PROVINCIAL CITIES DEVELOPMENT PROJECT

AMENDMENT NO. 1

(263-0161.3)

ARAB REPUBLIC OF EGYPT

USAID/CAIRO

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

MAY 1985

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: 1

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: EGYPT

3. PROJECT NUMBER: 263-0161.3

4. BUREAU/OFFICE: ASIA/NEAR EAST — 03

5. PROJECT TITLE (maximum 40 characters): Provincial Cities Development

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 08 DD 31 YY 91

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 81 B. Quarter 4 C. Final FY 88

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY 81 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total						
(Grant)	(20,000)	( )	(20,000)	(59,600)	(50,400)	(110,000)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
Host Country		25,000	25,000		68,000	68,000
Other Donor(s)						
TOTALS	20,000	25,000	45,000	59,600	118,400	178,000

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1)	729	541		30,000		35,000		110,000	
(2)									
(3)									
(4)									
TOTALS				30,000		35,000		110,000	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 545

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)
A. Code
B. Amount

13. PROJECT PURPOSE (maximum 480 characters)

Improve and expand the existing water and wastewater systems of the Provincial Cities and to continue assisting the cities in planning, budgeting, constructing and maintaining urban infrastructure.

14. SCHEDULED EVALUATIONS
Interim MM 04 YY 84 MM 04 YY 88 Final MM 03 YY 91

15. SOURCE/ORIGIN OF GOODS AND SERVICES
☐ 000 ☐ 941 ☒ Local ☒ Other (Specify) 935

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

1) This project is being amended to increase financing for foreign exchange and local currency costs to construct and renovate water and wastewater systems and to finance additional technical assistance for local implementation of subprojects. The PACD is also being extended.
2) USAID/Egypt Controller concurs with the proposed methods of implementation and financing.
Homi Jamshed: ~~Acting Controller~~

17. APPROVED BY
Signature: Frank B. Kimball
Title: Director, USAID/Cairo
Date Signed: MM 07 DD 17 YY 85

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

AID 1330-4 (8-79)

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TABLE OF CONTENTS

	Page
LIST OF DESIGN TEAM & REVIEW COMMITTEE MEMBERS	i
I. SUMMARY AND RECOMMENDATIONS	1
II. PROJECT BACKGROUND	5
A. Project Development	5
1) Project Funding	8
B. Progress to Date	9
III. PROJECT DESCRIPTION	11
A. Amended Project Goal and Purpose	11
B. Master Plans	12
C. Implementation Plan	12
1) Phase I	15
2) Phase II	15
IV. TECHNICAL ANALYSIS	16
A. Major Construction Program	16
1) Fayoum	16
2) Beni Suef	19
3) Minia	21
B. Subproject Construction	24
V. ADMINISTRATIVE ANALYSIS	26
A. Contracting Alternatives	26
B. Construction Alternatives	27
C. Subproject Construction	30
D. Construction Management	30
E. Analysis of Host Country Contracting Capabilities	31
VI. FINANCIAL ANALYSIS	32
A. Cost Methodology	32
B. Financial Plan	32
C. Cash Flow	33
D. Exchange Rate	33
E. Subproject Financing	33
VII. ECONOMIC ANALYSIS	36
VIII. BENEFICIARY ANALYSIS	39
IX. ENVIRONMENTAL ANALYSIS	40

X. INSTITUTIONAL DEVELOPMENT & TRAINING 44
A. Introduction 44
B. Training 45
C. Recurrent Costs 46
D. Policy Dialogue 47
E. Integration with Other Projects 48

XI. PROJECT IMPLEMENTATION 49
A. Implementation Plan and Schedule 49
B. GOE Implementing Agencies 50
C. USAID Implementing Personnel 50
D. Evaluation 51
E. External Audit 52
F. 611 (e) Certification 52

XII. CONDITIONS AND COVENANTS 53

ANNEXES
A. Draft Second Amendment to Project Authorization
B. 611(a) Considerations
C. 611(e) Certification
D. Logical Framework
E. Economic Analysis
F. Water and Wastewater Sector Benchmarks
G. Implementation Plans
H. Subproject Listing
I. Training Courses and Proposed Training
J. Management Improvement Program
K. Implementation Schedule
L. Statutory Checklist
M. MPIC Letter of Request

ANNEXES - VOLUME TWO
N. Technical Analysis
O. Cost Methodology

LIST OF DESIGN AND REVIEW COMMITTEE MEMBERS

PROJECT PAPER AMENDMENT TEAM

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MISSION PROJECT PAPER AMENDMENT EXECUTIVE COMMITTEE

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George Laudato	AD, Development, Policy, Planning and Evaluation
Donald Pressley	AD, Industrial Support
Bernard Wilder	AD, Human Resources and Development Cooperation
Kevin O'Donnell	Legal Advisor
Terrence McMahon	Controller

I. SUMMARY AND RECOMMENDATIONS

A. Project Title:

Provincial Cities Development (Water/Wastewater)

B. Project Number:

263-0161.3

C. Source of Funds:

Economic Support Fund

D. Total Project Amount: AID $110 million, GOE LE 57.4 million ($68M)

AID

Original Project Authorization	: $75 million
Date of Grant Agreement	: September 22, 1981
FY 81 obligation	: $20 million
FY 83 obligation	: $10 million
* Proposed FY 85 obligation	: $30 million
Proposed Additional Authorization, Phase II	: $35 million

GOE

Original Project Contribution	: LE 21 million ($25M)
* Proposed FY 85 Contribution	: LE 16 million ($19M)
Proposed Additional Contribution, Phase II	: LE 20.4 million ($24.2M)

* MPIC requested that AID reduce its planned FY 85 obligation of $45 million to $30 million and, further, has agreed to contribute the required local currency from the CIP Special Account.

E. Terms:

To GOE: entire amount as a Grant.

F. Grantee:

Grant funds will be made available to the Implementing Agencies: National Organization for Potable Water and Sanitary Drainage; and to the Cities of Fayoum, Beni Suef and Minia.

G. Coordinating Agencies:

USAID/Cairo and the Ministry of Planning and International Cooperation.

H. Implementing Agencies:

NOPWASD and the Governorates and Cities of Fayoum, Beni Suef and Minia.

I. Life of Project:

10 years: PACD 8/31/91.

J. Project Goal:

To assist the GOE to provide for basic human needs, primarily water and wastewater services, in their secondary cities. In addition, by the use of the Governorates and Cities as implementing agencies it is anticipated that this project will assist the GOE achieve its objectives in financial and administrative decentralization.

K. Project Purpose:

Purpose of the Project is to improve and expand the water and wastewater systems of Fayoum, Beni Suef and Minia. The secondary purpose of the project is to improve the capacity of the cities to plan, implement and maintain urban infrastructure systems.

L. Environmental Soundness of Project:

The findings and recommendations of the Environmental Assessments have been fully incorporated into the present design and the project is in compliance with the requirements of 22 CFR 16, AID Environmental Procedures.

M. Project Summary

The Provincial Cities Development (PCD) project was authorized in FY 81 as part of the Decentralization Sector Support Program. The project was designed to assist the GOE achieve its policy objective of economic and administrative decentralization. The Project consists of technical and capital assistance for the design, construction and management of urban infrastructure in Egypt's secondary cities. Technical Assistance was initiated in 1982 when AID entered into a direct contract with Wilbur Smith and Associates. Small-scale capital improvements have been concentrated in the water and wastewater sectors of the capital cities of Fayoum, Beni Suef and Minia. Medium-scale capital improvements in water and wastewater systems are now needed so as to provide for basic human needs. Project costs as estimated in 1980 have increased and additional funds must be authorized in order to achieve system improvements envisioned in the original Project Paper.

N. Purpose of Project Paper Amendment

To present accomplishments, amend the project goal, clarify project purpose and identify what remains to be done for completing the core water and wastewater systems and for upgrading the local capability to operate and maintain these systems.

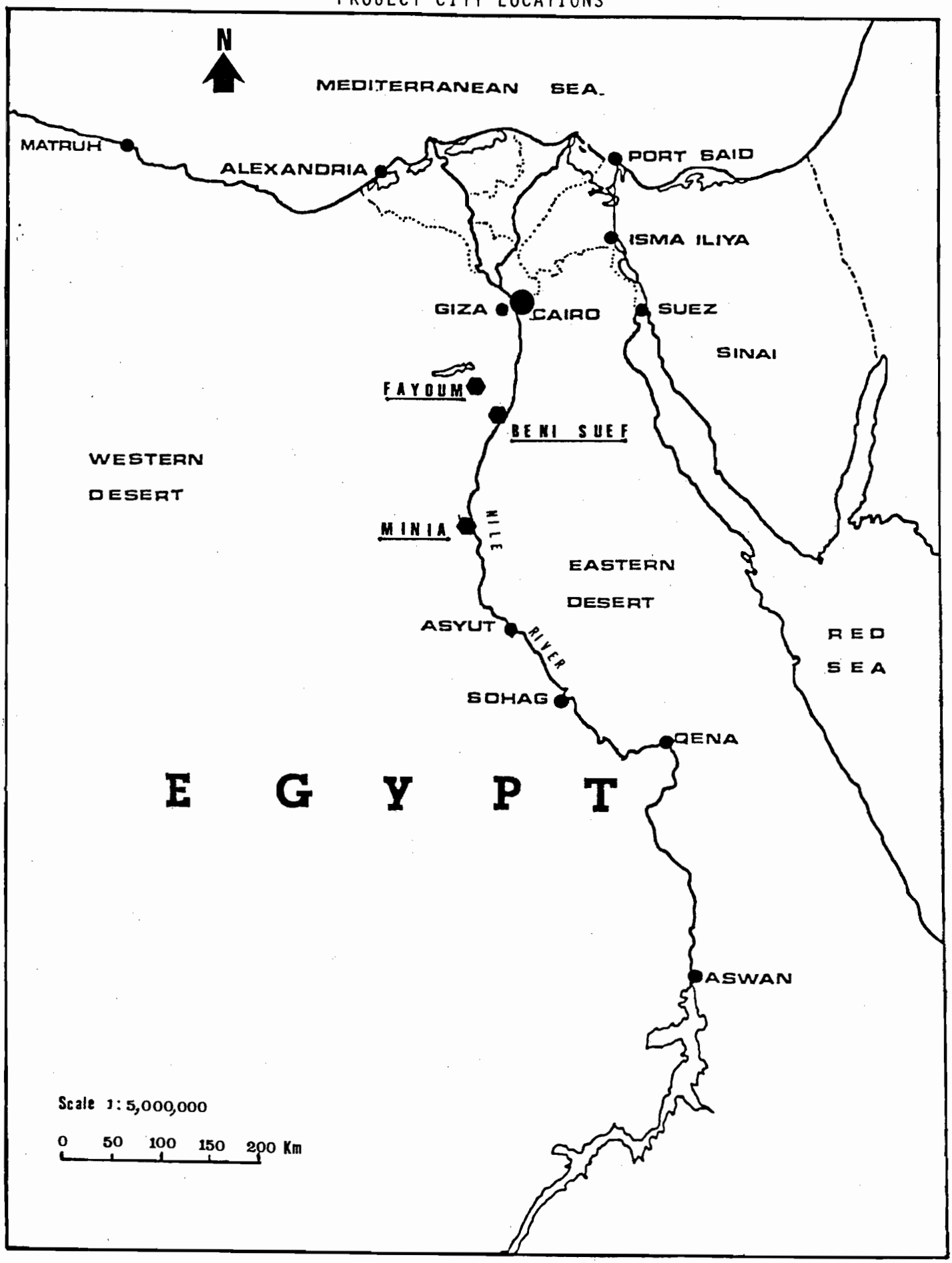
O. Recommendations:

1. USAID/Cairo recommends an FY 85 obligation of $30 million for improving water and wastewater services during Phase I.

2. USAID/Cairo recommends increasing the LOP from $75 million to $110 million. This increase will be used to fund the U.S. dollar and some local currency costs for Phase II design, construction, and advisory services for water and wastewater improvements in the cities of Fayoum, Beni Suef and Minia. The GOE contribution for LOP will increase from LE 21 million ($25 million) to LE 57.4 million ($68 million).

Figure

PROJECT CITY LOCATIONS



II. BACKGROUND

A. Project Development

2.01 The Provincial Cities Development (PCD) project was designed to support the GOE's decentralization of authority to local government levels. The objectives of the Local Government System Law (Law 43 of 1979) were two-fold: a) to develop the capacity of local governments so as to allow for the transfer of centralized authority to local governments; and b) to encourage local government units to solve problems locally. In theory this legislation was to increase the authority of local governments to make and implement decisions. The lack of administrative capability at the local level as well as the lack of financial and technical resources necessary to implement municipal decisions impeded decentralization aims.

2.02 To address these constraints, the GOE in 1979 suggested that a coordinated capital and technical assistance program be developed for three capital cities of the Upper Egypt Regional Planning Area. The Cities of Fayoum, Beni Suef and Minia were chosen because of their development potential. Further, they are fairly representative of Egyptian secondary cities in terms of size and capacity of local government to plan and implement development programs.

2.03 A feasibility study for PCD in 1980 found that local officials were most interested in using capital resources for improving municipal infrastructure, primarily water and wastewater systems and streets. In 1981, AID authorized for PCD obligations not to exceed $75 million in grant funds over a five year period. The GOE agreed to contribute the local currency equivalent of $25 million. These funds were to finance technical and capital assistance for the design, construction and management of urban infrastructure in the secondary cities.

2.04 Technical Assistance is provided by a General Consultant, Wilbur Smith and Associates, under a direct contract with USAID. The Consultant was tasked with providing to the cities:

a) conceptual water and wastewater system plans;
b) management advisory services;
c) training.

Teams of Resident Advisors, one American and one Egyptian, have been established in each city to provide day-to-day technical assistance to governorate and municipal employees.

2.05 The infrastructure in place at the beginning of the project was found to have been inadequately maintained and was insufficient to meet expanding needs. Comprehensive systems planning for infrastructure had not been undertaken by the cities nor did they possess sufficient technical expertise to execute such plans. The cities requested the development of these plans (herein titled Master Plan) as a priority so as to identify the technical and financial requirements necessary for improving their systems.

2.06 While these plans were being developed, and to meet immediate needs, top-priority subprojects were identified by the cities and the Consultant for immediate GOE and USAID funding. Approximately $13 million in USAID funds and $7 million in GOE funds have been used to implement 250 subprojects, of which 30% are completed. Ninety percent of the financing for top-priority subprojects has been used to improve water and wastewater systems while the remaining 10% has been used for street improvements, municipal equipment purchases and training programs. Annex H lists current subprojects.

2.07 The Consultant completed draft preliminary Master Plans in 1984. The estimated cost of comprehensive water and wastewater systems for the year 2000 for all three cities was estimated at $315 million (using 1983 costs). The Consultant prepared a five-phase Implementation Plan which staged the implementation of the Master Plan over a 15 year period. Project officials approved these plans in May, 1984. They requested that remaining project funds be obligated to implement Phase I and that AID and MPIC be solicited for additional funding for Phase II of the Implementation Plan.

2.08 This first Implementation Plan raised concerns that wastewater treatment in Phase I was being addressed prior to wastewater collection in Phase II. AID/W questioned the adequacy of cost estimates which used 1983 costs and a presumed exchange rate of $1=LE .90. Prior to additional obligation, therefore, the NEAC requested that a PP Annex or Amendment be prepared by the Mission "to address the following concerns:

a) evidence of firm and adequate cost estimates and plans to support them;

b) preparation of a detailed implementation plan which addresses contracting and monitoring arrangements, evidence of adequate management training support, and how USAID plans to raise and resolve policy concerns with PCD cities."

2.09 The Implementation Plans identified capital improvements to the wastewater treatment plants thereby requiring an Environmental Assessment (EA) of the project (22 CFR 216). The Near East Bureau Environmental Coordinator led an AID/W and Mission team that reviewed the Consultant's findings, conducted Scoping Sessions with local and national representatives, and identified potential environmental issues. The fieldwork for the Assessment has been completed and a final report is expected in May 1985.

2.10 Results of the Environmental Assessment necessitated refinements to the Master Plans and the development of more detailed Implementation Plans. These revisions primarily reconfigured the staging of the construction, establishing a precedence of wastewater collection and water treatment to water distribution and wastewater treatment.

2.11 The revised Implementation Plan, which would meet year 2000 service needs in five phases, would require approximately $461 million, using 1984 pricing and future escalations. The cost of implementing the first two phases, referred to as the Basic Service Implementation Plan, is estimated at $138 million. This is in addition to the $40 million committed and disbursed for top-priority subprojects and technical assistance to date. The Basic Service Plan identifies for financing the priority elements that address minimum basic needs of the current populations. GOE project officials approved this Plan in April 1985 and requested that USAID and the MPIC authorize additional funds.

2.12 Phase I of the Implementation Plan identifies improvements recommended for financing with remaining project funds of $70 million. Phase I would be self-contained and not contingent upon further funding and construction. Phase II construction would provide add-on improvements to Phase I elements, such as additional water towers and streams for the water treatment plants. Annex G illustrates the elements to be financed in the Basic Service Implementation Plan.

2.13 Project Funding To Date ($000,000)

	AID	GOE	TOTAL
Authorized	$ 75	$25	$100
Obligated	30	25	55
Obligated but uncommitted	6	19	25
Unobligated	45	-	45
Available for Phase I	$ 51	$19	$ 70

2.14 Proposed Funding ($000,000)

	Revised Project Budget	$110	$68	$178
	Original Authorization	75	25	100
	Proposed New Authorization	$ 35	$43	$ 78
	Revised Project Budget	$110	$68	$178
	Obligated to Date	30	25	55
*	Proposed FY 85 obligation	30	19	49
	Remaining obligation	$ 50	$24	$ 74

Prior to initiating Phase II construction remaining AID obligations should be programmed as follows:

FY 86	$ 20 million
FY 87	$ 20 million
FY 88	$ 10 million

2.15 Implementation Plan Funding ($000,000)

	Obligated but uncommitted	$ 6	$19	$ 25
*	Proposed FY 85 obligation	30	19	49
	Remaining obligation	50	24	74
	Total Available for Phases I and II			$138

* MPIC requested that AID reduce its planned FY 85 obligation of $45 million to $30 million and, further, has agreed to contribute the required local currency from the CIP Special Account.

B. Progress to Date

2.16 During project design local officials stated that improvements to the water and wastewater systems were of the highest priority to their cities. Mechanisms for improving this sector, however, were ill-defined prior to the introduction of PCD. System plans did not exist, equipment had been improperly maintained and become inoperative, financial and technical resources were inadequate to address the expanding needs of the cities, and procedures for correcting system deficiencies were reactive rather than preventive. Although local officials placed water and wastewater services as a high priority, experience indicates that it was receiving inadequate corrective attention.

2.17 After project authorization in September 1981, substantial procedural and technical arrangements had to be established in the cities in order to overcome a "quick-fix" mentality for major system deficiencies. USAID and GOE funding of $25 million have been disbursed and the following accomplishments have occured:

a. Technical Assistance initiated in cities using resident advisors, one American and one Egyptian, to transfer American technology and management practices;

b. Water and Wastewater Master Plans developed for improvements through the year 2000;

c. Two hundred and fifty top-priority subprojects identified, designed and are being implemented by the cities;

d. A two-phase Basic Service Implementation Plan to address minimum basic needs for USAID and GOE financing was approved by the GOE;

e. 26 training programs conducted for managerial, technical and clerical personnel;

f. Policy dialogue initiated with local officials on issues pertaining to tariffs, O&M requirements, and public participation in water conservation.

2.18 In general, the project has financed water and wastewater improvements and technical assistance to the three provincial cities. The improvements have been of a small-scale nature, primarily pipe replacements, road repairs, and equipment purchases. Implementing improvements of this size and nature has provided the opportunity for the cities to improve their capability to design, construct and manage urban infrastructure. In addition, the cities have increased their use of local consultants and contractors, strengthening the private sector's capability to design and construct infrastructure. In this manner, cooperation between the public and private sectors has increased.

2.19 These improvements to local procedures have strengthened municipal departments, including Infrastructure, Engineering, Legal and Procurement. Overall, these procedural changes have improved administrative practices relating to organization, planning, and financial management.

2.20 The project has effected an increased involvement of the Local Councils in the management of the cities. The three cities now have special Technical Committees which review designs, contract awards, and contractor performance and advise the Local Councils. The Resident Advisors have assisted Local Councils in understanding the technical requirements of the water and wastewater systems.

2.21 The project also has fostered cooperation between central government and local government officials. The Project Steering Committee is the senior level GOE implementing organization for PCD. It is composed of representatives from NOPWASD, Ministry of Finance, Ministry of Local Government, Ministry of Planning, and Governorate and Municipal officials. These officials routinely meet to discuss implementation issues and financing problems.

III. PROJECT DESCRIPTION

A. Amended Project Goal and Purpose

3.01 The original goal of PCD was to assist the GOE achieve its policy objective of economic and administrative decentralization. Expected measures of goal achievement included a significant increase of governorate-controlled budget allocations for capital investments, a significant increase in the amount of grants to the governorates for capital investments, and a significant increase in locally-raised and retained funds for public services. Such budget allocations have not occured; to the contrary, capital investments from the central government to the governorates for water and wastewater activities have been reduced in anticipation of capital improvements financed by PCD.

3.02 The original project design, in terms of its broad institutional goals, its time frame, and the range of infrastructure it considered, was overly ambitious. Consequently, in the course of implementation the Project's scope has narrowed and resulted in the current focus on planning and implementing water and wastewater systems. Project officials have actively pursued this narrowing of scope in order to direct GOE budget allocations to other sectors of the cities.

3.03 The amended project goal is to assist the GOE to provide for basic human needs in their secondary cities. In addition, by the use of the Governorates and cities as implementing agencies it is anticipated that this project will assist the GOE achieve its objectives in financial and administrative decentralization. PCD responds to the GOE's current initiatives by assisting the cities to provide basic human services.

3.04 The original project purpose, that is "to improve and expand the growing institutional capacity of the three governorates and their capital cities specifically to identify, plan for, budget, finance, design, construct, and maintain urban infrastructure and services at the municipal staff level," must be clarified so as to focus project efforts on improving water and wastewater services in the provincial cities. Purpose of the project, therefore, is to improve and expand the water and wastewater systems and to continue assisting the cities in planning, budgeting, constructing and maintaining urban infrastructure.

3.05 The PCD project will remain a mix of capital assistance and capacity-building components but its emphasis will be the implementation of portions of the Master Plans. Secondarily, assistance will be given to the cities for operating, maintaining and managing water and wastewater systems. An operations assistance program and additional training programs have been incorporated into both phases of the project. Further improvements of local capability to design, construct and manage urban systems is anticipated by the cities' implementation of subprojects.

An amended logical framework is provided at Annex D.

B. Master Plans

3.06 In cooperation with the cities, the general consultant developed preliminary Master Plans in 1983, and revised them in 1984. The estimated total project costs to improve and expand water and wastewater services for the year 2000 are $461 million. This cost far exceeds the authorized project funds of $100 million. The magnitude of these costs means that the full systems that were envisioned in the Sabbour feasibility study and the Project Paper, which included improved water and wastewater treatment and full distribution and collection, can no longer be provided with authorized funds.

3.07 The Master Plans determined that the level of services in each city varied. The Project Steering Committee authorized the Consultant to prepare Implementation Plans that would equalize levels of service as much as possible. To this end project funding was to be allocated to the cities in the following proportions:

- 43% to Fayoum
- 29% to Beni Suef
- 28% to Minia

C. Basic Service Implementation Plan

3.08 The general consultant developed a five-phase Implementation Plan which staged the implementation of the Master Plan over a 15-year period. Local officials worked with the Consultant and AID officials to develop a Basic Service Implementation Plan that would provide improved services to their current residents. This Plan, its costs summarized in table 3.08 and its components detailed in Annex G and Annex N, Technical Annex, consists of two phases: Phase I, with an anticipated

TABLE 3.08
BASIC SERVICE IMPLEMENTATION PLAN
Illustrative Cost Summary
(000,000)

	PHASE I		PHASE II		TOTAL	
	FX	LE	FX	LE	FX	LE
Capital Costs						
Water	9.8	16.6	8.4	19.6	18.2	36.2
Wastewater	4.8	11.8	1.1	7.3	5.9	19.1
Sub-Total	14.6	28.4	9.5	26.9	24.1	55.3
O & M Assistance	4.3	0.9	3.4	0.6	7.7	1.5
A & E / Consultants	4.2	3.9	11.8	4.8	16.0	8.7
Contingency	2.1	4.4	1.5	3.0	3.6	7.4
TOTAL	25.2	37.6	26.2	35.3	51.4	72.9
TOTAL DOLLAR EQUIVALENT	70.0		68.2		138.2	

implementation schedule of four years, identifies priority system improvements to be financed with remaining project funds of $70 million; Phase II, requiring additional funding of $68 million, extends Phase I construction by two years and includes additional improvements for meeting basic service needs.

3.09 In developing an Implementation Plan for each of the cities the GOE, the Consultant and USAID were guided by the following criteria:

1. Address as a first priority the minimum basic service needs, as identified by the Cities, the Consultant and AID, of the current population;

2. Identify investments that could stand alone and not be contingent upon future funding;

3. Provide facilities and material that would be simple to install, maintain and operate and would have low, long-term O&M costs;

4. Make small-scale interventions (i.e., leak surveys, line cleaning programs) that would improve system performance and reduce capital needs;

5. Include funding for management training and an operations assistance program;

6. Meet AID environmental criteria.

3.10 Substantial effort was expended to develop an Implementation Plan that was responsive to the cities' most immediate system needs. Recommendations of the resident advisors, local and municipal officials, and Ministry representatives were solicited. Additional analyses of system and staging alternatives were contributed by the Environmental Assessment team. Technical and financial alternatives were presented and explained to the cities and the Project Steering Committee. The approved Implementation Plan reflects both the cities' agreement on Consultant and AID recommendations as well as their own choices for treatment options and servicing of areas.

C.1 Phase I

3.11 Phase I of the Implementation Plan illustrates the most immediate service needs that can be financed with remaining authorized project funds of $70 million (table 3.08). Forty-one percent of the funding is for capital improvements to the water system, 27% for improving the wastewater system, 7% for training and operation assistance, and 25% for contingency, A&E, construction management and consultant services. The design work for both phases will be performed during Phase I and construction is estimated to be completed in 1990 (see table 6.2, Cash Flow Analysis).

C.2 Phase II

3.12 Phase II of the Implementation Plan finances construction of items that would provide 70% of the basic service needs of the cities. The Plan approximates the capital improvements envisioned in the original Project Paper. Construction

initiated during Phase I will be extended to expand water treatment plants, build elevated water towers, and extend wastewater collection. Additional funding of $26 million and LE 35 million ($42 M) is required for Phase II.

3.13 Estimated funds required for implementing both phases of the Basic Service Implementation Plan, using the recommended construction approach, are $51.5 million and LE 73 million. Equivalent dollar cost using .84 as the conversion rate is $138 million.

3.14 The Basic Service Implementation Plan was reviewed and approved by the cities and the Project Steering Committee during March and April, 1985. The specific elements to be considered for financing are illustrated and included in Annex N, Technical Annex.

IV. TECHNICAL ANALYSIS

4.01 The following sections summarize findings and proposed actions for improving water and wastewater systems in the three cities. Annex N provides a detailed listing of needs, proposed technical alternatives and recommendations for immediate implementation.

4.02 The Mission Environmental Engineer and the Near East Environmental Coordinator have reviewed these plans and determined that they are technically, economically, financially and environmentally feasible and meet 611(a) requirements (see Annex B).

4.03 The water and wastewater systems in the three project cities are old and in poor condition. Existing plants date from early in this century and there is a major need for new facilities. In addition, there are major deficiencies in the operation and maintenance of the systems. Institutional reforms must continue so as to improve the technical and management services available in this sector. A strong need exists to develop within each employee a sense of organizational pride; the importance of their jobs must be emphasized. A strong support system providing repair services and an adequate inventory of equipment, parts and supplies is required. Construction management, an inventory control system, O&M manuals and on-the-job training are also required and will be funded during both phases of the Implementation Plan.

4.04 The elements in the Implementation Plan have been identified for major construction or subproject implementation. While the design and major construction will be undertaken by an American-Egyptian firm, subproject construction will continue to be performed by local firms. The following sections describe the service needs of each of the cities and the major construction activity anticipated during Phase I and Phase II.

A. Major Construction Program

4.05.1 Fayoum

Of the three cities receiving assistance under the PCD Project, Fayoum is the largest with a population of 208,000. The needs of Fayoum in the water and wastewater sector exceed those of the other two cities. Generally, existing facilities are in extremely poor condition. Many of the major structures are extremely old, and can no

longer provide effective service in an efficient manner. Newer facilities are often of sub-standard construction and frequently have many design defects.

Water

Almost the entire population receives water services through the city system. It is estimated that over two-thirds of the current population is served by house connections; the remainder of the population is served by public fountains.

The Kohafa Water Treatment Plant with a rated capacity of 180 litres per second is the primary source of water for the city. The governorate's Azab Water Treatment Plant serves as an additional source of supply. The Kohafa Plant is frequently operated significantly above its rated capacity in order to meet peak demands.

The transmission system essentially consists of two 600-mm diameter lines from the Azab Water Treatment Plant. The transmission system is not extensive and is severely under-sized. Fayoum has one steel elevated storage tank (750 cubic meters) which is inconsistently used.

The distribution system is reasonably well-looped. However, due to the extensive use of small diameter lines and the inadequacy of the transmission system, many areas suffer low pressure problems. It is suspected that "unaccounted-for-water" (water not metered) is a significant problem.

An illustrative implementation plan has been developed which will benefit the greatest number of people at the least cost. The majority of the proposed actions do not involve major new structures, but rather maximize the effectiveness of existing facilities.

MAJOR WATER PROJECTS

Phase I

- Leak Detection
- Line Cleaning
- Water Filtration Plant
- Ground Storage Reservoir
- Two Elevated Storage Tanks

Phase II

- Water Plant Expansion
- Additional Ground Storage Reservoirs
- Additional Elevated Storage Tanks

Wastewater

Less than one-half of the current population is estimated to benefit directly from public sewers. The remainder of the population is either served by private cesspits or several public disposal sites.

The groundwater table in Fayoum is extremely high (within two meters of the surface) and it is suspected that infiltration accounts for one-third to one-half of the flow entering the wastewater treatment plant.

Three main pumping stations discharge directly to the treatment plant. In addition, there are three sub-stations which transmit flows to the main stations. The pumping stations and associated force mains are adequate to serve the immediate needs of Fayoum; however, the stations are in need of general rehabilitation.

The existing wastewater treatment plant utilizes a trickling filter process as well as an aerobic ditch process. Unfortunately, there are no secondary clarifiers, thus eliminating an important element of these secondary treatment processes. No chlorination is provided. The majority of the flow bypasses the secondary units. Sludge treatment is not provided. Sufficient sludge drying beds are not available.

An illustrative implementation plan has been developed which places emphasis on investment to improve the existing collection system.

MAJOR WASTEWATER PROJECTS

Phase I

- Infiltration Study
- Leak Repair
- Vacuum Truck
- Pump Station Rehabilitation
- Kaman Faras Pump Station
- Kaman Faras Site Investigation

Phase II

- Additional Leak Repair
- Additional Vacuum Trucks
- Additional Pump Station Rehabilitation

4.05.2 Beni Suef

Beni Suef, with a population of 180,000, is smaller than Fayoum and larger than Minia. The problems of Beni Suef are similar to those found in Fayoum, but not of the same severity. Generally, existing facilities are in poor condition. Many of the major structures are extremely old, and can no longer provide effective service in an efficient manner. Newer facilities are often of sub-standard construction, and frequently have many design defects. Project improvements have been limited to network expansion and small civil works.

Water

Over one-half of the population is served by house connections; the rest of the people obtain their water from public fountains. Two water treatment plants serve the city. The Old Water Treatment Plant has a design capacity of 210 litres per second and the New Water Treatment Plant (or the Czech Plant) has a design capacity of 200 litres per second. The existing level of operation and maintenance at both plants is insufficient to ensure that the public will have access to a consistently reliable source of potable water.

Treated water from the two treatment plants is stored in ground reservoirs prior to being pumped into the system. The existing elevated storage tanks are inoperative due to design and maintenance problems.

The distribution system is not very well looped and contains many dead-ends. This poor network contributes to pressure problems and problems with sediment accumulation in the lines. Many areas of the city suffer from extremely low pressure. "Unaccounted-for-water" is estimated to be approximately one-half of the volume leaving the treatment plants.

Existing water facilities are in extremely poor shape. Consultant cost estimates indicate that the rehabilitation of many of the facilities cannot be cost-effectively achieved.

An illustrative implementation plan has been developed which will benefit the greatest number of people at the least cost. The majority of the proposed actions do not involve major new structures, but rather maximize the effectiveness of the existing system to the maximum extent practical.

MAJOR WATER PROJECTS

Phase I

- Leak Detection
- Line Cleaning
- Water Filtration Plant
- Ground Storage Reservoir
- Elevated Storage Tank

Phase II

- Additional Ground Storage Reservoirs
- Two Additional Elevated Storage Tanks

Wastewater

Over one-half of the current population is estimated to benefit directly from public sewers. The remainder of the population is served primarily by private cesspits.

Infiltration into the collection system appears to be a substantial problem. Infiltration is estimated to account for approximately one-half of the flow entering the wastewater treatment plant. Sand and silt deposits are found in many areas of the network, thus indicating that pipe joint problems exist.

Four main pumping stations discharge wastewater directly to the treatment plant. In addition, there is one sub-station which transmits flow to a main station. The pumping stations and associated force mains are adequate to serve the present needs of Beni Suef, however, the stations are in need of general rehabilitation.

The existing wastewater treatment facility uses trickling filters to provide secondary treatment. The existing facility has a design capacity of approximately 300 litres per second. This facility appears to be one of the better operated and maintained facilities in Egypt; unfortunately, the plant operation and maintenance is still inadequate by any standard.

Discharge of the treatment plant effluent is to an agricultural drain which receives its initial flow solely from the plant. The velocity in the upper reaches of this drain is virtually nil. The drain is congested with vegetation and is obviously polluted for many kilometers. The obviously polluted portion of the drain has two villages located beside it.

An illustrative implementation plant has been developed which places emphasis upon improving the existing collection facilities.

MAJOR WASTEWATER PROJECTS

Phase I

- Infiltration Study
- Leak Repair
- Pump Station Rehabilitation

Phase II

- Additional Pump Station Rehabilitation

4.05.3 Minia

With a population of 160,000 people Minia is the smallest of the three cities receiving assistance under the PCD Project. The needs of Minia in the water and wastewater sector are not as severe as those of the other two cities. Generally, existing facilities are in fair to poor condition. Excessive design standards have resulted in extremely expensive new facilities.

Water

Approximately 60% of the current population is served by house connections; the remainder of the population is served by public fountains.

Minia is served by two adjacent water treatment plants. The Old Water Treatment Plant has a design capacity of 120 litres per second and the New Water Treatment Plant has a design capacity of 200 litres per second. The current water demand is estimated at about 500 litres per second during the summer months. Neither plant approaches a level of operation that is adequate nor efficient.

There is no transmission system other than parallel 400-mm and 500-mm diameter lines which go from the plants south along the Corniche approximately 1 kilometer to the downtown area.

Minia has two elevated storage tanks (500 cubic meters and 1,000 cubic meters) which are currently out-of-service. Both tanks are located within close proximity to the treatment plants, and thus are of limited benefit in stabilizing flow and pressure throughout the distribution system.

In many areas, the distribution network is not very well looped. This poor network coupled with the extensive use of small diameter lines contributes to pressure problems in some areas of the city. "Unaccounted-for-water" is estimated to be approximately one-half of that leaving the water treatment plant. It is suspected that leaking valves and pipe joints contribute significantly to this volume. Wastage due to the continuous discharges at the public fountains is another factor. However, the extremely poor condition of the water meters used throughout the system make the water use estimates somewhat suspect.

An illustrative implementation plan has been developed which will benefit the greatest number of people at the least cost. Emphasis is placed upon maximizing the effectiveness of the existing system.

MAJOR WATER PROJECTS

Phase I

- Leak Detection
- Line Cleaning
- Water Filtration Plant
- Ground Storage Reservoir
- Elevated Storage Tank

Phase II

- Water Plant Expansion
- Additional Ground Storage Reservoirs
- Two Additional Elevated Storage Tanks

Wastewater

Approximately 60% of the current population is estimated to benefit directly from public sewers. The remainder of the population is either served by private cesspits or several public disposal sites.

Unlike the other two cities, groundwater does not appear to be a major problem. Infiltration is probably minimal.

Minia has a multitude of pumping stations. Two major pumping stations discharge directly to the wastewater treatment plant. A third major pumping station is currently being constructed by NOPWASD. There are also three sub-stations and seven smaller lift stations. All of the existing stations are in need of general rehabilitation.

The existing treatment facility uses trickling filters to provide secondary treatment. The existing facility has a design capacity of about 160 litres per second; the current flow into the plant is approximately equal to the design capacity. Numerous operational and maintenance problems are associated with the treatment facility in Minia.

Discharge of the plant effluent is to an agricultural drain. The effluent does not appear to have a major impact upon the drain due to the large upstream flow and the relatively swift velocity in the drain.

An illustrative implementation plan has been developed which places emphasis upon improving the existing collection facilities.

MAJOR WASTEWATER PROJECTS

Phase I

- Infiltration Study
- Leak Repair
- Vacuum Trucks
- Pump Station Rehabilitation

Phase II

- Additional Pump Station Rehabilitation

B. Subproject Construction

4.06 Subprojects were initiated in 1982 to correct the most immediate system deficiencies. Over 30% of the 250 subprojects designed by municipal workers and local consultants and contractors have been completed. Generally, these small-scale activities include:

- Extensions of water pipelines to unserved areas
- Constructing and equiping laboratories
- Improving water treatment (alum mixing, flocculation basins, chlorination systems)
- Providing standby generators
- Repairing trickling filters
- Extensions of sewer lines to unserved areas
- Provide engineering and construction surveillance services

4.07 Increased subproject implementation is anticipated during Phases I and II. The Implementation Plan has identified activities that are within the capabilities of the cities to implement. An illustrative plan of the activities to be financed as subprojects includes the following:

4.07.1 Fayoum

Water subprojects

Leak repair
Hydraulic Analysis of System
Public Awareness Program
Improvement of Public Fountains
Improvements to Transmission Systems
Rehabilitation of Existing Water Plant
Kaman Faras Distribution System
Flow Conservation Program

Wastewater Subprojects

Hydraulic Analyses of Force Main System
Force Main Upgrading
Upgrading of Existing Primary Treatment Facilities
Kaman Faras Force Main
New Collectors.

4.07.2 Beni Suef

Water Subprojects

- Leak Repair
- Hydraulic Analysis of System
- Public Awareness Program
- Improvement of Public Fountains
- Modify existing raw water facilities
- Improvements to Transmission System
- Flow Conservation Program

Wastewater Subprojects

- Hydraulic Analysis of Force Main System
- Force Main Upgrading
- Upgrading of existing treatment facilities
- New collectors.

4.07.3 Minia

Water Subprojects

- Leak repair
- Hydraulic analysis of system
- Public Awareness program
- Improvement of public fountains
- Improvements to tranmission system
- Flow conservation program

Wastewater Subprojects

- Hydraulic Analysis of Force Main System
- Force Main Upgrading
- New Collectors
- Replacement of Undersized collectors
- Additional new collectors.

A four year technical assistance contract will be let to extend advisory services to the cities through 1990. It is anticipated that by the completion of this TA the cities will be fully familiar with implementing subprojects and be coordinating construction activities with NOPWASD's construction manager.

V. ADMINISTRATIVE ANALYSIS

A. Host Country and AID Direct Contracting

5.01 The AID standard for contracting construction services has been the host country contract. Although more suited to Agency management, this approach is subject to the inefficiencies of the host country contracting process. The technical and financial liability resides directly in the host country under this approach. Experience has shown, however, that generally AID finances the extra costs resulting from host country delays while providing the contractor a degree of immunity from direct AID intervention or recovery.

5.02 Some inefficiencies of this approach can be traced to the lack of technical expertise residing within the host country agency and the unfamiliarity of host country agencies with AID and contractors' requirements and vice versa.

5.03 As an alternative contracting approach an AID direct contract for design and construction services was reviewed. Support for considering this rarely-used approach was based on the following:

a) Host cities are not qualified nor legally empowered to contract with an international design and construction contractor;

b) The central agency responsible for water and wastewater capital development in the cities is NOPWASD, an agency not well accepted by the host cities. Further, the Ministry of Local Government, which oversees Governorate activities, does not possess the specific experience in procuring and managing USAID funded host country contracts;

c) Although the magnitude and exclusivity of the proposed construction program precludes substantial host cities participation, design and review meetings with city officials would be a natural extension of the Resident Advisors' advisory program;

d) USAID/Cairo has the required technical staff for the implementation responsibilities on this project.

5.04 Concerns by the Mission and AID/W for the use of this approach include the following:

a) Potential legal and liability problems with AID as the client for construction but not the owner of large physical plants in a foreign country;

b) Requirements for more direct hire personnel with specialized technical and contracting skills to monitor the construction;

c) Extension of AID financial liability beyond amount authorized, with potential for contractors' suits for delays.

5.05 These concerns cannot be easily addressed without further AID experience with direct contracting in Egypt. Further consideration should be given for the use of this alternative as a means for facilitating successful and timely project implementation in the current Egypt program.

5.06 Given these AID reservations with direct contracting for construction projects, the standard host country contracting mode will be utilized for implementation of Phase I and Phase II of PCD. NOPWASD will serve as the host country agency and a construction management contract will be entered to assist NOPWASD with managing the design/construction contract. The Project Steering Committee has authorized NOPWASD to contract for the design and construction of the major elements of the Implementation Plan (described in 4.05).

B. Construction Alternatives - Major Contracts

5.07 The Implementation Plan designates elements for subproject or major construction. The cities will be responsible for implementing the subprojects and an American or American/Egyptian firm will provide design and construction services for the major elements. A review of the following alternatives for constructing the major elements was conducted:

a) Conventional design then build
b) Fast Track
c) Design/Build

5.08 Traditional Design then Build: The AID standard for construction is the traditional design then build approach. An A&E firm is contracted to conduct all design work, prepare construction bid documents, and supervise construction. The procurement of an A&E firm under AID rules and regulations generally takes six to twelve months. The design period for the proposed scope of work would take approximately one year plus a three month mobilization period. The contractor procurement process would take at least three months. Construction under this conventional approach would take two to three years to initiate with the construction period estimated to last an additional 2 1/2 years. Total time to complete Phase I would be five years.

5.09 Fast Track: In order to save time, fast tracking is often used. Under this approach, the work is divided into components in relation to the desired construction schedule. These can be awarded to several contractors or to one general contractor under a series of work orders. Basically, the approach is to initiate the construction process while the design process is continuing. In the case of PCD, economy of scale is desired as well as American construction technology. In order to obtain savings under the fast tracking approach, a construction contract would have to be awarded shortly after the award of the A&E contract. The contract would have to be on a cost plus basis or a fairly loose fixed rate, both of which are somewhat risky regarding total costs. Construction could, however, probably be started within nine months after the award of the A&E contract.

5.10 Fast tracking is most appropriate in large projects with long design and construction phases or where economic pressure exists to develop a site as rapidly as possible. Strong project management capabilities must exist for successful use of this approach.

5.11 Design/Build: The design/build approach is the fastest method of initiating construction. In this case, only one construction contractor is procured who is assigned the responsibility of both design and construction. The lengthy A&E procurement process and subsequent negotiating phase is eliminated. The contractor will use either in-house design staff or procure an A&E as a subcontractor. Construction under this approach could be started as early as three months after contract award or as much as two years earlier than the traditional approach. In this case, design and construction will proceed simultaneously. Estimated time to complete Phase I would be four years.

5.12 Construction is expected to proceed in the cities concurrently. Although this will add some complexity to the program the uniformity of elements among the cities and the off-the-shelf or standardized nature of those elements (e.g., water towers, medium-scale water plants) offers an opportunity for simplifying the construction format. There are, however, major elements (e.g., rehabilitation works) that cannot be well defined without detailed plans. Design/build will be most appropriate for the construction of standardized items but the traditional design then build mode will be used for rehabilitation items, resulting in a modified design/build approach. The determination of the items to be constructed under design/build and traditional approaches will be made by the consultant charged with preparing the Terms of Reference (TOR) for the design/build contract. It is expected that these services will be provided by an IQC firm.

5.13 There are some risks with the design/build mode that must be minimized. The first line of control is the specification and contract package. Only construction packages that can be clearly defined and in many cases approach shelf items would be included. A rigid and timely design review process is also to be included. The less quantifable items concerning the wastewater treatment plants and pump station rehabilitation would be included as design items only with options to award after design, a variation of fast tracking.

5.14 The use of the design/build approach essentially trades control for time. The needs of the three cities are so great in the water and wastewater sector that the time factor for implementation of the project is extremely important. The nature of the project is such that most of the major elements can be defined in sufficient detail prior to the award of a modified design/build contract and the loss of control factor can be minimized.

5.15 It has been estimated that the use of a modified design/build mode could advance the construction of some major project elements by approximately one year. The cost savings realized as a result of a reduced inflation factor could be as much as $12,000,000. Table 6.2 presents cash flow projections for both the traditional and the modified design/build approach.

5.16 A modified design/build mode will be used for major project elements to the maximum extent practical. The design/build contract will include lump sum prices for major items such as water treatment plants and will utilize unit prices based on fixed quantities for some minor items such as sewer rehabilitation.

C. Subproject Construction

5.17 The subprojects, identified in Annex G as part of the Implementation Plans, primarily consist of design and installation of water and sewer lines and the additional rehabilitation/upgrading of existing treatment facilities. Construction of the subprojects will be performed at the local level and funded by USAID under a Fixed Amount Reimbursement procedure (FAR). Agreement on the procedures to be used in the approval of the FAR-financed construction activities and on any necessary advance of funds will be reached between USAID and the Cities prior to disbursement for new subprojects financed with funding authorized by this amendment. Designs will be prepared by local engineering consultants under contract with the cities, with guidance of the Resident Advisors during Phase I. These designs will be approved by the Cities and submitted to USAID and to the General Consultant for approval. The General Consultant will review subproject design for: (a) technical conformance to standard engineering practices; and (b) adherence to Implementation Plans and the requirements of the design/build construction program. Following USAID and the General Consultant's approval of the design, and AID's agreement on amount or percentage of reimbursement, the Cities will enter into contracts for construction of the subprojects with local construction contractors.

D. Construction Management

5.18 The services of a U.S. construction management firm to oversee the activities of the design/build contractor will be contracted through NOPWASD. Included in the construction manager's responsibilities will be engineering review and approval of design and shop drawings. Resident inspection of construction activities also will be required. The resident construction manager and the Resident Advisors will coordinate major construction activities with subproject activities.

After termination of the technical assistance contract in 1990 this coordination will take place between the cities' representatives and the resident construction manager. A cost plus contract is anticipated with payment in U.S. dollars and Egyptian pounds.

E. Analysis of Host Country Contracting Capabilities

5.19 The project will utilize host country contracts with payment through direct letters of commitment for the design, construction and construction managment of the major elements of the project. USAID has prior experience with NOPWASD, most recently in the Canal Cities project, and has found NOPWASD to have sufficient host country contracting capabilities.

VI. FINANCIAL ANALYSIS

A. Cost Analysis-Methodology

6.01 The Consultant, Wilbur Smith and Associates, prepared construction and O&M costs for review by USAID and project officials. Cost curves, containing foreign and local requirements, are presented in Annex O, Cost Methodology. All costs are expressed in 1984 USD and LE. Annual U.S. and Egyptian escalation factors were derived from the AID document entitled, "Contingency Allowances in Project Cost Estimates-August 1984."

6.02 Construction costs were developed from several references, making appropriate allowances for inflation, exchange rates, shipping and insurance charges, and contractor overhead and profit. Cost estimates were based on information presented in the Suez Water Facilities Master Plan prepared by Pirine-Harris International, 1979. Escalation to the year 1984 was performed using the Engineering News Record Construction Cost Index.

6.03 Base construction costs were increased by 15% to allow for contingencies during construction. Engineering design and construction surveillance costs were estimated at 15% of estimated total construction costs. An additional 3% of total construction costs was included for construction management contracted through NOPWASD. The total capital cost estimates were escalated to projected mid-year construction for each of the five phases comprising the Master Plan Implementation Program. The mid-year for Phase I is estimated to be 1987; for Phase II the mid-year is estimated to be 1988.

B. Financial Plan

6.04 The project financial plan for Phases I and II, as well as current obligations, are presented in table 6.1. The plan illustrates foreign exchange and local currency requirements as estimated by the Consultant and AID. Final determination of foreign exchange and local currency will be supplied by the design/build contractor.

C. Cash Flow

6.05 Table 6.2 illustrates the estimated cash flow for Phases I and II. Presented are projections for using the modified design/build (turnkey) construction approach and the conventional construction approach. As proposed in section 5.16 the design/build format will be utilized for major construction.

D. Exchange Rate

6.06 Local currency costs in the Master Plan and Implementation Plan were figured at $1.00 equal LE .84. Table 6.1 presents the estimated local currency requirements. It is recommended that the GOE agree to provide a fixed amount of local currency or a percentage of total local currency costs (in the original project GOE is committed to providing 25% of project costs; for the subproject financing the GOE is currently providing 34% of total costs). The exchange rate that USAID must use for reimbursements to the GOE in the form of Egyptian pounds purchased with dollars will be the rate established in the bilateral agreement.

6.07 Upon determining the foreign exchange requirements of Phase I to be less than $30 million, MPIC requested USAID to obligate only $30 million of its remaining authorization of $45 million. MPIC agreed to supply the equivalent of $15 million in local currency necessary to complete Phase I from the CIP-generated special account.

E. Subproject Financing

6.08 As noted in Section 5.17, a Fixed Amount Reimbursement (FAR) arrangement is proposed for future USAID financing of the subprojects. FAR is a form of project assistance under which the amount of reimbursement is fixed in advance based upon cost estimates reviewed and approved by USAID. Reimbursement is made to the cities upon the physical completion of the subproject.

6.09 The specific FAR procedures must be developed in cooperation with the cities but it is anticipated that the agreed reimbursement to the cities will cover the portion of subproject costs provided by USAID (currently at 66% but expected to decrease to 50% in future years). It is expected that GOE project funds will be used to cover the subproject costs and the FAR would reimburse the GOE account. Agreement on the specifics of the FAR procedure to be utilized, including any advance necessary, will be reached with the cities prior to disbursement for subprojects.

TABLE 6.1
SUMMARY COST ESTIMATE
AND FINANCIAL PLAN
(000,000)

	Obligated to Date					Basic Service Implementation Plan					Project Total						
	AID		GOE	DOLLAR EQUIVALENT		AID		GOE	DOLLAR EQUIVALENT		AID		GOE	TOTAL		DOLLAR EQUIVALENT	
	FX	LE	LE	AID	GOE	FX	LE	LE	AID	GOE	FX	LE	LE	FX	LE	AID	GOE
Capital Costs																	
Water	.4	7.6	3.8	9.5	4.5	18.2	11.6	24.6	32.0	29.3	18.6	19.2	28.4	18.6	47.6	41.5	33.8
Wastewater	.8	6.0	3.0	8.0	3.5	5.9	2.1	17.0	8.4	20.2	6.7	8.1	20.0	6.7	28.1	16.4	23.7
Other	.2	2.0	1.8	2.5	2.0	-	-	-	-	-	.2	2.0	1.8	.2	3.8	2.5	2.0
Sub-Total	1.4	15.6	8.6	20.0	10.0	24.1	13.7	41.6	40.4	49.5	25.5	29.3	50.2	25.5	79.5	60.4	59.5
O and M Assistance	1.2	-	-	1.2	-	7.7	1.5	1.6.	9.4	1.9	8.9	1.5	1.6	8.9	1.5	10.6	1.9
A&E/Consultant	5.6	2.6	-	8.8	-	16.0	5.1	2.0	22.1	2.4	21.6	7.7	2.0	21.6	11.3	30.9	2.4
In Kind Administrative	-	-	-	-	-	-	-	1.5	-	1.8	-	-	1.5	-	-	-	1.8
Contingency	-	-	-	-	-	3.6	3.8	2.1	8.1	2.4	3.6	3.8	2.1	3.6	7.4	8.1	2.4
TOTAL	8.2	18.2	8.6	30.0	10.0	51.4	24.1	48.8	80.0	58.0	59.6	42.3	57.4	59.6	99.7	110.0	68.0

Exchange rate used: $1.00 = LE .84

CASH FLOW PROJECTIONS
TURN-KEY

CASH FLOW PROJECTIONS

TABLE 6.2

Phase I	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	4,533,843	13,438,096	9,623,903	6,854,901	3,808,920	226,038	0	38,485,701 = Total LE
Annual $	0	9,200,966	7,490,633	4,921,574	2,535,664	974,287	0	25,123,123 = Total $

Phase II	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	0	383,070	858,077	8,346,765	14,152,312	9,666,491	897,704	34,304,419 = Total LE
Annual $	0	838,755	1,828,486	7,908,071	4,950,669	7,212,400	3,612,655	26,351,036 = Total $

Phase I + Phase II	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	4,533,843	13,821,166	10,481,980	15,201,666	17,961,232	9,892,529	897,704	72,790,119 = Total LE
Annual $		10,039,721	9,319,119	12,829,645	7,486,332	8,186,687	3,612,655	51,474,159 = Total $

CASH FLOW PROJECTIONS
CONVENTIONAL

Phase I	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	4,533,843	6,147,890	9,826,409	10,433,035	8,131,808	1,630,689	506,325	41,209,999 = Total LE
Annual $	0	0	5,659,517	9,525,588	7,314,291	3,528,460	2,104,459	28,132,315 = Total $

Phase II	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	0	383,070	858,077	961,046	9,349,377	15,247,822	11,114,153	37,912,544 = Total LE
Annual $	0	838,755	1,828,486	1,993,050	8,501,177	4,189,757	10,327,895	27,679,119 = Total $

Phase I + Phase II	CY85	CY86	CY87	CY88	CY89	CY90	CY91	
Annual LE	4,533,843	6,530,960	10,684,486	11,394,081	17,480,184	16,878,510	11,620,478	79,122,543 = Total LE
Annual $	0	838,755	7,488,003	11,518,638	15,815,468	7,718,217	12,432,354	55,811,434 = Total $

ID&CF22 27-May-85

NOTE: Includes 4-year extension for resident advisor program in Phase II.

VII. ECONOMIC ANALYSIS

7.01 The basic premise of the economic analysis provided in the original project paper was that the $100 million investment (US and GOE) in the Provincial Cities would yield an estimated $22.4 million annually in increased goods and services to the expected 560,000 Egyptians benefitting from the project in 1986, the original completion date. This stream of benefits would represent nine to ten percent of household income, or the equivalent of a monetary compensation of LE 2.25 per person per month. On subjective grounds, the paper concluded that the advantages of decent water, sewerage and road services in these cities would be worth more than LE 2.25 per person per month.

7.02 The economic analysis of the amended project proceeds in the same general manner as that of the original project with some refinement. The analysis calculates the level of benefits that would be required to yield various economic rates of return rather than attempting to estimate a single benefit level, with an implicit rate of return. Some additional modifications permit a clearer distinction between resource costs as measured under the Egyptian administered price regime and prices that would likely prevail in a market-oriented economy (shadow prices). Also, the economic costs and benefits will be estimated in constant 1984 dollars with the timing of expenditures and benefits appropriately placed for proper calculation of the economic internal rate of return.

7.03 The total cost of all projects put in place from 1982 until 1992 is estimated to be $101 million (1984 dollars). This includes contributions by the Egyptians, as described elsewhere in the project paper, converted to US dollar equivalents using on exchange rate of LE 1.50= $1 (or LE 1 = $.67). The estimated value of the Egyptian contribution was adjusted to market levels by multiplying the labor inputs by 0.88 and material inputs by 2.2; respectively, the average accounting ratios for urban public sector labor and for building and construction materials.[1/] These adjustments are designed to correct for the pricing system in Egypt, which tends to overvalue labor and undervalue materials relative to a more market-oriented economy. Operations and maintenance (O&M) costs, as estimated by the consulting firm of Wilbur Smith and Associates, were converted using the same exchange

1/ Based on the World Bank Report No. 4136-EGT, Arab Republic of Egypt, Issues of Trade Strategy and Investment Planning, and other World Bank reports on estimating accounting ratios.

rate and accounting ratio assumptions. On this basis, O&M costs were just under $1 million (1984) annually after 1990. The value of the Egyptian contributions was estimated to be 50 percent labor and 50 percent materials during the project, and 70 percent labor and 30 percent materials for O&M after the project.

7.04 The estimation of benefits is difficult since there is very little indication of how the beneficiaries value the services they are receiving. Water user fees are very low, roughly 25 to 30 piasters per cubic meter in the Provincial Cities, and the rates have not changed for at least twenty years. As is true throughout Egypt, no charges are levied for wastewater removed and treated. As an additional complicating factor, this project will upgrade and improve services that already are provided to some degree, thereby benefiting, at least partially, virtually all of the approximately one-half million people living in these three cities. The level of benefits for new sewerage services in Cairo was estimated to be $21 per capita (1984 dollars) for the Cairo Sewerage II project.

7.05 Assuming the rehabilation to be undertaken in the Provincial Cities provides benefits of equal value, the level of benefits would approximate $10 million annually (1984 dollars). However, the benefits of rehabilitation likely would be less than that for new services. As an additional benefit, much of the construction carried out under the project would be expected to be in place and operating if O&M operations are carried out as allowed for in the cost structure. The salvage value of this construction was assumed to be $40 million in the year 2020, the arbitrary endpoint for calculating the economic rate of return.

7.06 Based on the cost and benefit calculations described above, the economic rate of return is 8.5 percent. There is a very wide band of uncertainly around this estimate. For instance, if the benefit level were assumed to be only three-fourths of the value of new services ($7.5 million annually), the economic rate of return would fall to 5.8 percent. Alternatively, if O&M costs, proved to be much higher than expected; e.g., twice as large, or $2 million, the economic

rate of return would fall to 7.1 percent. A large number of plausible combinations of assumptions are possible; however, the range of economic returns that seems reasonable under the assumptions provided is from 5 to 10 percent.

7.07 A complete set of calculations, including graphs of the sensitivity of the economic rate of return to changes in each of the major assumptions, is provided in Annex E.

VIII. BENEFICIARY ANALYSIS

8.01 The assumptions regarding beneficiaries in the original Project Paper remain valid. The ranking of first and second order beneficiaries, however, should be reversed. Improvements to local infrastructure have been of greatest benefit to residents while municipal and governorate employees who participate in this project are second-order beneficiaries.

8.02 As a further justification for funding Phase II improvements, which would provide basic water and wastewater services to 70% of the current residents, health conditions would be expected to improve. It has been found that immunization of 100% of a population was not required to control epidemic diseases; when 70% of a population is connected to water supply and to the sewers, the potential for the transmission of water-borne diseases may be substantially diminshed. The importance of safe water, as against simply water, places heavy responsibilities on the design, operations and maintenance of water treatment and distribution systems.

8.03 The health results of overflowing wastewater into public spaces, often the play area for children, are high infections. The great need for the Ministry of Health program in Oral Rehydration Therapy exists because the conditions that enhance transmission of intestinal infections have not been controlled. Phase I and Phase II funding will expand sewerage collection networks into unsewered areas.

8.04 The need for safe water supply and effective wastewater removal and treatment is self-evident. The concept of multiple barriers for protecting the public in areas where intestinal and parasitic diseases are endemic is especially appropriate and must be incorporated in a funding strategy.

IX. ENVIRONMENTAL ANALYSIS

9.01 The Provincial Cities Development project has been subject to extensive environmental review during project design and development. An interdisciplinary team of American and Egyptian scientists and engineers conducted site specific environmental assessments of the proposed water and wastewater master plans for the project cities during September 1984 - February 1985. A scoping session was held under the chairmanship of the mayor in each of the three cities in September/October 1984 to review the purpose and objectives of the environmental assessments. These meetings were conducted in Arabic with English translation. Similar meetings were held in the three cities in late February 1985 to review the findings of the environmental assessment team and the recommended implementation plans. The findings and recommendations of the environmental assessments have been fully incorporated into the present design and the project is in compliance with the requirements of 22 CFR 216, A.I.D. Environmental Procedures.

9.02 The assessment team concluded that phased implementation of the proposed water and wastewater master plans will result in significant improvements in environmental quality and health in the project area through provision of an increased water supply of improved quality and the improved collection, conveyance, treatment and disposal of wastewater. The most significant benefits will occur through rehabilitation of the existing wastewater collection system and its expansion into presently unserviced areas, both of which will significantly reduce the number of people who are directly exposed to the severe health hazards created by the routine ponding to and flooding of raw sewage in high density urban areas.

