INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C. 20523

# PROJECT PAPER

# OMAN: Water Resources Development Project (272-0104)

October 2, 1986

AGENCY FOR INTERNATIONAL DEVELOPMENT

# PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: _____ — DOCUMENT CODE: 3

2. COUNTRY/ENTITY: SULTANATE OF OMAN

3. PROJECT NUMBER: 272-0104

4. BUREAU/OFFICE: Asia Near East (ANE) — 27

5. PROJECT TITLE (maximum 40 characters): Water Resources Development Project

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 92

7. ESTIMATED DATE OF OBLIGATION (Under "B." below, enter 1, 2, 3, or 4): A. Initial FY 86 — B. Quarter 4 — C. Final FY 90

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

| A. FUNDING SOURCE | FIRST FY 86 | | | LIFE OF PROJECT | | |
|---|---|---|---|---|---|---|
| | B. FX | C. L/C | D. Total | E. FX | F. L/C | G. Total |
| AID Appropriated Total | 14556 | | 14556 | 75000 | | 75000 |
| (Grant) | ( - ) | ( ) | ( ) | ( ) | ( ) | ( ) |
| (Loan) | ( 14556 ) | ( ) | ( 14556 ) | ( 75000 ) | ( ) | ( 75000 ) |
| Other U.S. 1. | | | | | | |
| Other U.S. 2. | | | | | | |
| Host Country | | | | 201000 | | 201000 |
| Other Donor(s) | | | | | | |
| TOTALS | 14556 | | 14556 | 276000 | | 276000 |

9. SCHEDULE OF A[illegible]UNDING ($000)

| A. APPROPRIATION | B. PRIMARY PURPOSE CODE | C. PRIMARY TECH. CODE 1. Grant | C. PRIMARY TECH. CODE 2. Loan | D. OBLIGATIONS TO DATE 1. Grant | D. OBLIGATIONS TO DATE 2. Loan | E. AMOUNT APPROVED THIS ACTION 1. Grant | E. AMOUNT APPROVED THIS ACTION 2. Loan | F. LIFE OF PROJECT 1. Grant | F. LIFE OF PROJECT 2. Loan |
|---|---|---|---|---|---|---|---|---|---|
| (1) ESF | 700 | 700 | 700 | | | | 14556 | | 75000 |
| (2) | | | | | | | | | |
| (3) | | | | | | | | | |
| (4) | | | | | | | | | |
| TOTALS | | | | | | | 14556 | | 75000 |

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 280

11. SECONDARY PURPOSE COD: 780

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

| A. Code | | | | | | | |
|---|---|---|---|---|---|---|---|
| B. Amount | | | | | | | |

13. PROJECT PURPOSE (maximum 480 characters)

Improve the capability of key water resources institutions necessary to plan, develop and manage Oman's limited water resources in a rational and coordinated manner, and to strengthen institutions and physical facilities which provide domestic water supplies and wastewater disposal in the Capital Region and selected towns and villages in northern Oman.

14. SCHEDULED EVALUATIONS: Interim MM 01 YY 88 — MM 01 YY 90 — Final MM 10 YY 92

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

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

17. APPROVED BY — Signature: F. Gary Towery — Title: U.S. AID Representative to Joint Oman-U.S. Commission — Date Signed: MM 07 DD 22 YY 86

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

OMAN

WATER RESOURCES DEVELOPMENT PROJECT

PROJECT PAPER

TABLE OF CONTENTS

## ABBREVIATIONS

### Organizations

| | |
|---|---|
| CCEPP | Council for the Conservation of the Environment and the Prevention of Pollution |
| CCEWR | Council for the Conservation of the Environment and Water Resources |
| Diwan | Diwan of Royal Court Affairs Directorate General of Technical Affairs |
| MAF | Ministry of Agriculture and Fisheries |
| MEW | Ministry of Electricity and Water |
| MEWR | Ministry of Environment and Water Resources |
| MRM | Ministry of Regional Municipalities |
| PAWR | Public Authority for Water Resources |
| WRC | Water Resources Council |

### Measurements

| | |
|---|---|
| ha. | Hectaires |
| m3 | Cubic meters |
| MCM | Million cubic meters |
| mg | Milligrams |
| mg/l | Milligrams per liter |
| Ml/d | Million liters per day |
| m3/ha/yr | Cubic meters per hectaire per year |
| TSP | Total disolved solids |

### Other Terms

| | |
|---|---|
| Falaj | Ancient irrigation system |
| Aflaj | Plural of Falaj |

### Exchange Rate

One Rial Omani (R.O.) = U.S. $2.60
One U.S. Dollar = Rial Omani .385

## I. SUMMARY AND RECOMMENDATIONS

A. Project Title

Water Resources Development - Phase I

B. Project Number

272-0104

C. Source of Funds

Economic Support Fund

D. Project Amount

| | Total | AID ($ million) | Oman |
|---|---|---|---|
| Total | 276 | 75 | 201 |
| Phase I | 186 | 15 | 171 |
| Phase II | 90 | 60 | 30 |

E. Terms

Loan repayable in twenty (20) years from the date of first disbursement, including a grace period of not to exceed five (5) years. Interest is payable from the date of first disbursement of the loan at the rate of five (5) percent per annum on the outstanding disbursed balance of the loan and on any due and unpaid interest accrued thereon.

F. The Borrower

The Government of the Sultanate of Oman. The Ministry of Electricity and Water will be the executing agency.

G. Life of Project

6 years: PACD 9/30/92

H. Project Goal

To provide a safe and reliable supply of water sufficient to meet the needs of the people of Oman and the planned development of the country.

I. Project Purpose - Phase I

To strengthen and improve the water system in the Capital Region through the design and construction of urgently needed improvements and the preparation of studies for the long term development of water and wastewater facilities.

J. Project Summary

The total project consists of three subprojects. Phase I of the project will finance a part of Subproject 2. Phase II will finance Subprojects I and III and the balance of activities under Subproject II.

Subproject I will strengthen the capacity of the Government of Oman to manage and develop its water resources and augment the country's water resource. Under this subproject a National Water Resources Strategic Plan will be prepared and a planning unit developed to support the Council for the Conservation of the Environment and Water Resources (CCEWR) which has the authority to regulate water resources. High priority water resources augmentation schemes identified in the strategic plan (e.g. aquifer recharge dams) will be undertaken.

Subproject II will strengthen the Capital Region water and wastewater systems through planning, design, construction and institutional development. This subproject will be undertaken in two phases. Phase I of the project consists of the design and construction of immediately required improvements in the Capital Region water system. These improvements fall into two categories: the addition of water sources and the strengthening and expansion of the transmission system. The A.I.D. loan will finance engineering services for design and supervision of construction. The Government of Oman will finance a portion of the cost of engineering services and 100 percent of the cost of construction.

Also under Phase I, a masterplan for water and wastewater facilities will be prepared to provide a long term plan for infrastructure development. It will make recommendations with regard to the organization of institutions, tariffs, accounting, training, etc.

In Phase II, the subproject will provide technical assistance to implement the institution building recommendations of the masterplan. Any improvements in the water system not financed in Phase I will be completed in Phase II.

Subproject III will explore ways to provide integrated water and wastewater facilities in towns and villages by designing, constructing and evaluation pilot activities. The institutional aspects of town and village water and wastewater will also be studied. Technical assistance and training to implement recommendations is included in the subproject.

K. Summary Findings

The project addresses the needs of Oman's most critical sector. It seeks to deal with a number of critical constraints on the development and utilization of the country's scarce water resources. Studies during the design process indicate that the choice of interventions is technically, economically, environmentally and socially sound. Wherever possible, least cost analyses have been conducted. In addition, the project includes a number of studies. The scopes of work for these have been written to ensure that analyses of technical, economic, environmental and social factors will be carried out.

L. Environmental Soundness of the Project

The project has been reviewed by the ANE Environmental Coordinator who participated in drafting the analysis of the project in Section VII.C. Adequate provisions have been incorporated into the project to assure that it will comply with the requirements of 22 CFR 16, A.I.D. Environmental Procedures.

M. Statutory Criteria

The Project meets all applicable statutory criteria and certifications (See Annex A).

N. Recommendations

That life-of-project funding of $75 million in loan funds be authorized to finance the Water Resources Development Project and a loan $14,556,000 be obligated in FY 1986 to finance Phase I of the project.

PROJECT COMMITTEE

Omani-American Joint Commission

Chairman: David H. Mandel, Assistant U.S. Representative
F. Gary Towery, U.S. Representative
Edvard Markeset, Chief Engineer
Anjab Sajwani, Project Officer
Douglas Robertson, Regional Legal Advisor
Mark Kraczkiewicz, Regional Economist

AID/Washington TDY Assistance

ANE/PD, Monica Sinding, Project Officer
ANE/PD, Stephen F. Lintner, Environmental Coordinator
S&T/H, Pamela Johnson, Social Analysis and Evaluation

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D C 20523

ASSISTANT
ADMINISTRATOR

SEP 15 1986

PROJECT AUTHORIZATION

Name of Country/Entity: Sultanate of Oman

Name of Project: Water Resources Development

Number of Project: 272-0104

1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Water Resources Development Project (the "Project") for the Sultanate of Oman involving planned obligations of not to exceed Seventy Five Million United States Dollars ($75,000,000) in loan funds over a five-year period from date of authorization, subject to the availability of funds in accordance with the AID OYB/allotment process, to help in financing the foreign exchange and local currency costs for the Project. The planned life of the Project is seven (7) years from the date of initial obligation.

2. The Project consists of three subprojects. Subproject I will strengthen the capacity of the Government of Oman to manage, augment and develop the country's water resources and develop a national water resources strategic plan. Subproject II will design and construct improvements in the existing water system and prepare long term plans for the development of water and wastewater infrastructure and institutions in the capital region. Subproject III will design, construct and evaluate pilot water and wastewater facilities in a selected group of towns and villages.

3. It is anticipated that the total authorized Project level will be obligated in increments. Prior to the obligation of funds for Subproject I, the A.I.D. Representative to the Omani-American Joint Commission, in consultation with cognizant AID/W offices, shall certify that the Ministry of Environment and Water Resources and the Council for the Conservation of the Environment and Water have been granted those authorities which he deems are sufficient to enable the Ministry and the Council to carry out the objectives of Subproject I. Prior to the obligation of funds for Subproject III, the A.I.D. Representative to the Omani-American Joint Commission, in consultation with cognizant AID/W offices, shall ensure that the requirements of Section 611 of the Foreign Assistance Act of 1961, as amended, have been satisfied with regard to such Subproject.

4. The Project Agreement which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

5. Terms and Conditions

a. Interest Rates and Terms of Repayment

The Sultanate of Oman shall repay the loan to A.I.D. in United States dollars within twenty (20) years from the date of the first disbursement of the loan, including a grace period of not to exceed ten (10) years. The Sultanate of Oman shall pay to A.I.D. in United States dollars interest from the date of first disbursement of the loan at the rate of three percent (3 percent) per annum for the first five years, four percent (4 percent) per annum for the next five years and six percent (6 percent) per annum during the ten year amortization period. Interest shall be calculated on the outstanding disbursed balance of the loan and on any due and unpaid interest accrued thereon.

b. Source and Origin of Commodities and Nationality of Services

Commodities financed by A.I.D. under the Project shall have their source and origin in the Sultanate of Oman or the United States, except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of commodities or services shall have the Sultanate of Oman or the United States as their place of nationality, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

c. Additional Condition Precedent for Specific Disbursements

Prior to any disbursement under the loan, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, for each services contract to be financed with the proceeds of the loan, the Borrower shall furnish to A.I.D.in form and substance satisfactory to A.I.D., except as A.I.D. may otherwise agree in writing, a signed contract for such services.

d. Covenants

(1) Project Evaluation

The Sultanate of Oman agrees to establish an evaluation program as part of the Project. Except as the Parties otherwise agree in writing, the program will include, during implementation of the project and at one or more points thereafter: (a) evaluation of progress toward attainment of the objectives of the Project; (b) identification and evaluation of problem areas or constraints which may inhibit such attainment; (c) assessment of how such information may be used to help overcome such problems; and (d) evaluation, to the degree feasible, of the overall development impact of the Project.

(2) Water Resources Development Project

The Parties recognize that this Agreement represents the initiation of the Water Resources Development Project. The Parties agree to work together to define the goals and objectives of the Project, develop detailed plans and budgets for implementation of the Project, and establish the necessary coordinating bodies to supervise implementation of the Project.

Charles W. Greenleaf, Jr.
Assistant Administrator
Bureau for Asia and Near East

9/15/86
Date

## III. PROJECT BACKGROUND AND RATIONALE

### A. Introduction

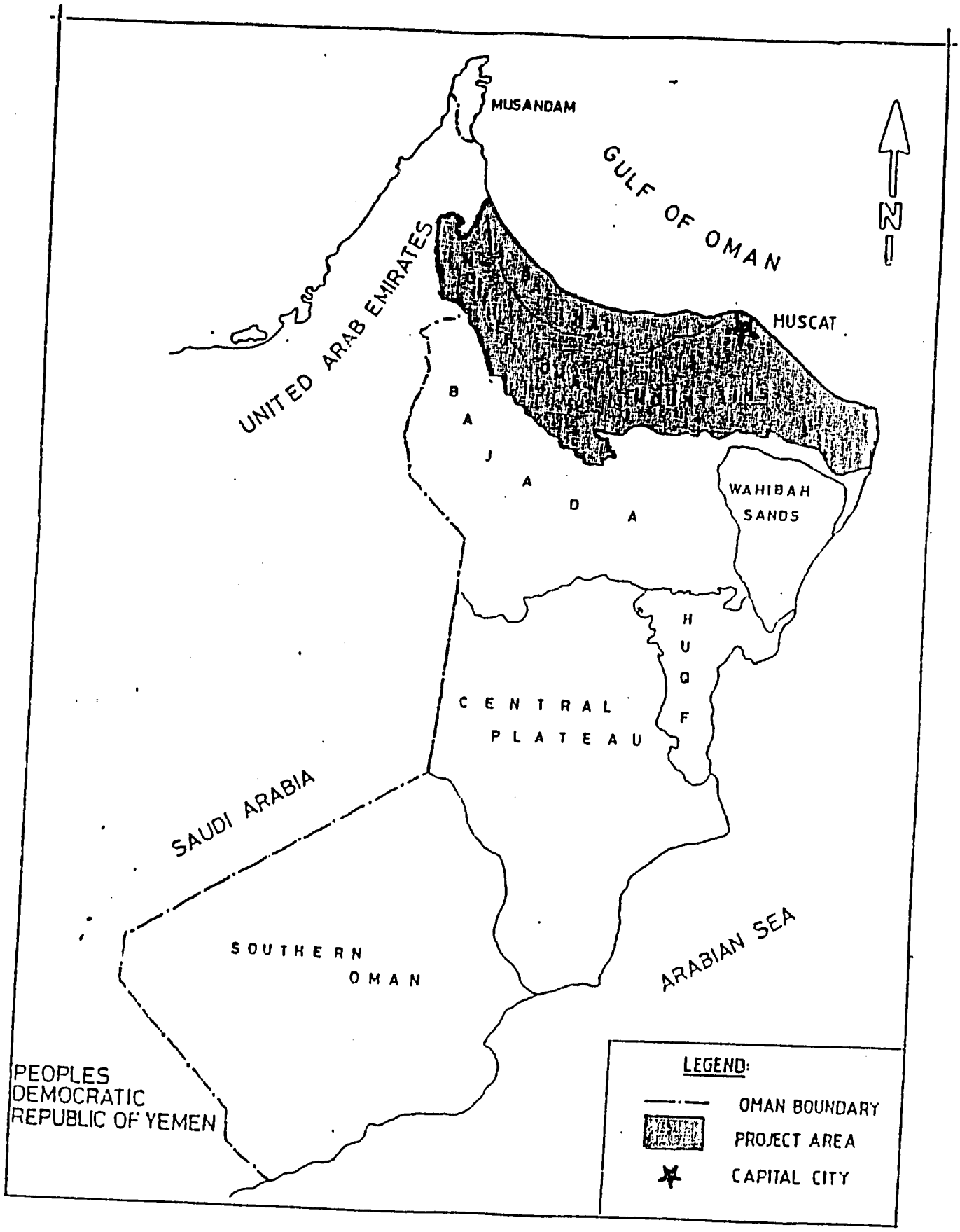
#### 1. Physical Setting

Oman is located on the southeastern edge of the Arabian Peninsula with a detached portion of the country on the Straits of Hormuz. No census of population has been taken in Oman. Estimates range from one to two million people. There are approximately 350,000 expatriates in the country. It has a land area of approximately 300,000 sq. kms. (115,800 sq.miles) which is about equal to the state of Colorado. The country is broken down into three large regions - the Dhofar in the south, a large expanse of desert wasteland in the central portion of the country and northern Oman. The latter is a geologically complex area and consists of several distinctive sub-regions, including the Batinah Plains on the coast along the Gulf of Oman, the mountains behind the plain known as Jebal Akhdar, and the interior region behind the mountains. In addition there are two small regions separated from northern Oman - Buraimi which is an oasis area in the desert between Oman and the United Arab Emirates and Musandam, the detached piece of land which forms one side of the Straits of Hormuz.

The project focusses on Northern Oman and the Capital Region excluding Buraimi and Musandam. Economic development in the latter two areas and the Dhofar are under the direction of special regional development committees which have their own budget and staff of expatriate experts. Activities under the project which have a national scope will first focus on northern Oman. Map 1 identifies the project area.

Northern and interior Oman are extremely arid, with very low and erratic rainfall. The climate in these areas has two characteristic periods: November-April brings northwest winds, while June-September brings monsoon winds from the southeast. Occasionally heavy rains will occur in the monsoon season. However, in northern Oman rainfall to recharge aquifers is infrequent at best. Mean annual rainfall ranges from about 300 mm (12 inches) in limited mountainous areas to about 100 mm (4 inches) along much of the coast line. In the period from 1976 to 1981, annual rainfall at Seeb, in the Capital Region, varied from 4 to 183 mm. From 1981 until just a few months ago virtually no rain fell, creating severe drought conditions in many parts of the country. Several periods of rain occurred during February-March 1986 which were sufficient to cause recharge in a few areas of the country. However, these rains were not sufficient to end the period of drought.

The southern-most portion of Oman, the Dhofar Region, receives annual monsoon rains in July and August, making it quite different from the rest of Oman.




MAP 1 - PROJECT AREA

## 2. Economic Setting

Prior to 1970, Oman was an isolated, undeveloped country, resisting efforts to modernize, with most of its population engaged in agriculture and fishing. Physical infrastructure was almost totally lacking. Health, education and other social services were virtually non-existent. Fifteen years under the leadership of His Majesty, Sultan Qaboos bin Said, combined with the revenue from oil have brought striking changes in the country. Oman is now tied together by an extensive network of roads and a modern telecommunications system. The number of schools and students has risen dramatically. Health services are widely available.

Oman has proven oil reserves of about 4 billion barrels which can last for about 22 years at the current rate of production of 550,000 barrels per day. By the standards of its Gulf neighbors, Oman has relatively little wealth. Oman's economic challenge is to complete the building of its infrastructure, diversify its economy, and train its people to run the country before its oil income is no longer available. The recent sharp decline in oil prices has demonstrated the importance of these tasks, while making it more difficult for Oman to continue developing as rapidly as it has in the past.

The Commission's efforts to obtain financial commitments for the project coincided with the oil price decline which has thrown the Government's finances into disarray. The estimates of the financial resources available for the Third Five-Year Plan sectoral allocations which had been issued are being revised to take into account the reduced resources which will be available over the next several years. Also as a result of the current financial situation, the ministries' operating expense budgets have been cut to an absolute minimum for 1986.

## 3. Agriculture Setting

The Ministry of Agriculture and Fisheries estimates that 40,000 to 45,000 HA (hectares) of land have been developed for agricultural purposes. All agriculture requires irrigation. Flood irrigation using open channels is most common. Average crop production utilizes approximately 15,000 M3/HA/yr. (cubic meters) of water while alfalfa uses 25,000 M3/HA/yr. The predominant crop is dates with groves on 50% of agricultural land, followed by mangos, bananas, limes and alfalfa. Miscellaneous crops such as vegetables and tobacco comprise about 8% of the land used for agriculture. Most of the recent agricultural development has been in the Batinah Plain, which has approximately 27,000 HA of land. Several large commercial farms producing vegetables, dairy products and eggs have been established in this area. In some areas, there appears to be a shift away from traditional crops to vegetables, resulting in seasonal surpluses. Range-fed livestock, dominated by goats, is also a major factor in agriculture.

## 4. Health Setting

Over the past 15 years the Government of Oman has placed great emphasis on the construction of a health infrastructure. There are now 163 health facilities ranging from small rural health centers to larger hopsitals. As a result, good quality health care is available to most of Oman's population. Although the emphasis within the health sector has been curative, preventative health programs are being mounted rapidly, especially in the area of child health. The Government has instituted programs for malaria control, immunization, the prevention of blindness, tuberculosis and, more recently, oral rehydration therapy (ORT).

In February, 1986, the Joint Commission brought a Child Health Team to Oman to study the current situation and make recommendations for a five year plan for child survival. The team was headed by Dr. David Sencer, retired Commissioner of Health of New York City, and included Dr. Stanley Foster of Centers for Disease Control (CDC). The team found that the health of Omani children is undoubtably far better than most current statistics would indicate:

> The Sultanate has obviously made spectacular gains in the past five years in improving child survival as reflected in the observations by all members of the Team. The published figures for the Sultanate indicate that the IMR (infant mortality rate) was 115 (per 1000) in 1983. The team estimated that the IMR is actually closer to 60."

In fact, follow-on work has shown the estimated rate to be about 45, due to recent programs in immunization and ORT. However, this rate can be further reduced through nutritional and sanitation programs.

In examining the causes of infant mortality, the team made the following statement:

> One will not expect a great reduction in the actual occurrence of diarrheal desease, until there is a great improvement in local sanitation and abundant clean drinking water. Therefore, the morbidity that one measures in determining the effectiveness of a diarrheal control program is the reduction in severe dehydration.

Oman has succeeded in sharply reducing deaths due to diarrheal diseases by curative measures. It has not yet treated the cause of diarrheal disease, unsafe water supplies.

## B. The Water Resources Sector

### 1. Introduction

The Batinah coast of northern Oman has been populated for many centuries. Omanis have also fished and farmed the land along the coastal plain using dug wells to provide water. In the mountains above the plains, naturally occurring groundwater resources have been tapped for nearly two thousand years through the use of the ancient falaj system of irrigation, which provides water to support community living and agriculture. As a result, the people of Oman have been accustomed for centuries to living in a green and pleasant oasis environment of gardens and date palms.

Until recent times, Oman's water resources have met all demands made upon them, largely because the simple and undemanding means of extraction used were adequate to meet the needs of the people. The level of extraction of groundwater was essentially in balance with natural replenishment. Thus the falaj systems and shallow, hand dug wells were adequate.

Since Sultan Qaboos bin Said came to power in 1970, Oman has undergone rapid and diversified growth. Buoyed by its oil revenues and in response to a change in government policy encouraging the development of the municipal, industrial and agricultural sectors of the economy, the government has made large investments in basic infrastructure, as well as encouraging a growing role for private enterprise. Such rapid development in an arid climate inevitably places strains on the crucial and limited resource of water.

As a result of the rapid growth of Oman and the introduction of modern means of water extraction, the country's limited water resources are being strained to meet growing demand. The results differ in different areas of the country. In some parts (e.g., the Batinah coast and Capital Region, which are the most heavily populated areas of Oman) water supplies are being degraded by overpumping which is causing rising salinity levels. Large- and small-scale seawater desalination is being used in many parts of the country to supplement natural water supplies, and in some parts of the country desalinated water is the primary source. In other parts of the country, aquifers are being mined or overpumped, though long term negative effects are not yet visible to the populace.

### 2. The Institutional Framework

Oman's critical water situation is attributable in large measure to major institutional deficiencies. In particular, there is a lack of coordination among or control over the large number of organizations with responsibilities for water or wastewater. The proliferation of institutions with sectoral responsibilities reflects the absence of a national water policy addressing the development and use of water resources and the collection, treatment and re-use of wastewater. At least nineteen central

government organizations have an impact on some aspect of water or wastewater in Oman. Most of them work independently, without clear guidance or a common goal.

Until recently, six principal organizations were considered critical to the Joint Commission's effort to develop a water resources project. They are:

a. The Water Resources Council (WRC), the supreme body responsible for water resources policy in Oman;

b. The Public Authority for Water Resources (PAWR), the technical and administrative support arm of the WRC;

c. The Ministry of Electricity and Water (MEW), which is responsible for providing water to municipalities throughout Oman, including the Capital Region;

d. The Ministry of Agriculture and Fisheries (MAF), which is responsible for providing water to the agricultural sector and, until recently, had principal responsibity for developing water resources;

e. The Directorate General for Technical Affairs, the operating arm of the Diwan of Royal Court Affairs, responsible for collecting, treating, and disposing of wastewater in the Capital Region; and

f. The Ministry of Regional Municipalities (MRM), which is charged with providing and managing wastewater collection and disposal facilities in all cities and towns outside the Capital Region.

In January, 1986, the Government underwent a partial reorganization. The following important changes in the management of water resources have taken place:

- The Ministry of Environment has been assigned responsibility for the management of Oman's water resources and has been re-titled the Ministry of Environment and Water Resources (MEWR);

- The WRC and the Council for the Conservation of the Environment and Prevention of Pollution (CCEPP) have been combined into a new Council for the Conservation of the

Environment and Water Resources (CCEWR) with a reconstituted membership and all the powers of the two predecessor councils;

- The Minister of Environment and Water Resources has been named Vice President of the new council (the Sultan is President), replacing the Minister of Agriculture and Fisheries as the head of the WRC and the Minister of Communications as the head of the CCEPP.

In June, 1986 a decree was issued which formally attached PAWR to the CCEWR. The Minister for Environment and Water Resources replaced the Minister for Electricity and Water as the President of PAWR.

These changes have the potential to have a significant impact on the water resources sector and this project. A major underlying assumption of the project is that the Government would create a strong central authority for the management and control of water resources. The changes described above are a positive move in this direction

## 3. The Water Resources Situation

### a. Outside the Capital Region

Very limited perennial surface water resources occur at the higher elevations in the northern Oman mountains and in the upstream portions of the piedmont zone (the area between the coastal plan and higher mountains) of the Batinah. For centuries, these streams and springs have been developed to provide water for villages and small population centers through the falaj system. Flow rates during the year, however, are quite variable and the total volume of surface flow is relatively low.

Groundwater is the principal water resource of the country. The bulk of the water demands in Oman are met by extracting groundwater by hand-dug or drilled wells. It is recharged principally by percolation of surface flows in wadis (normally dry washes) resulting from rainfall in the upper elevations. Percolation from direct rainfall is considered insignificant. Certain coastal areas of the Batinah, generally north of Muscat, are underlain by unusable ground water of high salt content. In part, this is a natural phenomenon when the groundwater level drops due to a lack of recharge, but overpumping, especially of wells located near the coast, is also contributing to a high rate of seawater migration. Agricultural return flows can also degrade water quality, as salts in the soil are dissolved and leached to the underlying groundwater by irrigation water when applied in excess of the amount required for crop production.

In the rural areas of Oman, life is based on the falaj system which provides irrigation for agriculture and water for domestic water supplies. (For more details on al-Falaj systems refer to Annex K.) Along the Batinah Coast and the flat plains of the interior, cultivation is characterized by the use of generally shallow hand-dug wells equipped with gas or diesel driven centrifugal pumps. Most of the fishing villages along the coast get drinking water from small desalination units or by tanker.

In the mountainous areas, aflaj (plural of falaj) have provided communities with water for irrigation and domestic purposes for over fifteen centuries. In some places, surface flows from springs or in the alluvium of wadis are intercepted by small dams and diversion structures and conveyed to nearby villages in open channels. In other places tunnels intersect the hydraulic grade line of the ground water upstream of the village and bring it to the surface by gravity. Well established social and financial structures addressing the operations and maintenance of the falaj have evolved and contributed to their longevity. Typically, the uppermost access point is set aside for the collection of drinking water, with successively lower points designated for the mosque, bathing, washing of cooking and eating utensils, and finally irrigation.

Current agricultural practices utilize surface flood irrigation methods which are relatively inefficient if one looks at the relationship between the amount of water pumped from the sources and the amount actually used by crops or lost by evaporation. Efficiency defined in these terms is estimated at between 25 and 40 percent. Evaporation is estimated at 10 to 15 percent. The unutilized water returns to the aquifer either through seepage from the conveyence system or as deep percolation and may be available for reuse downstream. To the extent that the water percolating through the soil leaches out salts, there is some degradation of water quality. Also, if the underlying aquifer is of poor quality, the water may be lost for further use. Annex L gives further details on agricultural water use.

PAWR estimated water demands for the 20,000 to 25,000 HA of agricultural lands in the Capital Area, along the Batinah Coast, and in the Northern Oman Mountains at about 1,200 million cubic meters (MCM) in 1982. Approximately 75 percent was delivered by aflaj; the balance was obtained from wells constructed primarily in the Batinah. (For planning purposes, MAF uses a value of 13,000 M3/HA/yr. assuming a representative crop pattern although other estimates indicate the figure should be 15,000 M3). Water demand in the non-agricultural sectors is believed to be small relative to agricultural demand, but there has been no comprehensive study of the relationship between the two.

As noted above, the supply of water from both wells and aflaj are very susceptible to drought. The Omanis have learned to expand and contract the acreage they plant to conform to the supply of water.

Urban migration and the decline of water levels over the past five years have caused a large number of aflaj and wells to be abandoned. The MAF believes only 4,000 out of a total of 10,000 aflaj are still in use. Opposing this trend, many men have left their villages for employment in the army, police and other jobs in urban areas but leave their families in the villages. These men return at regular intervals with the funds to improve their life style. The Government's policy of constructing schools and health centers in rural areas supports this trend. In many villages pumps, electric generators, large concrete houses, etc. are evidence of this trend. This puts pressure on traditional water supplies.

There are about 25 towns and 1,300 villages in the rural areas of northern Oman with an estimated total population of 350,000. There are piped water systems in only three of the towns, and none of the towns or villages have systems for the collection of wastewater. Water is obtained from a variety of sources, including the traditional falaj system, public or private drilled wells, dug wells and water tankers (bowsers).

In general the quality of water available for drinking from traditional sources is neither safe nor adequate in quantity. Despite the rules which govern the use of aflaj, it is apparent

that only water drawn very close to the source is likely to be safe. The lack of adequate water and sanitation facilities in these rural towns and villages results in a high incidence of enteric diseases, hardships in obtaining adequate supplies of water within convenient distances, and generally degraded environmental conditions. In many towns and villages, people are installing septic tanks close to drinking water wells causing them to become contaminated. In many cases, as villages have grown and aflaj contracted, the distance to the traditional sources has grown greater, reducing the convenience of these sources of water and, therefore, the quantity utilized. Villagers often pay R.O. 1.000 ($2.60) for a cubic meter of water delivered by bowsers. This amount lasts an average of three days if used only for cooking and drinking. A survey of water supplies in the Rustaq area conducted by the Ministry of Health found only three villages out of a total of 39 had safe and adequate water supplies using WHO criteria.

Additional pressures are being put on water supplies in many parts of Oman by the Government's land distribution policy. Every Omani male is entitled to a piece of land. To obtain title to the land, the recipient must build on it and use it within a specified period of time. Almost immediately, the recipient puts down a well, for land without water is of no value. In the areas where this is occurring, little is known about the water resources and no estimation of the impact of this process on water resources is made. Typically, the organizations responsible for land-use planning and land distribution have little or no relationship with the organizations which study or allocate water resources.

Although the most intensive development has taken place in the Capital, rapid economic development and urbanization is also occurring along the Batinah Coast which runs north from the Capital for approximately 150 miles. Along this coastal section of northern Oman, unrestricted well drilling and overpumping has led to depletion of aquifers and serious saline intrusion.

The urbanization process can be seen in important provincial towns such as Sohar, Sur and Nizwa. Rudimentary water systems have been installed in Nizwa and Sur, but those living in these and other towns generally utilize their own wells or trucked water supplies. None of the three towns have adequate water supplies. It is already certain that Sur will require a desalination plant.

Sanitation facilities are virtually non-existent outside the Capital Region. Occasionally, one finds a larger home in a town or village with a septic or holding tank. Often such facilities are improperly located or constructed and contribute to health hazards and the contamination of drinking water supplies.

b. The Capital Region

The most intensive development over the past 15 years has occurred in the Capital Region, which extends along the Batinah Coast, some seventy kilometers from Barka to Al Bustan. The Capital Region is developing outward from the older, more densely populated areas of Muscat and Muttrah. The newer areas are of generally lower density and contain commercial and residential areas, as well as a new central business district and modest industrial development. Areas further west are largely residential, with government buildings and commercial/shopping areas. No population census has been conducted, but the Capital Region population is estimated at about 350,000 and is believed to be growing at a rate of about 3.5 percent per year.

