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EVALUATION, CONCEPTUAL DESIGN

and

PROPOSED TERMS OF REFERENCE

for

GAZA WASTEWATER TREATMENT PLANT UPGRADE

(Contract #: HNE-0159-6-00-3080-00)

Final Report

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Prepared for:

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Prepared by:

Management Systems International
Evaluation and Conceptual Design Team
Kenneth Rikard, Team Leader
Thomas Bailey, Consultant
Saul Arlosoroff, Consultant
Osama Amad, Consultant

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MANAGEMENT
SYSTEMS
INTERNATIONAL

600 Water Street, S.W.
Washington, D.C. 20024
USA

202/484-7170
Fax: 202/488-0754

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EXECUTIVE SUMMARY

The United States Agency for International Development (USAID) Mission for the West Bank and Gaza is financing an interim program to upgrade and expand the Municipality of Gaza's Wastewater Treatment Plant (GWWTP). This program is needed to provide sufficient treatment of processes and facilities to handle projected flows up to the year 2005 and to upgrade the quality of the effluent to a suggested quality standard of 30 mg/l of BOD and 30 mg/l of TSS.

In an effort to develop sufficient information for preparing a contract package of a "Design/Then Build" Project for implementing the upgrade program, USAID contracted with the U.S. consulting firm of Management Systems International, Inc. (MSI). The MSI effort, ergo this report, is comprised of three major tasks: 1) to evaluate the existing GWWTP facilities and develop a prioritized list of repairs, including estimated costs, required to rehabilitate the existing plant and assure its safe and efficient operation; 2) develop a conceptual design, including estimated costs, process flow schemes and process design calculations, of a plant capable of meeting Gaza's estimated treatment needs up to the year 2005; and, 3) develop a proposed Scope of Work with sufficient detail to enable USAID to issue a Request for Proposal (RFP) for the design and construction of the conceptual design, or similar.

Chapter One details the information gathered during the field evaluation of the existing Works and the Teams recommendations for work which needs to be done at these sites. In accomplishing this task the Team placed heavy emphasis on the visual observations taken in concert with Gaza Municipal technicians as well as data provided by technicians from the United Nations Relief and Works Agencies for Palestine Refugees in the Near East (UNRWA). From these efforts the Team concluded the following:

- significant quantities (more than 15,000m^3/day) of untreated, and/or poorly treated, sewage is being disposed of to Gaza's beaches.
- the GWWTP facilities, especially the pumps, and the aeration and facultative ponds need to be replaced and/or rebuilt.
- the reuse facilities constructed by the United Nations Development Program (UNDP) have never been used.
- the estimated cost of bringing these facilities up to a dependable use level (after the UNRWA emergency program) is approximately $800,000.

Chapter Two details the Teams assumptions and specific recommendations for what work needs to be done to upgrade the System to meet Gaza's needs to the Year 2005. In developing these recommendations and cost estimates the Team focussed on expanding the information gathered during the evaluation phase and combining this information with technical data presented in previously submitted consultant reports on this subject. From this information the Team decided on the following design assumptions:

- Estimated Gaza Population in 2005 - 506,000
- Estimated water use in liters/capita/day in 2005 - 110
- Estimated % of water use reaching sewers - 75%
- Estimated % of population connected to GWWTP in 2005 - 75%
- Estimated daily flow at GWWTP in 2005 - 32,000 m^3/day
- Estimated BOD influent 2005 - 400 mg/liter
- Estimated TSS influent 2005 - 650 mg/liter
- Estimated SS influent 2005 - 12 mg/liter

The Team reviewed a number of alternative processes for treating the Gaza sewage however when you combine the probable USAID budgetary constraints (i.e., $5 million for construction), with the land ownership difficulties at the sites with the need to keep the system simple, energy efficient and dependable the alternatives are limited. For this specific facility the Team proposes a Modified Trickling Filter system. A properly designed and constructed Plant of this type will provide the opportunity to:

- maximize the use of existing infrastructure
- minimize the use of complex new technology
- be accomplished within the apparent land available
- be simply and cost effectively maintained
- provide a treatment which should meet the 30/30 BOD/TSS design standard
- be accomplished with the apparent USAID budget constraints
- minimize operational (specifically energy) costs
- provide an effluent acceptable for reuse as irrigation water and for aquifer recharge

Implementation of this conceptual design will use virtually the entire existing infrastructure but must be supplemented by the addition of several major components/activities. The most significant of these additions includes:

- construction of one (1) new 32,000 m^3 anaerobic pond
- significant increase in aeration capacity
- replacement of all four (4) large pumps at the treatment plant
- total renovation and conversion of Pond #4 - the present facultative pond
- construction of two (2) - 2500 m^3 each, trickling filters
- construction of sludge drying beds
- replacement of more than one (1) kilometer of discharge line
- addition of plant lighting and fencing
- considerable repiping, valve renovation, and electrical work

Included also in Chapter Two (2) are: I) estimated costs for completing each major activity, ii) a general layout of the recommended treatment and disposal activities, iii) a proposed flow profile for the conceptual design, iv) a schedule for implementing the recommended design and construction activities and, v) abbreviated specifications for the major construction activities.

Chapter Three (3) presents the documentation required to support the proposed Scope of Work for the "Design/Then Build" contract. In developing this section the Team placed strong emphasis on reducing contractor risk and enhancing cash flow. For example, efforts were made to package construction activities in modules that can be fairly easily completed, tested, measured and paid for. In addition, it is proposed that USAID pay for mobilization up-front and also pay - at least on a one time basis - for the purchase of U.S. manufactured equipment and materials at the time these commodities reach the appropriate Israeli Port. Considering the security situation at this site and the difficulty of importing equipment and materials into Gaza form the U.S. these issues are paramount if costs are to be held in an acceptable range. Similarly it is recommended that the time permitted to accomplish this work be limited to a fair but not extensive period of time. The Team believes it is important for the contractor to get on the project and prosecute the work as rapidly as possible. The estimated costs (construction only) for implementing this upgrade and expansion is $4.8 million.

CHAPTER ONE - EVALUATION

1.1 General

The United States Agency for International Development (USAID) Mission for the West Bank and Gaza is financing an interim program for the upgrading and expansion of the existing wastewater treatment plant serving the Municipality of Gaza. The objectives of this program are to provide sufficient treatment capacity to handle project flows up to the year 2005; and to upgrade the quality of the effluent to permit the safe recharge of the aquifer and reuse of the treated effluent for agricultural irrigation.

1.1.1 Study Objectives

To accomplish these objectives, USAID contracted with the Washington, D.C. consulting firm of Management Systems International (MSI) to: 1) evaluate the current physical and operating condition of the Gaza Wastewater Treatment Plant (GWWTP) and its related reuse facilities; 2) propose a conceptual design for the plant upgrades which will serve Gaza's projected 2005 flows and that will conceptually produce a treated effluent at the suggested quality level of 30 mg/l BOD, and 30 mg/TSS[1]; and 3) provide a proposed Terms of Reference (TOR) sufficient for USAID insertion into a Request for Proposal (RFP) for construction of the conceptual design.

Included in this chapter of the report are the Teams evaluation of the physical condition of the GWWTP works and the related reuse facilities which were constructed by the United Nations Development Program (UNDP) in 1986. Included also in this chapter of the report are the Teams recommendations, including cost estimates, for rehabilitation work necessary to assure the plants operational capacity. These recommendations assume that the emergency work currently in progress under the direction of UNRWA will be competed this August or September.

In preparing this evaluation the Team reviewed the condition of the: 1) treatment plant components, 2) disposal lines, and the 3) UNDP constructed "reuse" facilities.

1.2 Plant Review

The GWWTP was constructed in 1977 with a design capacity of 12,000m^3 /d. Most of the plants components are in a serious state of disrepair and the plant is being significantly overloaded. The related, UNDP constructed "reuse and disposal" facilities were never placed in operation and are also in a state of disrepair.

At the treatment plant site, only two of the four treatment ponds are currently in use. None of the aerators are working and all of the pumps need major overhaul or preferably, replacement. Large quantities (more than 4,000m^3 /d) of raw sewage are being diverted directly to the beach and then minimally treated for disposal. Similarly most of the minimally treated effluent is also being pumped to the beach for disposal. None of the 1986 UNDP constructed "reuse facilities"

---

[1]BOD is "Biological Oxygen Demand" and TSS is "Total Suspended Solids".

are in service and a one kilometer segment of the 5.0 km discharge line to Wadi Gaza has been destroyed.

To improve the short term performance of the GWWTP and return it to its originally designed 12,000m^3 / d capacity, the United Nations Relief and Works Agencies for Palestine Refugees in the Near East (UNRWA) has undertaken a short-term program to repair/restore critical components of the GWWTP works. This work is expected to be completed in August/September of 1997. None of the UNRWA work is designed to increase plant capacity.

Included in this MSI report is a list of recommended repair/rehabilitation work required to enhance and sustain the system operations beyond the UNRWA emergency improvements. If implemented, these MSI recommended improvements will increase the designed capacity of the GWWTP to approximately 16,000m^3/d. The estimated cost for completing these repairs/improvements is approximately $800,000 depending on USAID Geographic Code chosen for purchase of materials.

1.3 Project Works

The existing Gaza Municipal Wastewater Treatment Plant (GWWTP) is located in the Sheikh Ajleen District at the Southern boundary of the Municipality of Gaza in the Gaza Strip approximately 2km from the Mediterranean Sea. Increased population (currently approx. 326,000) and the projected additional flow from newly sewered areas, combined with deteriorated and failed components of the originally constructed system have overloaded the wastewater infrastructure and the plant's ability to perform. At present, the plant is serving a population of more than 200,000.

The wastewater treatment and reuse facilities consist of:

Wastewater Treatment

- inlet facilities
- anaerobic lagoons (2 ea.)
- aerated lagoon
- a facultative lagoon
- chlorination equipment
- pumping station
- valves and pipeline

Reuse Facilities

- 3 ea. rapid infiltration basins
- 5,000m^3 storage tank
- pumping station
- valves and pipeline

1.4 Physical Assessment

Along with representatives from the Municipality of Gaza and UNRWA the MSI team visually reviewed the entire system and assessed the current status of the components as follows:

Table 1.0 Summary of Physical Assessment-Existing Treatment Plant

Component	Exist. Condition	Post-UNRWA	Addnl. work. reqd.
Inlet Works/ Grit Trap	Poor	Good	NWP[2]
Pond # 1 (Anaerobic)	Fair	Good	NWP
Pond # 2 (Anaerobic)	Fair	Good	NWP
Flow Device	None	Install	NWP
Pond # 3 (Aeration)	Poor	Good	+6 addl[3]
Distribution Chambers	Fair	Good	NWP
Pond # 4 (Facultative)	Poor	Good	+ liner
Micro Strainers	Broken	Remove	NWP
Pump Station incl/ 4 pumps	Poor	Poor	new pumps[4]
Chlorination Station	Broken	NWP	repair
Operations Building	Poor	Poor	NWP
Electrical Panels (P.S. #1)	Poor	Good	NWP
Transformer	Good	Good	add 200kva
Distribution Piping	Fair	Fair	+200 m
Fencing	Poor	Poor	repair
Lighting	None	None	Add
Roads	Poor	Fair	NWP

Table 1.1 Summary of Physical Assessment - UNDP Reuse Facilities

Component	Present Condition	Rehab./Repair Needed
Storage Reservoir	Fair	Seal/waterproof interior walls
Percolation Ponds	Poor	Scarify bottoms/rebuild embankments
Booster Pump Station	Poor	Rehab pumps-replace electrical service
Irrigation Pumping	Fair	Remove/rebuild 6 ea. 4" valves Replace 1 km of 12" AC pipe
Valves and Distribution Chambers	Fair	Remove/rehab 15 ea. 18"/22" valves

[2]NWP acronym for No Work Planned to treat 16,000 m^3/day

[3] Six additional aerators equipped with fully outfitted motor control units will be required

[4]Install new pumps

1.5 Existing Facilities

Under the planned renovation being carried out by UNRWA, flow from the splitting box can be piped into Anaerobic Ponds No. 1 and No.2 in series. However, currently the entire flow stream is going to Pond No. 1 while Pond No.2 is being dried for cleaning. The volume of Ponds No. 1 and No. 2 is 20,200m^3 each (assuming a working depth of 4.5 m and a free board of 0.7 m).

Pond No.1 has a detention of 24 hours (based on 80% available capacity). Effluent from the Anaerobic ponds flows via gravity into Pond No. 3 for aeration treatment. However, at the time of this assessment none of the aerators were installed. Under the UNRWA contract six (6) existing aerators will be rehabilitated and installed. The volume of Pond No. 3 is 40,700m^3 with a depth of 4.6 m and a freeboard of 1.1 m.

Effluent from Pond No. 3 would normally flow to Pond No. 4, which is designated to be a facultative pond. Currently this pond is bypassed to allow for sludge removal and restoration of its embankments under the UNRWA contract. The volume of Pond No. 4 is 38,000m^3 with a depth of 4.2m and a freeboard of 1.5m.

Effluent Pumping Station No.1 is equipped with four (4) 50hp centrifugal pumps which are in need of replacement. Under the UNRWA contract, the wet well is to be enlarged, the building upgraded, the piping manifold improved, and a new electrical control panel is to be installed.

Three discharges are available to accommodate the out flow from Pumping Station No. 1:

- Discharge No. 1 - Beach Line (Functional) - This facility is currently the primary discharge for effluent disposal in the system. It consists of an 18 inch, 2.0 km pipeline and related facilities constructed in 1993.

- Discharge No. 2 - Wadi Gaza Line (Non-Functional)- This variable diameter (22", 18", 16" and 12") pipeline is approx. 5.0 km long. The line extends from the treatment plant past the UNDP constructed 5000m^3 storage tank. These facilities were constructed by UNDP to serve recharge/irrigation needs along a route extending from the storage tank to Wadi Gaza about 0.5 km west of Salahuldin Street. This route was abandoned in 1993 when major sections (approx. 1.0 km) deteriorated and failed.

- Discharge No.3- Overflow Line (Functional)- This is an emergency pipeline located immediately adjacent to the treatment plant. It is used intermittently to handle emergency overflows due to failures at the pumping station. The effluent is dumped into a small depression near a small settlement south of the plant.

The UNDP constructed reuse and reclamation facilities were completed in 1986. These facilities provide for the use of treated wastewater for irrigation purposes. These "reuse" facilities were never used due to the poor quality of the treated effluent. They consist of storage reservoir, percolating ponds, a booster effluent pumping station (P.S.No. 2), and irrigation pipes which provide individual services from the transmission line. Following is a brief description:

- Storage Reservoir: This 5,000 m^3 storage reinforced concrete tank is located about 2 km east of the treatment plant. It can be filled by regulating a series of valves from the main effluent line from Pumping Station No. 1. This reservoir has never been placed in operation due to the poor quality of the effluent. This tank can be either drained back to the force main or to one of three percolating ponds nearby. When constructed, this facility was designed to regulate pressure and stabilize flows.

- Percolation Ponds: This facility consists of three 13,000 m^2 percolation ponds located adjacent to the storage tank, and are part of the aquifer recharge process. Each pond is designed to function with a working depth of 0.5 m. The operation strategy was designed to allow each pond to be flooded for one day and then allow two days for percolation. Like the reservoir these ponds were never placed in service. At present the pond sites are inhabited by trespassing animals and people.

- Effluent Booster Pumping Station No. 2: This station is located about 0.5km downstream from the storage tank along the discharge line to Wadi Gaza. The station houses 4 pumps with an associated control panel and electrical components which appear to be non-operational. The pumps are intended to boost the pressure for the flow to the downstream portion of the distribution system in order for it to be utilized for irrigation.

- Irrigation pipe lines: Most of these lines are 4" pipes which are valved off the discharge pipe that runs along the western edge of Salahuldin Street. The boosted flow is designed to flow through this piping system for use in irrigating citrus orchards along Salahuldin Street. There is no indication that they have ever been effectively utilized.

1.6 Process Design

It is estimated that there is currently approximately 16,000 m^3 of sewage entering the treatment plant, with an additional 4,000m^3 /d being diverted directly to the beach. The sewage entering the plant is routed directly to Pond No. 1 for settling. From this pond it is pumped to Pond No. 3 which acts only as another settling pond since the planned aerators are not installed. Each of these ponds provides considerable detention time, resulting in a high percentage removal of Settleable Solids (SS) and Total Suspended Solids (TSS). Primary level BOD removal is realized through the existing system as shown in the following table that presents analysis performed by Metcalf & Eddy during the period of August through December of 1996.

Existing Influent/Effluent Data (Aug. - Dec., 1996)

	Influent (mg/L)	Effluent (mg/L)	Efficiency
BOD	378	217	43%
TSS	751	164	78%
SS	12	0.2	98%

The detention times for each of the ponds is much longer than typical primary settling basins, although considerably shorter than conventional facultative ponds. For example, assuming a 16,000 m^3 /d flow, the detention time for Pond No. 1 is about one day (assuming 20% reduction of its volume due to solids accumulation) and the detention time for Pond No. 3 is estimated to be 2 days (assuming 15% reduction of volume due to accumulation of solids). These somewhat high primary detention times explains the moderate to good primary reduction in the BOD.

1.7 Costs & Priorities

Following the site visit the MSI Team developed a preliminary cost for repairs and rehabilitation necessary to operate the plant at a level of 16,000m^3 /d or some 33 1/3% more than originally designed. The following two tables summarize these estimated costs and priorities:

Table 1.3 Recommended Repair and Rehabilitation of Existing Facilities (GWWTP)

Priority	Component	Repair	Cost (est.)
1.	Effluent Pump Station #1	Replace 50hp pumps and motors (4 ea.) incl. Transformer upgrade	$200,000
2.*	Pond #4 Facultative	Line pond embankment (9,000 m^2)	$90,000
3	Pond 3, Aeration	Install six (6) ea. 25 hp aerators	$100,000
4	Distribution Piping	Replace 210m of 800mm fbr.gls. pipe	$115,000
5	Facility Lighting	Install new lighting (8 poles/500m line)	$25,000

*Implementation of this activity should await final recommendation regarding plant upgrading and enlargement.