9.03 The Environmental Assessments recognized that in all three cities wastewater discharges into the agricultural drains will continue to be in violation of Egyptian public law No. 48 of 1980. This situation will remain until funding is available for construction of highly capital-intensive wastewater treatment facilities in later phases of the Implementation Plan. The assessment team concluded, on the basis of the analysis of original field data collected by Wilbur Smith and Associates, supplemented by field inspections, that the environmental and public health risks posed by continued discharge of partially treated wastewater to agricultural drains is significantly less than the continued direct contact with raw sewage currently occuring extensively within the

cities. It should be noted that the agricultural drains in all three areas also receive untreated wastewater from industrial facilities and large villages.

9.04 The assessment team strongly emphasized that in order to realize sustained benefits from capital investments in the rehabilitation of existing infrastructure and the construction of new facilities a parallel program of institutional development and training must be implemented. The team emphasized the need to give special attention to construction management to assure quality control and adherence to design specifications for rehabilitation and new construction. It noted that previous infrastructure investments had significant problems in operation and maintenance due to inadequate quality control during construction. The team noted that without continuous attention to proper operation and maintenance of the system minimal environmental improvements will result.

9.05 The infrastructure requirements to address environmental health concerns and to meet basic service needs were identified on a priority basis, beginning with a program which could be implemented with remaining project funds. It is recommended that as additional funds become available from either the Government of Egypt or foreign sources that implementation of the basic service program be continued using a phased approach to implementation of the water and wastewater master plans.

9.06 Given the massive need for system rehabilitation and expansion identified by the water and wastewater master plans, the Assessment team recommended that priority should be given to the following items under a phased approach to implementation:

Water Treatment:

- Repairs to existing water treatment plants only where they are technically and economically justified.

- Provision of additional water treatment capacities employing technology of intermediate complexity wherever possible.

Water Distribution:

- Reduction of water leakage from the water distribution system through a program of leak detection and line repair.

- Increased water distribution system storage capacities and pressure through the construction of ground and elevated storage.

Wastewater Collection:

- Construction of sewage collectors in areas flooded with wastewater on a priority basis for selected service areas.

- Repairs to existing sewers to reduce infiltration.

Wastewater Treatment:

- Improvements to primary treatment of wastewater treatment plants.

- Improvements in the terminal disinfection of wastewater effluents.

Industrial Pollution Control:

- Coordination with the Government Organization for Industrialization (GOFI), Ministry of Industry to assure that industrial facilities do not improperly discharge their wastewater into the municipal wastewater collection system.

Institutional Development and Training:

- Training of water treatment plant operators and maintenance personnel and distribution system maintenance crew to occur simultaneously with system repairs and new construction.

- Training of wastewater treatment plant operators and maintenance personnel and sewer system maintenance crew to occur simultaneously with system repairs and new construction.

- Implementation of an inventory control program for materials, spare parts and chemicals to assure availability and to support routine maintenance.

9.07 Special site specific concerns were identified in all three cities and are detailed in the Environmental Assessments. The following special concerns were identified in Fayoum and should receive special attention during project implementation:

- Implementation of procedures for protection of archaeological values in the Kaman Faris District, city of Fayoum.

- Implementation of a special study to evaluate solid and liquid waste management requirements in the Kaman Faris District, City of Fayoum.

9.08 The team recommended environmental issues to be reviewed during project monitoring so as to assure the environmental soundness of the project. These have been discussed with USAID/Cairo project staff.

9.09 The team recommended changes in water and wastewater policy to improve the performance of the system, operation and maintenance and water conservation. These have been incorporated into the policy issues section of the project paper amendment.

X. INSTITUTIONAL DEVELOPMENT AND TRAINING

A. Introduction

10.01 Improvement of institutional performance calls for a continuous, systematic process of organizational adaptation. One of the aims of technical assistance in PCD is to strengthen the capability of national and local organizations to sustain themselves. During the two and one-half years that the Resident Advisors have been working with the cities the following institutional improvements have occured:

a. Improved equipment procurement procedures for meeting local needs, including analysis of cost and specifications;

b. Improved procurement of construction services, including preparation of more concise terms of reference, establishment of bid evaluation criteria with special emphasis on the technical evaluation, and improved contracts specifying rights of the contracting parties;

c. Improved capacity of the cities to identify their engineering needs and recognize those that are beyond the expertise of municipal staff and thus requiring private sector local consulting assistance;

d. Introduction of construction supervision for local projects and a system by which to monitor and improve construction progress.

e. Improvement of engineering design quality and introduction of quality control for construction;

f. Improved maintenance and operation of water and wastewater facilities.

10.02 It is anticipated that further strengthening of local institutions will occur during the remaining years of the project. The cities will continue to be responsible for implementing the subprojects, with an estimated value of $28 million. Further, Phases I and II fund technical assistance and training for those organizations responsible for water and wastewater systems.

B. Training

10.03 The Project Paper identified operation and maintenance of public infrastructure at the municipal level as deficient. The causes of this deficiency are many and include: antiquated equipment and facilities; the absence of standard monitoring equipment; and a lack of motivation and skill. Although the plants do operate -water is pumped and sewage is collected- treatment is highly inadequate. Basically, the maintenance problems are due to a shortage of trained professional personnel and limited funds for replacement parts and supplies.

10.04 The cities have used subproject funds for correcting some of these deficiencies. The purchase of spare parts and supplies for treatment plants, distribution systems and equipment have been financed as subprojects. An inventory control system has been established in each city for monitoring depletion of expendable supplies (e.g. alum, chlorine).

10.05 The General Consultant has committed $1.75 million of the $8.5 million TA contract for training programs, a Training Needs Assessment and O&M manuals. Twenty-six courses have been conducted in which 537 city workers have participated. Field observations indicate that some improvement in job performance has occured following participation in certain training courses. Future programs will require follow-up by the course instructor so as to reinforce training lessons. Annex I provides a listing of courses and the number of participants.

10.06 The Training Needs Assessment identified important training needs in management, cost accounting, O&M, and training of trainees. The Management Improvement Program was originally designed to provide this training throughout the municipal organization. As the project came to focus on water and wastewater improvements the Management Improvement Program was revised to concentrate principally on the training needs of this sector. The Management Improvement Program, consisting of three expatriates and four Egyptians, began in February 1985 and has been well supported by municipal officials. The Consultant is reporting the Training Teams' findings to the UAD Training Coordinator on a monthly basis so that this information may be integrated with training efforts in other water/wastewater projects. Annex J provides the Scope of Work for the Management Improvement Program.

10.07 Phase I extends the Management Improvement Program now being implemented. By necessity, the technical training component, primarily using an "on the job" (OJT) format, will receive increasing emphasis. In addition, the management enhancement program initiated in the Consultant's contract will be expanded to include middle level managers from city departments. The contractor for the new facilities will also be tasked with conducting "start up" and on the job training for operators and managers. Annex I contains a description of Phase I training.

10.08 Phase II funding includes $2 million to be used for further training, primarily OJT for operators. It is anticipated that an Operations Assistance contract will be let to an expatriate firm, possibly a U.S. utility, to oversee and operate the water and wastewater facilities and train employees for a period of three years. Although a new program for Egypt, Ministry officials have been receptive to this arrangement, one which is being used in the U.S., Jamaica and Thailand. The primary training mode is "twinning" whereby the Operations Assistance team will be paired with counterparts -technicians and managers- to operate facilities. Additional management training needs identified during Phase I training will be funded during Phase II.

10.09 In addition to the specific training programs to improve institutional performance, the cities have the responsibility for implementing the subprojects identified in the Implementation Plan. Technical assistance will be funded in Phase I for a period of four years in order to continue advisory services to the cities for implementing and evaluating design and construction services. Technical assistance will not be extended in Phase II unless requested by the GOE.

C. Recurrent Costs

10.10 Costs for operating and maintaining water and wastewater systems were reviewed with project officials during discussions of the Implementation Plan. Estimates of annual labor and material costs, prepared by the Consultant, were presented to municipal officials. They are included in Annex O, Cost Methodology.

10.11 All parties recognize that substantial funds will be necessary to maintain these systems. Current budget allocations from the central government are grossly inadequate for proper maintenance. The Provincial Cities Development project is included in the Annual Water and Wastewater Review conducted between USAID and the GOE. Benchmarks to identify progress on issues facing this sector have been established (Annex F). The National Tariff Bill has been proposed and project Governors and Mayors will press for its passage. The Tariff Bill initially increases water tariffs to cover 35% of O&M costs with further increases to 100% scheduled by 1990. Since the Tariff Bill initially increases tariffs to cover only 35% of O&M costs, the cities must continue to request central government subsidies.

D. Policy Dialogue

10.12 PCD is linked to on-going policy discussions with the GOE. At the highest level the project is included in the annual water/wastewater sector review. At the Governorate and municipal levels discussions regarding increased local autonomy in the areas of personnel, tariffs and creation of utility districts are held. Local efforts to effect policy changes are hindered by the lack of financial responsibility at the local level.

10.13 The National Tariff Bill proposed at the Ministerial level would increase water tariffs to cover O&M costs. Under this Bill the cities would be allowed to retain these revenues for municipal O&M needs. Fiscal responsibility and tariff collection should increase when the cities are no longer required to transfer all local tariff revenues to the central government.

10.14 There are additional policy areas that can be resolved within the authority of the local governments. AID has discussed these policies with Governorate and municipal officials. In response to these concerns the cities have agreed to take the following actions:

1) To implement a public campaign to reduce the wastage of water delivered to commercial, residential and industrial users.

2) To develop, adopt, and implement an ordinance to restrict the use of suction pumps which draw water directly from the distribution system and place portions of the system under negative pressure.

3) To develop, adopt, and implement an appropriate Sewer Use ordinance in order to improve the general operation and maintenance of the system, and reduce the disposal of inappropriate materials (e.g., grease, oils, flammable solvents).

4) To coordinate with the General Organization for Industrialization (GOFI) to assure that industrial facilities do not improperly discharge their wastewaters into the municipal wastewater collection systems.

5) To develop an ordinance which requires, as appropriate, the parallel connection of water and wastewater lines to residential, commercial, and industrial users.

10.15 USAID will assist the cities through the General Consultant in the development and implementation of these ordinances.

E. Integration with other Projects

10.16 USAID is currently developing with the GOE an Institutional and Human Resource Development Project (IHRD) with the objective of strengthening national and local organizations responsible for developing, operating, maintaining, and managing water and wastewater systems. Management Advisors will assist NOPWASD in establishing profiency standards for technical personnel and in developing and conducting training and certification programs.

10.17 The ongoing Management Improvement Program in the cities includes a training of trainers component. It is anticipated that during Phase II the municipal trainers will integrate municipal staff into NOPWASD programs. Funds have been allocated in Phase II so as to assist the cities meet these training costs and additional requirements of the NOPWASD program.

10.18 USAID also is designing the Local Development II project which will assist the GOE to achieve its decentralization objectives by strengthening local capabilities. Under PCD the strengthening of local capabilities has occured in the Infrastructure, Procurement and Legal departments as well as at the Chairman and Local Council levels. Governorate and municipal interest remains strong that additional local services be improved and expanded. The local experience gained by working with PCD could be developed further by including the capital cities of Fayoum, Beni Suef and Minia for funding from LDII.

XI. PROJECT IMPLEMENTATION

A. Implementation Plan and Schedule

11.01 The following five project components will be funded during the remaining years of the project:

- Subprojects: to implement small-scale water and wastewater projects.

  A. Contracting Responsibility: Cities
  B. Design: Local consultants
  C. Construction: Local contractors and municipal workers
  D. Financing: Approximately equal GOE and USAID funding
  E. Implementation Schedule: Current to end of project

- Technical Assistance: to assist cities implement subprojects.

  A. Contracting Responsibility: USAID
  B. Financing: USAID
  C. Implementation Schedule: Current to 1990

- Major Construction: to implement medium-scale water and wastewater projects.

  A. Contracting Responsibility: NOPWASD
  B. Design and Construction: American or American-Egyptian contractor
  C. Financing: FX- USAID; LE- GOE and some USAID during Phase II
  D. Implementation Schedule:
     Contract for services: 1985/86
     Design services: 1986
     Construction: 1986-1991

- Training: to increase local capability to operate, maintain and manage water and wastewater systems.

  A. Contracting Responsibility: USAID through TA contract
     NOPWASD-on the job training
  B. Financing: GOE and USAID
  C. Implementation Schedule: Current to end of project

- Construction Management: to assist NOPWASD in managing the design/build contract.

  A. Contracting Responsibility: NOPWASD
  B. Financing: GOE and USAID
  C. Implementation Schedule: 1986 - 1991

An implementation schedule is listed in Annex K.

B. GOE Implementing Agencies

11.02 The respective city governments and their various departments have been the primary implementing agencies involved in the project. These include: the Mayor, the Local Council, Department of Infrastructure, Department of Planning, and Department of Finance. The cities will continue to be responsible for implementing the subprojects.

11.03 The senior level implementing body is the Project Steering Committee, comprised of the following representatives from the GOE:

Governors and Mayors of Fayoum, Beni Suef and Minia
Rapporteur of the Ministry of Local Government
Ministry of Planning and International Cooperation
Ministry of Finance
Ministry of Irrigation
National Organization for Potable Water and Sanitary Drainage

11.04 Meetings of the Project Steering Committee are held quarterly to which USAID and Consultant representatives are invited. The meetings are held to discuss issues common to all three cities, such as training or implementation progress, and to approve the funding requests of the cities before they are submitted to USAID. The PSC will remain the primary implementing organization and will work with NOPWASD to assure timely project construction.

11.05 NOPWASD will be the host country agency responsible for contracting for the design and construction of the major elements. Anticipated host country contracts through NOPWASD include the design/build contractor and the construction management firm. USAID has determined that NOPWASD possesses the contracting capability for this project.

C. USAID Implementing Personnel

11.06 Provincial Cities Developmemt is a Branch of the office of Urban Administration and Development in the Development Resource Directorate of USAID, Cairo. A USDH Project Officer (backstop 94) is assigned as Chief of this Branch and is responsible for project management. Three Foreign Service National Civil Engineers are assigned to PCD and are project-funded. Each is responsible for project monitoring and evaluation in one of the cities. Additional personnel

consulted for PCD activities include the Mission Environmental Officer, the UAD Training Coordinator, Controller, Legal, Contract offices and appropriate USDH engineers.

11.07 AID will continue to use a direct contract for providing general consulting services to the cities. Competitive bidding procedures will be followed for extending the current technical assistance program.

D. Evaluation

11.08 An interim Project Evaluation was conducted on PCD in March 1984. Its primary conclusion was that the project had achieved more significant accomplishments in the water and wastewater sectors of the three cities than in promoting decentralization. In regards to this, the Evaluation Team presented three options for Mission consideration:

a. Amend the project paper to reflect a shift of the project to one which emphasizes capital infrastructure inwater and wastewater without adding new funds.

b. Amend the project paper to reflect a shift to capital infrastructure in water and wastewater, adding additional funds to finance fully the recommendations of the master plans.

c. Redirect project toward original emphasis on decentralization and capacity-building.

11.09 PCD is part of the water and wastewater portfolio and is included in the annual review of this sector. Although its primary emphasis will continue to be the financing of water and wastewater systems the process by which the cities are being strengthened as they plan, implement and manage these systems is a very important element of this project. Project documents, including the Project Paper, are being amended to reflect this clarification of project purpose.

11.10 A second evaluation will be scheduled for 1988, as part of Phase II funding. The evaluation will review: the results of the design/build format; and the cities' implementation performance as a measurement of local institution building.

E. External Audit

11.11 Funds in the amount of $100,000 have been provided for an external audit of cost reimbursable host country contracts. This audit will be conducted upon completion of the project but prior to the PACD.

F. 611(e) Certification

11.12 The USAID Director's Section 611(e) Certification is included as Annex C and replaces the Certification signed in 1981. Although we conclude that the cities and NOPWASD have the capabilities to implement and maintain this project, such capabilities will be fortified with technical assistance (for the cities) and construction management services (for NOPWASD).

XII. CONDITIONS AND COVENANTS

12.01 Condition Precedent to Disbursement for Subprojects:

Prior to disbursement for new subprojects to the cities of Fayoum, Beni Suef and Minia the Grantee and USAID shall agree on procedures for a Fixed Amount Reimbursement arrangement to be used for USAID financing of new subprojects.

12.02 The Covenants in the original Project Paper continue to apply. They are essentially as follows:

(1) Continuation of the Project Steering Committee
(2) Sufficient staffing maintained for the project
(3) Development of a system of revenue retention
(4) Refund and interest rights are retained by USAID
(5) Initiation of a program of revenue-generation

12.03 Additional Covenants

A. The Grantee, through NOPWASD, and the Cities of Fayoum, Beni Suef and Minia shall operate, maintain and repair the project-financed infrastructure in conformity with sound engineering, financial and administrative practices and in such manner to ensure the continuing and successful achievement of the purposes of the project.

B. The Grantee, through NOPWASD, and the Cities of Fayoum, Beni Suef and Minia agree to train such staff as may be appropriate for the maintenance and operation of the system constructed under this project.

C. The Grantee will support passage of the National Tariff Bill or similar measure which permits tariff increases to cover operation and maintenace costs.

D. The Grantee, through the Cities of Fayoum, Beni Suef and Minia will adopt the following measures to improve the performance of the water and wastewater systems:

1. A public campaign to reduce the wastage of water delivered to commercial, residential and industrial users.

2. An ordinance to restrict the use of suction pumps which draw water directly from the distribution system and place portions of the system under negative pressure.

3. An appropriate sewer use ordinance in order to improve the general operation and maintenance of the system and reduce the disposal of inappropriate materials.

4. Coordination with the General Organization for Industrialization (GOFI) to assure that industrial facilities do not improperly discharge their wastewaters into the municipal wastewater collection systems.

5. An ordinance which requires, as appropriate, the parallel connection of water and wastewater lines to residential, commercial and industrial users.

ANNEX A

Second Amendment to the Project Authorization
Name of Country: Arab Republic of Egypt
Name of Project: Decentralization Sector Support Program
Number of Project: 263-0161

1. Pursuant to Section 532 of the Foreign Assistance Act of 1961, as amended, the Decentralization Sector Support Program for the Arab Republic of Egypt was authorized on August 12, 1982. That Authorization is hereby amended as follows:

   a. Delete the words "Five Hundred Twenty-Five Million Two Hundred Thousand United States Dollars (Dols 525,200,000)" in lines 4-6 of paragraph 1 and substitute the words "Five Hundred Sixty Million Two Hundred Thousand United States Dollars (Dols 560,200,000)" therefore as total authorized Program funding.

   b. Delete the words "Three Hundred Thirty-Nine Million United States Dollars ((Dols 339,000,000)" in lines 10-11 of paragraph 1 and substitute the words "Three Hundred Seventy-Four Million United States Dollars (Dols 374,000,000)" as grant funds to be obligated over a five year period from the date of the original authorization (8/12/84).

   c. I hereby reaffirm and carry forward all waivers set out in paragraph 5 of the authorization, including the provisions of A.I.D. Handbook 1 Supp. B, Chapter 18 for exceeding (1) the Dols 5,000 per item cost limitation; (2) the Dols 25,000 or 10% total costs limitation and; (3) the Dols 250,000 limitation on total local cost financing for the Provincial Cities Activity.

   d. The Activity Assistance Completion Date for the Provincial Cities Activity is hereby extended from August 30, 1986 to August 30, 1991, and the PACD of the Decentralization Sector Support Program is extended to August 30, 1991 for the Provincial Cities Activity only.

2. The Authorization cited above remains in force except as hereby amended.

Frank B. Kimball
Director
USAID/Egypt

July 17, 1985
Date

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611(a) Considerations

Section 611(a) of the Foreign Assistance Act requires that no agreement or grant which constitutes an obligation of over $100,000 of US funds shall be made "if such agreement or grant requires substantive technical or financial planning" until (1) "engineering, financial, and other plans necessary to carry out such assistance, and a reasonably firm estimate of the cost" to the US Government have been completed and (2) any necessary "legislative action within the recipient country "has occured or can be expected to occur in a timely manner.

The considerations of adequacy of planning required by Section 611 (a) have been met. The technical and financial analyses presented in the Amended Project Paper, along with the revised Implementation Plan, have identified the specific interventions required in the water and wastewater sectors, have costed out these interventions, and have addressed the question of what interventions can be financed, at what level, with available AID resources. The local councils responsible for subproject activities and particularly their special technical committees have proven to be fully competent to review designs, award contracts, and monitor contract performance.

No further legislative action on the part of the GOE is required for Project implementation. Extensive legislation necessary to empower local units of government to undertake the decentralized planning, financial management, and infrastructure development to be financed by the Project has already been passed. The Grant Agreement will propose the adoption of specific municipal ordinances which, if adopted, would further the proposes of the Project. Passage of such ordinances is not, however, required prior to obligation of additional funds to the Project.

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

CAIRO, EGYPT

ANNEX C

CERTIFICATION PURSUANT TO SECTION
611(e) of FAA 1961 as AMENDED

Background

The Provincial Cities Development Project was authorized in 1981 to assist the GOE develop urban infrastructure and the capacity to maintain it in the cities of Fayoum, Beni Suef and Minia. The project is authorized for $110 million in AID financing with the GOE contribution anticipated at LE 57.4 million.

Major components of the project include Technical Advisory Services, Training Programs and Capital Improvements to water and wastewater facilities. Three water treatment plants will be constructed and the contractor is charged with providing on the job training in plant operation for a period of two years. Training programs for wastewater plant operators, laboratory technicians, heavy equipment operators and supervisory personnel have been conducted since 1982 and will be funded through 1991. Local construction and maintenance of capital facilities funded to date have been found to be of good quality.

Certification

I, Frank B. Kimball, Director, the principal officer of the Agency for International Development in Egypt, having taken into account among other things, the maintenance and utilization of projects in Egypt previously financed or assisted by the United States, do hereby certify that in my judgment Egypt has both the financial capability and the human resources to effectively install, maintain and utilize the capital assistance to be provided for the rehabilitation and expansion in the Provincial Cities Development Project.

Frank B. Kimball

Frank B. Kimball

July 17, 1985

Date

ANNEX D

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 198 to FY 1991
Total U.S. Funding: $110 Million
Date Prepared: July, 1984

Project Title & Number Provincial Cities Development (263-0161.3)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
Goal: To assist the GOE in providing for basic human needs in the secondary cities of Fayoum, Beni Suef and Minia.	1. Reduction of enteric and parasitic diseases. 2. Expanded public services to residents.	1. Ministry of Health records. 2. Record of water and sewer hookups.	That rehabilitation, construction and maintenance of treatment facilities will improve the quality of life for residents.
Project Purpose: To improve and expand the water and wastewater systems of Fayoum, Beni Suef and Minia. The secondary purpose of the project is to improve the capacity of the cities to plan, implement and maintain urban infrastructure systems.	1. Increased water quantity and pressure throughout systems. 2. Elimination of flooding of sewage related to surcharging of the collection system and household vaults. 3. Treatment plants and pump stations in the three project cities operate as designed. 4. Improved management, accounting and O&M procedures and staff trained in their use.	1. Reduction of water pressure problems. 2. Visual inspection of formerly flooded areas. 3. Treatment records at wastewater facilities. 4. Improved system performance as measured by USAID engineers.	1. System elements have been properly design and constructed. 2. Long-term expatriate contract for operations, maintenance and training is properly designed and implemented.
Outputs: 1. Water treatment capacity is increased. 2. Number of areas receiving sewerage collection services is increased. 3. Improved sewerage treatment. 4. Improved local capability to plan, construct and maintain urban infrastructure. 5. Completed Master Plans for water and wastewater services in the three provincial cities to the year 2000.	1. Water treatment capacity increases by 100%. 2. Sewage collection services provided to 70% of current residents. 3. Quality of effluent improves. 4. $30 million worth of infrastructure designed and constructed by local firms and governments. 5. Fully-costed Master Plans for water and wastewater systems for the three provincial cities.	1. Review records of Infrastructure Dept. for outflow measurements. 2. Municipal records of households served by system. 3. Treatment plant records. 4. Physical inspection of quality and completeness of subprojects.	1. Cooperation and support of NOPWASD and Governorate and Municipal officials. 2. Consultants and Contractors perform their roles satisfactorily. 3. Funds, materials, equipment and manpower are provided in a timely manner. 4. Municipal employees are available for training.
Inputs: 1. Technical Assistance 2. A&E and Construction Services 3. Materials, Labor, Equipment 4. Training 5. Land and rights-of-way	USAID: $110 Million GOE : $ 68 Million	USAID-GOE Project Agreements GOE Budgets	1. Conditions Precedent are met. 2. Bids are within estimated costs. 3. FX and LE are available.

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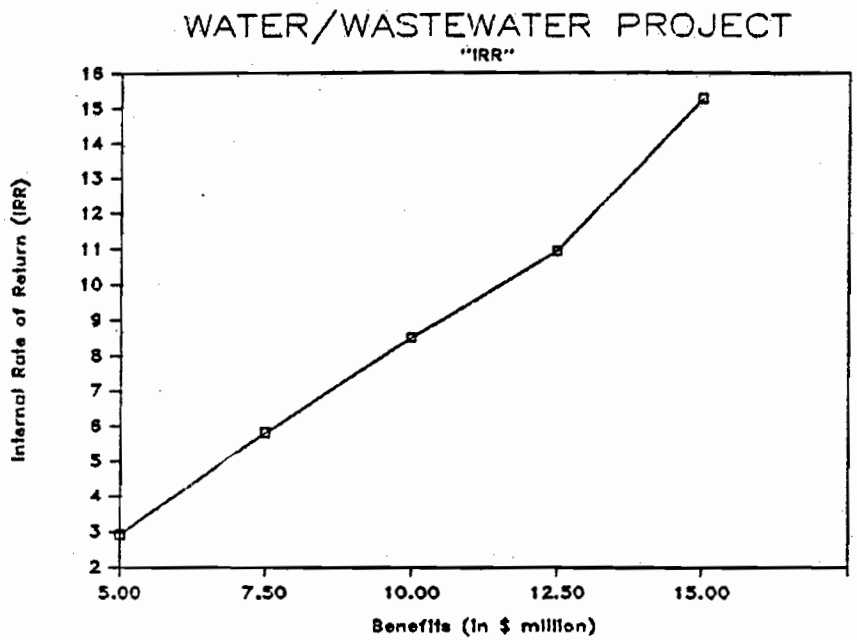
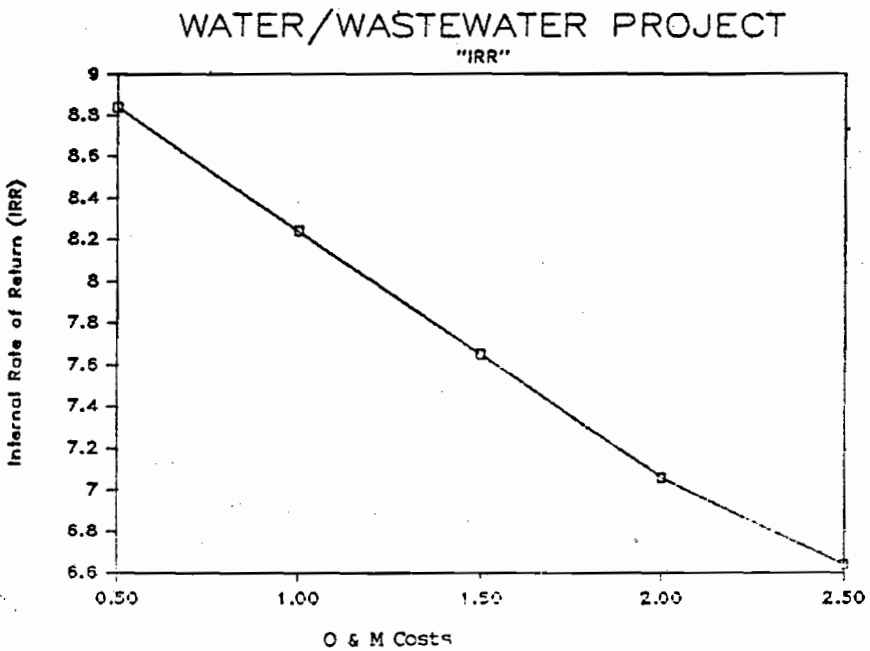
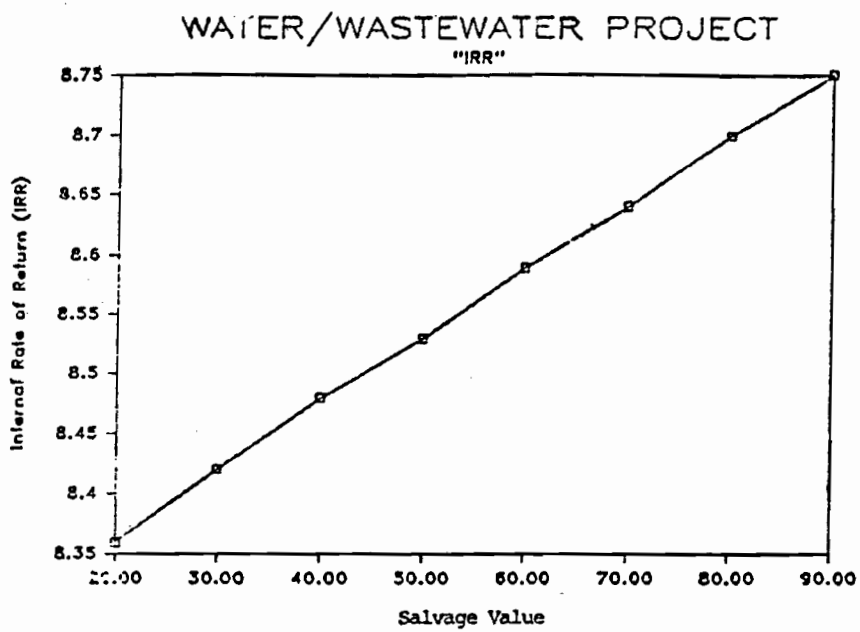


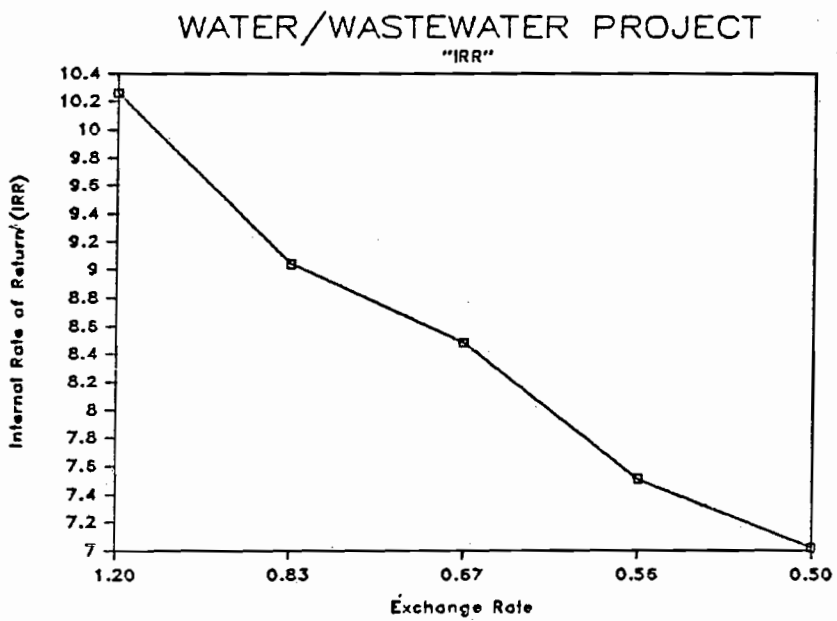
Benefits (in $ millions)	IRR (%)
5.00	2.93
7.50	5.82
10.00	8.53
12.50	10.97
15.00	15.27



O & M Costs	IRR (%)
0.5	8.84
1.0	8.24
1.5	7.65
2.0	7.06
2.5	6.64



Salvage Value	IRR (%)
20	8.36
30	8.42
40	8.48
50	8.53
60	8.59
70	8.64
80	8.70
90	8.75



Exchange Rate	IRR(%)
1.20 (LE 0.83/$)	10.26
o.83 (LE 1.20/$)	9.04
0.67 (LE 1.50/$)	8.48
0.56 (LE 1.80/$)	7.51
0.50 (LE 2.00/$)	7.02

8

WATER AND WASTEWATER SECTOR
1985 ANNUAL REVIEW TARGET BENCHMARKS

ITEM	1984	1985	1986	1987	1988	1989	1990
Institutional Development							
Ministry Headquarters	Reorganization and intensified sector management	Obtain expatriate contractor for management/training support		Review expatriate contractor needs for extention.			
NCPWASD	Planning for expatriate contractor services	Obtain expatriate contractor for management/training support	Issue National training standards, certification standards, design standards, financial standards	Review expatriate contractor needs for extension			Phase out all direct operations and become a total regulatory and service agency
		NCPWASD to develop plan to assist O&M organizations within governorates	O&M and Mgt Training 50	O&M and Mgt Training 100	O&M and Mgt Training 100	O&M and Mgt Training 100	O&M and Mgt Training 100
General		Develop plan to institute Sister Utility concept with US or UK utility	Sister Utility established for CGOSD NCPWASD	Sister Utility established for GOCWS AGOSD	Sister Utility established Canal Cities		
Construction Management	Construction Management Contractors in place for:						
	Alex	Continue	Continue	Continue	Continue	Continue	Continue
	Canal Cities	"	"	"	"	"	"
	Cairo Water	"	"				
	Cairo Wastewater	"	"	Continue	Continue	Continue	Continue
		Obtain construction Manager for Provincial Cities		"	"	"	

WATER AND WASTEWATER SECTOR
1985 ANNUAL REVIEW TARGET BENCHMARKS

ITEM	1984	1985	1986	1987	1988	1989	1990
NOPWASD		Complete training plan	Mgt Admin Training 100	Mgt Admin Training 300	Mgt Admin Training 300	Mgt Admin Training 300	Mgt Admin Training 300
General	Draft National Training Plan	Review, update and implement National Training Program					
Incentives Bonus	Implementation of Law 26 providing wastewater worker bonus	Update Law with consideration of water workers and merit awards		Review effects of law and recommend revisions as needed			
Certification	None	Develop operator certification standards	Implement certification plan and certify 50	Certify 200	Certify 250	Certify 300	Certify 300
Autonomy Autonomous Organizations	Concept under development at Behera		Evaluate Behera project and adjust concept as appropriate				
Revenue Retention	Concept under study	Implement full retention at Governor level with tariff plan.					

WATER AND WASTEWATER SECTOR
1985 ANNUAL REVIEW TARGET BENCHMARKS

ITEM	1984	1985	1986	1987	1988	1989	1990
Provincial Cities Water wastewater	Treatment works not performing satisfactorily	Develop comprehensive O&M needs/ management plan	Obtain expatriate O&M service/ training contractor for upgraded works	(Annually reduce expatriate staffing)		Review need to continue expatriate service	
Training							
Cairo West Bank	Minimal	Develop comprehensive training program Establish Regional Training Center at Zenien Treatment Site.	Trainer Training 160 persons O&M Training 100 persons	O&M Training 300 Mgt Training 50	O&M Training 500 Mgt Training 50	O&M Training 500 Mgt Training 50	O&M Training 500 Mgt Training 50
Alex Wastewater System	Selected management training	Develop comprehensive training program. Establish Regional Training Center	Trainer Training 50	O&M Training 200 Mgt Training 30	O&M Training 300 Mgt Training 30	O&M Training 300 Mgt Training 30	O&M Training 300 Mgt Training 30
Canal Cities System	Draft comprehensive training plan completed	Trainer Training 50 O&M Training 50 Mgt Training 25	O&M Training 150 Mgt Training 25	O&M Training 150 Mgt Training 25	O&M Training 150 Mgt Training 25	O&M Training 150 Mgt Training 25	O&M Training 125 Mgt Training 25
Cairo Water System	O&M Training 500	O&M Training 500	O&M Training 500	O&M Training 500	O&M Training 500	O&M Training 500	O&M Training 500
Provincial Cities Fayoum, Minia Beni Suef	Training Advisory Team mobilized	Complete detailed plan Mgt Training 50 O&M Training 50	O&M Training 100 Mgt Training 30	O&M Training 100 Mgt Training 30	O&M Training 100 Mgt Training 30	O&M Training 100 Mgt Training 30	O&M Training 100 Mgt Training 30

WATER AND WASTEWATER SECTOR
1985 ANNUAL REVIEW TARGET BENCHMARKS

ITEM	1984	1985	1986	1987	1988	1989	1990
Tariffs	Develop New National Plan	National Assembly approval and implementation of rate at 35% of O&M levels for water and 10% for wastewater			(Incremental annual increases to meet 1990 goal)		Increase Tariff levels to 100% of O&M for water and 50% for wastewater with tariff rates to increase annually thereafter to finance capital recovery
O&M Costs	Study by National Committee for Tariff Base Line	Expand/update study to include new works under construction	Adjust tariff plan and local O&M budgets as appropriate	(Annually review O&M levels to assure adequate national subsidy to the Governorates.)			
O&M Services Cairo West Bank	Treatment works not performing satisfactorly	(Redesign Zenien works)	(Upgrade/Rehab. Zenien works)	Obtain Expatriate O&M service/training contractor for West Bank new works		(Annually reduce level of contractor support)	Review need to continue support
Alex Waste-water	Treatment works not performing	(Reconstruction of Treatment Works)		Obtain Expatriate O&M service/ training contractor for new works		(Annually reduce expatriate staffing levels)	Review need to continue expatriate support
Canal Cities Wastewater	Treatment works not performing	Develop plan to meet temporary & long range treat-ment needs	Institute temporary treatment measures and design of long term works	Obtain expatriate O&M service/train-ing contractor for New Works		(Annually reduce expatriate staffing levels)	Review need to continue expatriate support

64

IMPLEMENTATION PLAN

General

The proposed implementation plan consists of both sub-projects and major projects. It is anticipated that sub-projects will be performed by Egyptian consultants and contractors, and that major projects will be performed primarily bv U.S. consultants and contractors.

The cost estimates for sub-projects are based solely upon Egyptian pound (LE) costs while the cost estimates for major projects include both an Egyptian pound component and a U.S. dollar ($) component.

An equivalent cost in terms of 1987 $ has been used in order to compare various alternatives to the proposed actions (only the proposed actions are shown here). The calendar year 1987 represents the approximate mid-point of the project. It is important to understand that the costs shown in the implementation plan are primarily for purposes of comparing various alternatives; the cash flow projections that have been developed and are included elsewhere are a more accurate indicator of the anticipated project costs.

Conversions

Base costs are in terms of 1984 Egyptian pounds and 1984 U.S. dollars. These base costs were increased to account for the projected impact of inflation. The following annual inflation rates were assumed (based upon AID/W guidance):

	LE	$
1985	13%	8%
1986	13%	9%
1987	12%	9%

An exchange rate of $1.00 = LE 0.84 was used to convert Egyptian pounds to U.S. dollars.

Thus, the following formulae were used to obtain equivalent 1987 $:

1984 DOLLARS TO 1987 DOLLARS,

1987 $ = 1984 $ × 1.283148

1984 POUNDS TO 1987 DOLLARS,

1987 $ = (1984 LE × 1.430128)/0.84

TABLE 2A

PROPOSED IMPLEMENTATION PLAN - PHASE I

FAYOUM WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		26,000	45,000	102,000
2	Leak Repair	185,000			315,000
3	Line Cleaning Program		108,000	69,000	272,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	15,000			26,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Intake & Pumping (300 lps)		191,000	357,000	783,000
9	Ground Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	Two Elevated Tanks (4,000 cu meters ea)		1,100,000	92,000	1,991,000
11	Minimal Work on Transmission System	500,000			851,000
12	Rehabilitation of Existing Water Plant	250,000			426,000
13	Kaman Faras Distribution System	1,500,000			2,554,000
14	Altitude Valve at Existing Elevated Tank	15,000			26,000
15					0
16					0
17					0
SUB-TOTAL		2,490,000	2,920,000	2,828,000	12,841,000
18	Contingencies @ 15%	374,000	438,000	424,000	1,927,000
19	Design & Supervision @ 15%	374,000	124,000	813,000	1,891,000
20	Major Project Construction Management @ 3%	75,000	25,000	159,000	374,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		3,313,000	3,612,000	4,784,000	17,930,000

ID#QF1I

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	25,000 sq meters
Ground Reservoir - 500 sq meters	included in above
Elevated Tanks - 4,600 sq meters	2,300 sq meters

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

TABLE 28

PROPOSED IMPLEMENTATION PLAN - PHASE I

FAYOUM WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		60,000	320,000	513,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	100,000			170,000
5	Vacuum Truck			60,000	77,000
6	Minimal Pump Station Rehabilitation		113,000	150,000	385,000
7	Upgrade Existing Treatment Plant (500 lps)	500,000			851,000
8	Kaman Faras Pump Station		613,000	685,000	1,923,000
9	Kaman Faras Force Main	1,825,000			3,107,000
10	New Collectors - Area No. 5	947,000			1,612,000
11	New Collectors - Area No. 2	243,000			414,000
12	New Collectors - Area No. 6 (partial)	190,000			323,000
13	New Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		3,812,000	801,000	1,295,000	9,515,000
18	Contingencies @ 15%	572,000	120,000	194,000	1,427,000
19	Design & Supervision @ 15%	572,000	112,000	290,000	1,537,000
20	Major Project Construction Management @ 3%	114,000	22,000	57,000	305,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24	Kaman Faras Site Investigation		15,000	80,000	128,000
25					0
26					0
27					0
28					0
TOTAL PROJECT		5,070,000	1,175,000	2,476,000	13,809,000

ID#QF2I

TOTAL LAND REQUIREMENTS

AVAILABLE LAND

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

Area No. 6 requires a pump station and force main.

TABLE 3A

BASIC SERVICE NEEDS

FAYOUM WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		26,000	45,000	102,000
2	Leak Repair	185,000			315,000
3	Line Cleaning Program		108,000	69,000	272,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	910,000			1,549,000
6	Improve Public Fountains	15,000			26,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Plant Expansion (300 lps)		1,320,000	2,245,000	5,128,000
9	Intake & Pumping (300 lps)		191,000	357,000	783,000
10	Expansion of Intake & Pumping (300 lps)		191,000	357,000	783,000
11	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
12	Ground Storage Reservoir (10,000 cu meters)		875,000	100,000	1,618,000
13	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
14	Reinforcement of Existing Transmission System	1,000,000			1,703,000
15	Rehabilitation of Existing Plant	250,000			426,000
16	Kaman Faras Distribution System	1,500,000			2,554,000
17	Altitude Valve at Existing Elevated Tank	15,000			26,000
SUB-TOTAL		3,890,000	5,856,000	5,576,000	23,749,000
18	Contingencies @ 15%	584,000	878,000	836,000	3,562,000
19	Design & Supervision @ 15%	584,000	220,000	1,619,000	3,446,000
20	Major Project Construction Management @ 3%	117,000	44,000	316,000	680,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		5,175,000	7,223,000	9,547,000	33,359,000

ID#F18N

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 16,000 sq meters	25,000 sq meters
Ground Reservoir - 3,000 sq meters	included in above
Elevated Tanks - 6,900 sq meters	2,300 sq meters

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

TABLE 3B

BASIC SERVICE NEEDS

FAYOUM WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Force Main Upgrading	250,000			426,000
5	Vacuum Trucks			180,000	231,000
6	Pump Station Rehabilitation		376,000	500,000	1,282,000
7	Upgrade Existing Treatment Plant (500 lps)	500,000			851,000
8	Kaman Faras Pump Station		613,000	685,000	1,923,000
9	Kaman Faras Force Main	1,825,000			3,107,000
10	New Collectors - Area No. 5	947,000			1,612,000
11	New Collectors - Area No. 2	243,000			414,000
12	New Collectors - Area No. 6 (partial)	190,000			323,000
13	New Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		3,962,000	1,079,000	1,845,000	10,950,000
18	Contingencies @ 15%	594,000	162,000	277,000	1,643,000
19	Design & Supervision @ 15%	594,000	122,000	404,000	1,737,000
20	Major Project Construction Management @ 3%	119,000	24,000	79,000	345,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		5,269,000	1,499,000	3,205,000	15,635,000

ID#F2BN

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

PROPOSED IMPLEMENTATION PLAN - PHASE I

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		23,000	40,000	90,000
2	Leak Repair	160,000			272,000
3	Line Cleaning Program		100,000	66,000	255,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	80,000			136,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Modify Existing Raw Water Facilities	169,000			288,000
9	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	One Elevated Tank (4,000 cu meters)		550,000	46,000	995,000
11	Reinforcement of Existing Transmission System	1,000,000			1,703,000
12	Rehabilitation of Existing New Water Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,434,000	2,168,000	2,417,000	9,234,000
18	Contingencies @ 15%	215,000	325,000	363,000	1,385,000
19	Design & Supervision @ 15%	215,000	81,000	645,000	1,332,000
20	Major Project Construction Management @ 3%	43,000	16,000	129,000	266,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		1,907,000	2,695,000	4,114,000	13,114,000

ID#QBS1I

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	44,000 sq meters
Ground Reservoir - 500 sq meters	included in above
Elevated Tank - 2,300 sq meters	2,300 sq meters

NOTE: Includes LE 0.8 million uncommitted sub-project disbursement.

70

TABLE 2B

PROPOSED IMPLEMENTATION PLAN - PHASE I

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	118,000			201,000
5	Minimal Pump Station Rehabilitation		188,000	250,000	641,000
6	New Collectors - Area No. 2	874,000			1,488,000
7	New Collectors - Area No. 3	600,000			1,022,000
8	Minimal Upgrading of Existing Treatment Plant	600,000			1,022,000
9					0
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		2,199,000	278,000	730,000	5,155,000
18	Contingencies @ 15%	330,000	42,000	110,000	774,000
19	Design & Supervision @ 15%	330,000	61,000	137,000	841,000
20	Major Project Construction Management @ 3%	66,000	12,000	27,000	167,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		2,925,000	498,000	1,564,000	7,834,000

ID#QBS2I

TOTAL LAND REQUIREMENTS
0 sq meters

NOTE: Includes LE 0.8 million uncommitted sub-project disbursement.

BASIC SERVICE NEEDS

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		23,000	40,000	90,000
2	Leak Repair	160,000			272,000
3	Line Cleaning Program		100,000	66,000	255,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	525,000			894,000
6	Improve Public Fountains	80,000			136,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Modify Existing Raw Water Facilities	169,000			288,000
9	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	Ground Storage Reservoir (6,000 cu meters)		560,000	60,000	1,030,000
11	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
12	Reinforcement of Existing Transmission System	1,000,000			1,703,000
13	Rehabilitation of Existing New Water Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		1,949,000	3,828,000	2,569,000	13,132,000
18	Contingencies @ 15%	292,000	574,000	385,000	1,968,000
19	Design & Supervision @ 15%	292,000	129,000	919,000	1,896,000
20	Major Project Construction Management @ 3%	58,000	26,000	180,000	374,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		2,591,000	4,782,000	5,253,000	19,292,000

ID#BS1BN

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	44,000 sq meters
Ground Reservoir - 2,000 sq meters	included in above
Elevated Tanks - 6,900 sq meters	2,300 sq meters

NOTE: Includes LE 0.8 million uncommitted sub-project disbursement.

TABLE 3B

BASIC SERVICE NEEDS

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Force Main Upgrading	168,000			286,000
5	Replacement of Undersized Collectors	400,000			681,000
6	Pump Station Rehabilitation		376,000	500,000	1,282,000
7	Upgrade Existing Treatment Plant	1,585,000			2,699,000
8	New Collectors - Area No. 2	874,000			1,488,000
9	New Collectors - Area No. 3	600,000			1,022,000
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		3,634,000	466,000	980,000	8,239,000
18	Contingencies @ 15%	545,000	70,000	147,000	1,236,000
19	Design & Supervision @ 15%	545,000	101,000	198,000	1,354,000
20	Major Project Construction Management @ 3%	109,000	20,000	39,000	270,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		94,000	500,000	802,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		4,833,000	788,000	2,064,000	12,220,000

ID#BS2BN

TOTAL LAND REQUIREMENTS
WWTP - 200,000 sq meters

AVAILABLE LAND
0 sq meters

NOTE: Includes LE 0.8 million uncommitted sub-project disbursement.

PROPOSED IMPLEMENTATION PLAN - PHASE I

MINIA WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		19,000	35,000	77,000
2	Leak Repair	139,000			237,000
3	Line Cleaning Program		94,000	61,000	238,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	40,000			68,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Intake & Pumping (300 lps)		191,000	357,000	783,000
9	Ground Reservoir (4,000 cu meters)		350,000	40,000	647,000
10	One Elevated Tank (4,000 cu meters)		550,000	46,000	995,000
11	Transmission System	895,000			1,524,000
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,099,000	2,524,000	2,784,000	9,740,000
18	Contingencies @ 15%	165,000	379,000	418,000	1,463,000
19	Design & Supervision @ 15%	165,000	80,000	747,000	1,376,000
20	Major Project Construction Management @ 3%	33,000	16,000	146,000	271,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		1,462,000	3,104,000	4,655,000	13,747,000

ID#QM1I

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

TABLE 2B

PROPOSED IMPLEMENTATION PLAN - PHASE I

MINIA WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		45,000	240,000	385,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	150,000			255,000
5	Vacuum Trucks			120,000	154,000
6	Minimal Pump Station Rehabilitation		376,000	500,000	1,282,000
7	New Collectors - Area No. 6	497,000			846,000
8	New Collectors - Area No. 4 (partial)	377,000			642,000
9	Expand Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,031,000	436,000	940,000	3,704,000
18	Contingencies @ 15%	155,000	65,000	141,000	555,000
19	Design & Supervision @ 15%	155,000	35,000	188,000	565,000
20	Major Project Construction Management @ 3%	31,000	7,000	37,000	112,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		1,372,000	648,000	1,866,000	5,833,000

ID#QM2I

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

BASIC SERVICE NEEDS

MINIA WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		19,000	35,000	77,000
2	Leak Repair	139,000			237,000
3	Line Cleaning Program		94,000	61,000	238,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	700,000			1,192,000
6	Improve Public Fountains	40,000			68,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Plant Expansion (200 lps)		985,000	1,676,000	3,828,000
9	Intake & Pumping (300 lps)		191,000	357,000	783,000
10	Expansion of Intake & Pumping (200 lps)		143,000	266,000	585,000
11	Ground Reservoir (4,000 cu meters)		350,000	40,000	647,000
12	Ground Reservoir (8,000 cu meters)		700,000	80,000	1,294,000
13	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
14	Transmission System	895,000			1,524,000
15					0
16					0
17					0
SUB-TOTAL		1,789,000	5,452,000	4,898,000	18,613,000
18	Contingencies @ 15%	268,000	818,000	735,000	2,792,000
19	Design & Supervision @ 15%	268,000	159,000	1,469,000	2,612,000
20	Major Project Construction Management @ 3%	54,000	32,000	287,000	515,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		2,379,000	6,686,000	8,589,000	26,454,000

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TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 15,000 sq meters	52,000 sq meters
Ground Reservoir - 3,000 sq meters	included in above
Elevated Tanks - 6,900 sq meters	2,300 sq meters

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

76

BASIC SERVICE NEEDS

MINIA WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		45,000	240,000	385,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Replacement of Under-Sized Collectors	300,000			511,000
5	Vacuum Trucks			120,000	154,000
6	Pump Station Rehabilitation		752,000	1,000,000	2,563,000
7	New Collectors - Area No. 6	497,000			846,000
8	New Collectors - Area No. 4	874,000			1,488,000
9	Expand Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,678,000	812,000	1,440,000	6,087,000
18	Contingencies @ 15%	252,000	122,000	216,000	914,000
19	Design & Supervision @ 15%	252,000	59,000	310,000	927,000
20	Major Project Construction Management @ 3%	50,000	12,000	61,000	184,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		2,232,000	1,117,000	2,627,000	9,072,000

ID#M2BN

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

SUBPROJECT LISTING
THROUGH MAY 31, 1985

ANNEX H

SPJ. CODE	DESCRIPTION OF THE SUB-PROJECT
BSW-01	replacement of unserviceable low and medium electric panels and cables.
BSW-02	replacement of unserviceable 5 x horizontal pumping units.
BSW-03.1	construction of 25 x valve boxes.
BSW-03.2	" " 100 x " " .
BSW-04.1	procurement of 7,500m x 4" pipes.
BSW-04.2	extend water pipelines to unserved areas.
BSW-04.3	extend water pipelines to unserved areas.
BSW-04.4	extend water pipelines to unserved areas.
BSW-04.5	extend water pipelines to dallala area.
BSW-04.6	extend water pipelines to unserved areas.
BSW-04.7	procurement of 3,000m x 4" pipes.
BSW-04.8	extend water pipelines to unserved areas.
BSW-05.1	rehabilitate water pipelines.
BSW-05.2	rehabilitate water pipelines.
BSW-05.3	procurement of 11,250m x 4" pipes.
BSW-05.4	rehabilitate water pipelines.
BSW-05.5	rehabilitate water intake structures, piping and pumping.
BSW-06.1	provide laboratory.
BSW-06.2	provide workshop.
BSW-07.1	improve water quality (alum mixing, dozing; flocculation basins; settling tanks; sludge removals&filters).
BSW-07.2	civil works and housekeeping.
BSW-08.1	improve bulk metering systems.
BSW-08.2	water meter repair shop.
BSW-09	improve chlorination systems.
BSW-10.1	provide maintenance equipment: 1x5 ton forklift + 1 x compressor + 1/2 x 15 ton mobile crane.
BSW-10.2	provide maintenance equipment: 1 x 10 ton truck + 2 x single cab pickup + 1 x double cab pickup.
BSW-11.1	eng. services: (W.-06.2, W-07, W-08.1, W-08.2, W-09, connect the two water intakes) of Top Priority Projects.
BSW-11.2	eng. services, construction surveillance (W-06.2, W-09).
BSW-11.3	eng. services, design of Water Master Plan jobs.
BSW-12.1	provide 2x500 kw standby generator sets.
BSW-12.2	provide foundations for 2x500 kw standby gen sets.
BSW-14	provide 4x3 hp alum mixing equipment + 3x830 GPD alum metering systems.
BSS-01.1	replacement of unserviceable medium electric panels and cables.
BSS-01.2	provide standby overhead power electric cable.
BSS-02.1	replacement of unserviceable 5 x lifting pump units of 80 l/s + 5 x submersed pumping units of 10 l/s.
BSS-02.2	provide measuring tools & pumps.
BSS-03.1	repair of the trickling filter.
BSS-03.2	civil maintenance.
BSS-03.3	provide laboratory.
BSS-04.1	extend sewer lines to unserved areas.
BSS-04.2& 3	extend sewer lines to unserved areas.

BSS-04.3	extend sewer lines to unserved areas, zone 1.
BSS-05.1	convert Orabi sewage lift station to be main station. (Master Project in I.P.)
BSS-06	provide underground electric cables to the sewerage systems, OWTP and old raw water intake. (omitted)
BSS-07	civil works.
BSS-08	improve flow measurement system.
BSS-09.1	provide chlorine store.
BSS-10.1	provide maintenance equipment: 1/2 x 15 ton mobile crane.
BSS 10.2	provide maintenance equipment: 1 x single cab pickup + 1 x double cab pickup + 2 x dumpers.
BSS-11.1	eng. services (S-04.2, S-05, S-08, S-09) of Top Priority Projects.
BSS-11.2	eng. services, construction surveillance (S-04.2, S-09.1, S-09.2).
BSS-11.3	eng. services, design of Sewerage Master Plan jobs.
BSS-12.1	provide 4x250 kw standby generator sets to Elghamrawi, Elnokh, Elmedan and Elbahr sewage lift stations.
BSS-12.2	construct 4x250 kw generator set's foundations.
BSS-12.3	provide electric cables.
BSS-14	provide 1x1500 G, 2000 psi high velocity water sewer cleaner.
BSR-01	street paving.
BSR-10.1	provide maintenance equipment: 1 motor grader + 1 x roller + 1 x bulldozer + 1 x loader.
BSR-10.2	provide maintenance equipment: 1 x loader.
BSR-10.3	extension of the existing city garage.
BSR-10.4	provide maintenance equipment: 1 x dumptruck.
BSR-10.5	provide maintenance equipment: 1 x water spray truck.
BSR-11	engineering services.
BSO-01	provide 2 x photocopier.
BSO-02	provide 1 x blueprint machine.
BSO-03	provide 7 x desk calculator + 15 x pocket calculators + 2 x Arabic-English typewriters.
BSO-04	technical library and project coordinator's office.
BSO-05	construction contractor pre-qualifications & bank fees.
BSO-06	training.
BSO-07	miscellaneous.

FY-W-01	Construction of 200 concrete control rooms (valve control boxes) throughout water network.
FY-W-02	Procurement equipment for excavation and maintenace of water network:- Front end loader + Bulldozer+Compressor-two utility trucks.
FY-W-03	U.S. Dollar procurement: 2 units standby generator set 500 K.W works in parallel.
FY-W-04	Syphon by-pass extension of water network.
FY-W-05	Kohafa plant genl. repairs, tools and equipment.
FY-W-06	Pneumatic hammer.
FY-W-07	Three-ton forklift.
FY-W-08	3000 household meters w/spare parts.
FY-W-09	Bulk control meters (Eight meters).
FY-W-10	Meter repair workshop.
FY-W-11	Utility pumps. (Four units).
FY-W-12	Valve repair parts for (W-01).
FY-W-13	Fully-equipped maintenance workshop pick-up truck.
FY-W-14	Two high pressure pumps
FY-W-15	Chlorine drum transport truck + 0.5 ton pick-up truck.
FY-W-16	Construct prechlorination room at Kohafa plant.
FY-W-17	Construct laboratory at Kohafa plant.
FY-W-18	Construct workshop at Kohafa plant.
FY-W-19	Install chlorine and alum injector systems.
FY-W-20	Relocate water intake from Joseph canal.
FY-W-23	Modify in-town El Azab connection.
FY-W-24	Construct distribution network extension: Bander Bridge - Sheikh Salem.
FY-W-25	Install Sheikh Salem Bridge Syphon.
FY-S-01	Replacement of unserviceable and inadequate pumps in existing stations: Pump replacement+Pump spare parts+Six pumps (20, 40, 80 Lps)
FY-S-02	Dar El-Ramad network extension.
FY-S-03	US Dollar procurement: 3 standby generator sets (500 KW) + one high velocity water-sewer jet cleaner.
FY-S-04	Three drainage pumps.
FY-S-05	Repair treatment plant aerators/motors.
FY-S-06	Repair treatment plant filters.
FY-S-07	Reconstruct sewer manholes.
FY-S-08	Sewer jet cleaner.
FY-S-09	Fully equipped maintenance workshop pick-up truck.
FY-S-10	Repair treatment plant sludge clarifies.
FY-S-11	Sewage tankers, two.
FY-S-12	Spare parts for vehicles and network.
FY-S-13	Repair network pump stations.
FY-S-14	Install syphon under railroad tracks.
FY-S-15	Construct collection network extension: Governorate Road.
FY-S-16	Tannery/Leather yards replacements

FY-R-01	Paving of certain streets in Fayoum.
FY-R-02	Reshape /resurface inbound Cairo - Fayoum access road to Obelisque square.
FY-R-03	Reshape/resurface both directions Cairo - Fayoum access road, obelisque square to railroad tracks.
FY-R-04	Construct Western Tanahla Canal Street..
FY-R-05	Construct Eastern sennouris canal street
FY-R-06	Motor road grader.
FY-R-07	Steel wheeled roller.
FY-R-08	Asphalt kettle with spray bar.
FY-R-09	Gas-motor-driven hand compactor.
FY-R-10	Power broom street sweeper.
FY-R-11	Supervisor's pick-up truck
FY-R-30	Reconstruct paving depot.
FY-O-01	Photocopier with automatic feed and sort, reduction enlarging + engineering drawings copying machine.
FY-O-02	Three electric typewriters with Arabic characters.
FY-O-03	Two electric typewriters with Latin characters.
FY-O-04	Five small desk calculators.
FY-O-05	Three printing calculators.
FY-O-06	Four passenger sedan.
FY-O-07	Management training needs.
FY-O-08	Design consultant, water/sewage system
FY-O-11	Design consultant, garage/workshop

MN-W-01 network and connections of 4,6,8, asbestos pipes including fittings and fire taps for Shaheen and El Masas areas.

MN-W-02 7 pumps of 120 Lps capacity complete with electrical panels. These pumps will replace inadequate or unserviceable pumps at the two water treatment
plant.

MN-W-03 equipment for filteration and sedimentation tanks of the new water treatment plant including pipes and valves for 7 filteration tanks.

MN-W-04 purchase water intakes equipments.

MN-W-05 engineering study and detailed design of supply and distribution improvements to solve shortage,pressure and new construction prblems in south area.

MN-W-06
(a) purchase and installation of electric panel.
(b) installation of 4 electric pumps
(c) construct pump house.