For its potable water supply, the Capital Region is dependent on desalinated water, supplemented by two water supply well fields. Both the quantity and quality of groundwater resources extracted from well fields in the eastern and western sections of the Capital Region have become inadequate, as a result of population growth pressures and increasing salinity due to overpumping. The well fields supply about 35 Ml/d (million liters per day), considerably more than their estimated safe yield of 10 Ml/d. The area's groundwater resources are also being threatened by encroaching development and a lack of effective policies to protect aquifers from dumping of wastes. To meet the Capital Region's need for water, the Government constructed a dual purpose (electricity and water) plant at Ghubrah which produces 45 Ml/d. Two new units have just been added to Ghubrah and are producing another 53 Ml/d. A new plant is planned at Barka which will add about 60 Ml/d by 1990.

The Capital Region water supply system is operated by the Ministry of Electricity and Water (MEW). The transmission system covers a distance of approximately 70 KM from Al Bustan in the east to Barka in the west. The service area is primarily in the coastal plain and extends up to 10 KM from the sea. The system has expanded rapidly in the last ten years. Between 1975 and 1984, the volume of water supplied increased almost fourteenfold. About three percent is trucked to consumers.

The average daily production of all sources during September 1985 was 88.1 Ml/d, just about equal to average daily water demand for 1985 of 87.0 Ml/d. MEW projects that by 1990 demand will increase 118.4% to 190 Ml/d and that it will increase by another 37.1%, to 260.5 Ml/d by 1995. (MEW estimated 1985 demand for water in the Capital Region based on current estimated 1985 average day demands and estimates of per capita demand by district.)

MEW's operating strategy for the water supply system is to bring both eastern and western well field water to the Ghubrah facility desalination plant, to the Wadi Aday reservoir and, perhaps, to other reservoirs in order to blend the well water with distilled water from the desalination units, chlorinate the blended water,

and distribute uniform quality water throughout the Capital Region. Well water tends to be at the high end of the acceptable limits for salinity. Desalinated water must be mineralized by adding chemicals. Blending the two provides for a uniform quality of water throughout the system, permits the continued use of wells which are producing brackish water and reduces the need for the chemicals used to make desalinated water drinkable.

The existing Capital Region water transmission system consists of a single 600 mm diameter transmission main extending east and west from the Ghubrah desalination plant and supplying the various transmission reservoirs. Water supply to the distribution system, other than some which tap directly off transmission mains, is normally accomplished by gravity from ground level storage reservoirs. The Capital Region is served by three distinct distribution systems.

Figure 1 shows projected water supply and demand and Map 2 shows the water system of the Capital Region. Annex N contains a more detailed description of the water system.

Key problem areas for the Capital Region water system are:

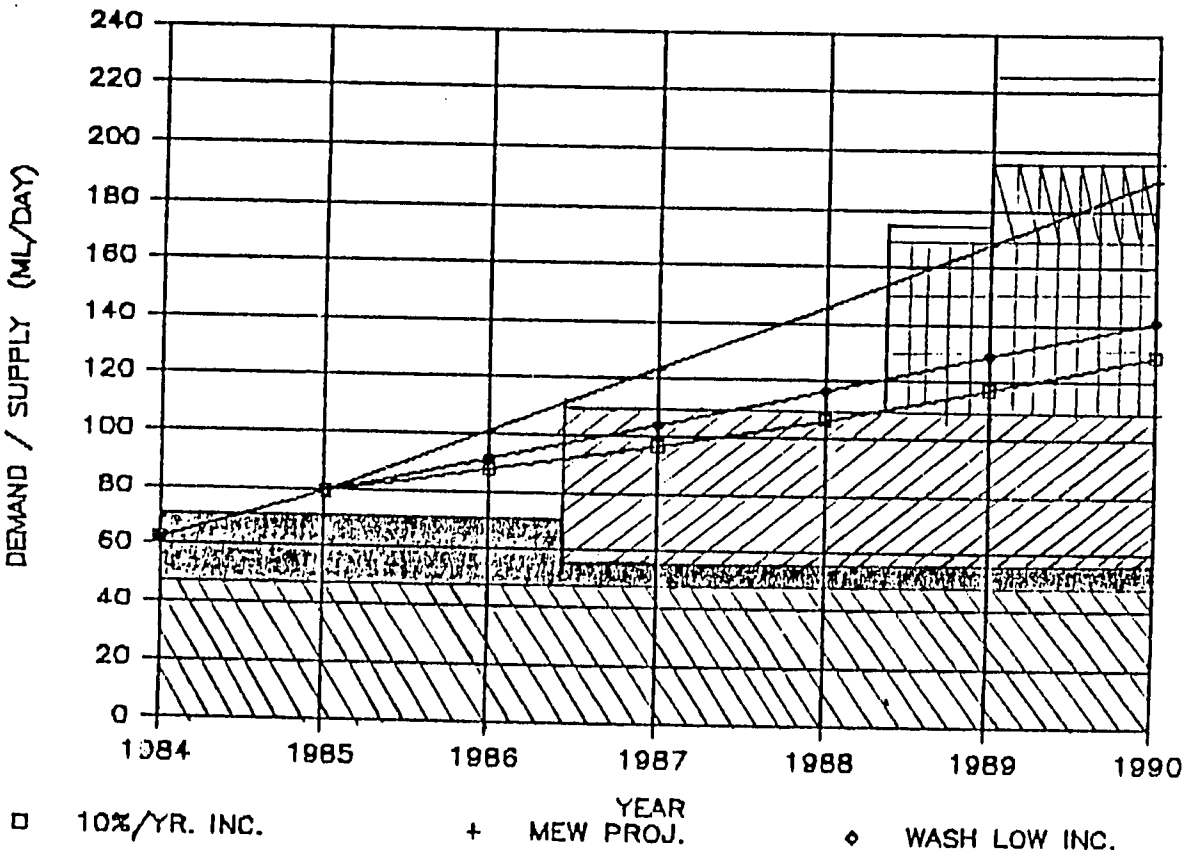
- the immediate need for an additional source of water to cover a projected deficit in supply in 1988;
- an immediate need to strengthen and expand transmission and storage capacity to handle projected system growth, improve system security and improve overall operating efficiency;
- the long-term dependence on costly desalinated water;
- generally high water consumption especially for irrigation;
- the potential loss of existing groundwater resources as a result of overpumping and pollution.

Capital Region public sewerage systems and wastewater treatment facilities are operated by the Directorate General for Technical Affairs of the Diwan for Royal Court Affairs (the Diwan). Within the Capital Region, there is only one small and overburdened treatment plant serving a small section of the city. The Darsayt activated sludge treatment plant has a design capacity of 20,000 people, but serves about 43,000 in the Ruwi-Muscat area. An expansion program is underway to bring the design population to 53,000. Currently, the plant produces one hundred cubic meters per day of waste sludge that must be trucked away for disposal. An outfall discharges one hundred meters offshore.

In the rest of the Capital Region, many housing developments, hotels and industrial plants have been provided with sewer service by developers which often are Government enterprises or ministries. These are often package aeration units, many of which are not functioning properly. Residences not served by waterborne sewage collection facilities are in general provided with septic tanks. About 2,000 cubic meters per day of septage and excess sludge from the package plants and septic tanks is trucked away and disposed of at municipal waste disposal sites which are little more than large pits in the ground. A rough

FIGURE - 1

# CAPITAL AREA WATER DEMAND / SUPPLY




Water Production

Production from Ghubra Desalination Units 1 & 2

Production from Ghubra Desalination Units 3 & 4

Production from Existing Well Fields

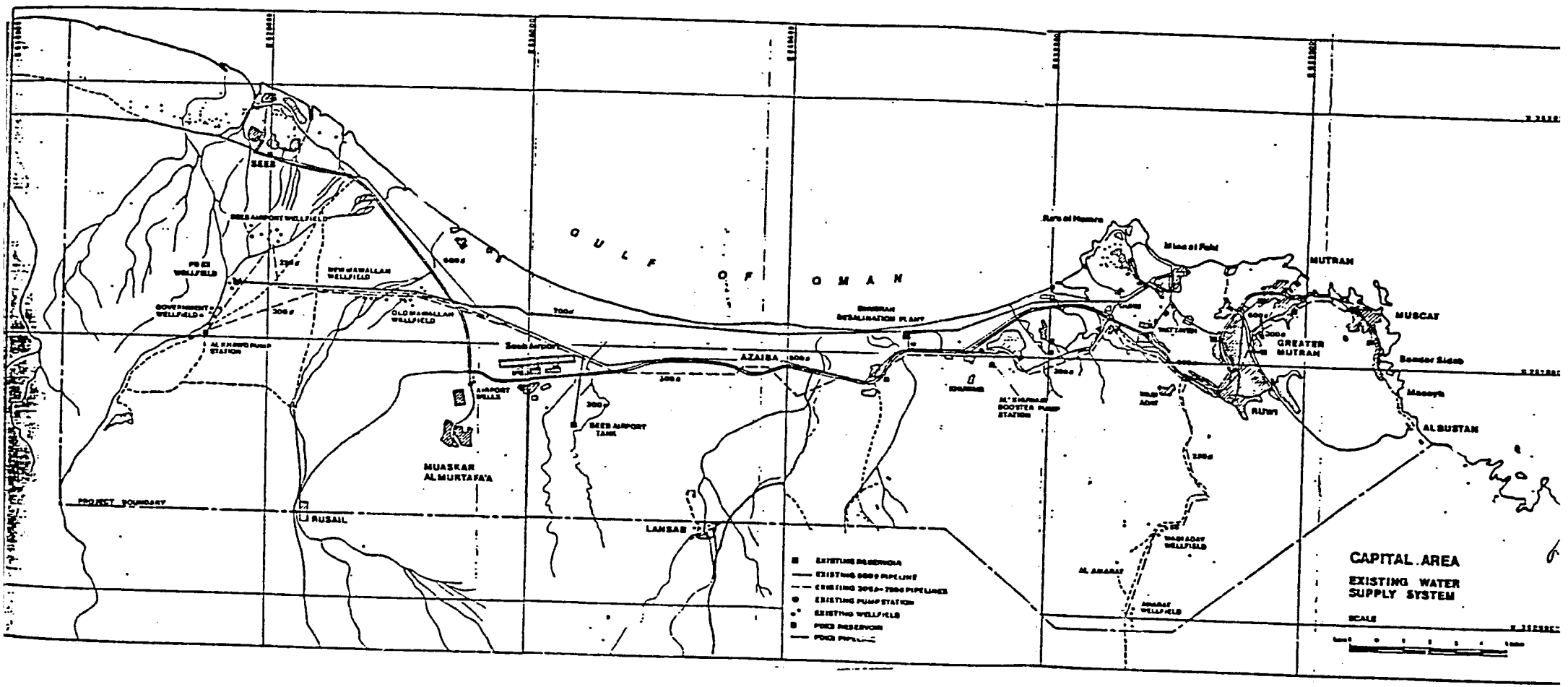
Projected Production from Barka Desalination Units 1 & 2

Projected Production from Barka Desalination Unit 3

Projected Production from New Well Fields (Barka & Bausher)

Note: Figure does not take into account shut down periods for annual maintenance of desalination units. During such periods, (one month for each unit per year), pumping from wells is heavily increased to meet demand.

Source: MEW and WASH Reports.




MAP 2 - WATER SUPPLY SYSTEM OF THE CAPITAL AREA

estimate indicates that only 25 percent of the sewerage generated by the population of the Capital is handled by a treatment facility of even the most rudimentary sort.

The existing facilities for the disposal of the septage removed from holding and septic tanks are environmentally hazardous and inadequate in capacity. The problem is so severe that an immediate solution must be found. The Commission has been asked to finance a study of the situation using WASH consultants. The study will review a preliminary decision to purchase an expensive, sophisticated mechanical treatment plant and will recommend alternatives.

Thus far, with the exception of the desalination plant at Ghubrah and the Darsayt wastewater treatment plant, the facilities operated and maintained by MEW and the Diwan have been relatively simple and limited. The Ghubrah facility is operated by a private contractor. Until a year ago the Darsayt plant was operated by a contractor, but it is now run directly by the Diwan which hired the employees of the contractor. The plant is supervised by a qualified expatriate and appears to be operating satisfactorily. There is heavy reliance on foreign nationals for both implementation of projects and operation and maintenance of all facilities.

MEW has a small, largely expatriate staff for operations and maintenance. The system is run by a qualified expatriate engineer who serves as the Director of Technical Affairs. His deputy, a hydrogeologist, has primary responsibility for the operation of the well fields. Most major repair work is done by local contractors who have proven their reliability. MEW has the following operations and maintenance programs:

- A meter repair shop has been set up and a major program of meter replacement has been started;
- A valve maintenance program has been designed and implemented;
- A program for systematically emptying and cleaning water storage tanks has been implemented;
- A meter installation training program for employees has been designed in cooperation with the Vocational Training Institute in Darsayt and a valve maintenance training program is being designed.

## C. Rationale for the Project

### 1. Rationale for Joint Commission Involvement

When the Joint Commission was formed in 1980, it was agreed that its program would focus on a few major sectors. Because of its importance to Oman's development, the Commission has been involved in water resources-related activities since its first project, the Wadi al-Khawd Aquifer Recharge Dam. This project was developed to demonstrate the concept of aquifer recharge by constructing a retarding structure to capture water which previously passed, unused, in runoff to the sea. The dam is

completed and the installation of a monitoring system to evaluate the impact of the dam is underway. The Commission continues to assist in this important sector by giving priority attention to training Omanis to work in water resources under the Scholarship and Training Project.

The Agency for International Development (A.I.D.) has consistently attached a high priority to the Commission's addressing the issue of water scarcity in Oman. The approved Joint Commission strategy, as embodied in the FY 1986 CDSS, is to concentrate the A.I.D.-supported program on a small number of critical sectors: grant funds are largely devoted to training and fisheries development, while new loan funding is to be concentrated exclusively on water resources projects over the ensuing five-year period.

In the course of developing a strategy for the use of A.I.D. funds in the second five years of the Commission's ten year life span, the Commission analyzed carefully what is known about the water sector and determined that Oman's water resources problems stem from three major factors:

a. The first is physical in nature and results from Oman's natural scarcity of water resources, coupled with ever-increasing demand for them;

b. The second is an inadequate institutional capacity to study, develop, and implement specific water resources projects and, perhaps more importantly, an inability to effectively manage and control existing water resources in the face of rising demand; and

c. The third factor is a range of social changes resulting from the growth and modernization of Omani society, including changes in some traditional practices and the growing unsuitability of other traditional practices.

Based on this assessment, the FY 1987 Action Plan established the Commission's goals and objectives in the sector as assisting in the development and management of Oman's scarce water resources by designing and funding a sector project focused on: (1) increasing the pool of knowledge about the country's water resources; (2) improving the quantity and quality of water delivered to end-users; and (3) improving the Government's institutional capability to study, develop, manage and utilize its limited water resources.

The Action Plan envisioned that the project identification and design process itself would play an important role in implementing the Commission's sector strategy. Activities financed by the Commission must be included in Oman's Third Five-Year Plan. The project design process has therefore become an integral part of the Government's effort to develop its Third Five-Year Plan.

Project design and implementation require a degree of coordination and cooperation between ministries which has not existed before. While this will be difficult to achieve, if the the project is successful it will bring about the first steps toward a more integrated approach to water resources management and the design, construction and operation of water/wastewater facilities. Feedback through the Omani side of the Commission indicates that the project development process was a contributing factor to the recent Government decision to add responsibility for water resource development to the Ministry of Environment, thereby putting MEW and MAF (which represent the two major competing users of water) on a more equal footing.

Finally, the proposed project is consistent with the basic documents signed by the Omani and U.S. Governments when the Commission was created. It clearly meets most if not all of the criteria for selecting Commission activities:

- it addresses a high-priority development need

- it is in line with the Government of Oman's own priorities

- it provides an opportunity to transfer U.S. technologies and brings to bear U.S. expertise

- it will be very visible and touch the lives of many Omanis

- it will strengthen Omani institutions and human resources

The Deputy Prime Minister for Financial and Economic Affairs and other senior members of the Government have endorsed the view that the Joint Commission's resources during the Third Five-Year Plan should be concentrated on water resources development. The project has been reviewed at various critical stages in the design process with various senior Omani officials, including the Deputy Prime Minister and other key ministers, as well as senior technical staff members of the concerned ministries.

## 2. Rationale for the Project

Water is considered the most serious constraint to further economic development of the country. Progress in developing new water resources and conserving existing ones will affect aspects of growth in most sectors and thus strongly influence the course that development takes in the country. Continued economic expansion will require careful management of this crucial resource and a well-planned program of water sector investments.

Limited availability of natural water supplies and the high cost of desalinated water are constraints to further expansion of the Capital Region. Moreover, the Government is seeking to slow migration into the Capital Region by improving the quality of life in towns and villages. Water and wastewater facilities are an important element in this strategy. In the agricultural sector, the Government is seeking limited self-sufficiency in

food products. This is a very difficult task as considerable increases in acreage will be required. While improvements in water-use efficiency and production techniques will optimize the use of available water, additional sources of irrigation water will be required. A coordinated water policy which recognizes the competition between domestic, industrial and agricultural demand for water and establishes priorities for its use is needed.

The scarcity of Oman's water resources is exacerbated by inadequate institutional capacity to study, develop and execute specific water resource projects and, perhaps more importantly, an inability to effectively manage and control existing water resources in the face of rising demand. To date, water resources development in Oman has not been of a regional nature but has focussed principally on satisfying local needs with local supplies. Historically, supply and demand were in approximate balance and such a local approach was reasonable. However, the rapid rate of growth experienced since the mid-1970s is expected to continue and the ever increasing demand for water, especially in the Capital Region and along the Batinah Coast, is causing a growing imbalance in the supply/demand ratio. Resulting long-term water shortages could curtail further development.

The development of water resources was given a very high priority in Oman's First and Second Five-Year Plans. Given the increasingly critical role which water availability is playing with respect to the country's economic development, the Third Five-Year Plan will continue to emphasize the development of Oman's water resources. Unfortunately, the lack of an integrated approach to water resources management is reflected in the country's five year plans and the funds allocated for water-related activities are scattered among the various ministries which develop projects to meet their own parochial objectives. This makes it difficult to determine how much is actually being spent on water-related activities.

The recent fall in oil prices has highlighted the urgent need to set investment priorities in infrastructure. The past pace of development can no longer be supported during the Third Five-Year Plan without threatening the country's long-term financial stability. Yet much remains to be done to complete the country's basic infrastructure in the water sector. Since water is the cornerstone of Oman's growth and future viability, the Government must not only be able to manage and control the country's water resources, it must also be able to plan and implement effective programs of investment in water-related facilities and operate and maintain these facilities.

The successful completion of the project will leave Oman with

- a national strategic plan for the utilization and management of water resources

- an organization capable of updating and implementing the plan

- a long-term masterplan for the development of water and wastewater facilities in the Capital Region

- a strengthened and improved water system for the Capital Region

- tested designs for the construction of water and wastewater facilities in towns and villages

- prefeasibility and feasibility studies required to continue the process of designing and constructing facilities in towns and villages

- strengthened institutions for the planning, design, construction, operation and maintenance of water and wastewater facilities throughout the country

## IV. PROJECT DESCRIPTION

### A. Introduction

The Joint Commission has developed a coordinated sector project for water resources development and utilitization to be jointly financed by the Governments of Oman and the United States. The project addresses Oman's goal of providing a safe and reliable supply of water sufficient to meet the needs of the people and the planned development of the country. The project has dual, complementary purposes. They are to improve the capability of key water resources institutions necessary to plan, develop and manage Oman's limited water resources in a rational and coordinated manner, and to strengthen institutions and physical facilities which provide domestic water supplies and wastewater disposal in the Capital Region and selected towns and villages of northern Oman.

The underlying premise of the project is that an integrated approach to the development, allocation, management and utilization of water resources is essential to preserving and obtaining maximum benefits from this precious commodity in Oman. To do this the Government of Oman requires:

1. Long-term plans for the management and development of water resources based on the best information available and a planning process to continuously update and improve these plans.

2. An effective policy-making body which can make and enforce policies, rules and regulations regarding the preservation, development and allocation of the country's water resources.

3. A technically capable organization which can collect and analyze data, implement the planning process and support the policy-making body.

4. Physical facilities and the institutions to manage them which can efficiently utilize the water resources which are available, to meet the needs of the people and the economic development of the country.

### B. Agriculture and Health

#### 1. Agriculture

To be truly comprehensive, a water resources sector project should focus on agricultural uses of water as well as municipal/industrial uses. In the course of project design, a consultant was employed to determine whether there were interventions which would have an impact on the utilization of water for agricultural purposes which could be included in the project. Based on his report entitled "Water Resources and Agricultural Development in Oman" (available from ANE/PD and the

Joint Commission), information obtained from the MAF's Third Five-Year Plan consultant and the Commission's previous experiences with the sector, we found that:

- agricultural development goals are essentially being set without regard to their impact on water resources

- there are no significant activities which would have a direct impact on agricultural use of water which could be managed within the limits of the financial resources available under the project.

Omani agriculture must start at square one with intensive research to determine what can be grown most economically with the least amount of water. Strengthened extension services are also required. Before any of this can occur fundamental changes in agricultural policy are required.

The project will promote changes in agriculture through improved water resources planning and management. A proposed national water resources plan will realistically appraise the availability of water for agricultural purposes and assess the impact of continuing agricultural policies and objectives. A strengthened water resources planning and management organization can then begin to impose limits on agricultural water use through the allocation process. The project, therefore, contains no agricultural subprojects but seeks to improve agricultural water use indirectly through water resources planning.

2. Health

As noted in Section III.A.4., Oman has made great strides in curative health care and is beginning to implement preventive health programs. The Joint Commission has provided ad hoc assistance in health by making available the resources of centrally-funded projects and small grants. The Child Health Planning Team is one example of the assistance rendered by the Commission. More importantly, health training has been given a high priority in the Commission's Scholarship and Training Project. A health specialist has completed a manpower assessment and short-term training program. Implementation of the program will begin shortly.

The Commission's approved strategy is to focus its resources on a few key sectors in order to minimize staff requirements and maximize impact. In the early stages of formulating the Commission's strategy, health was not included as a key sector. As a result, the Commission has neither the financial nor staff resources to play a major role in the health sector.

We recognize that health education is essential to ensuring that people benefit fully from improved water and sanitation facilities. We have had to omit any direct interventions in health from the project because it is impossible to include every

important intervention in the water resources sector. From the management point of view, the project is already complex and will require all the Commission's staff and financial resources. We also believe the areas of health and hygiene education are being adequately dealt with by others outside the project. Several project activities will indirectly have a positive impact on health education also.

The Government of Oman is receiving health sector assistance from the WHO, UNICEF and UNDP including activities related to health education for the people. The Ministry of Social Affairs and Labor, through a UN-supported community development project, is also providing health and hygiene education. The Commission will encourage the Government and UN bodies to focus additional resources on health education and preventive health programs by offering to finance the training components of their projects. This will free their resources for advisors, equipment, etc. Also, if necessary, the Commission can offer to fund a portion of the cost of well-thought-out projects sponsored by the UN organizations and the Ministry of Health. Finally, to the extent that staff time permits, the Commission will continue to offer the resources of central and regional health projects to the Government of Oman.

With regard to the impact of the project itself, several components described below involve social analyses of potential beneficiary groups. Activities such as wastewater reuse cannot be undertaken without an understanding of socio-cultural attitudes. These studies will, of necessity, provide valuable information on people's values and habits as they relate to the uses of water and personal sanitation and hygiene. They will, therefore, be of value to health planners. More directly, one of the proposed functions of a strengthened water resources planning organization is to assure that public education campaigns for conservation and hygiene are being planned and implemented by the appropriate Omani Government organizations.

C. Project Structure

The project consists of three main subprojects and, within each subproject, a series of specific interventions. The components of the project are designed to deal with specific problems or constraints and thereby contribute to the achievement of the project goal and purpose.

The three subprojects are:

Subproject I - Development of Water Resources Management and Planning Organization;

Subproject II - Capital Region Water Supply Improvement and Wastewater Planning; and

Subproject III - Town and Village Water and Wastewater Pilot Activities.

The first subproject is intended to improve the national institutional capacity to control water use and develop water resources, and to augment the country's water resources. This will be done through the provision of technical advisory services and training for a water resources planning organization, as well as consultants to prepare a strategic plan for the development and utilization of Oman's water resources. Consultants will also study, design and supervise construction of water resources augmentation activities.

The second and third subprojects address deficiencies in existing infrastructure in the Capital Region and outlying towns and villages, respectively. This will be done through a combination of planning, infrastructure design and pilot activities, and actual construction. In addition to planning, certain top priority infrastructure improvements which have been identified as critical will be undertaken. In the case of towns and villages outside the Capital Region, so little infrastructure now exists that it is necessary to begin by assessing needs and testing designs for integrated water and wastewater facilities, using alternate sources of energy and alternate approaches to water production, where appropriate. In recognition of the weaknesses of most institutions now assigned responsibility for providing water and wastewater services in the Capital Region and the towns and villages, both subprojects contain institutional development components.

The proposed mix of planning, design, and construction activities represents a concerted attack on the related issues of water use and water resources development. When all aspects of the project are completed, coordinated water resources and water/wastewater infrastructure planning will have been done, and limited infrastructure investments will have been made. Thus, this project will position Oman to undertake a major infrastructure investment program, whether it uses its own resources or external assistance.

Although some of the components of the project are linked at the implementation level, as will be discussed below in the more detailed descriptions of each subproject, the subproject components are primarily linked at the project goal level. Each subproject has its specific project purpose which, when achieved, will contribute to achievement of the overall project goal. This permits each subproject and, in some cases, individual subproject components, to be implemented independently of the others when they are ready to proceed.

There are several reasons why this approach to project design has been taken:

1. The Commission has limited staff resources for project design and implementation. Concentration of resources is an important method of dealing with this limitation. The design of a single large multi-component, sectoral project is more manageable than the design of several smaller projects over the remaining five

years in which the Commission must obligate funds. Project design work is essentially completed and this project paper, with limited modifications, will serve as the basis for the obligation of the funds required to implement project components when they are ready to go forward. Commission resources will largely be free to focus on implementation of the project components.

2. Some of the project components require major policy decisions and institutional changes on the part of the Government of Oman. Others require cooperation between ministries which can be difficult to achieve. As noted elsewhere, important changes have already been made. Although further progress is expected in the future, the project design allows the Commission and Government of Oman to proceed with the implementation of those activities for which the necessary preconditions have been met.

The utility of the project's flexible design has already been demonstrated. As setforth in the loan request from the Deputy Prime Minister for Financial and Economic Affairs (DPM) in Annex C, the Government of Oman is not in a position to make the financial commitments required to undertake the total project at this time. (See Section III.A.2, Economic Setting.) He has therefore requested the first loan for the project in FY 1986 to be used for the design and supervision of construction of Capital Region water system improvements and studies for the long term development of water and wastewater facilities in the Capital Region. He has committed the Government of Oman to provide funding for construction of the water system improvements.

The project will be implemented in two phases. The first phase will be financed with a loan of $14,556,000 to be authorized in FY 1986. The second phase of the project will include the balance of project activities.

Table 1, which lists the subprojects and the contracts planned under each subproject, provides an overview of the project structure.

We have used the term "Contract" to describe the constituent components of each subproject. These are not meant to be taken literally as single contracts with single contractors in all cases. Rather each "Contract" represents a specific type of activity which will be implemented under the subproject. Some "Contracts" will be implemented by more than one contractor and several "Contracts" will be implemented by one contractor. (See Section V.D., Contracting Plan.)

While the contracting process for some of these contracts will be initiated right away, others of necessity must follow the completion of earlier activities which will provide the required scopes of work. Annex G contains summaries of detailed scopes of work which were prepared during the design of this project to permit early initiation of contracting for critical consulting services which will be needed in the initial stage of the

Table 1

## WATER RESOURCES DEVELOPMENT PROJECT

### PROPOSED CONTRACTS

Subproject I - DEVELOPMENT OF WATER RESOURCES MANAGEMENT AND PLANNING ORGANIZATION

- Contract 1A - Executive and technical support services for the Council for Conservation of Environment and Water Resources (CCEWR).
- Contract 1B - Preparation of National Water Resources Strategic Plan.
- Contract 1C - Engineering services for feasibility studies, design and supervision of construction of projects to augment water resources.
- Contract 1D - Construction services for water resources augmentation facilities.

Subproject II - CAPITAL REGION WATER SUPPLY IMPROVEMENTS AND WASTEWATER PLANNING

- Contract 2A - Engineering services for design and supervision of construction of priority water system improvements.
- Contract 2B - Construction of priority water system improvements.
- Contract 2C - Action plan for resolution of priority wastewater and septage disposal problems.
- Contract 2D - Master Plan for long-term water supply and wastewater improvements.
- Contract 2E - Oceanographic studies for wastewater disposal planning.
- Contract 2F - Environmental impact statement for proposed water and wastewater improvements.
- Contract 2G - Technical assistance for institutional development and Training.

Subproject III- TOWN AND VILLAGE WATER AND WASTEWATER PILOT ACTIVITIES

Contract 3A - Selection, design, supervision of construction and evaluation of pilot water and wastewater projects in towns.

Contract 3B - Selection, design, supervision of construction and evaluation of pilot water and wastewater projects in villages.

Contract 3C - Construction services for pilot water and wastewater projects in towns.

Contract 3D - Construction services for pilot water and wastewater projects in villages.

Contract 3E - Technical assistance for institutional development and Training.

project. The detailed scopes of work are available from ANE/PD and the Joint Commission. The Logical Framework Matrix, Annex D, illustrates the relationships among the various components or subprojects and the contribution of various outputs to achievement of project purpose. Detailed descriptions of the subprojects are presented below.

## D. Subproject I - Development of Water Resources Management and Planning Organization

### 1. Introduction

Subproject I addresses the project purpose of developing the institution required to effectively plan, manage, and utilize Oman's scarce water resources, and expanding the country's water resources. Accordingly, it has been designed to enhance national water resources planning and management capability by providing a National Water Resources Strategic Plan and the technical expertise required to continue the planning process and implement the Plan. New sources of water identified in the plan will be studied and developed.

The Council for Conservation of the Environment and Water Resources (CCEWR) has the authority to manage the country's water resources, but it lacks the executive arm, required to provide it with plans, policies and programs and the means to implement them. By the terms of the decree which established it, the Public Authority for Water Resources (PAWR) is responsible for performing this function. However, the PAWR has been organized and staffed to collect and analyze data rather than to function as an executive support organization with a strong planning capability. It is largely staffed by expatriates provided under a contract with a U.S. firm. Most of the senior expatriates, including the Technical Secretary who directs PAWR's day-to-day operations, are former employees of the U.S. Geological Survey. The resources allotted to PAWR for planning have been limited with only one position available for an expert in this area. Two successive attempts to fill the water resources planning position have met with little success. In any event, giving top priority to data collection during the first five years of its existence was a necessity, as planning cannot be done without reliable data. PAWR has done an excellent job in the area for which it is organized and staffed, and it is essential that it continue this work. This subproject will provide support to enhance PAWR's data collection and analysis activities.

It is now essential to begin the planning and implementation process. A new orgnizational unit, appropriately staffed and directed, is required for this purpose. Annex H contains a detailed statement of recommended functions for a new water resources management and planning unit which could function under the direction of the CCEWR. One of the earliest planned activities under the project would be to secure executive and technical support services in the form of a long-term technical advisory services contract for this new unit of the CCEWR. The

unit would be headed by a full-time Omani director of Planning and Management and Water Resources and would be staffed by a team of experts provided by the consulting firm who would function as though they were employees of the CCEWR. These advisors, functioning as staff of the new unit, will assist the CCEWR in discharging its responsibilities for the coordination of sector activities, the development of national policy (through the CCEWR), and for the development of water resources. However, as quickly as possible, Omani counterparts would be recruited by the CCEWR and trained by the consultants. The consultant would be required to prepare and implement a plan for Omanizing the staff.

The new unit would serve the CCEWR by: preparing agendas; proposing resolutions and decrees for review and approval; providing the CCEWR with technical appraisals of resolutions, projects and other matters submitted to the CCEWR by other organizations; and recording actions taken by the CCEWR. It would develop and oversee the execution of water resources plans, policies and procedures reviewed and approved by the CCEWR and provide centralized coordination for all water resources-related activities of all other government agencies, including rule-making, standard-setting, facility planning and construction, and facility operation activities. The first National Water Resources Strategic Plan would be prepared by a project-funded consulting firm under the direction of the planning unit. It would prepare for CCEWR approval detailed rules and procedures for the allocation and monitoring of water use based on the Plan and supervise the implementation of such rules and procedures after approval by the CCEWR.

The unit would also develop improved measures for the protection of aquifers; flood protection; water resources-related contingency planning for catastrophic events; public information activities to enhance public awareness of the need for conservation, good health practices in relation to drinking water, and similar activities.

The unit would work closely with PAWR to identify data deficiencies, plan activities to obtain data, assure that all government agencies provide PAWR with all relevant data and assure the utilization of PAWR-generated data and analyses by all water resources organizations. Project funds may be used to finance a mini-computer for PAWR's hydrologic data bases which have outgrown the capacity of the PC's now being used.