Table 1.4 Recommended Repair/ Rehabilitation of Existing Facilities (UNDP "reuse")

Priority	Component	Repair/Rehab	Cost
1	Irrigation Piping	Rehab 6 ea. 4" valves; replace 1.0km of 16" line	$80,000
2	Pump Station #2	Rehab 3 ea. Pumps	$35,000
3	Valves/Distribution Chambers	Remove/Rehab 15 ea. Valves (18"/22")	$15,000
4	Percolation Ponds	Scarify ponds-rebuild embankments (2,500m)	$75,000
5	Storage Reservoir	Sealing of interior walls (1,300m^2)	$70,000

1.8 Process Flow

Figure No. 1 displays the existing process flow at the GWWTP.

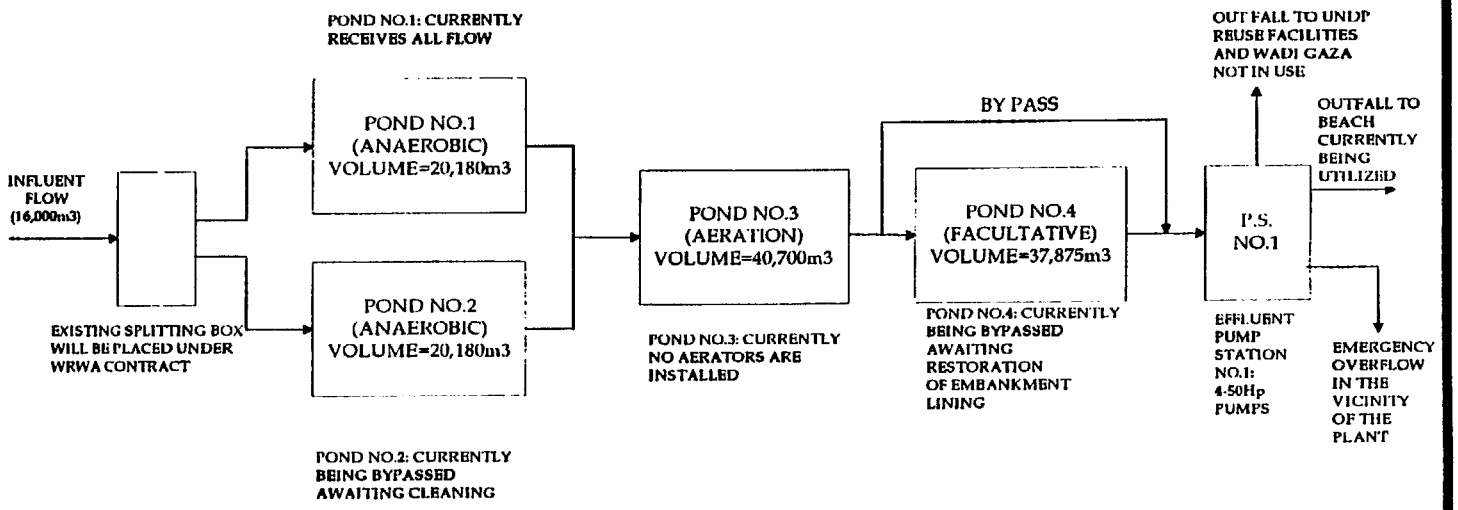


FIG. NO.1: GAZA WASTEWATER TREATMENT PLANT - EXISTING PROCESS FLOW

1.9 MEETINGS/CONTACTS

Gaza Municipality (2-27-92)
- Ragheb Atallah
- Hussein Abu Zaid
- Sami Shaqra
- Amron Kharoubi

USAID/Tel Aviv
- John Starnes
- Chuck McElroy
- Mohsen Ghazali
- Carl Maxwell

Metcalf & Eddy
- Haider Noori
- Fred Zobrist

UNRWA
- Richard Cook
- Issam Miqdadi
- Rafiq Abed
- Mustafa El-Kurd

1.10 List of Documents Reviewed

- Gaza Wastewater Project Master Plan - Analytical Studies, M&E, 1/97.
- GWWP Master Plan -Analytical Studies, Interim Report, M&E, December 1996
- Gaza Wastewater Treatment Alternatives, M&E, 2/97.
- UNDP - Recycling of Gaza Effluent Project: Plans and Specifications for the construction of a 5,000 m^3 Reservoir, Tahal, 11/85.
- UNDP - Recycling of Gaza Effluent Project: Plans and Specifications for the construction of percolating ponds, Tahal, 8/86.
- Construction Drawings of Main Pipeline between P.S. 1 and P. S. 2, Tahal, 6/80.
- Construction Drawings of Irrigation Pipeline, Tahal, 5/80.
- UNRWA - Construction Drawings of Gaza Wastewater Treatment Plant Modification, 4/94.

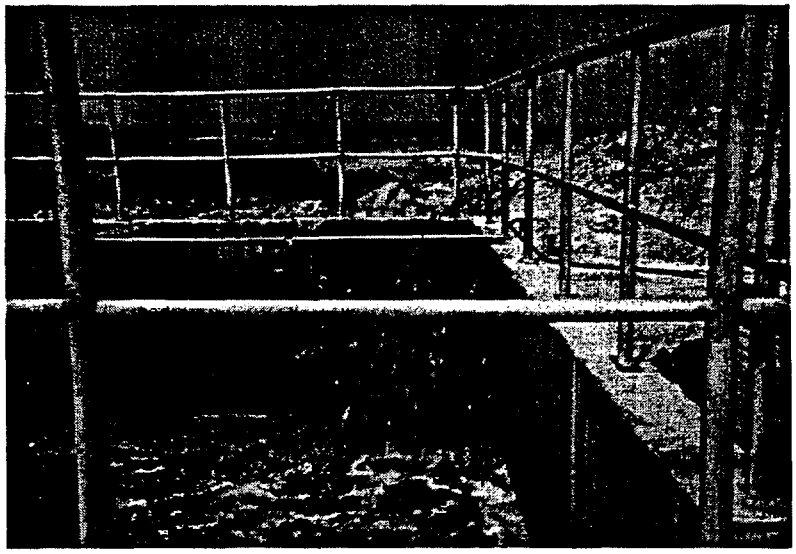
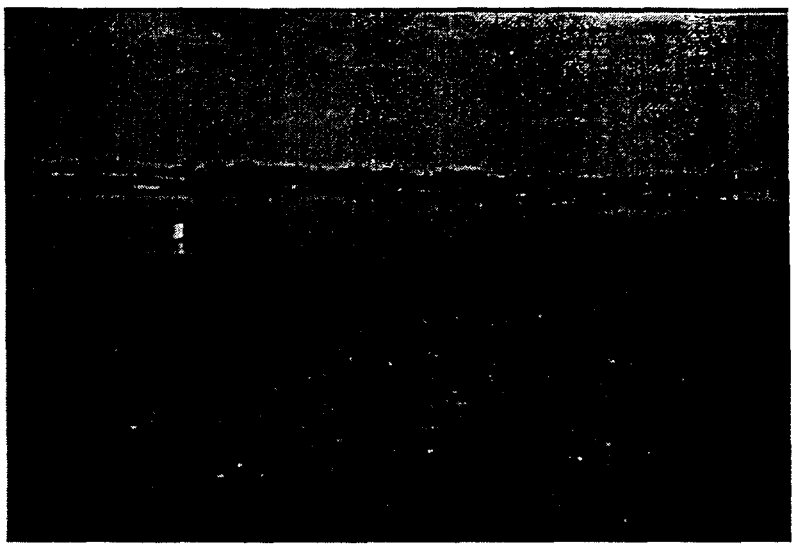


Photo 1:
Inlet Facility

Photo 2:
Pond #1



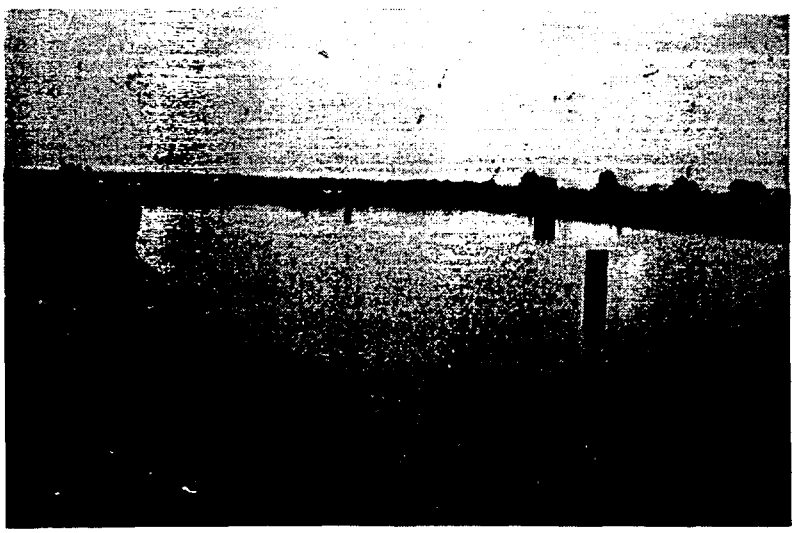


Photo 3:
Pond #2

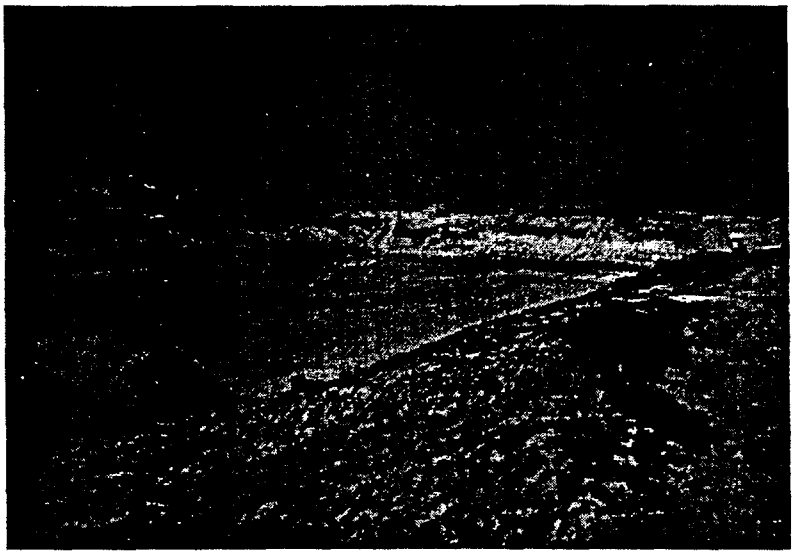
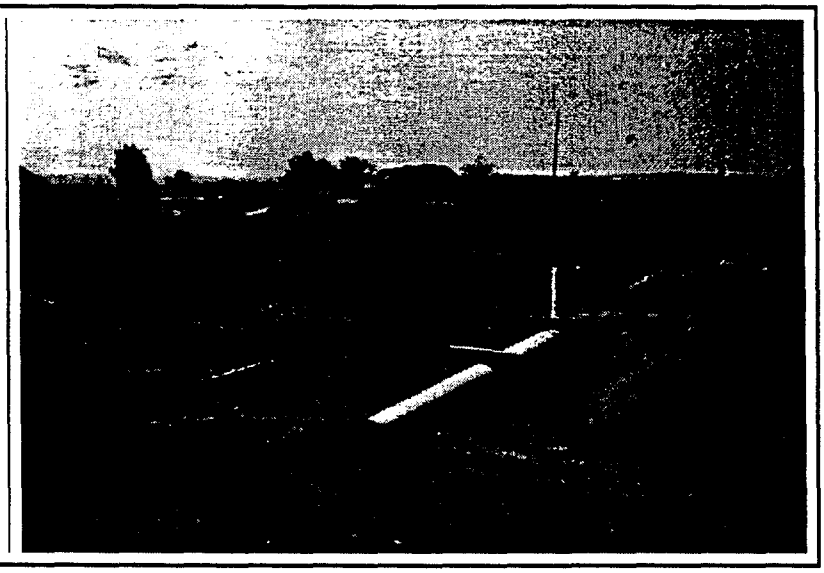


Photo 4:
Pond #3

Photo 5:
Pond #4



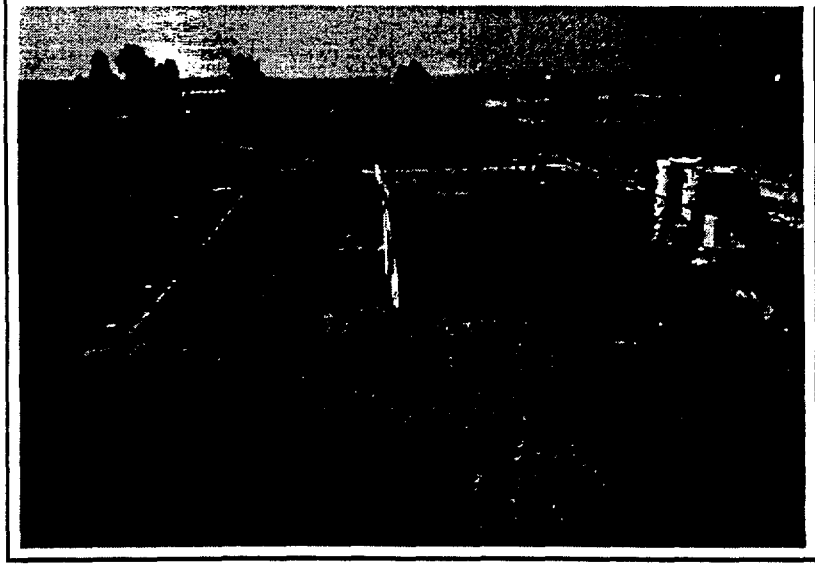
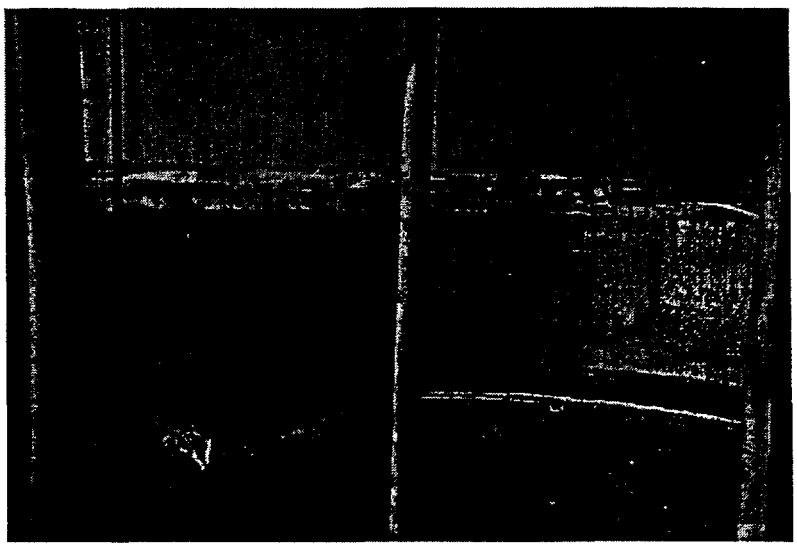


Photo 6:
Pump Station #1
Chlorinating Tanks

Photo 7:
Pump Station #1

Photo 8:
5000 M^3 Storage Tank
(Interior)



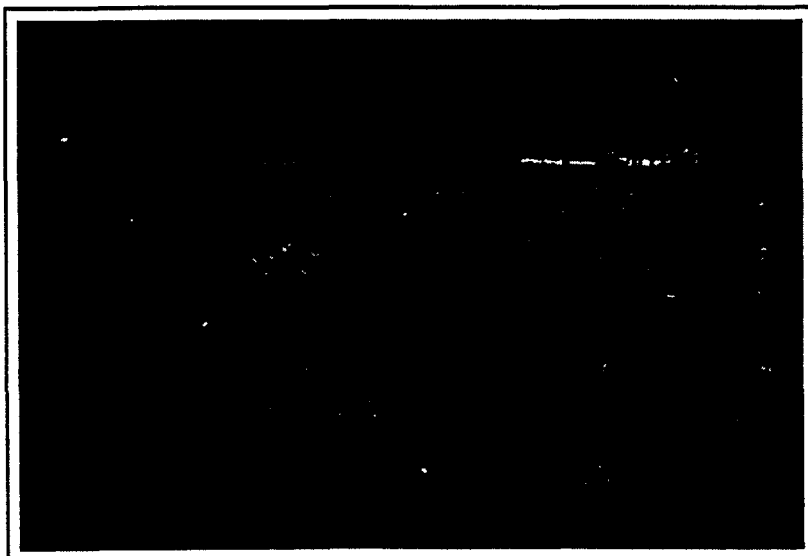


Photo 9:
Recharge Basin

CHAPTER TWO - CONCEPTUAL DESIGN

Following a review of the existing works and a briefing on the upgrades being conducted by the UNRWA, and a thorough review of various upgrade proposals which had recently been put forth by other consultants, the MSI Team developed a conceptual design. This chapter documents:

- the design assumptions.
- the system recommended.
- the system components (existing and proposed).
- the upgrades considered.
- the design alternative favored.
- the estimated costs to accomplish the upgrades.
- environmental considerations.
- abbreviated specifications.

2.1 Basic Data

2.1.1 Design Population

There are no census data available for Gaza nor is there any source that is closely monitoring the growth and projecting for the future. To ascertain a probable population and estimated sewage quantity/quality for the design date of 2005 the Team spoke with Municipal officials, UNRWA personnel, the Metcalf & Eddy Gaza Master Plan design team and a DHV engineer familiar with the Gaza situation. From these discussions the MSI Team developed design assumptions as follows:

Current Gaza City Population	326,000 (approximate)
Estimated Population Growth Rate [5]	5 %
Estimated Population for 2005	506,000
Estimated Water Use/Capita/Day	110 liter/capita/day
Estimated % of water use reaching the sewer	75%
Estimated % of population connected to plant in 2005	75%

Using these assumptions the MSI Team concluded that a design flow of 32,000 m^3/day would be appropriate.

This compares favorably with the Metcalf & Eddy "Minimum Rate" of 30,200 m^3/d for 2005. These design assumptions also compare favorably with design figures used in other previous studies developed for the GWWTP. A case can be made that future population growth and water usage will be constrained by a lack of potable water as the Gaza aquifer is drawn down..

