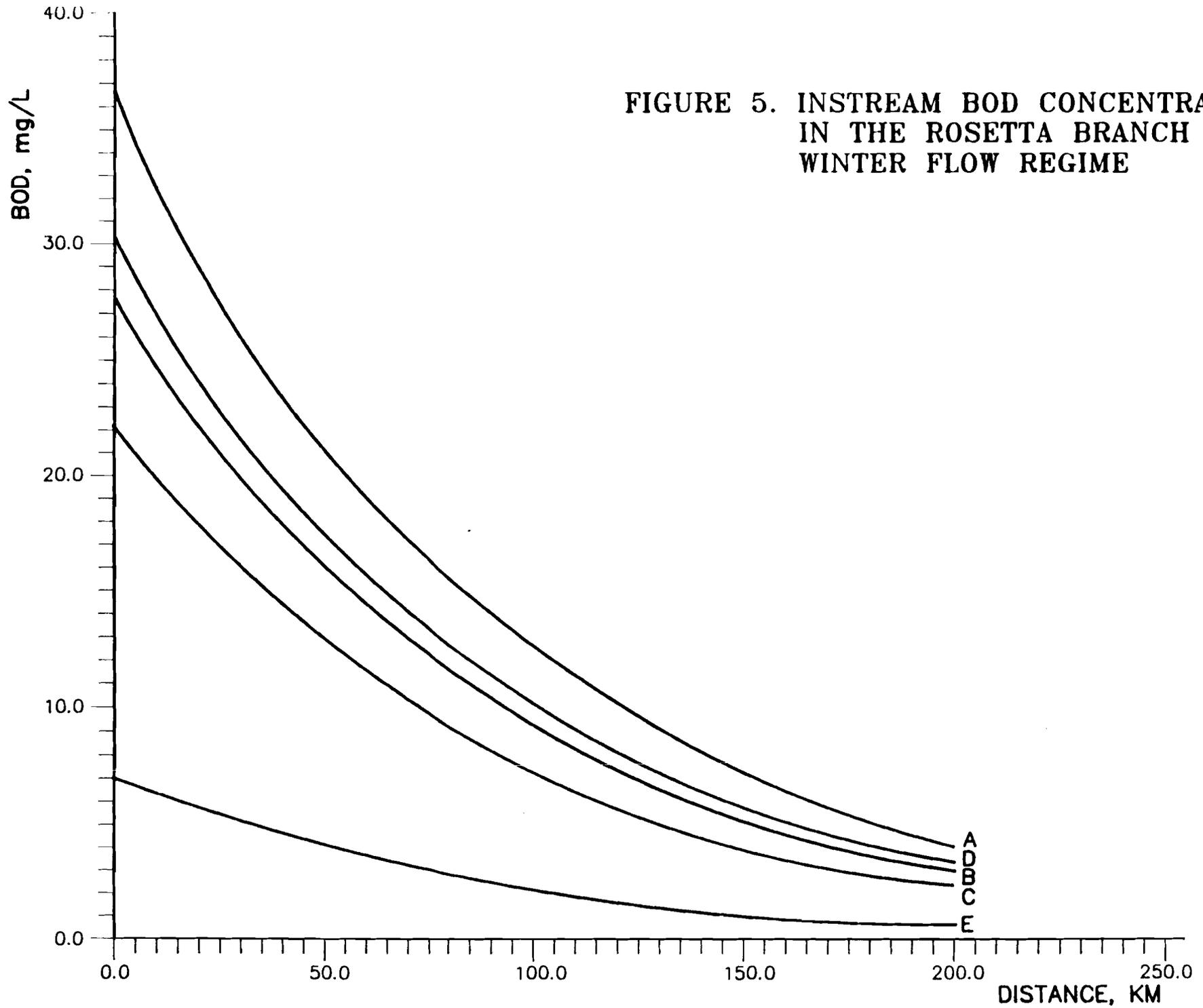


FIGURE 4. DISSOLVED OXYGEN DEFICIENCY FOR THE ROSETTA BRANCH BELOW THE RAHAWI DRAIN, WINTER FLOW REGIME

DO PROFILE FOR MINIMUM FLOW (WINTER) OF 2.2 MILLION M<sup>3</sup>/DAY

1/28

FIGURE 5. INSTREAM BOD CONCENTRATION  
IN THE ROSETTA BRANCH  