MN-W-07
(a) alum mixing and feed equipment for clarifiers
(b) pre-chlorination equipment for clarifiers
(c) automatic switch over clorine feeding equipment
(d) flow meters for intake, clarifiers, filters, outflow pipe (19 original)
(e) pressure gauges for pumps, intake, clarifiers and outflow to distribution system (22 original)
(f) loss of head gauge for filters (7)
(g) flow control valves for filters (11)
(h) laboratory equipment
(i) ibrahimia canal intake screens

MN-W-08 installation of water-lines in unserved areas, including replacement or upgrading of existing lines.
(a) Shaheen
(b) El Mosas
(c) Taha El Sabeh
(d) Kafr El Mansoura
(e) Salaghana
(f) El Khashaba
(g) Southern Zone

MN-W-09
(a) replacement of electric cables in two water treatment plants required by electric authority change over from 3.3 kv to 11 kv.
(b) the construction of the electrical panel room of the water treatment plant.

MN-W-10 south zone water project
(a) drill new well No. 7
(b) drill new well adjacent to well No. 6 and connect to existing facilities.
(c) canal and rail road crossing
(d) distribution mains

MN-W-11 water treatment plant improvement
(a) replace filter media both plants
(b) repair, cover, and remove sand from both clear wells
(c) construct chlorinator room, plants & intales
(d) rehabilitate existing sludge beds
(e) clean repair, and renovate clarifiers, both plants
(f) renovate both plants and Ibrahimia canal intalle including doors, windows, lights, painting interior and wooden workers kiosk at old plant
(g) repair and restore electric panels, new plant and Ibrahimia intake.
(h) purchase and install chlorinator booster pump, both plants.
(i) purchase and install running-hour meters for all pumps (twenty two)
(j) purchase and install two system pressure guages
(k) restore or replace hydroulically operated filter valves (new plant).

MN-W-12 water distribution system improvements
(a) contract to loop dead ends, tie crosses not connected and remove bottlenecks.
(b) install new pillar type fire hydrants and replace horizontal type.
(c) install gate valves through out the network to isolate areas.
(d) purchase 250 water meters.
(e) establish meter testing and repair shop.

MN-W-13 water wells improvements
purchase and install transformer, panel, pump and motor for Shalabi well and transfer Shalabi Diesel pump to Alkhsas well for stand-by.

MN-S-01 construction of new collector system to sreve presently unserved areas.
MN-S-02 underground electrical cables (4.5km) serving sewage treatment plant are unserviceable (will be replaced by 3.5 km of overhead cable with transmission posts.
MN-S-03 improvements to the sewer treatment plant consisting of repair of existing concrete conveyance systems and tanlls.
MN-S-04 sewage equipments: include 2 trucks mounted sewer jet cleaner, 1 bucket type sewer cleaner, 2 sewer vacuum (pumping tank) truck. Some of these items must be procured for U.S. (2 sewer tanker + 2 truck were actually bought).
MN-S-04 supply and erect an electrical pannel on the sewage treatment plant.
MN-S-05 renovation of existing sewage treatment plant: (civil work)
(a) replace screens in screen chamber
(b) replace filtration media
(c) replace trickling filter arms
(d) remove sludge and repair secondary clarifications
(e) flow meter
(f) replace by-pass "16 to the "18.
(g) replace chlorination equipment

MN-S-06 engineering study and detailed design of sewers extensions and unserved thousand units area in the west zone.

MN-S-07 engineering study detailed design to upgrade south city pump station and force main.

MN-S-08 engineering study and design of sewers and lift station to sewer south-east low level area.

MN-S-09 engineering study and design of sewer extensions to unserved areas in south zone.

MN-S-10 replace electric panel and cables in four existing pump stations (eng. study is on-going for this subproject.

MN-S-11 installation of sewers in unserved areas. (A. north zone. B. south zone. C. west zone.)

MN-S-12 improvements to sewage treatment plant.

MN-S-13 construction of sewer and lift station of south east low level area.

MN-S-14 additional wastewater treatment plant.
(a) expand enclosure for storage of back-up chlorine tanks
(b) purchase eight hach chlorine residual test kits and 11000 pillows (6 water, 2 sewer)
(c) purchase and install flow meter on treatment plant recirculation
(d) purchase laboratory equipment and chemicals

MN-S-15 wastewater forecmains.
interconnection of 300mm, 400mm and 600mm forcemains.

MN-S-16 wastewater pump stations.
(a) completion of shaheen pump station NOPWASD
(b) electric consultant contract to prepare plans, specifications, tender documents for pump stations new underground cables, switch gear, and motor control center
(c) contract for installation of underground cables switch gear, and motor control center (supplements LE 226,000 funded in S-10)
(d) purchase and install 15 pump running time meters on existing pumps
(e) purchase and install wet-well indicators in 5 existing pump stations
(f) purchase and install 30 pressure guages on 15 existing pumps
(g) repair and renovate existing pump station buildings

MN-S-17 gravity sewer improvements.
(a) consulting engineering contract to plan, design, prepare tender documents for installation of laterals to provide immediate servie to existing housing units in areas where existing gravity sewers are nearby
(b) contract to raise, repair, or replace estimated 100 manhole covers
(c) contract to construct four "test" waste disposal sites
(d) purchase basic pipe and fittings inventory

TRAINING COURSES AND PROPOSED TRAINING

ANNEX I

Training Courses Conducted

I) In-House Training, Designed and Conducted by The PCD Consultant Staff:

A. Priority Need Training

		Total	Fayoum	Beni Suef	Minia
1) Subject:	PCD Training Orientation Seminar				
Attendance:		60	25	-	35
Trainees:	City and Governorate Personnel				
Time:	1 day session				
Leaders:	PCD Training Advisors				

B. Management Training

2) Subject:	Training the Trainers				
Attendance:		3	2	1	-
Trainees:	City Engineers				
Time:	1 week				
Leaders:	PCD Training staff				
Materials:	Manual development				

C. Technical Training

3) Subject:	Pumps and Motors Workshop				
Attendance:					
Trainees:	Engineers	41	5	6	30
	Technicians	5	5	-	-
Time:	1 day				
Leader:	PCD Training staff				

II) Local Source Training Conducted by Local Institutions

A. Priority Needs Training

4) Subject:	English Language Phase I				
Attendance:		42	20	22	-
Trainees:	City Management Personnel				
Time:	30				
Leaders:	American University in Cairo (AUC), English Instructor				

		Total	Fayoum	Beni Suef	Minia
5) Subject:	English Language, Phase II				
Attendance:		31	20	11	-
Trainees:	City Management Personnel				
Time:	30				
Leaders:	AUC, English Instructor				
B. Management Training					
6) Subject:	President's Program				
Attendance:		2	2	-	-
Trainees:	City Mayors				
Time:	1 week				
Leaders:	AUC				
7) Subject:	Public Administration				
Attendance:		3	3	-	-
Trainees:	Engineers				
Time:	2 weeks				
Leaders:	AUC				
C. Technical Training					
8) Subject:	Liquid and Gas Pipeline Design				
Attendance:		3	3	-	-
Trainees:	City Engineers				
Time:	4 weeks				
Leaders:	Cairo University, Engineering Science				

		Total	Fayoum	Beni Suef	Minia
9) Subject:	Heavy Equipment Operation and Maintenance				
Attendance:		16	16	-	-
Trainees:	2 Engineers, 10 Technicians 4 Drivers				
Time:	1 week				
Leaders:	Caterpillar (MANTRAC) Training Center				
10) Subject:	Basic Diesel Engines				
Attendance:					
Trainees:	Engineers	8	4	2	2
	Technicians	12	4	4	4
Time:	1 week				
Leaders:	Caterpiller and Resident Advisors				
Total Trained During Year I: 1982-83		226	109	46	71

The PCD Training Staff also worked on the design of future training courses and developed training aids/manuals including: Chlorination Training, Project Management Training for Construction Supervisors, and Procurement Training.

Year II Training Work Plan:

The second year Work Plan continued the implementation of the first year Work Plan. Year II's focus was training for water and wastewater operations and maintenance, city management, and the training of trainers.

Training Accomplishments During Year II: 1983-84

During PCD's second year of implementation a large number of training materials were completed, and courses were conducted under a more organized PCD Training Staff.

Training Courses Conducted

Sixteen courses were convened and a total of 311 individuals were in attendance.

I) In-House Training, Designed And Conducted By The PCD Consultant Staff:

		Total	Fayoum	Beni Suef	Minia
I. Priority Needs Training					
1) Subject:	Phase II English Training				
Attendance:		10	-	-	10
Trainees:	Minia City Personnel involved in PCD project activities				
Time:	40				
Leaders:	PCD Staff				
II. Management Training					
2) Subject:	Project Planning & Evaluation				
Attendance:		20	8	12	-
Trainees:	Planning and Follow-up Department				
Time:	4-day sessions				
Leaders:	PCD Training Staff				

		Total	Fayoum	Beni Suef	Minia
3) Subject:	Project Contracting and Procurement Procedures and Practices Seminar				
Attendance:		60	20	25	15
Trainees:	Procurement & Evaluation staff				
Time:	4-day sessions				
Leaders:	PCD Training Staff				
Materials:	Contracting and Procurement Training Manual developed				
4) Subject:	Project Monitoring and Controlling				
Attendance:	PCD Training Staff	41	10	19	12
Trainees:	City Engineering Staff				
Time:	3-day workshop				
Leaders:	PCD Training Staff				
Materials:	Project Monitoring and Controlling Training Manual Developed				

(Engineer Abou El Maaty Omar of USAID assisted the PCD consultant staff in the development of the training materials and in the delivery of the seminar.)

III) Engineering and Technical Training

5) Subject:	Water Chlorination Workshop				
Attendance:		39	8	16	15
Trainees:	Engineers and Technicians				
Time:	2 day workshop				
Leaders:	Local Specialists				
Materials:	Chlorination Training Manual, Instructor's Guide and Visual Aid program developed				
6) Subject:	Preventive Maintenance for Water/Wastewater Plants: Maintenance Management Systems and Record-keeping				
Attendance:		45	20	25	-
Trainees:	Engineers & Supervisors				
Time:	3-day classroom and field demonstration training				
Leaders:	PCD Training Staff				
Materials:	System and Maintenance Cards				

		Total	Fayoum	Beni Suef	Minia
7)	Subject: Household Water Meter Repair Workshop				
	Attendance:	10	10	-	-
	Trainees: Household Water Meter Repair Team				
	Time: 2-day session				
	Leaders: Resident Advisor				
8)	Subject: Cairo Trade Fair Tour				
	Attendance:	17	17	-	-
	Trainees: Engineers/Technicians				
	Time: 1-day session				
	Leaders: Resident Advisor				

Local Source Training Conducted by Local Institutions

I. Management Training

9)	Subject: Top Management Seminar				
	Attendance:	3	2	1	-
	Trainees: City Management				
	Time: 1-week sesssion				
	Leaders: Sadat Academy				

II. Engineering and Technical Training

10)	Subject: Fluid Systems in Water and Wastewater				
	Attendance:	7	2	3	2
	Trainees: Engineers				
	Time: 4-week session				
	Leaders: Cairo University				
11)	Subject: Liquid and Gas Networks				
	Attendance:	5	2	1	2
	Trainees: Engineers				
	Time: 4-week sessions				
	Leaders: Cairo University				
12)	Subject: Oiling and Greasing				
	Attendance:	2	1	1	-
	Trainees: Engineers				
	Time: 4-week session				
	Leaders: Int. Research Center				

	Total	Fayoum	Beni Suef	Minia
Training Conducted by USAID/PCD Staff:				
I. Engineering and Technical Training				
13) Subject: Canal Authority Water Treatment Plant Tour in Port Said				
Attendance:	27	-	27	-
Trainees: Engineers				
Time: 2-day sessions				
Leaders: USAID Project Engineer/ Moustafa Dahy				
14) Subject: PCD Accounts and Bookkeeping Guidelines				
Attendance:	15	15	-	-
Trainees: Accountants, Bookkeepers, Budgeting Procurement Officers, and PCD Expediting Team				
Time: 4-day session				
Leaders: USAID Project Engineer Abou El Maati Omar				
16) Subject: PVC Pipe Workshop & Plant Tour				
Attendance:	10	10	-	-
Trainees: Engineers & Technicians				
Time: 2-day session				
Leaders: Arranged by USAID Project Engineer, and Conducted by Egyptian PVC Manufacturer				
Total Trained During Year II: 1983-84	**311**	**125**	**130**	**56**

4. Other Training Accomplishments

During the Program's second year much of the PCD Training Staff's time was spent on the development of Instructor Guides and Training Manuals for Water Treatment Plant Operator Training, Wastewater Treatment Plant Operator Training, and Water Distribution Network Operator Training. The PCD staff also developed the Train-The-Trainers curriculum and training materials.

The second year program utilized the PCD staff, local institutions and a number of short-term Egyptian specialists and USAID project staff in training delivery. A participant training evaluation was developed and distributed during training to analyze the effectiveness of the training delivery.

Year III Training Work Plan 1984-85

1. Training Assistance

The third year training plan proposes to continue with the planned training delivery, while simultaneously meeting identified needs of the Provincial Cities. It is expected that training in Project Planning and Evaluation, Preventive Maintenance, Water and Wastewater Distribution, and Treatment and Collection will be delivered during the year.

2. Management Assistance

A major component of the Year III Work Plan is the Management Plan Improvement Assistance Program planned for a period of approximately eighteen months duration. The program will provide management advisory services focusing on the strengthening of the existing municipal systems and practices in the areas of:

(1) Training,

(2) Cost Accounting and Financial Management, and

(3) Operations and Maintenance.

The three expatriate and four local management advisors will work closely with counterparts from the three cities, and will coordinate with the project's continuing training programs.

Proposed Training

PCD Project training activities were heavily baised towards technical needs during the first three years. This was a logical result of the Project's increasing attention with the water and wastewater needs of the cities. Accordingly, a major series of manuals were prepared that provided the cities with a solid, authoritative reference source for water and wastewater plant operation, distribution systems, and collection systems. Course materials were completed and instruction started with the water and wastewater plant operator manuals. The distribution and collection courses were to follow as the new priority of the PCD Project. It is felt that it will require extended project time for the completion of all courses. In addition to the water/wastewater courses, ancillary manuals and courses were developed and presented for:

* Preventive Maintenance
* Chlorination Procedures & Techniques
* Water and Wastewater Laboratory Procedures & Techniques

Paralleling the technical training needs of the cities are long identified management training needs. Responding to these needs, the PCD Project during its second and third years prepared manuals and presented courses in Project Contracting, Controlling and Monitoring, and Evaluation. As the result of an in-the-field cities management needs exercise, a management enhancement program will be undertaken in the fourth year that utilitzes an "organizational development" approach for training key upper level officials from the cities (with emphasis on the Infrastructure Departments).

Under the aegis of the PCD Training Section, but as independent functional units, both an Operations & Maintenance (O&M) Team and Cost Accounting Team were fielded during the final 18 months of the initial contract period to provide the cities with "OJT" training and support. The O&M Team focus is on water and wastewater facilities and piping networks; the Cost Accounting Team is involved with a financial analysis and recommendation process for strengthening the monetary resources of the water-related utilities.

Based on knowledge and insights gained thus far in the PCD Project, it is mutually felt by all concerned that further training activities should abide by the following tenets:

1. Whenever and however possible, training of all sorts should utilize the in-the-field OJT approach. When classroom-style lectures are a necessity, it is imperative that they be directly linked to timely and thorough in-the-field follow-up support services.

2. Based on the success of the management enhancement program and the continuing needs of the cities, the PCD Project should continue to support management training activities.

3. Project-supported technical training should be limited to subject areas directly linked to the water and wastewater needs of the cities; other technical areas should be minimized so as to maximize the amount of resources that can be brought to bear upon the Project's selected area of emphasis (i.e. water/wastewater).

4. As the PCD Project matures into the design and construction process for new and/or rennovated water and wastewater facilities, by necessity the technical training component of the Project will receive increasing emphasis. This increased emphasis will result in more person-months of technical expertise which can provide invaluable technical training resources. At the same time, the technical training needs of the cities in the water domains are and most likely will continue to be pressing.

Bearing-in-mind the above four points, the PCD Training Section would undertake to implement a training program during an extended two year period with the following parameters:

1. The current manual/classroom lecture format will be continued in order complete the two remaining outstanding topics for the major water and wastewater courses (water distribution and wastewater collection).

2. Select technical courses, such as the Preventive Maintenance Course, will be repeated in modified form. By modified it is meant that classroom presentation will be limited, if not eliminated; no new manuals will be prepared; and heavy emphasis will be placed on in-the-field, first-hand instruction. Also, on an "identified/critical" needs basis, new courses will be evaluated and prepared as deemed appropriate.

3. The O&M Team and the Cost Accounting Team will continue for an additional 18 months as the second phase of the project with no anticipated major alterations in scope, approach and/or method of implementation. By continuing both Teams for another 18 months, this will have the effect of providing each city with approximately one year of team service. At the present time, it is felt that each city will require this extended time in order to overlap plant and system improvements expected to be accomplished under the sub-project program.

4. Staff providing technical review and coordination for this Project will be the primary source of technical training guidance and needs identification for the Training Section. All technical training, whether it be of a classroom nature, OJT, and or in-the-field follow-up, will be closely coordinated with them. The Training Section will assist in training design, management, and implementation. It should be noted that it is assumed that the contractor for the new facilities will be responsible for all new facilities "start-up" training and OJT

5. As alluded to earlier, the PCD Project during the extension phase will continue to assess and address the management training needs of the cities. The primary vehicle for doing this will be the expansion of the management enhancement program initiated in the initial contract phase of the project to include middle-level managers from all city departments. As other management needs are identified programs will be formulated.

Management Improvement Assistance

Initial priority will be given to reviewing and updating the data and information developed in the 1983 needs assessment. This review will involve a brief period of about two months and will include detailed discussions with management and counterparts from each of the Provincial Cities. Areas of priority and required emphasis will be identified or confirmed. Refinements, adjustments, or modifications to the work program outlined herein will be considered and acted upon. The basic objective of this phase will be to build upon those infrastructure foundations that are effectively in place and address those institutional elements and systems in need of being strengthened.

Based on the review, a detailed work plan will be developed. The work plan will consist of a detailed list of tasks and sub-tasks to be performed by each specialist. The work plan will be reviewed with USAID and Provincial Cities officials and approvals obtained. This procedure will assure full understanding and agreement of specific work to be performed, work products to be delivered, and other expectations to be met. Work will be initiated and monitored according to this plan. The plan will be flexible to the extent that modification may be required by evolving events. Periodic reviews will be scheduled with appropriate USAID and Provincial Cities officials, and appropriate changes will be made as required. The following work tasks are envisaged. Specific roles and responsibilities and tasks and sub-tasks are listed for each proposed staff specialist. Some degree of flexibility will be required to accommodate evolving circumstances.

Cost Accounting and Financial Management Specialist. The US specialist for this area will be generally responsible for providing the individual cities with internal financial and information systems to assist in the local decision-making processes. This activity is proposed in recognition that current financial systems are tailored to meet national needs and priorities that are not necessarily responsible to local needs. Moreover, such an activity is necessary to meet local expectations. The improvements anticipated from this activity shall serve as the keystone to future, continuing financial management viability at the local government level.

The US specialist will direct and coordinate work tasks through an Egyptian cost accountant. The specific tasks to be performed include, but are not limited to, the following:

1. Review the national financial systems to determine legal requirements (laws, rules, and regulations), system components, and how a parallel system can be supplementary and complimentary to the existing ones.

2. Review and make recommendations for improving internal financial procedures at the local level including inventory control and equipment management as part of O+M requirements.

3. Identify local financial information needs in the area of utilities and how they interface with other elements of the local financial system.

4. Analyze the financial management and, reporting systems, the budget process, and other related information.

5. Design and implement a cost accounting system for municipal water and wastewater departments.

6. Obtain approvals for proposed systems and training programs from USAID and Provincial Cities officials.

7. Prepare a basic manual, flow charts, forms, and other documentation required for improving the capital budgeting operating procedures.

8. Translate all pertinent reports and documents from English to Arabic.

9. Provide input into the development of a training plan and schedule and assist implementation of this plan.

10. Provide ongoing technical assistance and training.

An Egyptian cost accountant will be responsible for performing the day-to-day activities in the cities. He will coordinate and direct all field work including the marshalling of local staff resources committed to the project.

Operation and Maintenance Specialist

The US specialist will provide "on-the-job" training in the proper and effective operation and maintenance of water and wastewater systems, including water treatment plants, wastewater treatment plants, water distribution systems, and wastewater collection systems in Beni Suef, Fayoum and Minia. The Operation and Maintenance Specialist will carry out his duties and responsibilities as the head of a multidisciplinary O & M team supported by three Egyptian engineering specialists in such areas as mechanical engineering, electrical engineering, and sanitary/civil engineering on a full-time basis, and such other Egyptian special disciplines as may be deemed or found necessary from time-to-time.

Four O & M Manuals are under development and will be available for reference and assistance to the O & M Specialist and his assistants in providing the critically needed on-the-job training. Training manuals include; (1) Water Treatment Plant Operator's Manual, (2) Water Distribution System Operator's Manual, (3) Wastewater Treatment Plant Operator's Manual, and (4) Wastewater Collection System Operator's Manual. A major function of the O & M Specialist and his on-the-job training team is to assist the water and wastewater operation personnel in making the transition from the formal classroom training to applying the knowledge gained in the performance of their everyday on-the-job O & M duties and responsibilities.

Specific tasks to be performed by the O & M Specialist and the multi-disciplinary team include:

1. Review, analyze, and evaluate procedures and practices for operation and maintenance activities to determine where improvements are needed.

2. Identify and list work activities actually being performed based on field observations and discussions with first-line supervisors, middle managers, and top managers. Using information gathered and the specialists' experience, develop a list of activities that should be performed. In addition, statements will be prepared for each activity describing:

   a. The reason or need for performing the activity.
   b. A description of the work to be carried out.
   c. The results to be achieved.

3. Provide on-the-job training using an on-site, hands-on approach with all plant and system staff. This should continue with follow-up until proper O & M procedures are established.

4. Examine staffing needs and manpower utilization requirements of the water and wastewater treatment plants, systems, and departments and relate them to present and projected workload and service demands.

5. Review present practices of operational planning, programming, scheduling, supervision, and performance measurement used by management personnel.

6. To the extent possible, assist in establishing performance standards for each defined work activity. Each performance standard will identify:

   a. Reasons for performing the activity.
   b. Optimum personnel complement or crew size to be used.
   c. Material required.
   d. Work procedures to be followed.
   e. Anticipated average daily production.

Draft standards will be developed for testing and revision as necessary on a continuous basis.

7. Develop and implement a manual system for providing information required to direct, manage, supervise, monitor and evaluate operations effectively.

8. Obtain approvals for proposed changes and new systems with USAID and Provincial Cities officials.

9. After securing approvals, prepare flow charts, operating procedures, and other materials required to implement systems modifications and related change.

10. Provide input into the development of training programs, plans, and schedules associated with this work element.

11. Initiate implementation activities.

12. Provide follow-up technical assistance and training.

13. Translate all pertinent reports and documents from English to Arabic.

The Training Specialist will have general responsibility for coordinating all training activities associated with the implementation of the individual programs resulting from the assessement and design activities of the financial and operation and maintenance specialist. This responsibility and the specific responsibilities delineated below are in addition to those responsibilities previously described for the Training Specialist.

It is anticipated that full implementation of systems improvement and management enhancement will require training and follow-up assistance before initiation of implementation. Specifically, a plan for providing hands-on technical assistance (problem solving) and training will be prepared for training local employees to perform their respective duties better under the new organizational arrangements and procedures. It is anticipated that all training will be conducted within Egypt. The nature and location of training would be determined as part of the development of the training plan and schedules.

Specific tasks to be performed by the Training Specialist include:

1. Develop a profile of needed training activities and services, including service populations by category, estimated training costs, and use of external facilities such as university and college programs.

2. Develop minimum standards and corresponding course curricula or on-the-job training programs applicable to needs identified.

3. Prepare specific recommendations regarding suitable courses, training programs, locations, and facilities for conducting training programs.

4. Develop programs for on-going training of trainers as well as basic and continuing training for meeting operational and management needs.

5. Prepare training materials and supervising the translation, printing, storage, and distribution of materials produced.

6. Supervise, monitor and coordinate the delivery of requisite training, including selection of trainers, curriculum design, and development of training goals and objectives.

7. Obtain approvals for proposed changes and new systems with USAID and Provincial Cities Development.

8. Translate all pertinent reports and documents from English to Arabic.

The Training Specialist will be assisted by the Egyptian national trainers currently assigned to the project. It is expected that the Training Specialist will work closely with the Financial and O & M Specialists for coordination of training programs.

On-going Implementation Assistance and Problem Resolution

Upon completion of the review and acceptance of the recommendations resulting from the needs assessment initial training and pre-implementation activities, on-going technical assistance, program monitoring, and other problem solving assistance will be provided in implementing the improvement program designed.

The implementation assistance will include, but not be limited to, the following:

1. Institutionalizing administrative policies and procedures that are in accord with new organizational arrangements and applicable statutes; assisting department neads and appropriate staff; implementing and training personnel on departmental regulations, policies, and procedures affecting the operations of their respective departments and functional units.

2. Providing other management support as needed, including but not limited to: clarifying the roles and relationships of supervisory and management personnel and improving their capacity to identify and solve problems; orientating and training of staff in specific operational methods; providing staff development programs; and advising on other changes that may be required during implementation.

Annex K

PCD IMPLEMENTATION SCHEDULE
CALENDAR YEARS 1982-1992
BASIC SERVICE IMPLEMENTATION PLAN

Major Activities	1982-1985	1986	1987	1988	1989	1990	1991
Top Priority Subprojects	o----------o						
Technical Assistance							
Development of Master Plans	o-----o						
Management Advisory services	o----------	----------	----------	----------	----------	----------o	
Training	o----------	----------	----------	----------o			
Implementation Plan							
Bid Preparation and Award	o--o						
Design Services	o----------o						
Construction Management	o----------	----------	----------	----------	----------	----------	----------o
Subprojects	o----------	----------	----------	----------	----------	----------	----------o
Major Construction		o----------	----------	----------	----------	----------	----------o
On-the-Job Training				o----------	----------	----------	----------o

Doc. 0063D, 5/6/85

101

5C(2) PROJECT CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A. includes criteria applicable to all projects. Part B. applies to projects funded from specific sources only: B.1. applies to all projects funded with Development Assistance loans, and B.3. applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT

1. FY 1985 Continuing Resolution Sec. 525; FAA Sec. 634A; Sec. 653(b).

   (a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or nor more than $1 million over that amount)?

   a) Congress will be notified by Congressional Notification

   b) The intended obligation is within the level of funds appropriated for Egypt

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimte of the cost to the U.S. of the assistance?

   a) Yes

   b) Yes. The financial plan and analysis are part of the Project Paper Amendment

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	No further legislative action is required other than action notifying that the Grant Agreement is signed.
4. FAA Sec. 611(b); FY 1985 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973, or the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See AID Handbook 3 for new guidelines.)	n/a
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	Yes
6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	No

7. FAA Sec. 601(a). Information and conclusions whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	This project will strengthen Egyptian private sector, providing consulting and construction services opportunities.
8. FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	Major project components, including technical assistance, design and construction services will be provided by U.S. private enterprises.
9. FAA Sec. 612(b), 636(h); FY 1985 Continuing Resolution Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	The GOE is contributing the equivalent of $68 million in local currency.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	No

11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes
12. FY 1985 Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	n/a
13. FAA 118(c) and (d). Does the project comply with the environomental procedures set forth in AID Regulation 16. Does the project or prograam taken into consideration the problem of the destruction of tropical forests?	Yes the project complies with AID environmental procedures. The destruction of tropical forests is not applicable.
14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate sysem for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?	n/a

15. FY 1985 Continuing Resolution Sec. 536. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution? — No

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote — n/a

the participation of women in the national economies of developing countries and the improvement of women's status, (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used? n/a

c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)?

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to whch the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed country)?

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project for more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country

"relatively least developed"? (M.O. 1232.1 defined a capital project as "the construction, expansion, equipping or alteration of a physical facility or facilities financed by AID dollar assistance of not less than $100,000, including related advisory, managerial and training services, and not undertaken as part of a project of a predominantly technical assistance character."

f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?

g. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information an conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Economic Support Fund Project Criteria

a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?

Yes

Yes

b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?

No

c. FAA Sec. 534. Will ESF funds be used to finance the construction of, or the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to nonproliferation objectives?

No

d.	FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?	n/a

110

MINISTRY OF Planning AND

INTERNATIONAL COOPERATION

ANNEX M

July 28, 1985

Mr. Frank Kimball
Director of USAID
Cairo, Egypt

Dear Mr. Kimball:

In September 1981 the Government of Egypt entered into an agreement with the Government of U.S.A. to undertake the Provincial Cities Development project. The initial project provided a grant of $75 million to the Government of Egypt for assisting the cities of Fayoum, Beni Suef and Minia to improve their urban infrastructure. Since that time Master Plans have been prepared, new equipment has been purchased and improvements have been made to the water and wastewater systems of the three cities.

The Master Plans identify needed improvements to the water and wastewater systems to meet the expected demands of the cities in the year 2000. A five-phase implementation plan has been prepared which will stage these improvements over the next fifteen years. Phases One and Two of this plan identify system improvements to meet minimum basic service needs of the current residents. Phase One will be funded with the remaining funds of the current authorization. Phase Two will require additional contributions from AID and the Government of Egypt.

For Phase Two we are requesting that AID authorize an additional grant of $35 million beyond the $75 million already authorized. These funds will be provided to the cities and NOPWASD for completing the construction of water and wastewater systems. This increase raises the U.S. commitment to the Provincial Cities Development project to $110 million. Against this increase the Government of Egypt will provide local currency financing of LE 20.4 million.

In addition to its remaining disbursement from the original authorization, the Government of Egypt will contribute LE 16 million for Phase One. These contributions for Phases One and Two total to LE 36.4 million and will bring the total local currency financing from the Government of Egypt to LE 57.4 million for the life of the project.

Sincerely yours,

Ahmad Abdel Salam

Ahmad Abdel Salam Zaki
Administrator

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TECHNICAL ANNEX

FAYOUM

INDEX

SECTION 1 - Current Status

1.1 WATER..... 1 - 2
1.2 WASTEWATER..... 2 - 4

SECTION 2 - Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION..... 5
2.2 WATER TREATMENT..... 5
2.3 WATER DISTRIBUTION..... 6
2.4 WASTEWATER COLLECTION..... 7
2.5 WASTEWATER TREATMENT..... 7 - 8
2.6 WASTEWATER DISPOSAL..... 8

SECTION 3 - Evaluation of Technical Alternatives

3.1 WATER TREATMENT..... 9 - 13
3.2 IMPROVING EXISTING WATER DISTRIBUTION SYSTEM..... 13 - 18
3.3 EXTENSION OF WATER DISTRIBUTION SYSTEM..... 18 - 20
3.4 REHABILITATION OF WASTEWATER COLLECTION SYSTEM..... 20 - 23
3.5 EXTENSION OF WASTEWATER COLLECTION SYSTEM..... 24 - 25
3.6 WASTEWATER TREATMENT..... 25 - 28
3.7 WASTEWATER DISPOSAL..... 29 - 30

SECTION 4 - Needs and Proposed Actions..... 31 - 34

SECTION 5 - Recommended Implementation Plan

5.1 GENERAL..... 35
5.2 WATER..... 35 - 36
5.3 WASTEWATER..... 36 - 37
5.4 SUPPORT..... 37
5.5 PHASE I..... 37
5.6 PHASE II..... 37

FAYOUM

Section 1

Current Status

1.1 WATER

Distribution

The existing water distribution system is constructed of cast iron, steel, and asbestos-cement pipe. Pipe diameters range from 100-mm to 450-mm. Due to severe corrosion problems, asbestos-cement pipe is used for all new lines.

The existing fire hydrants are of the below ground type. The local fire protection authorities prefer to use the pillar type hydrants.

Thirty-seven public fountains are an integral part of the distribution system.

"Unaccounted-for-water" is estimated to be approximately one-fifth of that entering the distribution system. This level of loss would tend to indicate that line leakage is not a major problem in Fayoum.

The distribution system is reasonably well looped. However, due to the extensive use of small diameter lines and the inadequacy of the transmission system, many areas suffer low pressure problems. System pressures reportedly range from 1 to 33 metres.

Transmission and Storage

The transmission system essentially consists of two 600-mm diameter lines from the governate's Azab Water Treatment Plant. One line follows the Azab-Fayoum Road, and the other the Bahr Youssef Canal. High service pumps at the Kohafa Water Treatment Plant pump treated water from ground reservoirs directly into the distribution system.

Fayoum has one steel elevated water storage tank (750 cubic metres) which currently is valved off from the system. The tank is located adjacent to the water treatment plant. Visual inspection of the tank indicates that it is in relatively good condition considering its age.

Treatment

Fayoum is served by the Kohafa Water Treatment Plant. In addition, the governate's Azab Water Treatment Plant serves as a secondary source of supply on a temporary basis.

The Kohafa Plant has a rated capacity of 180 litres per second (though total filtration capacity of 240 litres per second). The average daily demand during the summer months is estimated at approximately 350 litres per second. The Azab Regional Authority supplies about 120 litres per second of this demand. The rest of the demand is supplied by overloading the Kohafa Plant.

The Kohafa Plant was originally constructed in 1926; additional capacity was added in 1965 and 1975. With the exception of the pumping units, the mechanical components of the plant are essentially inoperative. The operators are unable to produce a floc. Breakthrough has occurred in some of the filtration units. Algae is a problem on the outside filtration units. The problems with this plant are so numerous that rehabilitation is not a realistic alternative.

A lack of a laboratory prevents proper operation of this facility.

The existing level of operation and maintenance at this facility is insufficient to ensure that the public will have access to a consistently reliable source of potable water.

Supply

The source of supply for the Kohafa Water Treatment Plant is the Bahr Youssef Canal. The raw water intake is located about 50 metres from the water plant. The raw water pumps are located at the plant site. The total rated pumping capacity is 465 lps.

The existing raw water facilities appear to be adequate for the immediate needs of Fayoum. However, a sewage force main crosses the Bahr Youssef just upstream of the intake. Also, there is a lack of prechlorination for algae control.

1.2 WASTEWATER

Collection

The existing collection system is constructed of vitrified clay pipe with jute and mortar joints. Manholes are constructed of clay bricks. Sewer connections are always made at a manhole and never directly to the sewer main. Though there is an extremely high groundwater table in Fayoum, the Master Plan concludes that infiltration to the system is being prevented by the surcharging of the collection system. This assumption is highly suspect considering the relatively dilute wastewater entering the treatment plant. However, if true, this would indicate that flows could substantially increase as a result of infiltration if the system were to be operated correctly. Infiltration could account for one-third to one-half of the flow entering the treatment plant.

Some of the older interceptors were constructed at very flat slopes; this is contributing to solids diposition in the lines.

The bakeries indiscriminately discharge waste oil into the sewers; this frequently results in blockages.

Maintenance is performed on an "as-needed" basis rather than on a routine basis.

Transmission

Three main pumping stations discharge wastewater directly to the treatment plant. In addition, there are three sub-stations which transmit flows to the main stations. The pumping stations and associated force mains are adequate to serve the immediate needs of Fayoum; however, the stations are in need of general rehabilitation. Wet wells are undersized and the stations are controlled manually. The operation of the stations is such that sewers are allowed to surcharge. This surcharging has an adverse effect upon the performance of the collection system. Solids diposition and grease accumulation can be attributed to surcharging.

Treatment

The existing wastewater treatment plant utilizes a trickling filter process as well as an aerobic ditch process. Unfortunately, there are no secondary clarifiers, thus eliminating a substantially important element of both of these processes. The rated capacity of the existing plant is 300 lps; the current flow into the plant is about one-half of the design capacity.

Limited wastewater analyses are available. The available analyses suggest that the strength of the influent is substantially affected by infiltration. The data also indicates that minimal treatment is provided by this facility.

The plant appears to be fairly sound in regard to the structures themselves.

New aeration paddles were installed in the aerobic ditches; however, they are rarely in operation.

The primary sedimentation units appear to be functioning reasonably well. After primary settling, the bulk of the flow is discharged without further treatment. A small portion of the flow is diverted to the aeration ditches where virtually no treatment is provided, and a portion of the flow is diverted to the trickling filters. The trickling filters are grossly underloaded.

No chlorination is provided at this facility.

Sludge treatment is not provided. Sufficient sludge drying beds are apparently not available. Much of the sludge is spread directly on adjacent lands for drying; the leachate from the sludge area is apparent in the valley immediately below the plant site.

115

NOPWASD is currently building a new activated sludge plant near the site of the existing plant. Reportedly, construction has been underway for several years with only some site work, miscellaneous equipment, and one building structure in evidence.

Disposal

Discharge of the treatment plant effluent is to an agricultural drain via a paved channel. The fall from the plant to the drain is tremendous. Significant aeration is occurring in the channel. The agricultural drain is of moderate size and the wastewater creates a visible flume upon its entry into the drain. The Ministry of Irrigation has plans to install a pumping station about 25 kilometres downstream to divert a major portion of the drain to an irrigation canal for use in new agricultural lands.

116

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Section 2

Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION

One alternative is to take no action. In this alternative, no additional improvements would be made to either the water system or the wastewater system. Under this alternative it would be impossible to maintain even the status quo. Continued development within and around Fayoum would create additional demands upon the existing facilities. The physical condition of these facilities is such that the various system components are rapidly distintegrating due either to age or poor quality of construction.

2.2 WATER TREATMENT ALTERNATIVES

The primary objective of the water treatment process is to produce water which is safe for human consumption and use. A secondary objective is to produce water which is aesthetically appealing to the consumer.

The team has identified several technical alternatives for the treatment of water from the canal:

* A slow sand filtration process or biological filtration process. Major process components would include filter units and chlorination facilities. Filter media would be manually cleaned.

* A conventional rapid rate sand filtration process. Major components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A dual media, high rate filtration process. Major process components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A direct filtration process utilizing dual media, high rate filters. Major process components would include rapid mix chambers, flocculation basins, filter units, and chlorination facilities. The major differences between this alternative and the above high rate filtration process are the lack of sedimentation basins and the smaller size of the flocculation basins.

117

2.3 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WATER DISTRIBUTION SYSTEM

The water distribution system should be capable of delivering clean, treated water to the consumer at an adequate pressure and in sufficient volume to meet everyday needs.

The team has identified several technical alternatives for improving the distribution of water in the existing system:

* A leak detection program of main lines followed by line repair of major leaks using pipe clamps and/or line replacement.

* A line cleaning program to remove accumulated sediment using pipe "pigs" or other appropriate equipment. In addition, fire hydrants and blow-offs would be added at critical points.

* Reinforcement of the distribution system by increasing transmission line sizes, looping dead-end lines, and inter-connecting lines at intersections.

* Additional elevated storage facilities throughout the distribution system--
  - Steel tanks,
  - Reinforced concrete tanks.

* Installation of flow limiting devices at all public fountains and residential connections.

* Improvement of drainage at all public fountains.

Technical alternatives for the extension of the distribution system have been limited to:

* Water demand criteria--
  - Instantaneous demand,
  - Fire demand.

* Materials of construction for pipelines--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

* Water meters--
  - Install at all connections,
  - No water meters,
  - Install at major users.

118

2.4 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WASTEWATER COLLECTION SYSTEM

The wastewater collection system should be capable of removing wastewater from the community in a safe, efficient manner.

The team has identified several technical alternatives for improving the existing system:

* An inflow/infiltration study of the sewers followed by repair of major leaks by line replacement and/or the use of liners.

* A sewer cleaning program to remove debris and sediment using sewer balls or other appropriate equipment.

* Rehabilitation and upgrading of pump stations.

* Repair, replacement, and/or reinforcement of force mains.

* Replacement of under-sized collectors.

Technical alternatives for the extension of the collection system have been limited to:

* Design criteria regarding manhole spacing, service connections, and pump station sizing--
  - NOPWASD standards,
  - Standard engineering practices.

* Materials of construction for sewers--
  - Vitrified clay (VC),
  - Polyvinyl chloride (PVC),
  - Reinforced concrete,
  - Prestressed concrete cylinder.

* Materials of construction for force mains--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

2.5 Wastewater Treatment Alternatives

The primary objective of the wastewater treatment process is to reduce the health risks associated with the disposal of wastewater.

The team has identified several technical alternatives for the treatment of wastewater from Fayoum:

* A primary treatment facility. Major process components would include screens, grit chambers, clarifiers, chlorination facilities, cascade aerator, and sludge drying beds.

* A secondary treatment facility using a trickling filter process. Major process components would include screens, grit chambers, primary clarifiers, trickling filters, secondary clarifiers, chlorination facilities, cascade aerator, and sludge drying beds.

* A secondary treatment facility using stabilization ponds. Major process components would include screens, stabilization ponds, maturation ponds, and chlorination facilities.

2.6 Wastewater Disposal Alternatives

The desired disposal alternative should be one which minimizes the health risks to adjacent communities and minimizes damage to water bodies.

Disposal alternatives have been limited to the following:

* Discharge to El Bats Agricultural Drain (the current discharge point).

* Irrigation of agricultural lands between the treatment plant site and El Bats Drain.

* Irrigation of reclaimed agricultural lands on the east bank of El Bats Drain, east of the treatment plant site.

120

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Section 3

Evaluation of Technical Alternatives

3.1 WATER TREATMENT ALTERNATIVES

* Slow Sand Filtration

The use of slow sand filters may be a good application of appropriate technology in Fayoum. The skills required to maintain and operate such a facility could realistically be developed in a relatively short time frame (3 to 6 months). The process is simple, yet highly reliable. The major disadvantage would appear to be the large area of land required for such a facility (approximately 24,000 square metres for a 600 litre per second plant with plain sedimentation).

Due to the fairly high reported turbidities of the raw water (greater than 25 NTU), it would be advisable to precede the filtration process with plain sedimentation basins. It would also be advisable to provide microscreening facilities for algae removal.

The slow sand filtration process itself would not involve pumping; however, pumping would be required to transport raw water to the plant and then finished water from the plant. There would also be some minor power consumption associated with the microscreening facilities, the chlorination facilities, and the administration building.

The slow sand filtration process requires neither rapid mix chambers nor flocculation basins. The filters are of a very simple design and do not require a backwash system. The construction of the plant would be a relatively simple operation, and could be accomplished using materials available within Egypt. However, the microscreens would be imported. Maintenance would be facilitated by the ready availability of replacement parts for most components of the plant.

The simplicity of operation, lack of dependence upon imported chemicals, and absence of a power requirement should lead to a very reliable and consistent operation.

Advantages

- Chemicals are not essential to the treatment process.

- Electrical power is not essential to the treatment process.

121

- There are extremely few mechanical components.

- Replacement components are readily available on the local market.

- Unskilled labor can be used for many plant functions.

- Simplicity of operation and maintenance.

- Simplicity of design and construction.

- Laboratory monitoring requirements for process control are minimal.

Disadvantages

- Large land area required (with plain sedimentation approximately 15 times the area of land required for a rapid filtration process).

- Filters are subject to upset if there are sudden and severe fluctuations in water quality.

- Certain types of algae may interfere with the filter operation.

- During the filter curing stage, there is the potential for an unskilled operator to introduce partially treated water into the distribution system. However, the problem is not extremely critical due to the fact that even during the curing stage the filter should be able to produce a finished water with a turbidity of less than 2 NTU.

- Greater loss of sand filter media can be expected as a result of the manual scraping required to clean the filters.

- Introduces a new, unfamiliar treatment concept to Fayoum.

* Rapid Rate Filtration

Fayoum currently uses a rapid rate filtration process to treat water. Rapid rate filters operate at rates (approximately 120 m/d) on the order of magnitude of about 30 times those of slow sand filters. In order to reduce the frequency of the filter backwash cycle, it is necessary to remove the bulk of the suspended matter prior to the filters. Alum addition, rapid mix chambers, flocculation basins, and sedimentation basins are all part of the process of preparing the raw water for application to the filter beds. Due to the frequency of cleaning required for the filter beds, it is necessary to install a backwash system to clean the filters.

Major advantages of this process are the small land area required (approximately 1,500 square metres for a 600 litre per second plant) and the familiarity of the existing staff with this process. The

122

major disadvantage is that the system requires operation skills not currently available in Fayoum; the existing facilities are not properly operated and maintained.

Construction of a conventional rapid rate filtration plant is complex; however, numerous contractors are familiar with this type of facility. Numerous components would have to be imported.

Proper operation and maintenance of a rapid rate filtration plant requires a staff of skilled operators, maintenance personnel, and laboratory technicians. In spite of the fact that the existing facilities utilize this process, Fayoum lacks the institutional support and human resource skills to operate such a system. To achieve the minimum level of skills required, the staff would need 18 months or more of training. In addition, considerable investment would be required in support facilities.

Advantages

- Process is commonly used throughout the world, and is presently used in Fayoum.

- Process is capable of producing a finished water of excellent quality.

- Land area required is not excessive.

Disadvantages

- Process is complex and difficult to operate.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from sedimentation basins.

* Dual Media, High Rate Filtration

This process is very similar to the rapid rate filtration process. However, it introduces the use of coal in the filter media in addition to the sand, and uses a higher rate of filtration (approximately 240 m/d).

The major advantage of this system is that the filter area is further reduced, thus the construction cost is also reduced.

123

In all other aspects, the system is virtually identical to the rapid rate filtration process with the exception of the increased frequency of backwash that is required.

Advantages

- Process is virtually identical to the rapid rate filtration process which is presently used in Fayoum.

- Capability of producing a finished water of excellent quality.

- Land area required is less than a slow sand filter process or a rapid filtration process.

- Minor redundancy in system. If upstream units operate at less than optimum levels, it is still possible to produce a finished water of good quality by placing a greater burden on the filters.

Disadvantages

- Process is complex.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from the sedimentation basins.

* Direct Filtration

The direct filtration process is similar to the dual media, high rate filtration process; however, the flocculation basins are of a reduced size and the sedimentation basins are eliminated altogether. Chemicals are added to destabilize the suspended matter rather than to create a floc which will slowly settle with the suspended matter adhering to it. All of the suspended matter is removed by the filter media; this is made possible by the use of a dual media filter for more efficient in-depth filtration.

The major advantage of this process is that construction costs are substantially reduced (approximately by 1/3 that of a conventional rapid rate filtration facility). The major disadvantage is that proper filter operation becomes extremely critical.

The operation of a direct filtration process is less complex than a conventional process; however, the filters require increased attention and more frequent backwashing.

Chemical costs typically are less with this process than a conventional process. However, the increased frequency of backwashing results in slightly higher power costs.

Advantages

- Substantially less chemicals are required than for a conventional plant.

- Operation is less complex than for a conventional plant.

- Construction costs are approximately 1/3 less than for a conventional plant.

- Land area required is minimal.

Disadvantages

- The filters must be monitored constantly and be properly maintained.

- The filters should be cured for approximately 1 hour after each backwash cycle.

- Imported chemicals are essential to proper operation.

- Expensive polymers may be required to optimize plant operation.

- Imported parts are required to maintain the system.

3.2 ALTERNATIVES FOR IMPROVING THE EXISTING WATER DISTRIBUTION SYSTEM

* Leak Detection and Line Repair

The draft Master Plan estimated that approximately 23% of the water leaving the treatment plant is unaccounted for. However, this estimate is based upon extremely limited data; it is suspected that the actual leakage may be considerably higher. If leakage could be substantially reduced, the need for expanded treatment facilities would be reduced and operation costs would be lowered.

A useful rule-of-thumb is that 20% of the leaks in a distribution network account for 80% of the water loss. For the most cost-effective solution, it is recommended that efforts be concentrated on the major leaks.

125

New, sophisticated equipment permits accurate and quick leak detection. Unfortunately, this equipment is expensive and requires considerable skill in its proper use. Normally, it is desirable to contract with a firm specializing in this field to conduct the leak detection program. The line repair work can be performed by city personnel or a local contractor.

Often leaks can be repaired quickly with a simple repair clamp. Where leaks are the result of deteriorating lines, whole sections of pipe may have to be replaced.

Advantages

- Low cost of leak detection program.

- Potential for substantially reducing investment in new capital structures.

- Potential for substantially reducing operation costs associated with treatment and pumping of wasted water.

- Offers relatively quick results.

Disadvantages

- Leak detection equipment is expensive and sophisticated. Skilled personnel are needed for the leak detection program.

- Results are uncertain.

- Impossible to accurately estimate the costs for the repair work in advance of the leak detection survey.

* Line Cleaning Program

Line sediment and deposits which coat pipe walls can substantially reduce the carrying capacities of lines. This reduced carrying capacity can result in increased pumping costs and can create pressure problems.

The magnitude of the problems created by deposits and sediment is extremely difficult to guage.

New, hydraulically driven pipe "pigs" are relatively expensive, and are easy to use. However, access points (launchers) are required for the introduction and removal of the pigs. These launchers may be somewhat expensive to install.

126

If the pigs cannot clear the system, it is necessary to use more expensive mechanical scraping equipment.

Once the investment has been made in the purchase of pigs, pumps, and launchers, a routine line cleaning program can be economically established. Blow-off assemblies and fire hydrants could be installed at strategic locations to facilitate the line cleaning program. This program can be conducted by city personnel.

Advantages

- Low cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing pumping costs.

- Potential for improving water pressure in many areas.

- Program can be performed quickly.

Disadvantages

- Results are unpredictable.

- Installation of launchers for the pipe pigs can be expensive, particularly in high density areas.

- If sediment and/or deposits are extremely heavy, the pipe pigs may not be able to clean the lines.

* Reinforcement of Distribution System

A computer analysis of the pipe network can be conducted to determine where deficiencies occur. These deficiencies can then be alleviated by strategically locating new mains, paralleling existing transmission mains, or in an extreme case, replacement of existing mains with larger sized pipe.

Dead-end lines can be extended and connected to nearby mains and lines crossing at road intersections can be interconnected to improve the hydraulics of the network.

Advantages

- Computer analyses can be performed at low cost.

- Benefits of network reinforcement can be clearly demonstrated once the computer analysis is performed.

- Line reinforcement can alleviate pressure problems and reduce pumping costs.

Disadvantages

- If major reinforcement of the network is needed, the capital cost can be high.

* Additional Elevated Storage

Additional elevated storage facilities could substantially improve the delivery of water to the consumer. The logical location for additional tanks would be in those areas furthest from the water treatment plant; however, the exact locations should be determined as part of a hydraulic analysis of the water transmission system.

Elevated storage tanks are expensive to construct, but are fairly economical to maintain. Generally, the use of elevated tanks is preferable to the use of ground reservoirs in combination with booster stations.

Reinforced concrete tanks are usually used in Egypt; however, steel tanks offer an attractive alternative. Maintenance costs for steel and concrete tanks are roughly equivalent. Steel tanks can be erected somewhat quicker and at a slightly lower cost. The concrete tanks could be constructed by local contractors, but steel tanks would be erected by one of several American firms.

Advantages

- Potential for improving water pressure in many areas.

- Low operation and maintenance cost.

- Ease of operation.

Disadvantages

- Long construction time required to erect tanks.

- High capital cost.

* Flow Limiting Devices

The installation of flow restrictors at all public fountains and at residential connections could significantly reduce water consumption. Such limiting devices would make it difficult for the consumer to use excessive quantities of water. This can be a very important consideration in a society where the minimum needs of the public are

guaranteed. Restriction of water usage would permit a more equitable distribution of available treated water.

Potential benefits would be the reduced size of treatment facilities required, and reduced operation costs.

The material cost of the static restrictors is very low and the installation cost is not excessive.

Advantages

- Low cost of installation and maintenance.

- Potential to reach more consumers.

- Potential for reducing investment in new capital structures needed for excessive water demands.

- Potential for reducing operation costs associated with treatment and pumping of excessive amounts of water.

- Work could be performed by city personnel.

Disadvantages

- Public resistance to limited availability of water.

- Difficulties associated with those connections serving multiple users.

- Water conservation may hinder good hygiene practices.

* Improved Drainage at Public Fountains

Generally, the public fountains in Fayoum are not well maintained. Ponded water around each of the fountains is typical. Organic matter from the cleaning of pots and pans is in evidence. It would be desirable to separate the water distribution function and the washing/cleaning function at each fountain. Fountains should only be located where adequate drainage to either a public sewer or an open drain can be provided. Fountains should be mounted on a solid base at an elevation well above ground level.

The public fountains serve a substantial portion of the population. Sanitary conditions should be maintained at the fountains. Landscaping and regular maintenance should be performed in order to create an atmosphere more conducive to cleanliness.

Advantages

- A large segment of the population would receive improved service at an extremely low cost.

- Public health should improve.

- The community would be more attractive.

Disadvantages

- Difficult to maintain sanitary conditions at the public fountain sites. Present users habits are ingrained.

3.3 ALTERNATIVES FOR THE EXTENSION OF THE WATER DISTRIBUTION SYSTEM

* Water Demand Criteria

A major consideration in the extension of the system is the water demand criteria which will be used to size lines and other facilities. Decisions must be made as to whether or not unlimited demands will be met or whether use will be restricted. Considering the difficulty in satisfying current demands and the high cost of new facilities, it may be advisable to severely limit water usage in order to guarantee equitable water distribution. In addition to the basic user demands upon the system, consideration must be given to water losses within the system. In the case of Fayoum, current losses may be approximately equal to the user demand.

The consultant has estimated that the year 1983 per capita water demand was about 151 litres per day (lpd); the year 2000 per capita demand is projected to be 200 lpd. This is an aggregate per capita demand which includes an allowance for governmental, industrial, and commercial consumption in addition to domestic consumption. Unaccounted-for water has been estimated at 23% of the water leaving the treatment plant, but will be reduced to 10% by the year 2000. The consultant has arrived at a year 2000 average daily summer demand (1.25 times average daily demand) of 960 litres per second (lps). This figure assumes elimination of public fountains within Fayoum.

Due to the limited availability of funds, it is extremely doubtful that the city will be able to provide central service to all areas within the current city limits. By restricted expansion of central service within the city, limiting water consumption, and reducing system losses, it would be possible to significantly reduce the proposed design capacity of the system.

Infinite variations in the demand are possible. One example would be to reduce water losses to 10%, to restrict domestic water consumption to 130 lpd per capita, and to limit central service to about 60% of the population. The resulting projected year 2000 water demand would then be calculated as follows:

1. Year 2000 Fayoum population -- 331,746

2. Percent Year 2000 population served by central system -- 60%

3. Percent Year 2000 population served by public fountains -- 40%

4. Year 2000 per capita demands -- 130 lpcd for central system
   30 lpcd for public fountains
   10 lpcd for government, industry, & commercial uses

5. Water losses -- 10% of base demand

6. Summer demand factor -- 1.25 times average daily demand

7. Calculations:

331,746 x 0.6 x 130	=	25,876,188
331,746 x 0.4 x 30	=	3,980,952
331,746 x 10	=	3,317,460
		33,174,600 lpd
33,174,600 / 24 /60 / 60	=	384 lps
384 x 1.1	=	422 lps average daily
422 x 1.25	=	528 lps average daily summer

Thus, an average daily summer demand of 528 lps for the year 2000 is one of numerous alternatives.

* Materials of Construction for Pipelines

Highly corrosive soils in Fayoum are believed to be the cause of rapid deterioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are of poor quality and not generally available with mechanical joints. The Jabault couplings used with locally produced asbestos-cement pipe offers only limited deflection at the pipe joints. The local asbestos-cement pipe is generally of good quality; however, the short sections used result in an excessive number of joints in the pipeline, and thus increase the

131

potential for leakage. Polyvinyl chloride (PVC) pipe has recently been introduced in Egypt; however, its availability and quality have not yet been adequately established. The PVC pipe is available with bell and spigot, gasketed joints and is produced in longer sections than the asbestos-cement pipe. Glass reinforced plastic (GRP) pipe is also available locally. Both PVC pipe and GRP pipe are relatively easy to install. Prestressed concrete cylinder pipe is commonly used for larger diameter lines; however, it is rather difficult to work with.

* Water Meters

Water meters offer the City the opportunity to conserve water usage. However, such conservation can only be achieved if the installation of meters is coupled with a rate schedule which assesses rates which are sufficiently high to discourage waste. Water meters require periodic calibration and overhaul. In addition, personnel are required for the meter readings. Records of the readings must be maintained and incorporated into the billing system.

Installation of water meters at connections for major users and the use of a flat rate for residential users and small businesses is a compromise which can often be more cost-effective than metering all users. However, here again a realistic rate schedule is required if the meters are to be effective.

3.4 ALTERNATIVES FOR THE REHABILITATION OF THE WASTEWATER COLLECTION SYSTEM

* Infiltration Study and Line Repair

The draft Master Plan for Fayoum has concluded that surcharging in the collection system has precluded any infiltration. However, it is suspected that as much as one-third of the influent to the wastewater plant is the result of infiltration. If infiltration could be substantially reduced, the need for expanded treatment facilities would be reduced and operation and maintenance costs would be lowered.

A simple infiltration study could be conducted to localize the areas of greatest concern. Efforts would be concentrated on the major problem areas in order to maximize the effectiveness of the line repair program. A goal of reducing infiltration to approximately 20% of the flow into the treatment plant could be realistically established.

132

The installation of liners in problem areas would be a relatively simple task. Due to the fact that house connections in Fayoum are only made at manholes, it would not be necessary to excavate each service connection and cut an opening in the liner for the connection.

A specialized firm would be required to install the liners.

Advantages

- Low cost of infiltration study.

- Potential for substantially reducing investment in new capital structures.

- Potential for substantially reducing operation costs associated with treatment and pumping of infiltration.

Disadvantages

- Specialized equipment is required for the installation of the pipe liners. Skilled personnel are needed to install the liners properly.

- Potential effectiveness of program cannot be gauged until after the infiltration study is completed.

- Impossible to accurately estimate costs for the repair work in advance of the infiltration study.

* Sewer Cleaning Program

Deposits, grease accumulations, and debris can substantially reduce the carrying capacities of sewers. This reduced line capacity can result in frequent backups of sewage and even flooding.

Sewer cleaning equipment has been purchased by Fayoum as part of a sub-project. An ongoing cleaning program could easily be established by the City.

Advantages

- Moderate cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing sewage backups and flooding incidents.

- Ongoing program can be established.

Disadvantages

- Success of completed project may be difficult to gauge.

- To be truly effective, project should be conducted in conjunction with other programs such as improved sewer construction techniques, improved pump station operating techniques, etc.

* Pump Station Improvements

The surcharging of sewers which results from the improper operation of pump stations can contribute significantly to problems with grease, sediment, and debris accumulating in the sewers. The pump stations could be operated in accordance with generally accepted practices if adequately sized wetwells, properly sized pumps, and reliable control systems were provided.

Upgrading of stations to meet existing and projected demands would improve the reliability of the service. Further improvements in reliability could be provided with the addition of standby pumps, bypass piping with valves, pressure gauges and wetwell level indicators, standby power generators, alarm systems, an inventory of spare parts, and O&M manuals.

The cost of a major rehabilitation program would be fairly high; however, the station structures appear to be fairly sound, and rehabilitation should therefore be somewhat cheaper than new construction.

Advantages

- Improved service reliability.

- Improved hydraulics in gravity sewer system. This would reduce problems with solids accumulations in the sewers.

Disadvantages

- High cost of major rehabilitation program.

- Length of time required to perform rehabilitation work.

* Force Main Improvements

Properly sized force mains can reduce friction losses and thus in turn reduce power consumption at the pump stations. A hydraulic analysis of the force main system would permit the economical sizing of force mains and permit a determination of optimum head conditions for each pump station.

134

Air release valves and blow-off assemblies could improve operating conditions and facilitated maintenance of force mains.

The hydraulic analysis of the system could be performed inexpensively and quickly. Replacement and/or paralleling of existing force mains could be expensive. The addition of air release valves and blow-off assemblies at critical locations could be done for a relatively low cost.

Advantages

- Reduced pumping costs.

- Elimination of potential problems due to air lock and solids accumulation.

- Low cost hydraulic analysis would permit the City to evaluate potential power savings prior to proceeding with expensive line replacements and/or paralleling.

Disadvantages

- High cost of major improvements.

- Difficulty in estimating improvements attributable to new air release valves and blow-off assemblies.

* Replacement of Undersized Collectors

Replacement of undersized gravity collectors in major problem areas would reduce sewage backups and flooding incidents.

A high initial cost is associated with the replacement of undersized sewers; however, properly sized and sloped sewers provide cost-effective, reliable service.

Advantages

- Reduced maintenance costs.

- Improved service. Reduced incidents of flooding and sewage backups.

Disadvantages

- High construction cost.

135

3.5 ALTERNATIVES FOR THE EXTENSION OF THE WASTEWATER COLLECTION SYSTEM

* Modification of Design Criteria

A major consideration in the extension of the collection system is the design criteria to be used for manhole spacing, service connections, and pump station sizing. Extremely conservative criteria can result in excessive, and unnecessary, construction costs and thus reduce the capability of the City to extend service. On the other hand, inadequate standards can result in poor service and high operation and maintenance costs.