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[5]The estimated population of Gaza City in 1992 was 243,000 which would indicate an average growth of approximately 5.0 % per year.

2.1.2 Process Design Criteria

Design Assumptions

Wastewater Flow

Average Daily	32,000 m^3/d
Peak Hour	48,000 m^3/d

Waste Load Influent

BOD	400 mg/l
TSS	650 mg/l
SS	12 mg/l

2.1.3 Design Objective

An effluent of:

BOD	30 mg/l
TSS	30 mg/l

2.1.4 System Recommended - Modified Trickling Filter System

2.1.5 Summary of System Components

2.1.5.1 Headworks (Splitting Basin)

Add two new valves of 800mm each

2.1.5.2 Primary Sedimentation Ponds/Grit Collection

Three (3 ea.) ponds operated in series

Pond Area #1 & #2	6700 m^2 each
Pond Area #3	9,800 m^2
Pond Volume #1 & #2	20,180 m^3 each
Pond Volume #3 (new)	32,000 m^3
Pond Operating Depth	4.5 meters
Total Detention Time	54 Hours
Estimated BOD reduction	40%

2.1.5.3 Bar Screens

Install 3 -one each at pond outlet pipes
Bars 5 cm x 6 mm (2" x 0.25") x 2 meters long

2.1.5.4 Pond #3 (Aeration/Oxidation pond)

Estimated BOD loading	8,000 kg/day
Volume	40,700 m^3
Effective Depth	4.6 meters
Area	12,300 m^2
Detention Time	30 Hours
Freeboard	1.1 m
Estimated BOD reduction	40%

Energy Requirements

Assume [6] 40 HP required per 3,800 m^3

Required: 428 HP

Aerators - Recommend 16 ea. in two rows/8 ea.

(6 @ 50HP @ 67% efficiency plus 10 new @ 25 HP provides 452 HP total)

2.1.5.5 Trickling Filters - To Be Constructed

Number of Units	2 each
Hydraulic Loading Factor	18.7m^3/d/m^2
Biologic Loading Factor	0.963 kg/BOD/m
Recirculation Ratio	1:1
Media Required (volume)	5,000m^3
Filter Area Required	1,712 m^2
Depth of Filter media	3.0 meters
Area required/unit	856 m^2
Volume/unit	2,500m^3
Diameter/unit	33.0 meters

2.1.5.6 Clarifier (Pond #4 Modification)

Length	48 meters
Effective Width	66.7 meters
Depth	4.2 meters
Freeboard	1.5 meter
Volume	13,500 m^3
Detention Time	10 hours
Estimated BOD Reduction	80% (Combined Trickling Filter & Clarifier)

2.1.5.7 Solids Holding Pond (Pond #4 Modification)

Length	54 meters
Width	66.7 meters
Depth	4.2 meters

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[6]See EPA Fact Sheet 2.1.11

Volume	15,128 m3
Capacity for Storage	60 days
Sludge Volume	250 to 480 m3/day

2.1.5.8 Sludge Drying Beds

Estimated Sludge Vol.	350 m^3/day
Depth	0.5 m
Drying Area 7-day	4,900m^2
Total Area Reqd.	7,000 m^2
Number Cells	7

2.1.5.9 Sludge Pumps (Trash Pumps w/ hose)

Pump 6 inch - 60m^3 /hr	one each
Pump 6 inch - 30 m^3/hr	one each
Hose 6 inch vacuum	100 meters
Hose 6 inch pressure	200 meters

2.1.5.10 Chlorination System[7]

Injection of 15 mg/l or 480 kg/d

2.2 Upgrades Considered

2.2.1 General

Since 1992 a number of studies have been conducted at the Gaza Wastewater Treatment Plant (GWWTP) with the objective of developing cost effective alternatives to improve and expand the Plant and its related discharge and reuse facilities. In 1993, the Dutch firm of DHV identified and researched six (6) alternative upgrade options. In 1994 the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) and Gaza City joined forces to upgrade the treatment plant by removing sand and sludge, upgrading the aeration capacity and making a number of other plant improvements. Portions of this work are still in process. In 1996/97 the U.S. firm of Metcalf & Eddy identified, reviewed and recommended additional upgrade options, which if implemented, would significantly improve overall GWWTP plant operations and capacity. While the proposed improvements are workable and sound from an engineering point of view, the constraint for implementing them appears to be available funding, or more specifically -the lack of funding.

[7]Convert chlorine system to bromine system for safety and cost efficiency.

2.2.2 DHV Considered Upgrades

In 1993 a team of consultants from the Dutch firm of DHV proposed to implement an immediate rehabilitation program for the GWWTP in an effort to reduce the pollution of Wadi Gaza and to enable the implementation of a demonstration scheme for irrigation with waste water. As a part of that study, the DHV engineers reviewed recommendations from the 1992 Camp Dresser Mckee report and developed a series of upgrade options of their own. In total, DHV developed six alternative upgrade options and concluded that the most feasible option would be to expand the anaerobic ponds and supplement this with an intermittent sand filter. Although this proposal was technically feasible it was never implemented. Today it would appear that the lack of available land would prohibit its full implementation as a "best" solution for expansion of the Plant to serve Gaza through the year 2005.

Table 2.1 summarizes the various alternatives proposed by DHV with MSI comments on why the MSI Team chose not to use all or part of the various alternatives. In most of these situations, MSI's reasons for not following the proposal are similar to those voiced by DHV.

Table 2.1 DHV Alternatives for Upgrading the GWWTP

DHV Alternative	MSI Comments
1. UASB[8] + trickling filter	Cost exceeds available budget; accept idea of trickling filter
2. UASB + aerated+facultative ponds	Cost exceeds available budget; accept idea of aerated ponds
3. Activated sludge	High operating costs; high use of energy
4. UASB - intermittent sand filters	Insufficient land area available
5. Anaerobic ponds+ intermittent sand filter	Insufficient land area available
6. Anaerobic ponds + intermittent sand filter	Insufficient land area available

2.2.3 Metcalf & Eddy Considered Upgrades

As part of their work in preparing a Master Plan for the Gaza Wastewater and Stormwater Project the U.S. firm of Metcalf & Eddy Int'l Inc. (M&E) in association with a local Gaza engineering firm, Khatib & Alami reviewed the GWWTP and developed a series of alternatives for upgrading and improving the plant. All together, M&E reviewed more than ten alternatives for upgrading the GWWTP. From their review of the alternatives, M&E recommends that a system utilizing anaerobic ponds followed by trickling filters would be the most cost effective and efficient for the GWWTP. The MSI Teams analyses supports much of that basic conclusion.

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[8]UASB:Upflow Anaerobic Sludge Blanket-developed in the 1970's in the Netherlands

Table 2.2 summarizes the MSI comments on why only part, or in some cases none, of the studied process was chosen. Much like the review of the DHV alternatives, the MSI reason for choosing or not choosing a particular studied process concurs with the consultants from M&E.

Table 2.2 Metcalf & Eddy Alternatives Considered for GWWTP Upgrade

Process	MSI Comments
1. Anaerobic/aerated/facultative lagoons	Requires excessive use of land.
2. Anaerobic lagoons w/trickling filters/polishing lagoons	Requires excessive use of land.
3. Anaerobic lagoons/intermittent sand filters	Requires excessive use of land.
4. UASB w/aerated and facultative lagoons	High capital costs and excessive land requirements.
5. UASB w/ aerated lagoons and intermediate sand filter	High capital costs and excessive land requirements.
6. Anaerobic lagoons w/activated sludge and clarifiers	Excessive construction and energy costs.

In addition to the processes shown in Table 2.2 the M&E team evaluated a number of other processes including:

Extended aeration process
Rotating biological Contractor (RBC)
Activated sludge
Trickling filters

As noted in the M&E report, the M&E Team rejected aeration and use of RBC's primarily because of high capital costs. In addition they rejected activated sludge because of high costs for operation and maintenance (O&M). Judging from their cost analyses and summary comments the M&E team favored the use of trickling filters combined with aeration, anaerobic ponds and clarifiers. The MSI Team concurs with that treatment process, however proposes a modified design.

2.2.4 The MSI Alternatives

As noted above, the MSI Team benefited significantly from the engineering studies, data and field experience provided by the DHV, UNRWA, City of Gaza, USAID and M&E technical personnel. By combining this information with visits to various plants within the Region the MSI Team was able to quite rapidly review a large number of proposed processes and technology's and make professional judgements as to whether a specific process or activity was appropriate. In making these judgements the MSI Team placed special emphasis on judging the process/upgrade with regards to the "Gaza specific" situation; i.e., the overall capital cost; cost of operation and

maintenance, available land, and available funding and USAID's desire to have a high quality effluent for reuse and aquifer recharge. For the most part, funding, land availability, simplification of operating and maintenance procedures and the desire to make extensive use of constructed infrastructure weighed heavily in the final selection of the "MSI Favored Alternative". The MSI favored proposal is a modified trickling filter design which utilizes primary sedimentation, aeration, and biological filtering as its principle processes.

2.3 Favored Alternative

2.3.1 Description of the Proposed Upgrade

The MSI favored alternative utilizes all of the existing plant and related facilities. The only proposed major modification of the existing facilities is the conversion of the facultative lagoon (currently known as Pond #4) into a clarifier and sludge pond. New facilities planned include two trickling filters, a new anaerobic settling pond, and the addition of ten new aerators in Pond #3. Other major work planned includes the replacement of all pumps in Pumping Station #1, construction of sludge drying beds, and the addition of required pumps, piping and electrical work to make the plant functional. The MSI proposal applies the use of settling, detention, aeration, biological filtering (a new technology for Gaza), clarification, and sludge removal as its form of treatment. Figure 2.1 schematically demonstrates the MSI favored treatment process.

2.3.2 Rationale for Choice

The proposed upgrade alternative was selected primarily because the system:

- utilizes all of the current infrastructure.
- minimizes the introduction of complex new technology
- uses only proven technology
- can easily be accomplished within the apparent land available.
- maximizes the use of low maintenance detention and aeration as treatment processes,
- provides a system that can simply and cost effectively be maintained,
- presents a treatment opportunity to meet the 30/30 (BOD/TSS) design standard,
- maximizes the use of local labor and materials, and
- can be accomplished within the apparent USAID budget constraints.

The process chosen does have some areas for concern namely, anaerobic ponds will emit some odor, however, with proper maintenance and operation this will be minimal. Also the process will generate sludge which will require manual labor for handling. Properly dried the sludge should be highly sought after by local farmers and gardeners.

Table 2.3 lists, item by item (including estimated cost's), the construction activities required to construct the MSI Favored Alternative.