WINTER FLOW REGIME

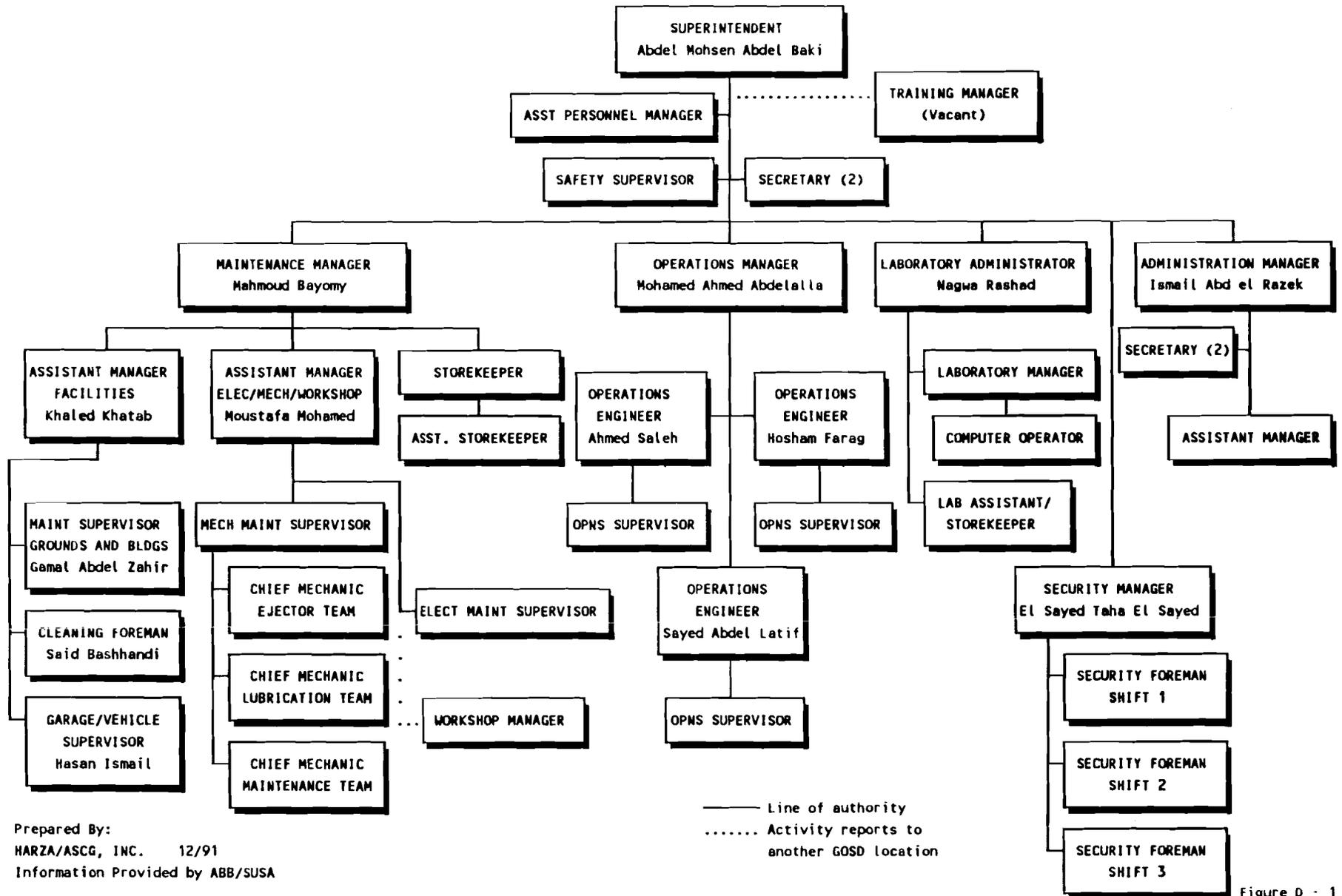


BOD PROFILES FOR MINIMUM FLOW (WINTER) OF 2.2 MILLION M<sup>3</sup>/DAY

129

# APPENDIX D

GENERAL ORGANIZATION FOR SANITARY DRAINAGE  
 WEST BANK OPERATIONS  
 ZENEIN WASTEWATER TREATMENT PLANT  
 CAIRO SEWERAGE II PROGRAM