2. Subproject I Components

a. Contract 1A - Executive and Technical Support Services for the CCEWR

The highest priority activity of the proposed subproject is to secure the executive and technical support services for a new water resources planning and management unit attached to the

CCEWR. This would take the form of a long-term contract with a consulting firm for the proposed unit of the CCEWR.

The principal objectives of the contract are to:

(1) Provide executive support to the CCEWR to assist it in making policy and implementing decisions for the development, protection, conservation and allocation of the water resources of Oman;

(2) Develop and establish a self-sustaining Omani executive unit to continue the functions of the consultant after the contract has been completed;

(3) Optimize the use and control of the water resources of Oman in the overall interest of the economic, physical, and social well-being of its people;

(4) Coordinate the relevant activities of the organizations and individuals who use, monitor, or affect water resources; and

(5) Implement and update, as necessary, the National Water Resources Strategic Plan being prepared under Contract 1B.

The consultant would be expected to provide five persons over a five-year period plus a pool of approximately 70 person months of short-term specialists to carry out the unit's tasks. The consultant's team members will function as though they were employees of the CCEWR, hired to assist the CCEWR in discharging its responsibilities for the coordination of sector activities and the development of national policies for the management of water resources. Because of the potential for a conflict of interest, the selected consultant will not be allowed to carry out any other contracts, subcontracts and joint ventures in Oman related to water resources. The estimated cost of the contract is $11.26 million.

b. Contract 1B - Preparation of National Water Resources Strategic Plan

One of the highest priority tasks for the new unit will be to supervise the preparation of the National Water Resources Strategic Plan which will be carried out by a separate consultant and financed under the project. This plan will provide the basis for the CCEWR to formulate a first draft of a national water resources policy for the protection, enhancement, conservation and allocation of Oman's water resources. The plan consultant will provide a multi-disciplinary team of water resources planners, economists, engineers, social scientists and other specialists as required. The consultant team will report directly to the CCEWR and its executive unit.

Specific objectives of the National Water Resources Strategic Plan are to:

(1) Provide a basis for the use and control of the water resources of Oman in the overall interest of the economic, physical, and social well-being and health of its people;

(2) Establish suitable bases for coordination of water resources-related activities by the organizations and individuals who use, monitor, or affect water resources;

(3) Establish technical criteria, guidelines, recommended policies and procedures and other bases for decision making for the protection, conservation, and allocation of the water resources of Oman; and

(4) Identify potential sources of water and other means of augmenting water supplies such as aquifer recharge and wastewater reuse.

It will take about one year to complete the Plan at an estimated cost of $2.83 million.

c. Contract 1C - Engineering Services for Feasibility Studies, Design and Supervision of Construction of Projects to Augment Water Resources

and

Contract 1D - Construction Services for Water Resources Augmentation Facilities

A major element of the National Water Resources Strategic Plan will be the identification of potential sources of additional water. These could be from aquifer recharge, wastewater reuse, expanded hydrogeological explorations for new sources of groundwater, agricultural irrigation projects and other possible water resource augmentation schemes. The Plan recommendations will form the basis for more detailed feasibility studies of potential water augmentation projects, followed by detailed design and construction. Upon completion of the Plan, it will be reviewed and approved by the CCEWR. The potential water resources augmentation projects contained in the Plan will be reviewed by the CCEWR and the Joint Commission and a prioritized list agreed upon. The Commission will then assist the responsible ministries to draw up scopes of work for feasbility studies of water resources augmentation facilities. Those proving to be feasible can be designed and constructed under the project or financed with other funds that may be available to the Government.

The project budget sets aside $2.61 million for consultant services and $13 million for construction of facilities.

3. Linkages Between Subproject Components

Under Subproject I, there are both general and specific relationships between the work to be undertaken by the consultant to the water resources planning and management unit of the CCEWR and the consultant preparing the National Water Resources Strategic Plan. In general, the relationship is that the Contract 1A consultant: (1) represents the CCEWR to the Contract 1B consultant in all technical matters, and (2) utilizes the results of the Contract 1B consultant's work.

More specifically, the relationship includes:

- Inputs from Contract 1A to Contract 1B: representation on a steering committee for Contract 1B; guidance on coordination with Government policies and activities; and technical overview.

- Inputs from Contract 1B to Contract 1A: information and informal technical evaluations; various technical inputs including rain gage network design, flood control concepts, aquifer protection plan elements, demand modification study results, supply modification study results, including recommendations on the reclamation and re-use of wastewater; and strategic plan proposals.

Activities by the Contract 1A consultant that will depend on inputs from the Contract 1B consultant, include:

- Computer hardware and software proposals for the CCEWR;
- Institutional/human resources development plan;
- CCEWR procedural handbook, preceded by procedural assistance throughout the first year; and
- Institutional action plan for the CCEWR.

As noted above, the scope of work for Contract 1C will be based on the results of Contract 1B and will involve the participation of the consultant provided under Contract 1A. The construction work under contract 1D will flow from the feasibility studies prepared under Contract 1C.

4. Critical Assumption

Accomplishment of the objective of this subproject--the development of a capable national water resource management and planning organization--assumes that the Government will:

a. Create a water resources planning and management organization under the CCEWR;

b. Identify and assign a suitable Omani director and other counterparts to receive training and work alongside the U.S. technical consultants from the outset;

c. Support the CCEWR in its efforts to enforce policies and regulations recommended by the planning unit.

## E. Subproject II - Capital Region Water Supply Improvement and Wastewater Planning

### 1. Introduction

Subproject II addresses the project purpose of strengthening and expanding the water and wastewater system in the Capital Region, through the preparation of plans and designs, the construction of priority water systems improvements, and the initiation of an institutional development program.

The Capital Region faces several key problems in the provision of adequate water and wastewater services:

a. The Region needs increased sources of water supplies to meet projected growth. Reliance on expensive desalinated water must be balanced against natural water sources. This problem is partially addressed in Subproject I which deals with the development and management of Oman's water resources. However, there are specific aspects of the problem which must be addressed in the context of planning and implementing capital improvements in the water and wastewater facilities of the region as well as in the operations and maintenance of these facilities.

b. The Capital Region water system requires immediate strengthening and expansion if it is to continue to provide the populace with reliable, adequate supplies of water. The system has grown without a long-term plan and in response to the growth of different sections of the region. This has resulted in a system with weaknesses and inefficiencies in its operations.

c. Much must be done in the area of sewage and wastewater disposal. There is an urgent need to provide both short- and long-term solutions to existing problems. Wastewater is both a potential water resource and a potential environmental hazard and, therefore, requires special attention.

d. Responsibility for the Capital's water and wastewater system is fragmented. Aside from the possibility of using recycled wastewater as a water resource, there are economies and efficiencies in linking the planning, implementation and operation of water and wastewater facilities. Immediately, better coordination between organizations is required. For the long term, more effective organizational arrangements should be explored.

To address these issues, key subproject outputs include: the preparation of a long-range masterplan for the integrated development of water supply and wastewater facilities in the Capital Region; the construction of priority improvements to the water system; an action program to deal with immediate wastewater problems; and a better understanding of the environmental and socio-cultural implications of alternative approaches to wastewater reclamation, re-use, and disposal. The subproject will also address the purpose of developing sector institutions by

strengthening the capabilities of relevant organizations (MEW for water and the Diwan for wastewater) to plan, construct, operate and maintain the Capital Region's water and wastewater facilities.

Upon the completion of Subproject II, implementation of recommendations related to strengthening institutions responsible for water and wastewater in the Capital Region will be underway. In addition, the Government will be in a position to initiate a major capital works program to improve upon and expand Capital Region water and wastewater facilities.

As noted in Section IV.B. Project Structure, the design and construction of water system improvements, and the masterplan for water and wastewater and associated studies will constitute the first phase of the project and utilize the FY 1986 $15 million loan.

2. Subproject Components

a. Contract 2A - Engineering Services for Design and Supervision of Construction of Priority Water System Improvements;

and

Contract 2B - Construction of Priority Water System Improvements.

Contract 2A will provide for the engineering services to design and supervise construction of priority water system improvements, while Contract 2B is for construction services for these improvements during the Third Five-Year Plan period, 1986-1990. These improvements have been found to be sufficiently urgent to warrant proceeding with them in advance of the preparation of a more systematic and longer-range masterplan.

The proposed improvements fall into two categories. The first relates to the improvement and strengthening of the region's water transmission system, including related storage and pumping. The second relates to the provision of additional water supplies including the design and construction of the Barka Desalination Plant and a related well field to meet the Capital's urgent need for an immediate new source of water. (Table 2 lists all the improvements which may be included in the subproject.)

(1) Water Transmission and Storage Improvements

During the period July 1985 to July 1986, a team of three WASH consultants developed computer models for the Capital Region water transmission and distribution system. Team members visited Oman on three occasions and two MEW employees received training in the U.S. at the consultant's home office. These models, which are useful for both hydraulic network analysis and water quality blending, serve as tools for effective operation of the system and for planning for future facilities needs. The resulting

computer models were used to conduct preliminary engineering studies and a feasibility report recommending improvements to the Capital Region water transmission system. Proposed improvements were evaluated in the areas of planned system additions (source pumping, transmission pipelines and storage), facilities for blending well and desalinated water, future service areas and expected impacts on existing wastewater systems.

The draft report entitled 'Feasibility Studies for Third Five Year Plan System Improvements for Capital Area Water Distribution," dated January 1986, was given to MEW for comment as oil prices began sliding and the country's financial future turned uncertain. As a result, MEW asked the consultants to return to Oman to undertake a major revision of the report to produce a list of improvements which could fit within projected budgetary resources.

Against the backdrop of more limited resources, MEW has revised its demand projections for the Capital Region. These were based on assumptions regarding planned housing development projects, planned investments in industrial projects and related growth factors which are no longer valid. They have also revised their priorities for providing service to new sections of the region. They have asked the consultants to scale down the size of planned facilities, extend investment time frames by phasing construction, etc. and to prioritize recommended activities. A revised final draft report should be completed by the end of July and the report issued in final form by the end of August.

Although the sizes and locations of recommended facilities may vary in the final report, the proposed improvements will continue to focus on the following.

(1) Facilities for blending desalinated water with well water to provide drinking water of more even quality;

(2) Provision of parallel mains, additional storage, and adequate valving to increase system reliability (including additional reservoirs, distribution piping, pumping stations, and special structures and crossings); and

(3) System expansion to serve existing built-up areas and provide for further growth of the system.

Where it was reasonable to consider alternative technologies or materials, the consultants recommended improvements which represent the least cost options. Section VIII.A. Technical Analysis, sets forth the alternatives which were explored and provides the basis for selecting the recommended improvements.

Annex Q contains the latest draft of the Chapter entitled "Proposed Budget for Improvements" from the revised draft WASH Report which describes the improvements in greater detail. The original draft study is available from the Joint Commission and ANE/PD and the complete revised draft study will be made

available as soon as it is received.

The scope of work for the engineer will include the preparation of the detailed designs for water system improvements during the Third Five-Year Plan, assistance in tendering for construction services and supervision of construction. We propose to have the contractor place a core team of resident advisors in Oman to function as an in-house projects department for MEW. They would then work with MEW on a day-to-day basis to formulate and supervise the implementation of the design, tendering and construction supervision process. This core group would assist MEW in drawing up task orders to be fulfilled by the consultant's home office or short-term staff in Oman.

One advantage in this approach is the institution building possibilities. MEW could assign one or more Omani engineers (perhaps new graduates) to the consultant's resident team to receive on-the-job training in Oman and in the consultant's home office. The consultant could also be tasked with designing and installing computer programs for the financial and physical management of the design and construction process and training MEW personnel to use the programs.

The total cost of the improvements which MEW can finance is $33.77 million. Engineering services are estimated at $3.37 million.

(2) The Barka Desalination Plant

The first WASH study entitled "Recommended Water Resources Sector Activities for the Third Five-Year Plan," dated June 1985, recommended the construction of a new desalination plant at Barka to meet the Capital Region's projected demand for water. The report states:

> Current conditions regarding water supply in the Capital Region can only be described as critical. Until additional desalination units are placed into operation, extensive use of groundwater of deteriorating quality will be required.

The WASH Report assessment of supply and demand demonstrates that, while conservation and other water saving activities can relieve some pressure, they can only slightly delay the onset of a serious deficit situation. Recycling of wastewater and the development of new natural sources resulting from the National Strategic Plan under Subproject I will certainly not meet the region's need in a reasonable time frame. The only ready solution is the construction of another desalination plant as quickly as possible. (See also Figure 1, Section III.A.3.b.)

Table 2

CAPITAL REGION WATER SUPPLY IMPROVEMENT

| DESCRIPTION | PURPOSE | COST |
|---|---|---|
| BARKA DESALINATION PLANT | | |
| Barka Desalination Plant | Construction of multipurpose power/desalination plant. | 103.90 |
| Barka Transmission Main | Construction of 65 km transmission main from Barka to Ghubrah to deliver Barka output to transmission system. | 44.13 |
| Barka Well Field | Develop a water supply well field to provide an additional water for the Capital. | 5.19 |
| Subtotal | | 153.22 |
| TOP PRIORITY WATER SYSTEM IMPROVEMENTS | | |
| OBCO Connection | Place in service an already completed 600 mm transmission line from Wadi Aday to Ghubrah. | 0.13 |
| Seeb Airport Diversion | Replace aging and inaccessable 600 mm transmission main with new, relocated 4.5 km, 600 mm pipeline. | 0.78 |
| Ghubrah Reservoir Expansion | Add storage capacity to existing reservoir to handle output of two new desalination units. | 5.19 |
| Nature Reserve Diversion | Replace aging and inaccessable 600 mm transmission main with new, relocated, 1 km, 600 mm pipeline. | 0.26 |
| Qurm Reservoir Extension | Increase the size of an existing transmission reservoir to meet increased demand in the service area. | 1.74 |
| SUBTOTAL | | 8.11 |
| SECOND PRIORITY WATER SYSTEM IMPROVEMENTS | | |
| Amirat/Madinat al Mahdah Pipeline, Reservoir, Pumpstation | Provide services to a developing suburb containing a large, low cost housing complex. | 11.27 |
| Azaiba/Ghala/Bawshar Pipeline & Reservoir | Provide water service to a developing suburb with several low cost housing projects. | 9.71 |
| Wadi Kabir/al Bustan Pipeline | Provide an increased supply of water and an alternative means of delivering water to a developing community. | 0.49 |
| Mutrah Storage Expansion | Increase the capacity of an important transmission reservoir to meet growing demand. | 3.69 |
| Subtotal | | 25.17 |
| TOTAL | | 186.50 |

In preparing an electric power masterplan for Oman, the Swiss firm, Electrowatt, looked at dual purpose plants and recommended the construction of a power/desalination plant at Barka. This was followed by a feasibility study done by the Japanese International Cooperation Agency (JICA). The report recommends the phased construction of three 60 MW gas-fired steam plants. It also recommends the installation of two additional 80 MW steam plants and five 80 MW gas turbine generators. For desalination, the report recommends the eventual installation of six 30,000 M3/d multistage flash units. The report recommends two units be put in service by 1988 and one by 1989. The recommended units for both desalination and power generation will be of the same design as those already in use in Oman which are widely used elsewhere in the world. The most complex features of the design will relate to the seawater intake and the recommended phasing of development of the plant. The latter is viewed as particularly critical by MEW and it wishes to spread its investment in the plant over time, while minimizing the cost following this approach.

MEW is hoping to complete construction of the recommended three desalination units and three combined cycle generators during the Third Five-Year Plan at an estimated cost of $103.90 million. The estimated cost of the required engineering services is 6 percent of the estimated construction cost, or approximately $6.23 million.

An additional $44.13 million is required to construct a 1200/1000 mm transmission line from Barka to Ghubrah (60 kms.). Communities on the western transmission system can be served directly from the line and additional water can be provided to the eastern system through an interconnection at Ghubrah. The engineering component is estimated at $3.53 million.

In January 1985, MEW issued an international tender for engineering services to develop a detailed masterplan for the phased development of Barka and for final design, tendering services and supervision of construction for the first phase of the plant. Proposals have been received from 17 firms, including four American firms.

Although the Commission recognized the urgent need for the Barka Desalination Plant, because of the progress made by MEW in implementing the project, it was not advisable to include any of the work related to Barka in the Water Resources Development Project. However, delays in awarding the contract have resulted because of the country's financial situation. The Minister for Electricity and Water has asked the Commission to finance the engineering services described above under the first phase of this project.

The plant is urgently needed under even the most optimistic projections of water demand, regardless of the outcome of other project activities. Having an American consultant on such a large project will enhance the prospects for American suppliers

and construction contractors at a time when the middle eastern market is extremely tight. Also, it will be a project with high visibility, which clearly demonstrates the value of the U.S.-Omani relationship.

The Commission is cognizant of the difficult procurement issues raised by the inclusion of the Barka Desalination Plant in the project. MEW does not wish to lose time by retendering for engineering services using A.I.D. procedures. Therefore, it will be necessary to waive some A.I.D. procedures and modify others. The proposed waiver and the resulting procurement procedure are discussed in detail in Section V.C.1.b.

b. Contract 2C - Action Plan for Resolution of Priority Wastewater and Septage Disposal Problems

In the course of developing the scope of work for the masterplan, the WASH consultants and Joint Commission learned that the Capital Region faced a very serious septage disposal problem which could not await the outcome of the masterplan. A first draft scope of work for a much shorter-term study was developed by one of the WASH consultants to provide a recommended course of action for wastewater and septage disposal which would meet the Capital's needs for the next several years while minimizing the risk of embarking on a course of action which would be at variance with the recommendations of the masterplan.

In the process of discussing the shorter-term study, the Commission and WASH consultants learned that the situation was even more urgent than originally thought. Essentially, septage pumped from holding tanks are being dumped into sewage lagoons which are little more than holes in the ground. The lagoons are clearly environmentally hazardous and the Ministry of Environment and Water Resources has ordered the site to be closed by July. An alternate lagoon site provides better treatment but is currently too small. The Diwan, to deal with the urgent problem, has taken offers on a very expensive, sophisicated, mechanical treatment plant. Both the WASH consultant and a WHO sanitary engineer believe the use of properly designed stabilization ponds has not been fully explored. Given the great difference in both initial capital costs and operation and maintenance costs between ponds and the mechanical treatment plant, they have strongly recommended that a study of the potential for using stabilization ponds be immediately undertaken. The Commission has offered to finance this study using available grant funds and WASH consultants.

Whether the study to be done under Contract 2C will be required as now written or in a modified form will depend on the resolution of the urgent short-term situation. If the study is not undertaken, the funds can be reallocated to other activities.

Contract 2C will secure the services of a consultant engineering firm to prepare an action plan for resolution of priority wastewater and septage disposal problems in the Capital Region

during the Third Five-Year Plan period. Principal objectives of the contract are to:

(1) Provide a plan for the environmentally sound and socially acceptable interim disposal of septage pending extension of sewerage services;

(2) Undertake feasibility studies of alternative approaches to expanded wastewater treatment and disposal in various sections of the Capital Region; and

(3) Provide designs for top priority wastewater system improvements which are consistent with the longer-term improvements to be incorporated in the masterplan for the Capital Region.

The estimated cost of the study is $920,000.

c. Contract 2D - Masterplan for Long-Term Water Supply and Wastewater Improvements;

Contract 2E - Oceanographic Studies for Wastewater Disposal Planning; and

Contract 2F - Environmental Impact Statement for Proposed Water and Wastewater Improvements.

This group of contracts will yield the studies necessary for a longer-range and more complete program of improvements and expansion of water and wastewater facilities in the Capital Region Contract 2D (for which the Terms of Reference are complete) is for the preparation of a masterplan for Capital Region water supply and wastewater improvements. Contract 2E will secure the services of technical experts to undertake oceanographic studies related to alternative approaches to wastewater disposal. Contract 2F will provide the environmental impact statement (EIS) required by both Omani and U.S. Government regulations.

Principal Contract 2D objectives are to:

(1) Provide a plan for the environmentally sound and socially acceptable development of water supply and wastewater disposal systems in the Capital Region at overall least cost;

(2) Provide for coordinated water supply and wastewater systems development;

(3) Provide long-term plan guidelines and standards for the future detailed design and construction of proposed first-stage facilities, for their operation and maintenance, and for the institutional and financial management arrangements to ensure that they can be implemented and sustained; and

(4) Provide a basis for decisions to fund those works found to have a high priority (proposed first-phase works).

Contract 2D also provides for an assessment of Capital Region water and wastewater institutional capabilities. Existing data on MEW and Diwan practices and procedures will be evaluated. Proposals will be prepared for improving administrative, financial and cost accounting systems that will facilitate management of sector institutions according to utility business principles. These could include any measures needed to improve either the percentage of customers billed or the percentage of billed revenue collected, necessary improvements in procedures for updating system inventory and system maps to reflect as built and repair data, and other organizational improvements which should be made regardless of future system expansion or construction.

In addition, a number of organizational options are to be evaluated, including: (1) separation of all management, including technical, administrative, and financial management for the Capital Region water supply and transmission, from the remainder of Oman; (2) creation of a single water and wastewater authority for the Capital Region and possibly certain other cities and larger towns; (3) establishment of a single combined authority for all of Oman; and (4) initiation of a program for the eventual Omanization of water and wastewater institutions.

It is estimated that the contract will be for a period of sixteen months and cost an estimated $4.81 million.

One important aspect which must be considered in developing a masterplan for the long-term development of the Capital Region's water and wastewater infrastructure is the possible need for the disposal of wastewater in the sea. Regardless of the degree to which wastewater is reused, sewage outfalls must be built, even if only to serve as emergency outlets. Environmentally safe outfalls can only be properly located and designed if adequate oceanographic information is available. One year will be required to develop oceanographic data for outfalls. The estimated cost of the oceanographic studies is $1.2 million.

Government of Oman regulations require a study of the environmental effects of all projects. The U.S. Government has similar rules. Water and wastewater projects can have a wide variety of impacts on the environment, some of which can be negative if proper care is not taken. Of particular significance is the impact of ocean outfalls for wastewater disposal, as noted above. In addition to looking at impacts on the physical environment, a complete study should also cover the impact of planned investment on marine life and wildlife, historic sites and ruins, and the social impact on peoples' ways of life and attitudes. A scope of work has been prepared by the ANE Bureau Environmental Coordinator.

Experience has shown that it is best to have an independent consultant organization assess the environmental impacts of major projects which are likely to have a significant effect on the environment at the planning stage. A well-qualified, independent consulting firm will be employed (Contract 2F) to prepare an environmental impact statement for the Capital Region masterplan. This will take about six months and will start when the one year masterplan study is approximately fifty percent completed. This will provide the opportunity for the modifications of the masterplan, based on the findings of the environmental study. The estimated cost of the study is $420,000.

Contract 2G - Technical Assistance for Institutional Development and Training

As noted above, the masterplan will address institutional issues such as reorganization, the staffing of organizations, the training of staff, the development of training programs and the installation of new accounting systems and rate structures. Upon completion of the masterplan, the institution building and training recommendations will be reviewed with the Government of Oman and a scope of work for Contract 2G developed to implement the recommendations accepted by all concerned. This would be a two-year effort at an estimated cost of $2.09 million. The contract will be jointly administered by MEW and the Diwan.

3. Linkages Between Subproject Components

Subproject II presents a phasing problem with implications for the linkages between the feasibility and design contracts for priority water and wastewater system improvements and the masterplan contract. The essential early elements of Contracts 2A (water) and 2C (wastewater) will have been determined within the first six months of the project. There will, therefore, be no meaningful input to these contracts from Contract 2E (Masterplan for Capital Area Water and Wastewater) which will still be in the data collection and evaluation stage. The Contract 2E consultant must treat the work started under Contracts 2A, B and C as given in preparing the masterplan. However, the masterplan consultant will be given the freedom to begin commenting on the work done under the earlier contracts and, will be expected to begin suggesting modifications to the ongoing water and sewerage construction programs as quickly as possible. Such modifications will be the subject of dialogue between the various consultants in the latter part of the first year.

4. Critical Assumptions

The most critical assumption underlying this subproject is that the Diwan and MEW will be able to work together cooperatively in reviewing and approving the work of the consultant and, perhaps most difficult of all, share the cost of the consultant. Discussions with key officers of the two organizations indicate

that they recognize the importance of integrated planning for both water and wastewater facilities and appear to be willing to cooperate. It may be necessary for the Commission to contract for some of the components described above with the Omani contribution being made directly from Finance.

Another critical assumption of the subproject is that the Government of Oman shares A.I.D.'s approach to studying and mitigating the environmental impacts of the proposed projects. Decrees which are as stringent as U.S. environmental regulations exist. Often the standards imposed, however, are overly strict and therefore unattainable or uneconomic. Since A.I.D. regulations require the preparation of an EIS under any circumstances, the project will present an opportunity to work closely with Oman's environmental regulators. In the process, their rules and our rules will have to be reconciled and, hopefully, those involved will learn something from the experience. The resulting collaboration should encourage the Government of Oman to continue its strong environmental protection policies while helping them to better balance these policies with the needs of development.

## F. Subproject III - Town and Village Water and Wastewater Pilot Activities

### 1. Introduction

This subproject is designed to begin addressing the need to provide water and sanitation facilities in the towns and villages of Northern Oman. This will involve surveying and analyzing the water and sanitation situation in these localities and designing pilot programs for the design and construction of integrated water/wastewater facilities. In conjunction with the needs assessment and pilot studies, alternative sources of energy and alternate means of providing water to isolated villages will be explored. Finally, efforts will be made to strengthen the institutions responsible for planning and supervising the design, construction, operation, and maintenance of water and sanitation facilities in the towns and villages. This will involve direct support to MEW, in the case of water, and the Ministry of Regional Municipalities (MRM), in the case of wastewater.

### 2. Subproject Components

a. Contract 3A - Selection, Design and Supervision of Construction and Evaluation of Pilot Water and Wastewater Projects in Towns; and

Contract 3B - Selection, Design and Supervision of Construction and Evaluation of Pilot Water and Wastewater Projects in Villages

While it is anticipated that one consultant will undertake both the town and village activities, two separate contract groups will be employed because the skills required for planning water

and wastewater activities in towns and villages is different. The level of engineering for villages is much less sophisticated while the social aspects are more complicated.

In both cases, the contract groups will quickly assess the water/wastewater needs of all towns and villages in Northern Oman using available data. A survey of villages in Northern Oman now planned for implementation by an inter-ministerial group under the direction of the Ministry of Health will greatly expedite selection of pilot villages. WASH consultants have provided comments on the questionnaire to be used for the survey in order to enhance usefulness of the resulting surveys to the project.

On the basis of this assessment and discussions with the implementing ministries, a group of approximately 10 towns and 200 villages will be selected for a more comprehensive needs study and the preparation of a preliminary plan for meeting water and wastewater needs for each town and village. This group of towns and villages will be rank ordered by urgency of need and suitability for construction of pilot water/wastewater systems, using criteria mutually agreed to by the Government of Oman and the Joint Commission. Approximately three towns and 20 villages will be selected. A major factor in the selection process will be the need to include a variety of critical conditions - e.g. physical location (on the ocean or in the interior), size of population, source of water (falaj, well, desalination unit), etc.

For each of the selected towns and villages detailed designs for water and wastewater facilities will be prepared. The consultants will attempt to utilize a variety of technologies in all aspects of their pilot activities and will build into their plans the follow-up studies and data collection which will be required to evaluate the pilot project.

Contracts for construction will be let and the consultants will supervise the work. Finally, the consultants will evaluate the results of the pilot activities and provide detailed guidance for replicating successful designs. An important part of the final report will be recommendations on design standards for the various types of water delivery and wastewater disposal systems recommended for replication. Another important end product of the project should be a detailed procedure or manual which sets forth, step-by-step, the process by which Oman can continue the process of studying the remaining villages and towns, determining the order of priority for investment in these towns, selecting one of the recommended systems, modifying standard designs to fit the specific site and constructing the improvements.

Although the activities described above are laid out in step-wise fashion (initial assessment, detailed assessment, design of pilot projects and construction of pilots), the contracts will be structured to allow for the immediate start of each succeeding step as soon as a town or group of villages has been identified

for inclusion in that step. While it is possible that detailed assessments may start before the preliminary assessment is completed, this is not very likely as the first step should be relatively brief in duration. However, it is very likely that design of pilot facilities will begin before the detailed assessment phase is completed and certainly design work and construction will overlap.

One element of the consultant's work will include a detailed study of the institutions responsible for the planning, design, supervision of construction, operations and maintenance of town and village water and wastewater facilities. They will recommend alternate approaches including reorganization, training, changes in tariffs and accounting systems, etc. This component will be completed by the end of the consultant's first year of activity in order to permit implementation of accepted recommendations to be undertaken in the second and third years of the project.

The objectives of these contracts are to:

(1) Provide guidance for the future design, construction, and operation of suitable water and sanitation facilities in towns in Oman, through the preparation of feasibility studies and recommendations for coordinated water, wastewater, and re-use projects for three pilot towns;

(2) Provide guidance for the design, construction, and operation of suitable water and sanitation facilities in villages throughout Oman, through the preparation of feasibility studies and recommendations for one or more systems of coordinated water and sanitation facilities in twenty pilot villages; and

(3) Make recommendations for institutional improvements to facilitate the development, operation, and maintenance of such systems.

The cost of the services for towns is estimated at $6.2 million and the cost of services for the villages is estimated at $6.2 million. Both contracts will run for about three years.

b. Contract 3C - Construction Services for Pilot Water and Wastewater Projects in Towns; and

Contract 3D - Construction Services for Pilot Water and Wastewater Projects in Villages.

The construction of the pilot projects will be undertaken through contracts let as part of this subproject. The actual scope of work and duration of construction services will be determined by the design work of the consultants. As noted above, pilot towns and villages will be selected as quickly as possible and not necessarily in a single group. Therefore construction contracts will be let as soon as designs are completed and approved. The pilot projects which will test alternative energy and water production technologies will probably require special contracting

arrangements with U.S. firms that can supply the required equipment. Such contracts will probably be handled by allocating procurement responsibility to the engineering consultant.

A detailed estimate of construction costs will be provided by the studies and design process. For budgeting purposes, $20 million has been allocated for construction of facilities in three towns and $20 million for construction in 20 villages. The number of villages and towns in which facilities will actually be built will depend to some extent on the the amount of money allocated to the two concerned ministries. This amount is subject to adjustment related to changes in oil revenues.

c. Contract 3E - Technical Assistance for Institutional Development and Training

The technical assistance required to implement the recommended institutional improvements and training will be provided through a contract amendment with the consulting firm working on the towns and villages pilot activities. The scope of work will be prepared by the concerned ministries and the Joint Commission. We expect this contract will require about two years and cost about $2.09 million.

## V. IMPLEMENTATION PLAN

### A. Introduction

The project will be implemented in two phases. In the first phase, the Capital Region Water System Improvement and Capital Region Water and Wastewater Masterplan components of Subproject II will be initiated. The balance of project activities will be initiated in the second phase of the project during FY 1987. The two-phase approach is necessary because the Government of Oman has not implemented the organizational changes required for sucessful implementation of some of the project components and is not in a position to make the necessary financial commitments for the total project at this time.
(See section IV. B. Project Structure)

### B. Overall Project Management

We have proposed to the DPM that the project be established under the general direction of a committee consisting of the Joint Commission, the MOFE and the concerned ministries. We expect the DPM to appoint such a committee in the near future. The members of the committee in addition to the MOFE and the Commission, would be:

Ministry of Environment and Water Resources
Ministry of Agriculture and Fisheries
Ministry of Electricity and Water
Ministry of Regional Municipalities
Diwan of Royal Court Affairs
Council for Conservation of Environment and Water Resources

The first product of the group will be a Project Agreement for Phase II. We expect this inter-ministerial committee will continue in existence after the Project Agreement is signed. The committee would review the project at regular intervals and recommend to MOFE adjustments in the project budget, changes in project activities and obligation of additional funds. The committee reviews would serve as part of the project monitoring and evaluation system and could result in amendments to the Project Agreement, if required.

### C. Subproject Implementation Arrangements

The project is organized around a series of contracts which are grouped into subprojects. Therefore, the essence of project implementation and management will be the contracting for services and the supervision of selected contractors. Key implementation decisions revolve around the mode of contracting (AID versus Host Country), the contracting agency (an Omani Government Ministry, the Commission or AID) and the grouping of contracts.

1. Phase 1

a. Contract 2 A and 2B - Capital Region Water System Improvements

By the end of July 1986, the MEW will have a completely revised draft of the report entitled "Feasibility Studies for Third Five-Year Plan System Improvements for Capital Region Water Distribution" prepared by WASH. This report will provide a prioritized list of improvements which can be designed and constructed during the plan period. The Commission and MEW will develop a detailed scope of work for the engineering services. The scope will include both final design, assistance with tendering and supervision of construction. It will provide for some flexibility in defining specifically what improvements will be included for design and supervision. Selection of the contractor will be on the basis of the total planned water system improvement program (excluding the Barka Desalination Plant and Transmission line).