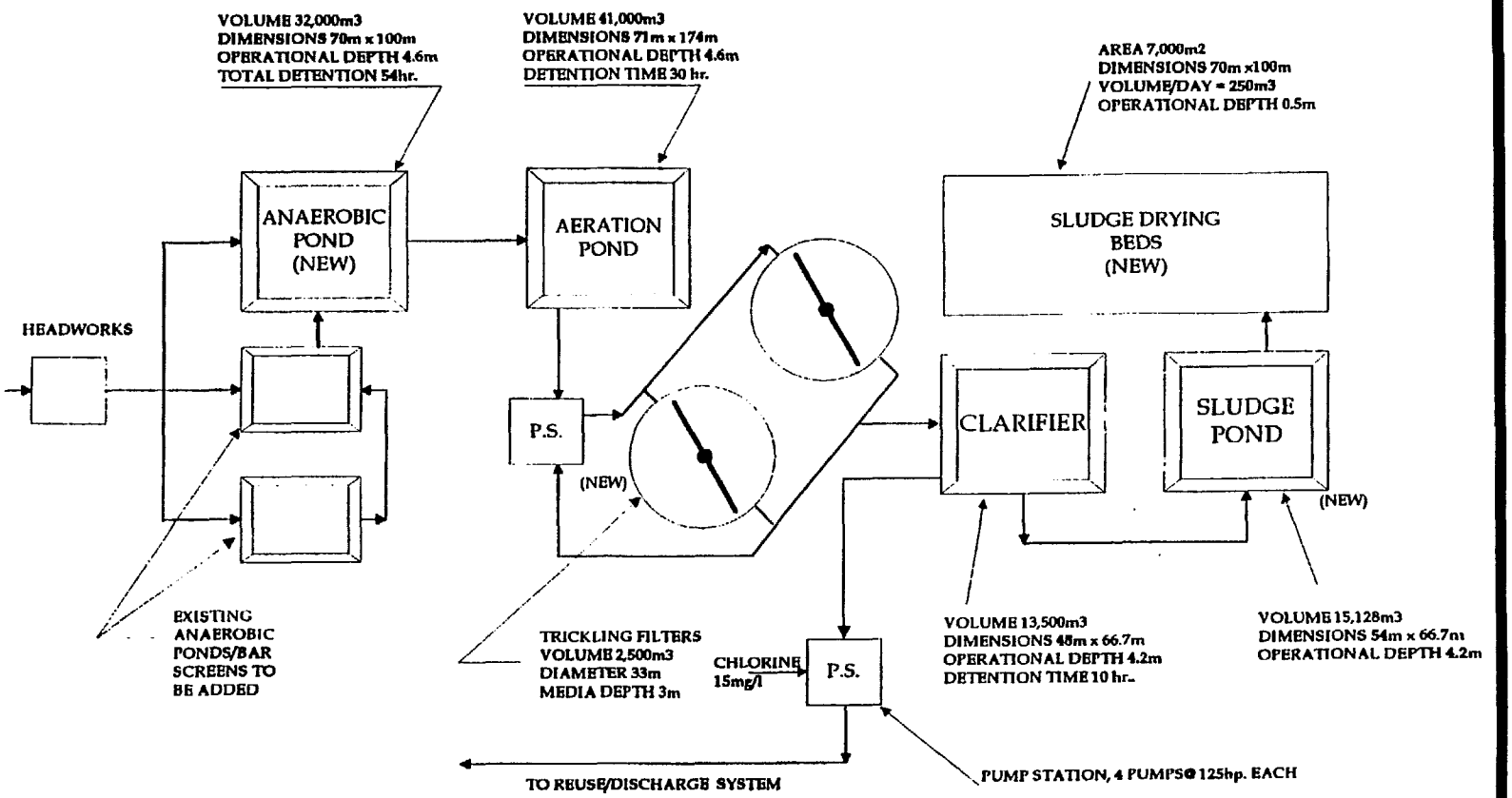

FIG. 2.2 CONCEPTUAL DRAWING-RECOMMENDED FACILITY AND NOMINAL DIMENSIONS

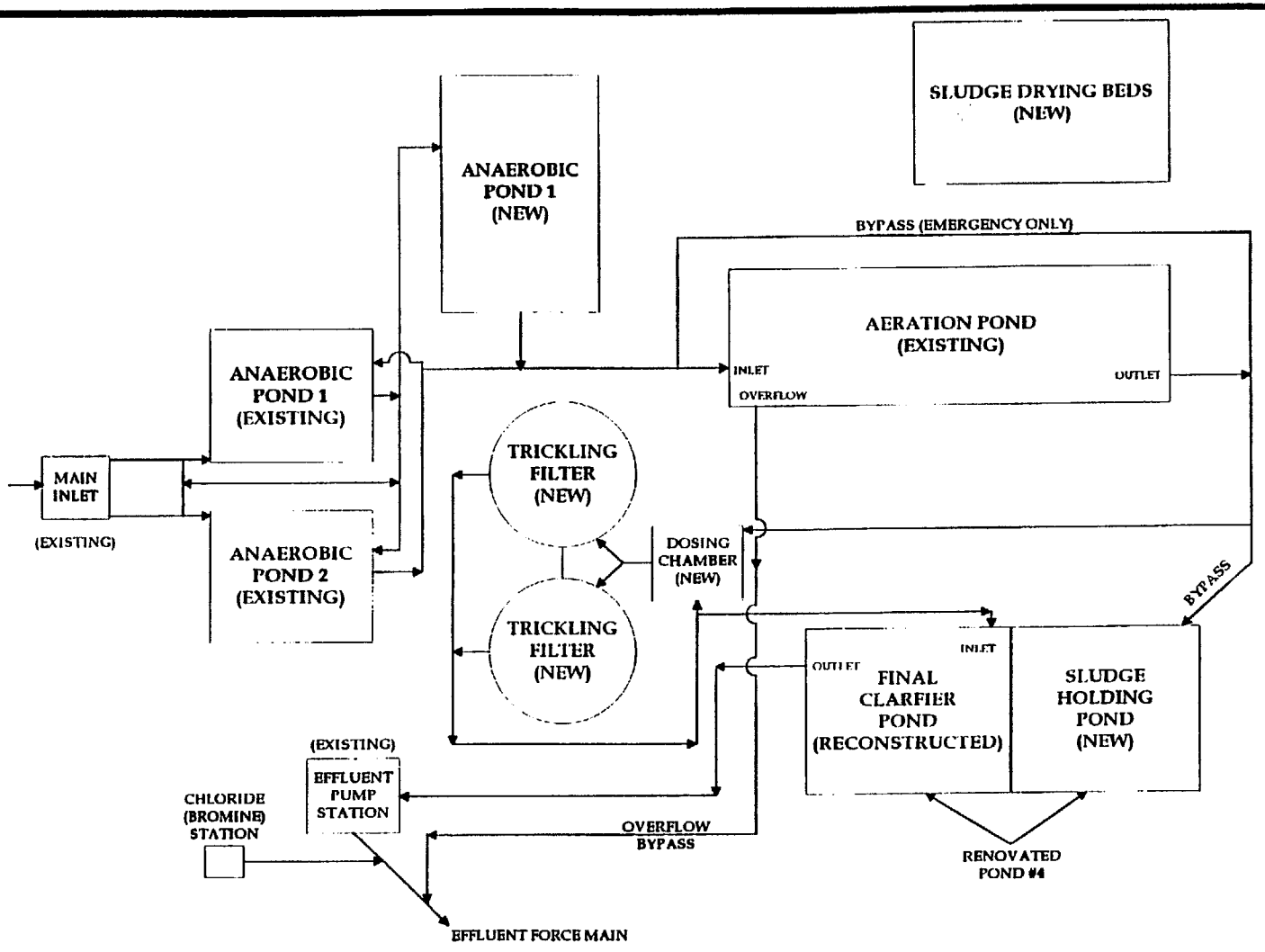

FIG. 2.3 PROCESS FLOW SCHEME - FAVORED ALTERNATIVE OPTION

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FIGURE 2.4
FLOW PROFILE FOR RECOMMENDED ALTERNATIVE

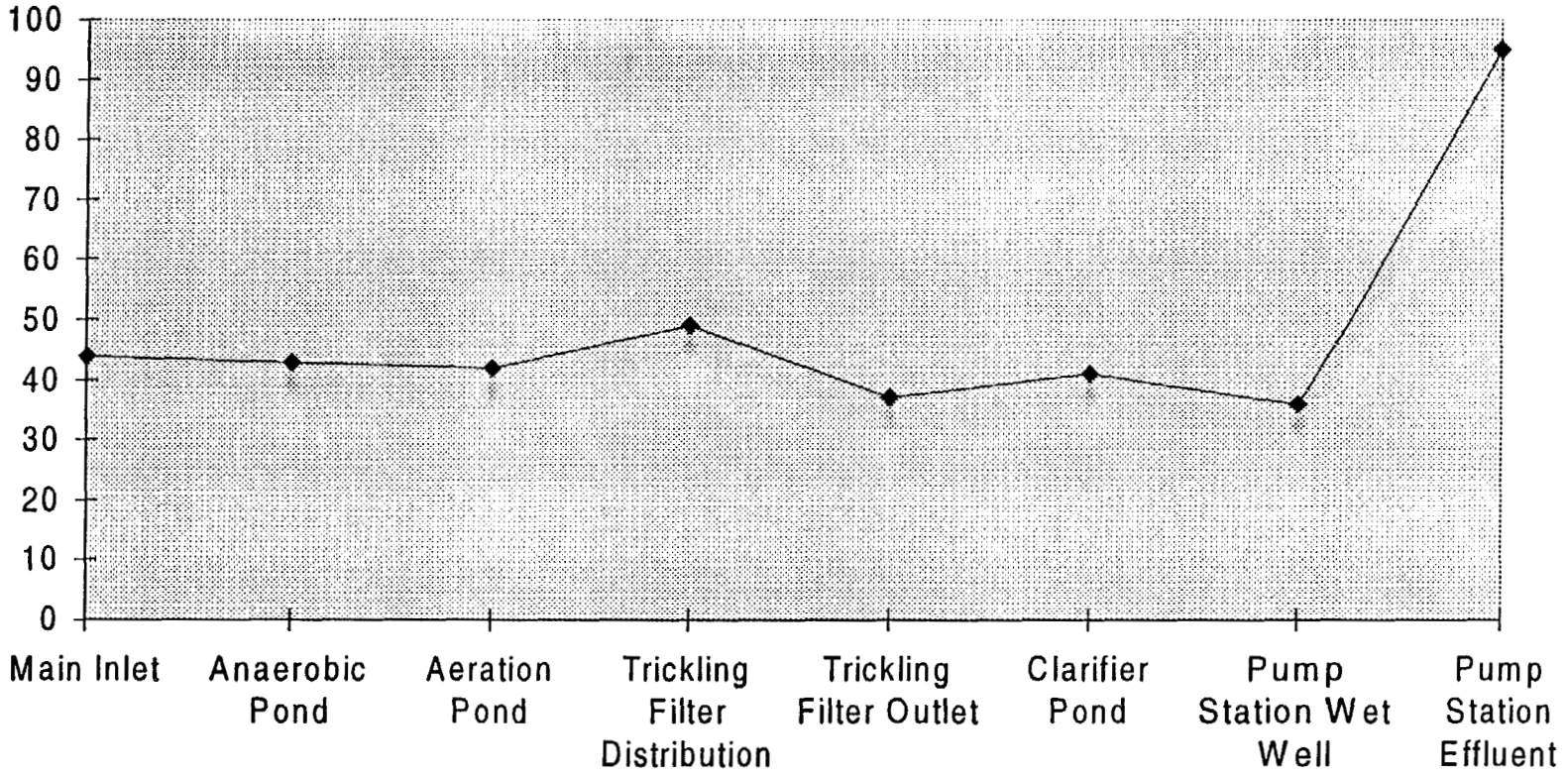


Table 2.3 Construction Elements (Favored Option) - GWWTP		
Item	Description	Cost (estimated)
1. Inlet Valves	P & I[9] (2ea.) 800mm valves @Ponds #1 and #2	$60,000
2. Bar Screens	P & I (2 ea.) bar screens: 5cm x 6mm x 2 meters w/2 cm openings @ ponds #1 and #2 outlets	$30,000
3. Aerators	P & I (10 ea.) 25 Hp floating aerators w/ electrical gear and panel @ Pond #3. Also construct a wire reinforced 4m x 4m x 15 cm concrete pad under each of the 16 aerators to prevent scouring.	$250,000
4. Anaerobic Pond	Construct new primary settling pond (#1A) volume 32,000 m^3 w/ hypalon liner 7,000 m2 and 2 ea. 800mm valves.	$365,000
5. Pipe 800mm	P & I 210 meters of 800mm diam. fiber glass pipe adjacent to Pond #3	$115,000
6. Transformer	P & I (1 ea.) 200 kva Transformer adjacent to Pond #3 w/upgrade line	$75,000
7. Aeration Pond Outlet	P&I 215meters of 800mm fbrgls pipe between aeration pond & trickling filter	$125,000
8. Trickling Filters	Construct (2 ea.) 2,500 m^3 trickling filters (Diam 33 m, Height 4 m,w/ 3.1 m of plastic media. Add 200m of 800mmfbgls pipe for connections.	$2.28 million
9. Dosing chamber/Pump sta.	Construct dosing chamber/pump station (1 ea. w/ 2 pumps) to serve trickling filters.	$90,000
10. Recirculating pumps	P & I (2 ea.) recirculating pumps to provide 1:1 recirculation to filters.	$90,000
11. Pump lift station	Construct pump lift station to service filters and clarification pond. (w/2 pumps)	$90,000
12. Final Clarifier	Construct clarification area in Pond #4 (L=48m, W=66.6m, Op. D=4.2m) Construct intermediate levee (8600 m^3). P&I 4400 m^2 liner (hypalon 2mm)	$100,000
13. Sludge holding pond	Construct pond area in current pond #4 (l=54m,w=66.6 m,d=4.2 m) hypalon liner 4800 m^2	$70,000
14. Sludge Drying Beds	Construct 3500 m^2 of drying beds: 7 cells (Total of 2500 m^3 of earthwork)	$30,000
15. Chlorine Station	Reconstruct existing station to deliver 15 mg/l of bromine with a 20 minute contact time	$50,000
16. Effluent Pump Station	P & I (4 ea.) 500m^3 /hr pumps.	$125,000
17. Sludge Pumps	P& I (2 ea.) 25 m^3 /hr capacity 6" pumps w/ pressure and vacuum lines.	$60,000
18. Miscl. Piping, electrical, etc.	Pressure test & repair all plant existing lines plus outlet lines to reuse facility & Wadi Gaza to operable condition.	$75,000

[9]P & I: Purchase and Install

Table 2.3 Construction Elements (Favored Option) - GWWTP		
Item	Description	Cost (estimated)
19. Facility Lighting & Fencing	P & I lighting/fencing for plant area	$50,000
20. Dike/levee strengthening	Rehab all levees as required.	$300,000

2.4 Reuse Site

In addition to the work required at the GWWTP the Team identified a list of improvements required in the previously UNDP constructed reuse and discharge facilities. For the most part these activities are renovation and repair. The most extensive activity in this improvement being the replacement of approximately one (1) km of 12 inch discharge line which has been destroyed. The MSI Team proposes to replace this 12 inch line with a 16 inch line to handle the increased discharge requirements as the GWTTP is increased from 12,000 m^3/d to 32,000 m^3/d.

To maximize the quantity of treated water for recharge at the UNDP constructed facility additional recharge ponds should be constructed, however conversations with City officials indicate that there is no more City land available at the UNDP site.

Table 2.4 summarizes the work required to make the re-use discharge facilities functional.

Table 2.4 Construction Elements - Recharge Facilities (Favored Alt.)		
1. Spreading Basins	Rebuild/strengthen levees for the recharge basins (3 ea.)	$75,000
2. Booster pump Station	Rehab existing pump station, incl. pumps (3 ea.) electrical panel, transformer and service.	$35,000
3. Wadi Gaza discharge line	Replace approx 1.0 km of 12" line w/ 16" UPVC line to Wadi Gaza	$130,000
4. Storage Tank Waterproof	waterproof interior walls of 5000 m^3 storage tank.	$70,000
5. Valve Rehabilitation	Rehab all valves in UNDP reuse system (approx. 25 ea.)	$30,000
6. Monitoring wells	P & I (6 ea.) shallow monitoring wells at recharge basin and agricultural areas to monitor recharge.	$30,000

Total Estimated Cost for Construction (Tables 2.3 and 2.4) is $4.8 million

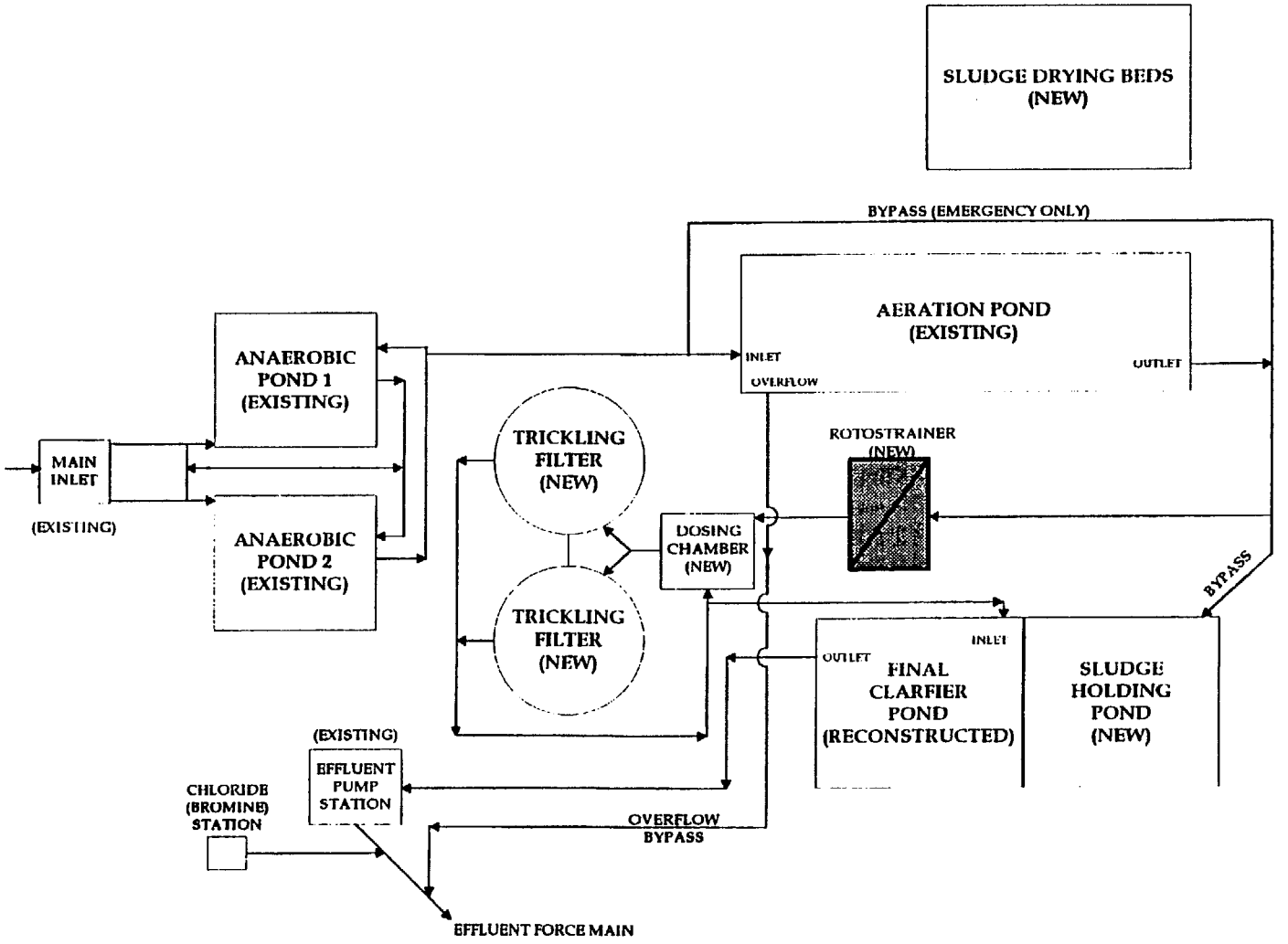
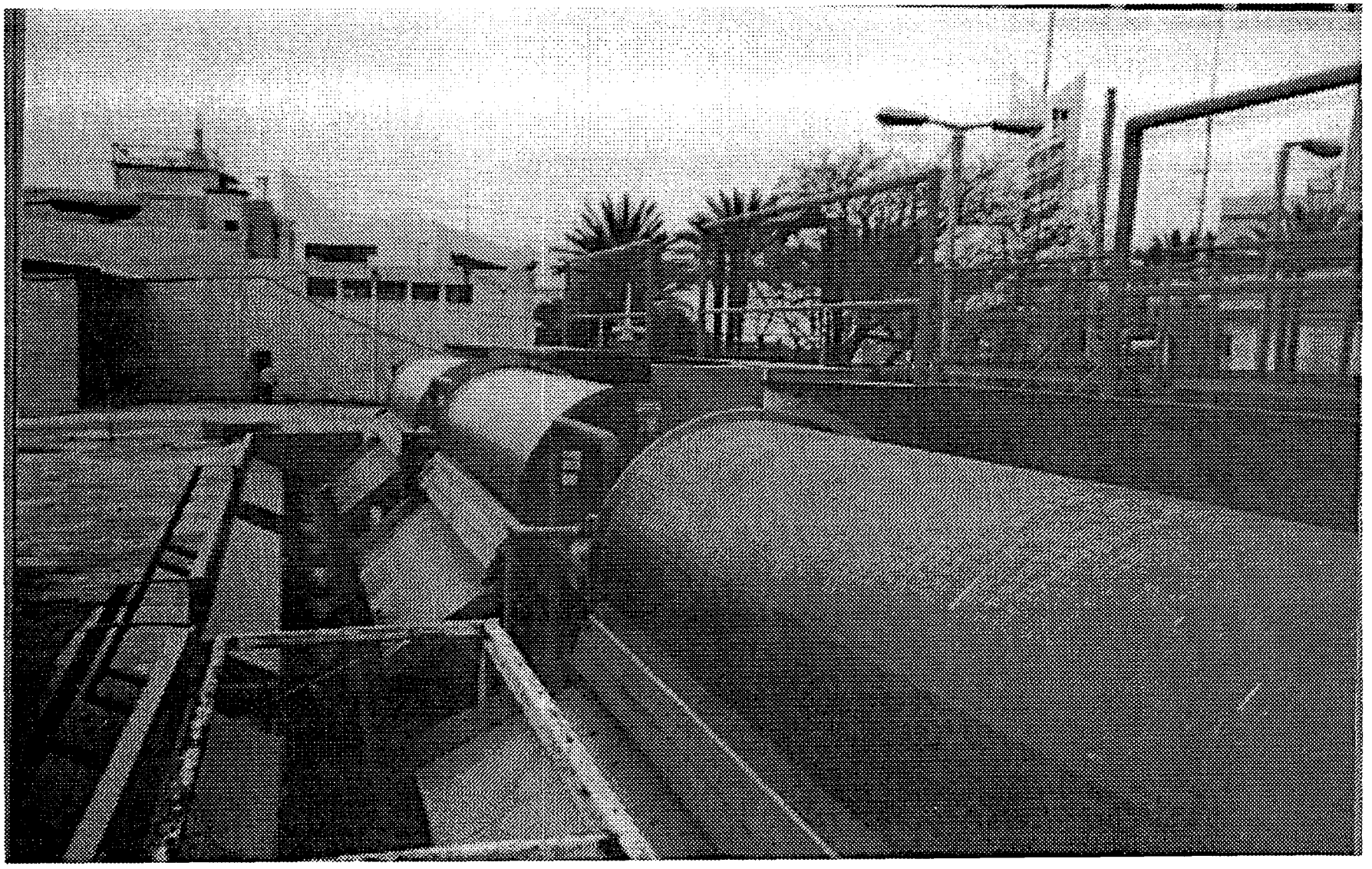


FIG. 2.5 PROCESS FLOW SCHEME - ALTERNATIVE OPTION



2.5 MSI Alternative

In addition to the favored upgrade, the MSI team focused on a number of other alternatives. Included in these was a system identical to the favored alternative except a roto-screen would be substituted for construction of a new (third) primary settling pond.

The fundamental differences between the recommended alternative and the workable option are elimination of the third aerobic pond (this option would not Construct Pond #1A) and the addition of two roto-strainers in its place. Overall the treatment differences between the two are small, if any. However, by using a third anaerobic pond the treatment capacity shifts to the front of the plant thereby attaining a greater reduction in BOD (40mg/l) ahead of the aeration pond with a less energy intense, lower maintenance solution. The roto strainers could cause a significant (10% to 15%) reduction in BOD ahead of the trickling filters when sized at 1,000 m^3 for each of two units operated in parallel. The screens would have openings of from 2mm to 3mm in order to remove filter-clogging materials. The cost of installing two units would approximately equal the cost of constructing and plumbing a third anaerobic pond.

2.6 Wastewater Reuse

2.6.1 General

The reuse of treated wastewater in arid regions of the world has long been accepted as an economic and environmentally sound water management alternative. Such organizations as the World Health Organization (WHO), and others, have taken the position that wastewater, especially domestic wastewater, represents too valuable a resource to be wasted.

In 1986, the United Nations Development Program (UNDP) constructed a system in Gaza, as part of the GWWTP facilities, to store, control and distribute wastewater for use in agricultural irrigation and to distribute wastewater for recharge into the aquifer. Unfortunately, the quality of the effluent, was such, that the idea and the capital improvements were never placed in operation. However, the facilities still exist and as a part of this MSI evaluation it is being recommended that these facilities be rehabilitated.