Existing criteria used in Fayoum for spacing of manholes calls for 30 metres of separation for line diameters of 180 mm to 225 mm. Manhole spacing of between 91 metres and 122 metres has been successfully employed in other countries for 200 mm diameter sewers.

Currently, all service connections must be made at a manhole. Main line connections are typically used in other countries.

The use of improved materials of construction and the availability of modern sewer cleaning equipment would make it feasible for Fayoum to relax existing standards regarding manhole spacing and service connections. If existing construction practices are continued, it would probably be best to maintain existing standards.

If pump stations could be properly operated and maintained, it would be possible to build stations to less restrictive standards. Currently, NOPWASD encourages considerable duplication in pumping capacity; the rated capacity of a station may often be only one-half of the in-place capacity. Existing standards result in substantial additional costs for each pump station constructed.

Advantages

- Substantial reductions in capital cost.

Disadvantages

- If relaxation of standards is not coupled with improved materials of construction and improved pump station maintenance, system performance may be substantially affected.

* Materials of Construction for Sewers

Existing sewers in Fayoum are constructed of vitrified clay (VC) pipe. Due to the non-availability of gasketed joints for locally manufactured VC pipe, cement mortar is used to seal the joints. In order to protect the rigid joint which is created by the cement

136

mortar, it is necessary to protect the entire pipeline with a concrete bedding. The numerous joints associated with the short pipe sections and the method of pipe jointing can contribute to substantial leakage problems.

Polyvinyl chloride (PVC) pipe is relatively new to the Egyptian market, and has not yet been used extensively. However, PVC pipe appears to be readily available and of reasonable quality. The PVC pipe is available with gasketed, bell and spigot joints. Advantages of the PVC pipe are ease of installation, tightness of joints, longer pipe sections result in fewer joints, and lower in-place cost. A disadvantage is the limited range of pipe diameters available.

Reinforced concrete pipe and prestressed concrete cylinder pipe are often used for large diameter sewers. These alternatives are economical; however, the inner surface of the pipe is subject to degradation by hydrogen sulfide unless a protective liner or coating is provided. Due to the weight of a section of concrete pipe, it is rather difficult to install.

* Materials of Construction for Force Mains

Highly corrosive soils in Fayoum are believed to be the cause of rapid deterioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are generally of poor quality and not available with mechanical joints.

Polyvinyl chloride (PVC) pipe is now being manufactured in Egypt. PVC pipe is easy to work with and relatively inexpensive to install.

Asbestos-cement (AC) pipe is available locally and is of good quality. The Jabault couplings used in Egypt offer limited joint deflection and are subject to displacement in poor soil conditions. The inner walls of the pipe are subject to attack by hydrogen sulfide.

Glass reinforced plastic (GRP) pipe is also used in Egypt. It is easy to install, but has a relatively expensive material cost.

3.6 WASTEWATER TREATMENT ALTERNATIVES

* Primary Treatment

The major advantages of a primary treatment facility in Fayoum would be the low cost and the ease of operation and maintenance. The existing staff could realistically achieve in short time frame the necessary level of skills required for the proper operation and maintenance of such a facility.

137

The major disadvantage of this alternative is the minimal levels of treatment provided. If the existing discharge to El Bats Drain is continued, further deterioration of the drain can be expected.

Primary facilities have the capability of removing most of the grit and floating solids from the wastewater. A substantial portion of the suspended matter can be removed and the bio-chemical oxygen demand (BOD) can be reduced.

Primary clarifiers are the major initial element of many secondary treatment processes, thus they can form the first stage of a staged construction program for secondary treatment.

Adequate sludge handling facilities are required if the clarifiers are to be properly maintained. Initially, the raw sludge could be pumped from the clarifiers to drying beds; later anaerobic digestors could be added if appropriate.

Advantages

- Ease of operation and maintenance. Good degree of reliability.

- Low construction cost and low operation and maintenance costs.

- Can be incorporated into future, secondary treatment facilities.

Disadvantages

- Limited level of treatment provided. Cannot meet existing water quality standards for discharge to surface water bodies.

* Trickling Filters

A trickling filter process would involve the addition of trickling filter units and secondary clarifiers to the previously described primary treatment process. Trickling filters have the capability of substantially improving the degree of treatment.

The exact degree of removal obtainable by this process is dependent upon numerous factors such as filter area and depth, number of stages, media type, and recirculation rates. Trickling filter plants are typically designed to provide BOD removals of anywhere from 65% to 85%.

This alternative requires skilled operators. The existing trickling filter facility in Fayoum is not operated to its capability. Considerable training would be required to upgrade the skills of the existing staff.

Though this process is capable of providing a relatively high level of treatment, it would not be able to meet water quality standards if discharge continues to El Bats Drain.

Advantages

- Easier to operate and maintain than many secondary processes.

- Lower operating cost than many secondary processes.

- Relatively high levels of treatment are obtainable on a consistent basis if properly operated.

- Can meet the existing water quality standards for El Bats Drain.

Disadvantages

- Skilled operators are required. Improper operation can drastically reduce effectiveness.

* Stabilization Ponds

Stabilization ponds would represent an excellent application of appropriate technology in Fayoum. The operation and maintenance of stabilization ponds is extremely simple. The climate in Egypt is well suited to this type of treatment process. There is virtually no mechanical equipment required. Power consumption is virtually nil.

The degree of removal obtainable is dependent primarily upon detention time. Operation in series and the use of anaerobic lagoons and maturation ponds in conjunction with the stabilization ponds can further improve the treatment capability of the system.

The primary disadvantage associated with the use of stabilization ponds is the extremely large land area required, particularly for high levels of treatment.

Construction can easily be staged to provide progressively higher levels of treatment as flow to the plant increases.

Advantages

- Extremely easy to operate and maintain.

- Simple to construct. Locally available materials and techniques are applicable.

- Very low operation and maintenance cost. Power consumption is virtually nil.

- Relatively stable biological process.

- Construction can be easily staged.

- Sludge disposal problems are greatly reduced.

Disadvantages

- Extremely large land area required.

- Susceptible to weed and odor problems.

* Aquaculture Ponds

An aquaculture process would involve the addition of water hyacinth ponds after either the previously described trickling filter process or stabilization pond process. The artificial wetlands that would be created would have the capability of providing an extremely high quality of effluent.

The use of shallow (0.5 metre depth) water hyacinth ponds with a total detention time of 3 days could reduce BOD another 70% and SS another 55% beyond the secondary level. Unmanaged ponds with no supplemental aeration would be extremely cost-effective in Egypt.

This process would have the capability of producing a high quality effluent.

As this is essentially proposed as an effluent polishing process, it would be subject to the advantages and disadvantages associated with the particular secondary treatment process chosen to precede the hyacinth ponds.

Advantages

- High level of treatment provided.

- Upgrades secondary facilities at a very low cost.

- Operation and maintenance costs associated with the ponds are minimal.

Disadvantages

- Should be proceeded by an initial treatment process.

- Large area of land required.

- Potential odor and mosquito problems.

3.7 WASTEWATER DISPOSAL ALTERNATIVES

* El Bats Drain

El Bats Drain has a high velocity, and the upstream flow provides substantial dilution of the existing wastewater discharge. This drain is the existing discharge point for treated wastewater from Fayoum. The wastewater leaves the plant via a paved channel and then enters the drain. El Bats Drain runs for a distance of about 50 kilometers and then empties into Lake Qarun.

The Ministry of Irrigation intends to eventually divert a substantial portion of the flow away from El Bats Drain in order to blend the water from the drain with canal water and use it in the irrigation of reclaimed agricultural lands.

The drain does not directly impact any villages along its run. A field survey indicates that dissolved solids (DS), chemical oxygen demand (COD), and phosphate levels all exceed the limitations established in Law 48/1982 for drains which are to be used for irrigation.

At the time of the field survey, the dilution ratio of the upstream drain flow to the wastewater discharge was approximately 4:1.

Advantages

- Precedent has been established for discharge to this drain.

- The existing wastewater discharge does not directly impact any towns or villages.

Disadvantages

- The existing discharge has a measurable effect upon El Bats Drain.

* Irrigation of Reclaimed Land

The agricultural land between the existing treatment plant site and El Bats Drain does not have access to canal water. In the past, effluent from the treatment plant has been diverted to irrigate this land. The only other source of irrigation water is the drain which passes by this land. Unfortunately, this drain is somewhat saline.

Land application systems have the capability of treating wastewater to extremely high levels. The degree of pretreatment required would be dependent primarily upon the type of crops to be grown.

141

Advantages

- No discharge to a surface water body, thus health risks to the general public are greatly reduced.

- Nutrient application to agricultural lands.

- Minimal treatment required for restricted crop irrigation.

Disadvantages

- Health risk to agricultural workers.

142

FAYOUM

Section 4

Needs and Proposed Actions

Though there are apparently well-qualified personnel associated with the City of Fayoum, it is apparent that due to either social or cultural reasons their involvement with direct day-to-day operations in the field is extremely limited. Field personnel typically lack sufficient training and skills to operate and maintain those facilities for which they are responsible. The duties of individuals generally are extremely limited in scope. The chain of command is often hazy, particularly in regard to responsibilities. There is a tendency by the individual not to concern himself with those problems which may arise unless these problems are clearly within his area of responsibility. Accordingly, he is either unconcerned or he assumes that someone else will take care of such problems. This lack of initiative appears to be rooted in the system. It is an unrealistic expectation to believe that the provision of training alone will eliminate a problem which is essentially a problem of attitude.

There is a strong need to develop a sense of pride in each employee. The use of team concepts might help to achieve such a goal. The employee should realize not only financial reward for his achievements, but also acknowledgment from his superiors.

It is recommended that serious consideration be given to the establishment of an independent organization for the operation and maintenance of the water and wastewater facilities. This organization should have the freedom to hire and fire.

There is a need at the present time to supply each employee with a clean, attractive work environment. At the treatment facilities and pump stations, this means that it is important to clean up inside and outside the buildings. Interior components should be painted with bright, cheerful colors. Non-functional equipment should be disposed of. Stored materials should be neatly stacked. The importance of landscaping should not be underestimated. Housekeeping practices should be applied to vehicles and field equipment also. Vehicles should be washed daily; field equipment should be cleaned after each use. All equipment should be regularly painted and rehabilitated.

A central shop is being established as a sub-project. A preventative maintenance program should be established in conjunction with the onstruction of this shop. This program should then be expanded to incorporate the water and wastewater facilities. At the current time, preventative maintenance is not practiced in Fayoum.

Another extremely important need is a safety program. Current safety practices in Fayoum are horrifying by American standards. The total lack of appropriate equipment and procedures for handling chlorine equipment highlights this concern. Each employee should receive instructions which will make him cognizant of the hazards involved with sewer gases, chemical handling, electrical systems, and mechanical equipment.

There are no operation and maintenance manuals that an interested employee can refer to in order to gain an understanding of basic procedures or for troubleshooting. Arabic language manuals should be developed for all new facilities and for the existing facilities.

A laboratory is needed not only for monitoring overall plant performance, but also for evaluating the effectiveness of each component within the process. This is necessary if the operator is to optimize efficiency at each plant. Laboratory facilities are important to ensure proper chemical feed rates. The laboratory tests which are performed on a daily basis should be those tests which are absolutely essential to the proper operation of the plant. Additional "icing on the cake" type tests should be avoided as they tend to diminish the overall importance of the laboratory program to the operator. Forms should be developed which will ensure proper recordkeeping and which will provide useful information to the system operator. Laboratory and plant personnel must understand the significance of each test and how it relates to their specific duties and responsibilities.

There is a need in Fayoum for trained inspectors for civil works. A very basic inspection and testing program should be established for the following:

1. Soil compaction,
2. Concrete quality,
3. Pipeline tightness.

Basic equipment should be provided and forms developed which will ensure that the essential elements of civil works are relatively sound. More sophisticated inspection and testing requirements associated with electrical systems, mechanical equipment, and the like would be contracted out to others.

It is almost imperative that a sewer inspection and rehabilitation program be established immediately in order to reduce what is suspected to be a substantial amount of infiltration. Initially, the main lines would be inspected and rehabilitated. If the cost-effectiveness of such a program justifies itself, it would then be appropriate to extend the program to the minor lines. Though it would be practical to completely eliminate infiltration, it should be possible to recover needed capacity in many of the pump stations and the treatment plant.

144

A leak detection survey is also needed for the water distribution system. Major leaks should be repaired as discovered. It is suspected that due to the nature of construction of the water lines that there are numerous small leaks rather than a few large leaks. It is therefore questionable whether or not it will be practical to correct more than a handful of such leaks. Therefore, only limited success is projected for this program.

None of the treatment facilities visited are operated properly. Available personnel are years away from being able to develop the necessary skills to properly operate and maintain such facilities. Therefore, it is extremely important that to the extent possible "appropriate technology" be used for all new facilities. Sophisticated equipment such as motorized valves and computer-operated control centers should be avoided. Complex processes such as activated sludge processes in wastewater treatment plants should not be used. Systems should be simple, durable, and reliable. Emphasis should be placed upon a realistically consistent realiability rather than a theoretical capability. For example, it would be better to have a water treatment plant which provides moderate quality drinking water 95% of the time rather than one that has the capability of providing excellent water but will not realistically function in the current environment. It should also be recognized that funding limitations can often place a severe constraint on annual budgets. Therefore, facilities that require large inputs of power or chemicals should be avoided to the extent possible. Similarly, facilities with high maintenance requirements (non-labor) should be avoided.

In regard to the water treatment plant, it is suggested that a slow sand filtration process would be most appropriate to the level of skills projected to be obtainable in the near future. Of course, such a process requires a large area of land. For this reason, it may be necessary to build at more than one site or to use a more sophisticated process such as direct filtration. The use of direct filtration or any other sophisticated process would require the use of skilled ex-patriate labor if proper operation is to be ensured. The existing water treatment facilities in Fayoum should be dismantled; it is in such a state of disrepair that rehabilitation and upgrading would not be cost-effective.

In regard to the wastewater treatment plant, it is suggested that screening facilities, primary settling units, and chlorination facilities would provide an appropriate level of treatment considering the current discharge point and the level of skills realistically obtainable in the near future. Of course, it must be recognized that primary treatment will not meet the requirements of Law 48. The provision of sludge digestion and adequate drying beds are necessary to ensure that sludge is frequently removed from the settling tanks. Irrigation of non-edible crops using a portion of the plant effluent

145

should be considered for that land immediately downhill of the plant and without access to canal water. The existing primary settling units appear to be salvageable. It is recommended that funds not be spent to rehabilitate the secondary units at this time.

Additional elevated storage facilities should be strategically located throughout the water distribution system. Several smaller tanks would provide better service than one large tank.

Additional wet well volume should be provided at the wastewater pumping stations. The practice of permitting the gravity sewers to operate under surcharged conditions should be stopped immediately. Rehabilitation of existing pumping stations is recommended.

Existing practices regarding the construction of water distribution systems and wastewater collection systems should be reviewed. It is suggested that the use of PVC pipe and other modern materials of construction would be more cost-effective than materials currently in use. Design standards appear to be unduly restrictive with little or no improvement in system reliability; it is recommended that only reasonable standards be funded as part of this project.

It is imperative that a program of construction inspection and materials testing be established for the major capital works. This program should be part of a construction management contract for the construction of the water treatment facilities and rehabilitation of the wastewater pumping stations to be performed under the Provincial Cities Development Project.

146

Section 5

Recommended Implementation Plan

5.1 GENERAL

This section contains a recommended implementation plan which will benefit the greatest number of people at the least cost. The majority of the proposed actions do not involve major new structures, but rather maximize the effectiveness of existing facilities.

5.2 WATER

Emphasis should be placed on investments, including new facilities and rehabilitation of existing facilities, which will improve the quantity and quality of water provided to the served population.

1. Priority should be given to extension of water service concurrently with the extension of wastewater collection into areas which can be most cost-effectively served. A lower priority should be given to fringe areas. It is suggested that a goal of providing central service to about 60% of the year 2000 population be established initially (approximately 59% of the current population is now served).

2. A leak detection survey of main lines in the existing system should be conducted. Major leaks should be repaired; severely deteriorated lines should be replaced.

3. A line cleaning program should be established. Access points for cleaning equipment should be provided. Blow-off assemblies and hydrants should be installed at critical locations.

4. A computer analysis of the pipe network should be performed. Those deficiencies which are identified by the analysis should be alleviated by strategically locating new mains and paralleling existing transmission lines to reinforce the system. Dead-end lines should be extended and looped into the distribution system.

5. Flow limiting devices should be installed at all public fountains and residential connections. Domestic water consumption should be limited to 130 lpcd.

6. The existing public fountains should be upgraded to include proper structures and drainage to reduce the ponding of water at the fountain sites. Where practical, the drain lines from the fountains should be connected to available sewers.

7. Build a new water treatment plant of 600 lps on land available at the site of the existing water treatment plant with appropriate technical features. The design should focus on simplicity of operation and ease of maintenance. The recommended facility is smaller than that which was proposed in the draft Master Plan; however, it should be designed to allow for plant expansion in the future. This facility would include a new raw water intake structure and ground storage reservoirs. It is suggested that a direct filtration process will be the most cost-effective treatment process for Fayoum.

8. After construction of the new treatment plant, decommission the existing water treatment plant.

9. Encourage the larger industries to use well water supplies to the maximum extent possible.

10. Additional elevated storage should be provided throughout the city. It is recommended that three 4,000-cubic metre tanks be erected. The exact location of the tank sites should be determined by the previously recommended computer analysis.

11. Install water meters only at service connections for major users. Use a flat rate system for residential users and small businesses.

5.3 WASTEWATER

Emphasis should be placed on investments to improve the existing collection system.

1. An infiltration study of the existing collection system should be conducted. Major leaks should be repaired by either line replacement and/or the use of liners.

2. A regular sewer cleaning program should be established.

3. A hydraulic analysis of the force main system should be performed. Force mains should be either repaired, replaced, or reinforced as appropriate. Blow-off assemblies, isolation valves, and air release valves should be installed at critical locations.

4. Under-sized collectors should be replaced.

5. Priority should be given to extension of wastewater service concurrently with the extension of water distribution into areas which can be most cost-effectively served. A lower priority will be given to fringe areas and to service in new drainage areas. It is suggested that a goal of providing central service to about 60% of the year 2000 population be set (approximately 38% of the current population is now served).

6. Where feasible, the wastewater collection system should be expanded to provide selected collectors in areas serviced by public fountains but not by sewers. This would allow for proper collection of wash water at the public fountain sites and provide discharge points for disposal of septage by haulers.

7. Vacuum trucks should be used to haul septage in unsewered areas. Provisions should be made to receive septage at the pump stations and at other convenient sites.

8. Consideration should be given to the use of construction materials which will reduce the potential for excessive infiltration in new sewers.

9. All of the existing pump stations should be rehabilitated. Simplicity and ease of operation and maintenance should be stressed in new designs. Design criteria for the sizing of pump stations should be modified in order to lower construction costs.

10. The existing primary clarifiers at the existing trickling filter plant should be rehabilitated to a design capacity of about 500 lps. Chlorination facilities and a cascade type aerator should be added to the existing facilities. Discharge of treated effluent should continue to El Bats Drain. The investment of scarce funds in the rehabilitation of or construction of new secondary facilities is not recommended as a cost-effective alternative.

11. Sludge thickeners should be added to the existing plant and the drying beds should be upgraded.

12. The existing trickling filters should be abandoned.

5.4 SUPPORT

Provision of extensive on-the-job training, establishment of a preventative maintenance program, development of adequate repair facilities, establishment of an inventory program, and the provision of operation and maintenance manuals are all seen as vital elements of this program.

5.5 PHASE I

Tables 2A and 2B are illustrative of a program which could be accomplished using existing funding levels for this project.

5.6 PHASE II

Tables 3A and 3B illustrate a program which would permit Fayoum to meet its most basic service needs coupled with a modest extension of service. Proper management of the proposed facilities is absolutely essential if minimal levels of service are to be adequately maintained within the service area until the year 2000. The additional facilities proposed in this program would be contingent upon the availability of approximately $50,000,000 and LE 15,000,000 (all three cities) for a follow-on program to Phase I.

ID#0023D

150

TABLE 2A 29-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

FAYOUM WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1997 $)
1	Leak Detection Survey		26,000	45,000	102,000
2	Leak Repair	185,000			315,000
3	Line Cleaning Program		108,000	69,000	272,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	15,000			26,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Intake & Pumping (300 lps)		191,000	357,000	783,000
9	Ground Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	Two Elevated Tanks (4,000 cu meters ea)		1,100,000	92,000	1,991,000
11	Minimal Work on Transmission System	500,000			851,000
12	Rehabilitation of Existing Water Plant	250,000			426,000
13	Kemen Faras Distribution System	1,500,000			2,554,000
14	Altitude Valve at Existing Elevated Tank	15,000			26,000
15					0
16					0
17					0
SUB-TOTAL		2,490,000	2,920,000	2,828,000	12,841,000
18	Contingencies @ 15%	374,000	438,000	424,000	1,927,000
19	Design & Supervision @ 15%	374,000	124,000	813,000	1,891,000
20	Major Project Construction Management @ 3%	75,000	25,000	159,000	374,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		3,313,000	3,612,000	4,784,000	17,930,000

ID#GF11

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	25,000 sq meters
Ground Reservoir - 500 sq meters	included in above
Elevated Tanks - 4,600 sq meters	2,300 sq meters

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

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151

TABLE 2B 30-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

FAYOUM WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		60,000	320,000	513,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	100,000			170,000
5	Vacuum Truck			60,000	77,000
6	Minimal Pump Station Rehabilitation		113,000	150,000	365,000
7	Upgrade Existing Treatment Plant (500 lps)	500,000			851,000
8	Kaman Faras Pump Station		613,000	685,000	1,923,000
9	Kaman Faras Force Main	1,825,000			3,107,000
10	New Collectors - Area No. 5	947,000			1,612,000
11	New Collectors - Area No. 2	243,000			414,000
12	New Collectors - Area No. 6 (partial)	190,000			323,000
13	New Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		3,812,000	801,000	1,295,000	9,515,000
18	Contingencies @ 15%	572,000	120,000	194,000	1,427,000
19	Design & Supervision @ 15%	572,000	112,000	290,000	1,537,000
20	Major Project Construction Management @ 3%	114,000	22,000	57,000	305,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24	Kaman Faras Site Investigation		15,000	80,000	128,000
25					0
26					0
27					0
28					0
TOTAL PROJECT		5,070,000	1,175,000	2,476,000	13,809,000

ID#QF21

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 2.7 million unallocated sub-project disbursement.

Area No. 6 requires a pump station and force main.

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132

TABLE 3A 29-Apr-85

BASIC SERVICE NEEDS

FAYOUM WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		26,000	45,000	102,000
2	Leak Repair	185,000			315,000
3	Line Cleaning Program		108,000	69,000	272,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	910,000			1,549,000
6	Improve Public Fountains	15,000			26,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Plant Expansion (300 lps)		1,320,000	2,245,000	5,128,000
9	Intake & Pumping (300 lps)		191,000	357,000	783,000
10	Expansion of Intake & Pumping (300 lps)		191,000	357,000	783,000
11	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
12	Ground Storage Reservoir (10,000 cu meters)		875,000	100,000	1,618,000
13	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
14	Reinforcement of Existing Transmission System	1,000,000			1,703,000
15	Rehabilitation of Existing Plant	250,000			426,000
16	Kaman Faras Distribution System	1,500,000			2,554,000
17	Altitude Valve at Existing Elevated Tank	15,000			26,000
SUB-TOTAL		3,890,000	5,856,000	5,576,000	23,749,000
18	Contingencies @ 15%	584,000	878,000	836,000	3,562,000
19	Design & Supervision @ 15%	584,000	220,000	1,619,000	3,446,000
20	Major Project Construction Management @ 3%	117,000	44,000	316,000	680,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		5,175,000	7,223,000	9,547,000	33,359,000

ID#F1BN

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 16,000 sq meters	25,000 sq meters
Ground Reservoir - 3,000 sq meters	included in above
Elevated Tanks - 6,900 sq meters	2,300 sq meters

NOTE: Includes LE 2.7 million uncommitted sub-project disbursement.

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153

TABLE 38 29-Apr-85

BASIC SERVICE NEEDS

FAYOUM WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Force Main Upgrading	250,000			426,000
5	Vacuum Trucks			180,000	231,000
6	Pump Station Rehabilitation		376,000	500,000	1,282,000
7	Upgrade Existing Treatment Plant (500 lps)	500,000			851,000
8	Kaman Faras Pump Station		613,000	685,000	1,923,000
9	Kaman Faras Force Main	1,825,000			3,107,000
10	New Collectors - Area No. 5	947,000			1,612,000
11	New Collectors - Area No. 2	243,000			414,000
12	New Collectors - Area No. 6 (partial)	190,000			323,000
13	New Wastewater Treatment Plant	BY NDPWASD	BY NDPWASD	BY NDPWASD	BY NDPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		3,962,000	1,079,000	1,845,000	10,950,000
18	Contingencies @ 15%	594,000	162,000	277,000	1,643,000
19	Design & Supervision @ 15%	594,000	122,000	404,000	1,737,000
20	Major Project Construction Management @ 3%	119,000	24,000	79,000	345,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		5,269,000	1,499,000	3,205,000	15,635,000

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TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

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TABLE 4

ANALYSIS OF WATER TREATMENT TECHNOLOGY ALTERNATIVES

FAYOUM WATER AND WASTEWATER MASTER PLAN

TECHNOLOGY	CAPITAL COST (1987 $)	ANNUAL OPERATION COST (1987 LE)	ANNUAL MAINTENANCE COST (1987 LE)	LAND REQUIRED (sq meters)	RELIABILITY
Conventional Dual Media, High Rate Filtration	7,436,000	309,000	34,000	11,000	Extremely high levels of skill are required. Proper chemical feed rates & flocculation are extremely important; filter operation is critical.
Dual Media, High Rate Direct Filtration	4,853,000	209,000	27,000	8,000	Very high levels of skill are required. Proper chemical feed rate is important; filter operation is extremely critical.
Slow Sand Filtration	6,353,000	187,000	46,000	18,000	Low levels of skill are required. Curing of filter is important.

NOTES: Based upon 300 lps treatment capacity.
These costs do not include design (15%), contingencies (15%), or construction management (3%).

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TECHNICAL ANNEX

BENI SUEF

INDEX

SECTION 1 - Current Status

1.1 WATER..... 1 - 3
1.2 WASTEWATER..... 3 - 5

SECTION 2 - Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION..... 6
2.2 WATER TREATMENT..... 6
2.3 WATER DISTRIBUTION..... 7
2.4 WASTEWATER COLLECTION..... 8
2.5 WASTEWATER TREATMENT..... 8 - 9
2.6 WASTEWATER DISPOSAL..... 9

SECTION 3 - Evaluation of Technical Alternatives

3.1 WATER TREATMENT..... 10 - 14
3.2 IMPROVING EXISTING WATER DISTRIBUTION SYSTEM..... 14 - 19
3.3 EXTENSION OF WATER DISTRIBUTION SYSTEM..... 19 - 21
3.4 REHABILITATION OF WASTEWATER COLLECTION SYSTEM..... 21 - 24
3.5 EXTENSION OF WASTEWATER COLLECTION SYSTEM..... 24 - 27
3.6 WASTEWATER TREATMENT..... 27 - 30
3.7 WASTEWATER DISPOSAL..... 30 - 32

SECTION 4 - Needs and Proposed Actions..... 33 - 36

SECTION 5 - Recommended Implementation Plan

5.1 GENERAL..... 37
5.2 WATER..... 37 - 38
5.3 WASTEWATER..... 38 - 39
5.4 SUPPORT..... 39
5.5 PHASE I..... 39
5.6 PHASE II..... 39

BENI SUEF

Section 1

Current Status

1.1 WATER

Distribution

The existing water distribution system consists of both cast iron pipe and asbestos-cement pipe. Pipe diameters range from 50 mm to 450 mm.

"Unaccounted-for-water" is estimated to be approximately one-half of that leaving the water treatment plant. It is suspected that leaking valves and pipe joints are a primary cause of this "unaccounted-for-water". Public fountains also contribute to wastage.

The system network is not very well looped and contains many dead-ends. This poor network contributes to pressure problems and problems with sediment accumulation in the lines. Many areas of the city suffer from extremely low pressure. Normally, the system operates at pressures ranging between 15 and 35 metres.

Transmission and Storage

Treated water from the two water treatment plants is stored in ground reservoirs prior to being pumped directly into the distribution system. The existing elevated storage tanks provide minimal capacity and are not currently in use.

Treatment

Beni Suef is served by two water treatment plants. The Old Water Treatment Plant has a design capacity of 210 litres per second and the New Water Treatment Plant (or the Czech Plant) has a design capacity of 200 litres per second.

The Old Water Treatment Plant contains three separate flow trains. The oldest train dates back to 1907. With the exception of the pumping units, the mechanical components of the plant are inoperative. Dilapidated facilities impede flocculation. Filter units are plagued with solids carry-over and inadequate backwashing. The problems with this plant are so numerous that rehabilitation is not a realistic alternative.

The New Water Treatment Plant (or the Czech Plant) was commissioned in 1982. This facility is a real heart-breaker. The instrumentation, rate-of-flow controllers, and plant controls are inoperative. The quality of the concrete work is so poor that the plant literally disintegrates before your very eyes. The condition of the plant is unfortunate because the basic design concept appears to be relatively well suited to the current level of operational skills available. Mechanical equipment has been kept to a minimum. Chemical mixing is by hydraulic turbulence. Hydraulics rather than mechanically operated paddles promote flocculation. No mechanical sludge collectors are used in the sedimentation basin. The mixing, flocculation, and settling processes appear to function extremely well. The filtration units have extreme problems that are probably due to the inoperative rate-of-flow controllers. There are other problems associated with the filters such as uneven flow distribution across the influent troughs and a suspected major problem with the underdrain system.

A laboratory has been established at the Czech Plant as part of a sub-project. Unfortunately, the laboratory does not yet have sufficient equipment to perform jar tests or to analyze turbidity or coliform.

The existing level of operation and maintenance at both plants is insufficient to ensure that the public will have access to a consistently reliable source of potable water. Neither plant approaches operation at an adequate level let alone optimum efficiency.

Supply

The source of supply for each of the water treatment plants is the Nile River. Each plant has a separate raw water intake structure/pumping station.

Though the intake structure/pumping station for the Old Water Treatment Plant is extremely old, it appears to be functioning satisfactorily. The raw water pumping station needs some rehabilitation; particularly, in regard to the electrical system and controls.

There is currently a problem with silting at the raw water intake for the Czech Plant. This silting problem has been attributed to the construction of a new bridge immediately upstream of the intake. It is believed that the silting problem is due to the construction operations rather than the effect of bridge structure itself.

158

A sub-project is being considered which would interconnect the two raw water intake structures/pumping stations in order to improve system reliability.

1.2 WASTEWATER

Collection

The existing collection system consists primarily of vitrified clay pipe with cement mortar joints. Manholes are constructed of cast-in-place concrete. Sewer connections are always made at a manhole and never directly to the sewer main.

Infiltration appears to be a substantial problem. Infiltration accounts for approximately one-half of the flow entering the wastewater treatment plant. The infiltration can be attributed primarily to the poor quality of pipe joints, the excessive number of joints associated with the use of short sections of vitrified clay pipe, and the high groundwater table (it is estimated that approximately 90% of the sewers in Beni Suef are below the groundwater table).

The city has vacuum trucks and sewer cleaning equipment which were provided as part of a sub-project. Blockages and overflows do not appear to be a major problem within the existing service area.

Transmission

Four main pumping stations discharge wastewater directly to the treatment plant. In addition, there is one sub-station which transmits flow to a main station. Standby power generators are being provided as part of a sub-project. The pumping stations and associated force mains are adequate to serve the present needs of Beni Suef; however, the stations are in need of general rehabilitation.

All of the stations visited appeared to be reasonably well maintained.

Treatment

The existing wastewater treatment facility uses trickling filters to provide secondary treatment. The existing facility has a design capacity of approximately 300 litres per second; the current flow into the plant is about one-half of the design capacity.

The existing facility in Beni Suef is one of the better operated and maintained facilities in Egypt. Unfortunately, the plant operation and maintenance is still inadequate by any standard.

Limited wastewater analyses are available. The available data suggests that the influent is substantially diluted by infiltration. The data also indicates that this facility provides minimal treatment.

The staff at this facility appears to be concientious, but lacking the fundamental skills and basic knowledge to properly operate a wastewater treatment facility. Major operational deficiencies include, but are not limited to, the following:

1. The sludge collector/surface skimmer mechanisms in the primary clarifiers appear to have been inoperative for a substantial period of time. Apparently, sludge removal from the clarifiers is severely hampered. The primary clarifiers are providing virtually no treatment. This lack of initial settling is adversely affecting the downstream treatment units.
2. The trickling filter media appears to have become clogged with inorganic materials as well as with organic materials.
3. The sludge collector mechanisms in the secondary clarifiers are operated intermittently rather than continuously.
4. The final clarifiers are overloaded due to the operational problems with the upstream units. It appears that the frequency of sludge removal from these clarifiers is insufficient.
5. The plant staff apparently does not use laboratory analyses to control chlorine feed rates or to diagnose problems with the various treatment units.
6. Though the pumps and interior facilities are relatively well maintained, there is a lack of housekeeping within the exterior treatment units. Grit, scum, and debris are allowed to accumulate in the troughs, in the channels, on the weirs, on the walls, and on the various components.

Certain design deficiencies contribute to the operational problems:

1. The influent flow spills over the inlet structure and onto the ground.
2. Flow measurement is hindered by a lack of a flow meter for the Parshall flume.
3. The trickling filters cannot be temporarily flooded in order to permit chlorination in an attempt to reduce ponding.
4. The media in the trickling filters is not of uniform size and thus is subject to plugging.
5. There is a lack of an adequate laboratory for routine analyses.
6. Sludge treatment is not provided.

160

Disposal

Discharge of the treatment plant effluent is to an agricultural drain which receives its initial flow solely from the plant. The velocity in the upper reaches of this drain is virtually nil. The drain is congested with vegetation and obviously polluted for many kilometres. The obviously polluted portion of the drain has two villages located beside it. Village animals frequently use the drain for bathing and drinking.

BENI SUEF

Section 2

Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION

One alternative is to take no action. In this alternative, no additional improvements would be made to either the water system or the wastewater system. Under this alternative it would be impossible to maintain even the status quo. Continued development within and around Beni Suef would create additional demands upon the existing facilities. The physical condition of these facilities is such that the various system components are rapidly distintegrating due either to age or poor quality of construction.

2.2 WATER TREATMENT ALTERNATIVES

The primary objective of the water treatment process is to produce water which is safe for human consumption and use. A secondary objective is to produce water which is aesthetically appealing to the consumer.

The team has identified several technical alternatives for the treatment of water from the River Nile:

* A slow sand filtration process or biological filtration process. Major process components would include filter units and chlorination facilities. Filter media would be manually cleaned.

* A conventional rapid rate sand filtration process. Major components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A dual media, high rate filtration process. Major process components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A direct filtration process utilizing dual media, high rate filters. Major process components would include rapid mix chambers, flocculation basins, filter units, and chlorination facilities. The major differences between this alternative and the above high rate filtration process are the lack of sedimentation basins and the smaller size of the flocculation basins.

162

2.3 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WATER DISTRIBUTION SYSTEM

The water distribution system should be capable of delivering clean, treated water to the consumer at an adequate pressure and in sufficient volume to meet everyday needs.

The team has identified several technical alternatives for improving the distribution of water in the existing system:

* A leak detection program of main lines followed by line repair of major leaks using pipe clamps and/or line replacement.

* A line cleaning program to remove accumulated sediment using pipe "pigs" or other appropriate equipment. In addition, fire hydrants and blow-offs would be added at critical points.

* Reinforcement of the distribution system by increasing transmission line sizes, looping dead-end lines, and inter-connecting lines at intersections.

* Additional elevated storage facilities throughout the distribution system--
  - Steel tanks,
  - Reinforced concrete tanks.

* Installation of flow limiting devices at all public fountains and residential connections.

* Improvement of drainage at all public fountains.

Technical alternatives for the extension of the distribution system have been limited to:

* Water demand criteria--
  - Instantaneous demand,
  - Fire demand.

* Materials of construction for pipelines--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

* Water meters--
  - Install at all connections,
  - No water meters,
  - Install at major users.

2.4 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WASTEWATER COLLECTION SYSTEM

The wastewater collection system should be capable of removing wastewater from the community in a safe, efficient manner.

The team has identified several technical alternatives for improving the existing system:

* An inflow/infiltration study of the sewers followed by repair of major leaks by line replacement and/or the use of liners.

* A sewer cleaning program to remove debris and sediment using sewer balls or other appropriate equipment.

* Rehabilitation and upgrading of pump stations.

* Repair, replacement, and/or reinforcement of force mains.

* Replacement of under-sized collectors.

Technical alternatives for the extension of the collection system have been limited to:

* Design criteria regarding manhole spacing, service connections, and pump station sizing--
  - NOPWASD standards,
  - Standard engineering practices.

* Materials of construction for sewers--
  - Vitrified clay (VC),
  - Polyvinyl chloride (PVC),
  - Reinforced concrete,
  - Prestressed concrete cylinder.

* Materials of construction for force mains--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

2.5 WASTEWATER TREATMENT ALTERNATIVES

The primary objective of the wastewater treatment process is to reduce the health risks associated with the disposal of wastewater.

The team has identified several technical alternatives for the treatment of wastewater from Beni Suef:

* A primary treatment facility. Major process components would include screens, grit chambers, clarifiers, chlorination facilities, and sludge drying beds.

164

* A secondary treatment facility using a trickling filter process. Major process components would include screens, grit chambers, primary clarifiers, trickling filters, secondary clarifiers, chlorination facilities, and sludge drying beds.

* A secondary treatment facility using stabilization ponds. Major process components would include screens, stabilization ponds, maturation ponds, and chlorination facilities.

* A tertiary treatment facility using an aquacultural process. Major process components would include screens, grit chambers, primary clarifiers, trickling filters, secondary clarifiers, sludge drying beds, and water hyacinth ponds.

2.6 WASTEWATER DISPOSAL ALTERNATIVES

The desired disposal alternative should be one which minimizes the health risks to adjacent communities and minimizes damage to water bodies.

Disposal alternatives have been limited to the following:

* Discharge to the Beni Bikhit Agricultural Drain (the current discharge point).

* Discharge to the Muhit Dimushiya Agricultural Drain.

* Irrigation of reclaimed agricultural lands on the east bank of the River Nile.

165

BENI SUEF

Section 3

Evaluation of Technical Alternatives

3.1 WATER TREATMENT ALTERNATIVES

* Slow Sand Filtration

The use of slow sand filters would appear to be a good application of appropriate technology in Beni Suef. The skills required to maintain and operate such a facility could realistically be developed in a relatively short time frame (3 to 6 months). The process is simple, yet highly reliable. The major disadvantage would appear to be the large area of land required for such a facility (approximately 14,000 square metres for a 600 litre per second plant).

Due to the low reported turbidities of the raw water (4 to 8 NTU), it should not be necessary to precede the filtration process with plain sedimentation basins. However, it may be necessary to provide microscreening facilities or roughing filters for algae removal.

The slow sand filtration process itself would not involve pumping; however, pumping would be required to transport raw water to the plant and then finished water from the plant. There would also be some minor power consumption associated with the chlorination facilities and the administration building.

The slow sand filtration process does not require rapid mix chambers, flocculation basins, or sedimentation basins. The filters are of a very simple design and do not require a backwash system. The construction of the plant would be a relatively simple operation, and could be accomplished using materials available within Egypt. However, it is recommended that microscreens be imported and installed prior to the filters. Maintenance would be facilitated by the ready availability of replacement components.

The simplicity of operation, lack of dependence upon imported chemicals, and absence of a power requirement should lead to a very reliable and consistent operation.

Advantages

- Chemicals are not essential to the treatment process.
- Electrical power is not essential to the treatment process.
- There are extremely few mechanical components.
- Replacement components are readily available on the local market.
- Unskilled labor can be used for many plant functions.
- Simplicity of operation and maintenance.

- Simplicity of design and construction.

- Laboratory monitoring requirements for process control are minimal.

Disadvantages

- Large land area required (approximately 10 times the area of land required for a rapid filtration process).

- Filters are subject to upset if there are sudden and severe fluctuations in water quality.

- Certain types of algae may interfere with the filter operation.

- During the filter curing stage, there is the potential for an unskilled operator to introduce partially treated water into the distribution system. However, the problem is not extremely critical due to the fact that even during the curing stage the filter should be able to produce a finished water with a turbidity of less than 2 NTU.

- Greater loss of sand filter media can be expected as a result of the manual scraping required to clean the filters.

- Introduces a new, unfamiliar treatment concept to Beni Suef.

* Rapid Rate Filtration

Beni Suef currently uses a rapid rate filtration process to treat water. Rapid rate filters operate at rates (approximately 60 m/d) on the order of magnitude of about 30 times those of slow sand filters. In order to reduce the frequency of the filter backwash cycle, it is necessary to remove the bulk of the suspended matter prior to the filters. Alum addition, rapid mix chambers, flocculation basins, and sedimentation basins are all part of the process of preparing the raw water for application to the filter beds. Due to the frequency of cleaning required for the filter beds, it is necessary to install a backwash system to clean the filters.

Major advantages of this process are the small land area required (approximately 1,500 square metres for a 600 litre per second plant) and the familiarity of the existing staff with this process. The major disadvantage is that the system requires operation skills not currently available in Beni Suef; the existing facilities are not properly operated and maintained.

Construction of a conventional rapid rate filtration plant is complex; however, numerous contractors are familiar with this type of facility. Numerous components would have to be imported.

Proper operation and maintenance of a rapid rate filtration plant requires a staff of skilled operators, maintenance personnel, and laboratory technicians. In spite of the fact that the existing facilities utilize this process, Beni Suef lacks the institutional

support and human resource skills to operate such a system. To achieve the minimum level of skills required, the staff would need 18 months or more of training. In addition, considerable investment would be required in support facilities.

Advantages

- Process is commonly used throughout the world, and is presently used in Beni Suef.

- Process is capable of producing a finished water of excellent quality.

- Land area required is not excessive.

Disadvantages

- Process is complex and difficult to operate.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from sedimentation basins.

* Dual Media, High Rate Filtration

This process is very similar to the rapid rate filtration process. However, it introduces the use of coal in the filter media in addition to the sand, and uses a higher rate of filtration (approximately 240 m/d).

The major advantage of this system is that the filter area is further reduced, thus the construction cost is also reduced.

In all other aspects, the system is virtually identical to the rapid rate filtration process with the exception of the increased frequency of backwash that is required.

Advantages

- Process is virtually identical to the rapid rate filtration process which is presently used in Beni Suef.

- Capability of producing a finished water of excellent quality.

- Land area required is less than a slow sand filter process or a rapid filtration process.

- Minor redundancy in system. If upstream units operate at less than optimum levels, it is still possible to produce a finished water of good quality by placing a greater burden on the filters.

Disadvantages

- Process is complex.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from the sedimentation basins.

* Direct Filtration

The direct filtration process is similar to the dual media, high rate filtration process; however, the flocculation basins are of a reduced size and the sedimentation basins are eliminated altogether. Chemicals are added to destabilize the suspended matter rather than to create a floc which will slowly settle with the suspended matter adhering to it. All of the suspended matter is removed by the filter media; this is made possible by the use of a dual media filter for more efficient in-depth filtration.

The major advantage of this process is that construction costs are substantially reduced (approximately by 1/3 that of a conventional rapid rate filtration facility). The major disadvantage is that proper filter operation becomes extremely critical.

The operation of a direct filtration process is less complex than a conventional process; however, the filters require increased attention and more frequent backwashing.

Chemical costs typically are less with this process than a conventional process. However, the increased frequency of backwashing results in slightly higher power costs.

Advantages

- Substantially less chemicals are required than for a conventional plant.

169

- Operation is less complex than for a conventional plant.

- Construction costs are approximately 1/3 less than for a conventional plant.

- Land area required is minimal.

Disadvantages

- The filters must be monitored constantly and be properly maintained.

- The filters should be cured for approximately 1 hour after each backwash cycle.

- Imported chemicals are essential to proper operation.

- Expensive polymers may be required to optimize plant operation.

- Imported parts are required to maintain the system.

- The Government of Egypt is reluctant to try innovative technologies in the water sector.

3.2 ALTERNATIVES FOR IMPROVING THE EXISTING WATER DISTRIBUTION SYSTEM

* Leak Detection and Line Repair

It is estimated that approximately one-half of the water leaving the treatment plant is unaccounted for. If this figure could be substantially reduced, the need for expanded treatment facilities would be reduced and operation costs would be lowered.

A useful rule-of-thumb is that 20% of the leaks in a distribution network account for 80% of the water loss. For the most cost-effective solution, it is recommended that efforts be concentrated on the major leaks. A goal of reducing the unaccounted for water to approximately 25% of that leaving the treatment plant should be established.

New, sophisticated equipment permits accurate and quick leak detection. Unfortunately, this equipment is expensive and requires considerable skill in its proper use. Normally, it is desirable to contract with a firm specializing in this field to conduct the leak detection program. The line repair work can be performed by city personnel or a local contractor.

Often leaks can be repaired quickly with a simple repair clamp. Where leaks are the result of deteriorating lines, whole sections of pipe may have to be replaced.

170

Advantages

- Low cost of leak detection program.

- Potential for substantially reducing investment in new capital structures.

- Potential for substantially reducing operation costs associated with treatment and pumping of wasted water.

- Offers relatively quick results.

Disadvantages

- Leak detection equipment is expensive and sophisticated. Skilled personnel are needed for the leak detection program.

- Results are uncertain.

- Impossible to accurately estimate the costs for the repair work in advance of the leak detection survey.

* Line Cleaning Program

Line sediment and deposits which coat pipe walls can substantially reduce the carrying capacities of lines. This reduced carrying capacity can result in increased pumping costs and can create pressure problems.

The magnitude of the problems created by deposits and sediment is extremely difficult to gauge.

New, hydraulically driven pipe "pigs" are relatively expensive, and are easy to use. However, access points (launchers) are required for the introduction and removal of the pigs. These launchers may be somewhat expensive to install.

If the pigs cannot clear the system, it is necessary to use more expensive mechanical scraping equipment.

Once the investment has been made in the purchase of pigs, pumps, and launchers, a routine line cleaning program can be economically established. Blow-off assemblies and fire hydrants could be installed at strategic locations to facilitate the line cleaning program. This program can be conducted by city personnel.

Advantages

- Low cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing pumping costs.

- Potential for improving water pressure in many areas.

- Program can be performed quickly.

Disadvantages

- Results are unpredictable.

- Installation of launchers for the pipe pigs can be expensive, particularly in high density areas.

- If sediment and/or deposits are extremely heavy, the pipe pigs may not be able to clean the lines.

* Reinforcement of Distribution System

A computer analysis of the pipe network can be conducted to determine where deficiencies occur. These deficiencies can then be alleviated by strategically locating new mains, paralleling existing transmission mains, or in an extreme case, replacement of existing mains with larger sized pipe.

Dead-end lines can be extended and connected to nearby mains and lines crossing at road intersections can be interconnected to improve the hydraulics of the network.

Advantages

- Computer analyses can be performed at low cost.

- Benefits of network reinforcement can be clearly demonstrated once the computer analysis is performed.

- Line reinforcement can allevitate pressure problems and reduce pumping costs.

Disadvantages

- If major reinforcement of the network is needed, the capital cost can be high.

* Additional Elevated Storage

Additional elevated storage facilities could substantially improve the delivery of water to the consumer. The logical location for additional tanks would be in those areas furthest from the water treatment plant; however, the exact locations should be determined as part of a hydraulic analysis of the water transmission system.

Elevated storage tanks are expensive to construct, but are fairly economical to maintain. Generally, the use of elevated tanks is preferable to the use of ground reservoirs in combination with booster stations.

Reinforced concrete tanks are usually used in Egypt; however, steel tanks offer an attractive alternative. Maintenance costs for steel and concrete tanks are roughly equivalent. Steel tanks can be erected somewhat quicker, but at a higher cost in Egypt. The concrete tanks could be constructed by local contractors, but steel tanks would be erected by one of several American firms.

Advantages

- Potential for improving water pressure in many areas.

- Low operation and maintenance cost.

- Ease of operation.

Disadvantages

- Long construction time required to erect tanks.

- High capital cost.

* Flow Limiting Devices

The installation of flow restrictors at all public fountains and at residential connections could significantly reduce water consumption. Such limiting devices would make it difficult for the consumer to use excessive quantities of water. This can be a very important consideration in a society where the minimum needs of the public are guaranteed. Restriction of water usage would permit a more equitable distribution of available treated water.

Potential benefits would be the reduced size of treatment facilities required, and reduced operation costs.

The material cost of the static restrictors is very low and the installation cost is not excessive.

Advantages

- Low cost of installation and maintenance.

- Potential to reach more consumers.

- Potential for reducing investment in new capital structures needed for excessive water demands.

- Potential for reducing operation costs associated with treatment and pumping of excessive amounts of water.

- Work could be performed by city personnel.

Disadvantages

- Public resistance to limited availability of water.

- Difficulties associated with those connections serving multiple users.

- Water conservation may hinder good hygiene practices.

* Improved Drainage at Public Fountains

Generally, the public fountains in Beni Suef are not well maintained. Ponded water around each of the fountains is typical. Organic matter from the cleaning of pots and pans is in evidence. It would be desirable to separate the water distribution function and the washing/cleaning function at each fountain. Fountains should only be located where adequate drainage to either a public sewer or an open drain can be provided. Fountains should be mounted on a solid base at an elevation well above ground level.

The public fountains serve a substantial portion of the population. Sanitary conditions should be maintained at the fountains. Landscaping and regular maintenance should be performed in order to create an atmosphere more conducive to cleanliness.

Advantages

- A large segment of the population would receive improved service at an extremely low cost.

- Public health should improve.

- The community would be more attractive.

Disadvantages

- Difficult to maintain sanitary conditions at the public fountain sites. Present users habits are ingrained.

3.3 ALTERNATIVES FOR THE EXTENSION OF THE WATER DISTRIBUTION SYSTEM

* Water Demand Criteria

A major consideration in the extension of the system is the water demand criteria which will be used to size lines and other facilities. Decisions must be made as to whether or not unlimited demands will be met or whether use will be restricted. Considering the difficulty in satisfying current demands and the high cost of new facilities, it may be advisable to severely limit water usage in order to guarantee equitable water distribution. In addition to the basic user demands upon the system, consideration must be given to water losses within the system. In the case of Beni Suef, current losses may be approximately equal to the user demand.

The consultant has estimated that the year 1983 per capita water demand was about 163 litres per day (lpd); the year 2000 per capita demand is projected to be 195 lpd. For that population served by public fountains a per capita demand of 60 lpd per capita is used throughout the planning period. Unaccounted-for water has been estimated at 56% of the water leaving the treatment plant, but will be reduced to 25% by the year 2000. The consultant has arrived at a year 2000 average daily summer demand (1.25 times average daily demand) of 799 litres per second (lps). This figure assumes elimination of public fountains within Beni Suef; villages would continue to be served by public fountains.

Due to the limited availability of funds, it is extremely doubtful that the city will be able to provide central service to all areas within the current city limits. It is also unlikely that service can be extended to the East Bank (159 lps average daily summer demand). By eliminating service to the East Bank, assuming severely restricted expansion of central service within the city, limiting water consumption, and reducing system losses, it would be possible to significantly reduce the proposed design capacity of the system.

Infinite variations in the demand are possible. One example would be to reduce water losses to 20%, to restrict water consumption to 165 lpd per capita, and to limit central service to about 65% of the population. The resulting projected year 2000 water demand would then be calculated as follows:

1. Year 2000 Beni Suef population (excludes East Bank) -- 220,000

175

2. Percent Year 2000 population served by central system -- 65%

3. Percent Year 2000 population served by public fountains -- 35%

4. Year 2000 population of villages -- 27,200

5. Year 2000 per capita demands -- 165 lpcd for central system
   60 lpcd for public fountains

6. Water losses -- 20% of base demand

7. Summer demand factor -- 1.25 times average daily demand

8. Calculations:

220,000 x 0.65 x 165	=	23,595,000
220,000 x 0.35 x 60	=	4,620,000
27,200 x 60	=	1,632,000
		29,847,000 lpd
29,847,000 / 24 /60 / 60	=	345 lps
345 x 1.20	=	415 lps average daily
415 x 1.25	=	518 lps average daily summer

Thus, an average daily summer demand of 518 lps for the year 2000 is one of numerous alternatives.

* Materials of Construction for Pipelines

Highly corrosive soils in Beni Suef are believed to be the cause of rapid deterioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are of poor quality and not generally available with mechanical joints. The Jabault couplings used with locally produced asbestos-cement pipe offers only limited deflection at the pipe joints. The local asbestos-cement pipe is generally of good quality; however, the short sections used result in an excessive number of joints in the pipeline, and thus increase the potential for leakage. Polyvinyl chloride (PVC) pipe has recently been introduced in Egypt; however, its availability and quality have not yet been adequately established. The PVC pipe is available with bell and spigot, gasketed joints and is produced in longer sections than the asbestos-cement pipe. Glass reinforced plastic (GRP) pipe is also available locally. Both PVC pipe and GRP pipe are relatively easy to install. Prestressed concrete cylinder pipe is commonly used for larger diameter lines; however, it is rather difficult to work with.

* Water Meters

Water meters offer the City the opportunity to conserve water usage. However, such conservation can only be achieved if the installation of meters is coupled with a rate schedule which assesses rates which are sufficiently high to discourage waste. Water meters require periodic calibration and overhaul. In addition, personnel are required for the meter readings. Records of the readings must be maintained and incorporated into the billing system.

Installation of water meters at connections for major users and the use of a flat rate for residential users and small businesses is a compromise which can often be more cost-effective than metering all users. However, here again a realistic rate schedule is required if the meters are to be effective.

3.4 ALTERNATIVES FOR THE REHABILITATION OF THE WASTEWATER COLLECTION SYSTEM

* Inflow/Infiltration Study and Line Repair

It is suspected that approximately one-half of the influent to the wastewater plant is the result of infiltration. If this figure could be substantially reduced, the need for expanded treatment facilities would be reduced and operation and maintenance costs would be lowered.

A simple inflow/infiltration study could be conducted to localize the areas of greatest concern. Efforts would be concentrated on the major problem areas in order to maximize the effectiveness of the line repair program. A goal of reducing infiltration to approximately 25% of the flow into the treatment plant could be realistically established.

The installation of liners in problem areas would be a relatively simple task. Due to the fact that house connection in Beni Suef are only made at manholes, it would not be necessary to excavate each service connection and cut an opening in the liner for the connection.

A specialized firm would be required to install the liners.

Advantages

- Low cost of inflow/infiltration study.

- Potential for substantially reducing investment in new capital structures.

- Potential for substantially reducing operation costs associated with treatment and pumping of infiltration.

Disadvantages

- Specialized equipment is required for the installation of the pipe liners. Skilled personnel are needed to install the liners properly.

- Potential effectiveness of program cannot be gauged until after the inflow/infiltration study is completed.

- Impossible to accurately estimate costs for the repair work in advance of the inflow/infiltration study.

* Sewer Cleaning Program

Deposits, grease accumulations, and debris can substantially reduce the carrying capacities of sewers. This reduced line capacity can result in frequent backups of sewage and even flooding.

Sewer cleaning equipment has been purchased by Beni Suef as part of a sub-project. An ongoing cleaning program could easily be established by the City.

Advantages

- Moderate cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing sewage backups and flooding incidents.

- Ongoing program can be established.

Disadvantages

- Success of completed project may be difficult to gauge.

- To be truly effective, project should be conducted in conjunction with other programs such as improved sewer construction techniques, improved pump station operating techniques, etc.

* Pump Station Improvements

The surcharging of sewers which results from the improper operation of pump stations can contribute significantly to problems with grease, sediment, and debris accumulating in the sewers. The pump stations could be operated in accordance with generally accepted practices if adequately sized wetwells, properly sized pumps, and reliable control systems were provided.

178

Upgrading of stations to meet existing and projected demands would improve the reliability of the service. Further improvements in reliability could be provided with the addition of standby pumps, bypass piping with valves, pressure gauges and wetwell level indicators, standby power generators, alarm systems, an inventory of spare parts, and O&M manuals.

The cost of a major rehabilitation program would be fairly high; however, the station structures appear to be fairly sound, and rehabilitation should therefore be somewhat cheaper than new construction.

Advantages

- Improved service reliability.

- Improved hydraulics in gravity sewer system. This would reduce problems with solids accumulations in the sewers.

Disadvantages

- High cost of major rehabilitation program.

- Length of time required to perform rehabilitation work.

* Force Main Improvements

Properly sized force mains can reduce friction losses and thus in turn reduce power consumption at the pump stations. A hydraulic analysis of the force main system would permit the economical sizing of force mains and permit a determination of optimum head conditions for each pump station.

Air release valves and blow-off assemblies could improve operating conditions and facilitated maintenance of force mains.

The hydraulic analysis of the system could be performed inexpensively and quickly. Replacement and/or paralleling of existing force mains could be expensive. The addition of air release valves and blow-off assemblies at critical locations could be done for a relatively low cost.

174

Advantages

- Reduced pumping costs.

- Elimination of potential problems due to air lock and solids accumulation.

- Low cost hydraulic analysis would permit the City to evaluate potential power savings prior to proceeding with expensive line replacements and/or paralleling.

Disadvantages

- High cost of major improvements.

- Difficulty in estimating improvements attributable to new air release valves and blow-off assemblies.

* Replacement of Undersized Collectors

Replacement of undersized gravity collectors in major problem areas would reduce sewage backups and flooding incidents.

A high initial cost is associated with the replacement of undersized sewers; however, properly sized and sloped sewers provide cost-effective, reliable service.

Advantages

- Reduced maintenance costs.

- Improved service. Reduced incidents of flooding and sewage backups.

Disadvantages

- High construction cost.

3.5 ALTERNATIVES FOR THE EXTENSION OF THE WASTEWATER COLLECTION SYSTEM

* Modification of Design Criteria

A major consideration in the extension of the collection system is the design criteria to be used for manhole spacing, service connections, and pump station sizing. Extremely conservative criteria can result in excessive, and unnecessary, construction costs and thus reduce the capability of the City to extend service. On the other hand, inadequate standards can result in poor service and high operation and maintenance costs.

180

Existing criteria used in Beni Suef for spacing of manholes calls for 30 metres of separation for line diameters of 180 mm to 225 mm. Manhole spacing of between 91 metres and 122 metres has been successfully employed in other countries for 200 mm diameter sewers.

Currently, all service connections must be made at a manhole. Main line connections are typically used in other countries.

The use of improved materials of construction and the availability of modern sewer cleaning equipment would make it feasible for Beni Suef to relax existing standards regarding manhole spacing and service connections. If existing construction practices are continued, it would probably be best to maintain existing standards.

If pump stations could be properly operated and maintained, it would be possible to build stations to less restrictive standards. Currently, NOPWASD encourages considerable duplication in pumping capacity; the rated capacity of a station may often be only one-half of the in-place capacity. Existing standards result in substantial additional costs for each pump station constructed.

Advantages

- Substantial reductions in capital cost.

Disadvantages

- If relaxation of standards is not coupled with improved materials of construction and improved pump station maintenance, system performance may be substantially affected.

* Materials of Construction for Sewers

Existing sewers in Beni Suef are constructed of vitrified clay (VC) pipe. Due to the non-availability of gasketed joints for locally manufactured VC pipe, cement mortar is used to seal the joints. In order to protect the rigid joint which is created by the cement mortar, it is necessary to protect the entire pipeline with a concrete bedding. The numerous joints associated with the short pipe sections and the method of pipe jointing can contribute to substantial leakage problems.

Polyvinyl chloride (PVC) pipe is relatively new to the Egyptian market, and has not yet been used extensively. However, PVC pipe appears to be readily available and of reasonable quality. The PVC pipe is available with gasketed, bell and spigot joints. Advantages of the PVC pipe are ease of installation, tightness of joints, longer pipe sections result in fewer joints, and lower in-place cost. A disadvantage is the limited range of pipe diameters available.

Reinforced concrete pipe and prestressed concrete cylinder pipe are often used for large diameter sewers. These alternatives are economical; however, the inner surface of the pipe is subject to degradation by hydrogen sulfide unless a protective liner or coating is provided. Due to the weight of a section of concrete pipe, it is rather difficult to install.

* Materials of Construction for Force Mains

Highly corrosive soils in Beni Suef are believed to be the cause of rapid detioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are generally of poor quality and not available with mechanical joints.

Polyvinyl chloride (PVC) pipe is now being manufactured in Egypt. PVC pipe is easy to work with and relatively inexpensive to install.

Asbestos-cement (AC) pipe is available locally and is of good quality. The Jabault couplings used in Egypt offer limited joint

182

deflection and are subject to displacement in poor soil conditions. The inner walls of the pipe are subject to attack by hydrogen sulfide.