The engineering contract will be a host country contract let in accordance with Handbook II. MEW will finance 100 percent of construction costs (Contract 2B) and will therefore utilize standard Government of Oman procedures to let construction contracts. The engineering consultant will prepare bid packages and assist MEW in evaluating tenders. MEW maintains a register of local contractors qualified for various types and sizes of contracts who are allowed to bid for work. Tender advertisements are placed in local papers. Based on previous experience, there is a large number of local and locally-based foreign contractors who are quite capable of carrying out any of the construction work called for under the project.

b. Contract 2A and 2B - Barka Desalination Plant and Transmission Main

As noted in the Section IV. D.2a.(2), MEW has asked the Commission to finance engineering services for the design and construction of the Barka Desalination Plant under the project. The process of selecting a contractor was initiated using the Government of Oman's standard international tendering procedures.

No prequalification stage was used in the process. A detailed request for priced proposals was prepared and the documents were offered to any firm seeking it. An advertisement was placed in the local newpapers and on the Tender Board's notice board. The widely distributed Middle East Economic Digest (MEED) published information on the tender for services in its 14-20 December 1985 edition. According to MEW, companies had from January 19 to March 17, 1985 to obtain the request for proposals and submit their proposals.

Twenty-four sets of documents were distributed and Fourteen proposals were received. Of the twenty four firms requesting documents, five were U.S. firms. One, Fluor, did not submit a proposal.

Of the Fourteen proposals, four were submitted by the following U.S. firms: Kuljian, Stone and Webster, Gibbs and Hill and Kellog. In keeping with standard Tender Board procedures, proposals included a request for detailed price quotations with the award to be made on the basis of both price and technical qualifications. The initial evaluation is to be done by MEW and its recommendations are reviewed and approved by the Tender Board itself. Normally, the award is made to the company which is lowest in price and judged to be technically qualified. According to MEW, because no prequalification stage was used, rigid adherence to a priced award is not necessary.

The scope of work for the Barka Desalination Plant tender document appears to be well written. It spells out what is expected of the consultant in terms of the scope of work and the proposal. It is a very straight forward project from the technology and engineering point of view, calling for well tried power generation and desalination units. It does not, however, provide any information on the criteria which will be used to make the award. It is generally understood by tenderers in Oman that price will be the deciding factor if there are no overriding technical deficiencies.

Although the Government of Oman's procurement procedures are different from the procedure specified in Handbook 11, it does comply with the spirit of some of the key provisions of Handbook 11. The procurement was given adequate publicity, especially through MEED which is probably more widely read by firms interested in business in the Middle East than the Commerce Business Daily. The interested firms had adequate time to obtain the tender documents and submit proposals. The numbers of documents distributed and the number of proposals submitted to MEW attest to this.

In its request to the Commission to finance the engineering services for Barka, MEW has made it clear that it cannot afford the 90 or more days it would take to retender. At minimum, it would require 30 days to rewrite the RFP, 30 days for advertising and 30 days for preparation of proposals. On the other hand, it would be very difficult for AID to finance a selected consultant using Oman's evaluation procedures. We believe, however, that it is possible to balance the needs and requirements of both Governments by utilizing the following course of action:

(1) AID will Waive Handbook 11 Chapter 1 Section 2.5. "Advertising" which requires the publication of an advertisement in "Commerce Business Daily." Section 2.5.3 states "The requirement for advertising may be waived...to avoid serious delay in project implementation provided that efforts shall...be made to secure proposals from a reasonable number of contractors." The steps taken by the Government of Oman are adequate to meet this requirement.

(2) MEW will Reject all non-U.S. proposals;

(3) MEW and the Commission will prepare objective technical evaluation criteria with appropriate weights;

(4) MEW and the Commission will review the standard contract form included in the RFP and prepare a list of changes and additions to make it acceptable to AID;

(5) MEW will issue an addendum to the four U.S. firms which submitted proposals. The addendum will advise them of the change in the procurement process, setforth the technical criteria that will be used for evaluation and ranking of proposals, and transmit the changes in the standard contract form.

(6) Each firm will be allowed two weeks to reconfirm its interest in the contract, extend the validity of its proposal, and provide any additional information it wishes to add in light of the change in evaluation criteria.

(7) Each firm will be allowed an additional two weeks to submit a price proposal in a sealed envelope to be used later in contract negotiations. The price sections of the four proposals will be removed and MEW will evaluate them against the technical criteria and rank them according to the numerical results of the evaluation.

(8) The Commission will independently evaluate the proposal with the help of a consultant.

(9) MEW will present the results of its evaluating and recommended ranking to the Commission for concurrence.

(10) With Commission approval, MEW will initiate contract negotiations with the top ranked firm.

The above plan for selection of the contractor for Barka strikes a balance between AID Handbook 11 and Government of Oman procedures. It saves considerable time by avoiding a complete retender and assures that the best qualified of the four U.S. firms is selected without regard to price. The Commission would utilize the services of a technically-qualified, independent consultant to conduct the evaluation of proposals. The required waiver of advertising in the "Commerce Business Daily" is included in the Project Paper (Annex S). The construction of the plant and related transmission lines will be financed by the Government of Oman. Contracting will be handled by the MEW and Tender Board. Because of the size of the project, an international tender will probably be called for. The engineering consultant will prepare the tender documents and assist in evaluating bids.

c. Contracts 2D, 2E, and 2F - Masterplan for Water and Wastewater and Associated studies.

Ideally, Contract 2E - Oceanographic Studies for Wastewater Disposal, should be started (at least) six months before work on Contract 2D starts to ensure the timely availability of oceanographic data for both the Masterplan and (EIS) contractor. However, this will not be possible and will also complicate project management by increasing the number of on going contracts. We therefore propose to add implementation of the oceanographic study (Contract 2E) to the scope of work of the water/wastewater masterplan contractor 2D. It will then be the responsibility of the masterplan contractor to determine how best to integrate the preparation of the plan and oceanographic studies. More than likely,the masterplan contractor will subcontract for the oceanographic studies and will, therefore have direct access to the data as it emerges.

Discussions to date indicate that it will be difficult to obtain the necessary degree of formal cooperation including the transfer of budget funds and the delegation of contracting authority from one ministry to another. At the same time, both the Director General for Projects, MEW, and the Deputy President for Technical Affairs at the Diwan are pressing the Commission to find a way to get the masterplan started as quickly as possible. Both have indicated that they are willing to cooperate in a less formal manner. In the past we understand MOFE has directly financed studies that involved more than one ministry.

If a suitable arrangement for contracting cannot be worked out between the two ministries, the Commission could perform the function of contracting agent. As noted above, the negotiation of a formal protoccol under which one Omani Government agency delegates contracting authority to another will be difficult and time consuming. The Commission contracting would be acceptable because the objective of the activity is to produce the best possible masterplan in the shortest time and there are no institution building benefits to be derived from the contracting process. There is also no significant difference in the expenditure of staff time required of the Commission regardless who actually contracts.

Because several Omani Government organizations have important responsibilities with regard to the masterplan, a coordination mechanism will be an essential precondition to implementation. The Commission will seek to bring together the representatives from the MEW, Diwan and MEWR to review and approve the scope of work, the contractor evaluation and ranking and the reports issued by the contractor in accordance with the terms of the contract. The involved organization will be asked to concur in a statement which lists the contracting actions, contractor workplans and reports and other actions that they must review and approve. Each will also be asked to designate an officer who can represent the organization and take responsibility for obtaining the organization's approval.

To minimize the number of contractors involved in the project, we propose to select one contractor for Contract 2A (Engineering for Water System Improvements) and for Contract 2D and 2E (Master plan and Oceanographic study) under Phase I.

The EIS contractor (2F) should start work when the Masterplan is about fifty percent completed. An independent contractor will be selected to prepare the EIS to assure objectivity. The contracting agency has not been determined.

2. Phase 2

a. Subproject I - Development of Water Resources Management and Planning Organization

This subproject consists of four planned contracts (Nos. 1A, 1B, 1C abd 1D). A precondition to implementation, however, is the creation of a planning unit and the appointment of an Omani executive director of the new organization. Ideally, the new organization should fall under the CCEWR in the same manner as PAWR which has just been transferred to the new Council. However, other options may be acceptable. One possible arrangement would be to have the new unit attached to the Office of the Minister for Environment and Water Resources. A second alternative would place the organization within PAWR as a separate unit. PAWR would then have to two distinct elements, one for data collection and analysis and the other for water resources planning.

Once a decision has been made regarding the planning unit, the contract for providing it with consultants (1A) and the contract for preparation of the National Water Resources Strategic Plan (1B) can be let. Draft scopes of work were completed by the WASH project design consultants. Omani officials, including the Minister for Environment and Water Resources have received either the complete scope or an executive summary for review. A final Omani Government review and approval of the scopes is required but cannot take place until the institutional arrangements are finalized.

(1) Contract 1A - Executive and Technical Support Services for the CCEWR

Because the work of the new planning unit will affect all water resources activities and because of the politically sensitive nature of the policies, plans, regulations, etc. which will be prepared and implemented by the new unit, its consultants will be barred from entering into any contracts in Oman which relate to water resources in any form. This will help to avoid conflict of interest situations and permit the consultant's staff to better function as though they were employees of the Government of Oman.

The pros and cons of having the same contractor provide the new unit with staff and prepare the National Water Resources Strategic Plan was debated at great length by the Commission and its design consultants. The benefits of having the planning unit consultants in a completely unbiased and independent position to assist the Government and Commission with the supervision and quality control of the plan consultants appear to outweigh any cost and administrative efficiency benefits which could be derived from a single contractor for both activities.

Since the consultants who will staff the planning unit will be required to function as though they were employees of the Government of Oman, it would not be appropriate to utilize the AID contracting mode. While a host country contract is most suitable, the new unit and the CCEWR will have little capability for contracting and will require considerable assistance from the Commission.

(2) Contract 1B - Preparation of National Water Resources Strategic Plan

Contracting for the plan will begin simultaneously with contracting for support services for CCEWR. Firms will have the opportunity to submit proposals for both contracts (as well as any others that may be tendered at the same time) but, as noted above, the firm selected for Contract 1A will have to withdraw from all other contract competitions. The contracting agency will be the CCEWR and its planning unit.

(3) Contract 1C - Engineering Services for Feasibility Studies, Design and Supervision of Construction of Project to Augment Water Resources; and

Contract 1D - Construction Services for Water Resources Augmentation facilities.

The detailed scopes of work for these contracts will be prepared by the planning unit of the CCEWR with the help of its consultants after the recommendations of the National Water Resources Strategic Plan are sufficiently firm and clear to permit work to begin. The plan will identify those water resource augmentation activities which have a high priority and deserve immediate attention.

Contract 1C should begin about a year after 1A (executive support for the CCEWR) and 1B (Strategic Plan). We would like to have the Strategic plan consultant carry out Contract 1C through the feasibility study stage by negotiating an amendment to Contract 1B. In accordance with Handbook 11, Chapter 1. Section 2.4.1.2 - Follow on Work, the procurement procedure used to select the Contract 1B consultant will make it clear that this is contemplated. Care in the preparation of the RFP will be required to insure the full range of potential follow on activities are identified and the skills required defined in order to insure that the 1B consultant will be qualified to

handle work under Contract 1C. In the event that the Strategic Plan recommends any completely unanticipated water augmentation activities which are outside the realm of the consultants experience, a new contractor can be selected by competative procedures. Also, the procedure for contracting for final design and supervision of constructing will depend on the water augmentation projects selected for the project.

This approach will greatly expedite and simplify project management by limiting the number of individual engineering contractors under the Commission's supervision. We also believe experience with the Stratigic Plan will give the consultant a significant advantage in implementing follow on. Finally, this approach could permit an early start of the water augmentation component of the project. If the Strategic Plan consultant, at an early stage of work, identifies a high priority water augmentation activity such as the detailed feasibility study of one or more aquifer recharge dams, this work could be added to the contract immediately by an amendment.

The Commission and Government of Oman will share the cost of construction of water augmentation facilities. Therefore, Handbook 11 procedure will be followed. The timing of 1D will depend on the nature of the water augmentation activities. Feasibility studies and final design of complex water recharge or wastewater recycling projects will take longer than the design of an on farm water management scheme or the drilling of a well field. The contracting agency will be determined by type of water augmentation. For example, an on farm water management project will be implemented by MAF. Recharge related activities are likely to be transferred from MAF to MEWR in the near future.

b. Subproject II - Capital Region Water Systems Improvement

(1) Contract 2A - Engineering services for water system improvements and

Contract 2B - Construction services for water system improvements

Under Phase 2, additional funding will be added to the contracts which will have started under Phase 1. (See section V.C.1. above)

(2) Contract 2C - Action Plan for Resolution of Priority Wastewater and Septage Disposal Problems

Using WASH consultants, a one month study of the Capital Region's urgent septage disposal situation will be undertaken from mid-July to mid-August. This study will recommend technically, environmental and cost effective methods for disposing of the raw septage currently being removed from septic and holding tanks around the city. The study should also recommend any studies which may be required in addition to what will be covered in Contract 2D - Masterplan for Water and Wastewater, as well as

modifications to the scope of work already drafted for this contract.

If additional studies are required, they will be implemented through the IQC mechanism, or as an urgent first phase of contract 2D depending on the level of effort required and the time frame. Every effort will be made to merge any additional studies with the Masterplan.

3) Contract 2G - Technical Assistance for Institutional Development and Training

The scope of work for this contract will be prepared as soon as the masterplan consultant has firm recommendations which can be discussed with the Government of Oman. We propose to have the scope of work for this contract implemented by the masterplan consultant through a negotiated amendment to Contract 2D. In accordance with Handbook 11, Chapter 1. Section 2.4.1.2 - Follow on Work. The procurement procedure used to select the Contract 2D consultant will make it clear that this is contemplated and will also assure that the selected contractor is qualified to provide the services we anticipate to be required under Contract 2G.

This approach will greatly expedite and simplify project management by limiting the number of individual contractors under the Commission's supervision. We also believe experience with the masterplan, will give the consultant a significant advantage in implementing follow on institutional development activities. Finally, this approach may permit the early start of institution building activities. For example, the masterplan contractor could, at an early stage of work, identify a training program which ought to be designed and implemented as quickly as possible.

c. Subproject III - Town and Village Water and Wastewater Pilot Activities

(1) Contract 3A - Consulting Services - Towns and

Contract 3B - Consulting Services - Villages

A single firm will be selected to provide services for both the town and village components of the subproject although two separate scopes of work will be involved and the staffing requirements for the two components will be different. The towns with 1,000 to 30,000 people present a very different set of circumstances from the small villages. Differences revolve around the scale of the pilot, the types of technology which are appropriate to the situation and cultural, social and environmental factors.

The towns will be more susceptible to solutions which utilize piped water and sewer systems with centralized treatment facilities. Issues relating to cost effectiveness, and

operations and maintenance are likely to be most critical. In the villages, appropriate small scale technologies will be sought and the issues are more likely to center on cultural acceptability and community participation.

Considerable flexibility will have to be retained in the contract since successive elements of the scope of work (i.e selection of pilot towns and villages, design of pilot water and wastewater facilities for the selected towns and villages, supervision of construction and evaluation of results) depend on the outcome of preceding activities. Also, the actual number of pilot towns and villages included in the project may vary with the availability of funds for construction. It may be necessary to define the initial stages of project activities with precision, using contract amendments to define what will be done in the latter stages with greater precision.

Although scopes of work have been prepared for the two contracts both, but especially the scope for villages, need to be further refined by the Commission and Government of Oman before they can be utilized in an RFP. The summaries in Annex G should, therefore, be viewed as illustrative rather than final. As with Subproject 2, the Commission will seek to develop a coordination mechanism under which the MRM and MEW will be able to work with the Commission in the implementation of the subproject. A written statement setting forth the specific points at which the two ministries must give their approval will be used.

The Commission may have to contract for services if the two organizations find it difficult to work out a formal agreement between them. Contracting arrangements will require further discussion with the two organizations and the MOFE.

(2) Contracts 3C and 3D - Construction Services for Towns and Villages

It is difficult to anticipate the shape of these construction services contracts in advance of the consultant's selection of towns and villages and design of pilot schemes. It is likely that a variety of techniques will be needed to deal with different situations. We anticipate small local contractors will be used in the villages and a larger local contractor will be used in the town. Since AID financing of construction is contemplated, agreement on contracting procedures will be required. This will be negotiated during the design stage of the subproject.

(3) Contract 3E - Technical Assistance for Institutional Development and Training

The scope of work for this contract will be developed by the consultant employed for Contracts 3A and 3B Engineering services for Towns and Villages. As with subproject 2G, the institutional building aspects of the subproject under contract 3E will be added to the 3A and 3B consultant's contract by amendment as

follow on work in accordance with Handbook 11. The contractor selection procedure for Contracts 2A and 3B will make this clear.

D. Contracting Plan

The Joint Commission is in a unique position with regard to contracting. The Commission's day-to-day affairs are managed by an AID officer and an Omani Government official, both of whom have contracting authority delegated to them by their respective governments. The Commission can therefore enter into AID contracts to the extent that the AID Representative has or is delegated the authority to do so. Similarly, the Commission can enter into host country contracts in accordance with Handbook 11 to the extent that the Managing Director is authorized to enter into contracts on behalf of the Omani Government.

Given the lack of contracting capability of some Omani Government organizations involved in this project and the difficulty which arises when more than one ministry is involved, we have determined that having the Joint Commission contract for some of the services required for the project may be most effective in relation to achievement of project goals.

There appears to be no basis for preferring a host-country contract over an AID contract in terms of Commission work-load. Either mode involves the Commission heavily in the contracting process and contract management. Neither mode eliminates the need to obtain implementing agency approvals at critical points in the process. The final decision will rest on the views of the implementing agency, the Commission and the specific situation.

This view is supported by the Commission's experience with four consultant contracts, one construction contract and a TDP Grant funded contract. Of the five contracts, one consultant contract is an AID direct contract. Set forth below is a table which groups the contracts which will be let to a single contractor and identifies the implementing agencies and the contracting agency. TBD indicates that a decision will have to be made at a later stage in the life of the project.

Table 3 - Contracting and Implementation Agencies

| No. | Contract Title | Implementing Agency | Contracting Agency |
|---|---|---|---|
| Subproject I - DEVELOPMENT OF WATER RESOURCES MANAGEMENT AND PLANNING ORGANIZATION | | | |
| 1A | Executive and technical support services for the CCEWR | CCEWR | CCEWR |
| 1B | Preparation of National Water Resources Strategic Plan | CCEWR | CCEWR |
| 1C | Engineering services for feasibility studies, design and supervision of construction of projects to augment water resources | TBD | TBD |
| 1D | Construction services for water resources augmentation facilities | TBD | TBD |
| Subproject II - CAPITAL REGION WATER SUPPLY IMPROVEMENT AND WASTEWATER PLANNING | | | |
| 2A | Engineering services for design and supervision of construction of priority water system improvements | MEW/ Diwan | MEW, Diwan or JC |
| 2C | Action plan for resolution of priority wastewater disposal | | |
| 2D | Masterplan for long-term water supply and wastewater improvements | | |
| 2E | Oceanographic studies for wastewater disposal planning | | |
| 2G | Technical assistance for institutional development activities | | |
| 2F | Environmental impact statement for proposed water and wastewater improvements | MEW, Diwan or MEWR | MEW, Diwan, MEWR or |
| 2B | Construction of priority water system transmission and storage improvements | MEW | MEW |
| Subproject III - TOWN AND VILLAGE WATER AND WASTEWATER PILOT ACTIVITIES | | | |
| 3A | Selection, design, supervision of construction and evaluation of pilot water/wastewater projects in towns | MEW MRM | MEW/MRM or JC and |
| 3B | Selection, design, supervision of construction and evaluation of pilot water/wastewater projects in villages | | |
| 3E | Technical assistance for institutional development | | |
| 3C | Construction Services for pilot water and wastewater projects in towns | MEW MRM | TBD |
| 3D | Construction services for pilot water and wastewater projects in villages | MEW MRM | TBD |

The table below shows how the contracts can be grouped by contractor to minimize the number of contractors.

Depending on the timing of the issuance of RFP's and the outcome of the technical selection process, Contractors 2, 3, 4, 5 and 8 could be the same one or two firms.

Table 4 - CONTRACTING PLAN

Subproject I

Contractor 1 - Contract 1A - Support for CCEWR Planning Unit
Contractor 2 - Contract 1B - Water Resources Strategic Plan
1C - Water Augmentation Feas. Studies
Contractor 2
or 3 - Contract 1C - Design and supervision
Contractor 4 - Contract 1D - Construction of Water Projects

Subproject II

Phase I

Contractor 5 - Contract 2A - Barka Desalination & Transmission
Contractor 6 - Contract 2A - Other Water System Improvements
Contractor 7 - Contract 2B - One or more Construction Companies
Contractor 6 - Contract 2D - Masterplan
2E - Oceanographic Studies
Contractor 8 - Contract 2F - Environmental Impact

Phase II

Contractor 6 - Contract 2C - Wastewater Action Plan
Contractor 6 - Contract 2G - Institutional Development

Subproject III

Contractor 9 - Contract 3A - Design and supervision - towns
3B - Design and supervision - villages
3E - Institutional development
Contractor 10 - Contract 3C - Local Construction Companies
3D - Local Construction Companies

## E. Joint Commission Staffing for Project Management

The Water Resources Development Project represents a heavy but supportable workload for the Commission. Several factors make it possible for the Commission to handle the project even if the Commission assumes responsibility for some contracting.

The Assistant U.S. Representative who is the Commission's senior project development officer will be the Project Manager for this project. He has, over the past two years, devoted about 75 percent of his time to the project and will continue to do so. He will have the following staff to assist him:

The Chief Engineer will be available to devote a considerable portion of his time to the Water Resources Development Project. The Wadi al-Khawd Project is almost completed. The Dam itself is finished and the monitoring and evaluation system will be completely installed by August or September. This leaves only the training of MAF staff in the use of the system by the consultant's hydrologist. The remaining activity will take little time to supervise. The School Construction Project is well underway and running smoothly. The Commission has employed a TCN engineer to conduct inspections under the supervision of the Chief Engineer. The TPD Grant for a power feasibility study will be contracted for in the next month and completed four months later. Once it is underway relatively little time will be required for supervision of this activity.

The Commission's USDH Project Development Officer will have some time to devote to the project in the near future. The day-to-day demands of the Fisheries Project and the Scholarship and Training Project diminish as a result of mid-course corrections now being implemented and the arrival of two very good chiefs of party. Since this officer's tour of duty runs well beyond the tours of the other involved officers, it is essential that he learn as much as he can about the project. His involvement is also essential for his career development.

The Commission's most experienced Omani project officer, who has participated in the design of the project, departs for long-term training in August. If no Omani replacement is found shortly, the Commission will probably seek a TCN on contract to fill this position until the Omani returns.

The Commission advertised for a PSC Water Resources Advisor to assist in managing the project. A good response was received and the resumes of about 15 potential candidates are in hand. Those not selected for the short list have been notified. The selection process has been suspended until further progress is made in reaching agreement with the Government of Oman on the water resources elements of the project. When this has occurred, the selection process will be resumed. Short listed candidates have been advised of the delay and most appear to remain available.

In addition to the Commission staff and the proposed PSC, support for project implementation will be available from the Regional Legal Advisor in Amman and the Regional Contract Officer in Yemen.

The group of people described above are more than adequate in terms of both numbers and skills to ensure that the project is and will be well managed.

F. Implementation Schedule

Annex R contains an implementation schedule for the project. Only the timing of Phase I is firm. The time frame for the other project components are based on the assumption that agreement with the Government of Oman on Phase II will be reached by the end of the second quarter of FY 1987 and the FY 1987 loan will be obligated by the end of the third quarter.

The projected life of project is seven years through FY 1992 with obligations through FY 1990. The Commission has a 10 year life span and is supposed to end in 1990.

Since funds will be obligated in FY 1990, an agreement must be negotiated between the two governments to either extend the life of the Commission or to devise an alternative approach to completing ongoing projects.

G. Small Business (Gray Amendment) Procurement

There will be a number of contracts over the life of this project. These contracts can be divided into three categories; 1) technical assistance; 2) engineering design and supervision for construction; and 3) contruction. This is a technical assistance project with some construction. Much of the technical assistance is planning and studies leading to the establishment of infrastructure and systems. The contracts proposed this project are expected to be host country contracts. All will be large enough to require publication in the CBD, and all of the notices will include the AID specific language set forth in C.I.B. 85-21. Because we are dealing with host country contracts, we will not, initially, have any 8(A) or small business set asides. However, there will be ample opportunity for Gray Amendment firms to bid as prime contractors, and prime contractors will be encouraged to enter into subcontracts and joint ventures with such firms.

(Next Page is numbered 70)

## VI. COST ESTIMATE AND FINANCIAL PLAN

### A. Basis of Cost Estimates

During the preparation of the project, detailed scopes of work were prepared for a number of study and technical assistance contracts which will be implemented early in the life of the project (Contracts 1A, 1B, 2C, 2D, 2F, 3A and 3B). The WASH consultants, while drafting scopes of work, assisted the Commission in preparing an illustrative list of the long and short-term specialists that would be required to implement the scopes and estimating the level of effort for each specialist for each contract. A very detailed budget estimate was then prepared for Contracts 1A, 1B and 2D. The cost factors used to compile these estimates were derived from ongoing Commission contracts or by checking prices in the market. A summary of these estimates is present below in the sections relating to the specific contracts. The complete budget estimate tables for each of the three contracts is included in the Project Paper as Annex I. For each of the three contracts a cost per person month was calculated and the three figures averaged. This produced an average cost per person month of $29,000. This figure includes contingency, escalation and the Government of Oman's contribution. The average cost figure was used in conjunction with level of effort estimates for the consultant contracts for which no detailed budget estimates were prepared.

Cost estimates for engineering design and construction supervision services were derived by taking a percentage of the estimated construction cost. Again the WASH consultants assisted by advising the Commission staff on the generally accepted percentages used by U.S. firms. Also, information was obtained from MEW on its experience with the cost of services in relation to the cost of construction.

Construction cost estimates are based on actual costs of similar work in Oman, adjusted and escalated as necessary. In those cases where there was a high degree of uncertainty, illustrative activities were identified and used to develop a cost estimate.

### B. Government of Oman Contribution

The Government of Oman will finance fifty to one hundred percent of the construction costs associated with the project. For all service contracts, the Government will be asked to provide office space. In addition, we have included in the cost estimates an estimate of the cost of "counterparts." The term counterpart is used broadly to mean all Omani Government employees associated with the contractor. This includes trainees and officers with responsibility for the management of the contract and/or implementation of the activity in which the contractor is involved. Support for service contractors works out to about 10 percent of the total contract costs.

### C. Expenditure and Subobligation Plans

Table 5 contains the projected expenditures for each project activity over the life of the project. Table 6 contains a plan for obligating and subobligating funds for various contracts. A number of contracts will be incrementally funded.

Table 5

Water Resources Development Project
Projected Expenditure Table
(U.S. $ Million)

| Component Activity | Total Cost Estimate U.S.$ | Contribution To Project Oman | Contribution To Project U.S. | FY-86 Oman | FY-86 U.S. | FY-87 Oman | FY-87 U.S. | FY-88 Oman | FY-88 U.S. | FY-89 Oman | FY-89 U.S. | FY-90 Oman | FY-90 U.S. | FY-91 Oman | FY-91 U.S. | FY-92 Oman | FY-92 U.S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SUBPROJECT 1 | | | | | | | | | | | | | | | | | |
| WATER RESOURCES MANAGEMENT AND PLANNING ORGANIZATION | | | | | | | | | | | | | | | | | |
| 1.A. Advisory Services - CCRWR | 11.26 | 1.50 | 9.76 | - | - | 0.14 | 0.87 | 0.30 | 1.89 | 0.30 | 2.12 | 0.30 | 1.96 | 0.30 | 1.91 | 0.16 | 1.01 |
| 1.B. National Water Resources Strategic Plan | 2.83 | 0.25 | 2.58 | - | - | 0.13 | 1.29 | 0.12 | 1.29 | - | - | - | - | - | - | - | - |
| 1.C. Engineering - Water Augmentation Facilities | 2.61 | 0.27 | 2.34 | - | - | - | - | 0.04 | 0:35 | 0.08 | 0.70 | 0.07 | 0.59 | 0.05 | 0.47 | 0.03 | 0.23 |
| 1.D. Construction - Water Augmentation Facilities | 13.00 | 6.50 | 6.50 | - | - | - | - | - | - | 1.30 | 1.30 | 1.95 | 1.95 | 1.95 | 1.95 | 1.30 | 1.30 |
| TOTAL - SUBPROJECT 1 | 29.70 | 8.52 | 21.18 | - | - | 0.27 | 2.16 | 0.46 | 3.53 | 1.68 | 4.12 | 2.32 | 4.50 | 2.30 | 4.33 | 1.49 | 2.54 |
| SUBPROJECT 2 | | | | | | | | | | | | | | | | | |
| CAPITAL AREA WATER SYSTEM IMPROVEMENT AND WATER/WASTEWATER PLANNING | | | | | | | | | | | | | | | | | |
| 2.A. Engineering - Water System Improvements | 13.13 | 1.31 | 11.82 | - | - | 0.38 | 3.39 | 0.38 | 3.39 | 0.28 | 2.52 | 0.27 | 2.52 | - | - | - | - |
| 2.B. Construction of Water System Improvements | 168.70 | 168.70 | - | - | - | 7.60 | - | 42.18 | - | 76.75 | - | 42.17 | - | - | - | - | - |
| 2.C. Plan for Priority Septage/Wastewater Needs | 0.92 | 0.08 | 0.84 | - | - | 0.08 | 0.84 | - | - | - | - | - | - | - | - | - | - |
| 2.D. Master Plan for Water/Wastewater Improvements | 4.81 | 0.44 | 4.37 | - | - | 0.17 | 1.63 | 0.27 | 2.74 | - | - | - | - | - | - | - | - |
| 2.E. Oceanographic Studies for Wastewater Planning | 1.20 | 0.00 | 1.20 | - | - | - | 0.60 | - | 0.60 | - | - | - | - | - | - | - | - |
| 2.F. Environmental Impact Statement for Masterplan | 0.42 | 0.00 | 0.42 | - | - | - | 0.21 | - | 0.21 | - | - | - | - | - | - | - | - |
| 2.G. Institutional Development & Training | 2.09 | 0.21 | 1.88 | - | - | - | - | - | - | 0.10 | 0.94 | 0.11 | 0.94 | - | - | - | - |
| TOTAL - SUBPROJECT 2 | 191.27 | 170.74 | 20.53 | - | - | 8.23 | 6.67 | 42.83 | 6.94 | 77.13 | 3.46 | 42.55 | 3.46 | - | - | - | - |
| SUBPROJECT 3 | | | | | | | | | | | | | | | | | |
| TOWN AND VILLAGE WATER AND WASTEWATER PILOT ACTIVITIES | | | | | | | | | | | | | | | | | |
| 3.A. Consulting Services - Towns | 6.22 | 0.62 | 5.60 | - | - | 0.06 | 0.58 | 0.26 | 2.32 | 0.09 | 0.80 | 0.09 | 0.80 | 0.09 | 0.80 | 0.03 | 0.30 |
| 3.B. Consulting Services - Villages | 6.22 | 0.62 | 5.60 | - | - | 0.06 | 0.58 | 0.26 | 2.32 | 0.09 | 0.80 | 0.09 | 0.80 | 0.09 | 0.80 | 0.03 | 0.30 |
| 3.C. Construction Services - Towns | 20.00 | 10.00 | 10.00 | - | - | - | - | 1.00 | 1.00 | 2.00 | 2.00 | 3.00 | 3.00 | 3.00 | 3.00 | 1.00 | 1.00 |
| 3.D. Construction Services - Villages | 20.00 | 10.00 | 10.00 | - | - | - | - | 1.00 | 1.00 | 2.00 | 2.00 | 3.00 | 3.00 | 3.00 | 3.00 | 1.00 | 1.00 |
| 3.E. Instutitional Development and Training | 2.09 | 0.21 | 1.88 | - | - | - | - | - | - | 0.10 | 0.94 | 0.11 | 0.94 | 0.00 | 0.00 | - | - |
| TOTAL - SUBPROJECT 3 | 54.53 | 21.45 | 33.08 | - | - | 0.12 | 1.16 | 2.52 | 6.64 | 4.28 | 6.54 | 6.29 | 8.54 | 6.18 | 7.60 | 2.06 | 2.60 |
| TOTAL PROJECT COST | 275.50 | 200.71 | 74.79 | - | - | 8.62 | 9.99 | 45.81 | 17.11 | 83.09 | 14.12 | 51.16 | 16.50 | 8.48 | 11.93 | 3.55 | 5.14 |
| PLANNED AID OBLIGATIONS | | | | 15.00 | | 15.00 | | 15.00 | | 15.00 | | 15.00 | | | | | |
| BALANCE OF AID FUNDS CARRIED FORWARD | | | | | | 20.01 | | 17.90 | | 18.78 | | 17.28 | | 5.35 | | 0.21 | |

Table 6

CONTRACT FUNDING (SUBOBLIGATION) PLAN
(U.S. Million)

| | Contract Amount | FY-86 | FY-87 | FY-88 | FY-89 | FY-90 |
|---|---|---|---|---|---|---|
| SUBPROJECT 1 | | | | | | |
| WATER RESOURCES MANAGEMENT AND PLANNING ORGANIZATION | | | | | | |
| 1.A. Advisory Services - CCEWR | 9.76 | | 3.88 | 5.88 | | |
| 1.B. National Water Resources Strategic Plan | 2.58 | | 1.29 | 1.29 | | |
| 1.C. Engineering - Water Augmentation Facilities | 2.34 | | | | 1.17 | 1.17 |
| 1.D. Construction - Water Augmentation Facilities | 6.50 | | | | 6.50 | |
| TOTAL - SUBPROJECT 1 | 21.18 | | 5.17 | 7.17 | 7.67 | 1.17 |
| SUBPROJECT 2 | | | | | | |
| CAPITAL AREA WATER SYSTEM IMPROVEMENT AND WATER/WASTEWATER PLANNING | | | | | | |
| 2.A. Engineering - Water System Improvements - Phase I | 8.17 | 8.17 | | | | |
| 2.A. Engineering - Water System Improvements - Phase II | 3.65 | | 3.65 | | | |
| 2.B. Construction of Water System Improvements | 0.00 | | | | | |
| 2.C. Plan for Priority Septage/Wastewater Needs | 0.84 | 0.84 | | | | |
| 2.D. Masterplan for Water/Wastewater Improve. - Phase I | 4.37 | 4.37 | | | | |
| 2.E. Oceanographic Studies for Wastewater Planning | 1.20 | 1.20 | | | | |
| 2.F. Environmental Impact Statement for Masterplan | 0.42 | 0.42 | | | | |
| 2.G. Institutional Development & Training | 1.88 | | | | 1.88 | |
| TOTAL - SUBPROJECT 2 | 20.53 | 15.00 | 3.65 | 0.00 | 1.88 | |
| SUBPROJECT 3 | | | | | | |
| TOWN AND VILLAGE WATER AND WASTEWATER PILOT ACTIVITIES | | | | | | |
| 3.A. Consulting Services - Towns | 5.60 | | 2.80 | 2.80 | | |
| 3.B. Consulting Services - Villages | 5.60 | | 2.80 | 2.80 | | |
| 3.C. Construction Services - Towns | 10.00 | | | 1.00 | 2.00 | 7.00 |
| 3.D. Construction Services - Villages | 10.00 | | | 1.00 | 2.00 | 7.00 |
| 3.E. Instutitional Development and Training | 1.88 | | | | 1.88 | |
| TOTAL - SUBPROJECT 3 | 33.08 | | 5.60 | 7.60 | 5.88 | 14.00 |
| TOTAL PROJECT COST | 74.79 | 15.00 | 14.42 | 14.77 | 15.43 | 15.17 |
| PLANNED AID OBLIGATIONS | 75.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| BALANCE OF AID FUNDS CARRIED FORWARD | | 0.00 | 0.58 | 0.81 | 0.38 | 0.21 |
| LOANS | 73.00 | 15.00 | 13.00 | 15.00 | 15.00 | 15.00 |
| GRANTS | 2.00 | | 2.00 | | | |

The subobligation table also depicts the "cash flow" situation; i.e., the carryover of obligated funds from one year to the next.