While various opinions exist as to what the demand for properly treated wastewater might be in the immediate area of the GWWTP, it is well documented that in countries immediately adjacent to Gaza the demand for such water far outstrips the supply. One can readily assume that as the Gaza population increases, and the demand for drinking water increases, the best use of the freshwater currently being used for irrigation will be for domestic use. When this occurs, the demand for the treated effluent from the GWTTP will significantly increase, especially during the summer months when agricultural demand is at its peak.

2.6.2 Gaza Wastewater Policy and Practices

The Palestinian Water Authority (PWA) in a November 1996 document " Wastewater reuse in Agriculture in Gaza Governates" stressed the policy to promote waste water reuse in agriculture. From that document we quote:

> "Water reuse is considered a priority in the Gaza Governates for a number of reasons, first the fresh groundwater resources are being depleted, second wastewater disposal practices form a serious pollution threat to the ground water. Wastewater reuse could free large amounts of fresh water currently used for irrigation and make this resource available to meet the growing demand for fresh water to cities and towns. Indeed the Palestinian Water Authority (PWA) considers wastewater as a mislocated water resource and its importance was highlighted in its Policy Principles "Water supply and wastewater management should be interfaced at all administrative levels."
>
> As part of the PA's agricultural policy, the Ministry of Agriculture includes the application of treated wastewater for irrigation. The plan is to irrigate with treated wastewater an area of 6800 dunums during the next five years. In particular they plan to use this water on fodder crops such as alfalfa and sunflowers and then to expand its use on olives, palms, and almonds.
>
> In the past ten years there were two attempts for the utilization of treated wastewater in agriculture. The first attempt was in Gaza City in 1986 and the other was in Jabalia. Both of these efforts were funded by the UNDP. Unfortunately neither of these efforts succeeded due to the following:
>
> 1. The treatment plants were not fully operational and the effluent properties were very poor and below the standards to be used for irrigation.
> 2. The idea of reuse was not readily accepted by the farmers who had no incentive to use treated wastewater when they could have fresh water from their private wells at low costs.
> 3. The farmers refused the shift to wastewater due to the mistrust between the Israeli Civil Administration and themselves. They considered this as a plan by the Israeli Civil Authority to control the water resources and thus disallow future use of private wells, and also due to,
> 4. Lack of coordination, public awareness, and institutional setup.

2.6.3 MSI Reuse Concepts

With the above considerations in mind, the MSI Team puts forth several scenarios for maximizing the use of wastewater.

Indirect Reuse

In this concept the receiving body is the soil, and final disposal is through evaportranspiration of the irrigated crops.

The system is based on recharge of the treated effluents to the aquifer by means of spreading basins. The effluents are subjected to preliminary adequate treatment to ensure their efficient and infiltration. Further treatment takes place as the effluents move through the soil and subsoil layers by means of physical and biological processes. The result is water of high quality. The water is pumped from the aquifer and used directly for irrigation.

This system does not require construction of operational storage installations since the storage function is fulfilled by the aquifer itself. Practical implementation of this method depends upon the existence of a suitable aquifer and the availability of spreading sites allowing efficient recharge. The latter are usually sandy areas such as river beds having high infiltration capacity and good hydraulic contact with the aquifer.

In order to confirm the opportunities for implementing this method in the context of the Gaza Sub-Aquifer, it is advisable to carry out a geohydrological survey, aimed at identifying suitable recharge sites. The survey should include:

- collection, compilation and analysis of the relevant available geological and hydrological information, including identification of potential recharge sites, near the existing recharge basins and along the force main.

- Geohydrological analysis to determine the safe distance between recharge sites and wells for potable supply.

- preliminary marking of production wells to be used for irrigation in order to minimize aquifer contamination from wastewater, and maximize mixing of ground-water under the spreading basins and the recharged effluent.

2.6.4 Recharge Alternatives

Conditions vary significantly between summer and winter as to the potential direct reuse by farmers and in-direct re-use. In order to maximize the re-use option one should design the system to handle total quantities of effluent during the winter season, when rainfall is added to the recharge process.

Summer Alternative (Present System)

Assuming that the GWWTP is upgraded to 32,000m^3/d and the overall area of recharge basins can not be increased the flow pattern will be as follows:

1. a maximum hourly flow will be approximately 1600m^3/hour;

2. recharge capacity of the three basins (4 hectare area = 40,000m^2) is approximately 80 to 100 m^3/m^2/year which equals approximately 3.2 to 4.0 million m^3/year. Assuming that two basins will operate the hourly flow for recharge spreading will be about 400 to 500 m^3/hour.

3. The balance of approximately 1100 to 1200 m^3/hour will be supplied to the farmers through the irrigation system constructed by UNDP, provided the farmers will agree to use the effluent.

4. The unused treated effluent will be pumped to Wadi Gaza by the booster pumping station.

Winter Alternative

During rainy periods the recharge rate can drop by 50% of optimal. The balance of approximately 1300 to 1400 m^3/hour would then have to be discharged to Wadi Gaza. Considering the high quality of the effluent (30/30BOD/SS) there should not be any adverse environmental impact nor any breach of Mediterranean Agreement (Barcelona Agreement). This will permit the discharge of any secondary effluent into the sea.

Re-pumping Alternative

High quality effluent that could be recharged and mixed with the background water would produce unrestricted water for irrigation use. Implementation of such a system would require approximately 5 to 7 wells drilled to approximately 30 to 100 meters depth and equipped with submersible pumps for use by the local farmers.

Drilling and equipping of each well would cost approximately $20,000, or approximately $150,000 to $200,000 for the system. This cost includes several small (2" to 4") wells for monitoring. Additional costs would be incurred to deliver the water to the use site.

2.6.5 Reuse Maximization

Implementation of this alternative would require the construction of additional recharge basins sufficient in size to handle the total quantity of effluent. For example, if all effluent went to recharge the system capacity of 32,000 m^3/day or approx. 12 x 10^6 /m^3/year would be required.

The area presently available is 40 dunams. The area needed is 150 dunams therefore an additional 110 dunams is required to maximize the use of effluent for recharge. This area could be significantly reduced if the effluent was maintained at 30 BOD and 30 TSS and the basins were properly maintained.

Under the best of conditions recharge of about $160m^3/m^2/year$ would occur. This would reduce the required recharge area to approximately 75 dunams or about double the currently available area.

2.7 Land Availability

To maximize the amount of effluent that can be recharged through controlled recharge basins (non Wadi Gaza) will require additional land. It is the understanding of the MSI Team that there is no additional City land available at the UNDP site. Local officials do state that other undefined government agencies own land at or near the UNDP site but the team was unable to determine which agency or what quantity.

2.8 Limitation - Wadi Gaza Discharge

When the sewage flow from the Gaza project reaches peak hourly discharge flows of 2000 m^3 /h probably about the year 2002 or 2003 the pumps at P.S.#2 during the winter months will not be sufficient to handle the entire flow due to head loss in the piping system. The determination of when this will occur will be dependent upon the amount of water that can be recharged. The most inflexible time will be after a rainy period when the GWWTP will be full and the infiltration at the recharge basins drops to a minimum. At those future times, the apparent emergency option will be to release high quality effluent to the sea.

2.9 Environmental Considerations

Although the Team was not required to do an extensive environmental assessment of the impact of the proposed GWTTP improvements, there is little question but that the proposed system upgrade will significantly improve the Gaza environment. First of all, there will be an immediate, significant and positive impact due to the improved treatment and safe disposal of the treated (30 BOD, 30 TSS) effluent. Currently almost all of Gaza's wastewater is being discharged directly to the beach in an untreated or poorly treated condition. Secondly, the project will make available treated wastewater which can be used for agricultural irrigation and/or recharging of the underlying aquifer. This recharge water will in turn decrease demand on the potable water being used for irrigation. More high quality water will then be available to Gaza's population for drinking and other personal use.

In addition to immediately and significantly improving the environment and public health conditions, the proposed system increases the safety margin at the plant should a failure of any of the existing or proposed facilities occur. For example, the additional reservoir increases the storage capacity at the plant by 32,000 cubic meters which increases the time available for any needed repair prior to emergency discharge. In addition, the new pumps will increase the

dependability of the plant and increase the volume and options of emergency overflow that can be handled. The improvements to the reuse and discharge facilities will increase the options for disposal of effluent as well as available storage. The improved electrical capacity will decrease the probability of plant system failure. The new lighting will significantly increase night safety at the plant, and the new fencing will secure the area from people and animals on a regular basis, as well as keep them away during an emergency.

As a part of the upgrade program, additional evaluations and testing of levees and dikes will take place. If, and when, areas of the dikes are found to be in a weakened condition measures will be taken to strengthen them. This strengthening may be accomplished by ramming, adding clay or bentonite to the current soils, and/or reconstruction and compaction of the identified weakened areas. In addition to this strengthening program, all ponds in the system will be lined, as needed, during the expansion and upgrading of the Plant. As a result, the safety and expected life of the Plant will be significantly enhanced and the risk of levee/dike failure will be reduced.

Except for minor soil disturbances, and increased construction traffic during construction, the Team is not aware of any negative impacts created by the construction of these improvements.

2.10 Abbreviated Specifications

2.10.1 General

The following abbreviated specifications are based on the Team's conceptual design for upgrading the existing facilities at the GWWTP, the UNDP constructed reuse site and the Wadi Gaza discharge line. These specifications are based on U.S. manufacture for the majority of new mechanical equipment. All equipment specified in this report was available by U.S. manufacture in March, 1977. The successful bidder will need to place strong emphasis on developing his/her design so that the equipment can be appropriately specified and ordered giving thought to time of manufacture and time for transportation. For example, the pump contractors contacted indicated they would need 180 days from guaranteed purchase to U.S. delivery of the item; another 30-60 days would be required to deliver to Gaza. This means that the contractor needs to place his/her orders immediately after notice to proceed. In all other respects, the project is rather straight forward utilizing standard construction practices, i.e. earthwork, concrete, equipment/material purchase and installation tasks.

2.10.2 The Specifications

These items are correlated with Table 2.3 and 2.4 of this Chapter.

- Inlet Valves
    - Contractor shall purchase and install two (2) new , 32 inch (800 mm) cast iron valves between the main inlet and the distribution junction for anaerobic Ponds #1 & #2 to allow for operation of the two ponds in series. The valves shall be cast

iron sluice gate type designed for a working pressure of 10 bars, complete with stem, fixing frames, all necessary fittings and accessories.

- Bar Screens

  - Contractor shall construct three (3) bar screens at the anaerobic ponds' outlets (the two existing and one newly constructed pond) in advance of the variable outlet weirs, to permit manual cleaning from the steel service bridge. Bar screens shall be constructed using steel bars 5 cm deep by 6mm wide by 2 meters long with a 2 cm bar spacing designed to screen all outflows from the anaerobic ponds

- Surface Aerators

  - Contractor shall purchase and install ten (10) new, 25 HP, floating aerators in Aeration pond #3. Alignment shall be balanced with the existing six (6) aerators in two rows to assure uniform effluent mix and flow. Newly purchased aerators shall be equivalent to Model 1225-SF Aqua-lator with stainless steel propeller, discharge passage, float assembly and intake cone.

  - Contractor shall construct sixteen (16) each 4 meter by 4 meter by 15 cm, B150 concrete (wire reinforced) pads in the aerator pond #3. Pads shall be placed to protect the pond bottom from aerator caused high velocity flow patterns and scour.

  - Contractor shall purchase and install an electrical control panel in either the electrical panel room between ponds #3 and #4 or the electrical control room between the aeration pond #3 and Pond # 1 A. Final location to be determined by location of electrical panel controlling the six (6) existing aerators being installed by UNRWA. All provisions shall be made for electrical service to the new control panel and to the ten (10) new aerators.

- Anaerobic Pond #1A

  - Contractor shall construct one (1) anaerobic primary sedimentation pond for physical solids removal and anaerobic biological action. Pond shall be designed and constructed to function in series with Ponds #1 and #2. The pond shall be constructed to have an effective operating volume of 32,000 m^3 with a depth of approximately 4.5 meters (designed detention time of 24 hrs). Levees/dikes will be constructed using an approximate soil of 70% sand and 30% clay unless testing determine a more suitable mix and/or method.

  - Contractor shall purchase and install a hypalon liner similar to GSE Hyperflex (HD) or equivalent to prevent erosion and/or water damage in Pond #1A. The liner shall extend at least 1.0 meter above the maximum water level and 2.0 meters along the pond bottom - from the side slope.

- Contractor shall purchase and install necessary piping to provide for in-series operation of the new pond with Ponds #1 and #2 and/or for isolation of Pond #1A for cleaning or bypass. Reinforced fiberglass pipe (32") or equivalent and two (2) compatible valves (w/cast iron sluice gates) designed for 10 bar pressure shall be installed between Ponds #1 and #2 which flow to the aeration pond.

- Transformer

  - Contractor shall purchase and install a 200 KVA transformer (minimum) to accommodate the additional electrical demand resulting from the addition of the ten (10) new 25 HP aerators, and associated pumps, required to operate the aeration and trickling filter systems.

  - Contractor shall purchase and install an estimated 500 meters of electrical supply cable sufficient to service the new transformers, pumps, lighting and electrical panels.

- Trickling Filters

  - Contractor shall construct two (2) circular trickling filters of reinforced concrete B300. Outside walls dimensions shall be approximately 4 meters high and inside diameter shall be 33 meters. Each trickling filter shall be complete, designed to meet hydraulic and biological loading factors and designed for a 1:1 recirculation ratio. Contractor shall make appropriate field investigation to determine that all foundation and footing support is appropriate to support the anticipated maximum dead and live loads.

  - Piping: Contractor shall purchase and install an estimated 200 meters of 32 inch (800 mm) diameter pipe for transporting effluent from the aeration pond outlet to the trickling filter dosing chamber/lift station. A 32 inch (800mm) sluice gate valve shall be added to the existing inlet to the facultative pond in order to control flow.

  - Media: Contractor shall purchase and install an estimated 5,000 m^3 of plastic filter media in the trickling filters (2,500 m^3 each) to service an operating depth of approximately 3.1 meters. Media shall be NSW 150, or equivalent.

  - Dosing Chamber/Pumps: Contractor shall size, construct and outfit (w/two (2) or more pumps) a dosing chamber to receive effluent from the aeration pond and deliver a minimum of 800 m^3/hr of effluent, with adequate pressure head, to each filters distribution arm to accommodate the maximum hourly flow. The dosing chamber shall be constructed of B300 reinforced concrete. The chamber shall be designed to accommodate a "float controlled" level sensor for individual pump start-up and shut-off. The contractor shall verify the filter arm hydraulic operating

head requirements and adjust accordingly the final design of all filter distributor appurtenances.

- Recirculating Pumps: Contractor shall purchase and install recirculating pumps with the capacity to provide a recirculation rate of 1:1 for the two (2) trickling filters. The recirculation pumps shall be constant speed, low head dry-well type, 25 HP, 600 rpm or equivalent.

- Pump Lift Station: Contractor shall design and construct a pump lift station (w/ two (2) pumps minimum) sufficient to receive effluent from the trickling filters' underdrain systems and transfer the effluent to the final clarifier pond. The pump controls shall be float operated and provide low water cutoff. Pumps shall be constant speed, moderate head and serviceable in dry well conditions.

- Pump Control Panel: Contractor shall purchase and install a pump control panel to service all trickling filter pumps as noted above. The control panel may be installed at the existing electric panel room near the aeration pond, or in a separate room constructed near the trickling filters, as a part of the other appurtences

- Final Clarifier

  - Contractor shall modify existing facultative pond (Pond #4) to provide for a newly constructed clarifier pond with length of 48 meters, operating width of 66.7 (approximately) and operating depth of 4.7 meters. Volume of the new pond to be approximately 13,500 m^3 to provide a detention time of approximately 10 hours.

  - Levee: Contractor shall construct a levee at the mid length point across the existing facultative pond (Pond #4). Bottom dimension to be approximately 39 meters, a top width of five (5) meters, and a height of approximately 5.7 meters. Levee to be appropriately compacted with a mix of approximately 30% clay to 70% sand.

  - Liner: Contractor shall purchase and install a hypalon liner to cover all side slopes of the new clarifier side slopes. The liner, GSE Hyperflex (HD) or equivalent, shall extend a minimum of 1.0 meter above high water levels and 2.0 meters along the bottom from the dike side slopes.

  - Piping: Contractor shall purchase and install sufficient piping to deliver trickling effluent to the clarifier at the south-west corner of clarifier pond to allow maximum flow through time to the outlet pipe, located at the North-east corner of clarifier pond.

- Sludge Holding Pond

  - Contractor shall construct a sludge holding pond within the existing facultative pond (Pond #4). This pond shall be developed in concert with the construction of

the final clarifier pond as discussed above. The sludge pond shall be approximately 54 meters long, 66.7 meters operating width and have an operating depth of 4.2 meters.

- Contractor shall line each side of the pond with a 2mm hypalon (GSE Hyperflex HD or equivalent) liner extending a minimum of 1.0 meter above the highest sludge level and 2.0 meters into the bottom along the slope of each side.

- Sludge Drying Beds

  - Contractor shall construct a sludge drying bed area of approximately 3,500 m^2. Area to be divided into seven (7) cells with dikes approximately two meters in height. Design of the dikes is to be sufficient to retain sludge placed by pumping to depths of 1.0 meter. Overall area dedicated to drying beds is not to exceed 7000 m^2.

- Chlorine Station

  - Contractor shall rehabilitate and convert the existing chlorination facility to a bromine disinfectant treatment facility that can apply an average equivalent chlorine dosage of 15mg/l or approximately 500 kg/day.

  - Contractor shall construct a contact chamber capable of providing a minimum of 20 minutes detention (contact) time to aid with effluent disinfection.

- Effluent Pump Station

  - Contractor shall purchase and install four (4) new replacement pumps, each with a capacity of approximately 500m^3 /hr against an estimated head of 60 meters. Pumps are to be installed in the existing pump station using the recently rehabilitated discharge manifold system.

- Sludge Pumps

  - Contractor shall purchase and install two (2) six inch (6") sludge (trash) pumps for the transfer of solids from the clarifier to the sludge holding pond and on to the sludge drying beds. One (1) pump shall have a capacity of 60 m^3 /hr while the second pump shall have a capacity of 30 m^3/hr.