Glass reinforced plastic (GRP) pipe is also used in Egypt. It is easy to install, but has a relatively expensive material cost.

3.6 WASTEWATER TREATMENT ALTERNATIVES

* Primary Treatment

The major advantages of a primary treatment facility in Beni Suef would be the low cost and the ease of operation and maintenance. The existing staff could realistically achieve in short time frame the necessary level of skills required for the proper operation and maintenance of such a facility.

The major disadvantage of this alternative is the minimal levels of treatment provided. If the existing discharge to the Beni Bikhit Drain is continued, further deterioration of the drain can be expected.

Primary facilities have the capability of removing most of the grit and floating solids from the wastewater. A substantial portion of the suspended matter can be removed and the bio-chemical oxygen demand (BOD) can be reduced.

Primary clarifiers are the major initial element of many secondary treatment processes, thus they can form the first stage of a staged construction program for secondary treatment.

Adequate sludge handling facilities are required if the clarifiers are to be properly maintained. Initially, the raw sludge could be pumped from the clarifiers to drying beds; later anaerobic digestors could be added if appropriate.

Advantages

- Ease of operation and maintenance. Good degree of reliability.

- Low construction cost and low operation and maintenance costs.

- Can be incorporated into future, secondary treatment facilities.

Disadvantages

- Limited level of treatment provided. Cannot meet existing water quality standards for discharge to surface water bodies.

* Trickling Filters

A trickling filter process would involve the addition of trickling filter units and secondary clarifiers to the previously described primary treatment process. Trickling filters have the capability of substantially improving the degree of treatment.

The exact degree of removal obtainable by this process is dependent upon numerous factors such as filter area and depth, number of stages, media type, and recirculation rates. Trickling filter plants are typically designed to provide BOD removals of anywhere from 65% to 85%.

This alternative requires skilled operators. The existing trickling filter facility in Beni Suef is not operated to its capability. Considerable training would be required to upgrade the skills of the existing staff.

Though this process is capable of providing a relatively high level of treatment, it would not be able to meet water quality standards if discharge continues to the Beni Bikhit Drain.

Advantages

- Easier to operate and maintain than many secondary processes.

- Lower operating cost than many secondary processes.

- Relatively high levels of treatment are obtainable on a consistent basis if properly operated.

Disadvantages

- Cannot meet existing water quality standards (Beni Bikhit Drain).

- Skilled operators are required. Improper operation can drastically reduce effectiveness.

* Stabilization Ponds

Stabilization ponds would represent an excellent application of appropriate technology in Beni Suef. The operation and maintenance of stabilization ponds is extremely simple. The climate in Egypt is well suited to this type of treatment process. There is virtually no mechanical equipment required. Power consumption is virtually nil.

The degree of removal obtainable is dependent primarily upon detention time. Operation in series and the use of anaerobic lagoons and maturation ponds in conjunction with the stabilization ponds can further improve the treatment capability of the system.

The primary disadvantage associated with the use of stabilization ponds is the extremely large land area required, particularly for high levels of treatment.

Construction can easily be staged to provide progressively higher levels of treatment as flow to the plant increases.

Advantages

- Extremely easy to operate and maintain.

- Simple to construct. Locally available materials and techniques are applicable.

- Very low operation and maintenance cost. Power consumption is virtually nil.

- Relatively stable biological process.

- Construction can be easily staged.

- Sludge disposal problems are greatly reduced.

Disadvantages

- Extremely large land area required.

- Susceptible to weed and odor problems.

* Aquaculture Ponds

An aquaculture process would involve the addition of water hyacinth ponds after either the previously described trickling filter process or stabilization pond process. The artificial wetlands that would be created would have the capability of providing an extremely high quality of effluent.

The use of shallow (0.5 metre depth) water hyacinth ponds with a total detention time of 3 days could reduce BOD another 70% and SS another 55% beyond the secondary level. Unmanaged ponds with no supplemental aeration would be extremely cost-effective in Egypt.

This process would have the capability of meeting water quality standards even if the discharge continues to the Beni Bikhit Drain.

As this is essentially proposed as an effluent polishing process, it would be subject to the advantages and disadvantages associated with the particular secondary treatment process chosen to precede the hyacinth ponds.

Advantages

- High level of treatment provided.

- Upgrades secondary facilities at a very low cost.

- Operation and maintenance costs associated with the ponds are minimal.

Disadvantages

- Should be proceeded by an initial treatment process.

- Large area of land required.

- Potential odor and mosquito problems.

3.7 WASTEWATER DISPOSAL ALTERNATIVES

* Beni Bikhit Drain

The Beni Bikhit Drain has an extremely low velocity and is clogged with excessive vegetation. This drain is the existing discharge point for treated wastewater from Beni Suef. The wastewater leaves the plant via an open ditch and crosses El Ibrahimiya Canal via a syphon and then enters the head of the Beni Bikhit Drain. The Beni Bikhit Drain runs for a distance of about 11 kilometers and then empties into the Beni Suef Drain. The Beni Suef Drain travels for a distance of about 40 kilometers and then discharges the bulk of its flow into El Zawyi Drain. El Zawyi Drain travels a distance of about 10 kilometers and then dumps into the River Nile.

The Ministry of Irrigation intends to eventually divert the majority of the flow away from El Zawyi Drain in order to blend the water from the drain with canal water and use it in the irrigation of agricultural lands.

The drain passes directly by two villages before there is any significant improvement in water quality. A field survey indicates that dissolved oxygen (DO), bio-chemical oxygen demand (BOD), dissolved solids (DS), chemical oxygen demand (COD), and phosphate levels all exceed the limitations established in Law 48/1982 for drains which are to be used for irrigation.

The bulk of the flow in the drain at its upper reach is composed of wastewater. The characteristics of the drain do not substantially change until its junction with the Muhit Beni Suef Drain.

Advantages

- Precedent has been established for discharge to this drain.

Disadvantages

- The existing discharge has a substantial effect upon the Beni Bikhit Drain. The drain is polluted as a result of the existing discharge. Advanced levels of treatment would be required to minimize the impact of the effluent.

- The discharge poses a health risk to two villages which border directly on the drain.

- The upper reach of the drain is stagnant.

* Muhit Dimushiya Drain

The Muhit Dimushiya Drain passes within one kilometer of the existing treatment plant site. This potential discharge point is approximately 6 kilometers above the point where the drain enters the River Nile.

The primary advantage of this alternative is that the assimulative capacity of the Nile would be used to dispose of the wastewater before it could create any major health or environmental problems.

Advantages

- The River Nile would quickly assimulate the wastewater.

Disadvantages

- Plant effluent from the existing wastewater treatment plant site would have to be pumped to the discharge point.

- The drain enters the River Nile at a point only 2 kilometers upstream of the new raw water intake for Beni Suef.

* Irrigation of Reclaimed Land

The Governate of Beni Suef has an ambitious plan to develop the east bank of the Nile. Treated wastewater could be used to irrigate new agricultural lands to be reclaimed on the east bank.

The wastewater from Beni Suef would have to be pumped across the Nile to the east bank. The Ministry of Irrigation is very much opposed to transporting either raw or treated wastewater across the Nile.

Land application systems have the capability of treating wastewater to extremely high levels. The degree of pretreatment required would be dependent primarily upon the type of crops to be grown.

Advantages

- No discharge to a surface water body, thus health risks to the general public are greatly reduced.

- Nutrient application to agricultural lands.

- Minimal treatment required for restricted crop irrigation.

Disadvantages

- Ministry of Irrigation opposed to transporting wastewater across the Nile to the application sites.

- Health risk to agricultural workers.

BENI SUEF

Section 4

Needs and Proposed Actions

Though there are apparently well-qualified personnel associated with the City of Beni Suef, it is apparent that due to either social or cultural reasons their involvement with direct day-to-day operations in the field is extremely limited. Field personnel typically lack sufficient training and skills to operate and maintain those facilities for which they are responsible. The duties of individuals generally are extremely limited in scope. The chain of command is often hazy, particularly in regard to responsibilities. There is a tendency by the individual not to concern himself with those problems which may arise unless these problems are clearly within his area of responsibility. Accordingly, he is either unconcerned or he assumes that someone else will take care of such problems. This lack of initiative appears to be deeply rooted within the system. It is an unrealistic expectation to believe that the provision of training alone will eliminate a problem which is essentially a problem of attitude.

There is a strong need to develop a sense of pride in each employee. The use of team concepts might help to achieve such a goal. The employee should realize not only financial reward for his achievements, but also acknowledgement from his superiors.

It is recommended that serious consideration be given to the establishment of an independent organization for the operation and maintenance of the water and wastewater facilities. This organization should have the freedom to hire and fire.

There is a need at the present time to supply each employee with a clean, attractive work environment. At the treatment facilities and pumping station, this means that it is important to clean up inside and outside each of the buildings. Interior components should be painted with bright, cheerful colors. Non-functional equipment should be disposed of. Supplies should be neatly stored. The importance of landscaping should not be underestimated. Housekeeping practices should be applied to vehicles and field equipment also. Vehicles should be washed daily; field equipment should be regularly painted and rehabilitated. The atmosphere at the water and wastewater facilities should be that of a food processing plant.

A central shop should be established in Beni Suef. A preventative maintenance program should be established in conjunction with the construction of this shop. This program should then be expanded to incorporate the water and wastewater facilities. At the current time, preventative maintenance is not practiced in Beni Suef.

Another extremely important need is a safety program. Current safety practices in Beni Suef are horrifying by American standards. The total lack of appropriate equipment and procedures for handling chlorine equipment highlights this concern. Each employee should receive instructions which will make him cognizant of the hazards involved with sewer gases, chemical handling, electrical systems, and mechanical equipment.

There are no operation and maintenance manuals that an interested employee can refer to in order to gain an understanding of basic procedures or for troubleshooting. Arabic language manuals should be developed for all new facilities and for the existing facilities.

A laboratory has been provided at the Czech Water Treatment Plant as a sub-project. Currently, the laboratory is lacking sufficient equipment to perform several key tests -- coliform, jar test, and turbidity. A laboratory is important not only for monitoring overall plant performance, but also for evaluating the effectiveness of each component within the process. This is necessary if the operator is to optimize efficiency at each plant. Laboratory facilities are important to ensure proper chemical feed rates. The laboratory tests which are performed on a daily basis should be those tests which are absolutely essential to the proper operation of the plant. Additional "icing on the cake" type tests should be avoided as they tend to diminish the overall importance of the laboratory program to the operator. Forms should be developed which will ensure proper recordkeeping and which will provide useful information to the system operator. Laboratory and plant personnel must understand the significance of each test and how it relates to their specific duties and responsibilities.

There is a need in Beni Suef for trained inspectors for civil works. A very basic inspection and testing program should be established for the following:

1. Soil compaction,
2. Concrete quality,
3. Pipeline tightness.

Basic equipment should be provided and forms developed which will ensure that the essential elements of civil works are relatively sound. More sophisticated inspection and testing requirements associated with electrical systems, mechanical equipment, and the like would be contracted out to others.

It is almost imperative that a sewer inspection and rehabilitation program be established immediately in order to reduce what is suspected to be a substantial amount of infiltration. Initially, the main lines would be inspected and rehabilitated. If the

190

cost-effectiveness of such a program justifies itself, it would then be appropriate to extend the program to the minor lines. Though it would be practical to completely eliminate infiltration, it should be possible to recover needed capacity in many of the pump stations and the treatment plant.

A leak detection survey is also needed for the water distribution system. Major leaks should be repaired as discovered. It is suspected that due to the nature of construction of the water lines that there are numerous small leaks rather than a few large leaks. It is therefore questionable whether or not it will be practical to correct more than a handful of such leaks. Therefore, only limited success is projected for this program.

None of the treatment facilities visited are operated properly. Available personnel are years away from being able to develop the necessary skills to properly operate and maintain such facilities. Therefore, it is extremely important that to the extent possible "appropriate technology" be used for all new facilities. Sophisticated equipment such as motorized valves and computer-operated control centers should be avoided. Complex processes such as activated sludge processes in wastewater treatment plants should not be used. Systems should be simple, durable, and reliable. Emphasis should be placed upon a realistically consistent realiability rather than a theoretical capability. For example, it would be better to have a water treatment plant which provides moderate quality drinking water 95% of the time rather than one that has the capability of providing excellent water but will not realistically function in the current environment. It should also be recognized that funding limitations can often place a severe constraint on annual budgets. Therefore, facilities that require large inputs of power or chemicals should be avoided to the extent possible. Similarly, facilities with high maintenance requirements (non-labor) should be avoided.

In regard to the water treatment plant, it is suggested that a slow sand filtration process would be most appropriate to the level of skills projected to be obtainable in the near future. Of course, such a process requires a large area of land. For this reason, it may be necessary to build at more than one site or to use a more sophisticated process such as direct filtration. The use of direct filtration or any other sophisticated process would require the use of skilled ex-patriate labor if proper operation is to be ensured. The existing water treatment facilities in Beni Suef should be dismantled; it is in such a state of disrepair that rehabilitation and upgrading would not be cost-effective.

In regard to the wastewater treatment plant, it is suggested that screening facilities, primary settling units, and chlorination

facilities would provide an appropriate level of treatment considering the level of skills realistically obtainable in the near future. Of course, it must be recognized that primary treatment will not meet the requirements of Law 48 in regard to either the plant effluent or the agricultural drain. The existing discharge is to a drain which provides little dilution and adversely impacts two villages. An alternative discharge point should be investigated. If feasible, it would be desirable to utilize the assimulative capacity of the Nile River by means of a direct discharge. The provision of sludge digestion or thickening facilities and adequate drying beds are necessary to ensure that sludge is frequently removed from the settling tanks. The existing primary settling units appear to be salvageable. It is recommended that funds not be spent to rehabilitate the secondary units at this time.

Additional elevated storage facilities should be strategically located throughout the water distribution system. Several smaller tanks would provide better service than one large tank.

Additional wet well volume should be provided at the wastewater pumping stations. The practice of permitting the gravity sewers to operate under surcharged conditions should be stopped immediately. Rehabilitation of existing pumping stations is recommended.

Existing practices regarding the construction of water distribution systems and wastewater collection systems should be reviewed. It is suggested that the use of PVC pipe and other modern materials of construction would be more cost-effective than materials currently in use. Design standards appear to be unduly restrictive with little or no improvement in system reliability; it is recommended that only reasonable standards be funded as part of this project.

The Czech Water Treatment Plant is an excellent example of a good design concept which has failed in application due to extremely poor construction. Proper construction management procedures would have prevented the deficiencies in this facility. It is imperative that a program of construction inspection and materials testing be established for the major capital works. This program should be part of a construction management contract for the construction of the water treatment facilities and rehabilitation of the wastewater pumping stations to be performed under the Provincial Cities Development Project.

192

BENI SUEF

Section 5

Recommended Implementation Plan

5.1 GENERAL

This section contains a recommended implementation plan which will benefit the greatest number of people at the least cost. The majority of the proposed actions do not involve major new structures, but rather maximize the effectiveness of existing facilities.

5.2 WATER

Emphasis should be placed on investments, including new facilities and rehabilitation of existing facilities, which will improve the quantity and quality of water provided to the served population.

1. Priority should be given to extension of water service concurrently with the extension of wastewater collection into areas which can be most cost-effectively served. A lower priority should be given to fringe areas. It is suggested that a goal of providing central service to about 70% of the year 2000 population be established initially (approximately 52% of the current population is now served).

2. A leak detection survey of main lines in the existing system should be conducted. Major leaks should be repaired; severely deteriorated lines should be replaced.

3. A line cleaning program should be established. Access points for cleaning equipment should be provided. Blow-off assemblies and hydrants should be installed at critical locations.

4. A computer analysis of the pipe network should be performed. Those deficiencies which are identified by the analysis should be alleviated by strategically locating new mains and paralleling existing transmission lines to reinforce the system. Dead-end lines should be extended and looped into the distribution system.

5. Flow limiting devices should be installed at all public fountains and residential connections. Domestic water consumption should be limited to 150 lpcd.

6. The existing public fountains should be upgraded to include proper structures and drainage to reduce the ponding of water at the fountain sites. Where practical, the drain lines from the fountains should be connected to available sewers.

7. Rehabilitation of the existing New Water Treatment Plant should be undertaken by NOPWASD.

193

8. Build a new water treatment plant of 300 lps on land available at the site of the existing New Water Treatment Plant with appropriate technical features. The design should focus on simplicity of operation and ease of maintenance. The recommended facility is smaller than that which was proposed in the draft Master Plan; however, it should be designed to allow for plant expansion in the future. It is suggested that a direct filtration process will be the most cost-effective treatment process.

9. After construction of the new treatment plant, decommission the existing Old Water Treatment Plant.

10. Encourage the larger industries to use well water supplies to the maximum extent possible.

11. Additional elevated storage should be provided in the northern sector of the city. It is recommended that three 4,000-cubic metre tanks be erected. The exact location of the tank sites should be determined by the previously recommended computer analysis.

12. Install water meters only at service connections for major users. Use a flat rate system for residential users and small businesses.

5.3 WASTEWATER

Emphasis should be placed on investments to improve the existing collection system and to provide a higher level of wastewater treatment in order to reduce pollution in the drain.

1. An inflow/infiltration study of the existing collection system should be conducted. Major leaks should be repaired by either line replacement and/or the use of liners.

2. A regular sewer cleaning program should be established.

3. A hydraulic analysis of the force main system should be performed. Force mains should be either repaired, replaced, or reinforced as appropriate. Blow-off assemblies, isolation valves, and air release valves should be installed at critical locations.

4. Under-sized collectors should be replaced.

5. Priority should be given to extension of wastewater service concurrently with the extension of water distribution into areas which can be most cost-effectively served. A lower priority will be given to fringe areas and to service in new drainage areas. It is suggested that a goal of providing central service to about 70% of the year 2000 population be set (approximately 57% of the current population is now served).

6. Where feasible, the wastewater collection system should be expanded to provide selected collectors in areas serviced by public fountains but not by sewers. This would allow for proper collection of wash water at the public fountain sites and provide discharge points for disposal of septage by haulers.

7. Vacuum trucks should be used to haul septage in unsewered areas. Provisions should be made to receive septage at the pump stations and at other convenient sites.

8. Consideration should be given to the use of construction materials which will reduce the potential for excessive infiltration in new sewers.

9. All of the existing pump stations should be rehabilitated. Simplicity and ease of operation and maintenance should be stressed in new designs. Design criteria for the sizing of pump stations should be modified in order to lower construction costs.

10. The existing trickling filter plant should be rehabilitated to a design capacity of 300 lps. Hyacinth ponds should be added to the existing plant in order to improve the level of treatment. Discharge of treated effluent should continue to the Beni Bikhit Drain.

11. Sludge thickeners should be added to the existing plant and the drying beds should be upgraded.

5.4 SUPPORT

Provision of extensive on-the-job training, establishment of a preventative maintenance program, development of adequate repair facilities, establishment of an inventory program, and the provision of operation and maintenance manuals are all seen as vital elements of this program.

5.5 PHASE I

Tables 2A and 2B are illustrative of a program which could be accomplished using existing funding levels for this project.

5.6 PHASE II

Tables 3A and 3B illustrate a program which would permit Beni Suef to meet its most basic service needs coupled with modest extension of service. The additional facilities proposed in this program would be contingent upon the availability of approximately $50,000,000 and LE 15,000,000 for a follow-on program to Phase I.

ID#0261H

195

TABLE 2A 29-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		23,000	40,000	90,000
2	Leak Repair	160,000			272,000
3	Line Cleaning Program		100,000	66,000	255,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	80,000			136,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Modify Existing Raw Water Facilities	169,000			288,000
9	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	One Elevated Tank (4,000 cu meters)		550,000	46,000	995,000
11	Reinforcement of Existing Transmission System	1,000,000			1,703,000
12	Rehabilitation of Existing New Water Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,434,000	2,168,000	2,417,000	9,234,000
18	Contingencies @ 15%	215,000	325,000	363,000	1,385,000
19	Design & Supervision @ 15%	215,000	81,000	645,000	1,332,000
20	Major Project Construction Management @ 3%	43,000	16,000	129,000	266,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		1,907,000	2,695,000	4,114,000	13,114,000

ID#QBS1I

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	44,000 sq meters
Ground Reservoir - 500 sq meters	included in above
Elevated Tank - 2,300 sq meters	2,300 sq meters

NOTE: Includes LE 0.2 million uncommitted sub-project disbursement.

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196

TABLE 2B 29-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	118,000			201,000
5	Minimal Pump Station Rehabilitation		188,000	250,000	641,000
6	New Collectors - Area No. 2	874,000			1,489,000
7	New Collectors - Area No. 3	600,000			1,022,000
8	Minimal Upgrading of Existing Treatment Plant	600,000			1,022,000
9					0
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		2,199,000	278,000	730,000	5,155,000
18	Contingencies @ 15%	330,000	42,000	110,000	774,000
19	Design & Supervision @ 15%	330,000	61,000	137,000	841,000
20	Major Project Construction Management @ 3%	66,000	12,000	27,000	167,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		2,925,000	498,000	1,564,000	7,834,000

ID#QBS2I

TOTAL LAND REQUIREMENTS
0 sq meters

NOTE: Includes LE 0.5 million uncommitted sub-project disbursement.

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TABLE 3A 29-Apr-85

BASIC SERVICE NEEDS

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		23,000	40,000	90,000
2	Leak Repair	160,000			272,000
3	Line Cleaning Program		100,000	66,000	255,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	525,000			894,000
6	Improve Public Fountains	80,000			136,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Modify Existing Raw Water Facilities	169,000			288,000
9	Ground Storage Reservoir (2,000 cu meters)		175,000	20,000	324,000
10	Ground Storage Reservoir (6,000 cu meters)		560,000	60,000	1,030,000
11	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
12	Reinforcement of Existing Transmission System	1,000,000			1,703,000
13	Rehabilitation of Existing New Water Plant	BY NDPWASD	BY NDPWASD	BY NDPWASD	BY NDPWASD
14					0
15					0
16					0
17					0
SUB-TOTAL		1,949,000	3,828,000	2,569,000	13,132,000
18	Contingencies @ 15%	292,000	574,000	385,000	1,968,000
19	Design & Supervision @ 15%	292,000	129,000	919,000	1,896,000
20	Major Project Construction Management @ 3%	58,000	26,000	180,000	374,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		2,591,000	4,782,000	5,253,000	19,292,000

ID#BS1BN

TOTAL LAND REQUIREMENTS	AVAILABLE LAND
WTP - 8,000 sq meters	44,000 sq meters
Ground Reservoir - 2,000 sq meters	Included in above
Elevated Tanks - 6,900 sq meters	2,300 sq meters

NOTE: Includes LE 0.6 million unprovided sub-project disbursement.

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198

TABLE 38 29-Apr-85

BASIC SERVICE NEEDS

BENI SUEF WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		75,000	400,000	641,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Force Main Upgrading	168,000			286,000
5	Replacement of Undersized Collectors	400,000			681,000
6	Pump Station Rehabilitation		376,000	500,000	1,282,000
7	Upgrade Existing Treatment Plant	1,525,000			2,699,000
8	New Collectors - Area No. 2	874,000			1,488,000
9	New Collectors - Area No. 3	600,000			1,022,000
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		3,634,000	466,000	980,000	8,239,000
18	Contingencies @ 15%	545,000	70,000	147,000	1,236,000
19	Design & Supervision @ 15%	545,000	101,000	198,000	1,354,000
20	Major Project Construction Management @ 3%	109,000	20,000	39,000	270,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		94,000	500,000	802,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		4,833,000	788,000	2,064,000	12,220,000

ID#BS2BN

TOTAL LAND REQUIREMENTS
WWTP - 200,000 sq meters

AVAILABLE LAND
0 sq meters

NOTE: Includes LE 0.8 million uncommitted sub-project disbursement.

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199

TABLE 4

ANALYSIS OF WATER TREATMENT TECHNOLOGY ALTERNATIVES

BENI SUEF WATER AND WASTEWATER MASTER PLAN

TECHNOLOGY	CAPITAL COST (1987 $)	ANNUAL OPERATION COST (1987 LE)	ANNUAL MAINTENANCE COST (1987 LE)	LAND REQUIRED (sq meters)	RELIABILITY
Conventional Dual Media, High Rate Filtration	7,436,000	309,000	34,000	11,000	Extremely high levels of skill are req... Proper chemical feed rates & flocculation are extremely important; filter operation is critical.
Dual Media, High Rate Direct Filtration	4,893,000	209,000	27,000	8,000	Very high levels of skill are required. Proper chemical feed rate is important; filter operation is extremely critical.
Slow Sand Filtration	6,353,000	187,000	46,000	18,000	Low levels of skill are required. Curing of filter is important.

NOTES: Based upon 300 lps treatment capacity.
These costs do not include design (15%), contingencies (15%), or construction management (3%).

ID#T4BS

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TECHNICAL ANNEX

MINIA

INDEX

SECTION 1 - Current Status

1.1 WATER..... 1 - 3
1.2 WASTEWATER..... 3 - 4

SECTION 2 - Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION..... 5
2.2 WATER TREATMENT..... 5
2.3 WATER DISTRIBUTION..... 6
2.4 WASTEWATER COLLECTION..... 7
2.5 WASTEWATER TREATMENT..... 7 - 8
2.6 WASTEWATER DISPOSAL..... 8

SECTION 3 - Evaluation of Technical Alternatives

3.1 WATER TREATMENT..... 9 - 13
3.2 IMPROVING EXISTING WATER DISTRIBUTION SYSTEM..... 13 - 18
3.3 EXTENSION OF WATER DISTRIBUTION SYSTEM..... 18 - 20
3.4 REHABILITATION OF WASTEWATER COLLECTION SYSTEM..... 20 - 23
3.5 EXTENSION OF WASTEWATER COLLECTION SYSTEM..... 23 - 25
3.6 WASTEWATER TREATMENT..... 25 - 28
3.7 WASTEWATER DISPOSAL..... 28 - 29

SECTION 4 - Needs and Proposed Actions..... 30 - 33

SECTION 5 - Recommended Implementation Plan

5.1 GENERAL..... 34
5.2 WATER..... 34 - 35
5.3 WASTEWATER..... 35 - 36
5.4 SUPPORT..... 36
5.5 PHASE I..... 36
5.6 PHASE II..... 37

MINIA

Section 1

Current Status

1.1 WATER

Distribution

The existing water distribution system consists of both cast iron , steel, and asbestos-cement pipe. Pipe diameters range from 100 mm to 500 mm.

Both below ground and pillar type fire hydrants have been installed. Most of the hydrants are inoperative.

Twenty public fountains are an integral part of the distribution system. Generally, these fountains discharge water continuously rather than as needed. Drainage around the fountains is extremely poor in most cases.

"Unaccounted-for-water" is estimated to be approximately one-half of that leaving the water treatment plant. It is suspected that leaking valves and pipe joints contribute significantly to this volume. Wastage due to the public fountains is another factor. However, the extremely poor condition of the water meters used throughout the system make the water use estimates suspect.

In many areas, the distribution network is not very well looped. This poor network coupled with the extensive use of small diameter lines contributes to pressure problems in some areas of the city. System pressures are reported to range between nil and 37 metres.

The public reportedly has complaints regarding the taste of the water.

Transmission and Storage

There is no transmission system other than parallel 400-mm and 500-mm diameter lines which go from the water treatment plant sites south along the Corniche approximately 1 kilometre to the downtown area. High service pumps located at the two treatment plants pump treated water directly into the distribution system via these transmission lines.

Minia has two concrete elevated storage tanks (500 cubic metres and 1,000 cubic metres) which are currently out-of-service. Both tanks are located within close proximity to the water treatment plant site,

and are therefore of limited benefit in stabilizing flow and pressure throughout the distribution system.

Treatment

Minia is served by two adjacent water treatment plants. The Old Water Treatment Plant has a design capacity of 120 litres per second and the New Water Treatment Plant has a design capacity of 200 litres per second. The current water demand is estimated at about 500 litres per second during the summer months.

The Old Water Treatment Plant was constructed in 1927. The chemical feed equipment has been allowed to deteriorate to a state of ruin. Major plant components appear to be in good condition considering the age of this facility. The basic design concept minimizes the amount of mechanical equipment used. Mechanical equipment is not used for chemical mixing, flocculation, or sludge collection. The current level of operation is such that it is not possible to evaluate the effectiveness of the design concept. Alum is currently being added by filling plastic buckets with chunks of alum and then lowering the bucket into the combination flocculator/clarifier units. There is no evidence of floc formation in these units. The rate-of-flow controllers do not appear to function properly.

The New Water Treatment Plant was built in 1964. This facility utilizes basically the same process as the Old Plant; however, there are mechanical components in the flocculator/clarifier units. The effective size of the filter media appears to be too large. Breakthrough of the media has occurred in the filtration units. Though this plant is plagued with problems similar to the Old Plant, it does have functioning instrumentation. Basic plant components are in fair condition.

Lack of laboratory facilities hampers operation at both treatment plants. The existing level of operation at both plants is insufficient to ensure that the public will have access to a consistently reliable source of potable water. Neither plant approaches operation at an adequate level let alone optimum efficiency.

Supply

Minia has raw water intake structures/pumping stations on both the Nile River and the Ibrahemeyah Canal. In addition, there are five wells which pump directly into the distribution system.

The Nile River intake structure/pumping station was recently rehabilitated as part of a sub-project. Currently, the Nile River is the sole source of supply for both treatment plants.

123

The Ibrahemeyah Canal supply is reportedly out-of-service at the present time, and in need of rehabilitation.

1.2 WASTEWATER

Collection

The existing collection system consists primarily of vitrified clay pipe with oakum joints. Manholes are constructed of clay bricks. Sewer connections are always made at a manhole and never directly to the sewer main.

Infiltration does not appear to be a major problem in Minia due to the fact that the groundwater table is low.

Transmission

Minia has a multitude of pumping stations. Two major pumping stations discharge directly to the wastewater treatment plant. A third major pumping station is currently being constructed by NOPWASD. There are also three sub-stations which transmit wastewater to the main stations. In addition, there are seven smaller lift stations serving specific needs or minor areas.11 of the stations visited appeared to be reasonably well maintained.

Wet well storage capacity is limited. This coupled with manual operation of the pumps and poor operating procedures leads to surcharging of the gravity collection systems. All of the existing stations are in need of general rehabilitation.

The new station being built by NOPWASD suffers from poor quality of concrete construction, poor quality of cast pipe and fittings, and some minor defects. The basic design , with the exception of the screening facilities, appears to be satisfactory though somewhat elaborate.

Existing force mains reportedly are cement-lined ductile iron pipe. Aggressive soils are causing pipe corrosion which results in breaks or failures.

Treatment

The existing wastewater treatment facility uses trickling filters to provide secondary treatment. The existing facility has a design capacity of approximately 160 litres per second; the current flow into the plant is about equal to the design capacity.

Numerous operational and maintenance problems are associated with the treatment facility in Minia.

Limited wastewater analyses are available. The available data suggests that infiltration is not a problem, and that minimal treatment is provided.

It is difficult to assess the operational capabilities of the staff due to the fact that the trickling filters are currently out-of-service for rehabilitation. In addition, a large volume of the wastewater flow to the plant is being bypassed. However, it would appear that the existing level of operation and maintenance is substandard.

Though the primary and secondary clarifiers are receiving wastewater, they appear to be virtually non-functional. Sludge and scum accumulations appear to present significant problems.

The trickling filters are currently out-of-servive in order to permit reconstruction of the underdrains and replacement of the media. The design of the filters is such that it is not possible to periodically flood them with a chlorine solution tin order to reduce ponding problems.

Routine cleaning of treatment units is not routinely performed. The plant site is not well maintained.

Laboratory analyses are not available for the control of chlorine feed rates or to diagnose performance of the various plant components.

On the positive side, pumps appear to be fairly well maintained and an ultrasonic flow meter has recently been installed at the Parshall flume. In addition, the chlorination equipment appears to be functional.

Disposal

Discharge of the treatment plant effluent is to an agricultural drain. The effluent does not appear to have a major impact upon the drain due to the large upstream flow and the relatively swift velocity in the drain. With the exception of some large animals bathing, the drain does not appear to impact adversely upon nearby villages.

205

MINIA

Section 2

Technical Alternatives for Proposed Water and Wastewater Interventions

2.1 NO ACTION

One alternative is to take no action. In this alternative, no additional improvements would be made to either the water system or the wastewater system. Under this alternative it would be impossible to maintain even the status quo. Continued development within and around Minia would create additional demands upon the existing facilities. The physical condition of these facilities is such that the various system components are rapidly distintegrating due either to age or poor quality of construction.

2.2 WATER TREATMENT ALTERNATIVES

The primary objective of the water treatment process is to produce water which is safe for human consumption and use. A secondary objective is to produce water which is aesthetically appealing to the consumer.

The team has identified several technical alternatives for the treatment of water from the River Nile:

* A slow sand filtration process or biological filtration process. Major process components would include filter units and chlorination facilities. Filter media would be manually cleaned.

* A conventional rapid rate sand filtration process. Major components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A dual media, high rate filtration process. Major process components would include rapid mix chambers, flocculation basins, sedimentation basins, filter units, and chlorination facilities.

* A direct filtration process utilizing dual media, high rate filters. Major process components would include rapid mix chambers, flocculation basins, filter units, and chlorination facilities. The major differences between this alternative and the above high rate filtration process are the lack of sedimentation basins and the smaller size of the flocculation basins.

2.3 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WATER DISTRIBUTION SYSTEM

The water distribution system should be capable of delivering clean, treated water to the consumer at an adequate pressure and in sufficient volume to meet everyday needs.

The team has identified several technical alternatives for improving the distribution of water in the existing system:

* A leak detection program of main lines followed by line repair of major leaks using pipe clamps and/or line replacement.

* A line cleaning program to remove accumulated sediment using pipe "pigs" or other appropriate equipment. In addition, fire hydrants and blow-offs would be added at critical points.

* Reinforcement of the distribution system by increasing transmission line sizes, looping dead-end lines, and inter-connecting lines at intersections.

* Additional elevated storage facilities throughout the distribution system--
  - Steel tanks,
  - Reinforced concrete tanks.

* Installation of flow limiting devices at all public fountains and residential connections.

* Improvement of drainage at all public fountains.

Technical alternatives for the extension of the distribution system have been limited to:

* Water demand criteria--
  - Instantaneous demand,
  - Fire demand.

* Materials of construction for pipelines--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

* Water meters--
  - Install at all connections,
  - No water meters,
  - Install at major users.

207

2.4 ALTERNATIVES FOR REHABILITATION AND EXPANSION OF WASTEWATER COLLECTION SYSTEM

The wastewater collection system should be capable of removing wastewater from the community in a safe, efficient manner.

The team has identified several technical alternatives for improving the existing system:

* An inflow/infiltration study of the sewers followed by repair of major leaks by line replacement and/or the use of liners.

* A sewer cleaning program to remove debris and sediment using sewer balls or other appropriate equipment.

* Rehabilitation and upgrading of pump stations.

* Repair, replacement, and/or reinforcement of force mains.

* Replacement of under-sized collectors.

Technical alternatives for the extension of the collection system have been limited to:

* Design criteria regarding manhole spacing, service connections, and pump station sizing--
  - NOPWASD standards,
  - Standard engineering practices.

* Materials of construction for sewers--
  - Vitrified clay (VC),
  - Polyvinyl chloride (PVC),
  - Reinforced concrete,
  - Prestressed concrete cylinder.

* Materials of construction for force mains--
  - Polyvinyl chloride (PVC),
  - Asbestos-cement (AC),
  - Cast iron (CI),
  - Ductile iron (DI),
  - Glass reinforced plastic (GRP).

2.5 WASTEWATER TREATMENT ALTERNATIVES

The primary objective of the wastewater treatment process is to reduce the health risks associated with the disposal of wastewater.

The team has identified several technical alternatives for the treatment of wastewater from Minia:

208

* A primary treatment facility. Major process components would include screens, grit chambers, clarifiers, chlorination facilities, and sludge drying beds.

* A secondary treatment facility using a trickling filter process. Major process components would include screens, grit chambers, primary clarifiers, trickling filters, secondary clarifiers, chlorination facilities, and sludge drying beds.

* A secondary treatment facility using stabilization ponds. Major process components would include screens, stabilization ponds, maturation ponds, and chlorination facilities.

2.6 WASTEWATER DISPOSAL ALTERNATIVES

The desired disposal alternative should be one which minimizes the health risks to adjacent communities and minimizes damage to water bodies.

Disposal alternatives have been limited to the following:

* Discharge to El Muhit El Gharbi agricultural Drain (the current discharge point).

* Irrigation of reclaimed agricultural lands on the east bank of the River Nile.

209

Section 3

Evaluation of Technical Alternatives

3.1 WATER TREATMENT ALTERNATIVES

* Slow Sand Filtration

The use of slow sand filters would appear to be a good application of appropriate technology in Minia. The skills required to maintain and operate such a facility could realistically be developed in a relatively short time frame (3 to 6 months). The process is simple, yet highly reliable. The major disadvantage would appear to be the large area of land required for such a facility (approximately 14,000 square metres for a 600 litre per second plant).

Due to the low reported turbidities of the raw water (4 to 8 NTU), it should not be necessary to precede the filtration process with plain sedimentation basins. However, it may be necessary to provide microscreening facilities for algae removal.

The slow sand filtration process itself would not involve pumping; however, pumping would be required to transport raw water to the plant and then finished water from the plant. There would also be some minor power consumption associated with the chlorination facilities and the administration building.

The slow sand filtration process does not require rapid mix chambers, flocculation basins, or sedimentation basins. The filters are of a very simple design and do not require a backwash system. The construction of the plant would be a relatively simple operation, and could be accomplished using materials available within Egypt. However, it is recommended that microscreens be imported and installed prior to the filters. Maintenance would be facilitated by the ready availability of replacement components.

The simplicity of operation, lack of dependence upon imported chemicals, and absence of a power requirement should lead to a very reliable and consistent operation.

Advantages

- Chemicals are not essential to the treatment process.

- Electrical power is not essential to the treatment process.

210

- There are extremely few mechanical components.

- Replacement components are readily available on the local market.

- Unskilled labor can be used for many plant functions.

- Simplicity of operation and maintenance.

- Simplicity of design and construction.

- Laboratory monitoring requirements for process control are minimal.

Disadvantages

- Large land area required (approximately 10 times the area of land required for a rapid filtration process).

- Filters are subject to upset if there are sudden and severe fluctuations in water quality.

- Certain types of algae may interfere with the filter operation.

- During the filter curing stage, there is the potential for an unskilled operator to introduce partially treated water into the distribution system. However, the problem is not extremely critical due to the fact that even during the curing stage the filter should be able to produce a finished water with a turbidity of less than 2 NTU.

- Greater loss of sand filter media can be expected as a result of the manual scraping required to clean the filters.

- Introduces a new, unfamiliar treatment concept to Minia.

* Rapid Rate Filtration

Minia currently uses a rapid rate filtration process to treat water. Rapid rate filters operate at rates (approximately 120 m/d) on the order of magnitude of about 30 times those of slow sand filters. In order to reduce the frequency of the filter backwash cycle, it is necessary to remove the bulk of the suspended matter prior to the filters. Alum addition, rapid mix chambers, flocculation basins, and sedimentation basins are all part of the process of preparing the raw water for application to the filter beds. Due to the frequency of cleaning required for the filter beds, it is necessary to install a backwash system to clean the filters.

Major advantages of this process are the small land area required (approximately 1,500 square metres for a 600 litre per second plant) and the familiarity of the existing staff with this process. The

major disadvantage is that the system requires operation skills not currently available in Minia; the existing facilities are not properly operated and maintained.

Construction of a conventional rapid rate filtration plant is complex; however, numerous contractors are familiar with this type of facility. Numerous components would have to be imported.

Proper operation and maintenance of a rapid rate filtration plant requires a staff of skilled operators, maintenance personnel, and laboratory technicians. In spite of the fact that the existing facilities utilize this process, Minia lacks the institutional support and human resource skills to operate such a system. To achieve the minimum level of skills required, the staff would need 18 months or more of training. In addition, considerable investment would be required in support facilities.

Advantages

- Process is commonly used throughout the world, and is presently used in Minia.

- Process is capable of producing a finished water of excellent quality.

- Land area required is not excessive.

Disadvantages

- Process is complex and difficult to operate.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from sedimentation basins.

* Dual Media, High Rate Filtration

This process is very similar to the rapid rate filtration process. However, it introduces the use of coal in the filter media in addition to the sand, and uses a higher rate of filtration (approximately 240 m/d).

The major advantage of this system is that the filter area is further reduced, thus the construction cost is also reduced.

In all other aspects, the system is virtually identical to the rapid rate filtration process with the exception of the increased frequency of backwash that is required.

Advantages

- Process is virtually identical to the rapid rate filtration process which is presently used in Minia.

- Capability of producing a finished water of excellent quality.

- Land area required is less than a slow sand filter process or a rapid filtration process.

- Minor redundancy in system. If upstream units operate at less than optimum levels, it is still possible to produce a finished water of good quality by placing a greater burden on the filters.

Disadvantages

- Process is complex.

- Imported chemicals are essential to proper operation.

- Imported parts are required to maintain the system components.

- Filters require frequent backwashing.

- Sludge must be removed periodically from the sedimentation basins.

* Direct Filtration

The direct filtration process is similar to the dual media, high rate filtration process; however, the flocculation basins are of a reduced size and the sedimentation basins are eliminated altogether. Chemicals are added to destabilize the suspended matter rather than to create a floc which will slowly settle with the suspended matter adhering to it. All of the suspended matter is removed by the filter media; this is made possible by the use of a dual media filter for more efficient in-depth filtration.

The major advantage of this process is that construction costs are substantially reduced (approximately by 1/3 that of a conventional rapid rate filtration facility). The major disadvantage is that proper filter operation becomes extremely critical.

The operation of a direct filtration process is less complex than a conventional process; however, the filters require increased attention and more frequent backwashing.

213

Chemical costs typically are less with this process than a conventional process. However, the increased frequency of backwashing results in slightly higher power costs.

Advantages

- Substantially less chemicals are required than for a conventional plant.

- Operation is less complex than for a conventional plant.

- Construction costs are approximately 1/3 less than for a conventional plant.

- Land area required is minimal.

Disadvantages

- The filters must be monitored constantly and be properly maintained.

- The filters should be cured for approximately 1 hour after each backwash cycle.

- Imported chemicals are essential to proper operation.

- Expensive polymers may be required to optimize plant operation.

- Imported parts are required to maintain the system.

3.2 ALTERNATIVES FOR IMPROVING THE EXISTING WATER DISTRIBUTION SYSTEM

* Leak Detection and Line Repair

It is estimated that approximately one-half of the water leaving the treatment plant is unaccounted for. If this figure could be substantially reduced, the need for expanded treatment facilities would be reduced and operation costs would be lowered.

A useful rule-of-thumb is that 20% of the leaks in a distribution network account for 80% of the water loss. For the most cost-effective solution, it is recommended that efforts be concentrated on the major leaks. A goal of reducing the unaccounted for water to approximately 25% of that leaving the treatment plant should be established.

New, sophisticated equipment permits accurate and quick leak detection. Unfortunately, this equipment is expensive and requires considerable skill in its proper use. Normally, it is desirable to

contract with a firm specializing in this field to conduct the leak detection program. The line repair work can be performed by city personnel or a local contractor.

Often leaks can be repaired quickly with a simple repair clamp. Where leaks are the result of deteriorating lines, whole sections of pipe may have to be replaced.

Advantages

- Low cost of leak detection program.

- Potential for substantially reducing investment in new capital structures.

- Potential for substantially reducing operation costs associated with treatment and pumping of wasted water.

- Offers relatively quick results.

Disadvantages

- Leak detection equipment is expensive and sophisticated. Skilled personnel are needed for the leak detection program.

- Results are uncertain.

- Impossible to accurately estimate the costs for the repair work in advance of the leak detection survey.

* Line Cleaning Program

Line sediment and deposits which coat pipe walls can substantially reduce the carrying capacities of lines. This reduced carrying capacity can result in increased pumping costs and can create pressure problems.

The magnitude of the problems created by deposits and sediment is extremely difficult to guage.

New, hydraulically driven pipe "pigs" are relatively expensive, and are easy to use. However, access points (launchers) are required for the introduction and removal of the pigs. These launchers may be somewhat expensive to install.

If the pigs cannot clear the system, it is necessary to use more expensive mechanical scraping equipment.

215

Once the investment has been made in the purchase of pigs, pumps, and launchers, a routine line cleaning program can be economically established. Blow-off assemblies and fire hydrants could be installed at strategic locations to facilitate the line cleaning program. This program can be conducted by city personnel.

Advantages

- Low cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing pumping costs.

- Potential for improving water pressure in many areas.

- Program can be performed quickly.

Disadvantages

- Results are unpredictable.

- Installation of launchers for the pipe pigs can be expensive, particularly in high density areas.

- If sediment and/or deposits are extremely heavy, the pipe pigs may not be able to clean the lines.

* Reinforcement of Distribution System

A computer analysis of the pipe network can be conducted to determine where deficiencies occur. These deficiencies can then be alleviated by strategically locating new mains, paralleling existing transmission mains, or in an extreme case, replacement of existing mains with larger sized pipe.

Dead-end lines can be extended and connected to nearby mains and lines crossing at road intersections can be interconnected to improve the hydraulics of the network.

Advantages

- Computer analyses can be performed at low cost.

- Benefits of network reinforcement can be clearly demonstrated once the computer analysis is performed.

- Line reinforcement can allevitate pressure problems and reduce pumping costs.

Disadvantages

- If major reinforcement of the network is needed, the capital cost can be high.

* Additional Elevated Storage

Additional elevated storage facilities could substantially improve the delivery of water to the consumer. The logical location for additional tanks would be in those areas furthest from the water treatment plant; however, the exact locations should be determined as part of a hydraulic analysis of the water transmission system.

Elevated storage tanks are expensive to construct, but are fairly economical to maintain. Generally, the use of elevated tanks is preferable to the use of ground reservoirs in combination with booster stations.

Reinforced concrete tanks are usually used in Egypt; however, steel tanks offer an attractive alternative. Maintenance costs for steel and concrete tanks are roughly equivalent. Steel tanks can be erected somewhat quicker and at a slightly lower cost. The concrete tanks could be constructed by local contractors, but steel tanks would be erected by one of several American firms.

Advantages

- Potential for improving water pressure in many areas.

- Low operation and maintenance cost.

- Ease of operation.

Disadvantages

- Long construction time required to erect tanks.

- High capital cost.

* Flow Limiting Devices

The installation of flow restrictors at all public fountains and at residential connections could significantly reduce water consumption. Such limiting devices would make it difficult for the consumer to use excessive quantities of water. This can be a very important consideration in a society where the minimum needs of the public are guaranteed. Restriction of water usage would permit a more equitable distribution of available treated water.

217

Potential benefits would be the reduced size of treatment facilities required, and reduced operation costs.

The material cost of the static restrictors is very low and the installation cost is not excessive.

Advantages

- Low cost of installation and maintenance.

- Potential to reach more consumers.

- Potential for reducing investment in new capital structures needed for excessive water demands.

- Potential for reducing operation costs associated with treatment and pumping of excessive amounts of water.

- Work could be performed by city personnel.

Disadvantages

- Public resistance to limited availability of water.

- Difficulties associated with those connections serving multiple users.

- Water conservation may hinder good hygiene practices.

* Improved Drainage at Public Fountains

Generally, the public fountains in Minia are not well maintained. Ponded water around each of the fountains is typical. Organic matter from the cleaning of pots and pans is in evidence. It would be desirable to separate the water distribution function and the washing/cleaning function at each fountain. Fountains should only be located where adequate drainage to either a public sewer or an open drain can be provided. Fountains should be mounted on a solid base at an elevation well above ground level.

The public fountains serve a substantial portion of the population. Sanitary conditions should be maintained at the fountains. Landscaping and regular maintenance should be performed in order to create an atmosphere more conducive to cleanliness.

Advantages

- A large segment of the population would receive improved service at an extremely low cost.

- Public health should improve.

- The community would be more attractive.

Disadvantages

- Difficult to maintain sanitary conditions at the public fountain sites. Present users habits are ingrained.

3.3 ALTERNATIVES FOR THE EXTENSION OF THE WATER DISTRIBUTION SYSTEM

* Water Demand Criteria

A major considêration in the extension of the system is the water demand criteria which will be used to size lines and other facilities. Decisions must be made as to whether or not unlimited demands will be met or whether use will be restricted. Considering the difficulty in satisfying current demands and the high cost of new facilities, it may be advisable to severely limit water usage in order to guarantee equitable water distribution. In addition to the basic user demands upon the system, consideration must be given to water losses within the system. In the case of Minia, current losses may be approximately equal to the user demand.

The consultant has estimated that the year 1983 per capita water demand was about 205 litres per day (lpd); the year 2000 per capita demand is projected to be 210 lpd. This is an aggregate per capita demand which includes governmental, industrial, and commercial uses. Unaccounted-for water has been estimated at 50% of the water leaving the treatment plant, but will be reduced to 25% by the year 2000. The consultant has arrived at a year 2000 average daily summer demand (1.25 times average daily demand) of 862 litres per second (lps).

Due to the limited availability of funds, it is extremely doubtful that the city will be able to provide central service to all areas within the current city limits. It is also unlikely that service can be extended to New Minia (the East Bank). By eliminating service to the East Bank, assuming severely restricted expansion of central service within the city, limiting water consumption, and reducing system losses, it would be possible to significantly reduce the proposed design capacity of the system.

Infinite variations in the demand are possible. One example would be to reduce water losses to 20%, to restrict domestic water consumption to 100 lpd per capita, and to limit central service to about 65% of the population. The resulting projected year 2000 water demand would then be calculated as follows:

219

1. Year 2000 Minia population (excludes New Minia) -- 261,947

2. Percent Year 2000 population served by central system -- 65%

3. Percent Year 2000 population served by public fountains -- 35%

4. Year 2000 per capita demands -- 100 lpcd for central system
   40 lpcd for public fountains
   65 lpcd for governmental, industrial, and commercial uses

5. Water losses -- 20% of base demand

6. Summer demand factor -- 1.25 times average daily demand

7. Calculations:

261,947 x 0.65 x 100	=	17,026,555
261,947 x 0.35 x 40	=	3,667,258
261,947 x 65	=	17,026,555
		37,720,368 lpd
37,720,368 / 24 /60 / 60	=	437 lps
437 x 1.20	=	524 lps average daily
524 x 1.25	=	655 lps average daily summer

Thus, an average daily summer demand of 655 lps for the year 2000 is one of numerous alternatives.

* Materials of Construction for Pipelines

Highly corrosive soils in Minia are believed to be the cause of rapid deterioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are of poor quality and not generally available with mechanical joints. The Jabault couplings used with locally produced asbestos-cement pipe offer only limited deflection at the pipe joints. The local asbestos-cement pipe is generally of good quality; however, the short sections used result in an excessive number of joints in the pipeline, and thus increase the potential for leakage. Polyvinyl chloride (PVC) pipe has recently been introduced in Egypt; however, its availability and quality have not yet been adequately established. The PVC pipe is available with bell and spigot, gasketed joints and is produced in longer sections than the asbestos-cement pipe. Glass reinforced plastic (GRP) pipe is

220

also available locally. Both PVC pipe and GRP pipe are relatively easy to install. Prestressed concrete cylinder pipe is commonly used for larger diameter lines; however, it is rather difficult to work with.

* Water Meters

Water meters offer the City the opportunity to conserve water usage. However, such conservation can only be achieved if the installation of meters is coupled with a rate schedule which assesses rates which are sufficiently high to discourage waste. Water meters require periodic calibration and overhaul. In addition, personnel are required for the meter readings. Records of the readings must be maintained and incorporated into the billing system.

Installation of water meters at connections for major users and the use of a flat rate for residential users and small businesses is a compromise which can often be more cost-effective than metering all users. However, here again a realistic rate schedule is required if the meters are to be effective.

3.4 ALTERNATIVES FOR THE REHABILITATION OF THE WASTEWATER COLLECTION SYSTEM

* Inflow/Infiltration Study and Line Repair

The draft Master Plan has concluded that infiltration in Minia is negligible due to the low water table.

A simple inflow/infiltration study could be conducted to localize the areas of greatest concern. Efforts would be concentrated on the major problem areas in order to maximize the effectiveness of the line repair program.

The installation of liners in problem areas would be a relatively simple task. Due to the fact that house connections in Minia are only made at manholes, it would not be necessary to excavate each service connection and cut an opening in the liner for the connection.

A specialized firm would be required to install the liners.

Advantages

- Low cost of inflow/infiltration study.

- Potential for substantially reducing investment in new capital structures.

221

- Potential for substantially reducing operation costs associated with treatment and pumping of infiltration.

Disadvantages

- Specialized equipment is required for the installation of the pipe liners. Skilled personnel are needed to install the liners properly.

- Potential effectiveness of program cannot be gauged until after the inflow/infiltration study is completed.

- Impossible to accurately estimate costs for the repair work in advance of the inflow/infiltration study.

* Sewer Cleaning Program

Deposits, grease accumulations, and debris can substantially reduce the carrying capacities of sewers. This reduced line capacity can result in frequent backups of sewage and even flooding.

Sewer cleaning equipment has been purchased by Minia as part of a sub-project. An ongoing cleaning program could easily be established by the City.

Advantages

- Moderate cost of equipment.

- Work can be performed by city personnel.

- Potential for reducing sewage backups and flooding incidents.

- Ongoing program can be established.

Disadvantages

- Success of completed project may be difficult to gauge.

- To be truly effective, project should be conducted in conjunction with other programs such as improved sewer construction techniques, improved pump station operating techniques, etc.

* Pump Station Improvements

The surcharging of sewers which results from the improper operation of pump stations can contribute significantly to problems with grease, sediment, and debris accumulating in the sewers. The pump stations could be operated in accordance with generally accepted practices if

222

adequately sized wetwells, properly sized pumps, and reliable control systems were provided.

Upgrading of stations to meet existing and projected demands would improve the reliability of the service. Further improvements in reliability could be provided with the addition of standby pumps, bypass piping with valves, pressure gauges and wetwell level indicators, standby power generators, alarm systems, an inventory of spare parts, and O&M manuals.

The cost of a major rehabilitation program would be fairly high; however, the station structures appear to be fairly sound, and rehabilitation should therefore be somewhat cheaper than new construction.

Advantages

- Improved service reliability.

- Improved hydraulics in gravity sewer system. This would reduce problems with solids accumulations in the sewers.

Disadvantages

- High cost of major rehabilitation program.

- Length of time required to perform rehabilitation work.

* Force Main Improvements

Properly sized force mains can reduce friction losses and thus in turn reduce power consumption at the pump stations. A hydraulic analysis of the force main system would permit the economical sizing of force mains and permit a determination of optimum head conditions for each pump station.

Air release valves and blow-off assemblies could improve operating conditions and facilitated maintenance of force mains.

The hydraulic analysis of the system could be performed inexpensively and quickly. Replacement and/or paralleling of existing force mains could be expensive. The addition of air release valves and blow-off assemblies at critical locations could be done for a relatively low cost.

Advantages

- Reduced pumping costs.

223

- Elimination of potential problems due to air lock and solids accumulation.

- Low cost hydraulic analysis would permit the City to evaluate potential power savings prior to proceeding with expensive line replacements and/or paralleling.

Disadvantages

- High cost of major improvements.

- Difficulty in estimating improvements attributable to new air release valves and blow-off assemblies.

* Replacement of Undersized Collectors

Replacement of undersized gravity collectors in major problem areas would reduce sewage backups and flooding incidents.

A high initial cost is associated with the replacement of undersized sewers; however, properly sized and sloped sewers provide cost-effective, reliable service.

Advantages

- Reduced maintenance costs.

- Improved service. Reduced incidents of flooding and sewage backups.

Disadvantages

- High construction cost.

3.5 ALTERNATIVES FOR THE EXTENSION OF THE WASTEWATER COLLECTION SYSTEM

* Modification of Design Criteria

A major consideration in the extension of the collection system is the design criteria to be used for manhole spacing, service connections, and pump station sizing. Extremely conservative criteria can result in excessive, and unnecessary, construction costs and thus reduce the capability of the City to extend service. On the other hand, inadequate standards can result in poor service and high operation and maintenance costs.

Existing criteria used in Minia for spacing of manholes calls for 30 metres of separation for line diameters of 180 mm to 225 mm. Manhole

224

spacing of between 91 metres and 122 metres has been successfully employed in other countries for 200 mm diameter sewers.

Currently, all service connections must be made at a manhole. Main line connections are typically used in other countries.

The use of improved materials of construction and the availability of modern sewer cleaning equipment would make it feasible for Minia to relax existing standards regarding manhole spacing and service connections. If existing construction practices are continued, it would probably be best to maintain existing standards.

If pump stations could be properly operated and maintained, it would be possible to build stations to less restrictive standards. Currently, NOPWASD encourages considerable duplication in pumping capacity; the rated capacity of a station may often be only one-half of the in-place capacity. Existing standards result in substantial additional costs for each pump station constructed.

Advantages

- Substantial reductions in capital cost.

Disadvantages

- If relaxation of standards is not coupled with improved materials of construction and improved pump station maintenance, system performance may be substantially affected.

* Materials of Construction for Sewers

Existing sewers in Minia are constructed of vitrified clay (VC) pipe. Due to the non-availability of gasketed joints for locally manufactured VC pipe, cement mortar is used to seal the joints. In order to protect the rigid joint which is created by the cement mortar, it is necessary to protect the entire pipeline with a concrete bedding. The numerous joints associated with the short pipe sections and the method of pipe jointing can contribute to substantial leakage problems.

Polyvinyl chloride (PVC) pipe is relatively new to the Egyptian market, and has not yet been used extensively. However, PVC pipe appears to be readily available and of reasonable quality. The PVC pipe is available with gasketed, bell and spigot joints. Advantages of the PVC pipe are ease of installation, tightness of joints, longer pipe sections result in fewer joints, and lower in-place cost. A disadvantage is the limited range of pipe diameters available.

225

Reinforced concrete pipe and prestressed concrete cylinder pipe are often used for large diameter sewers. These alternatives are economical; however, the inner surface of the pipe is subject to degradation by hydrogen sulfide unless a protective liner or coating is provided. Due to the weight of a section of concrete pipe, it is rather difficult to install.

* Materials of Construction for Force Mains

Highly corrosive soils in Minia are believed to be the cause of rapid detioration of cast iron pipes; therefore, new lines of cast iron or ductile iron should be adequately protected against corrosion. Locally manufactured cast iron pipe products are generally of poor quality and not available with mechanical joints.

Polyvinyl chloride (PVC) pipe is now being manufactured in Egypt. PVC pipe is easy to work with and relatively inexpensive to install.

Asbestos-cement (AC) pipe is available locally and is of good quality. The Jabault couplings used in Egypt offer limited joint deflection and are subject to displacement in poor soil conditions. The inner walls of the pipe are subject to attack by hydrogen sulfide.

Glass reinforced plastic (GRP) pipe is also used in Egypt. It is easy to install, but has a relatively expensive material cost.

3.6 WASTEWATER TREATMENT ALTERNATIVES

* Primary Treatment

The major advantages of a primary treatment facility in Minia would be the low cost and the ease of operation and maintenance. The existing staff could realistically achieve in short time frame the necessary level of skills required for the proper operation and maintenance of such a facility.

The major disadvantage of this alternative is the minimal levels of treatment provided. If the existing discharge to El Muhit El Gharbi Drain is continued, further detioration of the drain can be expected.

Primary facilities have the capability of removing most of the grit and floating solids from the wastewater. A substantial portion of the suspended matter can be removed and the bio-chemical oxygen demand (BOD) can be reduced.

Primary clarifiers are the major initial element of many secondary treatment processes, thus they can form the first stage of a staged construction program for secondary treatment.

Adequate sludge handling facilities are required if the clarifiers are to be properly maintained. Initially, the raw sludge could be pumped from the clarifiers to drying beds; later anaerobic digestors could be added if appropriate.

Advantages

- Ease of operation and maintenance. Good degree of reliability.

- Low construction cost and low operation and maintenance costs.

- Can be incorporated into future, secondary treatment facilities.

Disadvantages

- Limited level of treatment provided. Cannot meet existing water quality standards for discharge to surface water bodies.

* Trickling Filters

A trickling filter process would involve the addition of trickling filter units and secondary clarifiers to the previously described primary treatment process. Trickling filters have the capability of substantially improving the degree of treatment.

The exact degree of removal obtainable by this process is dependent upon numerous factors such as filter area and depth, number of stages, media type, and recirculation rates. Trickling filter plants are typically designed to provide BOD removals of anywhere from 65% to 85%.

This alternative requires skilled operators. The existing trickling filter facility in Minia is not operated to its capability. Considerable training would be required to upgrade the skills of the existing staff.

Advantages

- Easier to operate and maintain than many secondary processes.

- Lower operating cost than many secondary processes.

- Relatively high levels of treatment are obtainable on a consistent basis if properly operated.