These budget tables will be revised as necessary, each year prior to the obligation of the year's funds.

D. Grant Funds

A recent analysis of the Commission's grant funding and grant funded projects indicates that as much as $7 million may be available to subobligate for the Water Resources Development Project. This will make it possible to maintain an estimated U.S. contribution of $75 million to the project over five years. The availability of these funds will firm up in the next several months and if they are to be used in the project the necessary authorization will be processed in FY 1987.

E. Contract by Contract Comments

1. Contract 1A - Executive and Technical Support Services for the CCEWR

A detailed cost estimate was prepared for this contract. A summary of the estimate is included as Table 7 and detailed tables are in Annex I.

| | |
|---|---|
| Total Cost | $11.26 |
| AID Share | $ 9.76 |
| Oman Share | $ 1.50 |

2. Contract 1B - Preparation of National Water Resources Strategic Plan

A detailed cost estimate was prepared for this contract. A summary of the estimate is included as Table 8 and detailed tables are in Annex I.

| | |
|---|---|
| Total Cost | $ 2.83 |
| AID Share | $ 2.58 |
| Oman Share | $ .25 |

Table 7

SUMMARY TABLE
COST ESTIMATE
CONTRACT 1A - EXECUTIVE AND TECHNICAL SUPPORT SERVICES TO CCBWR

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | 22,000 | 2.75 | 60,500 | 3,300 | 63,800 | 300 | 3,828,000 |
| Medium Term Resident | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 12 | 139,200 |
| Short Term | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 58 | 672,800 |
| Home Office | 22,000 | 2.86 | 62,920 | 0 | 62,920 | 20 | 220,220 |
| Total - Personnel Cost | | | | | | 390 | 4,860,220 |
| Total - Direct Costs | | | | | | | 1,034,630 |
| Total - In-country Support Costs | | | | | | | 1,615,000 |
| Total | | | | | | | 7,509,850 |
| Contingency (10 percent) | | | | | | | 750,985 |
| Escalation (20 percent) | | | | | | | 1,501,970 |
| Total - AID Contribution | | | | | | | 9,762,805 |
| Total - Omani Contribution | | | | | | | 1,499,221 |
| TOTAL CONTRACT COST | | | | | | | 11,262,026 |

Table 8

SUMMARY TABLE
COST ESTIMATE
CONTRACT 18 - NATIONAL WATER RESOURCES STRATEGIC PLAN

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | 35,400 | 2.75 | 97,350 | 5,310 | 102,660 | 75 | 967,440 |
| Short Term | 25,500 | 2.75 | 70,125 | 3,825 | 73,950 | 10 | 138,040 |
| Home Office | 18,500 | 2.75 | 52,910 | 0 | 52,910 | 8 | 92,950 |
| Total - Personnel Cost | | | | | | 93 | 1,198,430 |
| Total - Direct Costs | | | | | | | 492,070 |
| Total - In-country Support Costs | | | | | | | 500,000 |
| Total | | | | | | | 2,190,500 |
| Contingency (10 percent) | | | | | | | 219,050 |
| Escalation (20 percent) | | | | | | | 175,240 |
| Total - AID Contribution | | | | | | | 2,584,790 |
| Total - Omani Contribution | | | | | | | 246,421 |
| TOTAL CONTRACT COST | | | | | | | 2,831,211 |

3. Contract 1C - Engineering Services for Feasibility Studies, Design and Supervision of Construction of Projects to Augment Water Resources

For budgeting purposes we have used 20 percent of estimated construction costs. This figure is higher than normal because the activity includes feasibility studies as well as detailed designs, construction tendering services and construction supervision.

| | |
|---|---|
| Total cost | $ 2.61 |
| AID Share | $ 2.34 |
| Oman Share | $ .27 |

4. Contract 1D - Construction Services for Water Resources Augmentation Facilities

The Wadi al-Khawd recharge dam cost about $15 million. The MAF has built several smaller dams for between $3 and $6 million. A well field can be installed for $1 to $3 million. It is unlikely that a dam of the size of al-Khawd will be undertaken. The budget allocation of $13 million will cover the cost of several small dams and possibly a well field or two. The purpose of this illustrative discussion is to demonstrate that the amount reserved is neither too small to accomplish something useful nor too large to be effectively used.

| | |
|---|---|
| Total Cost | $ 13.00 |
| AID Share | $ 6.50 |
| Oman Share | $ 6.50 |

5. Contract 2A - Engineering Services for Design and Supervision of Construction of Priority Water System Improvements

The activities to be covered under this contract fall into three categories - the Barka desalination plant, the Barka transmission main and other smaller improvements. Based on discussions with MEW, the WASH consultants and the various reports, we have estimated the cost of engineering for the plant at 6 percent of the construction costs. The services include the masterplan for the full development of the plant, detailed design of the plant, tendering assistance and supervision of construction. For the transmission main we have estimates ranging from MEW's 6 percent to the WASH feasibility study of about 12 percent. Because the work of designing and supervising the construction of the main is part of the large Barka contract, we believe it will be lower rather than higher and have used an estimate of 8.5 percent. For the other smaller activities, we have used the figure in the WASH feasibility study of about 12 percent. (See Table 9 below.)

6. Contract 2B - Construction of Priority Water System

The construction cost estimates for the Barka transmission main and the other smaller improvements are from the WASH feasibility report. The consultants obtained unit costs from MEW. These were derived from recent (1985) contracts that MEW had let.

The estimate for Barka plant is based on a variety of sources including the Electrowatt power masterplan, the JICA feasibility study and the Director General for Projects of MEW who based his estimate on his experience with the Ghubrah plant. None of these sources includes a detailed analysis of the cost of the proposed plant. We have essentially used the Director General's estimate as he has had extensive education and experience with desalination and multi-purpose plants and his estimate is likely to prove quite accurate. In any event the spread among the various sources of information is not so great as to cause serious doubt about the validity of the estimate used in the Project Paper. Moreover, the masterplan which the consultant will develop will include a detailed, phase by phase cost estimate.

Table 9
ESTIMATED COSTS
Contracts 2A and 2B

| | | Total | Oman | U.S. |
|---|---|---|---|---|
| Barka Desal Plant | Eng. | 6.23 | 0.62 | 5.61 |
| | Const. | 97.67 | 97.67 | 0.00 |
| Barka Transmission | Eng. | 3.53 | 0.35 | 3.18 |
| | Const. | 40.63 | 40.63 | 0.00 |
| Other Improvements | Eng. | 3.37 | 0.34 | 3.03 |
| | Const. | 30.40 | 30.40 | 0.00 |
| Total | | 181.83 | 170.01 | 11.82 |
| Total Eng. | | 13.13 | 1.31 | 11.82 |
| Total Const. | | 168.70 | 168.70 | 0.00 |

7. Contract 2C - Action Plan for Resolution of Priority Wastewater and Disposal Problems

The WASH consultants roughly estimated a level of effort of 40 person months. In view of the ongoing short-term study, we reduced this to about 30 person months and multiplied this level of effort by the average cost per person months derived from the contracts for which detailed estimates were prepared.

| | |
|---|---|
| Total Cost | $ .92 |
| AID Share | $ .84 |
| Oman Share | $ .08 |

8. Contract 2D - Masterplan for Long-Term Water Supply and Wastewater Improvements

A detailed cost estimate was prepared for this contract. A summary of the estimate is included as Table 10 and detailed tables are in Annex I.

| | |
|---|---|
| Total Cost | $ 4.81 |
| AID Share | $ 4.37 |
| Oman Share | $ .44 |

Table 10

SUMMARY TABLE
COST ESTIMATE
CONTRACT 2D - CAPITAL REGION WATER AND WASTEWATER MASTERPLAN

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | 37,600 | 2.75 | 103,400 | 5,640 | 109,040 | 114 | 1,334,000 |
| Short Term | 46,700 | 2.75 | 128,425 | 7,005 | 135,430 | 43 | 545,200 |
| Home Office | 18,500 | 2.75 | 52,910 | 0 | 52,910 | 16 | 181,610 |
| Total - Personnel Cost | | | | | | 173 | 2,060,810 |
| Total - Direct Costs | | | | | | | 781,900 |
| Total - In-country Support Costs | | | | | | | 799,000 |
| Total | | | | | | | 3,641,710 |
| Contingency (10 percent) | | | | | | | 364,171 |
| Escalation (10 percent) | | | | | | | 364,171 |
| Total - AID Contribution | | | | | | | 4,370,052 |
| Total - Omani Contribution | | | | | | | 443,844 |
| TOTAL CONTRACT COST | | | | | | | 4,813,896 |

9. Contract 2E - Oceanographic Studies for Wastewater Disposal Planning

The WASH consultants obtained actual cost data for similar projects. In particular, the cost of similar studies done for the Alexandria Sewage Project was used. These estimates were escalated and adjusted for time and local conditions.

| | |
|---|---|
| Total Cost | $ 1.20 |
| AID Share | $ 1.20 |
| Oman Share | $ 0.00 |

10. Contract 2F - Enviromental Impact Statement for Proposed Water and Wastewater Improvements

A detailed estimate was prepared by the ANE Environmental Coordinator. It is included in Annex I.

| | |
|---|---|
| Total Cost | $ .42 |
| AID Share | $ .42 |
| Oman Share | $ .00 |

11. Contract 2G - Technical Assistance for Institutional Development and Training

A rough estimate of the level of effort required for this contract, 72 person months, was made and then multiplied by the average person month cost, $29,000, derived from the detailed budget estimates.

| | |
|---|---|
| Total Cost | $ 2.09 |
| AID Share | $ 1.88 |
| Oman Share | $ .21 |

12. Contracts 3A and 3B - Selection, Design, Supervision of Construction and Evaluation of Pilot Water and Wastewater Projects in Towns and Villages

These estimates were prepared in two parts. A detailed level of effort estimate was prepared for the survey and studies part of the project. This was multiplied by the person month average (111 person months times $29,000). We then added 15 percent of the budget allocation ($20 million) for construction to this figure. The 15 percent allowance recognizes the fact that work will be taking place at several locations outside the Capital.

| | Towns | Villages |
|---|---|---|
| Total Cost | $ 6.22 | $ 6.22 |
| AID Share | $ 5.60 | $ 5.60 |
| Oman Share | $ .62 | $ .62 |

13. Contracts 3C and 3D - Construction Services for Pilot Water and Wastewater Project in Towns and Villages

This is strictly a budget allocation. We have allowed about $1 million per village and $6 million per town. The U.S. contribution to construction will be adjusted as required based on the needs for other project activities, the availability of Government of Oman funds and the results of the preliminary surveys and studies.

| | Towns | Villages |
|---|---|---|
| Total Cost | $ 20.00 | $ 20.00 |
| AID Share | $ 10.00 | $ 10.00 |
| Oman Share | $ 10.00 | $ 10.00 |

14. Contract 3E - Technical Assistance for Institutional Development and Training

We have roughly estimated a level of effort of 72 person months which we have multiplied by the person month average.

| | |
|---|---|
| Total Cost | $ 2.09 |
| AID Share | $ 1.88 |
| Oman Share | $ .21 |

## VII. PROJECT ANALYSES

### A. Technical Analysis

#### 1. Initial Identification of Sectoral Problems and Constraints

In November 1984, in anticipation of the preparation of the Third Five-Year Plan, the Commission was asked to provide consultants to assist MEW in an analysis the Capital Region water system and develop a coherent five-year investment plan and a scope of work for a Masterplan for the Region's water system. MEW subsequently asked that the study should also cover rural Oman since it was understood that the Government would give priority to development outside the Capital Region. In developing the scope of work for the study the Commission concluded that an effective job could not be done if the report did not consider fundamental water resources issues and wastewater as well as domestic water supply.

Over a period of five months from February to June, 1985, four WASH consultants spend a total of 20 person-weeks in conducting a broad ranging review of water resources, domestic water supply and wastewater disposal in Oman. The end product was a report which would: (a) assist MEW in the preparation of a program of water supply projects and actions to be included in the Third Five-Year Plan; (b) suggest other projects and actions related to water resource needs beyond those of MEW; and (c) foster an integrated approach to future water resources planning and development.

The WASH Report identified lack of a strong central management of water resources and a water resources management plan, as the most critical deficiency in the water resources sector. In the Capital Region the report supported the view that a masterplan for water and wastewater was urgently needed and provided a recommended list of projects which the consultants viewed as being required during the Third Five-Year Plan period. Finally, outside the Capital Region the WASH report highlighted the serious deficiencies in both water and wastewater facilities and the need for coordination in the construction of water and wastewater facilities.

The WASH report was reviewed by the Commission and the Government of Oman and was found to thoroughly and accurately represent the water resources situation in Oman. It is the first complete and frank presentation of the situation known to the Commission. The WASH Report provided the basis for the PID and for subsequent visits by WASH consultants to assist with the project design. The final project addresses the major problems or constraints identified in the sectoral analyses prepared by the WASH consultants. Most of its recommendations for action have been accepted and incorporated into the project. The executive summary of the report is included as Annex F. The complete report is available from ANE/PD and the Joint Commission.

## 2. Subproject Technical Analyses

### a. Introduction

Of the three subprojects, only Subproject II involves the immediate construction of facilities. Additional technical analyses carried out in support of this subproject are discussed below. In all other cases, the subprojects include studies which will provide more intensive technical analyses. These will be used to design follow-on activities.

### b. Computer Model and Engineering Feasibility Study of Capital Region Water System

In response to a recommendation of the WASH study, the Commission financed the preparation of a computer model of the Capital Region water system. At the request of the Commission, in October 1985, the WASH computer modeling team was also directed to conduct preliminary engineering studies and prepare a feasibility report of recommended improvements to the Capital Area water transmission system. This was a logical extension of the assignment as the hydraulic network analysis model allowed a rational evaluation of the proposed MEW system improvements.

Mathematical models of water distribution systems are commonly used to plan system enlargements, to evaluate unusual operating conditions or to evaluate normal operating conditions. The primary tool for hydraulic network analysis used during the engineering study of water system improvements was a microcomputer-based, static water system simulation model called WATER developed by Camp Dresser & McKee, Inc. WATER was selected for use because of its:

- ease in data preparation and input
- simplified output and analysis and
- proven effectiveness in analyzing water systems in the U.S. for over 15 years.

Use of the WATER model provides an output of:

- critical information on flows and friction losses in pipes
- pressures throughout the transmission/distribution system
- predictions of flow that can be delivered to any location

This permits the model to be used to predict the effects of system expansion, emergency situations or selected operating strategies through simulation.

The WATER model delivered to MEW by WASH and used in analyzing system improvements utilized the following input data collected by the consultants for MEW's system:

Nodes - All critical points of the system were defined as nodes. Nodes include pipe junctions, pump station locations and reservoir locations.

Demand distribution - Average daily demand was assigned to the various nodes using actual performance as measured by flow meters.

Pumping stations - Pump curves based on actual performance were entered into the model for every pump in the system.

Reservoirs - The hydraulic grade line elevation of reservoirs and other critical data are input into the model.

Pipe network - the model included data to define the various pipelines connecting nodes (e.g. length, diameter, etc.).

Three separate models were created, one for the eastern transmission system, one for the western transmission system and one for the combined system. (See Section III.B.3.b. and Annex J for a description of the water system.)

The following design criteria were used in evaluating proposed improvements:

The transmission system was evaluated for its ability to deliver projected water demands to the transmission system reservoirs. The design criterion was used to keep the system's hydraulic grade line elevation greater than the top water level of the transmission reservoirs. The specific condition evaluated was the design year's projected maximum day demand.

Water storage was divided into three categories: source storage transmission storage and distribution storage. Source storage should be equal to 24 hours of average day demand and transmission storage should be equal to 48 hours of average day demands. There would be no distribution storage.

In the analysis of capacity of pump stations, pump equipment was sized to provide design year maximum day requirements with the largest pump out of service.

For water quality goals, the maximum permissible level of total dissolved solids (TSD) in the water is 1500 milligrams per liter (mg/l) and the desired level is 500.

The feasibility study evaluated four areas which are summarized below:

Planned System Augmentation: Data and records collected by the WASH team during the two modeling visits were compiled for input to the computer models. The transmission system (i.e. source pumping, pipelines, and storage) was analyzed to determine the

extent of system augmentation that was required. The review included the proposed sequence of construction and the estimated cost of each improvement.

Facilities for Blending: Output from a computer model which estimated water quality based upon different blending options was used to evaluate alternate arrangements for blending water from the existing and proposed wells with water from the desalination facilities.

Further System Expansion: While future expansion of the system was not entirely within the scope of this part of the work, the MEW had in its Third Five-Year Plan, identified areas for expansion. The Commission requested that obvious requirements for system expansion over the next five years be identified and that recommended mains serving these areas be sized appropriately.

Wastewater System Review: Four conceptual plans for wastewater system expansion which were developed by consultants employed by the Diwan were briefly reviewed. Any obvious problems that the water system expansion might inflict on the wastewater system and which required immediate resolution were identified. The feasibility of coordinating the four wastewater plans with the planned water system improvements was briefly evaluated.

Implementation of the feasibility study activities began during the WASH computer modeling team visit to Oman in October and November 1985 when data and records were collected and initial modeling runs were made. The MEW trainees in the modeling project assisted in these activities. Finalization of the modeling runs and evaluation of the system improvements were made in December 1985 and January 1986 at the home offices of the WASH team consultants. The draft report was then given to the Commission and MEW for review and comment. A two-person team returned to Oman in early July 1986 for a three-week stay during which they will revise the report to reflect the current economic situation.

At the request of the Commission, the WASH team utilized an economic cost analysis for arriving at a "least-cost" approach to system improvements recommended for the Third Five-Year Plan. An economic analysis could not be applied to all of the recommended improvements as in many cases there was no other technically feasible or, at least, reasonable option.

The least-cost analysis approach was mainly applied to the recommended improvements to the Eastern transmission system where alternative configurations of pipe size, pumping and blending schemes were identified. The alternatives evaluated are:

Alternative 1 - Improving the transmission capacity by providing an additional 1000 mm main from Ghubrah to Wadi Aday and an 800 mm main from Wadi Aday to Ruwi Roundabout.

Alternative 2 - Providing the same increased capacity by installing an additional 900 mm main from Ghubrah to near the Inter-continental Hotel and an 800 mm main from there to Wadi Aday. The increased demand from Wadi Aday to Ruwi would be met by a new booster pumping station at Wadi Aday. Compared to Alternative 1, this option trades a smaller and shorter pipeline for the cost of construction and operation (20 year period) of a booster station.

Alternative 3 - Providing the same increased capacity by a combination of a new 900 mm main and an existing 600 mm main to Wadi Aday, plus an 800 mm main from Wadi Aday to Ruwi. The existing 600 mm main was designed to convey Eastern well field water from Wadi Aday to Ghubrah for blending with the desalted seawater. Using this main for transmission capacity will necessitate blending of the two water qualities at Wadi Aday. The cost of the existing facilities that would be utilized in this scheme were included in the cost analysis.

The above analysis is being rerun in the process of revising the feasibility study with a view to testing other options to lower costs further. The final recommendations of the report will, however, stress the cost savings involved in using the 600 mm main originally built for centralized blending for transmission of water from Ghubrah.

Similarly, the revised report will be recommending a lower cost alternative for the provision of water service from Wadi Aday to Amirat, a newly-developing community. In this case, the report will recommend conversion of a pump station at Wadi Aday which was also built for central blending.

The so called central blending concept is aimed at producing a totally uniform quality of water throughout the system and providing a mechanism for chlorination of well water. With water coming from both desalination units and groundwater, the range in quality is especially wide and variable. The WASH analysis isolated the capital and operating costs specifically attributable to complete central blending and laid out options which could approximate the results of central blending while providing the same level of service at a lower cost. In the revised draft, the Team will recommend the deferral of investments only required for blending.

The only other cost analysis included in the feasibility study was a criteria of combining additional storage requirements for adjacent distribution service areas within the same facility to promote a unit cost reduction for storage through scale. This criteria was only applied where technically feasible.

The cost estimates prepared for the recommended improvements were based on current MEW unit cost data, previous construction projects and contract unit prices, and from interpolation of cost data where unit prices were not available. New transmission mains were costed as ductile iron pipes with cement mortar lining

and polyethlene wrapping in line with the MEW current policy on materials of construction. This pipe material is considered the most appropriate choice by the WASH team for the following reasons:

- The transmission mains are subject to high operating pressures and to external loading due to heavy equipment traffic.

- The transmission system is mainly located along the coast and is in contact with corrosive groundwater.

- There is no local manufacturing capability of pipe material that would be suitable for the service and any material used should be imported. Any difference in cost of pipe for different materials would only be a small portion of the shipping and handling cost.

- Ductile iron pipe is a very common choice of material for water utilities due to a long and successful history of performance. Facilities for this service are usually designed for a 30 to 50 year lifetime due to the cost and inconvenience of replacing pipelines under paved streets.

The Capital Region water system is very basic and unsophisticated. Topography, population distribution, soil characteristic, limit the options available to system planners. The modeling exercise provides a suitable method of identifying system improvement options, testing their effects on the system over time and analyzing options to determine the least cost solution. One interesting benefit of the model was to demonstrate to MEW officials the significant impact of pumping costs. The current financial situation has increased the value of the computer model as a tool to analyze costs.

c. Barka Desalination Plant Studies

The need for and location of the planned desalination/power generation facility was evaluated as part of a power masterplan prepared by Electrowatt, a Swiss firm, under the direction of an electrical engineer with many years of experience with A.I.D. and the World Bank and now employed by MEW for this purpose. The Commission has not conducted a detailed evaluation of the Electrowatt study, but a brief review by the Commission, supplemented by the comments of the Ministry's power advisor, the MEW's Director for Technical Affairs for the water system and WASH consultants indicate that it is thorough and well done.

The study provides a detailed power development plan through the year 2010. It starts with a careful analysis of power demand which is used to prepare load growth projects. It also looks at the demand for water in order to determine whether combined power and desalination plants are required. It analyzes fuel supplies and fuel costs, sets forth planning principles, options and costs and then develops various planning scenarios. These are analyzed

from the economic perspective. Finally, the study lays out a power development plan for 1986 to 1990. The report recommends the immediate construction of the Barka Plant based on the projected need for both power and water by 1988.

Following the Electrowatt study, the Japan International Cooperation Agency (JICA), prepared "The Feasibility Study for the Power and Desalination Complex Plant Project in the Sultanate of Oman," dated August 1985. While providing a great deal of useful information, the report is apparently deficient in several respects, most notably its estimates of cost. In any event the change in economic conditions has changed a fundamental assumption of the study; that sufficient funds will be available to construct the plant whenever required. Although the report does perform various economic calculations to determine the size and type of generators and desalination units, it does not really look at options for phasing investment in the plant. The report does, however, contain useful information for the consultant who will prepare the masterplan.

Based on our discussions with MEW staff, our review of the existing reports and the recommendations of the WASH Team, we believe the fundamental need for the Barka Plant is well established. There are no real options for the location of the plant. A piece of land of sufficient size to permit future development, is not easy to find. The Barka location places the plant at the western edge of the Region between the capital and the rapidly developing Batinah coast. This is the direction in which the Capital is growing. Hence, the plant will be located close to the area from which new demand for both power and water will arise.

The scope of work for an engineering consultant to prepare a masterplan for the development of power and desalination facilities at the Barka site clearly recognizes that more analysis must be done before final design. The scope provides a suitable means for expediting construction of first phase works by having the selected consultant prepare the masterplan, and after its approval, move on to final design. A copy of the scope of work extracted from the RFP is includes in Annex P.

## B. Financial and Economic Analysis

### 1. Financial Analysis

#### a. Rates for Water and Sewer Service

##### (1) Sewers

The only public sewer system which exists in the country serves a small portion of the Capital. In January 1986, the Government began charging users of the system at the rate of 10 percent of the monthly water bill. There is no available information on the cost of providing sewer service so it is not possible to determine how much of the cost of service is covered by the charge. The charge is an important first step, nontheless, in that it demonstrates that the Government accepts the principle of payment for utilities. The use of water utilization to determine charges for sewer service is a widely accepted methodology.

The scope of work for the proposed water/wasterwater masterplan for the Capital Region includes the financial and economic analysis of recommended sewer investments, recommendations regarding sewer charges and proposals for institutional changes, including changes in the financial management of planned sewer systems. Similarly, the scopes of work for the design and construction of pilot water/wasterwater facilities in towns and villages will address financial issues in the context of a total institutional assessment.

##### (2) Water Rates

In the traditional falaj system, the right to a share in the water is bought and sold in free market fashion. As a result, water in Oman has never been viewed as a free good. This principle seems to have been transferred to water obtained from other sources. In towns and villages, people pay as much as $2.60 for a cubic meter of trucked water. By comparison with other countries, the customers of MEW operated municipal water supply systems are accustommed to paying quite high rates for domestic water consumption. (See Table 11.)

For water supplied by MEW, rates were set by a financial circular in 1985 and reaffirmed recently. These rates are as follows:

Government and Domestic use - $1.16 (R.O. 0.448)/M3
Industrial and Commercial use - $1.75 (R.O. 0.672)/M3

Tankers bringing water to homes charge from $0.63 to $1.89. For connections, MEW charges from $91.00 to $156.00 depending on the size of of the pipe. Customers also make a deposit for meters ranging from $78 to $156.

Table 11 Comparison of Water Rates

| Country/Locality | Rates ($ per 1000 U.S. Gallon) |
|---|---|
| Oman | $4.41 |
| Jordan | $3.31 |
| United States | |
| West Coast | $1.07 |
| Denver | $0.42-0.68 |
| Sante Fe | $1.37-2.20 |
| Tucson | $0.66-1.46 |

b. Estimated Cost of Water Service and Extent of Cost Recovery

In 1984, an independent consultant to MOFE prepared estimates of the cost of water sold in the capital and rural areas for the years from 1980 to 1982. For the Capital Region, the consultant used expenditure records from MEW, segregating operations and maintenance cost including fuel, administrative, planning and other overhead expenditures by three cost centers: (1) the Ghubrah Desalination Plant; (2) groundwater production; and (3) distribution. Based on records of capital projects undertaken, the consultant developed estimated tota. investments in the Capital's water system. Fuel costs and capital costs were allocated between power and water at Ghubrah. Charges for capital recovery were based on estimates of asset life and three percent for the cost of capital. Since the water supply system has largely been financed from the government's oil revenue and has not incurred interest expenses, this national cost of capital is appropriate.

The consultant estimated the cost of desalinated water in 1982 at approximately $2.21/M3. The cost of well water is estimated at $.29/M3. The cost of distribution of water was estimated at $.64/M3. The average cost of water in 1982 was $1.80/M3. The consultant found that average revenue from the sale of water was a bit more than the $1.16/M3 charged to domestic consumers. Comparing 1980, 1981 and 1982, the consultant found the average cost of water was declining. This was due to the fact that the output of desalinated water is fixed. Hence, increases in demand were met by increased pumping from well fields.

From the above analysis, it would appear that revenues covered not only all fuel and operations and maintenance costs (which represent about half the cost of water sold), but also provided for some capital recovery. This situation has probably continued through 1986, with more and more water being pumped from the region's well fields. The addition of 2 new units at Ghubrah has more than doubled the output of desalinated water. At this time almost 90 percent of the region's water is coming from Ghubrah in order to give the well fields a much needed rest. With such a large percent of the the Region's water being supplied by desalination and normal increases in the cost of fuel, salaries, etc., the degree to which revenue covers cost must be declining.

The financial consultant attempted to estimate the cost of water outside the capital, but financial records were so scarce, that resulting figures had little validity.

c. Financial Impact of the Barka Desalination Plant and Water System Improvements

Improvements to the transmission and distribution system are likely to have a positive effect on the financial picture. The improvements will reduce operations and maintenance costs because several troublesome pipelines which have had a high rate of breakage will be replaced. Pumping costs may also be reduced as a result of some of these improvements. Barka will significantly increase the capital assets of the system and will also contribute to keeping the percentage of desalinated water in the system at a high level. At the same time the unit cost of producting desalinated water should decline a bit due to the increased efficiency of newer units.

With no change in tariffs, normal increases in fuel costs, salaries, etc. and continued dependence on desalination, revenue can be expected to cover an ever decreasing percentage of the cost of water. The Government is aware of this situation but most responsible officials feel that water rates are already as high as possible for most Omanis.

In the long run, the solution to the financial situation rests with:

- improved water resources management which will permit the greater use of ground water and perhaps recycled effluents (which may or may not be less costly)

- better management of the water system which will result in reduced waste and more efficient operations and maintenance

- a revised tariff structure which will help to conserve water and distribute the burden more equitably.

d. Assessment of the Adequacy of Government Public Utility Accounting

The MEW's accounting system is cash based. Revenues collected are deposited with MOFE, and MEW submits payment vouchers to the MOFE for direct payment to vendors. MEW is provided a quarterly allotment of funds for operating expenses by MOFE. MEW accounts for cash expenditures by posting single entry transaction details in a manual register. Cost accounting and mangement control is made difficult by MEW's division of tasks and budgets. Ghubrah is financially under the control of the Directorate General of Power. Budgets for personnel, vehicles, and other operating expenses are under the control of the Directorate for Administration. Responsibility for capital budgets and expenditures rests with the Directorate General of Projects. The Directorate General of Water handles house connections.

In June 1985, the management firm of Touche, Ross evaluated the feasibility of converting the Directorate General of Electricity to public utility as part of the Power Masterplan. Both this and the financial assessment report discussed above touch on the adequacy of the current accounting system to provide information on the cost of water and cost recovery. Touche, Ross found that MEW does not maintain a register of its assets and their book value. The accounting firm concluded that MEW would have to change its complete accounting system to meet the needs of a public utility.

In sum, current MEW accounting and management information systems are inadequate to furnish the cost data needed to establish the cost of providing water service and thus to develop and evaluate alternative rate structures.

e. Financial Aspects of Project

The Government appears to be interested in a more rational institutional arrangement for its public utilities as evidenced by the Electrowatt masterplan study of the power sector. This includes a tariff study and a study of the feasibility of converting the power components of MEW into a public utility corporation.