  - Contractor shall purchase and provide a total of 100 meters of 6" flexible suction (vacuum) pipe and 200 meters of 6" flexible pressure pipe for use in sludge handling operations.

- Miscellaneous Repairs to Existing Facilities

- Contractor shall be responsible for evaluation, testing, and repair of all existing treatment, reuse, and discharge facilities to assure the MOG that all new and existing facilities are functional and compatible to provide treatment, reuse, and discharge capacity as designed. These evaluations shall include physical, mechanical, and electrical components. The objective is to assure a seamless workable plant.

- Facility Lighting and Fencing

  - Contractor shall purchase and install a minimum of six (6) 10 to 15 meter of 15 cm diameter light poles and place them at strategic locations throughout the treatment works to assure adequate lighting for employee safety and plant operations.

  - Contractor shall purchase and install up to four (4) 1000 watt high pressure sodium fixtures each directed at key operational locations throughout the plant. Contractor is responsible for providing sufficient (estimated 500 meters) electrical cable to power and switch the lights.

  - Contractor shall purchase and install sufficient (estimated 1200 meters) woven wire fencing to secure the perimeter of the upgraded and improved treatment facility.

- Dike/Levee Strengthening

  - Contractor shall evaluate, test and rehabilitate, as required, to assure safety of all levees and/or dikes within the treatment plant. Dike rehabilitation may be accomplished through hydraulic equalizing, ramming, recompacting with clay or bentonite additives, or by lining to prevent wind and/or water erosion, undermining, or breeching of any dike or levee.

- Recharge Basins

  - Contractor shall evaluate and rehabilitate the three(3) recharge basins adjacent to the UNDP reuse facility with the objective to accommodate an effluent spreading rate of up to 1.0 meter/day of treated effluent from the GWWTP and up to 20,000 m^3/day of infiltration on an annual basis.

- Booster Pump Station

  - Contractor shall rehabilitate the existing booster pump station (P.S. #2) on the UNDP reuse and irrigation system. The existing four (4) 550 m^3/hr pumps shall be serviced and placed in operating condition. The existing electric control panel and related all other mechanical/electrical components shall be renovated, tested and placed in operating condition.

- Wadi Gaza Discharge Line

- Contractor shall purchase and install (replace) approximately 1.0 km of 16 inch (400mm) UPVC pipe. This pipe replaces an existing 12 inch AC pipe on the irrigation/discharge system from the booster pump station. A connection fitting shall be provided and installed to transition the existing 16" AC line to this newly installed 16" UPVC line.

- Storage Tank Waterproofing

  - Contractor shall apply a waterproofing sealant (gunite or similar) to all interior surfaces of the existing UNDP constructed 5000 m^3 storage tank in sufficient quantities to minimize leakage into and/or through the concrete walls.

- Valve Rehabilitation

  - Contractor shall provide all supplies, material, labor and equipment required to remove, rehabilitate, service, and reinstall all valves 4 " (100 mm) and larger. It is estimated that there are approximately fifteen (15) valves from 18" to 22" and an additional ten (10) valves of 16" or smaller size.

- Monitoring Wells

  - Contractor shall bore and develop six (6) shallow (approximately 30 meters) 4 " diameter monitoring wells at or along the reuse/recharge basins and agricultural areas.

  - Contractor shall provide the MOG two (2) sets of sampling equipment necessary to measure and monitor aquifer change related to the recharge program.

2.11 Task Schedule

Table 2.1 represents the MSI Teams estimated optimum timeline for completion of this project.

Table 2.1 Task Schedule Activity

		Day	0	100	200	300	400	455
Task #1	Design Report	(45 days)						
Task #2	Design Drawings, Specs., and contract documents	(45 days)						
Task #3	Construction Management	(365 days)						
Task #4	Construction	(335 days)						
	A) Pond #1A							
	B) Aeration Pond							
	C) Trickling Filters							
	D) Pond #4 & Sludge Beds							
	E) Install Pumps & Pump Structures							
	F) All other							
Task #5	Operations/Mtnc. incl. Testing and Training and Handbooks	(30 days)						

Total Time From Issuance of Notice to Proceed to Project Completion is Projected as 455 Days.

LIST OF CONTACTED SUPPLIERS

Equipment	Company	Contact
Pumps	Fairbanks-Morse Pumps P.O. Box 6999 Kansas City, Kansas 66106	Zeki O. Oral (913) 371-5000
	ABS Pumps 140 Pond View Drive Meriden, Connecticut 06450	Sarah Whelin (203) 238-2700
Aerators	Aerators Inc. 11765 Main Street Roscoe, Illinois	Jack Callahan (815) 623-2111
Screens	Lakeside Equipment Corp. 1022 E Devon Ave., Box 8448 Bartlett, Illinois	Larry Lehnert (630) 837-5647
Filter Media	NSW Corp. 530 Gregory Avenue Roanoke, Virginia 24016	Kenneth Krupa (340) 981-0362
Pond Liner	GSE Lining Technology, Inc. 19103 Gundle Road Houston, Texas 77073-3598	Mark Harris (281) 443-8564
UPVC Pipes	Certain Teed Corporation P.O. Box 860 Valley Forge, Pennsylvania 19482	John Calkins (610) 341-7913
Fiberglass Pipes	XERXES Corporation 1210 No. Tustin Avenue Anaheim, California 92807	Steve Robles (714) 630-0013

CHAPTER THREE - TERMS OF REFERENCE

Chapter three is the MSI proposed Terms of Reference placed in the USAID recommended format.

SECTION B

SUPPLIES OR SERVICES AND PRICES/COSTS

PURPOSE

The purpose of this contract is to obtain complete project management services from a U.S. firm for the preparation of final engineering designs and the construction of an upgraded and expanded wastewater treatment facility at the existing Gaza Municipal Wastewater Treatment Plant in the Sheikh Ajleen district of the Municipality of Gaza in the Gaza Strip. This contract will be carried out using performance-based contracting procedures.

B.1. FIXED PRICE

The firm, fixed price for the deliverables described in Section C. of this contract is:

Provisional Sum Items	$ 4,800,000
Lump Sum Tasks	$ 1,320,000
Incentive Allowance	$ 105,000
TOTAL CONTRACT PRICE	$6,225,000

Funds in the amount of $ TBD are hereby obligated with additional increments to follow over the next 12-month period. These funds are broken down as follows:

Provisional Sum Items			$ TBD
Lump Sum Tasks			$ TBD
Incentive Allowance			$ TBD
TOTAL CONTRACT PRICE			$TBD

Accounting and Appropriation Data:

PIO/T No.: 294-0020	-#-#####		
Appropriation:	###/#####		
Allotment:	T######	-	$ TBD
	T######	-	$ TBD

B.2. PARTIAL PAYMENTS

B.2.(a) Upon submission, inspection, and acceptance of the deliverables described in Sections C. and F. of this contract, and submission to the payment office specified in Section G.2. of this contract of the required payment documentation (see the clause of this contract entitled "Payments" [FAR 52.232-01]), the Contractor shall be entitled to partial payments as shown below. Payment for services rendered for interim outputs under the construction program and for those items for which a monthly rate is indicated will not be made more than monthly and only upon USAID acceptance of fully completed deliverables or measurable increments as indicated in subcontract payment schedules approved by USAID. Payment requests shall consolidate deliverables eligible for payment into a combined billing.

Deliverable	Fixed Price	Due Date*
Task 1 - Design Report (*LUMP SUM*)	$ 100,000	Day 45
Total Design Report Price	$ 100,000	
Task 2 - Design Drawings, Technical Specifications, & Procurement Documents *(LUMP SUM)*	$ 170,000	Day 90
Total Design Drawings, Technical Specifications, & Procurement Documents Price		$ 170,000
Task 3 - Construction Management Services (*LUMP SUM*)	$ 750,000	
Total Construction Management Services Price		$ 750,000
Task 4 - Construction Program (*PROVISIONAL SUM*)	$4,800,000	Day 425

Total Construction Program Provisional Sum
$4,800,000
Note: This element will be divided into eight (8) sub-elements

4.a	*Mobilization*	*$ 480,000*
4.b	*Pond # 1A*	*$ 295,000*
4.c	*Aeration Pond/System*	*$ 300,000*
4.d	*Trickling Filters*	*$1,355,000*
4.e	*Pond #4/Sludge Beds*	*$ 395,000*
4.f	*Pumping Stations*	*$ 180,000*
4.g	*Recharge/Reuse/Disposal*	*$ 295,000*
4.h	*U.S. Manufactured Material & Equipment*	*$1,500,000*

Task 5 - Operation and Maintenance (*LUMP SUM*)
- Manual of Standard O&M Procedures — $ 300,000 — Day 455

Note: This element will be broken into three (3) sub-elements
$ 300,000

5.a	*Spare Parts*	*$ 200,000*	
5b	*Handbooks*	*$ 25,000*	
5c	*Testing /Training*	*$ 75,000*	
Incentive Payment (*ALLOWANCE*)**			
• Schedule Adherence Incentive			
o Task 1		$ 2,500	
o Task 2		$ 2,500	
o Task 4		$ 50,000	
• Budget Adherence Incentive			
o Task 4		$ 50,000	
Total Incentive Payment Allowance			$ 105,000
TOTAL CONTRACT AMOUNT			**$6,225,000**

* "Due dates" are defined as calendar days after the effective date of the contract. In the event that a deliverable due date falls on a day on which USAID/West Bank & Gaza offices are officially closed, the deliverable shall be due on the first working day thereafter.

** Incentive Payment Allowance excludes those items with no noted "due date" in calendar days .

For deliverables under construction management services, payment installments of 15%, 80%, and 5% are authorized, respectively, for 1) successful award and signing of associated subcontracts, 2) completion of all construction and satisfactory start-up, and 3) full adherence with and expiration of one-year warranty.

B.2.(b) Payment shall be in accordance with the clause of this contract entitled "Payments" (FAR 52.232-01). "Prompt Payment" (FAR 52.232-25), "Electronic Funds Transfer Payment Method" (FAR 52.232-28), "Documentation for Payment" (AIDAR 752.7003).

B.2.(c) Payment shall be made by the payment office designated in Section G. of this contract.

B.2. (d) Mobilization

Contractor will be entitled to a mobilization payment **(John to finish wording)** Contractor may bill this amount immediately following signing of all contractual documents and receiving from USAID the Official Notice To Proceed.

B.2. (e) Special Payment for Delivered Materials/Equipment.

USAID will make a one-time, special payment to contractor for Contractor purchased, U.S. Manufactured equipment and materials, which are to be incorporated into the Works. Contractor may bill when the materials/equipment have been received at the appropriate Israeli Port. Payment will be based on the actual prices listed on a Certified Invoice/Bill of Lading. Materials

to be included in this payment include, and will be limited to, pumps, pipe, valves, filter media, pond lining, and aerators.

B.3. PROVISIONAL SUMS

Provisional sums identified are for anticipated major subcontracts and represent levels that cannot be exceeded without Contracting Officer approval. Such sums are to be used for completing construction activities and for procuring commodities. Use of any provisional sum requires the prior approval of USAID. The Contractor's direct costs associated with such activities should be included as part of the deliverables for "Construction Management Services". Provisional sums are only to cover major subcontracts and are to be billed separately and in accordance with pre-agreed subcontractor payment schedules. For all construction and commodities subcontracts for which provisional sums are to be used, the subcontracts will be competitively procured using procurement documents approved by USAID. Likewise, the proposed award of any such subcontract must first be approved by the RCO.

B.4. COST REIMBURSABLE ALLOWANCES

(John to Note!!!!!!)

B.5. INCENTIVE PAYMENTS

B.5.(a) The Contractor shall receive "Schedule Adherence Incentive Payments" of $2,500 for Task 1, $2,500 for Task 2, and $50,000 for Task 4, if all deliverables under the respective tasks are fully accepted, in writing, by USAID by or before the indicated "due date".

B.5.(b) The Contractor will receive $50,000 as a "Budget Adherence Incentive Payment" if the final amount paid, including all change orders, by USAID for the deliverables under Task 4 does not exceed the Provisional Sum amount of $4,800,000.

B.6. LOGISTIC SUPPORT

B.6.(a) The following logistic support will be provided by USAID in accordance with current Mission and Embassy policy which may be amended from time to time:

USAID/West Bank/Gaza will request that U.S. citizen contractor personnel be accorded eligibility for USEA membership, which includes access to the American Club facilities and the Embassy Commissary.

B.6.(b) The costs of any logistic support being provided by USAID and/or the Palestinian Authority are not included in the fixed price of this contract. Where USAID or the Palestinian Authority does not meet its commitment to provide the logistic support specified above, the

Contractor shall immediately notify the Contracting Officer in writing. Any resulting adjustment in the contract price or delivery schedule will be handled under the clause of this contract entitled "Changes - Fixed Price" (FAR 52.243-01, Alternates I or II [see Section I. of this contract for applicability]).

B.6.(c) The Contractor shall be responsible for providing or arranging for all logistic support, except to the extent set forth in Section B.5.(a) above. The Contractor and any employee or consultant of the Contractor or its subcontractors is prohibited from using U.S. Government facilities (such as office space or equipment) or U.S. Government clerical or technical personnel in the performance of this contract. If at any time it is determined that the Contractor, or any of its employees or consultants, have used U.S. Government facilities or personnel without authorization from the Contracting Officer, then the amount payable under this contract shall be reduced by an amount equal to the value of the U.S. Government facilities or personnel used by the Contractor, as determined by the Contracting Officer. If the parties fail to agree on an adjustment made pursuant to this clause, it shall be considered a "dispute" and shall be dealt with under the terms of the clause of this contract entitled "Disputes" (FAR 52.233-01 and Alternate I).

B.6.(d) Notwithstanding any other provision of this contract, if the Contractor's travel is shortened or the Contractor's overseas work assignment is not completed due to the Contractor's misconduct or inexcusable nonperformance, travel, per diem, and transportation costs shall be absorbed by the Contractor, and shall not form the basis for adjustment to the fixed price of the contract. For the purposes of this contract, misconduct is defined as the deliberate and/or repeated disregard for the laws and regulations of the Palestinian Authority or of USAID, the continued existence of conflict of interest after advice that such conflict exists (see also Section H.4. of this contract), or general behavior unbecoming a professional serving as a part of the U.S. foreign assistance program (see also the clause of this contract entitled "Personnel" [AIDAR 752.7027]). Inexcusable nonperformance shall be defined as unauthorized absences or failure to undertake and/or complete assigned tasks which are within the scope of this contract, when such absences or failures are within the control of the individual.

B.7. RELATIONSHIP OF CONTRACTOR TO USAID

This is a non-personal services contract. Under the IRS 20-factor test, USAID has determined that the Contractor is an independent contractor and not an employee of USAID, and hence, shall not be supervised by USAID. As is normal for all USAID non-personal services contracts with firms, other institutions, and individuals for the furnishing of technical assistance, the Contracting Officer's Technical Representative (COTR) has the authority to issue "technical directions" as set forth elsewhere in this contract. However, such "technical directions" should not be interpreted to constitute "direction" as defined by the Internal Revenue Service. USAID does not have the authority to control or direct the day-to-day activities of the Contractor and will not do so. Consistent with the Contractor's status as an independent contractor, USAID is not withholding income tax or social security.

END SECTION B
****

SECTION C

ABBREVIATIONS/BACKGROUND/DESCRIPTION/STATEMENT OF WORK

C.1. ABBREVIATIONS

It is understood that wherever the following terms appear in this Statement of Work they signify:

C.1.(a) " **Contractor** " means the firm contracted by USAID to perform project management services for the Project.

C.1.(b) " **COTR** " means the Contracting Officer's Technical Representative.

C.1.(c) " **Days** " means calendar days.

C.1.(d) " **Employer** " means USAID.

C.1.(e) " **MOA** " means the Palestinian Ministry of Agriculture

C.1.(f) " **MOG** " means the Municipality of Gaza.

C.1.(g) " **MPIC** " means the Palestinian Ministry of Planning and International Cooperation.

C.1.(h) " **PA** " means the Palestinian Authority.

C.1.(i) " **Project** " means the Gaza Wastewater Project (Project Number 294-0020) of USAID. This project covers the upgrading and expansion of the wastewater and stormwater infrastructure serving the City of Gaza.

C.1.(j) " **Project Area** " means the City of Gaza.

C.1.(k) " **PWA** " means the Palestinian Water Authority.

C.1.(l) " **RCO** " means the USAID Regional Contracting Officer.

C.1.(m) " **USAID** " means the United States Agency for International Development.

C.1.(n) " **USD** " or " **US$** " means United States Dollars.

C.1.(o) " **Works** " means the wastewater and stormwater infrastructure facilities of the Project.

C.2. BACKGROUND ON THE PROJECT

C.2.(a) Summary

The United States Agency for International Development (USAID) Mission for the West Bank and Gaza is financing an interim program for the upgrading and expansion of the existing wastewater treatment plant serving the Municipality of Gaza. This interim program will: 1) provide sufficient increased capacity in the treatment facilities to handle projected flows up to the Year 2005 and 2) upgrade the quality of the effluent to permit the safe recharge of the aquifer and reuse for irrigation of selected agricultural crops.

C.2.(b) Collaboration

USAID and the Contractor will work in close collaboration with the Municipality of Gaza (MOG) and the Palestinian Water Authority (PWA) to implement an interim program for upgrading the existing wastewater treatment plant serving the Municipality of Gaza.

The PWA has overall responsibility for the management of the water resources of the Gaza Strip. The MOG operates and maintains the wastewater infrastructure serving the city.

C.2.(c) Project Setting

The existing Gaza Municipal Wastewater Treatment Plant is located in the Sheikh Ajleen district at the southern boundary of the Municipality of Gaza in the Gaza Strip approximately 2 km from the Mediterranean Sea. The Gaza Strip is a part of territory that has been occupied by Israel since 1967, but is currently undergoing a transition to self-rule by the Palestinians under the terms of the Oslo Peace Accords. After the peace accords, the population growth rate has accelerated. The estimated population of 326,200 (March 1996) has overloaded the existing wastewater infrastructure.