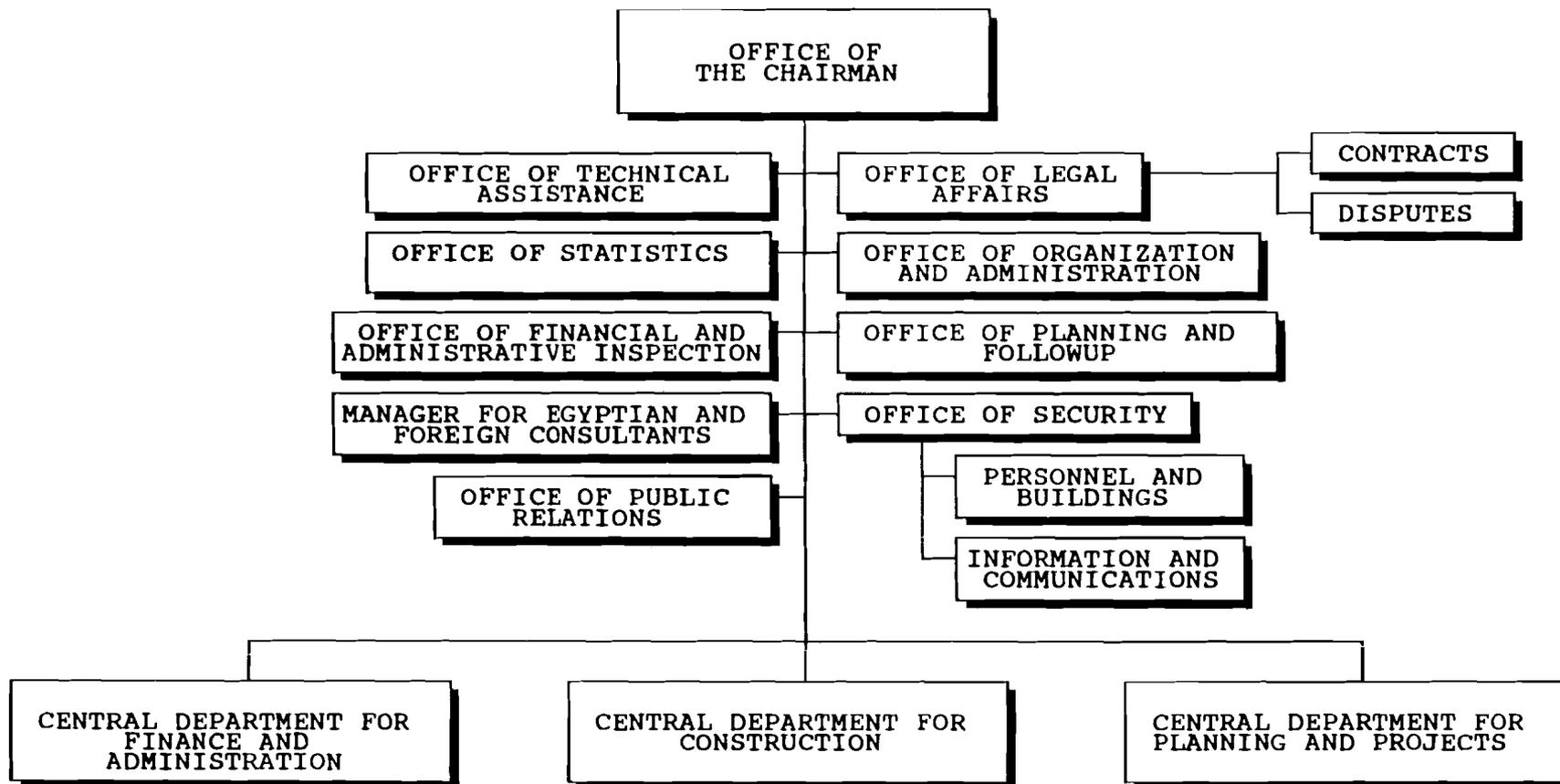


Prepared By:  
 HARZA/ASCG, INC. 12/91  
 Information Provided by ABB/SUSA

Figure D - 1

131

ORGANIZATION OF CWO  
CAIRO SEWERAGE II PROGRAM

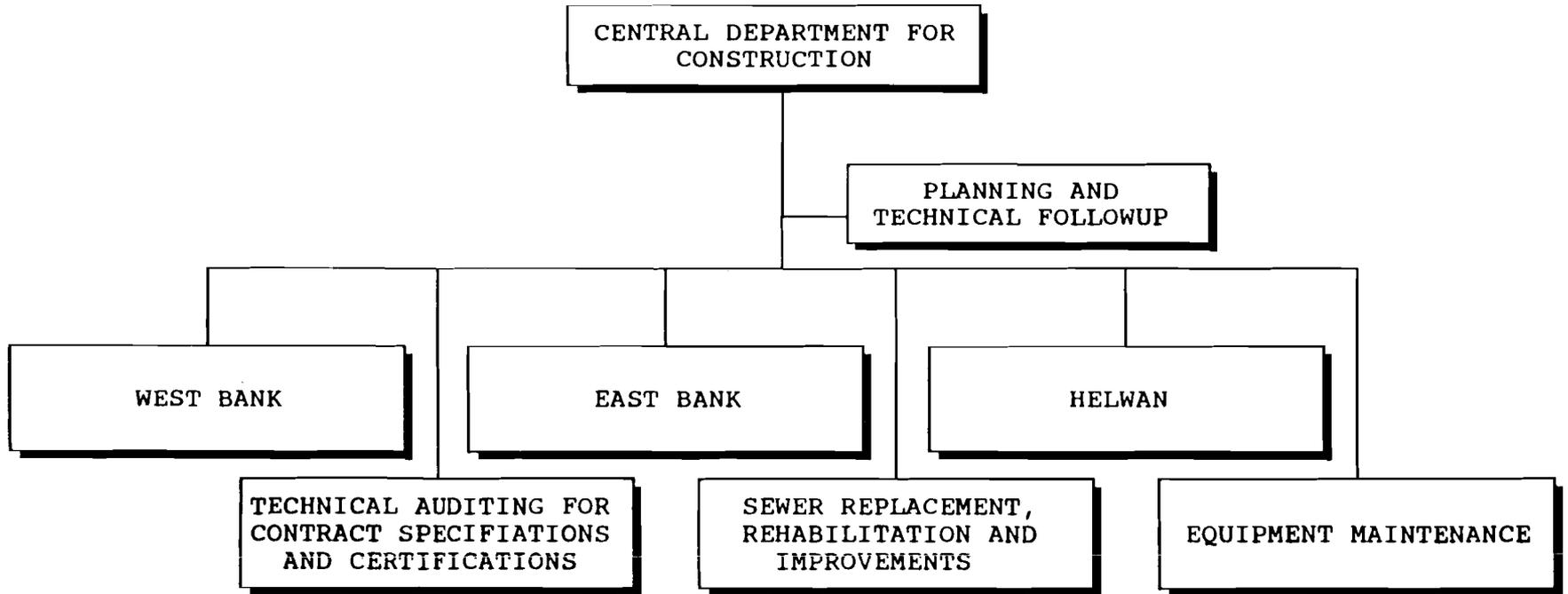


Prepared by:  
HARZA/ASCG, INC.  
Information provided by CWO  
12/91  
CSIID-2.DWG