In both Subproject II and Subproject III, we have built into the scopes of work for Contracts 2D (Capital Region Water and Wastewater Masterplan) and 3A and B(Engineering Services for Town and Village Water and Wastewater Activities), institution assessments which will address the financial issues in the context of recommended organizational changes. The project will then provide the technical assistance and training Contract 2G (Technical Assistance for Institutional Development and Training) and 3E (Institutional Development & Training for Capital Region & Towns & Villages) required to implement accepted changes, including a new accounting system.

2. Economic Analysis

a. Introduction

Given the diverse nature of the components of the project and the lack of cost and benefit specifications for some of the capital elements which will not be designed and constructed until later in the life of the project, economic analysis cannot be undertaken for the whole project. This analysis attempts to assess the economic benefits which may be derived from various components.

b. Subproject I - Water Resources Planning and Management and the Capital Region Water and Wastewater Masterplan

In formulating a water resources strategic plan and providing support services for a strong central water resources management organization and in providing a long-term plan for the development of the Capital Region's water and wastewater facilities, the project can be expected to rationalize the use of water or reduce water consumption from levels that would otherwise occur making the saved water available for other productive uses. These reductions are likely to result from implementation of conservation measures including alternative water pricing schemes, increasing use of recycled effluent, better control over irrigated agriculture and improvements in irrigation techniques, the use of recharge dams, etc.

Savings in water consumption as a result of project activities are not likely to materialize immediately. It is impossible to place an accurate value on the water saved or to estimate the amount likely to be saved. In order to illustrate the potential value of water resources planning and water system masterplanning, we can utilize the cost of producing desalinated water as a surrogate. The Electrowatt study estimates the cost of water from Barka at $1.38/M3. The estimated cost of the strategic plan, the Capital Region masterplan and support services to the new planning unit of the CCEWR is about $20 million. If we assume that project activities save only five percent of the amount consumed in 1985 in the Capital Region and this savings does not begin until 1990, the internal rate of return (IRR) on the $20 million is 5.0 percent. If the amount of water saved is increased by fifty percent, the IRR is 9 percent. If we assume planning and studies will reduce the growth of demand from 1993 to 2011 using a projected demand growth of 10 percent through the year 2000 and five percent thereafter, the IRR jumps to 18 percent. This level of growth is the lowest of the three projections in Figure 1. (See Table 12).

The lowest calculation is very conservative both in terms of the value assigned to the water saved ($1.38/M3) and the amount of water saved (5 percent of 1985 consumption in the Capital). The assumption that project activities will actually save five percent of projected demand for water each year beginning in 1990 is probably more realistic. Projected demand in 1990 ranges from 119 to 139 percent of the 1985 amount. The value of these savings is 75 percent greater than savings based on five percent of 1985 consumption and this only takes into account consumption in the Capital Region. The strategic plan, and planning unit will have a national effect.

Oman recently borrowed in the European money market to cover a portion of its budget deficit. The interest on the loan was 8 and 5/8th percent. Bank lending in Oman is at an interest of about 10.2 percent. The opportunity cost of capital can therefore reasonably be expected to fall with the range set by government

Table 12

ECONOMIC ANALYSIS OF STUDY AND PLANNING BENEFITS

| | Value of Water per m3 | $1.38 | Value of Water per m3 | $1.38 | Value of Water per m3 | $1.38 |
|---|---|---|---|---|---|---|
| | Internal Rate of Return | 5% | Internal Rate of Return | 9% | Internal Rate of Return | 18% |
| YEAR | | BENEFITS | | BENEFITS | | BENEFITS |
| 1987 | Studies and Planning Costs | -5.04 | Studies and Planning Costs | -5.04 | Studies and Planning Costs | -5.04 |
| 1988 | | -7.42 | | -7.42 | | -7.42 |
| 1989 | | -2.42 | | -2.42 | | -2.42 |
| 1990 | | -2.26 | | -2.26 | | -2.26 |
| 1991 | | -2.21 | | -2.21 | | -2.21 |
| 1992 | | -1.17 | | -1.17 | | -1.17 |
| 1993 | Benefits of reduced growth in | 1.99 | Benefits of reduced growth in | 2.98 | Benefits of reduced growth in | 4.31 |
| 1994 | water consumption equal to | 1.99 | water consumption equal to | 2.98 | water consumption equal to | 4.73 |
| 1995 | 5 % of 1985 Capital Region use | 1.99 | 5 % of 1985 Capital Region use | 2.98 | 5% of annual projected demand | 5.21 |
| 1996 | | 1.99 | plus 50 %. | 2.98 | with demand projected to | 5.73 |
| 1997 | | 1.99 | | 2.98 | grow at 10 % per year thru | 6.31 |
| 1998 | | 1.99 | | 2.98 | 2000 and 5 % thereafter. | 6.94 |
| 1999 | | 1.99 | | 2.98 | | 7.63 |
| 2000 | | 1.99 | | 2.98 | | 8.01 |
| 2001 | | 1.99 | | 2.98 | | 8.41 |
| 2002 | | 1.99 | | 2.98 | | 8.83 |
| 2003 | | 1.99 | | 2.98 | | 9.27 |
| 2004 | | 1.99 | | 2.98 | | 9.74 |
| 2005 | | 1.99 | | 2.98 | | 10.22 |
| 2006 | | 1.99 | | 2.98 | | 10.74 |
| 2007 | | 1.99 | | 2.98 | | 11.27 |
| 2008 | | 1.99 | | 2.98 | | 11.84 |
| 2009 | | 1.99 | | 2.98 | | 12.43 |
| 2010 | | 1.99 | | 2.98 | | 13.05 |
| 2011 | | 1.99 | | 2.98 | | 13.70 |

borrowing and commercial lending. An investment which should earn 9 percent and is more likely to earn 18 percent represents a wise use of resources and these elements of the project must be viewed as economically feasible.

c. Capital Region Water System Improvements

The transmission and storage inprovements to be constructed under the subproject have been subject to a least cost analysis in the feasibility study performed by WASH. The results of this analysis are addressed in Section V.A.2.b.

Barka has been evaluated from the economic point of view in both the Electrowatt power masterplan and the JICA feasibility study. The masterplan evaluates the economic viability of the plant in the context of meeting Oman's total power needs. The evaluation takes into account such factors as the cost of fuel, and alternate methods of meeting project demand for both water and power. The JICA study attemps to evaluate the economics of unit sizes and the types of general power equipment. The masterplan for Barka which will be financed under the project will have to accept as a given that a desalination and power plant will be built at Barka. Otherwise the consultant will be required to restudy both the financial and economic aspects of the project in great detail in order to be able to recommend a cost effective program of staged development.

The scope of work for the masterplan for water and wastewater includes a requirement for detailed economic evaluations of alternative methods of meeting the Region's water and wastewater needs over a 25 year period. The present value of each alternative's capital, operations and maintenance costs will be calculated using appropriate shadow prices and discounted over the selected planning horizon.

d. Town and Village Water and wastewater Pilot Activities

The scopes of work for the selection, design, construction and evaluation of pilot activities provide for detailed economic evaluations of proposed activities. This is particularly important in view of the experimental nature of the activity. The project will seek to balance levels of water and wastewater services against the cost. Furthermore, the subproject seeks to provide a standard procedure for evaluating town and village needs and determing how to provide services most economically.

In the development of alternative water and wastewater programs for the towns, various levels of service and various means of providing service will be studied. Some of the alternatives will include house connections, standpipes, trucked water, public versus private latrines, septic tanks, versus water borne sewage systems. Since alternatives will include great variations in levesl and amounts of service provided, the determination of

which alternative is the least costly will be difficult. To assist in this assessment, the cost of providing the differential benefits among the schemes being considered will be segregated. Specifically, the present worth of the incremental capital and operating costs of serving differing numbers of beneficiaries and of providing differing levels and quantities of service as well as other benefits will be separately identified. The corresponding per beneficiary costs will also be computed, and, as may be appropriate, compared to the present worth of the capital operating costs of methods now used by or available to households for securing water and disposing of wastes. Once an alternative program has been selected on the basis of the least cost, as well as financial, technical , environmental public health and cultural factors, a water/wastewater project will be designed and the cost effectiveness of the alternative selected will be subjected to further tests.

For the village pilot projects, alternatives to be examined include wells, various methods of treating falaj water, trucking, varying levels of service to customers including tankers, public storage and standpipes, alternative energy sources and methods of pumping water. For sanitation individual and communal facilities will be investigated. These will include septic tank systems, pour flush latrines as well as other methods. To identify the least costly alternatives among these varying systems and levels of service, capital and operating costs of each will be estimated for typical village sizes and locations. The alternative system costs will then be compared on the basis of cost per inhabitant served, per unit of water delivered, etc. After screening the alternative systems on the basis of least amount of cost as well as cultural, environmental, public health and technical factors, the remaining alternative systems will be applied to pilot villages. Since the pilot villages will be selected to provide the broadest possible range of conditions, the least costly system will vary from village to village giving differences in potential water sources, topography, settlement patterns, population size, etc.

C. Environmental and Social Analysis

The proposed project has been developed to include environmental and social analyses as an integral part of the design and implementation of each subproject. Implementation of the project is anticipated to have significant positive impacts on the environment through the improved management of water resources, enhanced ability to protect water quality and the establishment of a coordinated approach to the provision and upgrading of water and wastewater services. Social impacts and beneficiaries will be widespread as the project improves water and sanitation services and increases long-term water availability for all Omani's working and living in the project area. It is important to note that the project provides for a variety of types of activities which will support the institutional and human resources development of environment and natural resources management organizations. Preparation of the environmental and

social soundness analysis plans for the project benefited from field visits in January-February, March and December, 1985 by Dr. Stephen F. Lintner, Environmental Coordinator, Bureau for Asia and Near East and in January 1986 by Dr. Pamela R. Johnson, former Social Science Advisor, Bureau for Near East.

It is the objective of the Sultanate of Oman that all development activities, both public and private, will be conducted in an environmentally sound manner to assure the long-term interests of the nation and its people. Government of Oman policy requires that all development projects should be safe, should not damage the natural environment or cultural heritage of the country and should maintain, and, if possible enhance the ammenities of the areas where they are located. In addition, it is the policy of the Government of Oman to improve the public health of its citizens through investment in major programs to improve water and wastewater services in active support of the goals and objectives of the International Drinking Water Supply and Sanitation Decade (1981-1990).

To support the attainment of these objectives the Government of Oman has both passed significant environmental legislation and is actively pursuing improvements in water and wastewater management and services. The Law on the Conservation of Environment and Prevention of Pollution (Royal Decree 10/82) requires that an Environmental Impact Statement be submitted with the application for any license for a development project. The Environmental Impact Statement must be accompanied by a No Environmental Objection (N.E.O.) certificate issued by the MEWR. The certificate serves to assure that the project has received proper environmental review and that any required modifications in the design and/or mitigation activities have been incorporated into the project design.

The MEWR became operational on September 1, 1985 and is presently staffed with a mixture of Omani and expatriate personnel. The Ministry is presently active in the implementation of its responsibilities for environmental oversight and monitoring. It is currently reviewing Environmental Impact Statements and issuing No Environmental Objection certificates.

In order to support the Government of Oman in implementation of the requirement for the preparation and use of Environmental Impact Statements (Omani terminology) in the project design and implementation process, it is planned that Omani procedures will be substituted for those of 22 CFR 216, "A.I.D. Environmental Procedures" for the purpose of implementing all subprojects, other than Subproject II, Contract 2D - Masterplan for Long-Term Water Supply and Wastewater Improvements, will require an Environmental Impact Statement (Contract 2E and F).

The adoption of such an approach to environmental review for A.I.D. funded projects is authorized by the provisions of 22 CFR 216.9 which states that "concise reviews of the environmental issues involved including summary environmental analyses or other

appropriate documents" may serve as a substitute for an Environmental Assessment. The preparation of a comprehensive Environmental Impact Statement for the Capital Region Water and Wastewater Master Plan will be required to meet both Omani and A.I.D. procedures for the preparation of such studies. Preparation of an Environmental Impact Assessment (A.I.D. terminology, 22 CFR 216.7) for the Master Plan rather than the more common Environmental Assessment (A.I.D. terminology, 22 CFR 216.6) is required because of the proposed alternative of marine disposal of treated wastewater.

Authority to issue A.I.D. environmental clearances for activities subject to the preparation of standard Environmental Impact Statements (Omani terminology) has been delegated to the Environmental Officer, Omani-American Joint Commission by the Environmental Coordinator, Bureau for Asia and Near East. It should be noted, however, that the comprehensive Environmental Impact Statement for the Capital Area Water and Wastewater Master Plan will be supervised, reviewed and cleared by the Environmental Coordinator.

At the request of Omani authorities all studies of social impacts, as described in A.I.D. Handbook 3, Appendix 3F, "Social Soundness Analysis", will be conducted as either: (a) elements of the Environmental Impact Statement following U.S. domestic practice or (b) as elements of broader technical studies funded under the project. This approach was requested in order to both conform to the approach used in the preparation of Omani Environmental Impact Statements and to assure the direct integration of social analyses into project design and implementation.

Social Analysis sections of standard Environmental Impact Statements or other project funded studies will include, as appropriate the following items: an analysis of beneficiaries; an examination of the social acceptability of the proposed intervention; the identification of key social issues which will influence successful implementation, operation and maintenance; the identification of priority activities to promote public awareness to assure support at the local level for improved water management and sanitation practices; and development of analyses of the potential for the spreading and diffusion of institutional and technical interventions supported by the project. It should be noted that the scopes of work for all subprojects require the use of a bilingual (Arabic/English) social scientists with demonstrated knowledge of social, economic and political conditions in Oman.

Planned environmental and social science inputs are described below for each proposed subproject.

Subproject I - Water Resources Management and Planning

Contract 1A - Executive Support Services to the Water Resources Council

This activity is not subject to formal environmental review as it is a technical assistance activity. It will, however, promote improved water resources management and assure the protection of groundwater quality. The scope of work requires the provision of an interdisciplinary professional staff to assure the integration of environmental and social concerns into the planning activities of the CCEWR. All studies prepared under the Subproject will include analyses of environmental and social issues as appropriate. It should be noted that the Subproject includes funding for the training of Omani personnel in water resources management.

Contract 1B - Preparation of National Water Resources Strategic Plan

This subproject is not subject to formal environmental review. Its successful implementation is critical to assure the sustained availability of water in an adequate quantity and quality for agricultural, domestic, governmental and industrial users in Oman. The plan is especially important for the long-term protection of groundwater and the control of salt water intrusion into coastal aquifers. In addition, the scope of work will provide for preparation by an interdisciplinary team of an analysis of the social acceptability of water and wastewater service treatment and disposal alternatives. It will include an analysis of beneficiaries and social impacts. The scope of work requires provision of an interdisciplinary staff to assure integration of environmental and social concerns into the Strategic Plan.

Subproject II - Capital Region Water Supply Improvements and Wastewater Planning

Contract 2A - Engineering Services for Design and Supervision of Construction of Priority Water System Improvements

and

Contract 2B - Construction of Priority Water System Improvements

All project-funded construction activities will be subject to the preparation of site specific Environmental Impact Statements as required under Omani law. These statements will conform with Environmental Impact Guidance Notes - Form L (Infrastructure Projects) and will fulfill the environmental requirements of both the Government of Oman and A.I.D. They will include an analysis of beneficiaries and social impacts. Preparation of the Environmental Impact Statements shall include consultation with the Ministry of Heritage and Culture to determine if proposed

actions would potentially impact archaeological and/or historical sites. The Ministry shall be requested to provide an archaeologist to survey sites of reservoirs, pump station sites and the right-of-ways for transmission mains and pipelines. An analysis shall also be made of potential impacts to rare and endangered plant and animal species and/or their critical habitats.

Implementation of subproject activities may result in the local disruption of water, power and telephone services to an undetermined extent due to the cutting of unmapped services lines during construction. Construction areas will also experience substantial short-term increases in noise and dust associated with construction activities. Possible breakage of glass may occur due to use of explosive charges for excavation of rock, if such explosives are used.

The statements will be submitted for concurrent review and approval by the MEWR and the Environmental Officer, Omani-American Joint Commission. No construction will be authorized nor will the studies be determined to be complete until both a No Environmental Objection (N.E.O.) certificate is issued by the MEWR and an environmental clearance issued by the Environmental Officer. Copies of the Environmental Impact Statements, No Environmental Objection certificates and Environmental Officer's clearance shall be submitted to the Environmental Coordinator, Bureau for Asia and Near East for inclusion in permanent Bureau environmental files.

Contract 2C - Action Plan for Resolution of Priority Wastewater and Septage Disposal Problems

This contract funds a short-term study of septage and wastewater disposal. It will only recommend conceptual solutions and provide an action plan which will lay out a program of more detailed feasibility and design studies. The study, if undertaken, will include at least a brief analysis of the environmental impact of recommendations. The detailed preparation of site specific Environmental Impact Statements as required under Omani law will have to be prepared by those responsible for the subsequent studies.

Contract 2D - Masterplan for Long-Term Water Supply and Wastewater Improvements

The project will support preparation of a detailed interdisciplinary study of the social acceptability of water and wastewater service, treatment and disposal alternatives in the Capital Region as part of the Masterplan. This study will provide both general and site specific information concerning social attitudes with regard to the siting of wastewater treatment facilities, the restricted reuse of treated wastewater for irrigation and/or aquifer recharge and the marine disposal of treated wastewater. The study will include an analysis of

factors and concerns which must be addressed in design and implementation of the Capital Area Water and Wastewater Master Plan and its associated Environmental Impact Statement. General social science input will be provided to project funded advisory services and planning studies through the participation of a social scientist on the interdisciplinary teams.

The development of the Masterplan also will be supported by the preparation of a comprehensive Environmental Impact Statement (U.S.terminology). To provide required data for sea disposal of wastewater, the subproject will also fund oceanographic studies to support the development of the Capital Region Water and Wastewater Masterplan since it involves offshore discharge of effluent.

Contract 2F - Environmental Impact Statement for Proposed Water and Wastewater Improvements

The development of the Master Plan will require the preparation of a comprehensive Environmental Impact Statement under both Omani law and the provisions of 22 CFR 216, "A.I.D. Environmental Procedures." Preparation of an Environmental Impact Statement under the A.I.D. procedures is required because the proposed alternative of marine disposal of treated wastewater on an interim and/or long-term basis will have an impact on the Indian Ocean, an area which is outside the jurisdiction of any nation. In addition, the study shall serve to support the implementation of the "Kuwait Regional Conference of Plenipotentiaries on the Protection and Development of the Marine Environment and Coastal Areas" (Kuwait Action Plan) sponsored by the Regional Seas Program of the United Nations Environmental Programme. This agreement has been ratified by the Government of Oman and is presently being implemented by the Regional Organization for the Protection of the Marine Environment (ROPME) headquartered in Kuwait.

The study will comply with content and format requirements for Environmental Impact Statements of both governments and will follow a detailed scope of work cooperatively prepared by the Environmental Coordinator, Bureau for Asia and Near East, A.I.D. and representatives of the Ministry of Environment of Oman. The Statement will be prepared by an independent consultant and will include the use of a "scoping session" in the refinement of the scope of work.

The Environmental Impact Statement will be a concise document which will provide an analysis of the potential environmental impacts of the proposed action, identify reasonable technical alternatives, review possible alternatives for phased implementation and propose mitigation activities to avoid or reduce adverse impacts. All proposed alternatives and mitigations should be pragmatic, cost-effective and implementable. Their evaluation should include an analysis of

capital cost, recurrent cost, institutional responsibility, personnel and training requirements and an assessment of reliability under Omani conditions. The Environmental Impact Statement will be prepared in both a formal draft and final forms. It will be prepared in two volumes, a bilingual Executive Summary in Arabic and English and a Technical Report in English with an Arabic title page, table of contents and summary.

The Environmental Impact Statement will focus on issues concerning the environmental impacts of the siting of proposed facilities, restricted reuse of treated wastewater for irrigation and/or aquifer recharge, and the disposal of treated wastewater in the marine environment. These studies will benefit from detailed oceanographic studies and an analysis of the social acceptability of water and wastewater service, treatment and disposal prepared under other subprojects. The Statement will include a detailed beneficiary analysis and review any special public awareness activities which should be undertaken to support environmentally safe reuse of treated wastewater. Sections of the Statement will analyze potential environmental impacts, alternatives and mitigation actions as they relate to: (1) the protection of archaeological and historical sites; and (2) the protection of rare and endangered plant and animal species and/or their critical habitat. The statement will also include a detailed environmental monitoring program and identify equipment and training requirements for its implementation.

The scope of work for the Environmental Impact Statement requires that the consultant conduct a series of three technical seminars concerning the following topics: (1) the Environmental Impact Statement process as practiced in the United States; (2) the environmental and social analysis of issues concerning the restricted reuse of treated wastewater for irrigation and/or aquifer recharge; and (3) the environmental and social analysis of issues concerning the disposal of treated wastewater. It is also planned that the Government of Oman will provide an Omani staff member from the MEWR and MEW. The scope of work also authorizes the consultant to conduct special training sessions for Omani personnel assigned on topics relevant to the study.

Due to the complex nature of the study, the Bureau Environmental Coordinator will conduct a series of field visits to support the Omani-American Joint Commission and the Ministry of Environment in the preparation and review of the Statement and the development of the environmental mitigation plan for use in project implementation. The Environmental Coordinator will also be responsible for coordination with the President's Council on Environmental Quality (CEQ) on procedures for review and filing of the Environmental Impact Statement.

Subproject III - Town and Village Water and Wastewater Pilot Activities

The Subproject will provide support for the design and possible implementation of a series of small scale water supply and

wastewater facilities on a pilot basis. All subproject funded studies and construction activities will be subject to the preparation of site specific Environmental Impact Statements as required by Omani law. These Statements will conform with Environmental Impact Statement Guidance Notes - Form L (Infrastructure Projects) and will fulfill the environmental analysis requirements of both the Government of Oman and A.I.D. Preparation of the Environmental Impact Statements shall include consultation with the Ministry of Heritage and Culture to determine if proposed actions would potentially impact archaeological and/or historical sites. An analysis shall be made of potential impacts on rare and endangered plant and animal species and their critical habitats.

The interdisciplinary design team which will prepare the plans for the facilities will include an environmental health advisor and a social scientist. The Environmental Impact Statements will provide an analysis of beneficiaries, analyze the potential for diffusion of the intervention demonstrated by the pilot activity and provide an analysis of social issues associated with implementation, operation and maintenance and public awareness activities.

The Statements will be submitted for concurrent review and approval by MEWR and the Environmental Officer, Omani-American Joint Commission. No construction will be authorized, nor will studies be determined to be completed until both a No Environmental Objection (N.E.O.) certificate is issued by the Ministry of Environment and an environmental clearance issued by the Environmental Officer. Copies of the Environmental Impact Statements, No Environmental Objection certificates and Environmental Officer's clearance shall be submitted to the Environmental Coordinator, Bureau for Asia and Near East for inclusion in permanent Bureau environmental files.

At the village level, the studies and analyses carried out by this project will assist Omani institutions to answer questions of acceptability and feasibility related to a wide range of issues. Annex O summarizes the broad range of human factors that need to be considered in planning for the management of water resources, water supply and wastewater. In addition to these general concerns, those specific issues that require particular attention in Oman include:

- the significance of the falaj to rural life and agriculture

- the critical nature of water rights in Oman and the complexity of introducing significant change in traditional water rights, practices and laws

- the conditions under which wastewater can be reused

- expectations regarding levels of service and treatment of water and wastewater

Because of the nature of this project, these issues will be addressed during project implementation. Provision for appropriate study has been incorporated into terms of reference and budgets for the relevant portions of the project. In addition, an assessment of the acceptability of water and wastewater service, treatment and disposal alternatives will be carried out as part of the background work for the national strategic plan.

Recommendations regarding changes in the falaj system will be particularly difficult to implement. As an A.D. Little report on agriculture notes, "In the short run, Oman has no choice but to maintain its falaj system if agricultural production is to be maintained and expanded. Even if it were desirable to do so and alternatives available, the country cannot rapidly switch to a new water supply system . . . socio-political considerations require a slow transition to any new system."

Information on the falaj system will be important both for the water resources and towns and villages components of the project. A number of studies have been made of the operation of the falaj in a specific village. However, there remain significant information gaps that will need to be filled to permit the identification of alternative water management schemes, evaluation of the importance or social importance of a particular falaj, and the development of national policies regarding agricultural water supply or the role of the falaj.

## D. Beneficiary Analysis

### 1. Introduction

No single sector could be as critical for Oman's future development and the well being of its population as water. The decisions with respect to water allocation and management that are ahead hold the key to future settlement patterns, economic prospects in the post-oil era and the quality of life for the residents of Oman.

The direct beneficiaries of the project include residents of the Capital Area, rural towns and villages and recipients of training. This project will, through technical studies and assistance, strengthen the capacity of the Government of Oman institutions to assess and plan for the potentially far-reaching benefits and impacts of investments and decisions in the management of their water resources. The principal potential direct and indirect impacts which will receive ongoing consideration during project implementation include:

- Alterations to current allocations of water resources that could affect rural incomes, land and water values, and settlement patterns, including urbanization.

- Potential disruption, resettlement, and inconvenience due to acqusition of sites and rights of way, and construction of works and facilities.

- Possible increased costs and/or restrictions on the use of water for domestic, commercial, industrial and agricultural purposes (with particular reference in towns and villages to modifications to the falaj system).

### 2. Subproject I - Development of Water Resources Management and Planning Organization

The water resources management and strategic planning component of this project includes provisions for technical studies and assistance to enhance the capability of Omani institutions to assess and plan for the impacts of water resource allocation decisions. The terms of reference and budget for the strategic plan and for the executive support services reflect the need to: identify beneficiaries; to consider the human impacts of recommendations; and to present data to Omani decision-makers on the magnitude of potential impacts of alternate scenarios.

### 3. Subproject II - Capital Region Water Supply Improvements and Wastewater Planning

The estimated 350,000 residents of the Capital Area will benefit from the results of coordinated comprehensive water and wastewater planning, the construction of priority water system improvement projects, and strengthened sectoral institutions. Together with anticipated Government of Oman future investments in

wastewater collection and treatment, this will result in improved water quality and reliability, greater access to services for populations of all income levels, and the health and other benefits associated with improved water supply and appropriate wastewater management. For some users, especially those currently unserved by municipal water, there is the potential for cost savings as they are able to switch from trucked to piped water.

In addition to a wide range of studies and analyses to be carried out in preparation of the Master Plan, the study for the preparation of the Environmental Impact Statement will identify beneficiaries and any potential adverse impacts on human populatior and develop a mitigation plan if required.

4. Subproject III - Town and Village Water and Wastewater Pilot Activities

The pilot program of water and sanitation for towns and villages will benefit the residents of those three towns and twenty villages where improvements are introduced, recipients of training, and, as the program is replicated by Government of Oman investment, residents of other Omani towns and villages. It is estimated that two-thirds of Oman's total population lives in the rural areas, in 25 towns and some 1300 villages. Given average populations, an estimated 2000 villagers and 24,000 town residents will benefit from improved water supplies and sanitation. In addition, preliminary studies for an additional 80 villages will make it possible for the Government of Oman to extend the program to an additional 8000 villagers and consider nationwide replication.

E. Institutional Analysis

1. Introduction

This project has a dual purpose which couples institutional development with the improvement and expansion of infrastructure needed for providing a safe and reliable supply of water to meet Oman's current and projected needs. More specifically, the project will initiate development of the institutions and human resources required to effectively plan and manage the country's water resources in a rational and coordinated manner, as well as the facilities to improve the delivery of water and sanitation services in the Capital Area and selected towns and villages of Northern Oman.

The institutional analysis which follows is intended to provide additional information on the status of water and wastewater sector institutions in Oman, to explore project feasibility from an institutional perspective, and to highlight institutional issues which have been addressed during the course of project development.

## 2. Status of Sector Institutions

In the course of developing this project, its designers have made preliminary assessments of sector institutions and identified deficiencies in current institutional arrangements as the basis for drawing certain conclusions about the need for institutional and human resource development in the sector. Section III.B.2, describes the institutions which have had responsibility for water and wastewater in Oman, as well as new actors on the scene. It also discusses the evolution of these institutions, their current responsibilities, and the nature of relationships among them.

A key finding concerns the large number of institutions responsible for the development and/or exploitation and utilization of water resources and for wastewater. At least nineteen Omani organizations have been identified as currently having some sectoral responsibilities. This proliferation reflects the importance attached to the issue of water in Oman because of the scarcity of water resources, the sector is one which touches all facets of Omani life today and impinges on prospects for Omani development generally. Therefore, many Government agencies have water resources-related concerns and responsibilities which overlap. However, no single Government body has been capable of addressing major water resources issues.

This can be attributed in part to a distinct shortage of data, studies, and planning tools which would have facilitated a better understanding of the status of water resources in Oman, as well as the nature and extent of demand. Thus, although PAWR initiated a well-regarded program of exploratory studies which is yielding valuable data on the country's resources, no Government organization has yet begun to use this and other needed information as the basis for seriously exploring strategy options.

The historical lack of effective coordination among sector institutions has also been an impediment to the articulation of a national water resources policy. The Water Resources Council (WRC), which had nominal authority to articulate a national water policy addressing both water resource development and use, has been largely ineffective. The WRC did not exhibit the political will to take charge of the sector. This can, in some measure, be attributed to the fact that the Council did not have a support technical group which could recommend implementable policy.

In addition to the fragmentation of institutions responsible for developing a national policy for the development and use of water resources in Oman, there are many inadequacies in current water/wastewater facilities planning and service delivery. In the Capital Area, MEW has proceeded to develop and expand wells and desalination plants, as well as transmission and distribution facilities but not at a pace sufficient to keep up with development. The Diwan, on the other hand, has only very partially addressed the issue of wastewater collection, treatment, and

disposal, with the result that large amounts of untreated sewage now contaminate the environment. No mechanism currently exists for coordinating water and sewerage facilities planning or service delivery in the Capital Area.

In the towns and villages of Northern Oman, the situation is worse. Only three towns have piped water systems developed by MEW; none of the towns or villages have systems for the collection of wastewater, although MRM has nominal responsibility for this function and has apparently done some physical facilities planning. Most communities rely on an inadequate number of Government-drilled and hand-dug wells or on deteriorating falaj systems for drinking water as well as irrigation. The current drought is highlighting the inadequacies of these water supplies. Throughout Northern Oman cultivation is being cut back, and as a last resort some villages are being abandoned entirely.

Inadequacies in rural water facilities and the complete lack of attention to sanitation are in some measure attributable to gaps in coverage of government programs and insufficient resources. Although there are both traditional local leaders and regional government administrative units, decision-making is evidently centralized. Allocation decisions appear to be highly susceptible to the influence of individual leaders, and service delivery is uneven. Further, there is a general tendency for the rural areas, which are losing population to the Capital Area and the larger towns, not to be able to command their fair share. This was recognized by the Government and, in conjunction with preparing the Third Five-Year Plan, it was announced that greater attention would be paid to the needs of the towns and villages.

Although the quality of urban and rural sector institutions is variable, they share certain deficiencies in staffing and in their administrative practices and procedures. In the area of staffing, like most Omani organizations, water and wastewater sector institutions are heavily dependent on expatriate contractors. At present, long- and short-term contractors are involved in all aspects of system design, development, operations and maintenance. There is little evidence of adequate Omani capability to manage them. A number of administrative and procedural deficiencies have been noted elsewhere in the PP. For instance, the Financial Analysis discusses in detail several areas, including accounting, in which MEW needs assistance. Other examples include the need for coordination in the issuance of well permits, regulation/licensing of contract well diggers, and the availability of free or highly subsidized loans for mechanized pumps and irrigation equipment.

### 3. Prospects for Strengthening Sector Institutions

In January 1986, the Government underwent a partial reorganization which addresses some of the institutional deficiencies which have been noted. This may, in some measure, be the result of the dialogue which the Joint Commission has been

conducting with the Government during the course of project identification and development.

The need for a strong, centralized water resources planning and management organization was identified as the core issue very early in the project design process and immediately brought to the attention of key Omani officials, including the Deputy Prime Minister for Financial and Economic Affairs. In January, the Ministry of Environment was retitled the Ministry of Environmental and Water Resources (MEWR) and assigned responsibility for the management of Oman's water resources. At the same time, a new Council for Conservaion of Environment and Water Resources (CCEWR), combining the responsibilities of the WRC and those of the Council for the Conservation of the Environment and Prevention of Pollution, was created, with the Minister of Environment and Water Resources as its Vice Chairman.

These changes suggest a sincere Government commitment to rationalizing the current proliferation of sector institutions and the lack of coordination among them. In particular, the reorganization provides a central point of focus for planning, developing, and managing the country's water resources and for balancing the competing demands of the domestic, commercial, and industrial sectors with those of the agricultural sector. However, the role, functions, and authorities of MEWR and CCEWR remain to be resolved and both lack an executive arm with technical capability.

PAWR, which acted in support of the WRC, is undertaking high-quality groundwater testing programs, mapping, and evaluation work. It is also conducting an ongoing basic assessment of the water resources of Oman and gaining an understanding of how these resources could be exploited which will serve as essential background for the development of a water resources master plan. PAWR will now serve the CCEWR, as it did WRC.