The existing treatment plant was originally constructed in 1977, expanded by the UNDP in 1986, and is presently being upgraded by the UNRWA. The current upgrading of the plant is intended to ensure adequate treatment of a design flow of 12,000 m^3/day. The treatment facilities include two (2) parallel anaerobic lagoons, a single aerated lagoon, a facultative lagoon, and chlorination. The 1986 expansion of the plant by the UNDP provided reuse facilities at an agricultural site about 1 km east of the treatment plant. These reuse facilities consist of two (2) rapid infiltration basins (4 hectares total surface area), two (2) pump stations, a 5,000-m^3 storage tank, and an overflow line to Wadi Gaza. The reuse facilities have never been used as the quality of the effluent from the treatment plant has never met acceptable standards for reuse. Today, most of the effluent is pumped to the beach and the remainder is diverted to a small wadi flowing toward the Netzarim Settlement and to adjacent low areas where it is allowed to percolate into the ground.

In the Conceptual Design Report for Upgrading and Expanding Gaza Wastewater Treatment Plant and Disposal Facilities the Management Systems International (MSI) Evaluation Team estimated that wastewater flows for the year 2005 will be approximate 32,000 m^3/day. Estimates of sewage currently arriving at the GWWTP site range from 12,500 m^3/day to more than 16,000 m^3/day. Currently the majority of this sewage is being diverted directly to the beach discharge receiving little, if any, meaningful treatment. An estimated 60% of the population is presently connected to the wastewater collection system. It is expected that by 2005 this percentage will increase to 75%. The MPIC is promoting the development of a new regional wastewater treatment plant that would meet the future needs of the Municipality of Gaza. Though the MPIC proposes to have the regional plant online in 1998, many experts are skeptical and believe that the regional plant will not be in service until the Year 2002 or beyond. Accordingly, USAID has proposed an interim program that will bridge the gap between present needs and projected Year 2005 needs.

C.2.(d) USAID Strategy

The Strategy for the West Bank and Gaza, which covers the period FY 1996 - FY 2000, was developed to facilitate the transition from short-term, emergency programs essential in the initial days of Palestinian self-rule to a development program that reflects the demands of an extremely dynamic political and economic situation. The overall goal of the USAID program is to strengthen Palestinians' commitment to the process by helping them realize the tangible benefits of peace. The program places a heavy emphasis both on short-term, visible results and on longer-term objectives that will lead to sustainable improvements in the lives of Palestinians. The Mission's strategy in the water resources sector is "*Greater access to and more effective use of scarce water resources*".

C.2.(e) Project Purpose

Through the Gaza Wastewater Project of which this activity is a component, USAID seeks to provide stormwater/wastewater collection, treatment, and reuse which is reliable, efficient, cost effective, environmentally sound, and financially sustainable.

C.3. PROJECT DESCRIPTION

C.3.(a) Gaza Wastewater Project

The four-year, $40 million Gaza Wastewater Project was initiated on 30 June 1995 with an initial Grant Agreement with the United Nations Relief and Works Agency (UNRWA). Through the grant, UNRWA implemented the urgent and emergency Phase I of the project. Phases II, III, and IV are currently being implemented by a U.S. contractor, Metcalf & Eddy (M&E), as part of a $24 million contract with an effective date of 23 May 1996.

C.3.(b) UNRWA Grant (Phase I)

UNRWA initiated the project through a $5.9 million grant that provided: 1) emergency sanitary sewer and storm drain cleaning and repair, 2) the procurement of emergency commodities for maintenance of sanitary sewers and storm drains by the Municipality of Gaza, 3) emergency upgrading of stormwater retention facilities at the Sheikh Radwan Reservoir, and 4) cleanup and improvements to a natural depression in the Waqf Area for emergency retention of stormwater flows on a temporary basis. The purpose of Phase I of the project was to provide immediate relief from flooding of the most heavily populated areas of the city during the rainy season.

C.3.(c) M&E Contract (Phases II, III, and IV)

Through its contract with M&E, USAID will: 1) develop new wastewater and stormwater collection and conveyance systems critical to resolving current system problems, 2) lay the framework for future system improvements, 3) strengthen the municipality's operation and maintenance capability, 4) improve public awareness of system operations, benefits, and costs, and 5) establish a systematic water quality and monitoring program for surface water and groundwater in the municipality and surrounding areas. Phase II of the project includes institutional support to the municipality, a public awareness campaign within the community, and training in operations and maintenance for municipal employees. Phase III of the project covers the development of a stormwater/wastewater master plan for Gaza City for the planning period 1995 through 2025 and the preparation of engineering designs for a $20.8 million construction program. Phase IV of the project provides $5.3 million for rehabilitation of the Sheikh Radwan Reservoir and selected wastewater and stormwater pump stations and $15.5 million for the extension of sanitary sewers and storm drains to expand the service area within Areas A-1 and A-2 of Gaza City.

C.3.(d) Upgrading and Expansion of the Existing Gaza Municipal Wastewater Treatment Plant (Phase V)

The Initial Environmental Examination (IEE) conditioned construction of new sanitary sewers upon a firm commitment from other donors to expand the capacity of the existing Gaza Municipal Wastewater Treatment Plant to a level sufficient to meet the increased wastewater loadings. However, the MPIC has been soliciting funds for a new regional wastewater treatment plant in lieu of expansion of the existing plant. Though donor funds have been pledged for studies and design of a new regional plant, there have not been any firm commitments for construction funds. USAID does not believe that the new facility will be online in sufficient time to permit the extension of sanitary sewers to expand the service area of Gaza City under the M&E contract (Phase IV). Accordingly, USAID has pledged $5 million in construction funds to upgrade and expand the existing treatment plant to meet the immediate needs of Gaza City until such time as the regional wastewater treatment plant can be completed or until the year 2005.

As part of the development of a stormwater/wastewater master plan for Gaza City, M&E studied various alternatives for upgrading and expanding the existing treatment plant. M&E recommended the addition of trickling filters and final clarifiers to the existing flow stream and the restoration

of the reuse facilities that were originally built in 1986. USAID has endorsed this recommendation with some slight modifications.

The recently approved Phase V of the project covers an interim program for the upgrading and expansion of the existing wastewater treatment plant serving the Municipality of Gaza. This interim program will: 1) provide sufficient increased capacity in the treatment facilities to handle projected flows up to the Year 2005 and 2) upgrade the quality of the effluent to permit the safe recharge of the aquifer and reuse for irrigation of selected agricultural crops.

Under Phase V of the project, the existing treatment plant will be upgraded and expanded to treat an estimated flow of 32,000 m^3/day of wastewater to a level acceptable for reuse for irrigation of selected agricultural crops. A level of 30 mg/l BOD and 30 mg/l SS is being used as the treatment objective for the upgraded treatment plant. It is envisaged that this interim program will consist of:

- The addition of new bar screens at the outlets of the proposed and existing anaobic ponds.
- The provision of additional surface aerators for the existing aeration pond, including construction of concrete pads beneath each (16) aerator to prevent scouring of pond bottom.
- The construction of a new anaerobic sedimentation pond.
- The provision of two trickling filters with associated recirculation and effluent pump stations after the existing aerated lagoon.
- Division and conversion of the existing facultative pond into both a secondary settling unit and a waste sludge lagoon
- The addition of sludge drying beds.
- The addition of a chlorine contact chamber prior to the existing effluent pump station and conversion of the chlorine facility to a bromine disinfection unit.
- The replacement of the existing effluent pumps (four each) at the treatment plant pumping station.
- Strengthening of all existing dikes.
- Miscellaneous plumbing and electrical repairs and modifications to existing facilities to assure plant operation.
- The addition of facility lighting and fencing at the treatment plant
- The rehabilitation and testing of the booster pumping station near the recharge facility.
- The testing and repair of existing distribution and discharge system.
- The replacement of approximately one kilometer of 12" pipe with 16" pipe.
- Installation of shallow monitoring wells in the vicinity of the recharge basins and the agricultural area.

C.4. STATEMENT OF WORK FOR CONTRACTOR

C.4.(a) Summary

Under this Contract, the Contractor will prepare final engineering designs and construct upgraded and expanded wastewater treatment, reuse and disposal facilities at the existing Gaza Municipal Wastewater Treatment Plant in the Sheikh Ajleen district of the Municipality of Gaza.

C.4.(b) Contract Elements

The Contract consists of five major elements:

C.4.(b)(1) Design Report The final engineering design report will be based on the March 1997 conceptual design report prepared by Management Systems International Inc.

C.4.(b)(2) Design Drawings, Technical Specifications, and Procurement Documents The design drawings, technical specifications, and procurement documents will be based on the approved final engineering design report, and shall be of sufficient detail as to permit the competitive procurement of those subcontracts required to construct the Phase V wastewater treatment, reuse and disposal facilities described in this statement of work (see C.4.(c) (4) (22)).

C.4.(b)(3) Construction Management Services The Contractor shall be fully responsible for delivery of each deliverable included in this Contract as part of the construction program. This will include entering into competitively procured subcontracts for the construction, and assuming all financial risks of construction subcontractor performance.

C.4.(b)(4) Construction Program The actual construction of the wastewater treatment, reuse and disposal facilities comprising Phase V of the Gaza Wastewater Project shall be an integral part of this Contract.

C.4.(b)(5) Operation and Maintenance A program for the overall operation and maintenance of the wastewater treatment, reuse and disposal facilities (including existing components) will be developed.

C.4.(c) Description of Tasks

The Contractor will carry out the specific tasks described below in order to accomplish the desired performance measures.

C.4.(c)(1) Task 1 - Design Report

C.4.(c)(1)(aa) Description: The Contractor shall produce a design report establishing the basic design parameters for the proposed wastewater treatment, reuse and disposal facilities, including monitoring wells. The design report will confirm the validity of recommendations regarding the specific components and sizing of same contained in the conceptual design report prepared by MSI for Phase V. Representative activities needed to complete this task and to be covered in the design report include:

- Site surveys for the proposed wastewater treatment, reuse, and disposal facilities
- Geotechnical investigations as required for the proper design of structures and foundations
- Hydrogeological evaluation of the recharge program
- Agricultural assessment of the proposed re-use program
- Chemical and biological analyses of groundwater in the vicinity of the recharge basins and the agricultural area
- Soil analyses for proposed application of treated wastewater effluent for aquifer recharge and irrigation of agricultural lands
- Design criteria proposed by the Contractor
- Design calculations and assumptions
- General layout of the proposed facilities
- Process Flow Diagrams
- Recommendations regarding spare parts and other items of support required to support the operation and maintenance of the proposed facilities
- Detailed cost estimates for the capital costs of all major components of the proposed wastewater treatment and disposal facilities
- Detailed cost estimates for the operation and maintenance costs of the proposed wastewater treatment, reuse and disposal facilities (including existing components)
- Proposed tariff structures for reuse of treated wastewater effluent
- Coordination arrangements and details for maintaining service at the existing treatment plant during construction of the new facilities
- Proposed breakout of the proposed system components by subcontract
- Schedule indicating all major benchmarks for the proposed procurements and a plan of action for implementing the proposed upgrading and expansion program in a timely manner

C.4.(c)(1)(bb) Deliverable: Design Report establishing the basic design parameters for construction of the proposed upgraded and expanded wastewater treatment, reuse and disposal facilities.

C.4.(c)(1)(cc) Special Resources: Conceptual design report prepared by Management Systems Int'l.

C.4.(c)(1)(dd) Performance Measure: The MOG and the PWA have a Design Report sufficiently detailed, including technical specifications, design parameters, and preliminary design drawings, describing and costing, the proposed wastewater treatment and disposal facilities, to identify fully all major system components and their functions for the purpose of making reasoned decisions regarding their suitability for the intended uses.

C.4.(c)(1)(ee) Special Requirement: Unless otherwise agreed in writing by USAID, the estimated cost of the proposed facilities should be within the $5 million budget allocated for the construction activity.

C.4.(c)(2) Task 2 - Design Drawings, Technical Specifications, and Procurement Documents

C.4.(c)(2)(aa) Description: The Contractor shall prepare final design drawings and procurement documents for the competitive procurement, consistent with USAID regulations, of a subcontract, or subcontracts, covering construction of the proposed wastewater treatment and disposal facilities, including monitoring wells. The packaging of the subcontracts shall be as recommended by the Contractor in the design report, subject to the approval of USAID.

C.4.(c)(2)(bb) Deliverables: Complete design drawings and technical specifications packaged within appropriate procurement documents for the competitive procurement of the proposed wastewater treatment and disposal facilities. Specifically, design drawings, technical specifications, and procurement documents for the following treatment and disposal facilities:

- The addition of bar screens at the outlets from the new and existing anaerobic ponds.
- The addition of a third anaerobic sedimentation pond.
- The provision of additional surface aerators for the existing aeration pond, including concrete pads beneath each aerator to prevent scouring of pond bottom.
- The provision of two trickling filters, with associated recirculation and effluent pump station, after the existing aerated lagoon
- Division and conversion of the existing facultative pond into a secondary settling unit clarifier and a waste sludge lagoon.
- The addition of sludge drying beds.
- The addition of a chlorine/bromine contact chamber prior to the existing effluent pump station and conversion of the facility for bromine treatment.
- The replacement of the existing four effluent pumps at the treatment plant.
- Strengthening of all existing dikes.

- Miscellaneous plumbing and electrical modifications and repairs to existing facilities.
- The reconstruction of the third spreading basin at the reuse facilities.
- The testing and repair of existing distribution and discharge systems.
- The rehabilitation of the existing booster pump station and servicing of the existing pumps to place them in working condition.
- Installation of shallow monitoring wells in the vicinity of the recharge basins and the agricultural area.

C.4.(c)(2)(cc) Special Resources: None.

C.4.(c)(2)(dd) Performance Measure: The MOG and the PWA have accepted and approved the design drawings and technical specifications for the proposed wastewater treatment and disposal facilities.

C.4.(c)(3) Task 3 - Construction Management Services

C.4.(c)(3)(aa) Description: The Contractor shall be fully responsible for delivery of each deliverable identified under "**Task 4 - Construction Program**". The Contractor will enter into a competitively procured subcontract (or subcontracts) for the construction and will assume all financial risks of construction subcontractor performance. The construction management services will include, but not necessarily be limited to, advertising the availability of the procurement documents, managing the bidding process, evaluating bids, awarding subcontracts, providing performance bond coverage, managing construction, implementing a quality control program, monitoring progress, conducting construction progress meetings, preparing monthly progress reports, and processing partial payment requests for subcontractors.

C.4.(c)(3)(bb) Deliverables: Construction subcontract (or subcontracts) fully completed and closed out for the upgraded and expanded wastewater treatment and disposal facilities.

C.4.(c)(3)(cc) Special Resources: None.

C.4.(c)(3)(dd) Performance Measure: All subcontracts for the upgraded and expanded wastewater treatment, reuse and disposal facilities fully completed in accordance with the agreed schedule and at a cost not exceeding the provisional sum set aside for construction.

C.4.(c)(3)(ee) Special Requirement: Release of any advertisements or any procurement documents requires the prior approval, in writing, of the Contracting Officers Technical Representative (COTR).

C.4.(c)(4) Task 4 - Construction Program

C.4.(c)(4)(aa) Description: Construction of the wastewater treatment and disposal facilities will be performed by Palestinian (located in the West Bank or the Gaza Strip), Israeli, and/or U.S.

firms under subcontract with the Contractor. Per the conceptual design report, it is envisaged that these treatment and disposal facilities will be as follows, unless otherwise agreed to in writing by USAID:

- Inlet Valves

  - Contractor shall purchase and install two (2) new , 32 inch (800 mm) cast iron valves between the main inlet and the distribution junction for anaerobic Ponds #1 & #2 to allow for operation of the two ponds in series. The valves shall be cast iron sluice gate type designed for a working pressure of 10 bars, complete with stem, fixing frames, all necessary fittings and accessories.

- Bar Screens

  - Contractor shall construct three (3) bar screens at the anaerobic ponds' outlets (the two existing and one newly constructed pond) in advance of the variable outlet weirs, to permit manual cleaning from the steel service bridge. Bar screens shall be constructed using steel bars 5 cm deep by 6mm wide by 2 meters long with a 2 cm bar spacing designed to screen all outflows from the anaerobic ponds

- Surface Aerators

  - Contractor shall purchase and install ten (10) new, 25 HP, floating aerators in Aeration pond #3. Alignment shall be balanced with the existing six (6) aerators in two rows to assure uniform effluent mix and flow. Newly purchased aerators shall be equivalent to Model 1225-SF Aqua-lator with stainless steel propeller, discharge passage, float assembly and intake cone.

  - Contractor shall construct sixteen (16) each 4 meter by 4 meter by 15 cm, B150 concrete (wire reinforced) pads in the Aerator Pond #3. Pads shall be placed to protect the pond bottom from aerator caused high velocity flow patterns and scour.

  - Contractor shall purchase and install an electrical control panel in either the electrical panel room between ponds #3 and #4 or the electrical control room between the aeration pond #3 and Pond # 1 A. Final location to be determined by location of electrical panel controlling the six (6) existing aerators being installed by UNRWA. All provisions shall be made for electrical service to the new control panel and to the ten (10) new aerators.

- Anaerobic Pond #1A

  - Contractor shall construct one (1) anaerobic primary sedimentation pond for physical solids removal and anaerobic biological action. Pond shall be designed and

constructed to function in series with Ponds #1 and #2. The pond shall be constructed to have an effective operating volume of 32,000 m^3 with a depth of approximately 4.5 meters (designed detention time of 24 hrs.)

- Contractor shall purchase and install a hypalon liner similar to GSE Hyperflex (HD) or equivalent to prevent erosion and/or water damage in Pond #1A. The liner shall extend at least 1.0 meter above the maximum water level and 2.0 meters along the pond bottom - from the side slope.

- Contractor shall purchase and install necessary piping to provide for in-series operation of the new pond with Ponds #1 and #2 and/or for isolation of Pond #1A for cleaning or bypass. Reinforced fiberglass pipe (32") or equivalent and two (2) compatible valves (with cast iron sluice gates) designed for 10 bar pressure shall be installed between Ponds #1 and #2 and the new ponds' inlet, the new ponds' outlet shall be connected to the existing outlet pipe for ponds #1 & #2 which flow to the aeration pond.