Figure D - 2

132

ORGANIZATION OF CWO  
CAIRO SEWERAGE II PROGRAM

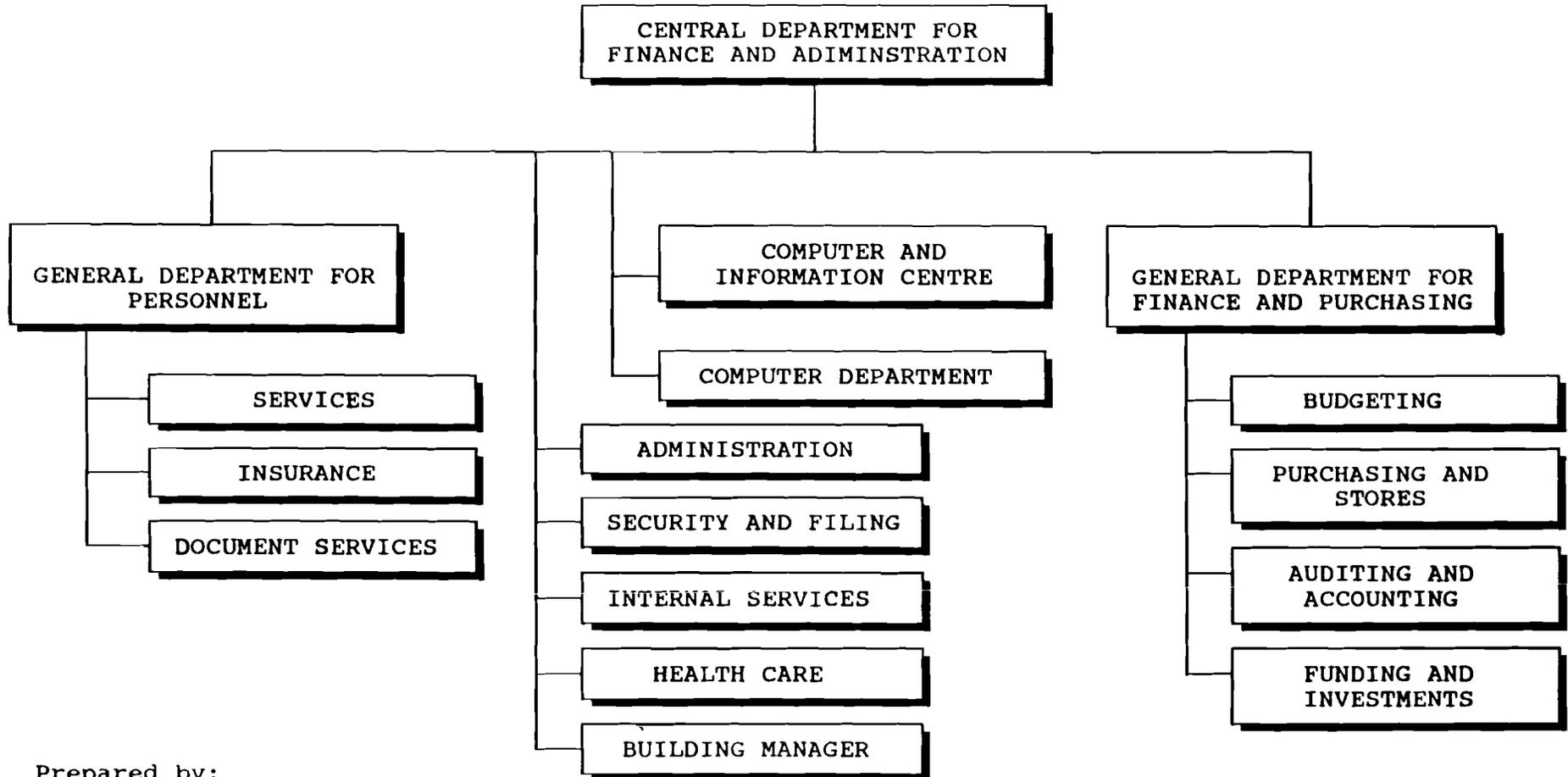


Prepared by:  
HARZA/ASCG, INC.  
Information provided by CWO  
12/91  
CSIID-3.DWG

Figure D - 3

1/23

ORGANIZATION OF CWO  
CAIRO SEWERAGE II PROGRAM

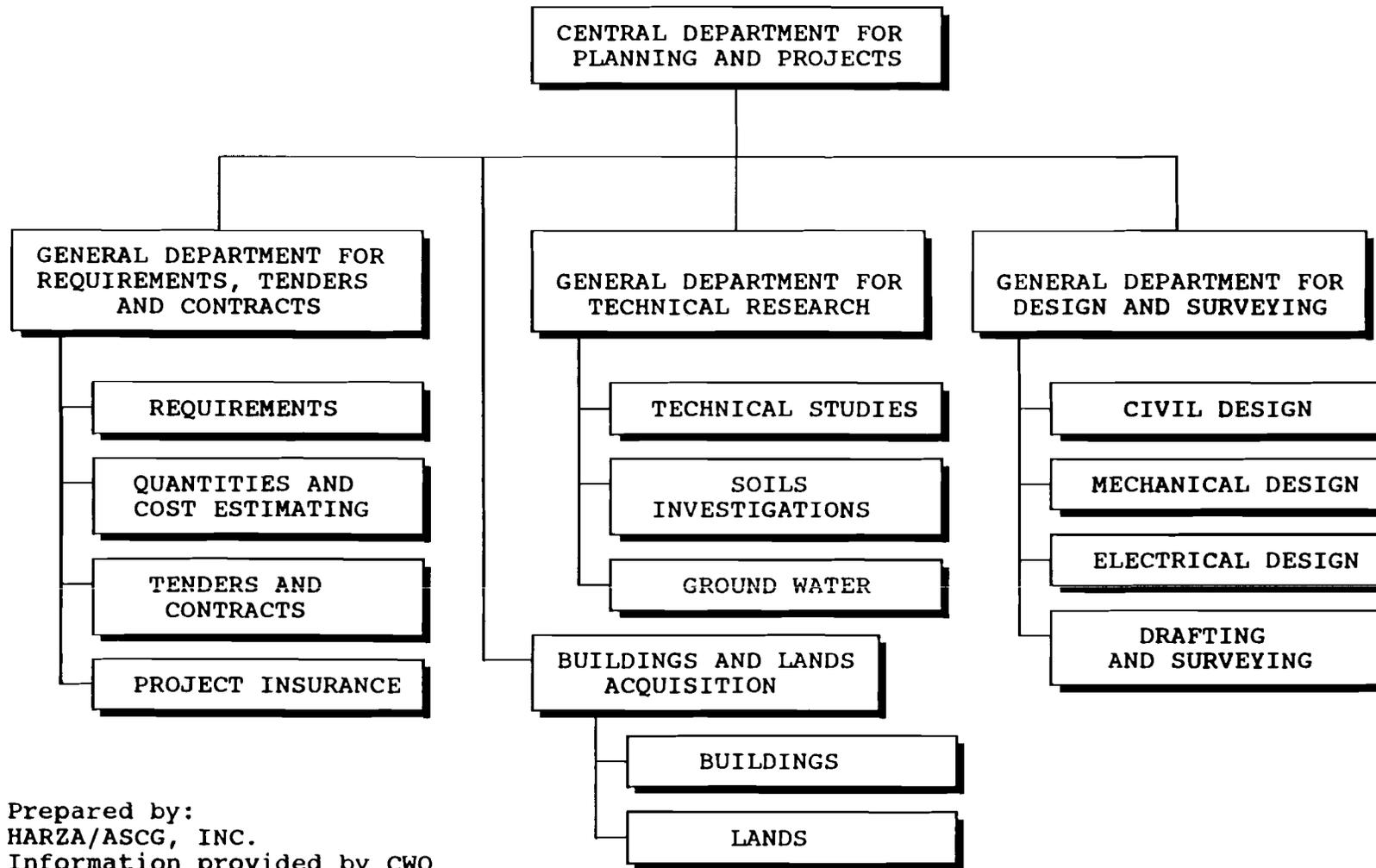


Prepared by:  
HARZA/ASCG, INC.  
Information provided by CWO  
12/91  
CSIID-4.DWG