The implicit strategy for institutional and human resource development in this project should be noted. Basically, what is hoped for, in the Omani context, is a staged increase in the capabilities of local institutions and Omani staff. In the short run, Omani contracting entities must learn to better manage expatriate contractors so that they get more mileage out of them. Simultaneously, the Government should identify candidates for long-term training, with a view toward getting control over key policymaking and contract management positions in the medium-term. In the longer run, the Government will want to "Omanize" sector institutions by identifying and training enough Omanis to replace its contractors, before the country's oil runs out and it is no longer in a position to afford the high cost of heavy dependence on expatriate assistance.

The need for institutional and human resource development at both the national policy planning and service delivery levels is addressed throughout the project. Subproject I will provide the information and planning tools necessary for the development of a

water resources strategic plan. The review and approval of this document by the Government will put it in a position to undertake a systematic program of resource development as well as establish priorities for water use. A critical assumption is that the Governmnent will in fact adopt the strategy and enforce compliance with it.

Subproject II for the development of Capital Area institutions and facilities and Subproject III for the development of institutions and facilities in the outlying towns and villages both include components addressed to the identification of current institutional deficiencies as the basis for exploring alternative organizational arrangements. Follow-on contracts are planned to address implementation of recommended changes.

Short-term training is already being provided in the water resources area under the Commission's ongoing training project. In addition, advisors under this project will be charged with helping the Government identify candidates for medium- and longer-term training and the project includes funds to cover training costs.

Certain other project outputs will provide water and wastewater service delivery institutions with important planning tools and data. The Capital Area master plan will provide a basis for integrated water and wastewater planning, as well as service delivery. It may go so far as to recommend an integrated water/wastewater institution for the Capital Area. In the case of the towns and villages program, consultants will pilot varied approaches to improving service delivery with a view toward the Government replicating successful ones widely. They will also recommend institutional changes to strengthen planning and improve services. The extent to which these project outputs contribute to the achievement of project purpose will be a function of the acceptability of individual contractors, the quality of their work, and the political will of the Government of Oman to rationalize water resource planning and development and resource allocation, as well as improve the level of service delivery in both urban and rural areas.

Interestingly, current heavy reliance in Oman on expatriate assistance in all aspects of water/wastewater system planning, design, development, operations, and maintenance should defuse an issue which is increasingly associated elsewhere with the provision of large amounts of costly U.S. technical assistance. The resistance which expatriate advisors meet in many developing country settings should not be a problem for this project.

Finally, a continued dialogue between the Government and the Joint Commission in support of the implementation of study recommendations and project outputs generally will be helpful. Planned reviews within the Government of key project outputs--e.g., the Strategic Water Resource Plan and the Capital Area master plan--will present regular opportunities for addressing these concerns at the highest levels.

## F. Administrative Analysis

### 1. Joint Commission Experience with Omani Government Project Management

The Commission has a mixed experience with Omani Government project management. The Wadi al-Khawd Aquifer Recharge Dam and School Construction Projects have been handled fairly well by the implementing organization. The Commission's two technical assistance projects, on the other hand, have not run as smoothly.

In analyzing the Commission's experience with project management on the part of the Government of Oman, a number of factors standout.

- Omani government organizations are thinly staffed with personnel (both expatriate and Omani) of uneven quality.

- Competent officers (both Omani and expatriate) tend to be overloaded with work.

- The Oman Government has had considerable experience in contracting for engineering services and the construction of major capital projects.

- Omani Government organizations rely heavily on their consultants and exercise relatively little quality control over their work.

- Omani Government financial management of contracts varies from organization to organization depending on the competence of staff.

- The Government of Oman is a very "top down" operation. Only a few very senior officers can make decisions.

The Commission is heavily involved in day-to-day project and contract management. Although competent Government officers help make things run more smoothly, they are usually too busy to do more than be briefed by Commission staff and make the required decisions. On the financial side, the Commission's controller thoroughly reviews every payment voucher.

Set forth below is a more detailed evaluation of the implementation ability of each Omani Government unit potentially involved in the project to function effectively in implementing project activities. By and large, implementing project activities reqires the ability to contract for services and supervise contractors. The Implementation Plan in Section V of the project paper takes into account the results of this analysis.

## 2. Evaluation of Omani Government Organizations Involved in the Project

### a. CCEWR

The CCEWR itself is a ministerial body which reviews, approves and decides. It delegates operational responsibilities to other organizations. It has a secretariat which came from the CCEPP. The secretariat had extensive operational authority for the enforcement of environmental rules until the MEWR was created. It still has some operational functions. Recently this unit procured air pollution monitoring equipment. The relationship of the secretariat to the Council and MEWR have yet to be worked out. This will, presumably, be done in the process of creating the new planning unit. The ability of the secretariat to function effectively as an implementing organization is unknown. Much depends on who is the secretary general of the organization.

Because of the perceived weakness of the CCEWR as it is currently organized, the Commission is seeking significant organizational changes. Also, as noted in the project description, the consultant will have to have an operational role in water resources planning, if planning is to be done in the next five years. The major problem will be to identify a small number of capable Omanis who can be trained to take over key policy and contract management positions in the proposed planning unit. The planning consultant will be expected to play a major role in assuring the quality of work by the strategic plan consultant. Regardless of who contracts for services, the Commission will have to play a major role in the process.

### b. PAWR

The PAWR is a reasonably well-run organization, capable of contracting for services, drilling and studies. It supports an extensive field staff, handles the compilation and analysis of data and acts as a secretariat to the old WRC. It has recently been transferred to the CCEWR and is now under the direction of the Minister of Environment and Water Resources. The extent of PAWR's involvement in the project has not yet been defined. If PAWR is responsible for implementing any element of the project, we would expect relatively few problems.

### c. MEW

MEW's Directorate General for Projects and Directorate General for Water have a number of well, qualified personnel. The Directorate General for Projects has successfully managed a large number of large projects. The extension of the Ghubrah Desalination Plant which cost about $90 million is a good example. Recently the Directorate contracted with GE for the installation of three gas turbines at Rusail. Kuljian is the consultant. MEW staff are, unfortunely overextended and are forced to rely heavily on their engineering consultants.

The most likely source of problems in project/contract management will be MEW's lack of familiarity with AID procurement procedures and the staff's lack of time to actually undertake such tasks as writing RFPs, developing evaluation criteria and reviewing consultants' reports. We expect MEW will play an active and effective role in evaluating proposals and bids, selecting contractors and negotiating contracts. Contracts for engineering services will have to assign as much responsibility as possible to the contractors and state clearly exactly what is to be delivered when in order to ease project implementation and the management of the contractors.

With a properly designed contract, MEW should be able to effectively handle the supervision of engineering contractors to assure that they are doing the job they are hired for. However, the Commission will have to monitor MEW's performance closely to assure that the contractors are receiving the attention they require.

When the institution building and training activities begin, the need to free overburdened staff will become a problem. The consultant preparing the training and technical assistance scope of work will have to take this into consideration. The Commission will encourage MEW to begin to augment its staff before this project element begins. It may also be necessary to provide expatriate replacements for training through the consultant's contract.

d. The Directorate General for Technical Affairs of the Diwan for Royal Court Affairs

This office of the Diwan handles an extrodinary variety of activities--the construction of low cost housing and commercial centers, wastewater facilities, roads, street lighting, etc. Its small staff is seriously overextended and great reliance is placed on consulting firms who assist with day-to-day work.

As with MEW, the Commission will be monitoring the masterplan contractor closely to ensure that the Diwan provides the contractor with required information and, more importantly, the required feedback on the plan as it evolves. Also as with MEW, the consultant, in preparing institution building and training recommendations, will have to take into account the shortage of staff and the limited number of qualified Omanis.

e. The MEWR

This organization came into existence about a year ago and then only for environment. Water resources responsibilities were added about six months ago. On the environmental side, the MEWR has moved aggressively to establish its authority. How it will be organized on the water resources side is not yet clear. The Ministry is not likely to have much project management or contracting capability.

It is not clear what role this ministry will play in the water resources activities of the project. This remains to be worked out. The environmental side of the ministry will be heavily involved in that it must review environmental impact statements and issue no objection certificates for all physical construction activities. It will also be very involved in the EIS for the Capital Region water/wastewater masterplan. It is unlikely that the Ministry will actually contract for any of the required services but the Commission will have to monitor its participation closely to assure that it does not become a bottleneck for the project.

f. MRM

Though it has been in existence for almost two years its functions are still not well defined and it is largely understaffed for the work it is doing. The ministry appears to be seeking to assume responsibility for all municipal functions in towns and villages, including sanitation, water, roads, etc. At the moment it appears to be focussing on food inspection and the construction of public latrines.

MRM will be sharing responsibilities with MEW for implementation of Subproject III. The sharing arrangement will have to take into account the weakness of this Ministry. Also, the consultant designing the institutional development and training component of the project will have to take into account the limited staff and limited number of Omanis available for training for the activities it designs.

3. Joint Commission Capability

The Commission has an adequate staff of experienced officers to handle the project. The Commission does not have adequate water resources expertise and is therefore in the process of selecting an appropriately qualified candidate for a PSC. As noted in Section V.E., the project will represent the core of the Commission's activities for the next five years.

The contracting for Phase I of the project should be well within the Commission's capacity. However, if agreement is quickly reached on all subprojects and components for Phase II, the number of contracts which must be let more or less simultaneously will stretch the Commission's capacity. We will carefully monitor the implementation schedule in order to anticipate this bunching of contracts and call for TDY assistance as much in advance as possible.

The Commission will require the services of the Regional Legal Advisor and Regional Contracts Officer on a regular basis during the early stages of the project when there will be considerable contracting activity.

## VIII. EVALUATION ARRANGEMENTS

### A. Users of the Evaluation

The evaluation plan for this project is directed toward decision makers in the Government of Oman and the Omani-American Joint Commission. To maximize the use of the information, periodic evaluation and reviews will be timed to key contracting and funding decisions. To facilitate Joint Commission and Omani review and action, summaries of reports and recommendations will be made available in Arabic.

### B. Project Purpose

To improve the capability of key Omani Government organizations to plan and manage the country's scarce water resources in a rational and coordinated manner and to strengthen institutions and physical facilities, thus directly affecting the utilization and availability of water resources by providing domestic water supplies and wastewater disposal services.

### C. Managers' Priority Questions

- Progress in Policy Dialogue
- Extension of Key Contracts
- Future Year Funding

### D. Evaluation Plan

#### 1. General

The Water Resources Development Project is a complex, multi-year effort that will result in both institutional development and the construction of capital works in the water and wastewater sector. The strategy for evaluating the project is to integrate evaluation into project implementation to the extent possible. Most of the data that will be necessary for evaluation will be collected under specific subprojects and contracts. Periodic evaluations will be tied to key decision points in the project implementation cycle. In addition, under the Water Resources subproject, the project will begin to establish an evaluation capacity in the Government of Oman so that it will be able to assess the effectiveness and impact of their policies, programs and projects in the water resources sector.

There will be one major external review during the life of the project. To the extent possible, this review will be timed to follow the completion of the water resources strategic plan (12 months), the water and wastewater master plan for the Capital Area (16 months), and the studies and designs of water and sanitation improvements for selected towns and villages (16 months). It will precede major project decisions with respect to follow on activities and contracts as well as the third tranche of project funding. We estimate this evaluation will take place in January 1988. A second less extensive evaluation is scheduled for January 1990 to review project progress toward delivering planned outputs and achieving project goals.

Each subproject will be monitored and assessed independently, both for its own progress and for its contribution to the achievement of the project purpose. The external review is described here and budgeted as a comprehensive evaluation. However, the project manager will decide whether, for ease of management, the external review of the subprojects will be carried out separately or jointly.

2. Subproject I - Development of Water Resources Management Organization and Planning

Baseline: Institutional descriptions contained in the project paper; analyses for strategic plan; Third Five Year Development Plan

Monitoring: Outputs of subprojects, contracts, Action Plans, Government decrees and budgets

Key Indicators:
- Existence of approved water resources strategic plan
- Evidence of interagency coordination and support in implementation of strategic plan
- Evidence of development of effective executive directorate for CCEWR
- Existence of programs (planned or underway) recommended in the strategic plan, such as:
  conservation of water
  augmentation of water resources
- Budgetary allocations, especially in Fourth Five Year Development Plan (1990-1994), reflecting strategic plan
- Evidence of water allocation decisions reflecting strategic plan
- Appropriate counterpart staffing
- Identification and appropriate placement of trainees

Key Decision Points:
- Contract amendment
- Follow on contracts for resource augmentation and other capital works

3. Subproject II - Capital Region Water Supply Improvements and Wastewater Planning

Baseline: Data collected in preparation of project paper, water and wastewater master plans and analyses for institutional development component

Monitoring: Subproject and contract outputs, Government decrees and budgets

Key Indicators:
- Adoption of water and wastewater master plan
- Evidence of coordinated planning for water and wastewater expansion
- Improvements in water service (as measured by production figures, per capita consumption, cost of water, reliability of service)

- Budgetary allocations for capital expenditures that derive from the master plan
- Improvements in key operational aspects of water and wastewater institutions
- Appropriate counterpart staffing
- Identification and appropriate placement of trainees

Key Decision Points:
- Key contracting actions (for institutional development and training)

4. Subproject III - Towns and Villages Water and Wastewater Pilot Activities

Baseline: Ministry of Health baseline survey; feasibility studies; Towns and Villages survey; Institutional Evaluation; Financial Analysis and Operation and Maintenance Study

Monitoring: Project progress and study reports, field visits

Follow on Evaluation: To assess replicability (see Contracts 3A and 3B)

Key Indicators:
- Water supply service levels in selected towns and villages, as indicated by:
  - size and type of treatment, storage and distribution capacity
  - reliability (source yield, operational and instituitonal)
  - quality (bacteriological studies)
- Evidence of improved institutional capability in selected towns and villages to operate and maintain water and wastewater systems
- Evidence of coordination of water and wastewater planning and implementation
- Evidence of replication of pilot programs, recommendations and lessons learned

Key Decision Points:
- Contract amendments
- Allocation of funds for capital works

E. Overall Impact Evaluation

Each of the subprojects will be evaluated by the project officer in a subproject completion report. In addition, a final evauation of the Water Resources Development Project will be carried out in the context of the overall final evaluation of the accomplishments of the Omani-American Joint Commission. This evaluation will take place in October 1992.

F. Evaluation Support

The bulk of the costs for data collection is budgeted within the individual subprojects and contracts. Ad hoc external assistance as required for the annual reviews will be requested as TDY assistance from AID/W and/or grant funded by the Joint

Commission. Well in advance of the major external review of the project, TDY assistance will be requested to develop a detailed scope of work and budget. The evaluation will be funded from the Joint Commission Grant. The following estimated level of effort will be required from project funds:

Notional Budget:

| | |
|---|---|
| 9 person months @ 15,000 | $135,000 |
| Travel and per diem | 70,000 |
| In-country support costs | 15,000 |
| Report preparation | 5,000 |
| Total | $225,000 |

The skills that will be required for the external review include:

Senior Water Resource Planner, team leader
Utility Manager
Finance Specialist
Social Scientist
Rural Water Supply Expert
Environmental Engineer
Water Supply Engineer
Wastewater Engineer
Communications Expert

## IX. MONITORING PLAN

### A. Organization

An analysis of the staffing and project management capabilities of the Commission staff have been discussed in Sections V.E and Section VII F.3. Monitoring of the project will be carried out by a project committee under the direction of the Assistant U.S. Representative who will be formally designated as the Project Manager. The committee will include the Commission's other project officer, the Chief Engineer and the PSC water resources advisor. Each will be designated as subproject managers. The PSC advisor will be assigned Subproject I, the Chief Engineer Subproject II and the project officer Subproject III. Each subproject manager will have an Omani or TCN counterpart to assist with project implementation activities.

The Commission's project committee will be supplemented as required by the Regional Legal Advisor and the Regional Contracts Officer as well as other short term specialists as required.

### B. Methodology

Each subproject manager will be required to meet regularly with responsible Government of Oman officials and contractor personnel and to visit project sites. Meeting and site visit reports will be prepared.

Each subproject manager will be required to review and prepare written evaluations of contractor progress reports and other contract deliverables.

Each subproject manager will be required to prepare a quarterly progress report which measures progress against selected progress indicators described in the previous report.

The project manager will meet with the subproject managers at regular intervals (no less than biweekly) to review overall project progress. The project will also be reviewed formally during the Commission's semi-annual portfolio reviews.

The project manager will be responsible for consolidating subproject progress reports into a single report to Commission management and AID/W. The project manager will also be responsible for monitoring overall financial progress and working with the MOFE on the financial supervision of the project.

### C. Financial Management

The Commission Controller has a well established voucher review process which is used regardless of whether the contract is a host country contract or an AID contract. This process is computerized and the Controller's staff is well trained to implement it. The Controller will meet with the Omani Government officials responsible for reviewing vouchers and issuing

certificates of performance to explain what is expected of them. He will than work with individual contractors to assure that their presentation of bills and vouchers meets AID requirements.

The Controller and his staff will be expected to monitor the performance of implementing agency officials and contractors and to advise the subproject managers of problems. The Controller will particularly be alert to consistent lateness in processing vouchers and transmitting them to the Commission and unsupported disallowances as well as ineffective reviews.

## X. CONDITIONS AND COVENANTS

In addition to the standard conditions and covenants the following additional ones will be added to the Loan Agreement:

### A. Conditions Precedent to Disbursement for Each Contract to Finance with the Proceeds of the Loan

#### 1. Additional Disbursement

Prior to any disbursement under the loan or to the issuance by AID of documentation pursuant to which disbursement will be made, for each contract to be financed with the proceeds of the loan, the Borrower shall furnish to AID in form and substance satisfactory to AID, except as AID may otherwise agree in writing, a signed contract.

### B. Special Covenants

#### 1. Project Evaluation

The parties agree to establish an evaluation program as part of the Project. Except as the Parties otherwise agree in writing, the program will include, during implementation of the project and at one or more points thereafter: (a) evaluation of progress toward attainment of the objectives of the project; (b) identification and evaluation of problem areas or constraints which may inhibit such attainment; (c) assessment of how such information may be used to help overcome such problems; and (d) evaluation, to the degree feasible, of the overall development impact of the Project.

#### 2. Water Resources Development Project

The Parties recognize that this Agreement represents the first phase of the larger Water Resources Development Project. The Parties agree to work together to define goals and objectives of the project, develop detailed plans and budgets for implementation of the project and establish the necessary coordinating bodies to supervise implementation of the project. The Parties further agree to draft and execute a formal project agreement including a mutually agreeable plan to finance project activities as quickly as possible.

SCHEDULE OF TABLES

## SCHEDULE OF MAPS



## SCHEDULE OF FIGURES

5C(1) - COUNTRY CHECKLIST

listed below are statutory criteria applicable generally to FAA funds, and criteria applicable to individual fund sources: Development Assistance and Economic Support Fund.

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FAA Sec. 481(h)(1); FY 1985 Continuing Resolution Section 528. Has it been determined or certified to the Congress by the President that the government of the recipient country has failed to take adequate measures or steps to prevent narcotic and psychotropic drugs or other controlled substances (as listed in the schedules in section 202 of the Comprehensive Drug Abuse and Prevention Control Act of 1971) which are cultivated, produced or processed illicitly, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents or from entering the U.S. unlawfully? — No

2. FAA Sec. 481(h)(4). Has the President determined that the recipient country has not taken adequate steps to prevent (a) the processing, in whole or in part, in such country of narcotic and psychotropic drugs or other controlled substances, (b) the transportation through such country of narcotic and psychotropic drugs or other controlled substances, and (c) the use of such country as a refuge for illegal drug traffickers? — No

3. FAA Sec. 620(c). If assistance is to a government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) the debt is not denied or contested by such government? — No

| | | |
|---|---|---|
| 4. | FAA Sec. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities? | No |
| 5. | FAA Sec. 620(a), 620(f), 620(D); FY 1985 Continuing Resolution Sec. 512 and 513. Is recipient country a Communist country? (If so, has the President determined that assistance to the country is important to the national interests of the United States? | No |
| | Will assistance be provided to Angola, Cambodia, Cuba, Laos, Syria, Vietnam, Libya, or South Yemen? Will assistance be provided to Afghanistan or Mozambique without a waiver. | No<br>No |
| 6. | FAA Sec. 620(j) Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction by mob action of U.S. property? | No |
| 7. | FAA Sec 620(l). Has the country failed to enter into an agreement with OPIC? | No |
| 8. | FAA Sec. 620(o), Fishermen's Protective Act of 1967, as amended, Sec. 5. (a) Has the country seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters? | No |
| | (b) If so, has any deduction required by the Fishermen's Protective Act been made? | N/A |
| 9. | FAA Sec. 620(q), FY 1985 Continuing Resolution Sec. 518. (a) Has the government of the recipient country been in default for more than six months on interest or principal of | No |

| | | |
|---|---|---|
| | any A.I.D. loan to the country? (b) Has the country been in default for more than one year on interest or principal on any U.S. loan under a program for which the appropriation bill (or continuing resolution) appropriates funds? | No |
| 10. | FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the amount of foreign exchange or other resources which the country has spent on military equipment? (Reference may be made to the annual "Taking into Consideration" memo: "Yes, taken into account by the Administrator at time of approval of Agency OYB." This approval by the Administrator of the Operational Year Budget can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.) | Yes |
| 11. | FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption? | No<br>N/A |
| 12. | FY Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the A.I.D. Administrator in determining the current A.I.D. Operational Year Budget? (Reference may be made to the Taking into Consideration memo.) | Current<br>NA |
| 13. | FAA Sec, 620A; FY 1985 Continuing Resolution Sec. 521. Has the President determined that the country (a) grants sanctuary from prosecution to any individual or group which has committed an act | No |

| | | |
|---|---|---|
| | of international terrorism, or (b) otherwise supports international terrorism? Has the government of the recipient country aided or abetted, by granting sanctuary from prosecution to, any individual or group which has committed or is being sought by any other governmen for prosecution for any war crime or act of international terrorism? | No |
| 14. | ISDCA of 1985 Sec. 552(b). Has the Secretary of State determined that the country is a high terrorist threat country after the Secretary of Transportation has determined, pursuant to section 1115(e)(2) of the Federal Aviation Act of 1958, that an airport in the country does not maintain and administer effective security measures? | No |
| 15. | FAA Sec. 666. Does the country object, on the basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. who is present in such country to carry out economic development programs under the FAA? | No |
| 16. | FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? | No |
| | Has it transferred a nuclear explosive device to a non-nuclear weapon state, or if such a state, either received or detonated a nuclear explosive device? (FAA Sec. 620E permits a special waiver of Sec. 669 for Pakistan.) | No |
| 17. | FAA Sec. 670. If the country is a non-nuclear weapon state, has it, on or after August 8, 1985, exported illegally (or attempted to export illegally) from the United States any material, equipment, or technology | No |

which would contribute significantly to the ability of such country to manufacture a nuclear explosive device?

18. ISDCA of 1981 Sec. 720. Was the country represented at the Meeting of Ministers of Foreign Affairs and Heads of Delegations of the Non-Aligned Countries to the 36th General Assembly of the U.N. of Sept. 25 and 28, 1981, and failed to disassociate itself from the communique issued? If so, has the President taken it into account? (Reference may be made to the Taking into Consideration memo.)

No

N/A

19. FY 1985 Continuing Resolution. If assistance is from the population functional account, does the country (or organization) include as part of its population planning programs involuntary abortion?

N/A

20. FY 1985 Continuing Resolution Sec. 530. Has the recipient country been determined by the President to have engaged in a consistent pattern of opposition to the foreign policy of the United States?

No

B. FUNDING SOURCE CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria

FAA Sec. 116. Has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights? If so, can it be demonstrated that contemplated assistance will directly benefit the needy?

No

N/A

2. Economic Support Fund Country Criteria

| | |
|---|---|
| FAA Sec. 502B. Has it been determined that the country has engaged in a consistent pattern of gross violations of internationally recognized human rights? | No |
| If so, has the country made such significant improvements in its human rights record that furnishing such assistance is in the national interest? | N/A |

Annex A

# 5C(2) PROJECT CHECKLIST

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

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

## A. GENERAL CRITERIA FOR PROJECT

1. FY 1986 Continuing Resolution Sec. 524; FAA Sec. 634A.

   Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project.

   Project was requested in FY 1986 CP and a notification describing changes in the project will be sent to the committees prior to authorization.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $500,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimte of the cost to the U.S. of the assistance?

   (a) & (b) yes - see Project Paper Sections VI and VII.

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

   None required

| | | |
|---|---|---|
| 4. | FAA Sec. 611(b); FY 1986 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See AID Handbook 3 for new guidelines.) | Any water or water-related land resource construction will be preceded by studies which will assure that the principles, standards and procedures are met. |
| 5. | FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project? | Yes - See Annex B |
| 6. | FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. | No |
| 7. | FAA Sec. 601(a). Information and conclusions whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions. | The project will encourage efforts in (e). |

| | | |
|---|---|---|
| 8. | FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise). | U.S. engineering firms and technical assistance consultants will be used. |
| 9. | FAA Sec. 612(b), 636(h); FY 1986 Continuing Resolution Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars. | Oman will contribute more than fifty percent to the total cost of the Project. |
| 10. | FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release? | No |
| 11. | FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise? | Yes |
| 12. | FY 1986 Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity? | NA |

| | |
|---|---|
| 13. FAA 118(c) and (d). Does the project comply with the environomental procedures set forth in AID Regulation 16. Does the project or program take into consideration the problem of the destruction of tropical forests? | Yes |
| 14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate sysem for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)? | NA |
| 15. FY 1986 Continuing Resolution Sec. 533. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution? | No |
| 16. ISDCA of 1985 Sec. 310. For development assistance projects, how much of the funds will be available only for activities of economically and socially disadvantaged enterprises, historically black colleges and universities, and private and voluntary organizations which are controlled by individuals who are black Americans, Hispanic Americans, or Native Americans, or who are economically or socially disadvantaged (including women)? | NA |

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

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

NA

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

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

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

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

| | | |
|---|---|---|
| f. | FAA Sec. 128(b). If the activity attempts to increase the institutional capabilities of private organizations or the government of the country, or if it attempts to stimulate scientific and technological research, has it been designed and will it be monitored to ensure that the ultimate beneficiaries are the poor majority? | NA |
| g. | FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government. | NA |

2. Development Assistance Project Criteria (Loans Only)

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

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

3. Economic Support Fund Project Criteria

a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the maximum extent feasible, is this assistance consistent with the policy directions, purposes, and programs of part I of the FAA? — Yes. The project will help Oman to rationalize the use of its scarce water resources which are the key to long term development.

b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities? — No

c. ISDCA of 1985 Sec. 207. Will ESF funds be used to finance the construction of, or the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified — No

that such country is a party to the Treaty on the Non-Proliferation of Nuclear Weapons or the Treaty for the Prohibition of Nuclear Weapons in Latin America (the "Treaty of Tlatelolco"), cooperates fully with the IAEA, and pursues nonproliferation policies consistent with those of the United States?

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

## 5C(3) - STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed? — Yes

2. FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him? — Yes

3. FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company? — The country does not so Discriminate / Yes

4. FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of an agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.) — Yes

5. FAA Sec. 604(g). Will construction or engineering services be procured from firms of countries which receive direct economic assistance under the — Yes

| | | |
|---|---|---|
| | FAA and which are otherwise eligible under Code 941, but which have attair a competitive capability in international markets in one of these areas? Do these countries permit United States firms to compete for construction or engineering services financed from assistance programs of these countries? | Yes |
| 6. | FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates? | Yes |
| 7. | FAA Sec. 621. If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? | Yes |
| | If the facilities of other Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs? | Yes |
| 8. | International Air Transport. Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U.S. carriers be used to the extent such service is available? | Yes |
| 9. | FY 1985 Continuing Resolution Sec. 504. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States. | Yes |

B. Construction

| | | |
|---|---|---|
| 1. | FAA Sec. 601(d). If capital (e.g., construction) project, will U.S. engineering and professional services be used? | Yes |
| 2. | FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? | Yes |
| 3. | FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million? (except for productive enterprises in Egypt that were described in the CP)? | Yes |

C. Other Restrictions

| | | |
|---|---|---|
| 1. | FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? | Yes |
| 2. | FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? | N/A |
| 3. | FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries? | Yes |
| 4. | Will arrangements preclude use of financing: | |
| a. | FAA Sec. 104(f); FY 1985 Continuing Resolution Sec. 527 (1) To pay for performance of abortions as a method of family | Yes |

| | | |
|---|---|---|
| | planning or to motivate or coerce persons to practice abortions; (2) to pay for performance of involuntary sterilization as a method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization; (3) to pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning; (4) to lobby for abortion? | Yes<br>Yes<br>Yes |
| b. | FAA Sec. 488. To reimburse persons, in the form of cash payments, whose illicit drug crops are eradicated? | Yes |
| c. | FAA Sec. 620(g). To compensate owners for expropriated nationalized property? | Yes |
| d. | FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs? | Yes |
| e. | FAA Sec. 662. For CIA activities? | Yes |
| f. | FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained? | Yes |
| g. | FY 1985 Continuing Resolution, Sec. 503. To pay pensions, annuities, retirement pay, or adjusted service compensation for military personnel? | Yes |
| h. | FY 1985 Continuing Resolution, Sec. 505. To pay U.N. assessments, arrearages or dues? | Yes |
| i. | FY 1985 Continuing Resolution, Sec. 506. To carry out provisions of FAA Section 209(d) (Transfer of FAA funds to multilateral organizations for lending)? | Yes |

| | | |
|---|---|---|
| j. | FY 1985 Continuing Resolution, Sec. 510. To finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields? | Yes |
| k. | FY 1985 Continuing Resolution, Sec. 511. Will assistance be provided for the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights? | Yes |
| l. | FY 1985 Continuing Resolution, Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress? | Will not be so used. |

ANNEX B

CERTIFICATION PURSUANT TO SECTION 611(e)

OF THE FOREIGN ASSISTANCE ACT OF 1961

AS AMENDED

I, F. Gary Towery, the principal officer of the Agency for International Development in Oman, having taken into account, among other things, the utilization and maintenance of water and wastewater facilities in Oman, previously financed by the Government of Oman, do hereby certify that in my judgment Oman has both the financial capabilities and the human resources capability to effectively utilize and maintain the water and wastewater facilities to be constructed under the capital assistance project, No. 272-0104 (Oman - Water Resources Development Project).

F. Gary Towery
U.S. A.I.D. Representative
Omani-American Joint Commission

July 22, 1986
Date

بسم الله الرحمن الرحيم

Sultanate of Oman
Office of
The Deputy Prime Minister
for Financial & Economic Affairs
Muscat

سلطنة عمان
مكتب
نائب رئيس الوزراء
للشئون المالية والاقتصادية
مسقط

No.FD/8/11/128S/86

# CONFIDENTIAL

Date 23rd July 1986

His Excellency
Saif Bin Hamed Al-Battashi
Omani Co-Chairman
Omani-American Joint Commission for
Economic and Technical Cooperation
P O Box 6001
Ruwi

and

The Honourable
G. Cranwell Montgomery
American Co-Chairman

After Compliments,

Reference to our letter No.FD/8/11/116S/86 dated 29th June 1986, we would like to request an increase in the amount of the loan from dollars 10 million to dollars 15 million in order to finance studies needed for the long term development of water and sewage facilities in the capital area.