Disadvantages

- Skilled operators are required. Improper operation can drastically reduce effectiveness.

* Stabilization Ponds

Stabilization ponds would represent an excellent application of appropriate technology in Minia. The operation and maintenance of stabilization ponds is extremely simple. The climate in Egypt is well suited to this type of treatment process. There is virtually no mechanical equipment required. Power consumption is virtually nil.

The degree of removal obtainable is dependent primarily upon detention time. Operation in series and the use of anaerobic lagoons and maturation ponds in conjunction with the stabilization ponds can further improve the treatment capability of the system.

The primary disadvantage associated with the use of stabilization ponds is the extremely large land area required, particularly for high levels of treatment.

Construction can easily be staged to provide progressively higher levels of treatment as flow to the plant increases.

Advantages

- Extremely easy to operate and maintain.

- Simple to construct. Locally available materials and techniques are applicable.

- Very low operation and maintenance cost. Power consumption is virtually nil.

- Relatively stable biological process.

- Construction can be easily staged.

- Sludge disposal problems are greatly reduced.

Disadvantages

- Extremely large land area required.

- Susceptible to weed and odor problems.

3.7 WASTEWATER DISPOSAL ALTERNATIVES

* El Muhit El Gharbi Drain

El Muhit El Gharbi Drain is the existing discharge point for treated wastewater from Minia. El Muhit El Gharbi Drain runs for a distance of about 11 kilometers and then is joined by El Disut Drain.

The Ministry of Irrigation intends to eventually divert the majority of the flow away from El Muhit El Gharbi Drain in order to blend the water from the drain with canal water and use it in the irrigation of agricultural lands.

The existing discharge does not appear to have a major impact upon water quality in the drain. A field survey indicates that dissolved oxygen (DO), bio-chemical oxygen demand (BOD), turbidity, chemical oxygen demand (COD), and phosphate levels all exceed the limitations established in Law 48/1982 for drains which are to be used for irrigation; however, it is not clear whether or not this is a result of the wastewater discharge. The wastewater flow is substantially diluted by the upstream flow. It is estimated that the dilution ratio of the drain flow to the wastewater flow was greater than 8 to 1 at the time of the field survey.

Advantages

- Precedent has been established for discharge to this drain.

- The existing discharge does not appear to have a major impact upon water quality in the drain.

Disadvantages

- The discharge poses a potential health risk to agricultural workers along the route of the drain.

* Irrigation of Reclaimed Land

The Governate of Minia has an ambitious plan to develop the east bank of the Nile. Treated wastewater could be used to irrigate new agricultural lands to be reclaimed on the east bank.

The wastewater from Minia would have to be pumped across the Nile to the east bank. The Ministry of Irrigation is very much opposed to transporting either raw or treated wastewater across the Nile.

Land application systems have the capability of treating wastewater to extremely high levels. The degree of pretreatment required would be dependent primarily upon the type of crops to be grown.

Advantages

- No discharge to a surface water body, thus health risks to the general public are greatly reduced.

- Nutrient application to agricultural lands.

- Minimal treatment required for restricted crop irrigation.

Disadvantages

- Ministry of Irrigation opposed to transporting wastewater across the Nile to the application sites.

- Health risk to agricultural workers.

230

Section 4

Needs and Proposed Actions

Though there are apparently well-qualified personnel associated with the City of Minia, it is apparent that due to either social or cultural reasons their involvement with direct day-to-day operations in the field is extremely limited. Field personnel typically lack sufficient training and skills to operate and maintain those facilities for which they are responsible. The duties of individuals generally are extremely limited in scope. The chain of command is often hazy, particularly in regard to responsibilities. There is a tendency by the individual not to concern himself with those problems which may arise unless these problems are clearly within his area of responsibility. Accordingly, he is either unconcerned or he assumes that someone else will take care of such problems. This lack of initiative appears to be a problem which is deeply rooted within the existing organization. It is an unrealistic expectation to believe that the provision of training alone will eliminate a problem which is essentially a problem of attitude.

There is a strong need to develop a sense of pride in each employee. The use of team concepts might help to achieve such a goal. The employee should realize not only financial reward for his achievements, but also acknowledgement from his superiors.

It is recommended that serious consideration be given to the establishment of an independent organization for the operation and maintenance of the water and wastewater facilities. This organization should have the freedom to hire and fire.

There is a need at the present time to supply each employee with a clean, attractive work environment. At the treatment facilities and pumping station, this means that it is important to clean up inside and outside each of the buildings. Interior components should be painted with bright, cheerful colors. Non-functional equipment should be disposed of. Supplies should be neatly stored. The importance of landscaping should not be underestimated. Housekeeping practices should be applied to vehicles and field equipment also. Vehicles should be washed daily; field equipment should be regularly painted and rehabilitated. The atmosphere at the water and wastewater facilities should be that of a food processing plant.

A central shop should be established in Minia. A preventative maintenance program should be established in conjunction with the construction of this shop. This program should then be expanded to

231

incorporate the water and wastewater facilities. At the current time, preventative maintenance is not practiced in Minia.

Another extremely important need is a safety program. Current safety practices in Minia are horrifying by American standards. The total lack of appropriate equipment and procedures for handling chlorine equipment highlights this concern. Each employee should receive instructions which will make him cognizant of the hazards involved with sewer gases, chemical handling, electrical systems, and mechanical equipment.

There are no operation and maintenance manuals that an interested employee can refer to in order to gain an understanding of basic procedures or for troubleshooting. Arabic language manuals should be developed for all new facilities and for the existing facilities.

A laboratory is needed not only for monitoring overall plant performance, but also for evaluating the effectiveness of each component within the process. This is necessary if the operator is to optimize efficiency at each plant. Laboratory facilities are important to ensure proper chemical feed rates. The laboratory tests which are performed on a daily basis should be those tests which are absolutely essential to the proper operation of the plant. Additional "icing on the cake" type tests should be avoided as they tend to diminish the overall importance of the laboratory program to the operator. Forms should be developed which will ensure proper recordkeeping and which will provide useful information to the system operator. Laboratory and plant personnel must understand the significance of each test and how it relates to their specific duties and responsibilities.

There is a need in Minia for trained inspectors for civil works. A very basic inspection and testing program should be established for the following:

1. Soil compaction,
2. Concrete quality,
3. Pipeline tightness.

Basic equipment should be provided and forms developed which will ensure that the essential elements of civil works are relatively sound. More sophisticated inspection and testing requirements associated with electrical systems, mechanical equipment, and the like would be contracted out to others.

A leak detection survey is needed for the water distribution system. Major leaks should be repaired as discovered. It is suspected that due to the nature of construction of the water lines that there are numerous small leaks rather than a few large leaks. It is therefore

232

questionable whether or not it will be practical to correct more than a handful of such leaks. Therefore, only limited success is projected for this program.

None of the treatment facilities visited are operated properly. Available personnel are years away from being able to develop the necessary skills to properly operate and maintain such facilities. Therefore, it is extremely important that to the extent possible "appropriate technology" be used for all new facilities. Sophisticated equipment such as motorized valves and computer-operated control centers should be avoided. Complex processes such as activated sludge processes in wastewater treatment plants should not be used. Systems should be simple, durable, and reliable. Emphasis should be placed upon a realistically consistent realiability rather than a theoretical capability. For example, it would be better to have a water treatment plant which provides moderate quality drinking water 95% of the time rather than one that has the capability of providing excellent water but will not realistically function in the current environment. It should also be recognized that funding limitations can often place a severe constraint on annual budgets. Therefore, facilities that require large inputs of power or chemicals should be avoided to the extent possible. Similarly, facilities with high maintenance requirements (non-labor) should be avoided.

In regard to the water treatment plant, it is suggested that a slow sand filtration process would be most appropriate to the level of skills projected to be obtainable in the near future. Of course, such a process requires a large area of land. The use of direct filtration or any other sophisticated process would require the use of skilled ex-patriate labor if proper operation is to be ensured. The existing water treatment facilities in Minia could be rehabilitated; however, it should be realized that even a rehabilitated plant would be only marginally acceptable due to the current level of skills available to operate and maintain such a facility.

In regard to the wastewater treatment plant, it is suggested that screening facilities, primary settling units, and chlorination facilities would provide an appropriate level of treatment considering the level of skills realistically obtainable in the near future. Of course, it must be recognized that primary treatment will not meet the requirements of Law 48 in regard to either the plant effluent or the receiving body. The provision of sludge digestion or thickening facilities and adequate drying beds are necessary to ensure that sludge is frequently removed from the settling tanks. It such be realized that the provision of sludge handling facilities will require additional skills for their proper operation. The existing primary settling units appear to be salvageable. It is recommended that funds not be spent to rehabilitate the secondary units at this time.

Additional elevated storage facilities should be strategically located throughout the water distribution system. Several smaller tanks would provide better service than one large tank.

Additional wet well volume should be provided at the wastewater pumping stations. The practice of permitting the gravity sewers to operate under surcharged conditions should be stopped immediately. Rehabilitation of existing pumping stations is recommended. Sizing of pumping stations should be based upon reasonable standards.

Existing practices regarding the construction of water distribution systems and wastewater collection systems should be reviewed. It is suggested that the use of PVC pipe and other modern materials of construction would be more cost-effective than materials currently in use. Design standards appear to be unduly restrictive with little or no improvement in system reliability; it is recommended that only reasonable standards be funded as part of this project.

It is imperative that a program of construction inspection and materials testing be established for the major capital works. This program should be part of a construction management contract for the construction of the water treatment facilities and rehabilitation of the wastewater pumping stations to be performed under the Provincial Cities Development Project.

234

Section 5

Recommended Implementation Plan

5.1 GENERAL

This section contains a recommended implementation plan which will benefit the greatest number of people at the least cost. The majority of the proposed actions do not involve major new structures, but rather maximize the effectiveness of the existing facilities.

5.2 WATER

Emphasis should be placed on investments, including new facilities and rehabilitation of existing facilities, which will improve the quantity and quality of water provided to the served population.

1. Priority should be given to extension of water service concurrently with the extension of wastewater collection into areas which can be most cost-effectively served. A lower priority should be given to fringe areas. It is suggested that a goal of providing central service to about 70% of the year 2000 population be established initially (approximately 60% of the current population is now served).

2. A leak detection survey of main lines in the existing system should be conducted. Major leaks should be repaired; severely deteriorated lines should be replaced.

3. A line cleaning program should be established. Access points for cleaning equipment should be provided. Blow-off assemblies and hydrants should be installed at critical locations.

4. A computer analysis of the pipe network should be performed. Those deficiencies which are identified by the analysis should be alleviated by strategically locating new mains and paralleling existing transmission lines to reinforce the system. Dead-end lines should be extended and looped into the distribution system.

5. Flow limiting devices should be installed at all public fountains and residential connections. Domestic water consumption should be limited to 100 lpcd.

6. The existing public fountains should be upgraded to include proper structures and drainage to reduce the ponding of water at the fountain sites. Where practical, the drain lines from the fountains should be connected to available sewers.

275

7. Rehabilitate the existing Water Treatment Plant to a design capacity of 150 lps.

8. Build a new water treatment plant of 500 lps on a site available to the south of the City. The new plant should incorporate appropriate technical features. The design should focus on simplicity of operation and ease of maintenance. The recommended facility is smaller than that which was proposed in the draft Master Plan; however, it should be designed to allow for plant expansion in the future. It is suggested that a slow sand filtration process would be most appropriate to the situation in Minia; however, it my be advantageous to construct a direct filtration plant if this process is to be used in the other two cities.

9. Encourage the larger industries to use well water supplies to the maximum extent possible.

10. Additional elevated storage should be provided throughout the city. It is recommended that three 4,000-cubic metre tanks be erected. The exact location of the tank sites should be determined by the previously recommended computer analysis.

11. Install water meters only at service connections for major users. Use a flat rate system for residential users and small businesses.

5.3 WASTEWATER

Emphasis should be placed on investments to improve the existing collection system and to provide a higher level of wastewater treatment in order to reduce pollution in the drain.

1. An inflow/infiltration study of the existing collection system should be conducted. Major leaks should be repaired by either line replacement and/or the use of liners.

2. A regular sewer cleaning program should be established.

3. A hydraulic analysis of the force main system should be performed. Force mains should be either repaired, replaced, or reinforced as appropriate. Blow-off assemblies, isolation valves, and air release valves should be installed at critical locations.

4. Under-sized collectors should be replaced.

5. Priority should be given to extension of wastewater service concurrently with the extension of water distribution into areas which

236

can be most cost-effectively served. A lower priority will be given to fringe areas and to service in new drainage areas. It is suggested that a goal of providing central service to about 70% of the year 2000 population be set (approximately 60% of the current population is now served).

6. Where feasible, the wastewater collection system should be expanded to provide selected collectors in areas serviced by public fountains but not by sewers. This would allow for proper collection of wash water at the public fountain sites and provide discharge points for disposal of septage by haulers.

7. Vacuum trucks should be used to haul septage in unsewered areas. Provisions should be made to receive septage at the pump stations and at other convenient sites.

8. Consideration should be given to the use of construction materials which will reduce the potential for excessive infiltration in new sewers.

9. All of the existing pump stations should be rehabilitated. Simplicity and ease of operation and maintenance should be stressed in new designs. Design criteria for the sizing of pump stations should be modified in order to lower construction costs.

10. The inlet structure, the primary clarifiers, and the chlorination facilities at the existing plant should be rehabilitated to a design capacity of about 600 lps. Discharge of the treated effluent should continue to the El Muhit El Gharbi Drain.

11. Sludge thickeners should be added to the existing plant and the drying beds should be upgraded.

5.4 SUPPORT

Provision of extensive on-the-job training, establishment of a preventative maintenance program, development of adequate repair facilities, establishment of an inventory program, and the provision of operation and maintenance manuals are all vital elements of this program.

5.5 PHASE I

Tables 2A and 2B are illustrative of a program which could be accomplished using existing funding levels for this project. A balanced program is proposed; however, there are insufficient funds available to adequately address the needs of Minia in the water and wastewater sector.

5.6 PHASE II

Tables 3A and 3B illustrate a program which would permit Minia to meet its most basic service needs couple with a modest expansion of the service area. The additional facilities proposed in this program would be contingent upon the availability of an additional $50,000,000 and LE 15,000,000 for the three provicincial cities. The additional facilities would be treated as a follow-on program to Phase I. This follow-on program would require optimum utilization of all available facilities if existing service levels are to be maintained.

ID#0024D

TABLE 2A 30-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

MINIA WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		19,000	35,000	77,000
2	Leak Repair	139,000			237,000
3	Line Cleaning Program		94,000	61,000	238,000
4	Hydraulic Analysis	15,000			26,000
5	Public Awareness Program	10,000			17,000
6	Improve Public Fountains	40,000			68,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Intake & Pumping (300 lps)		191,000	357,000	783,000
9	Ground Reservoir (4,000 cu meters)		350,000	40,000	647,000
10	One Elevated Tank (4,000 cu meters)		550,000	46,000	995,000
11	Transmission System	895,000			1,524,000
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,099,000	2,524,000	2,784,000	9,740,000
18	Contingencies @ 15%	165,000	379,000	418,000	1,463,000
19	Design & Supervision @ 15%	165,000	80,000	747,000	1,376,000
20	Major Project Construction Management @ 3%	33,000	16,000	146,000	271,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		1,462,000	3,104,000	4,655,000	13,747,000

ID#QM1I

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

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TABLE 2B 30-Apr-85

PROPOSED IMPLEMENTATION PLAN - PHASE I

MINIA WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	128,000
2	Leak Repair		45,000	240,000	385,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Minimal Force Main Upgrading	150,000			255,000
5	Vacuum Trucks			120,000	154,000
6	Minimal Pump Station Rehabilitation		376,000	500,000	1,282,000
7	New Collectors - Area No. 6	497,000			846,000
8	New Collectors - Area No. 4 (partial)	377,000			642,000
9	Expand Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,031,000	436,000	940,000	3,704,000
18	Contingencies @ 15%	155,000	65,000	141,000	555,000
19	Design & Supervision @ 15%	155,000	35,000	188,000	565,000
20	Major Project Construction Management @ 3%	31,000	7,000	37,000	112,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		15,000	80,000	128,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		1,372,000	648,000	1,866,000	5,833,000

ID#QM2I

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

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TABLE 3A 29-Apr-85

BASIC SERVICE NEEDS

MINIA WATER AND WASTEWATER MASTER PLAN (WATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Leak Detection Survey		19,000	35,000	77,000
2	Leak Repair	139,000			237,000
3	Line Cleaning Program		94,000	61,000	238,000
4	Hydraulic Analysis	15,000			26,000
5	Flow Limiting Program	700,000			1,192,000
6	Improve Public Fountains	40,000			68,000
7	Direct Filtration Plant (300 lps)		1,320,000	2,245,000	5,128,000
8	Plant Expansion (200 lps)		985,000	1,676,000	3,828,000
9	Intake & Pumping (300 lps)		191,000	357,000	783,000
10	Expansion of Intake & Pumping (200 lps)		143,000	266,000	585,000
11	Ground Reservoir (4,000 cu meters)		350,000	40,000	647,000
12	Ground Reservoir (8,000 cu meters)		700,000	80,000	1,294,000
13	Three Elevated Tanks (4,000 cu meters ea)		1,650,000	138,000	2,986,000
14	Transmission System	895,000			1,524,000
15					0
16					0
17					0
SUB-TOTAL		1,789,000	5,452,000	4,898,000	18,613,000
18	Contingencies @ 15%	268,000	818,000	735,000	2,792,000
19	Design & Supervision @ 15%	268,000	159,000	1,469,000	2,612,000
20	Major Project Construction Management @ 3%	54,000	32,000	287,000	515,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		188,000	1,000,000	1,603,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WATER PROJECT		2,379,000	6,686,000	8,589,000	26,454,000

ID#M1BN

TOTAL LAND REQUIREMENTS
- WTP - 15,000 sq meters
- Ground Reservoir - 3,000 sq meters
- Elevated Tanks - 6,900 sq meters

AVAILABLE LAND
- 52,000 sq meters
- included in above
- 2,300 sq meters

NOTE: Includes LE 0.7 million uncommitted sub-project disbursement.

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TABLE 3B 29-Apr-85

BASIC SERVICE NEEDS

MINIA WATER AND WASTEWATER MASTER PLAN (WASTEWATER)

ITEM NUMBER	DESCRIPTION	SUB-PROJECT (1984 LE)	MAJOR PROJECT (1984 LE)	MAJOR PROJECT (1984 $)	TOTAL COST (1987 $)
1	Infiltration Study		15,000	80,000	125,000
2	Leak Repair		45,000	240,000	385,000
3	Hydraulic Analysis of Force Main System	7,000			12,000
4	Replacement of Under-Sized Collectors	300,000			511,000
5	Vacuum Trucks			120,000	154,000
6	Pump Station Rehabilitation		752,000	1,000,000	2,567,000
7	New Collectors - Area No. 6	497,000			846,000
8	New Collectors - Area No. 4	874,000			1,488,000
9	Expand Wastewater Treatment Plant	BY NOPWASD	BY NOPWASD	BY NOPWASD	BY NOPWASD
10					0
11					0
12					0
13					0
14					0
15					0
16					0
17					0
SUB-TOTAL		1,678,000	812,000	1,440,000	6,087,000
18	Contingencies @ 15%	252,000	122,000	216,000	914,000
19	Design & Supervision @ 15%	252,000	59,000	310,000	927,000
20	Major Project Construction Management @ 3%	50,000	12,000	61,000	184,000
21	Operation & Maintenance Manuals		15,000	80,000	128,000
22	On-the-Job Training		75,000	400,000	641,000
23	Inventory		22,000	120,000	191,000
24					0
25					0
26					0
27					0
28					0
TOTAL WASTEWATER PROJECT		2,232,000	1,117,000	2,627,000	9,072,000

ID#M2RN

TOTAL LAND REQUIREMENTS AVAILABLE LAND

NOTE: Includes LE 0.7 million uncertified sub-project disbursement.

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242

TABLE 4

ANALYSIS OF WATER TREATMENT TECHNOLOGY ALTERNATIVES

MINIA WATER AND WASTEWATER MASTER PLAN

TECHNOLOGY	CAPITAL COST (1987 $)	ANNUAL OPERATION COST (1987 LE)	ANNUAL MAINTENANCE COST (1987 LE)	LAND REQUIRED (sq meters)	RELIABILITY
Conventional Dual Media, High Rate Filtration	6,557,000	270,000	30,000	10,000	Extremely high levels of skill are required. Proper chemical feed rates & flocculation are extremely important; filter operation is critical.
Dual Media, High Rate Direct Filtration	4,314,000	183,000	24,000	7,000	Very high levels of skill are required. Proper chemical feed rate is important; filter operation is extremely critical.
Slow Sand Filtration	5,462,000	163,000	39,000	15,000	Low levels of skill are required. Curing of filter is important.

NOTES: Based upon 250 lps treatment capacity.
These costs do not include design (15%), contingencies (15%), or construction management (3%).

ID#T4M 30-Apr-85

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ANNEX O

PROVINCIAL CITIES DEVELOPMENT PROJECT

WATER AND WASTEWATER
COST AND LAND REQUIREMENTS ESTIMATING METHODOLOGIES

April 1985

Submitted To:

United States Agency for International Development
and
Arab Republic of Egypt

Prepared By:

Wilbur Smith and Associates

in association with

Public Administration Service

Engineering and Geological Consulting Office

244

TABLE OF CONTENTS

Section	Page No.
WATER TREATMENT PLANTS	1
Base Construction Costs	1
Land Requirements	2
Annual Operation and Maintenance Costs	2
WATER LINES	2
Base Construction Costss	2
Annual Operation and Maintenance Costs	3
UNDERGROUND WATER STORAGE RESERVOIRS, REINFORCED CONCRETE ELEVATED WATER STORAGE TANKS, AND RAW WATER INTAKES AND PUMP STATIONS	4
Base Construction Costs	4
Land Requirements	4
Annual Operation and Maintenance Costs	5
WASTEWATER TREATMENT PLANTS, WASTEWATER UNIT TREATMENT PROCESSES, AND WASTEWATER PUMP STATIONS	5
Base Construction Costs	5
Land Requirements	8
Annual Operation and Maintenance Costs	8
SEWER LINES, FORCE MAINS, AND SEWER MANHOLES	8
Base Construction Costs	8
Annual Operation and Maintenance Costs	11
LAND, FIRE HYDRANTS, AND WATER AND SEWER SERVICE CONNECTIONS	11
CONSTRUCTION CONTINGENCIES, ENGINEERING, AND CAPIITAL COSTS	12
COST AND LAND REQUIREMENT CURVES	13
APPENDIX A - COST AND LAND REQUIREMENT CURVES FOR WATER FACILITIES	A-1
APPENDIX B - COST AND LAND REQUIREMENT CURVES FOR WASTEWATER FACILITIES	B-1

245

WATER AND WASTEWATER
COST AND LAND REQUIREMENTS ESTIMATING METHODOLOGIES

WATER TREATMENT PLANTS

BASE CONSTRUCTION COSTS

Construction costs were developed from several references for the following four types of water treatment plants

- Rapid sand filtration
- Slow sand filtration
- Conventional dual media, high rate filtration
- Dual media, high rate direct filtration

making appropriate allowances for escalation (inflation), exchange rates, shipping/insurance costs, and contractor overhead and profit. Egyption customs duties and taxes were excluded. Base construction cost curves were broken into foreign components and local components and are expressed in 1984 USD and LE, respectively.

In the initial drafts of the Water Master Plans, cost estimates were based on information presented in the Suez Water Facilities Master Plan prepared by Pirine-Harris International, 1979. Later, when comparison of various treatment plant options was requested by USAID, the major reference source utilized was the three-volume U.S. Environmental Protection Agency (EPA) publication " ESTIMATING WATER TREATMENT COSTS" published in August 1979. This publication presents detailed cost estimates and related design criteria for conventional dual media, high rate and dual media, high rate direct filtration plants. Costs and criteria were presented for all of the unit processes used for these two types of plants, facilitating the estimation of costs for unit processes common to other types of plants (slow sand filtration and rapid sand filtration).

Costs presented in the EPA publication are in terms of October 1978 dollars. Escalation to the year 1984 was performed using the Engineering News Record Construction Cost Index.

The "base" construction costs do not include allowances for contingencies, engineering, legal, or administrative services. They do include contractor's overhead and profit.

For imported items, 40% was added for shipping, insurance, handling, and inland transportation.

For the non-imported items which were expressed in Egyptian Rounds, a conversion rate of $1.00 U.S. = L.E. 0.84 was used.

For the slow sand filtration alternative, preliminary designs were performed for plain sedimentation basins and slow sand filter units; costs for these units were then estimated based on current construction and materials costs. The EPA publication was used for estimating the cost of other processes and facilities used in all types of plants (eg. chlorination facilities, administration buildings, etc.).

As pointed out elsewhere, it is possible that one or more of the treatment alternatives would not be technically feasble, or would require pretreatment processes which would increase their cost. This would be determined by bench scale treatability and pilot plant studies to be performed prior to the final selection of treatment method.

LAND REQUIREMENTS

Land requirements were also estimated primarily on the basis of information presented in the above-mentioned EPA publication. In that publication, land requirements were presented for three conventional dual media, high rate plants and three direct filtration plants. For other types of plants, appropriate adjustments were made. For example, for a slow sand filtration plant, the area required for flocculation/coagulation/sedimentation and repid sand filtration units was subtracted (from the area required for the conventional high rate plant) and the areas required for plain sedimentation and slow sand filtration units were added. Land areas required are expressed in hectares.

ANNUAL OPERATION AND MAINTENANCE COSTS

Operation and maintenance (O&M) costs were also estimated based on information presented in the same EPA publication ("ESTIMATING WATER TREATMENT PLANT COSTS"). In that pubication, a breakdown of O&M costs was presented for each size and type of plant. Adjustments were facilitated by the fact that chemical usage was estimated in pounds per year, electrical requirements in kilowatt-hours per year, and fuel requirement in gallons per year. Although man-hours were also presented for use in estimating labor costs, it was believed more appropriate to estimate labor costs based on probable staffing according to local practice using current unit labor costs for the various categories.

Current local unit prices for chemicals, energy, and fuel costs were applied. It was assumed that the primary coagulant would be alum and that coagulant aids would not be cost-effective due to their high cost in Egypt. Annual O&M costs are expressed in 1984 LE.

WATER LINES

BASE CONSTRUCTION COST

Base construction cost curves in 1984 USD and LE for foreign and local components, respectively, and as appropriate, were developed for the following types of water pipe for the size ranges indicated:

Type Pipe*	Size Range mm
PVC	100-300
AC	400-600
PCCP	700-1,200

* PVC - polyvinylchloride
AC - asbestos-cement
PCCP - prestressed concrete pipe

247

The foregoing types of pipe and size ranges were selected on the following basis: (1) suitability for intended use, (2) availability in Egypt in the quantities required when needed, (3) quality, (4) Egyptian pipe installation techniques, (5) longevity, (6) unit cost, (7) size needs of the PCD project, and (8) related factors. The size range for each pipe type was based on the size range availability of each respective type of pipe in Egypt. As examples, PVC is only available up to 300 mm in diameter. Only PCCP is manufactured in Egypt in sizes of 700-mm diameter and larger.

The water line cost curve was developed in considering the following:

1. Minimum cover of 1.0 m. Total excavation depth included the minimum cover, pipe diameter, and bedding depth requirements.

2. Average depth to ground water table and trench dewatering.

3. Sheeting (consumed), bedding using selected material, and backfilling.

4. Removal of surplus trench material.

5. Cost of pipe, transportation, unloading, labor, testing, valves & fittings, and percentage of pipe broken.

6. Contractor overhead and profit @ 15%.

7. No rock excavation was assumed.

8. No pavement restoration was assumed.

9. Other related factors affecting the construction cost.

Unit prices for the above elements of water line installation were obtained from recent tenders by reputable Egyptian contractors. Pre-1984 bid prices were escalated by annual inflation rates to obtain 1984 unit cost estimates.

Unit cost curves for each component by type pipe material for each associated size range were then drawn through points plotted for at least two pipe sizes each.

ANNUAL OPERATION AND MAINTENANCE COSTS

Estimated annual O&M cost curves were developed in 1984 LE for both total and a breakdown of major standard cost categories. Separate annual O&M cost curves were developed for two assumed conditions: one for an assumed 2% stockpile of pipe and another assuming no stockpile.

The estimates were based on known proper O&M practices and procedures. That is, the estimates were based on what the three provincial cities should be doing to adequately operate and maintain their water distribution systems, not on what they are currently actually doing in this regard.

Some assistance in developing these estimates was obtained through interviews with personnel of the City of Alexandria Water Department. Unit costs for items such as labor took into account current salaries being paid to O&M personnel in the provincial cities.

248

UNDERGROUND WATER STORAGE RESERVOIRS, REINFORCED CONCRETE ELEVATED WATER STORAGE TANKS, AND RAW WATER INTAKES AND PUMP STATIONS

BASE CONSTRUCTION COST

The base construction cost curve for underground water storage reservoirs was developed by completing a preliminary design of three reservoirs ranging in size from 1,000 to 11,000 m^3. Cost estimates were developed for each size in 1984 LE taking into account the depth and associated excavation, and the quantities of concrete and reinforcing steel required. The estimated costs of the high service pump stations required were included in the water treatment plant cost curves. The estimated base construction costs for each of the three sizes of underground reservoirs were plotted on 2-cycle by 2-cycle log-log paper and a curve of "best-fit" was drawn through the points.

Similar procedure to the foregoing was followed in developing the base construction cost curves for reinforced concrete elevated water storage tanks and raw water intakes and pumping stations. A preliminary design was completed for three reinforced concrete elevated water storage tanks ranging in capacity from 2,000 to 10,000 m^3. A curve of "best-fit" was drawn through the three plotted points. Unit costs for concrete, reinforcing steel, labor, and other elements were based on recent tenders from reputable contractors. Elevated water tank curve is for tanks of height to maximum water level of 50 m and a tank of 5-m depth mounted atop reinforced concrete support columns.

The base construction cost curve for raw water pump stations was based on information presented in the Suez Water Facilities Master Plan prepared by Pirnie-Harris International, 1979, which was escalated to 1984 USD and LE. To the estimated costs of the raw water pump stations were added the estimated costs of raw water intakes of corresponding sizes and lengths appropriate to the average conditions related to the raw water sources used by the three provincial cities.

The base construction cost curve for the raw water intakes and pump stations is for "firm pumping capacity", defined as follows:

$$\text{Firm Pumping Capacity (lps)} = \text{Peak Day Water Demand (lps)}$$
$$= 1.25 \times \text{Av. Daily Water Demand (lps)}$$

The estimated costs were further based on the raw water pump stations containing six installed pumping units, with any four units equalling the firm pumping capacity and the remaining two units each serving as 25% standbys.

LAND REQUIREMENTS

The land area requirements for the underground water storage reservoirs and the raw water intakes and pump stations are included in the land area requirement curves for each of the four types of water treatment plants considered.

269

The land areas required for the reinforced concrete elevated water storage tanks were developed quite simply. The land areas for three different capacity tanks ranging in size from 2,000 to 10,000 m^3 were determined and a curve of "best-fit" drawn. The tanks have a fixed storage height of 5 m which was divided into the volume in cubic meters to establish the corresponding surface area. The length/width dimensions were established as a square or near square configuration. To each length and width dimension was added 10 meters to ensure reasonable minimum set-backs from sidewalks/streets and adjacent property lines and buildings.

ANNUAL OPERATION AND MAINTENANCE COSTS

The estimated annual O&M costs for underground water storage reservoirs and raw water intakes and pump stations are included in the estimated annual O&M cost curves for each of the four types of water treatment plants considered.

Since reinforced concrete elevated water storage tanks normally require little maintenance and repair, if properly constructed, the estimated annual O&M costs consist primarily of labor, chlorine, equipment, and materials for periodic (annual) cleaning and disinfection. Other maintenance involves taking care of the grounds at the tank site and routine maintenance of the altitude valve and appurtenances.

WASTEWATER TREATMENT PLANTS, WASTEWATER UNIT TREATMENT PROCESSES, AND WASTEWATER PUMP STATIONS

BASE CONSTRUCTION COSTS

Base construction cost curves for foreign and local components in 1984 USD and LE, respectively, were developed for the following types of wastewater treatment plants:

- Trickling Filter
- Waste Stabilization Pond

These were considered to be the most cost-effective and simplest to operate and maintain of the types available. Their cost-effectiveness includes lowest construction and annual O&M costs. Both treatment plant processes are ideally suited to the favorable year-round weather conditions in Egypt in the vicinity of the three provincial cities.

Preliminary designs were prepared for three different capacity plants of each type and curves of "best-fit" were drawn through the plotted points on log-log graph paper. The waste stabilization ponds are the more cost-effective of the two type plants in those instances where they can be located on desert land in relative close proximity to their service areas. Where desert sites are at substantial distances, trickling filter plants were found more cost-effective, even when located on more expensive agricultural land. This is because of the smaller land areas require to accomodate trickling filter plants of identical capacities, and the avoidance of additional lengthy and expensive force mains and costly wastewater pump stations, especially of greater total dynamic heads.

250

Each of the three provincial cities currently has a trickling filters plant with trickling filters of adequate capacity (when operated as high rate) to meet year 2000 needs. Therefore, it was found to be most cost-effective to rehabilitate, upgrade, and expand these existing plants,

To do so, however, will require the installation of certain additional unit treatment processes such as primary sedimentation tanks, final clarifiers, chlorination facilities, etc. Consequently, separate cost curves were developed for each of the unit treatment processes comprising typical trickling filter plants in Egypt. When the construction costs from the individual unit treatment process cost curves are combined for a specific treatment plant capacity, a total construction cost is obtained for a trickling filter plant of that capacity.

The base construction cost curve for the waste stabilization ponds was developed for volume in m^3, rather than capacity in lps. This was done to provide flexibility in use of the curve for achieving variable fecal coliform effluent design standards. For purposes of the PCD Project, two alternative fecal coliform effluent design standards were chosen as follows:

Method of Effluent Reuse/Criteria	Standard: BOD mg/l	Standard: Fecal Coliforms No./100 ml (1)
Irrigation of trees, cotton, and other non-edible crops	60	50,000
Discharge to receiving agricultural drain	25	5,000

(1) These concentrations should not be exceeded in 80% of the samples tested.

For the raw wastewater design flow and chemical/bacteriological characteristics involved in each city, the waste stabilization pond design volume required for either or each set of effluent design standards was calculated using the methodology outlined in the World Bank manual for waste stabilization ponds authored by J.P. Arthur and entitled "Notes on the Design and Operation of Waste Stabilization Ponds in Warm Climates of Developing Countries", World Bank Technical Paper Number 7, Washington, DC, USA, 1983.

Three preliminary designs at three different capacities were completed and the construction costs were estimated for each to develop the base construction cost curves for each of two types of wastewater pump stations considered for installation in the three provincial cities under the PCD Project as follows:

- Conventional wet well/dry well
- Submersible

For smaller size-range requirements up to 50-lps capacity, submersible wastewater pump stations are generally the more cost-effective, especially when motor horsepower requirements are 50 hp or less. For wastewater flows in excess of 50 lps, and especially 50 hp, the conventional dry well/wet well type are the most cost-effective. Because of the relative flat terrain in each of the three provincial cities, the dividing line between selection of the two types of pump stations became 50 lps for Master Planning purposes as, generally, the horsepower requirements up to 50-lps capacity were estimated to be 50 hp or less.

The base construction cost curves for each of the two types of wastewater pump stations were developed for "firm pumping capacity" defined as follows:

Firm Pumping Capacity (lps) = 1.5 x Av. Daily Wastewater Flow (lps)

The base construction cost curves for the wastewater pump stations were also based on the following:

- Both type wastewater pump stations contain three installed pumping units with any two equalling firm pumping capacity and with a third unit as a 50% standby plus a fourth unit in storage as a spare.

- All pump stations to be equipped with manually-operated bar screens.

- Conventional wet well/dry well pump stations include standby diesel generators.

- Up to 5-year supply of appropriate spare parts.

The foregoing is consistent with the intent of, but not necessarily in full compliance with, the design criteria of the National Organization for Potable Water and Sanitary Drainage (NOPWASD). The NOPWASD design criteria for the number of pumping units to be provided in wastewater pump stations is as follows:

Total No. of Pumping Units = No. of Operating Units
+ No. of Standby Units
+ No. of Units in Maintenance & Repair

Standard procedure in the U.S. and other countries, of course, is to provide at least one installed standby pumping unit. In addition, a supply of spare parts is provided to facilitate and expedite repairs.

However, to install one or more additional pumps for use when one or more of the operating pump units is in "maintenance and repair" is extremely costly, and is believed unnecessary, even in a developing country such as Egypt where pumps, motors, and spare parts must be imported and are in short supply. The installation of one or more pumping units involves, not only the cost of the pumping unit itself, but also the substantially greater cost of the civil works and electrical work associated with the pump stations. That is, the pump stations must be made substantially larger in size.

To deal with the importing necessity and shortage of spare parts condition in Egypt, it is proposed that technical design specifications for tender documents not only require provision of spare parts, but also a spare pumping unit. The pumping unit would be placed in storage, rather than installed in the pump station. This was concluded as a more cost-effective solution to the problem and the base construction cost curves for both types of wastewater pump stations were developed on this basis.

252

LAND REQUIREMENTS

For each of the three preliminary designs for each type of wastewater treatment plant and pump station, site dimensions and land area requirements were determined and land requirement curves were drawn.

Land area requirements were not estimated for the various wastewater unit treatment processes. Whenever unit treatment processes are required for installation, they are added to upgrade or expand existing wastewater treatment plants located on existing sites already owned by the cities. Therefore, no site acquisitions or land area requirement curves are needed for unit treatment processes.

ANNUAL OPERATION AND MAINTENANCE COSTS

Estimated annual O&M cost curves were developed in 1984 LE for both total and a breakdown of major standard costs categories for each type of wastewater treatment plant, unit treatment process, and pump station. The estimates were based on known proper O&M practices and procedures. That is, the estimates were based on what the three provincial cities should be doing to adequately operate and maintain their wastewater treatment plants and pump stations, not on what they are currently actually doing in this regard.

Some assistance is developing these estimates was obtained through interviews with personnel of the City of Alexandria Wastewater Department. Unit costs for items such as labor took into account current salaries being paid to O&M personnel in the provincial cities.

Information on annual O&M costs for waste stabilization ponds was obtained from the previously-mentioned World Bank manual and adjusted for inflation and conditions in Egypt in the provincial cities.

SEWER LINES, FORCE MAINS, AND SEWER MANHOLES

BASE CONSTRUCTION COSTS

The following two types of pipe for the indicated size ranges were determined most suitable, available, and cost-effective for installation in the three provincial cities under the PCD Project for use as force mains:

Type Pipe	Size Range mm
Grey Cast Iron	150-300
Ductile Iron	350-1,000

Base construction cost curves for both types of pipe were developed based on recent bids from reputable Egyptian construction contractors for up to three sizes of each type of pipe.

Force main cost estimates were based on minimum cover of 1.0 m to pipe crown.

253

Similarily, the following four types of pipe for the indicated size ranges were determined to be most suitable, available, and cost-effective for installation in the three cities to complete and/or extend their respective wastewater collection systems:

Type Pipe	Size Range mm
PVC	175-300
VC	350
RC	400-700
PCCP	800-1,200

PVC - polyvinylchloride
VC - vitrified clay
RC - reinforced concrete
PCCP - prestressed concrete pipe

All sewer line base construction cost curves were developed for an average depth to invert of 3.0 m and recognize the requirement for the minimum 1.0 m cover for the most upgrade ends of terminal sewer laterals.

The elements considered in developing the unit cost curves for both force mains and sewer lines included the unit cost of each of the following:

1. Minimum cover and total trench excavation depth.

2. Average depth to ground water table and trench dewatering.

3. Pipe diameter and unit purchase cost for each type and size.

4. Pipe loading, unloading, and transportation.

5. Sheeting (consumed), bedding using selected material, backfilling, and compacting.

6. Installation, adjustement, jointing of pipe, and testing.

7. Removal of surplus excavation material, pipe cleaning, site clearing, and percentage of pipe damaged.

8. For force mains, only, valves and fittings.

9. Contractor overhead and profit @ 15%.

10. No rock excavation was assumed.

11. Other related factors affecting the construction cost such as soil stabilization.

254

Estimated base construction cost curves were developed for sewer manholes of the following five types for the various manhole depth and sewer size ranges indicated:

Type	Depth m	Sewer Size mm
A	up to 1.2	$<$ 375
B	1.2 to 2.5	$<$ 375
C	2.5 to 3.5	$<$ 375
D	3.6 to 7.0	$\leq$ 375 to $<$ 600
E	4.0 to 7.0	$>$ 600

The following apply to the above-mentioned base construction cost curves for sewer manholes:

1. All manhole types are circular except Type E which is 1.5-m square.

2. Internal diameters of Types A, B, C, & D are 0.6, 1.0, 1.2, & 1.2, respectively, and all have cast iron covers of 0.60 m in diameter.

3. All manhole walls are poured-in-place concrete except the upper slab of Type E is reinforced concrete with cast iron cover weighing 350 kg and diameter 0.76 m.

The additional elements considered in developing the manhole cost curves included the following:

1. Depth to manhole invert.

2. Diameter of manhole & access.

3. Thickness of manhole walls & foundation.

4. Excavation, sheeting (consumed), dewatering, installation of sub-base, carpentry, installation of concrete, and shaping manhole bottom & slopes.

5. Cost of cast iron steps and cover and their installation.

6. Grouting of sub-base, backfilling, and surplus removal.

7. Other related factors affecting the cost of manhole installation.

Recent bids from reputable Egyptian contractors were used as a basis for estimating the base construction costs for force mains, sewer lines, and sewer manholes. Adjustments were made, as necessary, for inflation to 1984 USD and LE.

255

ANNUAL OPERATION AND MAINTENANCE COSTS

Since force mains are pressure pipes similar to water mains, the annual O&M cost curves developed for water lines can be applied to estimate annual O&M costs for force mains.

Annual O&M cost curves were developed for two size ranges of sewer lines, namely, 150 to 300 mm and 375 to 600 mm. The cost estimates took into account labor, equipment, fuel, and maintenance. Each curve was developed for three separate total lengths of pipe within the foregoing indicated size ranges.

Some assistance is developing these estimates was obtained through interviews with personnel of the City of Alexandria Wastewater Department. Unit costs for items such as labor took into account current salaries being paid to O&M personnel in the provincial cities.

Manhole annual O&M costs are included in the sewer line annual O&M cost curves.

LAND, FIRE HYDRANTS, AND WATER AND SEWER SERVICE CONNECTIONS

The following unit costs were estimated for the indicated items:

WATER

Item	Estimated Unit Cost LE
Fire Hydrant	450 ea
Water Service Connections	
- With Wall-Mounted Meter	150 ea
- Without Wall-Mounted Meter	100 ea

WASTEWATER

Sewer Service Connection	150 ea

The unit costs for fire hydrants were based on recent construction bids on PCD sub-projects.

Water and sewer service connection unit cost estimates were based on information provided by the cities on actual charges being made to property owners for their provision and installation by the cities.

Unit costs for land acquisition by type were obtained from city personnel through the PCD Project Resident Advisors and are summarized below:

Type Land	Estimated Unit Cost LE/hectare
Urban	50,000
Agricultural	20,000
Desert	5,000

CONSTRUCTION CONTINGENCIES, ENGINEERING, AND CAPITAL COSTS

Base construction costs were increased by 15% to allow for contingencies during construction to obtain "estimated total construction costs". Engineering design and construction surveillance costs were estimated at 15% of estimated total construction cost. An additional 3% of total construction cost was included for construction management. This was done in view of USAID's preference to package all of the complex or major projects (such as water treatment plants and wastewater pump stations) into a major, single design/construct contract.

Additional engineering costs for special services, such as leak detection surveys, infiltration studies, preparation of O&M manuals, and provision of "on-the-job" O&M training in the newly constructed water and wastewater facilities, were estimated on an individual basis.

The estimated costs for construction contingencies, engineering design and construction surveillance, construction management, and additional engineering services were combined to estimate total capital costs in 1984 USD. Subtotals were also developed for the foreign and local components of the total capital costs in 1984 USD and LE, respectively.

The 1984 USD and LE foreign and local component capital cost estimates were then escalated to projected mid-year construction for each of the five stages comprising the Master Plan Implementation Program. To accomplish this, an implementation schedule was developed for each of the five stages based on what was possible, but not necessarily probable, assuming that each implementation stage would be funded out of five-consecutive fiscal years. That is, the five stages were each lagged one year from the previous stage. The following mid-year construction was thus estimated for each of the five stages:

Stage	Mid-Year Construction
1	1987
2	1988
3	1989
4	1990
5	1991

257

Also considered was the minimum year by which the facilities in each stage were needed. All the facilities in Stages 1 through 4 were estimated to be needed by or before 1990. As can be noted from above, the mid-year construction for the first four stages could not be lagged more than one year as the fourth stage will be completed, as it is, a year or more later than needed or desired. Stage 5 could be, and probably will be, lagged for a longer period, but this will further escalate the costs due to inflation.

Annual escalation was performed in accordance with the guidance received from USAID and contained in its document entitled "Contingency Allowances in Project Cost Estimates - August 1984". The resulting escalation factors corresponding to the mid-year construction of each of the five stages were determined as indicated below for the foreign and local components:

Stage	Mid-Year Construction	Escalation Factor	
		Local	Foreign
1	1987	1.43013	1.28315
2	1988	1.60174	1.39863
3	1989	1.79395	1.50353
4	1990	2.00923	1.62381
5	1991	2.25032	1.75372

These escalation factors represent average projected inflation rates of about 8.5% for foreign and about 12.5% for local capital costs. The combined effective inflation rate lies between these two values and average around 10%, depending on the mix of foreign and local components associated with each individual implementation project. In the cases of water and sewer line design/construction projects, the escalation assumes the higher 12.5% average annual escalation because the local components for such projects are either 100% or dominantly local.

COST AND LAND REQUIREMENT CURVES

The base construction cost, land requirements, and annual O&M cost curves for water facilities are included in Appendix A, pp. A-1 to A-17, and those for wastewater facilities are included in Appendix B, pp. B-1 to B-19.

258

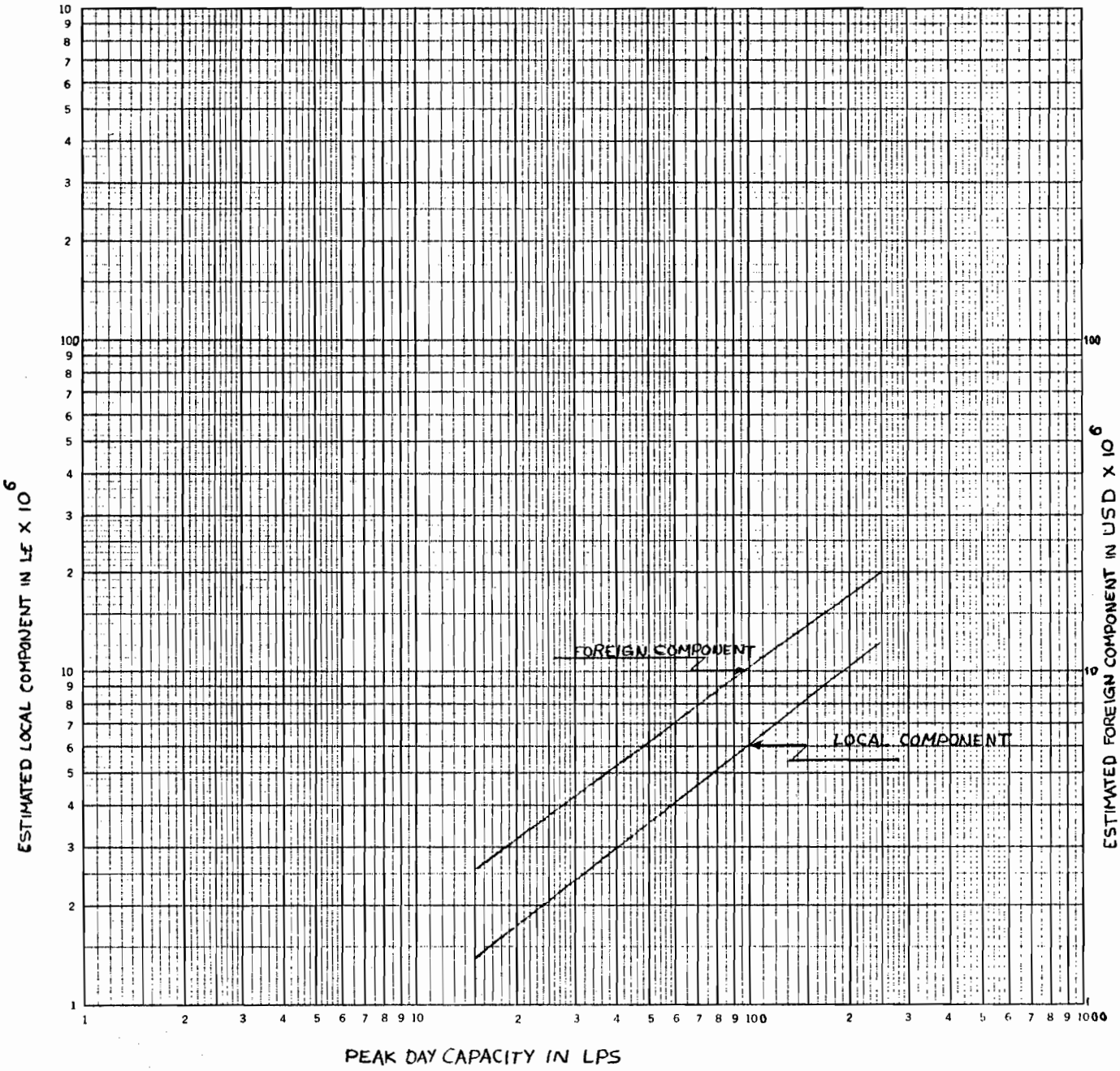
APPRNDIX A

COST AND LAND REQUIREMENTS CURVES
FOR
WATER FACILITIES

ESTIMATED BASE CONSTRUCTION COST

RAPID SAND WATER FILTRATION PLANTS

1984

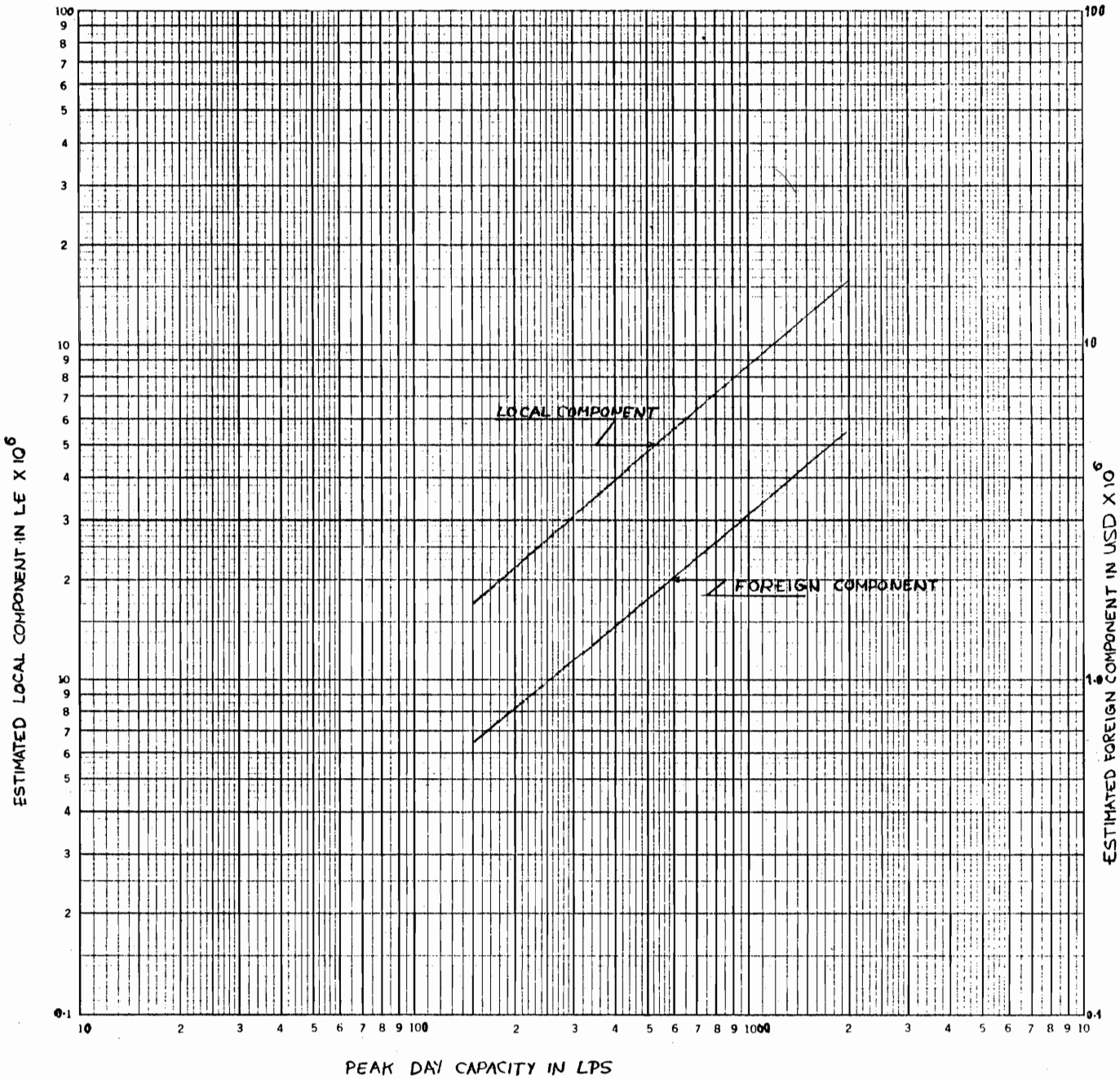


260

ESTIMATED BASE CONSTRUCTION COST COST

SLOW SAND WATER FILTRATION PLANTS

1984



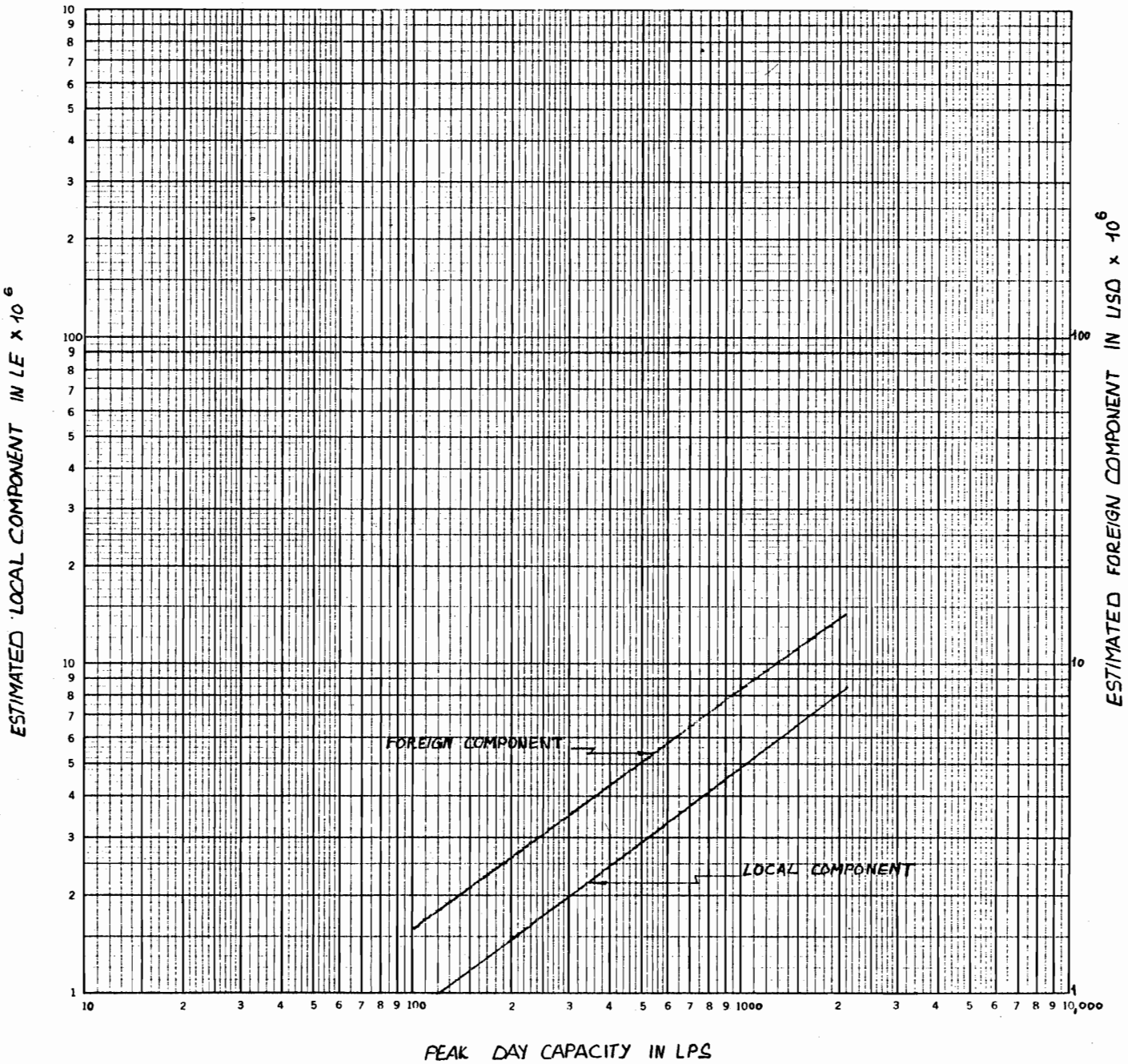
261

ESTIMATED BASE CONSTRUCTION COST

CONVENTIONAL DUAL MEDIA, HIGH RATE

WATER FILTRATION PLANTS

1984



NOTE :-

1) PEAK DAY CAPACITY = 1.25 x AV. DAILY WATER DEMAND

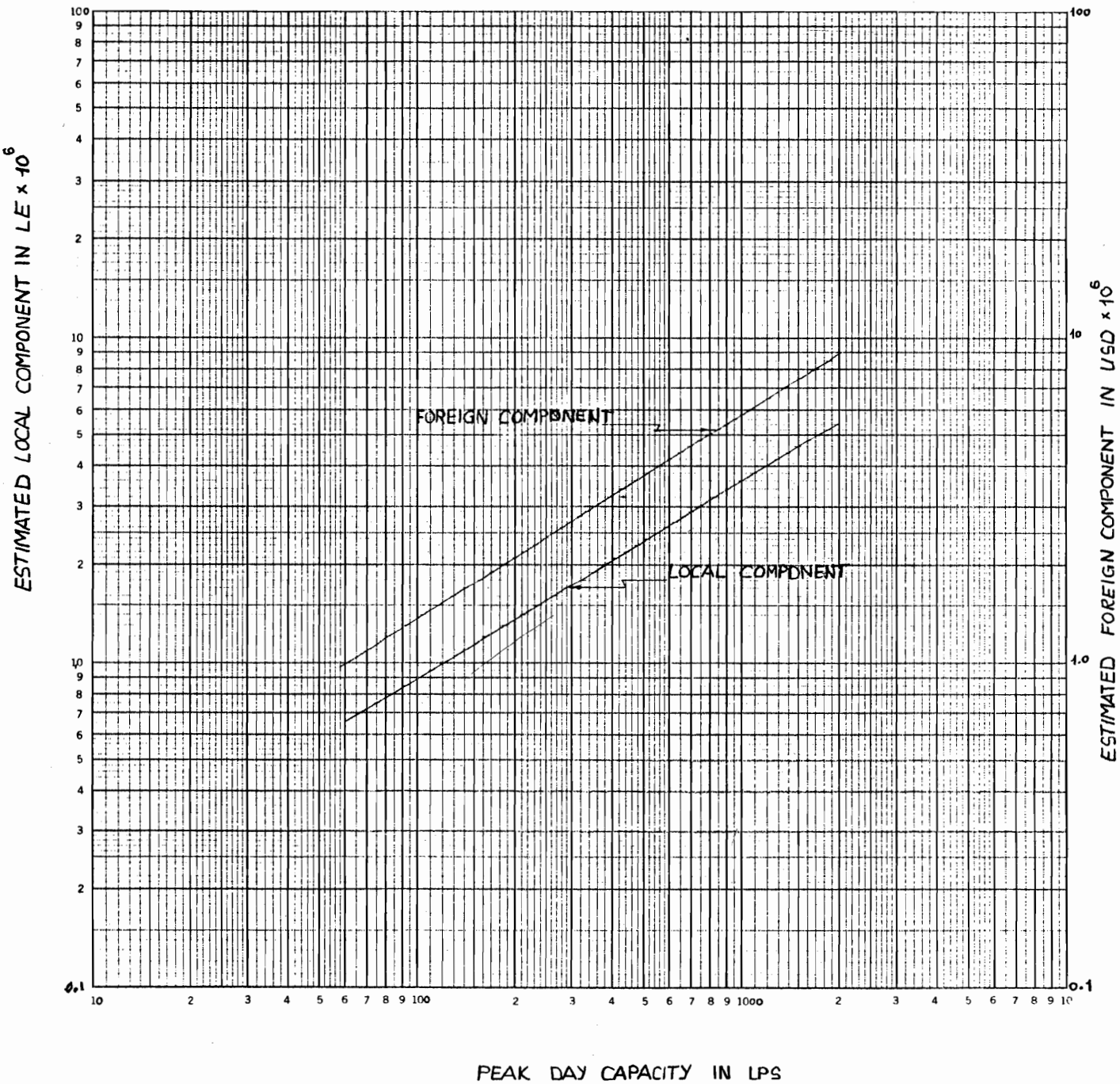
262

ESTIMATED BASE CONSTRUCTION COST

DUAL MEDIA, HIGH RATE DIRECT FILTRATION

WATER TREATMENT PLANTS

1984

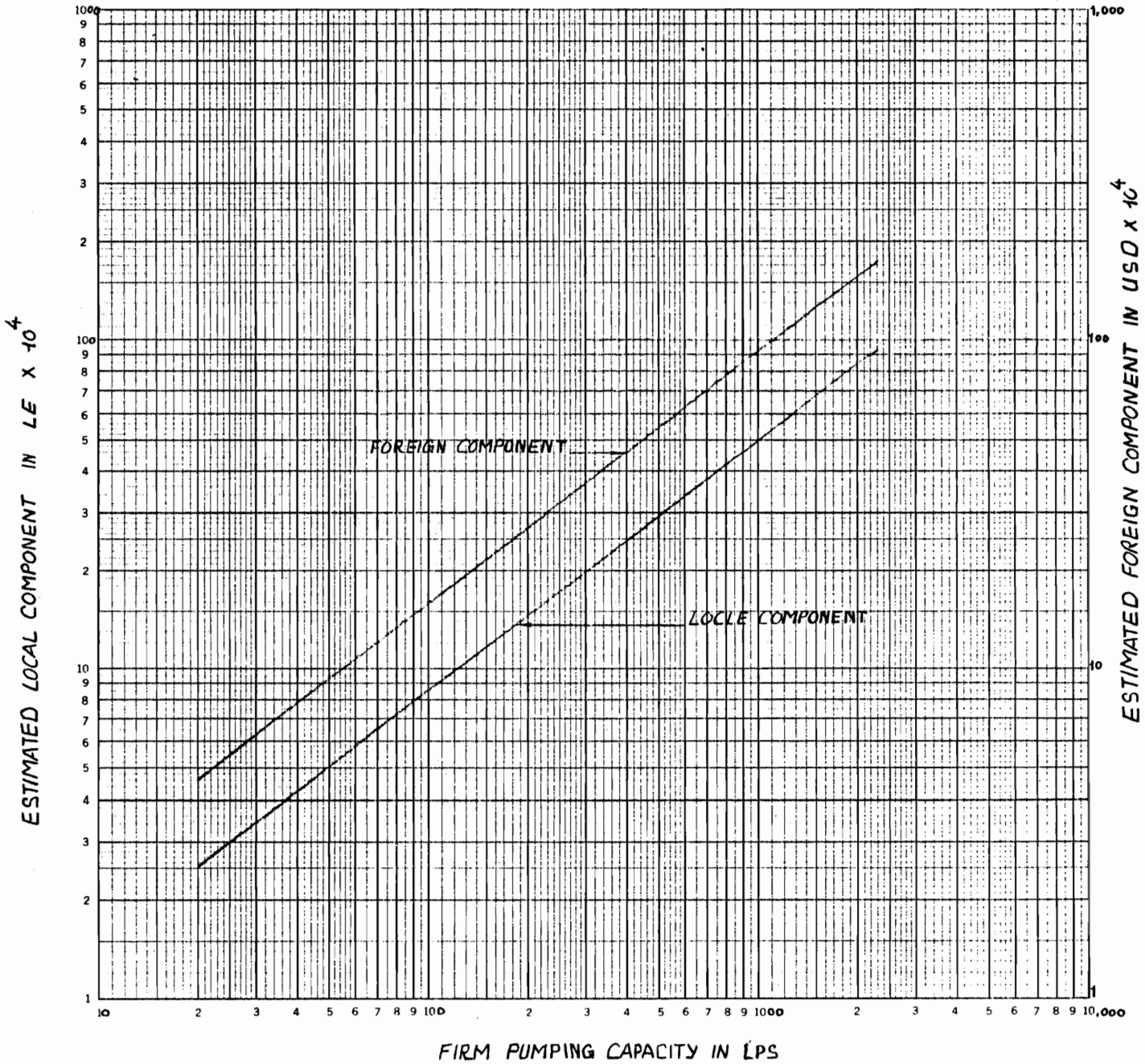


263

ESTIMATED BASE CONSTRUTION COST

RAW WATER PUMP STATIONS

1984



NOTE :-

1) FIRM PUMPING CAPACITY = PEAK DAY WATER DEMAND = 1.25 X AV. DAILY WATER DEMAND.