Figure D - 4

196

ORGANIZATION OF CWO  
CAIRO SEWERAGE II PROGRAM

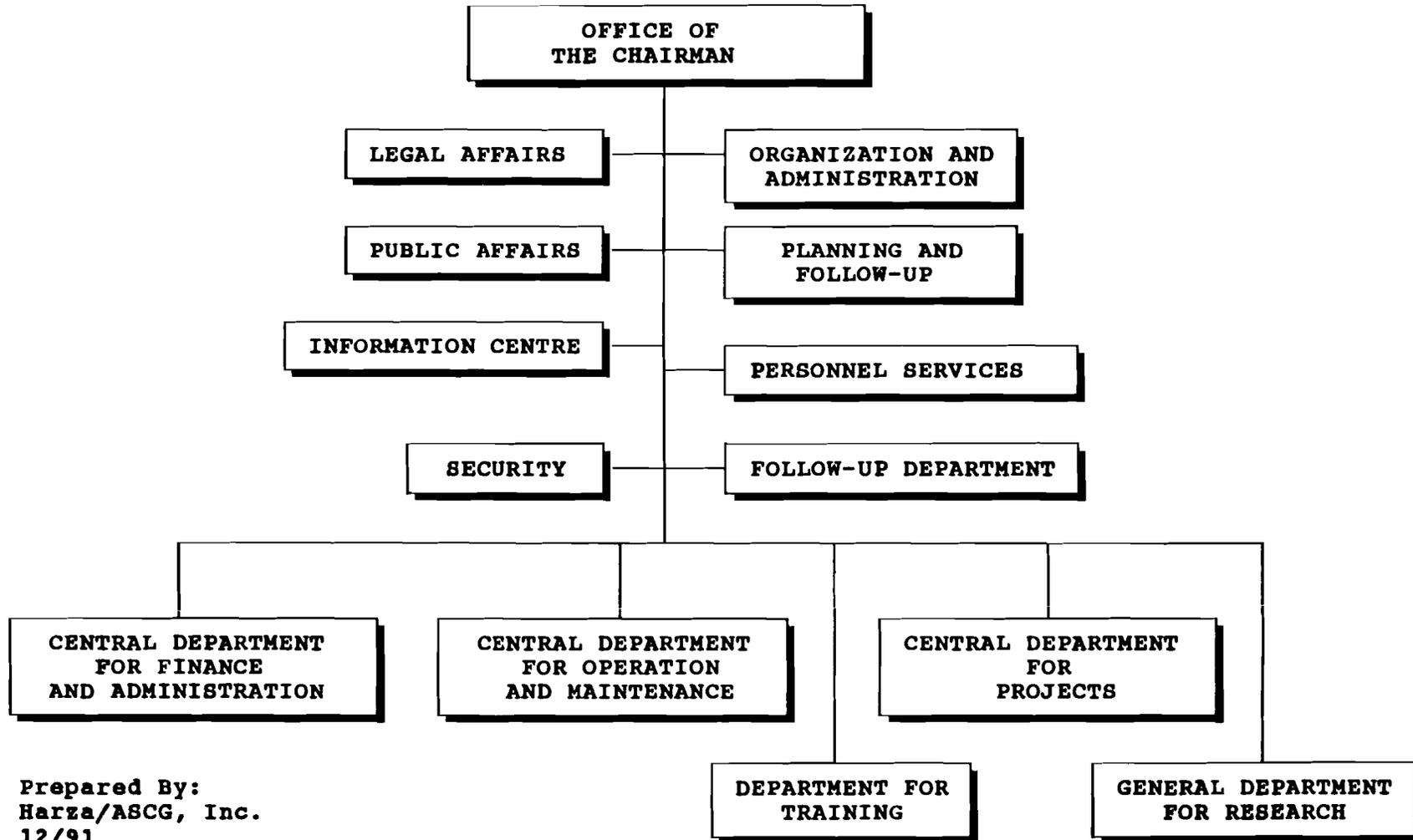


Prepared by:  
HARZA/ASCG, INC.  
Information provided by CWO  
12/91  
CSIID-5.DWG