- Pond #3 Bypass

  - Contractor shall remove the existing 24 " (600 mm) bypass line along the east side of the aeration pond (Pond #3) and replace subject line with 32" (800 mm) diameter reinforced fiber glass pipe or UPVC equivalent beginning at the 32" valve located immediately south of the pond inlet and running approximately 210 meters to the 32" to 24" reducer at the south end pond outlet. The reducer shall be removed and replaced with a 32"cast iron suice gate valve or equivalent.

- Transformer

  - Contractor shall purchase and install a 200 KVA transformer (minimum) to accommodate the additional electrical demand resulting from the addition of the ten (10) new 25 HP aerators, and associated pumps, required to operate the aeration and trickling filter systems.

  - Contractor shall purchase and install an estimated 500 meters of electrical supply cable sufficient to service the new transformers, pumps, lighting and electrical panels.

- Trickling Filters

  - Contractor shall construct two (2) circular trickling filters of reinforced concrete B300. Outside walls dimensions shall be approximately 4 meters high and inside diameter shall be 33 meters. Each trickling filter shall be complete, designed to meet hydraulic and biological loading factors and designed for a 1:1 recirculation

ratio. Contractor shall make appropriate field investigation to determine that all foundation and footing support is appropriate to support the anticipated maximum dead and live loads.

- Piping: Contractor shall purchase and install an estimated 200 meters of 32 inch (800 mm) diameter pipe for transporting effluent from the aeration pond outlet to the trickling filter dosing chamber/lift station. A 32 inch (800mm) sluice gate valve shall be added to the existing inlet to the facultative pond in order to control flow.

- Media: Contractor shall purchase and install an estimated 5,000 m^3 of plastic filter media in the trickling filters (2,500 m^3 each) to an operating depth of approximately 3.1 meters. Media shall be NSW 150, or equivalent.

- Dosing Chamber/Pumps: Contractor shall size, construct and outfit (w/two (2) or more pumps) a dosing chamber to receive effluent from the aeration pond and deliver a minimum of 800 m^3/hr of effluent, with adequate pressure head, to each filters' distribution arm to accommodate the maximum hourly flow. The dosing chamber shall be constructed of B300 reinforced concrete. The chamber shall be designed to accommodate a "float controlled" level sensor for individual pump start-up and shut-off. The contractor shall verify the filter arm hydraulic operating head requirements and adjust accordingly the final design of all filter distributor appurtenances.

- Recirculating Pumps: Contractor shall purchase and install recirculating pumps with the capacity to provide a recirculation rate of 1:1 for the two (2) trickling filters. The recirculation pumps shall be constant speed, low head, dry-well type, 25 HP, 600 rpm or equivalent.

- Pump Lift Station: Contractor shall design and construct a pump lift station (w/ two (2) pumps minimum) sufficient to receive effluent from the trickling filters' underdrain systems and transfer the effluent to the final clarifier pond. The pump controls shall be float operated and provide low water cutoff. Pumps shall be constant speed, moderate head and serviceable in dry well conditions.

- Pump Control Panel: Contractor shall purchase and install a pump control panel to service all trickling filter pumps as noted above. The control panel may be installed at the existing electric panel room near the aeration pond, or in a separate room constructed near the trickling filters, as a part of the other appurtences

- Final Clarifier

  - Contractor shall modify existing facultative pond (Pond #4) to provide for a newly constructed clarifier pond with length of 48 meters, operating width of 66.7 (approximately) and operating depth of 4.7 meters. Volume of the new pond to be approximately 13,500 m^3 to provide a detention time of approximately 10 hours.

  - Levee: Contractor shall construct a levee at the mid length point across the existing facultative pond (Pond #4). Bottom dimension to be approximately 39 meters, a top width of five (5) meters, and a height of approximately 5.7 meters. Levee to be appropriately compacted with a mix of approximately 30% clay to 70% sand. Final proportion to be supported with appropriate soil testing.

  - Liner: Contractor shall purchase and install a hypalon liner to cover all side slopes of the new clarifier pond. The liner, GSE Hyperflex (HD) or equivalent, shall extend a minimum of 1.0 meter above high water levels and 2.0 meters along the bottom from the dike side slopes.

  - Piping: Contractor shall purchase and install sufficient piping to deliver trickling filter effluent to the clarifier at the south-west corner of clarifier pond to allow maximum flow through time to the outlet pipe, located at the north-east corner of clarifier pond.

- Sludge Holding Pond

  - Contractor shall construct a sludge holding pond within the existing facultative pond (Pond #4). This pond shall be developed in concert with the construction of the final clarifier pond as discussed above. The sludge pond shall be approximately 54 meters long, 66.7 meters operating width and have an operating depth of 4.2 meters.

  - Contractor shall line each side of the pond with a 2mm hypalon (GSE Hyperflex HD or equivalent) liner extending a minimum of 1.0 meter above the highest sludge level and 2.0 meters into the bottom along the slope of each side.

- Sludge Drying Beds

  - Contractor shall construct a sludge drying bed area of approximately 3,500 m^2. Area to be divided into seven (7) cells with dikes approximately two meters in height. Design of the dikes is to be sufficient to retain sludge placed by pumping to depths of 1.0 meter. Overall area dedicated to drying beds is not to exceed 7000 m^2.

- Chlorine Station

  - Contractor shall rehabilitate and convert the existing chlorination facility to a bromine disinfectant treatment facility that can apply an average equivalent chlorine dosage of 15mg/l or approximately 500 kg/day.

  - Contractor shall construct a contact chamber capable of providing a minimum of 20 minutes detention (contact) time to aid with effluent disinfection.

- Effluent Pump Station

  - Contractor shall purchase and install four (4) new replacement pumps, each with a capacity of approximately 500m^3 /hr against a minimum head of 60 meters. Pumps are to be installed in the existing pump station using the recently rehabilitated discharge manifold system.

- Sludge Pumps

  - Contractor shall purchase and install two (2) six inch (6") sludge (trash) pumps for the transfer of solids from the clarifier to the sludge holding pond and on to the sludge drying beds. One (1) pump shall have a capacity of 60 m^3 /hr while the second pump shall have a capacity of 30 m^3/hr.

  - Contractor shall purchase and provide a total of 100 meters of 6" flexible suction (vacuum) pipe and 200 meters of 6" flexible pressure pipe for use in sludge handling operations.

- Miscellaneous Repairs to Existing Facilities

  - Contractor shall be responsible for evaluation, testing, and repair of all existing treatment plant, reuse, and discharge facilities to assure the MOG that all new and existing facilities are functional and compatible to provide treatment, reuse, and discharge capacity as designed. These evaluations shall include physical, mechanical, and electrical components. The objective is to assure a workable plant.

- Facility Lighting and Fencing

  - Contractor shall purchase and install a minimum of six (6) 10 to 15 meter by 15 cm diameter light poles and place them at strategic locations throughout the treatment works to assure adequate lighting for employee safety and plant operations.

- Contractor shall purchase and install up to four (4) 1000 watt high pressure sodium fixtures each directed at key operational locations throughout the plant. Contractor is responsible for providing sufficient (estimated 500 meters) electrical cable to power and switch the lights.

- Contractor shall purchase and install sufficient (estimated 1200 meters) woven wire fencing to secure the perimeter of the upgraded and improved treatment facility.

- Dike/Levee Strengthening

  - Contractor shall evaluate, test, and rehabilitate as required all levees and/or dikes within the treatment plant to assure the safety and structural stability of the ponds. Dike rehabilitation may be accomplished through hydraulic equalizing, ramming, recompacting with clay or bentonite additives, or by lining to prevent wind and/or water erosion, undermining, or breeching of any dike or levee.

- Recharge Basins

  - Contractor shall evaluate and rehabilitate the three(3) recharge basins adjacent to the UNDP reuse facility with the objective to accommodate an effluent spreading rate of up to 1.0 meter/day of treated effluent from the GWWTP and up to 20,000 m^3/day of infiltration on an annual basis.

- Booster Pump Station

  - Contractor shall rehabilitate the existing booster pump station (P.S. #2) on the UNDP reuse and irrigation system. The existing four (4) 550 m^3/hr pumps shall be serviced and placed in operating condition. The existing electric control panel and all other mechanical/electrical components shall be renovated, tested and placed in operating condition.

- Wadi Gaza Discharge Line

  - Contractor shall purchase and install (replace) approximately 1.0 km of 16 inch (400mm) UPVC pipe. This pipe replaces an existing 12 inch AC pipe on the irrigation/discharge system from the booster pump station. A connection fitting shall be provided and installed to transition the existing 16" AC line to this newly installed 16" UPVC line.

- Storage Tank Waterproofing

- Contractor shall apply a waterproofing sealant to all interior surfaces of the existing UNDP constructed 5000 m^3 storage tank in sufficient quantities to minimize leakage into and/or through the concrete walls.

- Valve Rehabilitation

  - Contractor shall provide all supplies, material, labor and equipment required to remove, rehabilitate, service, and reinstall all valves 4 " (100 mm) and larger. It is estimated that there are approximately fifteen (15) valves from 18" to 22" and an additional ten (10) valves of 16" or smaller size.

- Monitoring Wells

  - Contractor shall bore and develop six (6) shallow (approximately 30 meters) 4 " diameter monitoring wells at or along the reuse/recharge basins and agricultural areas.

  - Contractor shall provide the MOG two (2) sets of sampling equipment necessary to measure and monitor aquifer change related to the recharge program, including water chemistry and hydrology.

For payment purposes Task #4 - Construction Program has been divided into six specific and discrete sub-elements for which the contractor will receive payment provided he/she satisfactorily and completely finishes the sub-unit to its operational state. These sub-units are:

4a - Mobilization
4b - Pond # 1A
4c - Trickling Filters
4d - Aeration Pond/System
4e - Pond #4 reconstruction & Sludge Beds
4f - Pumping Stations
4g - Recharge/Reuse/Discharge
4h - Purchase and Delivery to an appropriate Israeli Port U.S. Manufactured materials and Equipment

C.4.(c)(4)(bb) Deliverables: The existing Gaza Municipal Wastewater Treatment Plant, including reuse facilities, upgraded and expanded, in service, and fully functional. Deliverables can be delivered by sub - units as described above.

C.4.(c)(4)(cc) Special Resources: Provisional sum of $4,800,000.

C.4.(c)(4)(dd) Performance Measure: For Item 4a the measure is a USAID approved Contractor design, construction schedule and mobilization plan. For Item 4h the measure is a USAID

accepted, Contractor provided, Certified true cost Invoice/Bill of Lading detailing the specific pieces of equipment and material delivered to an appropriate Israeli Port and certification that the material has been delivered to subject Port. For Items 4b through 4g the measures are Field Tests conducted by Contractor to demonstrate that the wastewater treatment and disposal facilities can treat and dispose of wastewater from the City of Gaza in a satisfactory manner and that pipelines, storage tanks, and treatment units have passed all leakage tests.

C.4.(c)(4)(ee) Special Requirement: All major mechanical units and associated controls shall be of U.S. manufacture, unless otherwise agreed in writing by USAID.

C.4.(c)(5) Task 5 - Operation and Maintenance

C.4.(c)(5)(aa) Description: The Contractor shall develop a program of operation and maintenance, to be implemented by the City of Gaza, for the wastewater treatment facilities (including existing components) and the reuse facilities (including existing components). The operation and maintenance program will include the following:

- Manual of Standard O&M Procedures for the Treatment Facilities

Manual (5 copies) containing an operations and maintenance program for the wastewater treatment facilities. The manual shall provide an overview of the wastewater treatment process. The manual will explain in detail the function of each unit. The manual shall include a recommended reporting program and contain suggested reporting forms. The manual will include a series of simplified standard operations, maintenance, and safety procedures and a troubleshooting guide for common problems. The manual shall be in both English and Arabic. Standard procedures, to the maximum extent practicable, shall be pictorial and complemented with standard symbols. Procedures shall include identification of the tools and equipment required, any expendable materials needed, applicability of the procedure, recommended frequency of the procedure, safety cautions, estimated time to perform, categories of personnel designated to perform the procedure, and step-by-step illustrations. Standard procedures and reporting forms shall be available in plastic card versions (5 sets) as well as bound with the manual. At a minimum, the standard procedures shall cover the following:

- Gate Valves
- Check Valves
- Pressure Regulators
- Hydrostatic and Leakage Tests
- Pump Inspection
- Replacing Pump Packing
- Electric Motors
- Electrical Systems
- Instrumentation and Controls
- Screening Unit

- Anaerobic Lagoons
- Aerated Lagoon
- Trickling Filter Towers
- Settling Pond
- Sludge Holding Lagoon
- Disinfection (Bromine) System
- Flow Measurement
- Trickling Filter Pump Station
- Effluent Pump Station No. 1
- Treatment Plant Record keeping

- Manual of Standard O&M Procedures for the Recharge and Reuse Facilities

Manual (5 copies) containing an operations and maintenance program for the recharge and reuse facilities. The manual shall provide an overview of the aquifer recharge and agricultural irrigation system, including discharges and/or emergency overflows to Wadi Gaza. The manual will explain in detail the function of each system component. The manual shall include a recommended reporting program and contain suggested reporting forms. The manual will include a series of simplified standard operations, maintenance, and safety procedures and a troubleshooting guide for common problems. The manual shall be in both English and Arabic. Standard procedures, to the maximum extent practicable, shall be pictorial and complemented with standard symbols. Procedures shall include identification of the tools and equipment required, any expendable materials needed, applicability of the procedure, recommended frequency of the procedure, safety cautions, estimated time to perform, categories of personnel designated to perform the procedure, and step-by-step illustrations. Standard procedures and reporting forms shall be available in plastic card versions (5 sets) as well as bound with the manual. At a minimum, the standard procedures shall cover the following:

- Gate Valves
- Check Valves
- Pressure Regulators
- Hydrostatic and Leakage Tests
- Pump Inspection
- Replacing Pump Packing
- Electric Motors
- Electrical Systems
- Instrumentation and Controls
- Effluent Pump Station No. 2
- Rapid Infiltration Basins
- Storage Tanks
- Irrigation System
- Shallow Monitoring Wells
- Flow Measurement

- Recharge and Reuse Facilities Record keeping

- A tranche of Spare Parts designed to assure the safe and efficient operation of the Works for a two year period. Special attention to be given to all pumps, valves, controls and other major pieces of mechanical/electrical equipment.

C.4.(c)(5)(bb) Deliverables: A complete program for the operation and maintenance (O&M) of the wastewater treatment and disposal facilities available to the Municipality of Gaza. This program will be evidenced in the form of four major deliverables:

- Manual of Standard O&M Procedures for Wastewater Treatment Facilities
- Manual of Standard O&M Procedures for Wastewater Recharge and Reuse Facilities
- Completion of a USAID/MOG approved testing and training program sufficient to assure safe and efficient operation of the Plant and associated Works.
- Delivery of a USAID approved tranche of spare parts and materials sufficient to assure safe and efficient operation of the Works for a two year period.

C.4.(c)(5)(cc) Special Resources: None.

C.4.(c)(5)(dd) Performance Measure: The MOG has a basis for an O&M program in place for ensuring the continued satisfactory operation of the wastewater treatment and disposal facilities serving the City of Gaza.

C.4.(c)(5)(ee) Special Requirements: None.

C.5. PROGRESS MONITORING

C.5.(a) Summary

Inherent to every task under this Contract is performance monitoring. The Contractor will keep the COTR and the MOG fully informed as to the status of all activities during the life of the Contract. No separate payment will be made for performance monitoring as such work will be deemed an integral part of completing the tasks included under this Contract.

C.5.(b) Monthly Progress Meetings

Not less than monthly, the Contractor will conduct progress meetings to inform USAID, the MOG, the construction subcontractors, and other involved parties as to progress towards accomplishing the tasks, to coordinate activities, and to identify major issues impeding the progress of the works.

C.5.(c) Monthly Progress Reports

On a monthly basis, the Contractor will submit progress monitoring reports which will serve as the principal performance monitoring tool under the Contract. The format and content of the reports shall be as proposed by the Contractor as part of a technical proposal or during negotiations and approved by USAID. Performance will be evaluated with reference to the followings questions:

- Is the progress towards completion of each task sufficient, such that there is a reasonable expectation that the task will be completed on time?

- Is the quantity and quality of information and analysis developed under each task adequate to permit fully informed decision-making, with solid technical support?

- Is the information and analysis developed under each task presented in a manner that is appropriate to policy-makers, their technical staff, and technical personnel who will use the data?

- Is the information needed to evaluate progress towards completing each task readily provided by the Contractor, in a format which is easy for USAID and the MOG to evaluate?

END SECTION C
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For inclusion in Section D:

Where not otherwise specified herein, the Contractor shall deliver not less than five (5) copies of all studies, reports, specifications, procedures, procurement documents, manuals, maps, drawings, and similar written and illustrated documents identified in the Contract as a deliverable or other submittal. In addition, the Contractor shall deliver an electronic version (Wordperfect Version 5.2 or other approved format) on computer disks for all written deliverables.

For inclusion in Section H:

In the case of specific deliverables under the construction program, the decision has been made to have a greater restriction of the acceptable Source and Origin requirements as stated in Section C. USAID reserves the right to alter the source and origin requirements as political circumstances dictate.

For inclusion in Section H:

USAID agrees to approve the design report within ten (10) days of receipt provided that the Contractor coordinates activities closely with USAID during the development of the design report and routinely submits incomplete draft sections of the report during the preparation of the final design report. Similarly, USAID agrees to approve procurement documents for construction services within ten (10) days of receipt provided that the procurement documents are in full compliance with the design report, the Contractor coordinates activities closely with USAID during the development of the procurement documents, and the Contractor routinely submits incomplete draft sections of the procurement documents during the preparation of same.

Conceptual and Relevant Reports

The Gaza Wastewater and Stormwater Project Master Plan - Analytical Studies (Interim Report), Metcalf & Eddy International, Inc., December 1996

Sewerage and Drainage in Beach Camp, Gaza Town Area, Feasibility Study, United Nations (UNRWA) by DHV Consultants, The Netherlands, 1993

Evaluation, Conceptual Design and Terms of Reference Report for GWWTP, MSI Consultants, USA, 1997

[9]Addnl.. Reqd.--Defined as additional work required for operation at 16,000 m^3/day