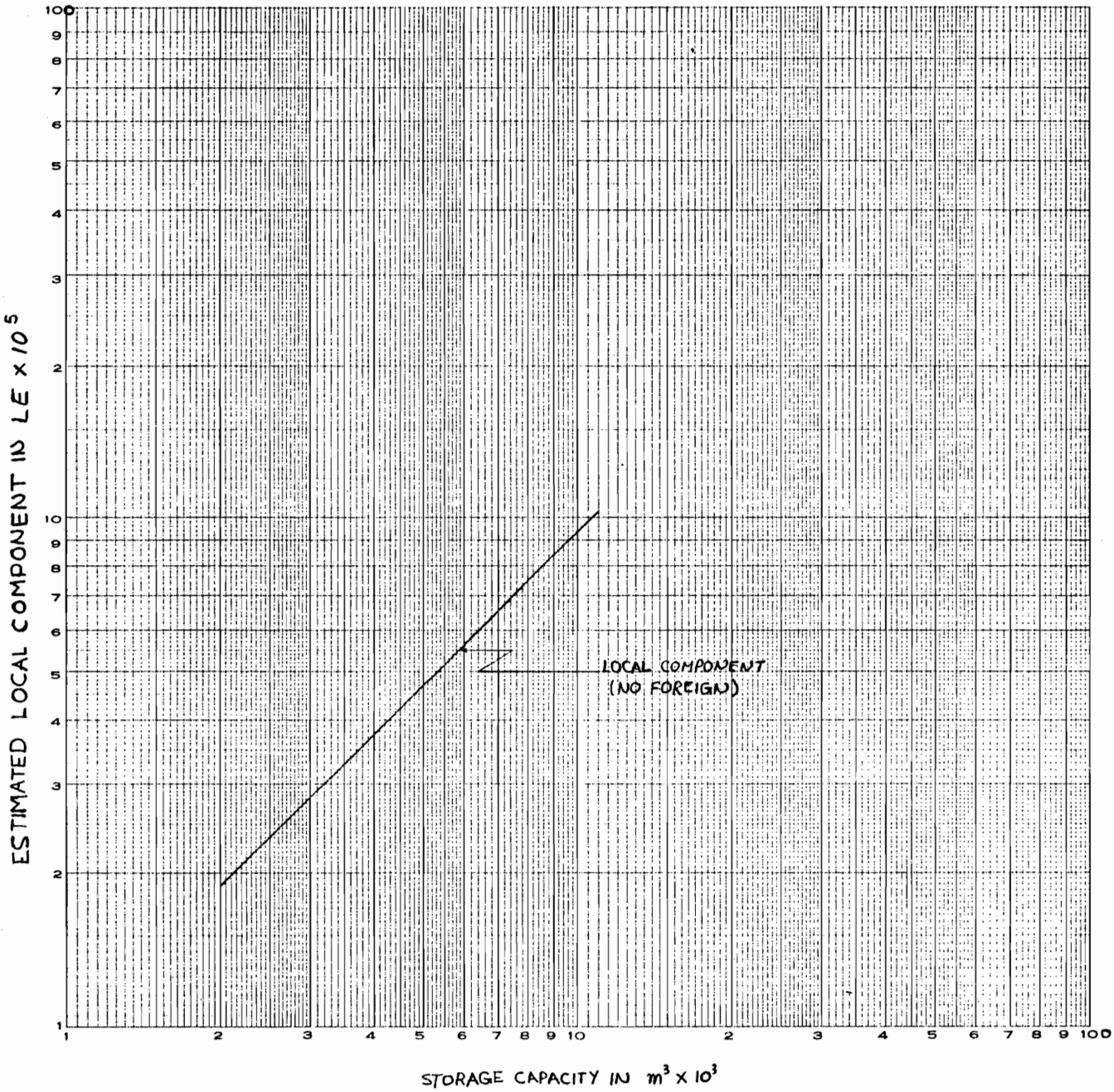
2) PUMP STATIONS CONTAIN 6 INSTALLED UNITS WITH ANY 4 EQUALLING FIRM PUMPING CAPACITY & THE REMAINING 2 EACH SERVING AS 25% STANDBYS.

264

ESTIMATED BASE CONSTRUCTION COST

UNDERGROUND WATER STORAGE RESERVOIRS

1984



NOTE :

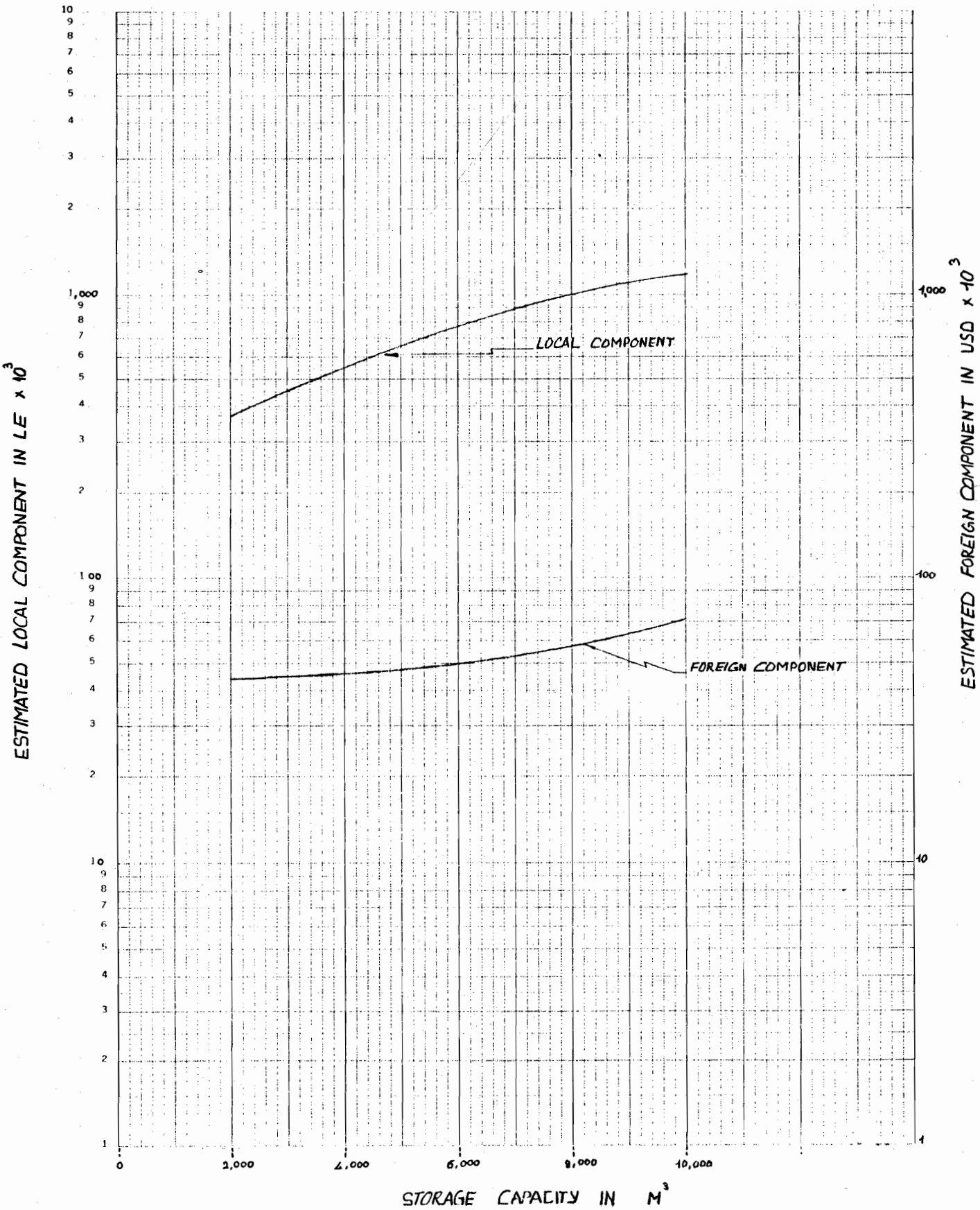
COST OF HIGH SERVICE PUMPING STATION INCLUDED IN COST CURVES FOR WATER TREATMENT PLANTS.

265

ESTIMATED BASE CONSTRUCTION COST

REINFORCED CONCRETE ELEVATED WATER STORAGE TANKS

(HEIGHT TO MAXIMUM WATER LEVEL = 50 M)

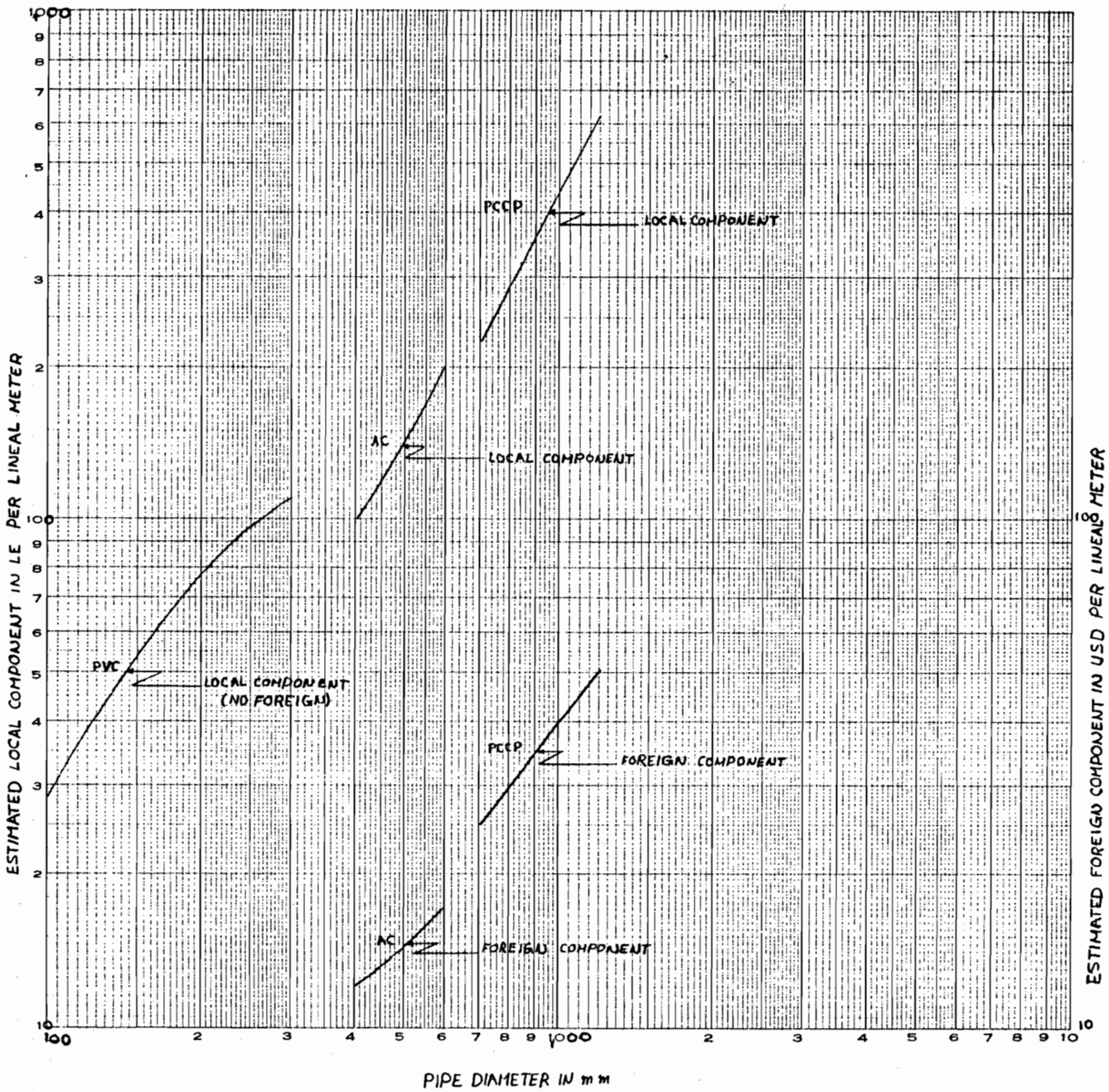


266

ESTIMATED BASE CONSTRUCTION COST

WATER LINES

1984



NOTE: BASED ON THE FOLLOWING:

1) MINIMUM COVER OF 1.0 m
2) NO ROCK EXCAVATION
3) NO PAVEMENT RESTORATION

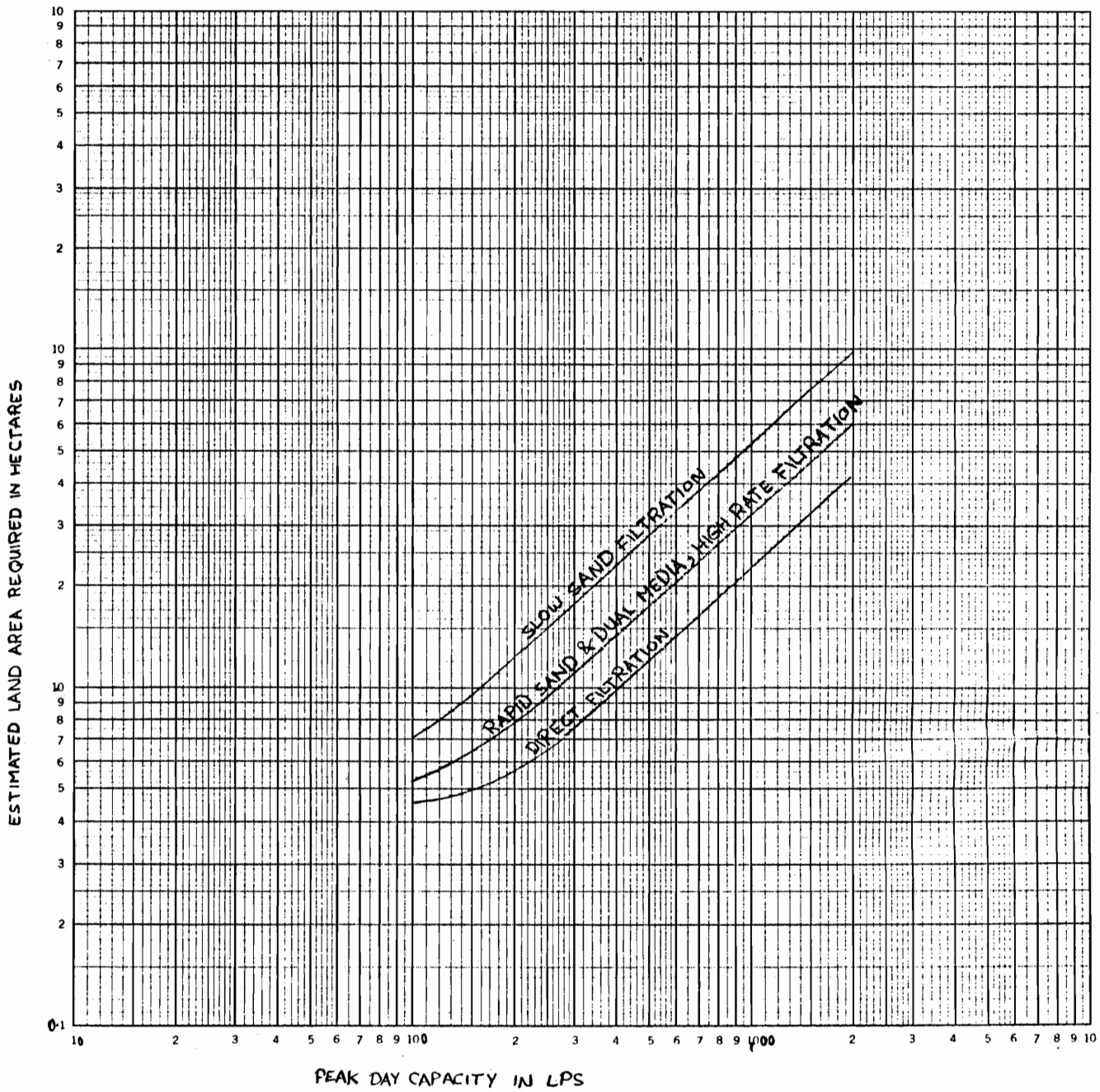
267

ESTIMATED LAND REQUIREMENTS

VARIOUS TYPES

OF

WATER TREATMENT PLANTS

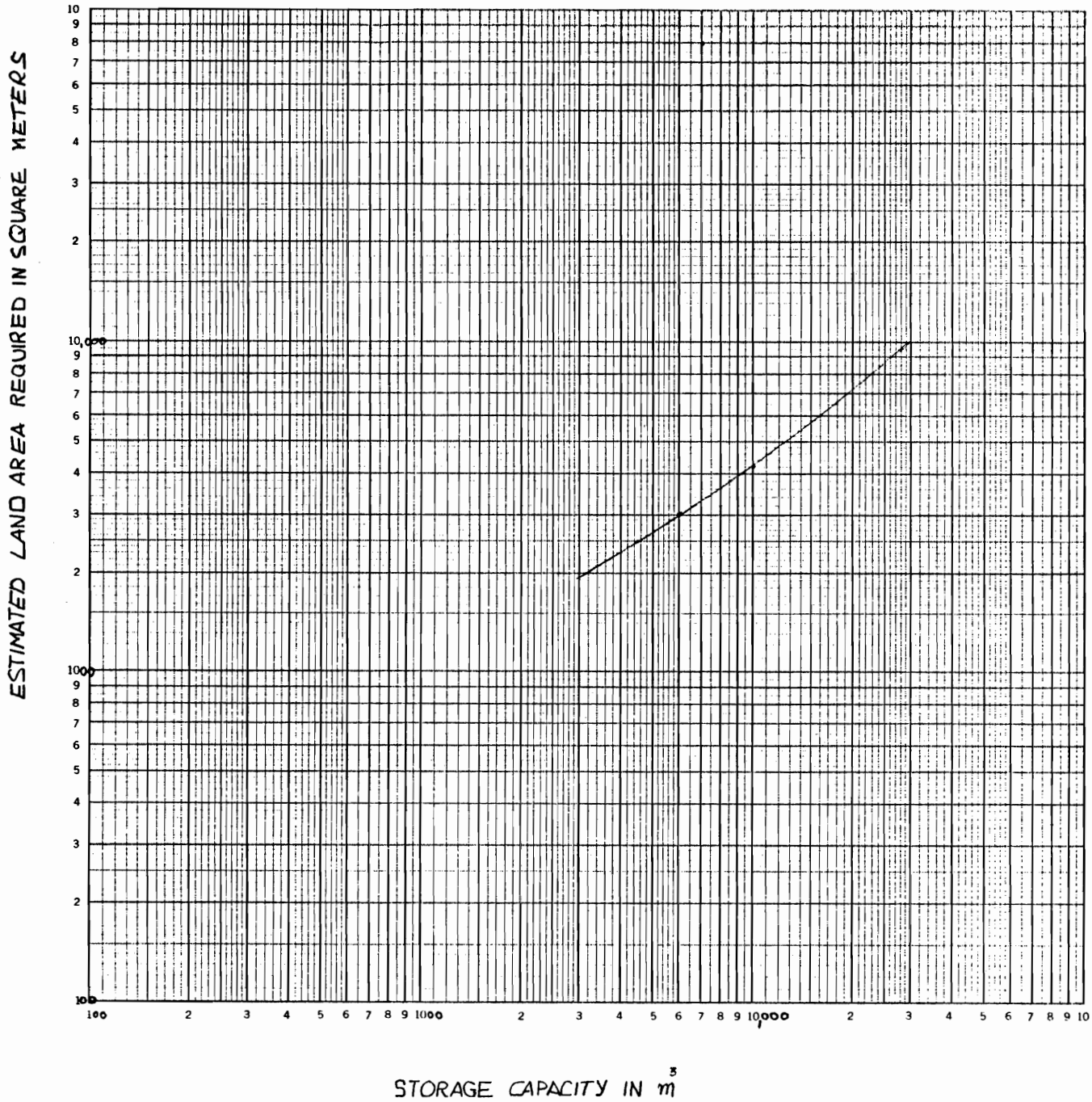


268

ESTIMATED LAND REQUIREMENTS

REINFORCED CONCRETE

ELEVATED WATER STORAGE TANKS



269

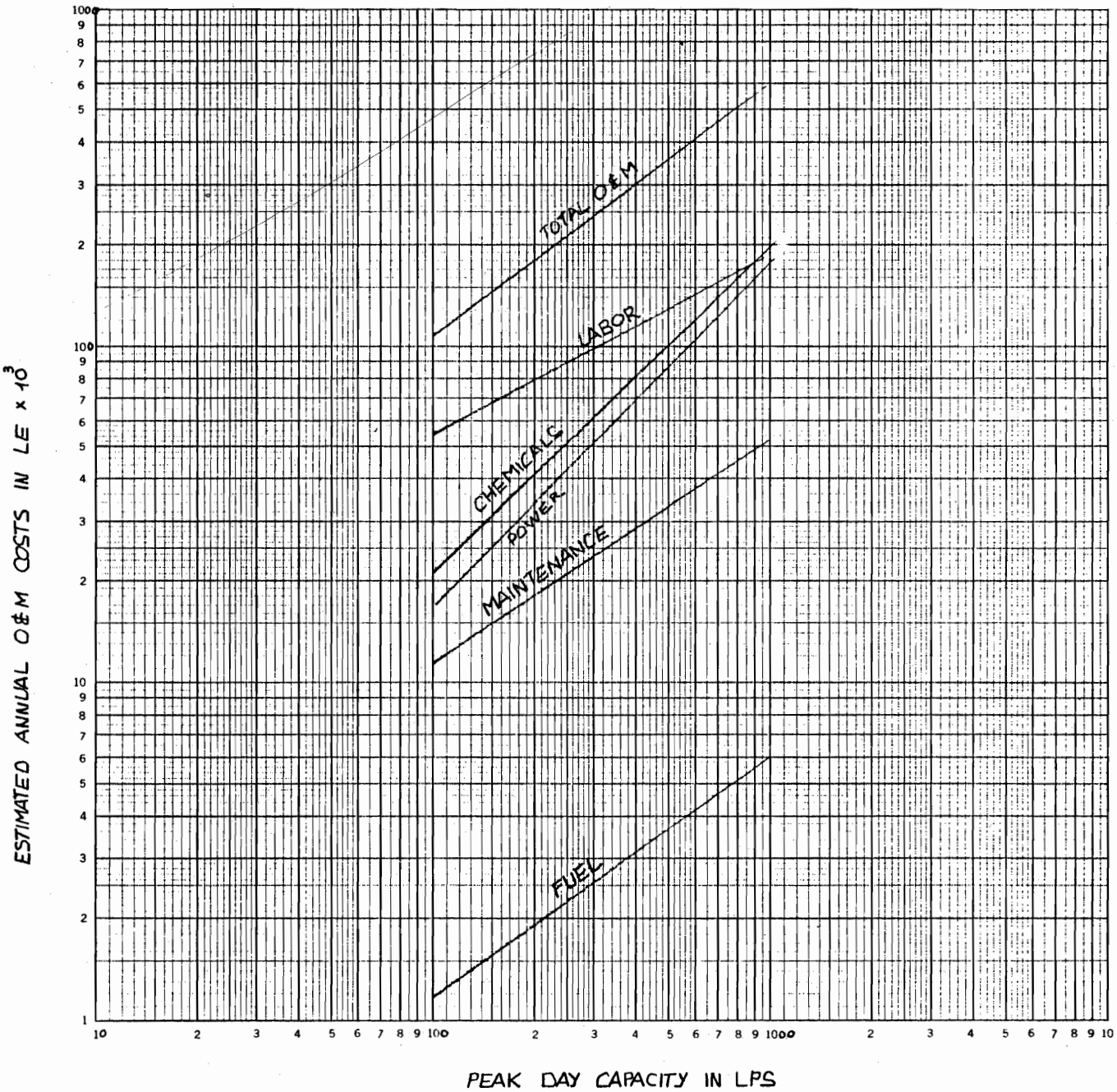
ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

CONVENTIONAL DUAL MEDIA, HIGH RATE

AND

RAPID SAND WATER FILTRATION PLANTS

1984



NOTE :-

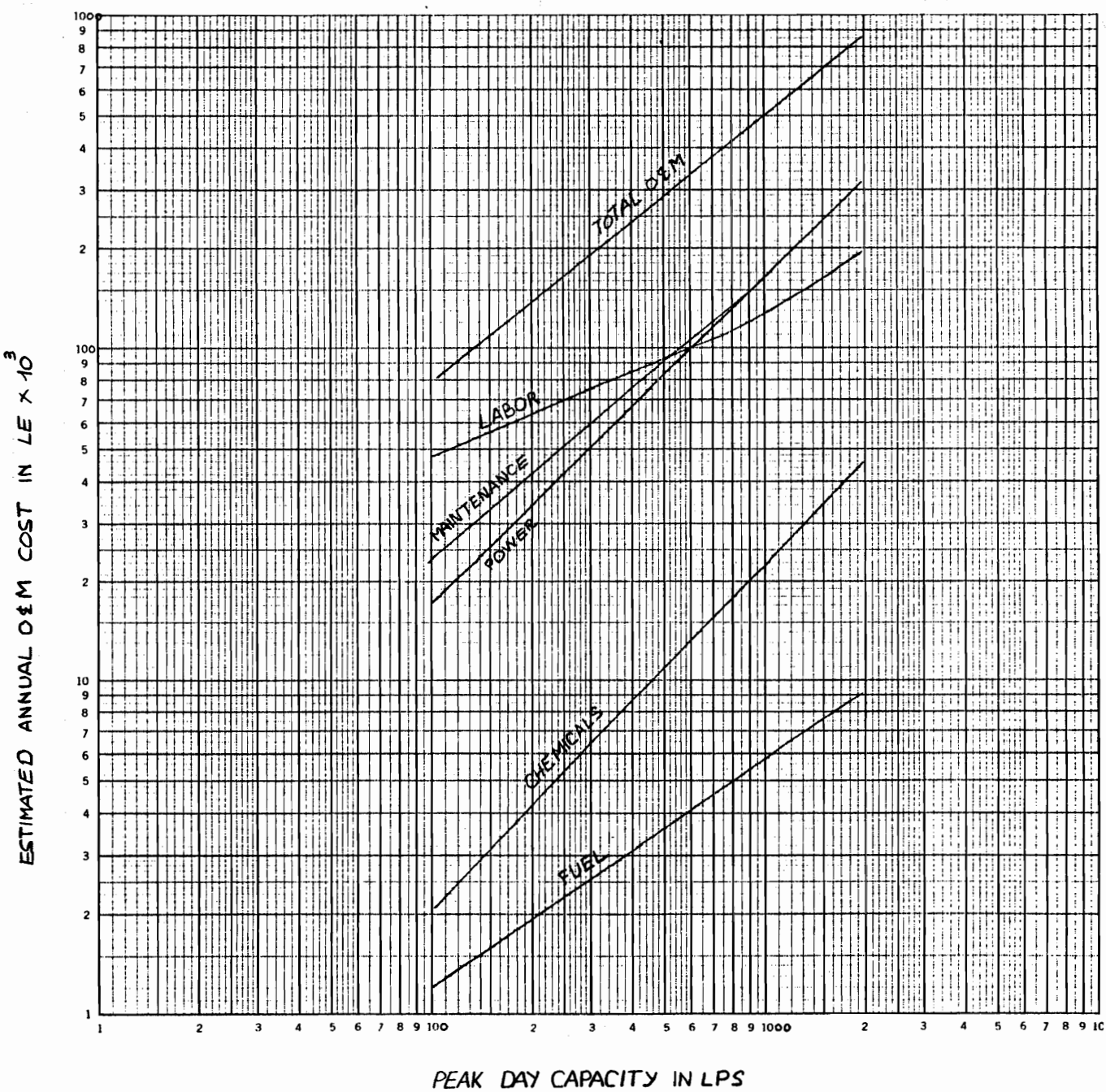
1) COSTS BASED ON UTILIZATION FACTOR OF 70 % OF PEAK DAY DESIGN CAPACITY

270

ESTIMATER ANNUAL OPERATION AND MAINTENANCE COST

SLOW SAND WATER FILTRATION PLANTS

1984



NOTE :-

1) COSTS ARE BASED ON UTILIZATION FACTOR OF 70% OF PEAK DAY DESIGN CAPACITY.

2) INCLUDES PERIODIC REPLACEMENT OF FILTER MATERIAL.

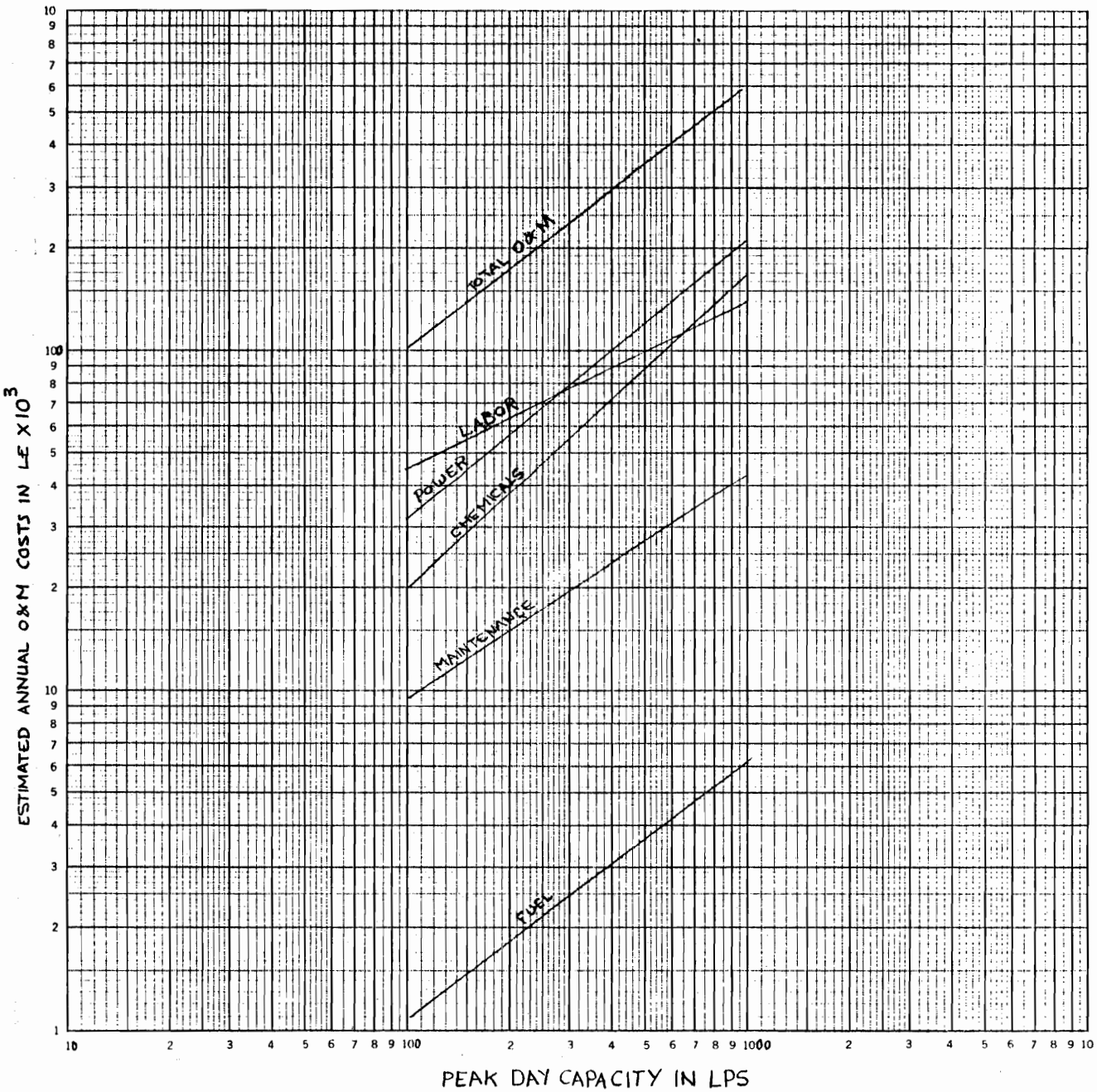
271

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

DUAL MEDIA, HIGH RATE DIRECT FILTRATION

WATER TREATMENT PLANTS

1984



NOTE:

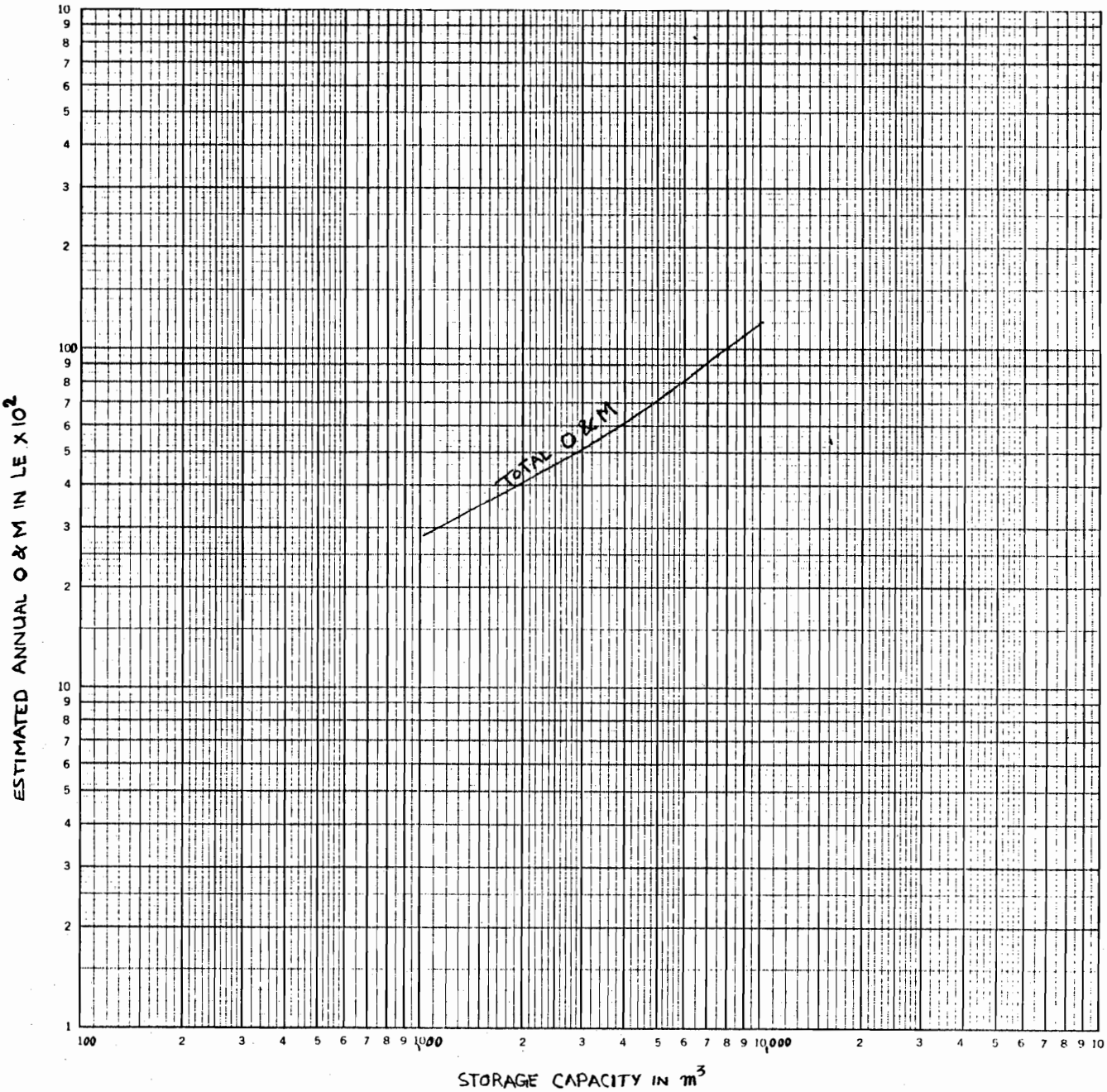
1) COSTS BASED ON UTILIZATION FACTOR OF 70% OF PEAK DAY DESIGN CAPACITY.

272

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

REINFORCED CONCRETE ELEVATED WATER STORAGE TANKS

1984



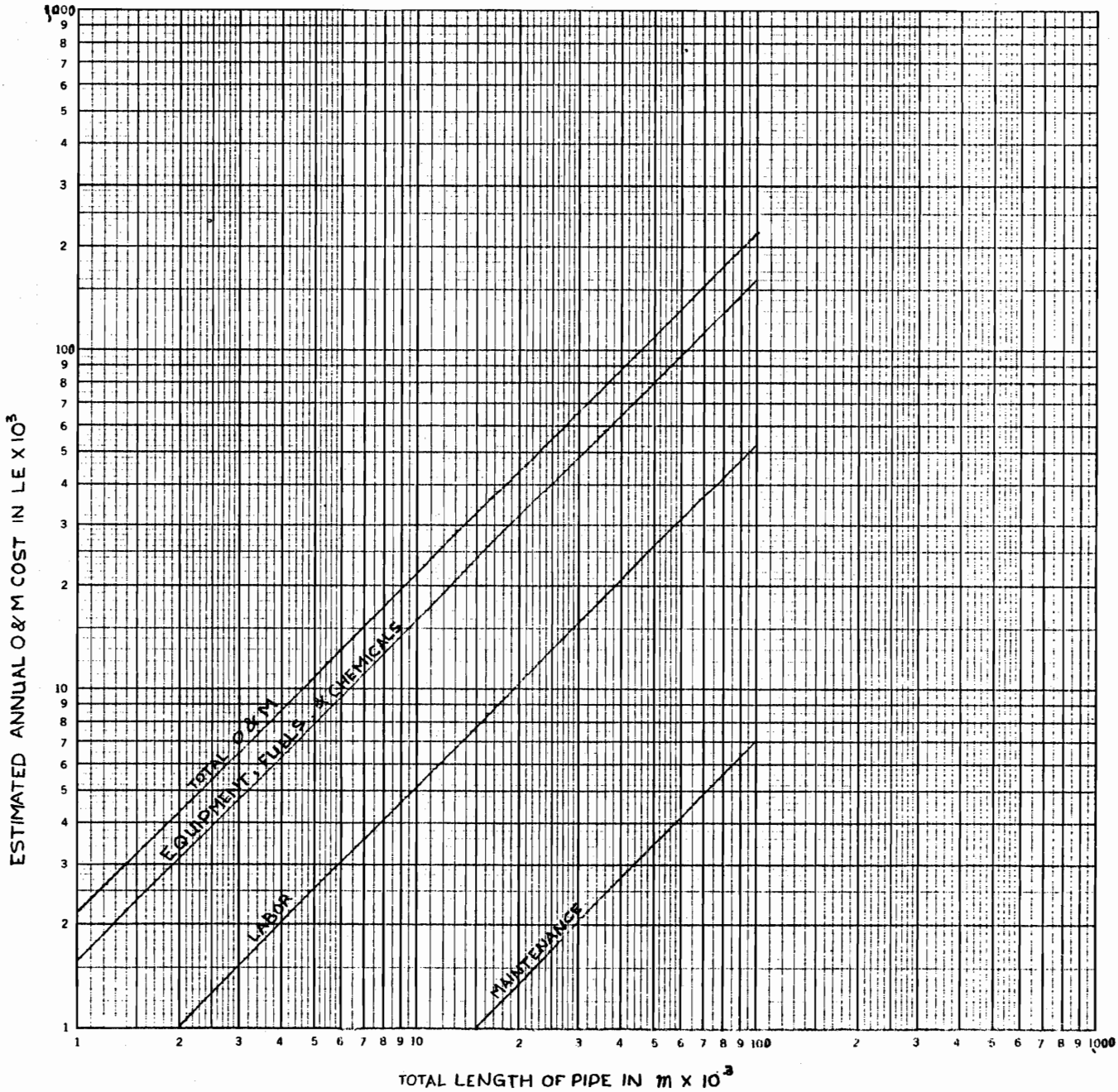
273

ESTIMATED ANNUAL OPERATION & MAINTENANCE COSTS

WATER LINES

(WITH 2% PIPE STOCK)

1984



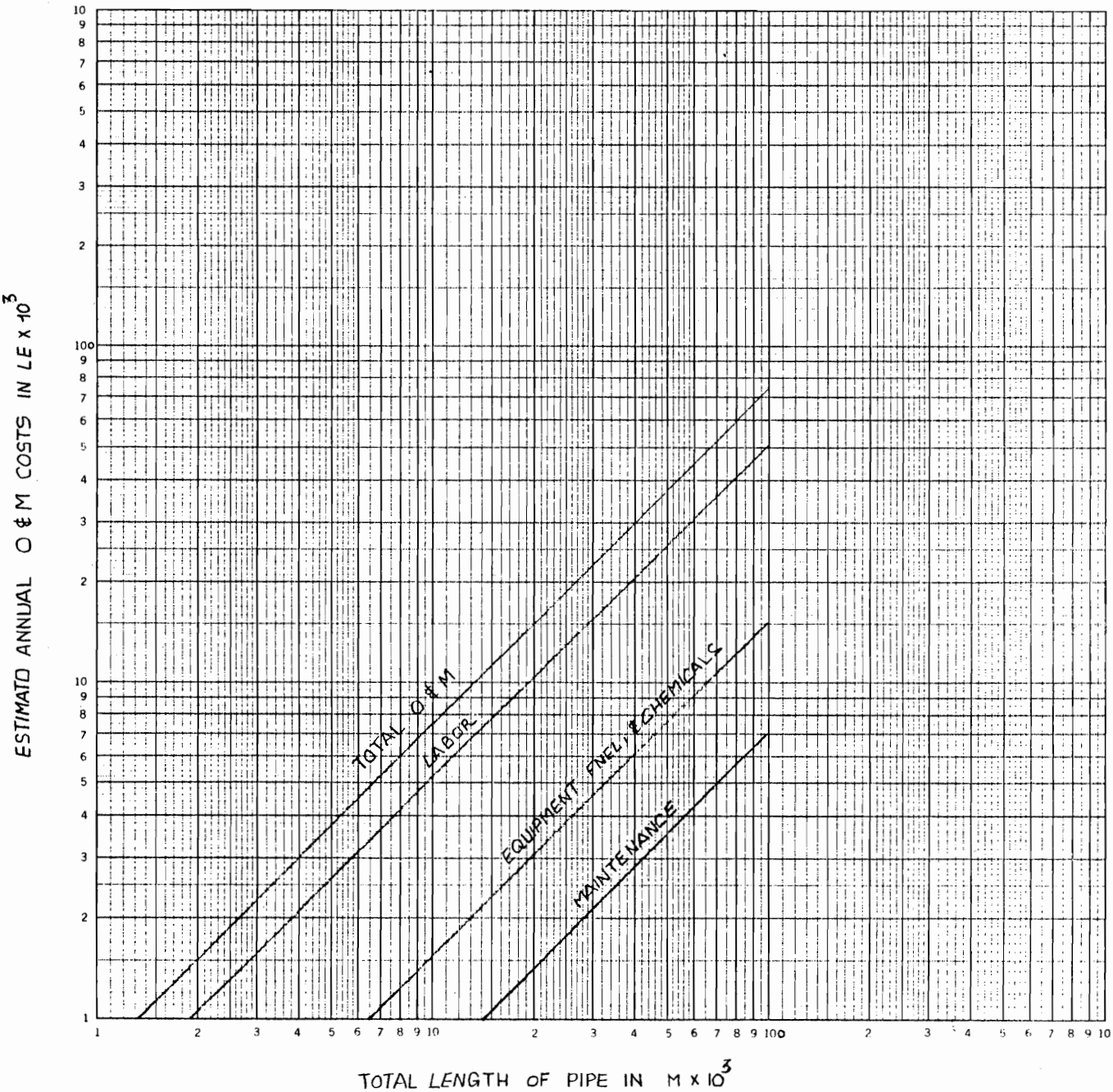
274

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

WATER LINES

(WITHOUT PIPE STOCK)

1984



275

APPRNDIX B

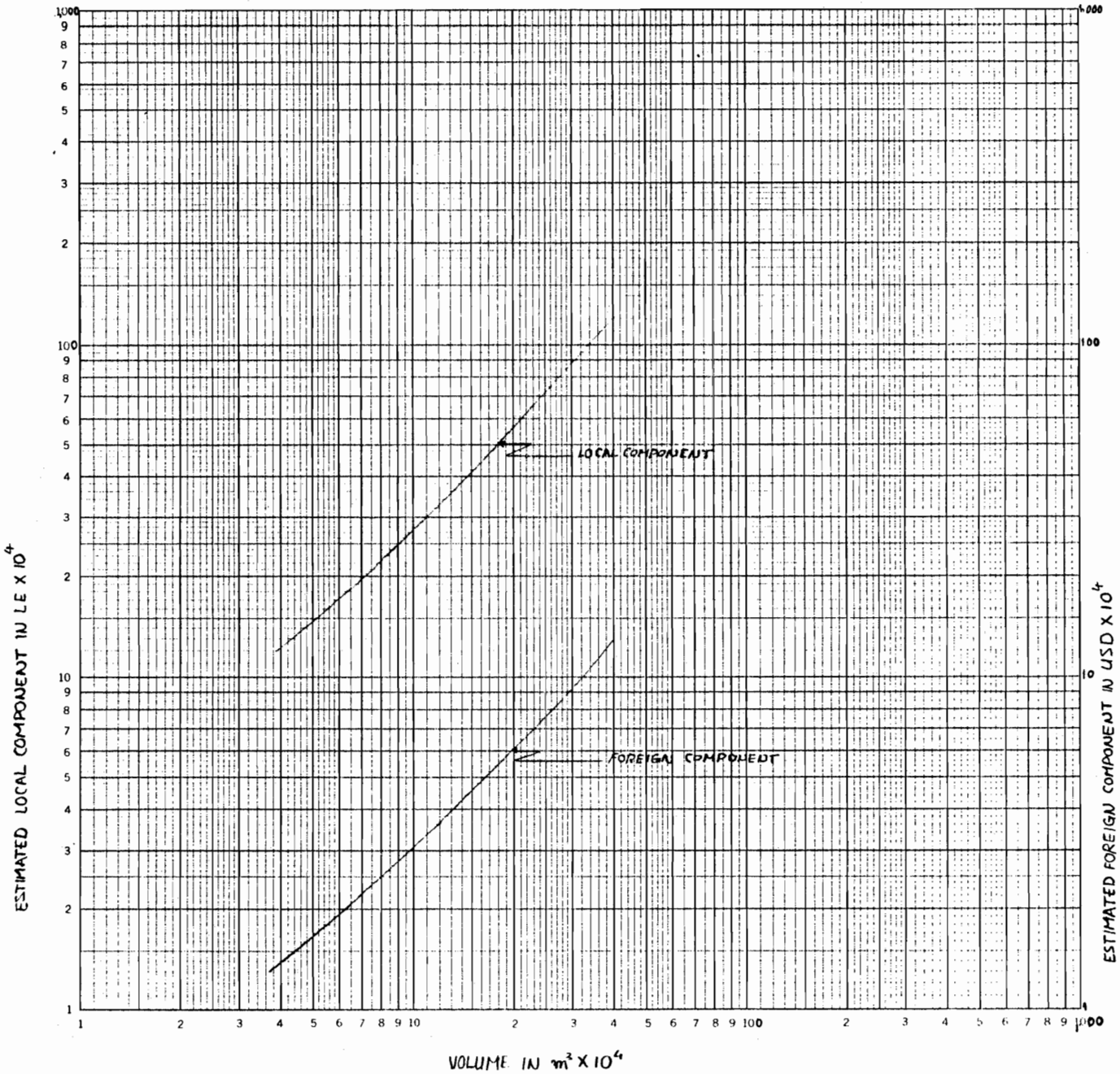
COST AND LAND REQUIREMENTS CURVES FOR WASTEWATER FACILITIES

276

ESTIMATED BASE CONSTRUCTION COST

WASTE STABILIZATION PONDS

1984

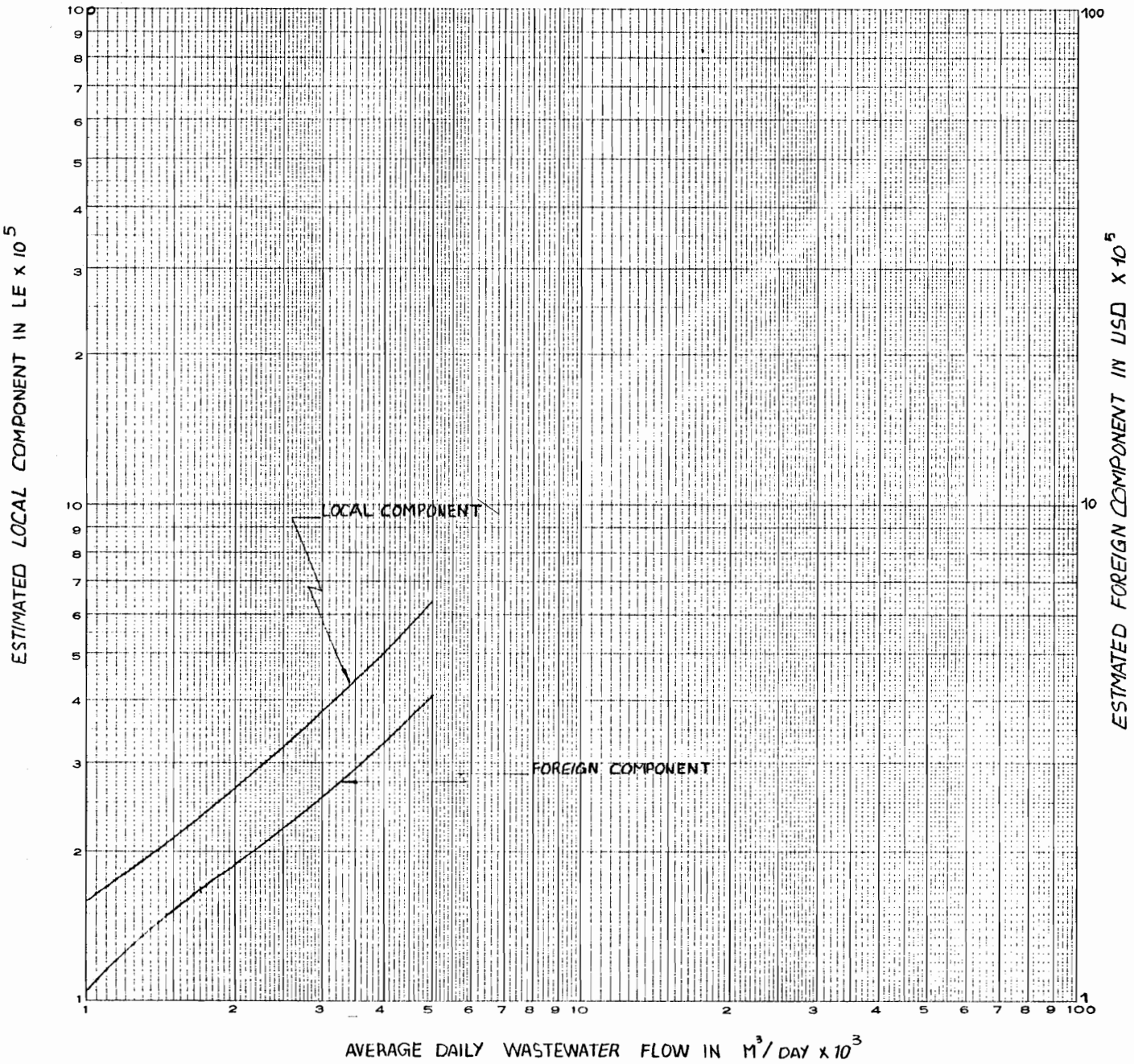


277

ESTIMATED BASE CONSTRUCTION COST

PRIMARY WASTEWATER TREATMENT

1984



NOTE :-

1) INCLUDES PRELIMINARY TREATMENT IN THE FORM OF SCREENING AND GRIT REMOVAL AND SLUDGE PUMPING.

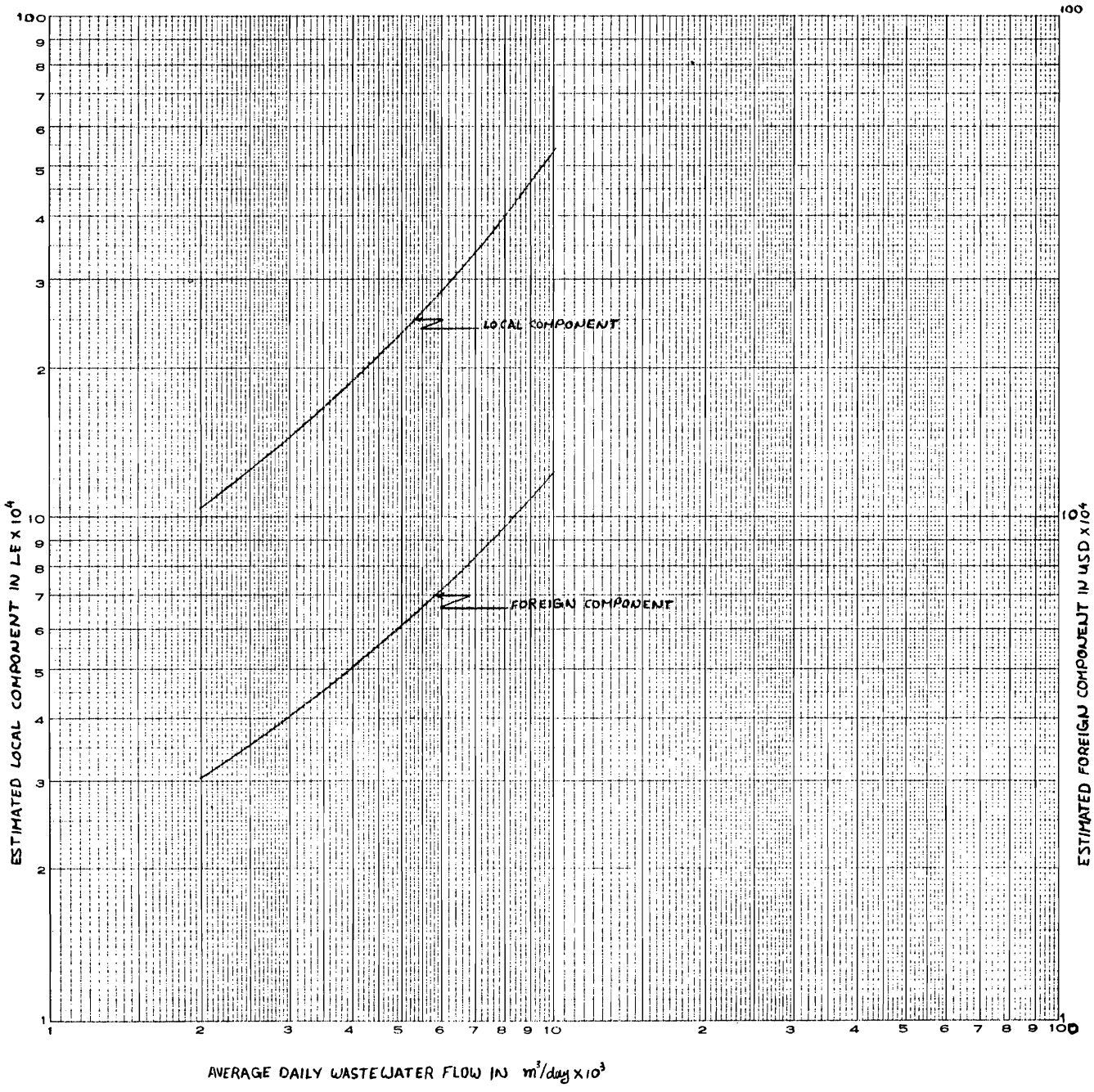
2) DOES NOT INCLUDE CHLORINATION FACILITIES AND SLUDGE DRYING BEDS.