Figure D - 5

46

CURRENT ORGANIZATIONAL CHART FOR THE  
 GENERAL ORGANIZATION FOR SANITARY DRAINAGE  
 CAIRO SEWERAGE II PROGRAM

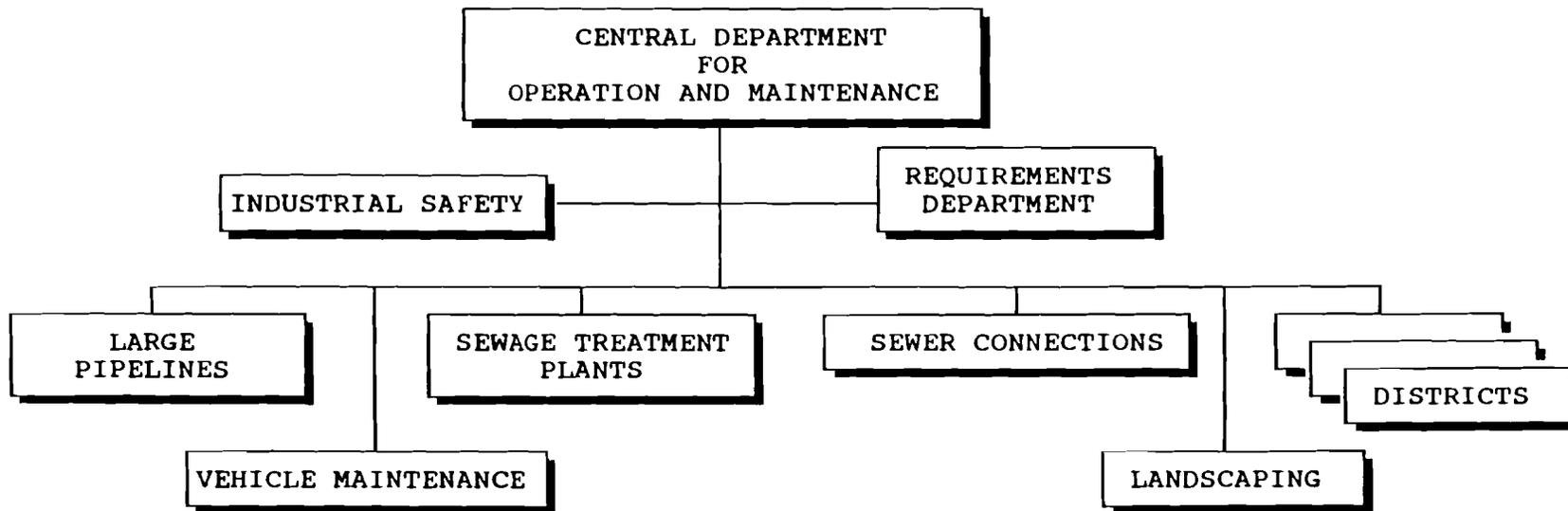


Prepared By:  
 Harza/ASCG, Inc.  
 12/91  
 Information provided by GOSD

Figure D - 6

136

CURRENT ORGANIZATIONAL CHART FOR THE  
GENERAL ORGANIZATION FOR SANITARY DRAINAGE  
CAIRO SEWERAGE II PROGRAM

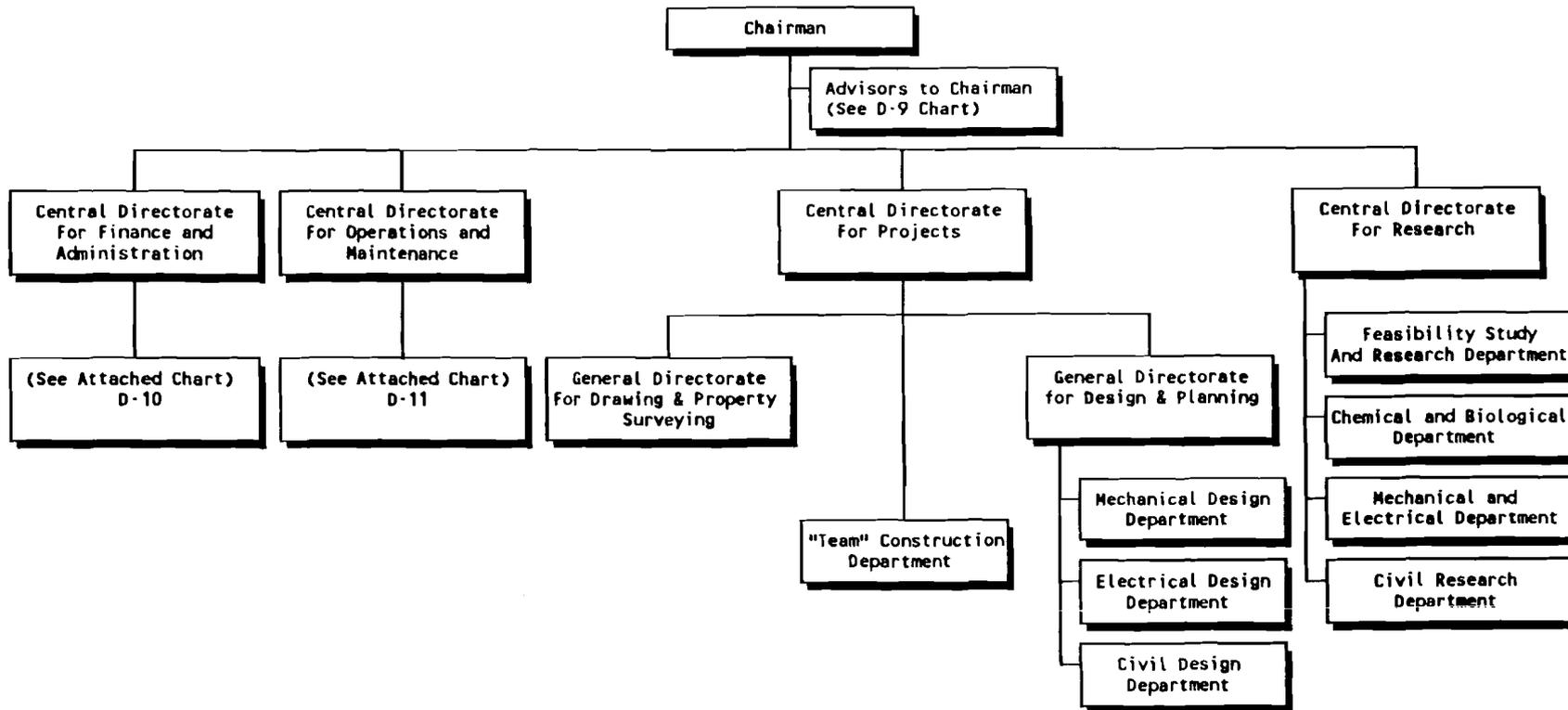


Prepared by:  
Harza/ASCG, Inc.  
12/91  
Information provided by GOSD  
CSIID-7.DWG

Figure D - 7

137

GOSD PROPOSED ORGANIZATION  
December 1991

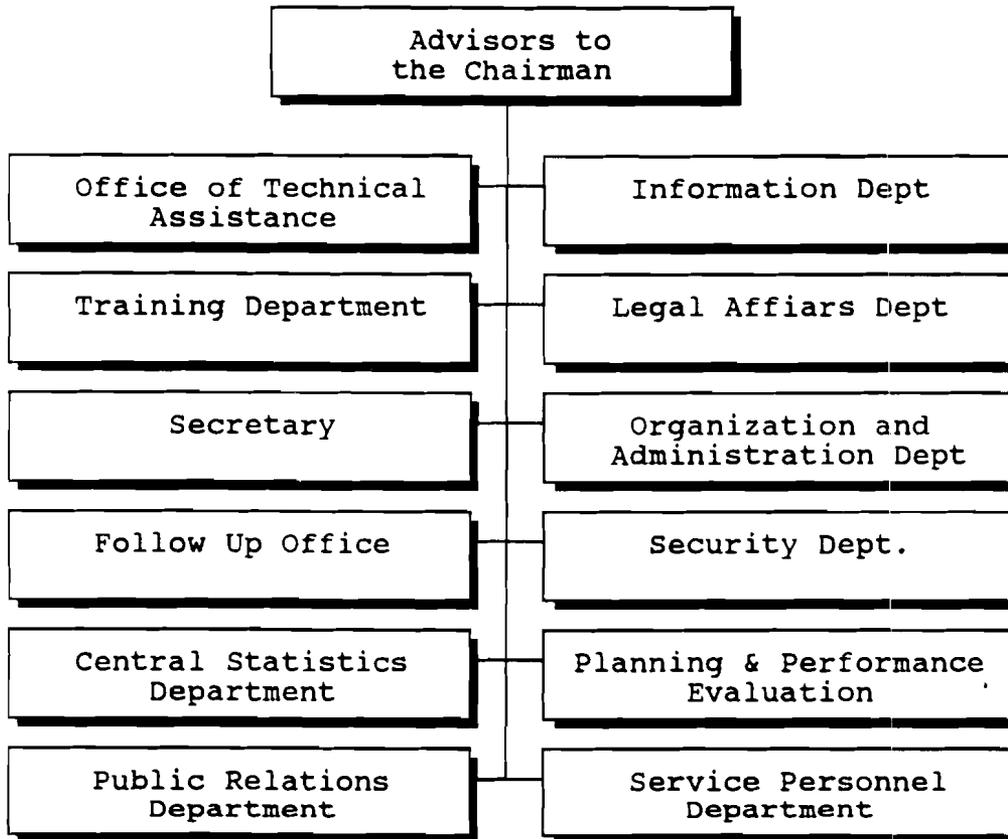


Prepared by:  
HARZA/ASCG, INC.  
Information provided by GOSD  
CSIID-8

Figure D-8

138

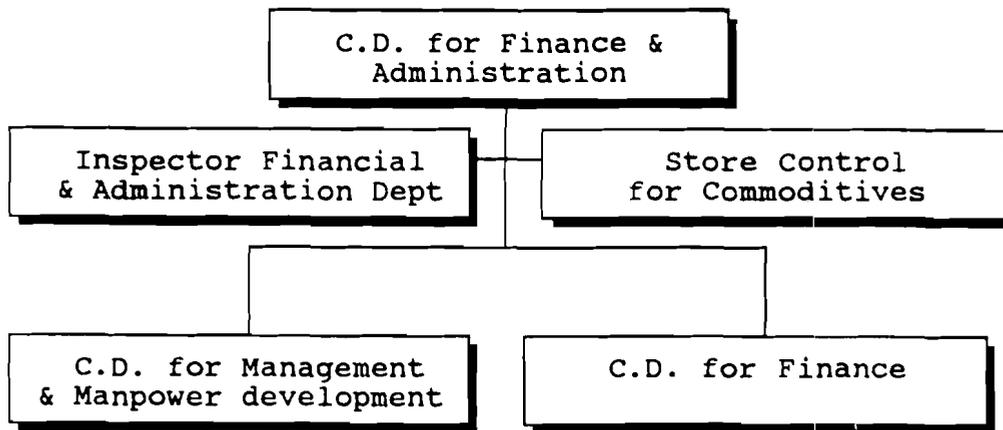
COSD Proposed Organization  
Details of Chairman's Office



Prepared by:  
HARZA/ASCG, Inc.  
Information Provided by GOSD  
CSIID-9

Figure D-9

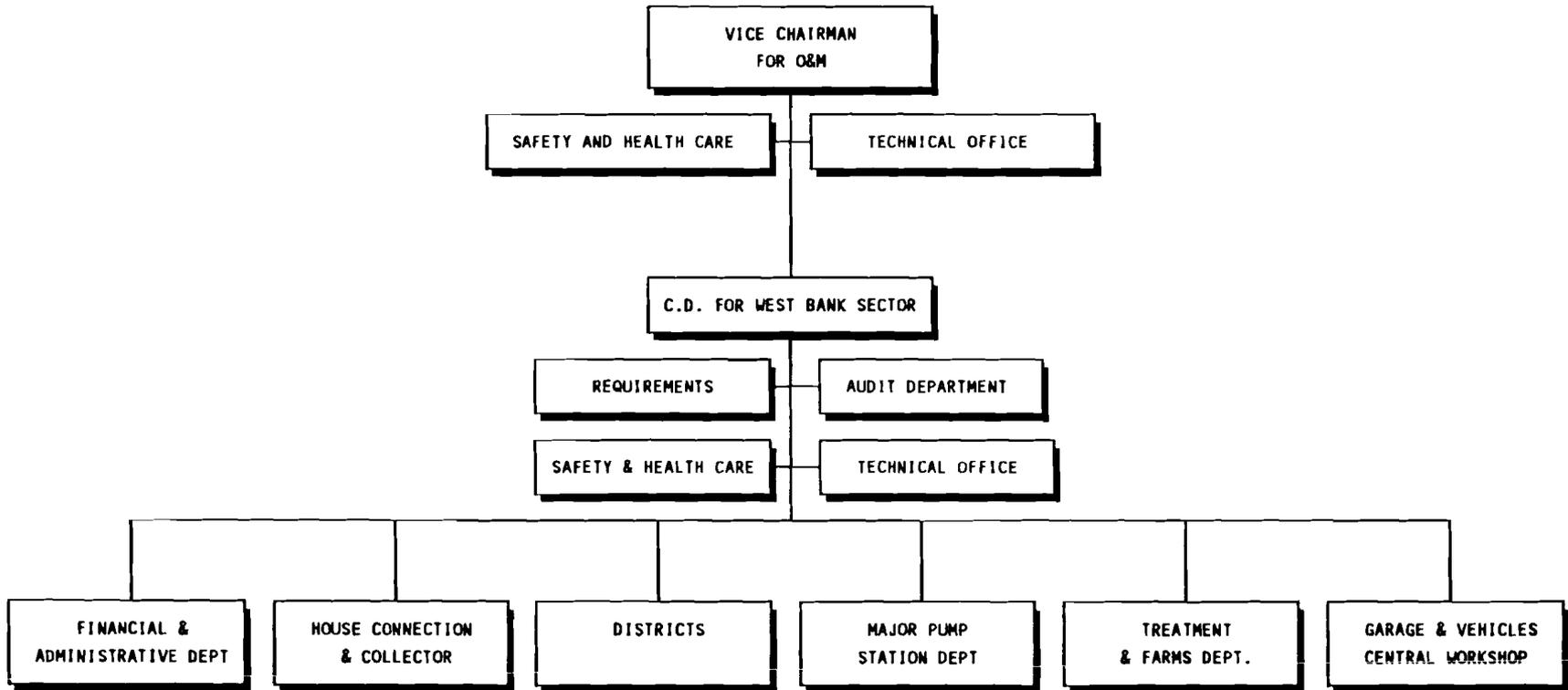
GOSD Proposed Organization  
Details of C.D. for Finance and Administration