278

ESTIMATED BASE CONSTRUCTION COST

SINGLE-STAGE, HIGH RATE TRICKLING FILTERS

1984



NOTE:

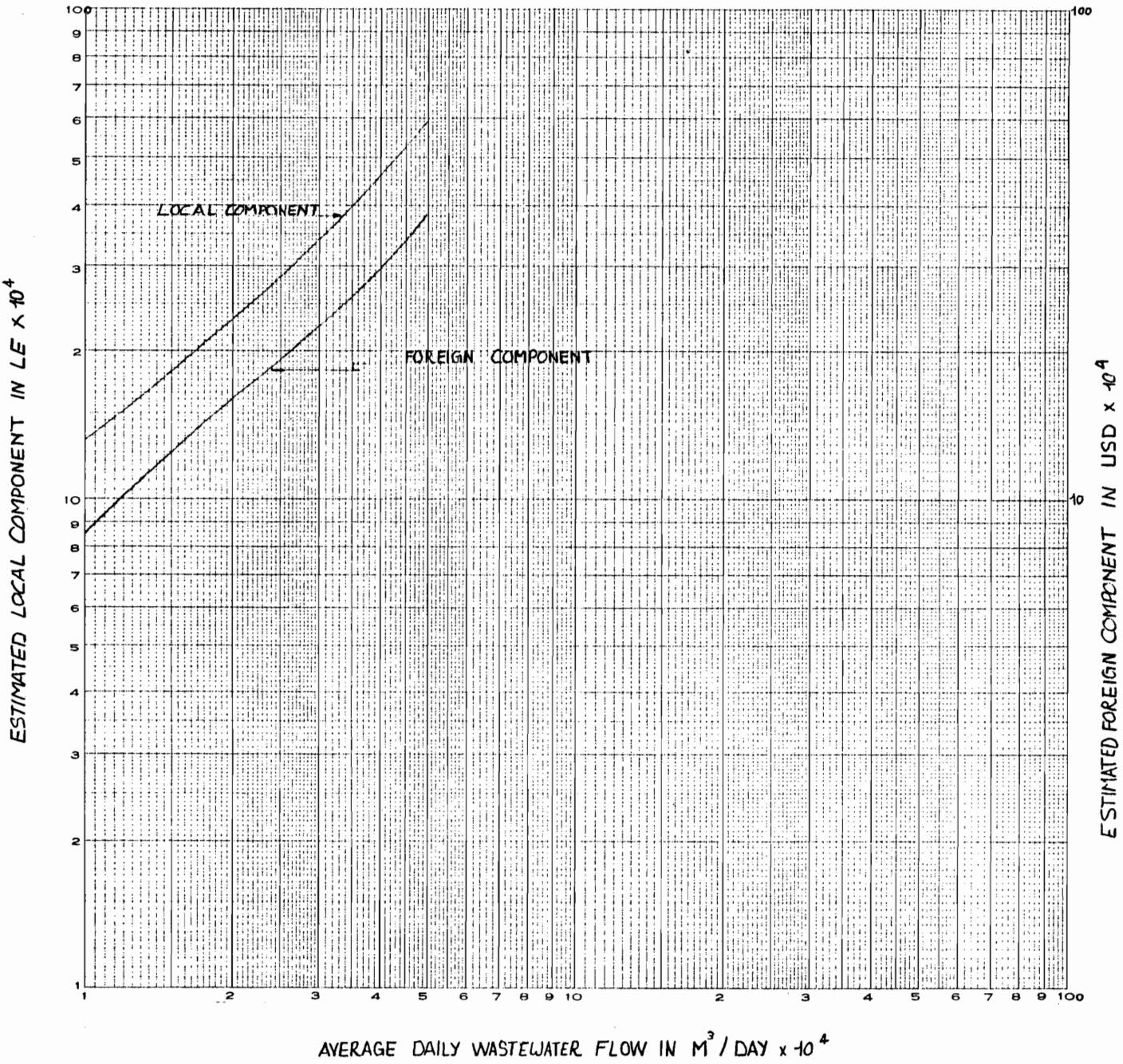
INCLUDES TF EFFLUENT RECIRCULATION SYSTEM (PIPING & PUMPING) TO TRICKLING FILTERS AND PRIMARY SEDIMENTATION TANKS FOR RECIRCULATION RATIO OF 1.0.

279

ESTIMATED BASE CONSTRUCTION COST

WASTEWATER FINAL CLARIFIERS

1984



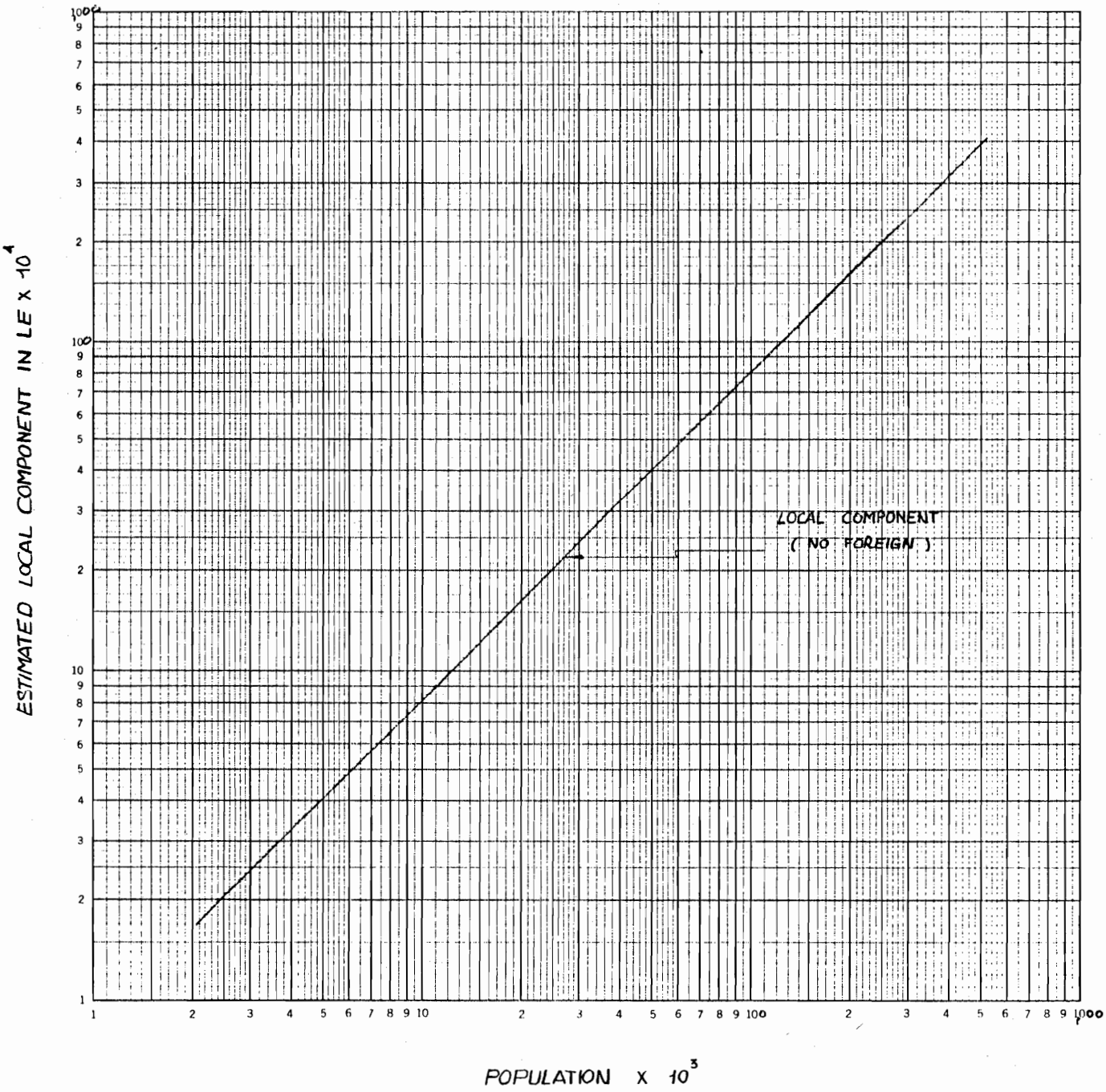
NOTE :-

1) INCLUDES SLUDGE PUMPING

280

ESTIMATED BASE CONSTRUCTION COST

SLUDGE DRYING BEDS

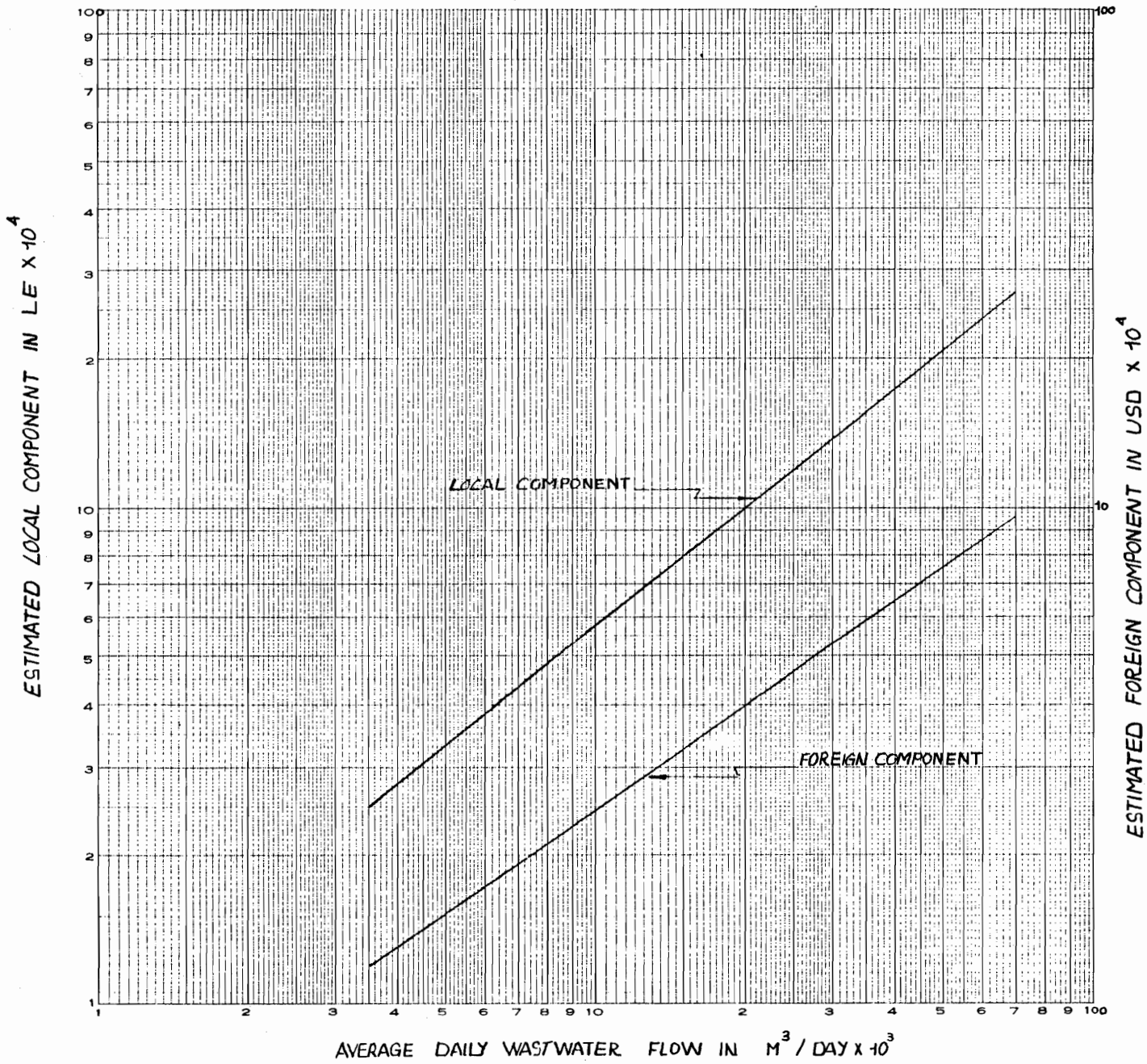


281

ESTIMATED BASE CONSTRUCTION COST

WASTEWATER CHLORINATION FACILITIES

1984



NOTE :-

1) INCLUDES CHLORINE CONTACT TANKS, CHLORINATORS, AND CHLORINE BUILDING

2) CHLORINE CONTACT TIME = 30 MIN. AT AV. DAILY WASTEWATER FLOW.

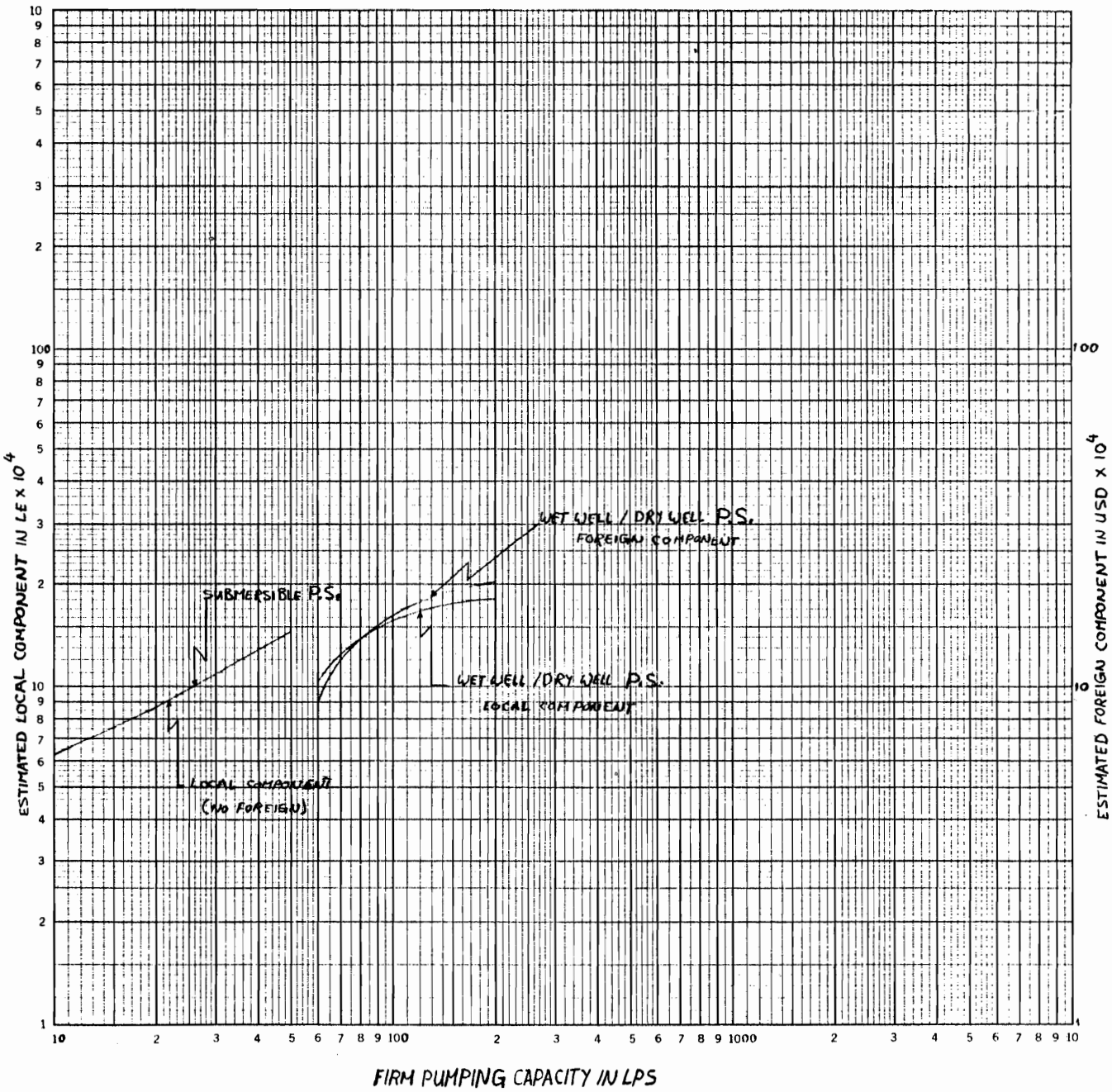
282

ESTIMATED BASE CONSTRUCTION COST

WASTEWATER PUMP STATIONS

WET WELL/DRY WELL & SUBMERSIBLE

1984



NOTE:

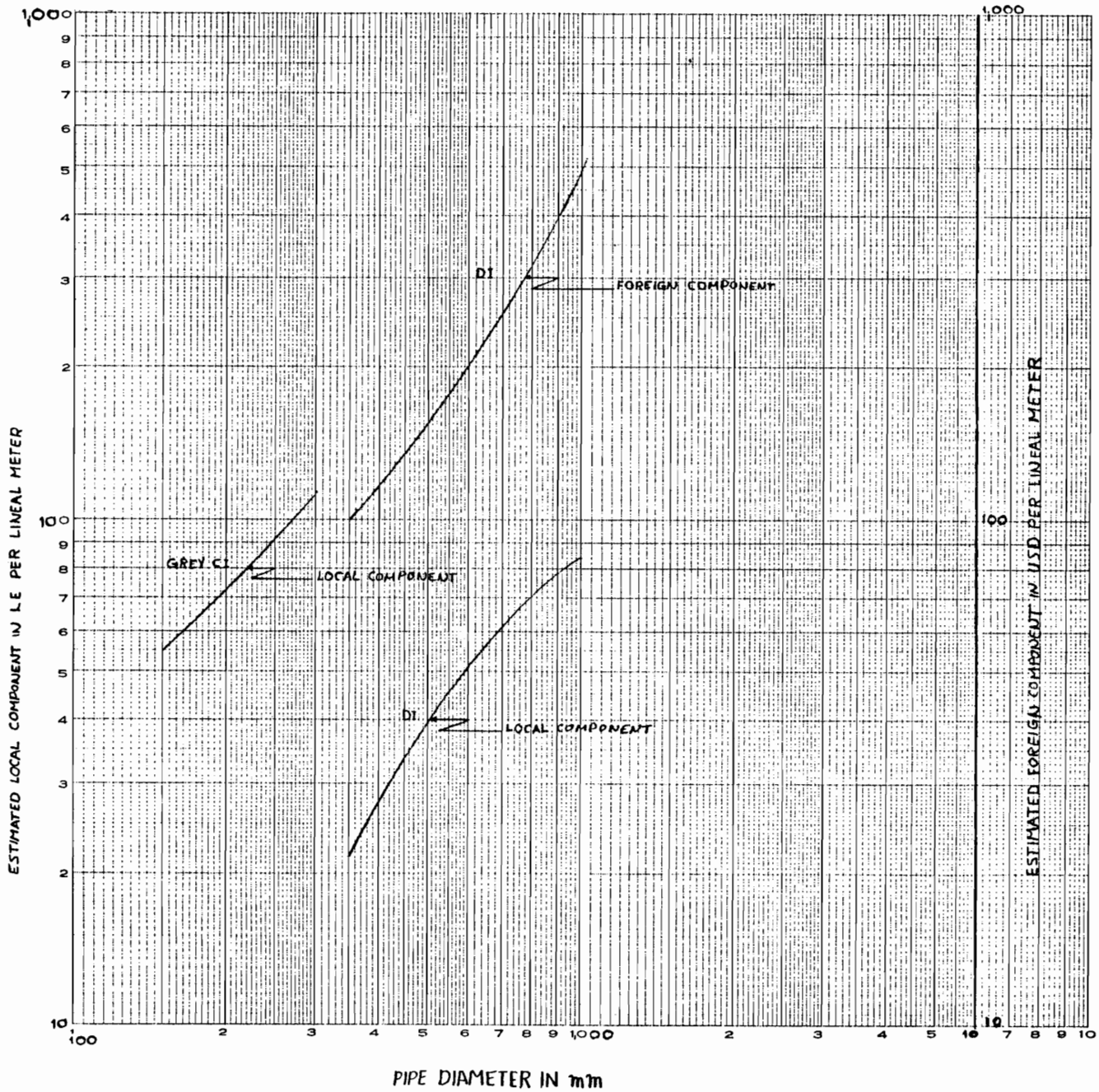
1) FIRM PUMPING CAPACITY = 1.5 X AV. DAILY WASTEWATER FLOW.
2) BOTH TYPE PUMP STATIONS CONTAIN 3 INSTALLED UNITS WITH ANY 2 EQUALLING FIRM PUMPING CAPACITY & WITH A THIRD UNIT AS A 50 % STANDBY PLUS A FORTH UNIT IN STORAGE AS A SPARE.
3) ALL P.S. EQUIPPED WITH MANUALLY-CLEANED BAR SCREENS.
4) SUBMERSIBLE P.S. INCLUDE 2 STANDBY PORTABLE DIESEL PUMPS.
5) WET WELL/DRY WELL P.S. INCLUDE STANDBY DIESEL GENERATOR.

283

ESTIMATED BASE CONSTRUCTION COST

FORCE MAINS

1984

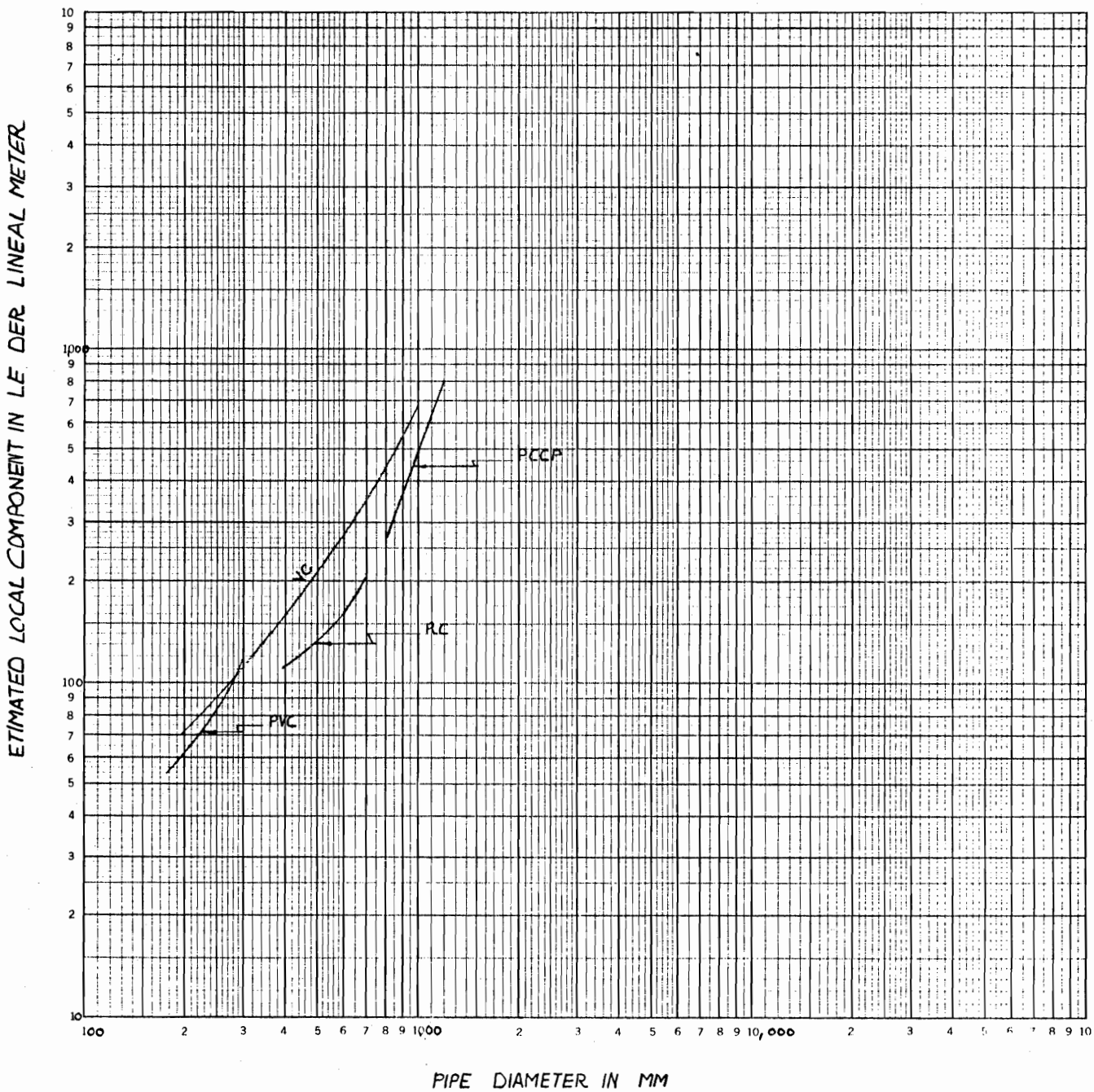


284

ESTIMATED BASE CONSTRUCTION COST

SEWER LINES

1984



NOTE :-

1) NO FOREIGN COMPONENT FOR SEWER LINES

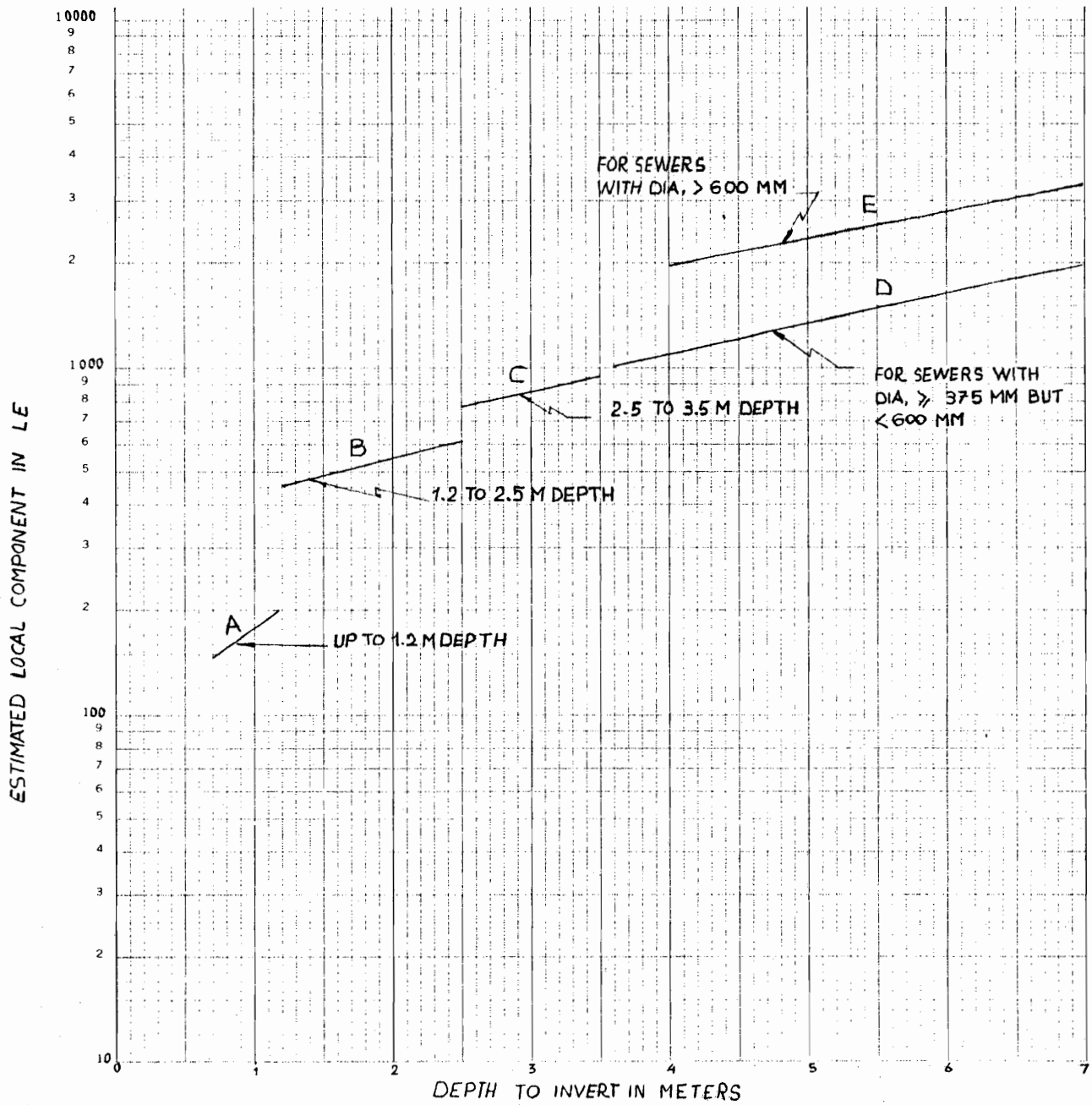
2) ALL CURVES FOR AVERAGE DEPTH TO INVERT OF 3.0 M

245

ESTIMATED BASE CONSTRUCTION COST

SEWER MANHOLES

1984



NOTE:

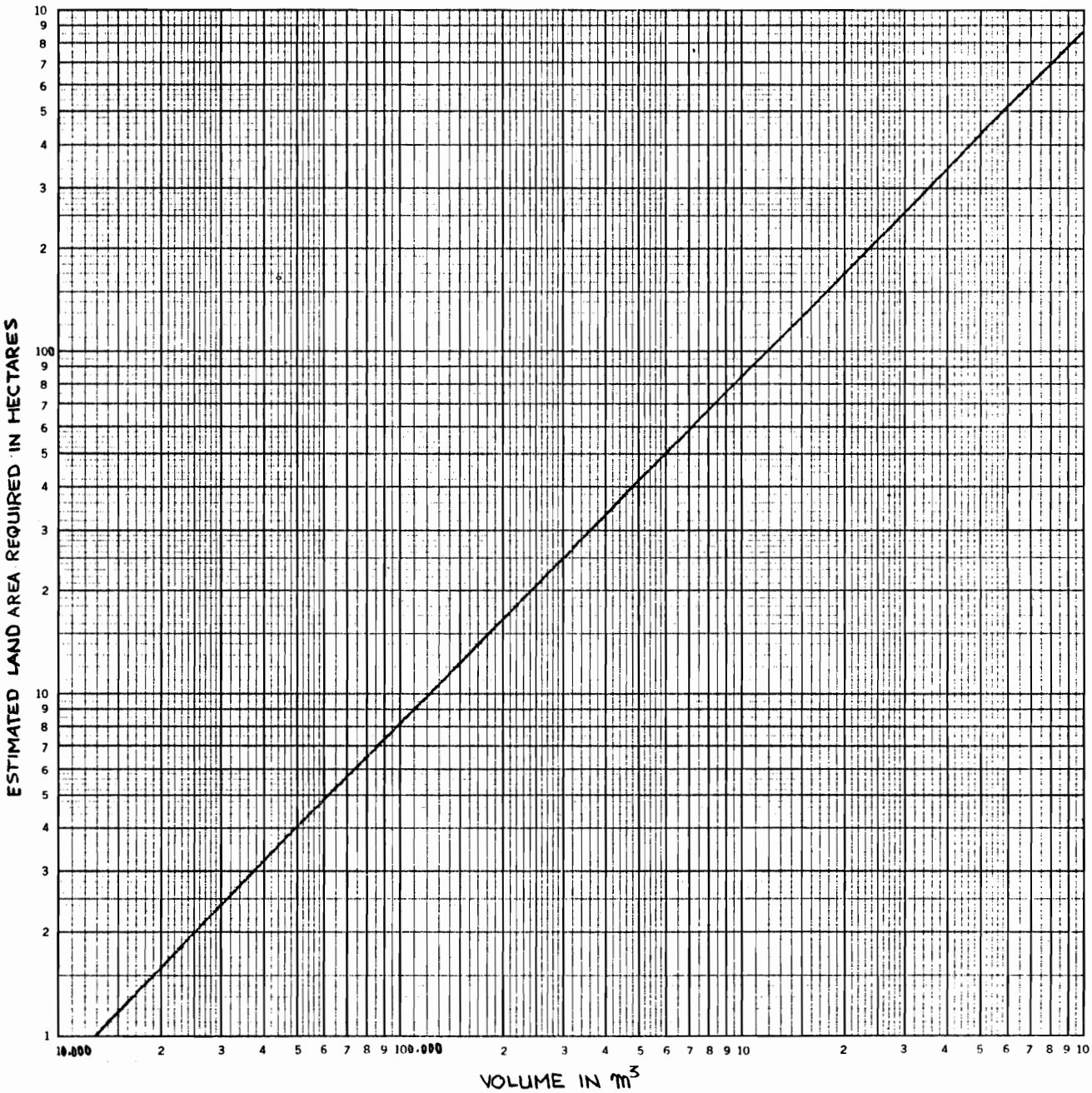
1) ALL MANHOLE TYPES ARE CIRCULAR EXCEPT TYPE E WHICH IS SQUARE (1.5 m X 1.5 m)
2) INTERNAL DIAMETERS OF TYPES A, B, C, & D ARE 0.6, 1.0, 1.2, & 1.2, RESPECTIVELY, & HAVE CI COVERS OF DIA. 0.60 m.
3) ALL WALLS ARE POURED-IN-PLACE PLAIN CONCRETE EXCEPT THE UPPER SLAB OF TYPE E IS REINFORCED CONCRETE WITH CI COVER WEIGHING 350 kg & DIA. 0.76 m.
4) NO FOREIGN COMPONENT.

BEST AVAILABLE COPY

287

ESTIMATED LAND REQUIREMENTS

WASTE STABILIZATION PONDS

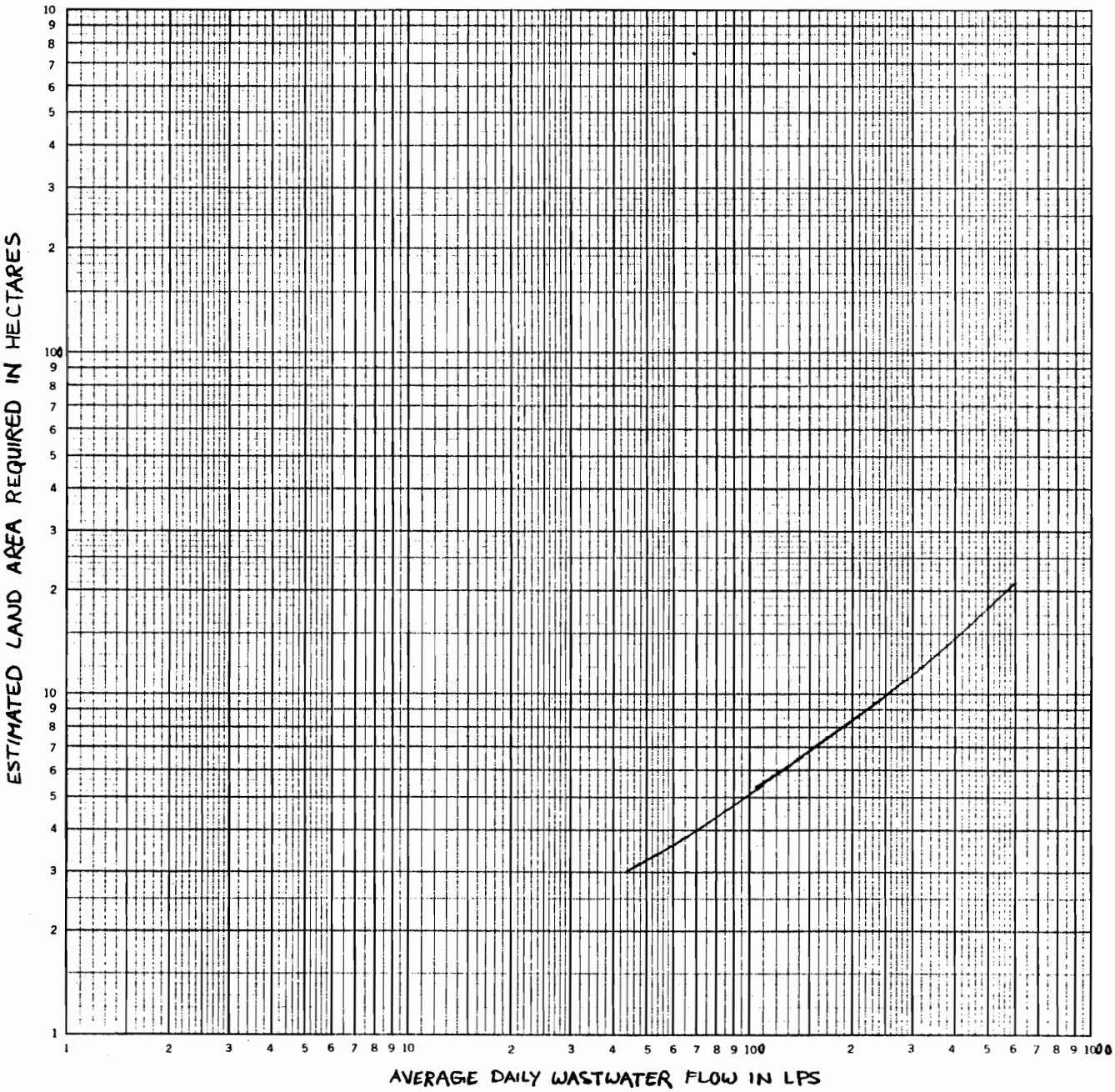


288

ESTIMATED LAND REQUIREMENTS

SINGLE-STAGE, HIGH RATE TRICKLING FILTER

WASTEWATER TREATMENT PLANTS

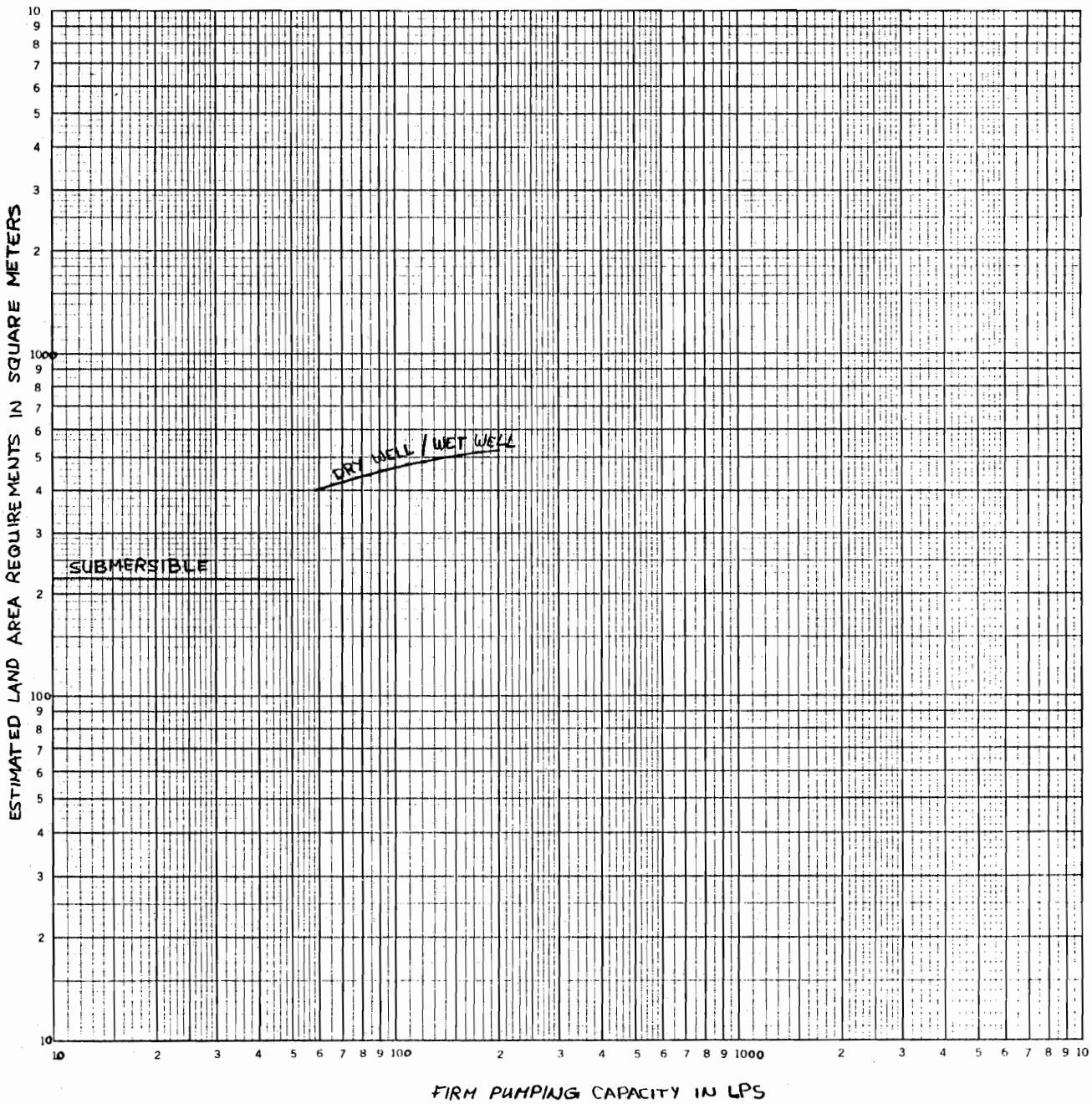


289

ESTIMATED LAND REQUIREMENTS

WASTEWATER PUMP STATIONS

SUBMERSIBLE & CONVENTIONAL DRY WELL / WET WELL

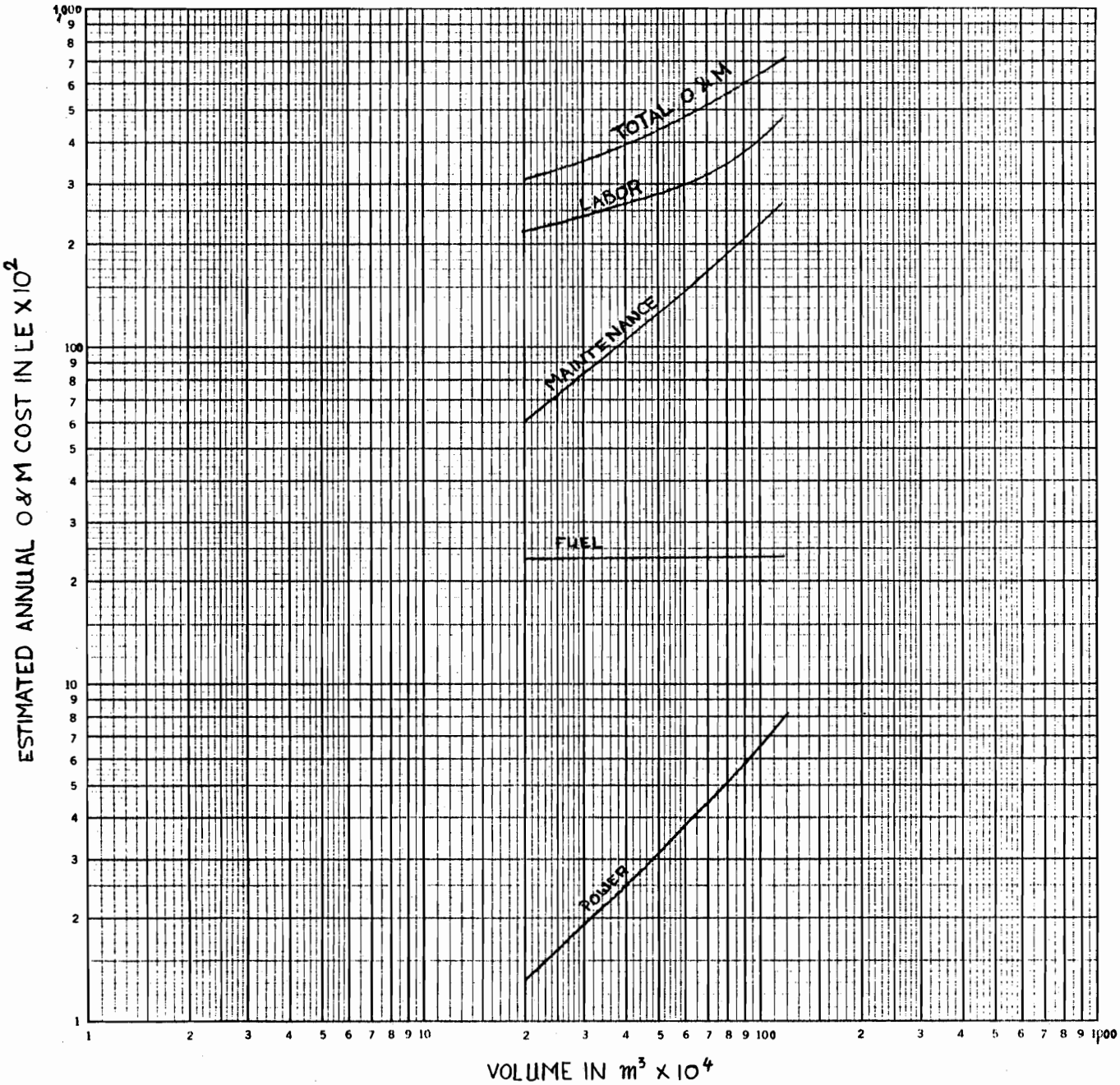


290

ESTIMATED ANNUAL OPERATION & MAINTENANCE COSTS

WASTE STABILIZATION PONDS

1984



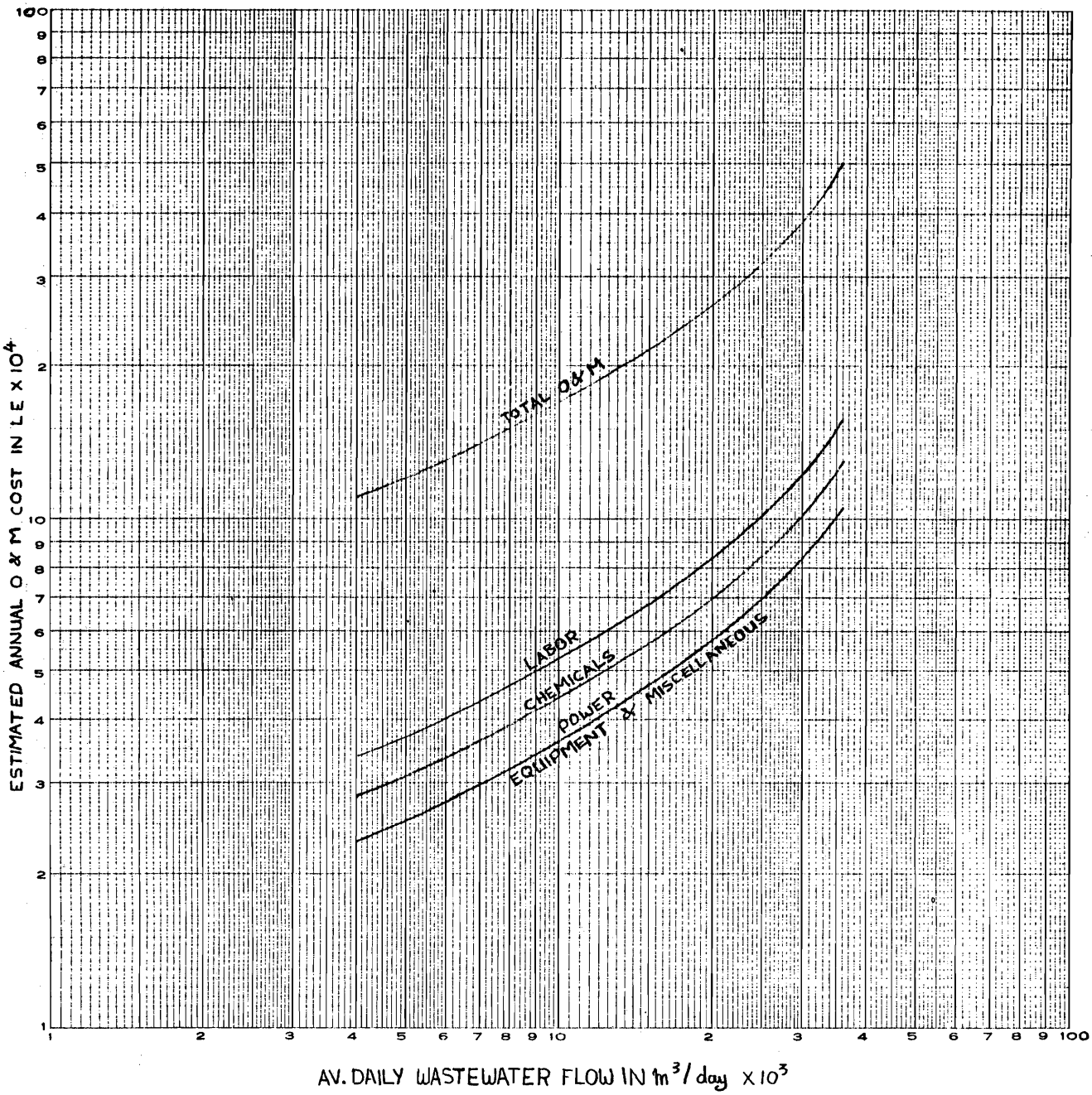
291

ESTIMATED ANNUAL OPERATION & MAINTENANCE COSTS

SINGLE-STAGE, HIGH RATE TRICKLING FILTER

WASTEWATER TREATMENT PLANTS

1984



NOTE:

SAME CURVE IS USED TO SEPARATELY OBTAIN ANNUAL O & M POWER COST & ANNUAL O&M EQUIPMENT & MISCELLANEOUS COST.

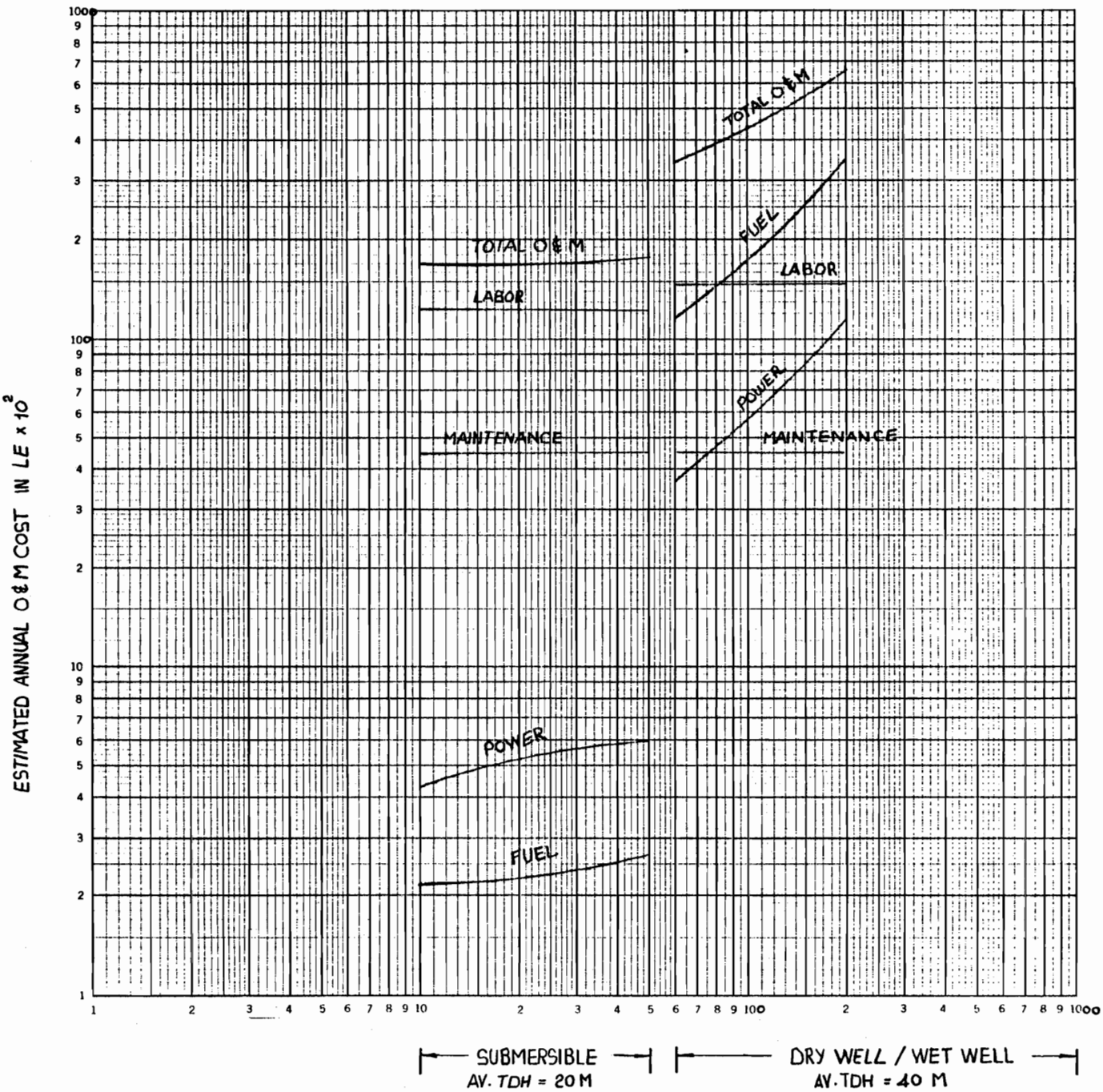
292

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

SUBMERSIBLE AND CONVENTIONAL DRY WELL / WET WELL

WASTEWATER PUMP STATIONS

1984



PEAK WASTEWATER FLOW IN LPS

NOTE :-

1) PEAK WASTEWATER FLOW = 1,5 X AV. DAILY WASTEWATER FLOW

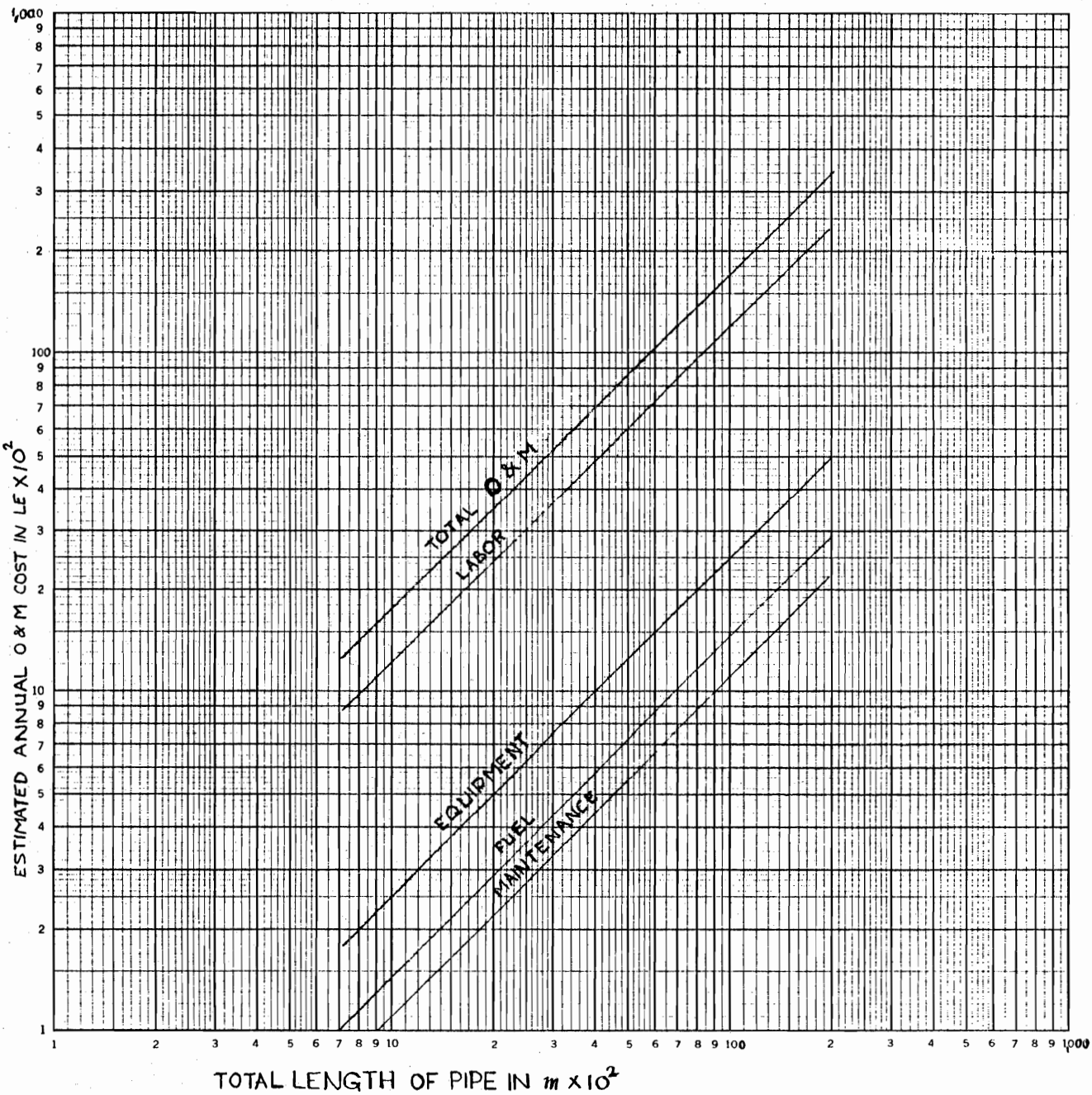
293

ESTIMATED ANNUAL OPERATION & MAINTENANCE COSTS

SEWER LINES

(DIAMETER 150 mm TO 300 mm)

1984



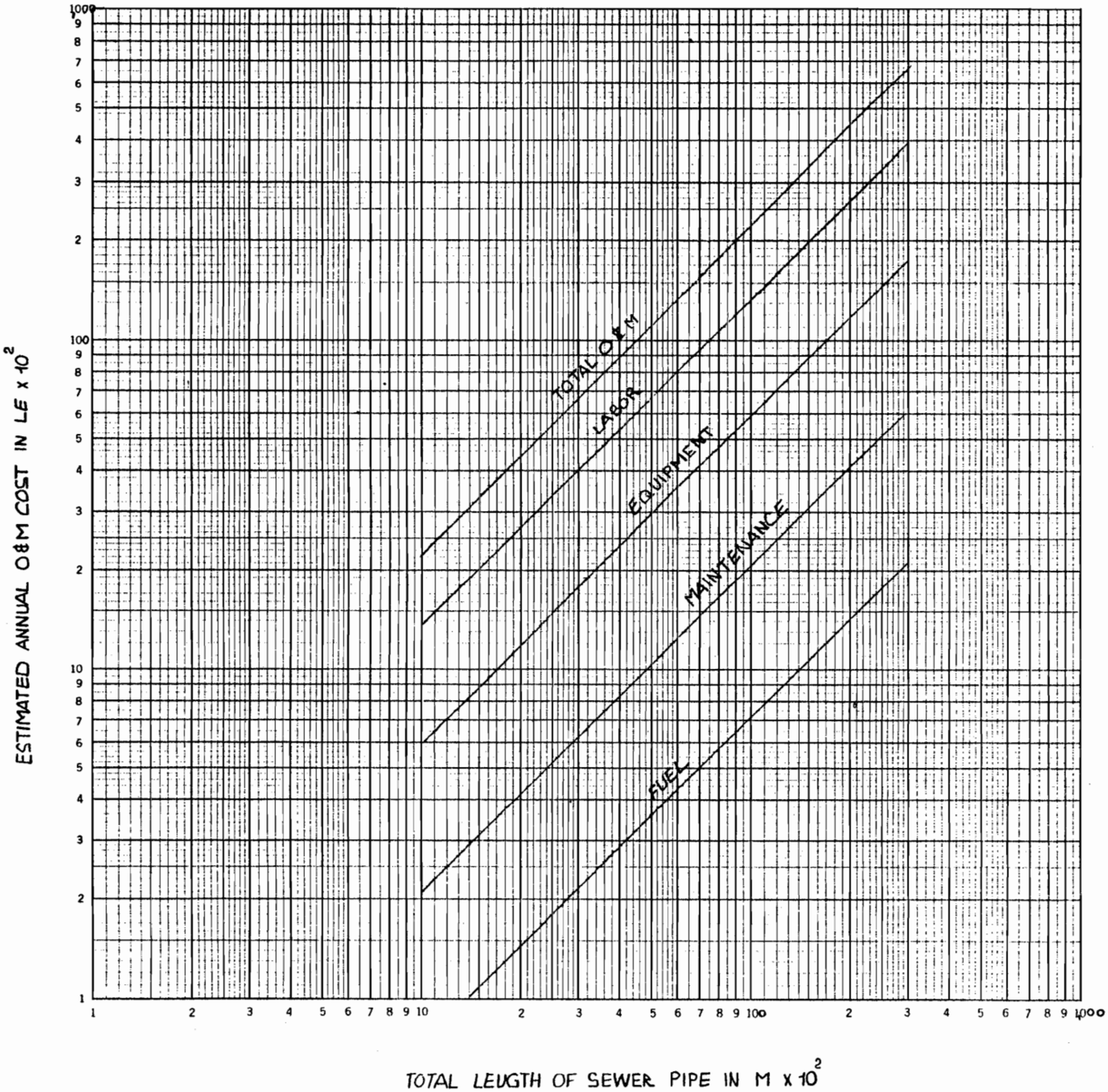
294

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS

SEWER LINES

(DIAMETER 375 MM TO 600 MM)

1984



295