Prepared by:  
HARZA/ASCG, Inc.  
Information provided by GOSD  
CSIID-10.dwg

Figure: D-10

GOSD PROPOSED ORGANIZATION - DETAILS OF  
THE CENTRAL DIRECTORATE FOR OPERATIONS  
AND MAINTENANCE

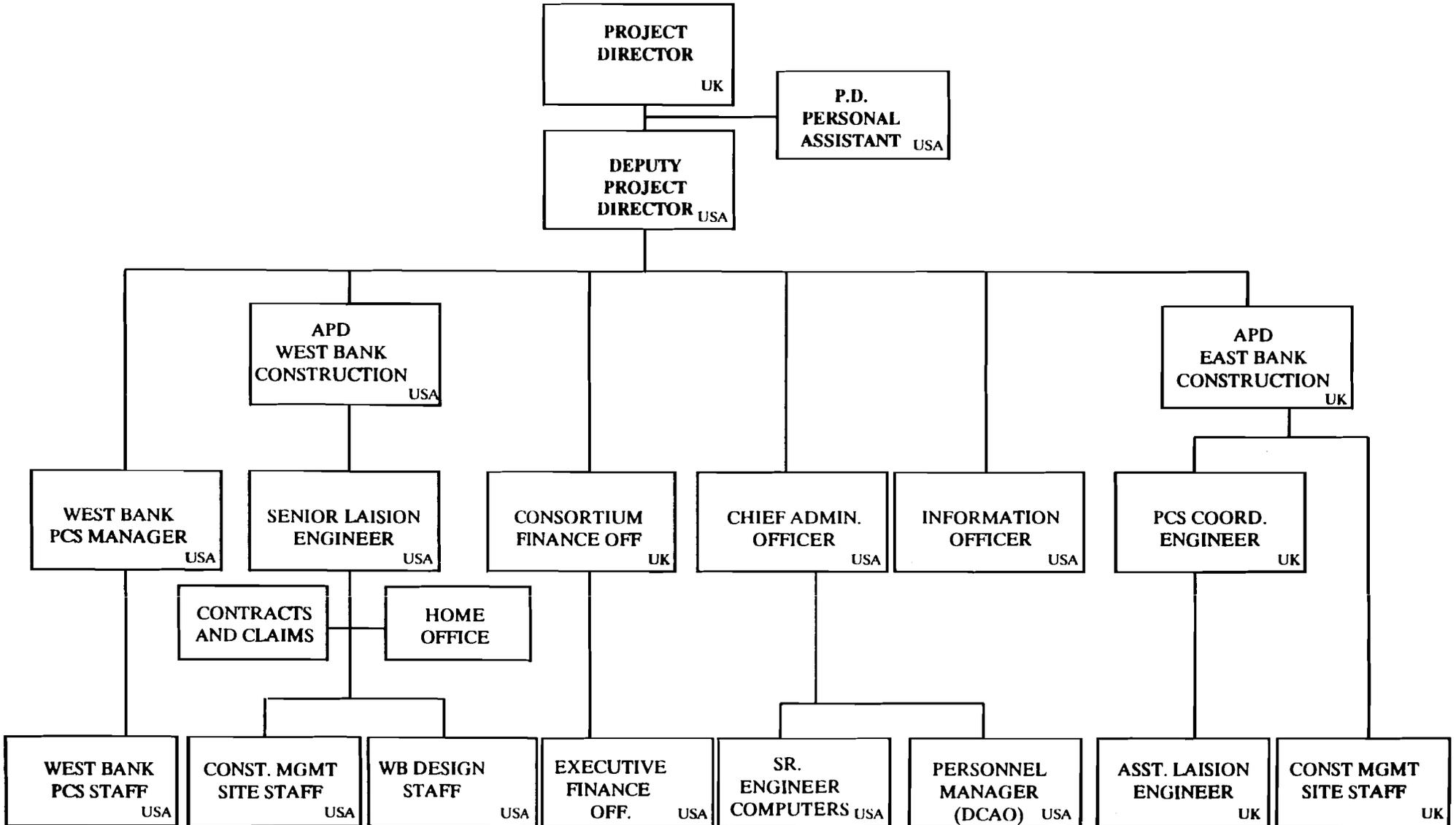


Prepared by:  
HARZA/ASCG  
Information provided by GOSD  
CSIID-11.dwg

Figure D-11

141

**AMBRIC ORGANIZATION  
JULY 1991 - FEB. 1992**



142