With my best respect,

Qais Bin Abdul Munim Al-Zawawi
Deputy Prime Minister for
Financial and Economic Affairs

Deputy Prime Minister for Financial & Economic Affairs
Sultanate of Oman

Date Rec'd. 27-7-86

ACTION

INFO

Due Date

Action Taken

Date Typed Initials

P. O. Box 506, Muscat - Tel. : 738201 - Telex : 5333 MALIYA ON ص.ب ٥٠٦ مسقط - هاتف : ٧٣٨٢٠١ - تلكس : ٥٣٣٣ مالية أو إن

ANNEX D

LOGICAL FRAMEWORK

Project Title: Water Resources Development
Subproject I - Development of Water Resources Management and Planning Organization
Project Number: 272-0104

Life of Project:
FY 1986 to FY 1992
U.S. Funding $75 Million
Omani Funding $201 Million

| Narrative Summary | Objectively Verifiable Indications | Means of Verification | Assumptions |
|---|---|---|---|
| **Goal:** | | | |
| To provide a safe, reliable supply of water sufficient to meet the needs of the people and the planned development of Oman. | 1. Bacteriologic tests of water quality.<br>2. Statistics on water supplies.<br>3. Five-year development plans. | 1. Ministry of Health records.<br>2. Water production statistics.<br>3. Development Council publications. | That the rational use of water resources will assure an adequate supply of water for domestic use and development. |
| **Subproject Purpose:** | | | |
| To develop an institution capable of planning, managing and supervising the utilization of Oman's water resources, and expand expand the country's water resources. | 1. A regularly up-dated National Water Resources Strategic Plan.<br>2. A formally issued body of policies, regulations, water allocations, etc.<br>3. New sources of water in use. | 1. Published editions of the water resources plan.<br>2. The Official Gazette which publishes government regulations.<br>3. The records of the CCEWR. | The Government of Oman has the will to enforce water resources management policies, regulations and especially the allocation of water among competing users. |
| **Outputs:** | | | |
| 1. A strong ministerial level policy-making and regulatory body.<br>2. A water resources planning unit supporting the policy making body.<br>3. A National Water Resources Strategic Plan.<br>4. Completed water resources augmentation schemes. | 1. CCEWR issues policies, regulations, etc.<br>2. Planning unit is established as regular government organization with budget and staff; key members are Omani.<br>4. Initial water resources plan is issued and updated at least once.<br>5. Water augmentation schemes are completed and in production. | 1. CCEWR meeting minutes.<br>2. Water production records.<br>3. CCEWR meeting agendas.<br>4. Planning unit studies.<br>5. Published editions of water resources plan.<br>6. Government budgets. | 1. The Government of Oman will establish a planning unit to support the CCEWR.<br>2. The Government of Oman will assign a qualified Omani to head the new unit. |
| **Inputs:** | | | |
| 1. Consulting services.<br>2. Training.<br>3. Land and rights of way.<br>4. Omani counterparts | A.I.D. - $21.8 million<br>Oman - $8.52 million | 1. Project Agreements<br>2. Project implementation and site inspection reports. | 1. Funds are budgeted for the project.<br>2. Counterparts are made available to the project.<br>3. Conditions Precedent are met. |

ANNEX D

LOGICAL FRAMEWORK

Project Title: Water Resources Development
Subproject II - Capital Region Water System Improvement and Wastewater Planning
Project Number: 272-0104

Life of Project:
FY 1986 to FY 1992
U.S. Funding $75 Million
Omani Funding $201 Million

| Narrative Summary | Objectively Verifiable Indications | Means of Verification | Assumptions |
|---|---|---|---|
| Goal: | | | |
| To provide a safe, reliable supply of water sufficient to meet the needs of the people and the planned development of Oman. | 1. Bacteriologic tests of water quality.<br>2. Statistics on water supplies.<br>3. Five-year development plans. | 1. Ministry of Health records.<br>2. Water production statistics.<br>3. Development Council publications. | That the rational use of water resources will assure an adequate supply of water for domestic use and development. |
| Subproject Purpose: | | | |
| To strengthen and expand the water and wastewater system of the Capital Region and the institutions responsible for the operation of these systems. | 1. Fourth Five-Year Plan investment program is based on masterplan.<br>2. Capital Region water sources are doubled.<br>3. Income from tariffs are sufficient to provide some measure of capital recovery.<br>4. Reorganized institutions are functioning.<br>5. The water system is able to meet demand. | 1. The Fourth Five-Year Plan.<br>2. Water production records.<br>3. Financial records and reporting.<br>4. Observation of new organizations | The Government of Oman is willing to implement reorganizations, revise tariff schedules and utilize the masterplan for investment planning. |
| Outputs: | | | |
| 1. Increase water supplies.<br>2. Strengthen and expanded water transmission and storage facilities.<br>3. A masterplan for the long-term, integrated development of the Region's water and wastewater infrastructure.<br>4. Reorganized institutions with utility accounting systems and a revised tariff structure. | 1. Barka Desalination Plant is completed and delivering water to the system.<br>2. Other system improvements are completed and in service.<br>3. The masterplan is completed and accepted by the Government of Oman.<br>4. The reorganization of institutions is completed and personnel trained.<br>5. A revised accounting system is in use.<br>6. A revised tariff schedule has been designed and adopted by the Government. | 1. Financial records.<br>2. The final masterplan.<br>3. Water system supply and demand records. | The two organizations responsible for water and wastewater in the Capital will cooperate in the implementation of institutional development recommendations and preparation of the masterplan. |
| Inputs: | | | |
| 1. Engineering and consulting services.<br>2. Training.<br>3. Land and rights of way.<br>4. Omani counterparts | A.I.D. - $20.53 million<br>Oman - $170.74 million | 1. Project Agreements<br>2. Project implementation and site inspection reports.<br>3. Contractor progress reports. | 1. Funds are budgeted for the project.<br>2. Counterparts are made available to the project.<br>3. Conditions Precedent are met. |

NNEX D

LOGICAL FRAMEWORK

roject Title: Water Resources Development
ubproject III - Town and Village Water and Wastewater Pilot Activities
roject Number: 272-0104

Life of Project:
FY 1986 to FY 1992
U.S. Funding $75 Million
Omani Funding $201 Million

| Narrative Summary | Objectively Verifiable Indications | Means of Verification | Assumptions |
|---|---|---|---|
| al: | | | |
| provide a safe and reliable supply of ater sufficient to meet the needs of the ople and the planned development of Oman. | 1. Bacteriologic tests of water quality.<br>2. Statistics on water supplies.<br>3. Five-year development plans. | 1. Ministry of Health records.<br>2. Water production statistics.<br>3. Development Council publications. | That the rational use of water resources will assure an adequate supply of water for domestic use and development. |
| ubproject Purpose: | | | |
| provide integrated water and wastewater cilities in towns and villages and to rengthen the institutions responsible for wn and village water/wastewater facilities. | 1. Replicable plans and procedures for the construction of water/wastewater in towns and villages are completed.<br>2. Quality of life in pilot towns and villages is improved.<br>3. Fourth Five-Year Plan investment program is based on pilot results.<br>4. New tariff structure in use.<br>5. new accounting system in use.<br>6. Reorganized institutions functioning. | 1. Water production records of MEW.<br>2. MEW financial records.<br>3. Development Plans and the records of the Development Council. | The Government of Oman is willing implement reorganization, revise tariffs and utilize the pilot results for investment planning. |
| tputs: | | | |
| Surveys and analyses of the water/waste-ter needs of towns and villages.<br>Operational pilot integrated water/waste-ter facilities in 3 towns and 20 villages.<br>Strengthened institutions for the plan-ng, design, construction, operations and intanance of water/wastewater facilities. | 1. Integrated water/wastewater facilities in pilot towns and villages completed and experience evaluated.<br>2. Recommendations for reforming tariffs, accounting system and institutions reviewed, approved and implemented. | 1. The final masterplan report.<br>2. Water production records of MEW.<br>3. Project reports and site inspection reports.<br>4. Government budgets. | The two organizations responsible for water and wastewater will cooperate in the implementation of pilot activities and the implementation of institutional development recommendations. |
| puts: | | | |
| Consulting services.<br>Training.<br>Land and rights of way.<br>Omani counterparts<br>Construction services. | A.I.D. - $33.08 million<br>Oman - $21.45 million | 1. Project Agreements<br>2. Project implementation and site inspection reports. | 1. Funds are budgeted for the project.<br>2. Counterparts are made available to the project.<br>3. Conditions Precedent are met. |

1/2 UNCLASSIFIED STATE 275460/01

ACTION: JC-2 INFO: AMB DCM CHRON 5/KJH

VZCZCMS0517SYS180
PP RUFHMS
DE RUEHC #5460/01 2500247
ZNR UUUUU ZZH
P R 0702452 SEP 85
FM SECSTATE WASHDC
TO RUFHMS/AMEMBASSY MUSCAT PRIORITY 6956
INFO RUEHAM/AMEMBASSY AMMAN 9601
BT
UNCLAS STATE 275460

LOC: 07 141
07 SEP 85 0722
CN: 18180
CHRG: JC
DIST: JC

275460

AIDAC AMMAN FOR RLA AND CONT

| Date: | 9/07/85 |
|---|---|
| Al-Habsi | |
| Towery | |
| Mandel | |
| Youssef | |
| Lemky | |
| Markeset | |
| Sajwani | |
| Squire | |
| Al-Harthy | |
| Doe | |
| Edinger | |
| Action: | Mandel |
| File: | CRWR |

CRWR PID
CRWR PP

E.O. 12356: N/A
TAGS:
SUBJECT: OMAN - WATER RESOURCES DEVELOPMENT PROJECT 272-0104 - ANPAC REPORTING CABLE

REFERENCE: PID ON SUBJECT PROJECT

1. THE ANPAC MET ON AUGUST 20, 1985 TO REVIEW SUBJECT PID. THE ANPAC RECOMMENDED THAT THE JOINT COMMISSION PROCEED WITH THE PROJECT DESIGN. IT INDICATED ITS WILLINGNESS TO SEEK AUTHORIZATION OF THE FULL DOLS 75 MILLION LIFE OF PROJECT AID FUNDING OF A DOLS 196 MILLION TOTAL PROJECT. THE A.I.D. FUNDING WOULD, OF COURSE BE SUBJECT TO THE AVAILABILITY OF FUNDS. IT IS PLANNED THAT OBLIGATIONS WILL BE MADE AS FUNDS BECOME APPROPRIATED AND ALLOTTED OVER THE LIFE OF THE PROJECT; ESTIMATED AT DOLS 15 MILLION PER YEAR FOR 5 YEARS.

2. PLANNING: THE ANPAC NOTED SINCE THE PROJECT AGREEMENT ONCE SIGNED IS A PUBLIC COMMITMENT TO CONTRIBUTE DOLS 75 MILLION TO A DOLS 196 MILLION, MULTI-FACETED ACTIVITY, THE PROJECT MUST BE DESIGNED IN SUCH A WAY THAT THERE ARE MUTUALLY AGREED UPON POLICY AND PROGRAMMATIC INDICATORS OF THE GOVOMAN'S DETERMINATION AND ABILITY TO ADDRESS THE POLICY ISSUES,

AND IMPLEMENT THE PROJECT ACCORDING TO MUTUALLY AGREED UPON COMPONENTS OF THE STRATEGIC PLAN. BECAUSE SOME COMPONENTS OF THE PROJECT ARE TO BE DESIGNED OR MODIFIED DURING THE PROJECT AS THE STRATEGIC AND MASTER PLANS ARE DEVELOPED, AND BECAUSE THE STRATEGIC PLAN WILL NOT BE COMPLETED UNTIL A YEAR OR MORE AFTER THE PP IS WRITTEN AND THE PROAG SIGNED, IT IS IMPORTANT THAT THE PP IDENTIFY THE POLICY AND PROGRAMMATIC INDICATORS THAT HAVE BEEN AGREED UPON, AS WELL AS EXPECTED INDICATORS FLOWING FROM THE STRATEGIC PLAN. SOME OF THESE INDICATORS MAY NEED TO BE GENERIC IN NATURE SINCE SPECIFIC INFORMATION WILL NOT BE AVAILABLE UNTIL THE STRATEGIC PLAN IS COMPLETED. IT IS ALSO IMPORTANT THAT CRITERIA FOR THE INCLUSION OF PHYSICAL SUB PROJECTS BE DEVELOPED. PROPOSED SUBPROJECTS FOR PHYSICAL INFRASTRUCTURE SHOULD NOT BE MADE PART OF THE PROJECT UNTIL IT HAS BEEN DETERMINED THAT SUCH A SUB-PROJECT IS FEASIBLE, I.E.

CONSISTENT WITH REQUIREMENTS SET FORTH IN SUBPARAGRAPH (3) BELOW. (HOWEVER THE ANPAC RECOGNIZED THAT THE CAPITAL AREA WATER DISTRIBUTION SYSTEM FOR WHICH OBLIGATION AND COMMITMENTS WILL BE MADE IN YEARS 3, 4, AND 5 WILL HAVE MET 611 REQUIREMENTS DURING THE PP PREPARATION PHASE.)

3. IN VIEW OF THE ABOVE THE ANPAC STATED THAT THE PP SHOULD CONTAIN A VARIETY OF POLICY AND PROGRAM INDICATORS THAT WILL PROVIDE, PRIOR TO EACH YEAR'S OBLIGATION, GUIDANCE AS TO THE EXTENT TO WHICH PROGRESS IS BEING MADE IN THREE BROAD AREAS:

(1) POLICY DEVELOPMENT:
A) TO WHAT DEGREE ARE THE POLICY MEASURES AGREED UPON BEING REVIEWED AND, AS APPROPRIATE, ARE RECOMMENDATIONS FOR ACTION BEING DEVELOPED; AND,
B) ARE THEY BEING IMPLEMENTED?

(2) IMPLEMENTATION OF PROGRAM:
A) ARE THERE ANNUAL WORK PLANS FOR THE VARIOUS SUB-ACTIVITIES UNDERWAY OR PLANNED?
B) HAVE ALL NECESSARY RESOURCES BEEN PROVIDED IN A TIMELY MANNER?

(3) THE PHYSICAL SUB-PROJECTS:

A) HAVE FEASIBILITY STUDIES BEEN COMPLETED ON SUB-PROJECTS PROPOSED FOR INCLUSION IN THE PROJECT;
B) HAS IT BEEN DETERMINED THAT THE SUB-PROJECTS ARE TECHNICALLY, FINANCIALLY, SOCIALLY AND ENVIRONMENTALLY SOUND;

C) HAVE FIRM COST ESTIMATES BEEN MADE;
D) DO THE SUB-PROJECT PLANS INCLUDE A COMPUTATION OF BENEFITS AND COSTS MADE, INSOFAR AS PRACTICAL IN ACCORDANCE WITH THE PRINCIPLES, STANDARDS, AND PROCEDURES ESTABLISHED PURSUANT TO THE WATER RESOURCES PLANNING ACT;
E) IS THERE EVIDENCE THAT THE SUB-PROJECT WILL BE EFFECTIVELY MANAGED AND UTILIZED; AND
F) HAS THE GOVOMAN COMMITTED THE RESOURCES NECESSARY TO COMPLETE SUB-PROJECTS FOR WHICH A.I.D FUNDS ARE TO BE OBLIGATED FOR DESIGN AND CONSTRUCTION SUPERVISION COSTS?

4. DATA COLLECTION: ANPAC REQUESTED THAT THE JOINT COMMISSION, AS A PART OF THE DESIGN EFFORT, PAY SPECIAL ATTENTION TO THE DESIGN OF A COMPREHENSIVE DATA COLLECTION, MONITORING AND EVALUATION PLAN TO INSURE APPROPRIATE DATA WILL BE COLLECTED TO SUPPORT DECISIONS AS DISUSSED ABOVE AND THAT THE CAPACITY BE CREATED WITHIN THE GOVOMAN TO PROPERLY UTILIZE AND INTERPRET THE

DATA. TO DEVELOP THIS PLAN, AID/W WOULD BE PLEASED TO PROVIDE A SPECIALIST IN MONITORING AND EVALUATION SYSTEM AS A MEMBER OF THE PP DESIGN TEAM.

5. BENEFICIARYGNALYSIS: THE AN C NOTEDLHE BENESICPRY ANAL SIS TF THE PID WAS TIMPED AND NOTED THAT THE PP SHOULD EXAMINE WHO WILL BENEFIT FROM VARIOUS SEGMENTS OF THE PROJECT.

6. IRRIGATION - AGRICULTURAL WATER USE

THE ANPAC NOTED THAT AGRICULTURAL WATER USES ACCOUNTED FOR 90 PER CENT OF ALL WATER USE. THE PRC NOTED THAT THI MINISTRY OF AGRICULTURE AND FISHERIES (MAF) PLAYS THE LEADING ROLE IN MANY WATER RELATED ISSUES, BUT THAT ITS LIMITED ROLE IN THE PROGRAM DID NOT SEEM CONDUCIVE TO BRINGING ABOUT THE CLOSE COOPERATION NECESSARY. THE PRC SUGGESTED THAT PROJECT DESIGN TEAM CONSIDER GIVING GREATER EMPHASIS TO AGRICULTURAL WATER USES AND IDENTIFICATION OF AGRICULTURALLY RELATED WATER RESOURCES SUB-PROJECTS, AS APPROPRIATE.

7. INTERRELATIONSHIP OF OTHER DEVELOPMENTAL ACTIVITIES.

THE ANPAC WAS MADE AWARE OF THE ON-GOING AND PLANNED A.I.D. FUNDED TRAINING, AGRICULTURAL AND HEALTH ACTIVITIES WHICH IMPACT UPON THIS PROJECT AND WHICH WILL IN TURN BE AFFECTED BY THIS PROJECT. IT IS SUGGESTED THAT THE PP SHOW THESE INTERRELATIONSHIPS. THE RELATIONSHIP BETWEEN WASTEWATER ACTIVITIES TO THE PROJECT ACTIVITIES SHOULD BE DESCRIBED.

8. PILOT SUB-PROJECT EVALUATION PLANS

THE ANPAC NOTED THAT SPECIAL BASELINE AND IMPACT DATA MUST BE COLLECTED FOR PILOT SUBPROJECTS TO DETERMINE HOW EFFECTIVE THE PILOT ACTIVITY IS PRIOR TO EXPANSION TO OTHER AREAS. IT SUGGESTED THAT EACH PILOT SUB-PROJECT CONTAIN ITS OWN EVALUATION PLAN.

9. FINANCIAL ANALYSIS

THE ANPAC NOTED THAT THE COST AND THEREFORE PRICING POLICY DECISIONS TO BE MADE AS A RESULT OF THIS PROJECT WOULD DEPEND IN LARGE MEASURE ON ACCOUNTING DATA GENERATED BY THE MEW, CAM AND POSSIBLY OTHER ORGANIZATIONS PARTICIPATING IN THIS PROJECT. THE ANPAC URGED THE JOINT COMMISSION TO DETERMINE IF THE ACCOUNTING AND MANAGEMENT INFORMATION SYSTEMS RELIABLY GENERATE THE NECESSARY FINANCIAL DATA ON WHICH TO BASE THESE DECISIONS. IF NOT, THEN THIS SHOULD BE INCLUDED IN THE TERMS OF REFERENCE FOR THE INSTITUTIONAL DEVELOPMENT ASPECTS OF THE PROJECT. THE JOINT COMMISSION SHOULD CONSIDER USING THE SERVICES OF A FINANCIAL ANALYST AS PART OF THE DESIGN EFFORT TO MAKE THIS DETERMINATION AS WELL AS ASSIST IN THE DEFINITION AND PREPARATION OF THE PROJECT'S FINANCIAL ANALYSIS

10. OUTREACH ELEMENTS

THE ANPAC NOTED THAT SOME OF THE SUB"PROJECTS WOULD REQUIRE ATTENTION TO BE PAID TO WAYS OF MODIFYING OR ENCOURAGING THE MODIFICATION OF BEHAVIOR WITH REGARD TO THE USE OF WATER AND WASTEWATER. IF THIS IS TO BE DONE THROUGH OUTREACH EDUCATIONAL PROGRAMS, THE VALUE OF ADDING ELEMENTS WHICH RELATE TO HEALTH PRACTICES SHOULD BE EXAMINED BY PROJECT PAPER TEAM.

11. PLEASE ASSURE THAT DESIGN TEAM REMAINS ALERT FOR AND IDENTIFIES MINORITY CONTRACTING OPPORTUNITIES.

12. SEPTEL ADDRESSES COMPOSITION OF PP DESIGN TEAM, INCLUDING WASH CONTRACTORS AND AID/W SUPPORT. SHULTZ
BT
#5460

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# EXECUTIVE SUMMARY

This report was funded by the Omani-American Joint Commission for Economic and Technical Cooperation to: (1) assist the Ministry of Electricity and Water (MEW) in the preparation of a program of water supply projects and actions to be included in the third five-year plan (1986-1990), (2) suggest other projects and actions related to water resource needs beyond those of MEW, and (3) foster an integrated approach to future water resources planning and development.

This report, which represents less than 20 person-weeks of effort, is intended only to serve the three purposes above. It should not be interpreted as being an in depth study of the current water resources situation in Oman.

The term water resources is used in this report to include all sources and uses of water. The facilities to extract and transmit the water, and the disposition of wastewater.

## PRINCIPAL FINDINGS

### Institutional Factors

- The large number of government agencies with water resources related responsibilities and the absence of effective coordination have resulted in a high degree of fragmentation and overlapping of such responsibilities.

- The Water Resources Council (WRC) has the responsibility and the authority to coordinate all the activities related to water resources throughout the Sultanate, but has been unable to fully meet this objective

- The Public Authority for Water Resource (PAWR) has the responsibility and the authority to assist the WRC in carrying out its objectives.

- Weaknesses in coordination and the absence of a comprehensive national water resources policy have led to inefficiencies in water use, excessive use of limited groundwater resources by competing users and a lack of clear direction in the development of additonal water resources.

- Total extractions from groundwater sources appear to be exceeding their current replenishment capacity, and saline intrusion along the northern coast is becoming an increasing threat to any aquifers.

- Lack of effective controls over groundwater extractions is a major cause of aquifer overpumping.

- Irrigation use currently accounts for more than 90 percent of total groundwater extractions.

- Failure to allocate sufficient groundwater for municipal water supply has resulted in the need to build expensive seawater desalination plants to serve most of the needs of the Capital Area. In rural areas, problems in carrying out water supply schemes have, in some areas, also necessitated the use of desalination plants.

- Water supply needs in rural areas are not being adequately addressed.

Water Resources

- With irrigation water usages exceeding municipal water supply usage by twenty to one, it is clear that the Ministry of Agriculture and Fisheries will have a major voice in the direction of future national water resource planning. An increase in the efficiency of irrigation practices of only ten percent, for example, would approximate the total capacity of the existing and under-construction desalination plants at Ghubrah.

- The long historical use of falaj systems as the prinicipal source of both water supply and irrigation throughout Oman has resulted in the development of laws to protect them which adversely affect the interests of potential users of groundwater within 3.5 km of aflaj wells.

- The potential of safely increasing groundwater extractions by means of aquifer recharge enhancement in selected wadis appears to be promising.

Water Supply: Capital Area

- Population of the Capital Area is estimated by others to be approximately 350,000 and average water use was 81,000 $m^3$/day (18 mgd). By 1990 water use could increase to as much as 190,000 $m^3$/day (42 mgd) and most of the increase will probably have to come from desalination plants, unless major changes occur.

- The two well fields which now provide about 18 000 $m^3$/day (4 mgd) are subject to contamination from increasing development and lack of controls over pollutant discharges. These fields are routinely overpumped to meet peak daily demand.

- Additional transmission, storage and distribution facilities are urgently needed, as well as improvements in operating them.

Water Supply Outer Areas

- Current population in the study outside the Capital Area is about 350,000 most of whom now obtain their drinking water from shallow dug wells or the falaj system.

- Preliminary studies for some 24 communities were completed in 1980. Designs for six of them are underway and will be under various stages of implementation during the remainder of the second five year plan. Completion of these systems is envisioned by mid 1986.

Design for an additional six systems will be carried out during the third five year plan. Apart from these 24 studies only four systems have been constructed.

- The three systems just constructed are the only municipal water systems now existing in the study area outside the Capital Area. The total population of these three municipalities is estimated about 60,000, less than one third of whom have piped connections to the new systems.

- Brackish water problems in many of the coastal communities will require the construction of demineralization or desalination plants.

- Some small rural communities are served by basic systems consisting of a well, a small storage tank and a few hundred meters of piping connected to one or two standpipes or public faucets.

Wastewater

- Only about 12 percent of the total population of the Capital Area is presently served by a wastewater collection and treatment system in the Ruwi-Muttrah area. The entire Capital Area has been divided into four study areas since separate preliminary planning studies to evaluate the wastewater problems have just been completed.

- There are some 125 small, usually poorly operated, package treatment plants in the Capital Area which are privately owned and operated. The remaining dwellings outside of the served portions of Ruwi-Muttrah generally use on-site holding tanks and cesspools (soak pits).

- Treated wastewater is now being used on a limited scale for irrigation of parks and greenbelt. As wastewater systems grow in numbers and size, the volume of effluent will greatly exceed the demands for irrigation for parks and greenbelts. Futher study and planning

must proceed in order to select the appropriate options as to treatment and disposal.

- The uncontrolled disposal of septage by haulage contractors is a serious problem.

- There are no wastewater collection and treatment systems outside the Capital Area The current program of constructing new water systems in the outer communities will require wastewater systems to avoid health hazards from overloaded on-site facilities and uncollected wastewater.

Other Factors

- Expanding water and wastewater systems will stretch current capabilities of operating and managing these systems.

- The existing desalination plant is operated by a private firm under contract. Until recently this was also true of the wastewater treatment plant.

## RECOMMENDATIONS

The recommendations for projects and actions to be included in the third five-year plan are presented in Tables A through E, at the end of this summary. (These appear as Tables 5-9 in the report.) The prinicipal recommendations are described in the following sections. Where the tables provide additional details on those recommendations, the appropriate reference is made in parentheses.

### Institutional Factors

1. Augment PAWR's capabilities or take such other steps as needed to enable the WRC to meet its objective of providing leadership in the development and control of the water resources of Oman. (A-1)

Water Resources (Table A)

2. Prepare a national water resources strategic plan to provide guidance for the use, allocation, development, and control of water resources in Oman. (A-2)

3. Construct the most promising aquifer recharge facilities by the Ministry of Agriculture and Fisheries with the concurrence of the Water Resources Council. The number of schemes should be initially limited and extensively monitored. (A-3)

4. Establish interim policies for improved control over the use of Oman's water resources. (A-6)

5. Take immediate actions for the conservation and increased efficiency in the use of water. (A-10)

Water Supply: Capital Cities (Table B)

6. Develop a computerized model of the water system for distribution system analysis, management, planning, design, operation and quality control. (B-1)

7. Prepare a water supply master plan for the entire Capital Area. In addition to studies of water use and sources, the plan will address wastewater reuse, financial and economic feasibility, ability to pay, operation and maintenance matters, recommendations regarding organization and management capabilities, and public awareness and acceptance issues. (B-2)

8. Construct additional facilities for storage, transmission and distribution of water. (B-7)

9. Construct a new 50,000 $m^3$/day (11 mgd) desalination plant at Barka. (B-6)

Water Supply : Outer Areas (Table C)

10. Construct water systems for Rustaq, Ibri, Adam, and Bilad Bani Bu Ali. (C-1)
11. Design and construct water systems in six additional outer towns to be selected. (C-2)

12. Construct desalination plants at Sur and Sohar to supplement presently inadequate groundwater sources; construct extensions to the Sur and Sohar distribution and storage systems; and explore additional water resources for Nizwa water supply, storage and distribution system. (C-3, C-4)

Wastewater (Table D)

13. Prepare a wastewater master plan for the Capital Area which will integrate the four preliminary planning efforts recently completed. (D-1)

14. Construct wastewater facilities in the Capital Area recommended by the proposed master plan. (D-2)

15. Conduct feasibility studies for wastewater collection and treatment for those communities outside the Capital Area for which water systems are being provided, and construct the proposed facilities as funds permit. (D-3)

Water and Wastewater in Villages

16. A large proportion of Omani villages do not have safe means of disposal of human wastes. When linked with contaminated water and fly breeding, these unsatisfactory hygiene practices could have been a major contributor to the more than 300,000 cases of enteric diseases reported in Oman in 1983.

17. Community and household water supplies vary greatly in quality, with wells and the falaj systems readily contaminated. In studies being performed for the Ministry of Health, recommendations have been made for careful

assessment of the environmental sanitation practice and resource in rural and semi-urban areas, followed by the development of workshops and action programs for improved environmental health.

## BUDGET ESTIMATES

The estimated budget allocations for the water resources activities recommended for the third five-year plan are presented in Table E. The estimated annual costs by categories are as follows:

Estimated Costs, Million R.O.*

| | 1986 | 1987 | 1988 | 1989 | 1990 | Total |
|---|---|---|---|---|---|---|
| Water Resources | 1.60 | 2.88 | 2.61 | 2.30 | 2.30 | 11.69 |
| Water Supply (Capital Area) | 7.85 | 24.98 | 24.33 | 7.00 | 7.00 | 71.16 |
| Water Supply (Outer Areas) | 3.54 | 4.83 | 10.02 | 10.85 | 8.25 | 37.49 |
| Wastewater Facilities | 7.50 | 35.63 | 46.35 | 29.65 | 29.00 | 148.13 |
| TOTAL | 20.49 | 68.32 | 83.31 | 49.80 | 46.55 | 268.47 |

* 1985 Costs

## TABLE A. RECOMMENDED WATER RESOURCES ACTIVITIES

| ACTIVITY | DESCRIPTION | RESPONSIBLE AUTHORITY |
|---|---|---|
| 1. Provide effective support to the Water Resources Council (WRC) | There is an urgent need to augment PAWR's capabilities or take such other steps as required to ensure the WRC is given effective advice and assistance to carry out its duties. | WRC |
| 2. Prepare a national water resources strategic plan | The single most important activity in the entire sector is the preparation of a broad plan for the use, allocation and development of water resources in Oman, with emphasis on the Batinah plain and the Capital Area. (See Annexes F-1, G-1 and G-2) | WRC |
| 3. Construct aquifer recharge facilities | Aquifer recharge enhancement appears to be a promising possibility for increasing the fresh water sources of the Sultanate. The MAF indicate they have about 10 projects ready for design and construction at an average cost of RO 700,000 each. (See Annex F-2) | WRC (MAF) |
| 4. Establish an improved raingauge network | The lack of adequate rainfall data is a severe constraint on water resource planning. Improvements in rainguaging are proposed, with initial emphasis on areas tributary to the Capital Area (See Annex F-3) | WRC (PAWR) |
| 5. Coordinate water supply and wastewater planning | Master plans are proposed for both the water supply and wastewater sectors. The WRC should take the lead role in ensuring coordination by reviewing the proposed scopes of work of these master plans, and by ensuring that consideration is given to the relative merits of establishing combined water and wastewater executing agencies. | WRC |
| 6. Establish interim policies for improved control over the use of water | One of the results of the water resources strategic plan will be to recommend policies, procedures and guidelines for the control, allocation, use and development of water. Until the plan results are available, some policies should be set as soon as possible, on an interim basis. (See Annex F-4) | WRC |
| 7. Initiate measures for flood protection and flood control | While flooding in Oman is infrequent it can be disastrous when it occurs. Criteria for the control of flooding and protection from its effects should be established. (See Annex F-5) | WRC (PAWR) |
| 8. Continue ongoing water resources studies | Miscellaneous ongoing studies throughout Oman including diversion and recharge projects, and Wadi Bani Khaus as noted in the Brown and Root Report. | WRC (PAWR/MEW) |
| 9. Institutional development and training | Allowance has been provided in the proposed budget for advisory services required to support institutional development and training needs. | WRC |
| 10. Actions for control of water resources | There are several possibilities for conservation and control of water resources which could be implemented with the backing of the WRC, including more efficent irrigation practices, maximum utilization of wastewater, and effective control over groundwater extractions. | WRC |

TABLE 8. RECOMMENDED WATER SUPPLY ACTIVITIES FOR THE CAPITAL AREA

| ACTIVITY | DESCRIPTION | RESPONSIBLE AUTHORITY |
|---|---|---|
| 1. Develop computerized model of water supply system | A computerized model of the existing water supply facilities would be used for distribution system analysis, management, planning, design, operation, and quality control. The program would be developed by consultants for subsequent use by MEW personnel. Training of MEW personnel would be provided during the development, confirmation, and installation of the model. (See Annex F-7 and G-3 for details) | MEW |
| 2. Prepare a water supply master plan | An updated, comprehensive water supply master plan would be conducted by consultants and serve as the means to rationalize the use of water resources in the area, and to provide guidance for the staging of required extensions and additions to the existing facilities in parallel with water demands. Key sections of the plan would provide financial and economic analysis including ability-to-pay, operations and maintenance, training, and recommendations for improving existing organizational and managerial procedures. The water master plan should be coordinated with authorities within the Capital Area Municipality responsible for wastewater. (See Annex G-2) | MEW |
| 3. Continue studies at Wadi Dayqah | Further studies in Wadi Dayqah should be undertaken. The nature of these studies would be based on the findings of the Resources Strategic Plan and the Water Supply Master Plan. | MEW |
| 4. Complete the construction of the Ghubra desalination plant | The two additional desalination units at the Ghubrah plant now under construction will be put into service as soon as possible to reduce the current overpumping of Capital Area groundwater resources. | MEW |
| 5. Construct facilities to develop Barka well fields | Wellfields in the Barka area (possibly Wadi Ma'awil or Wadi Bani Kharus) need to be developed for direct use or for blending with desalination water at Barka. It may be necessary to develop a well field in this area prior to the Barka facility becoming operational for direct use to meet peak demands. | MEW |
| 6. Construct a new desalination plant and pumping facilities at Barka | The 50,000 $m^3$/day Stage 1 capacity new desalination plant at Barka, and associated works together with pump station and transmission line, are key components of the improvements needed in the next five years to meet Capital Area water demands. | MEW |
| 7. Construct system improvements | Additional storage, transmission and distribution mains will be needed to make efficient use of new sources and provide increased reliability. | MEW |
| 8. Take key conservation actions | MEW should work with other appropriate government agencies to minimize the threat of contamination of the existing Capital Area wellfields. MEW should also initiate a series of measures to conserve its limited supplies. (See Annex F-8) | MEW |
| 9. Insititutional development and training | Allowance has been provided in the proposed budget for advisory services required to support institutional development and training needs | MEW |

TABLE C. RECOMMENDED WATER SUPPLY ACTIVITIES FOR THE OUTER TOWNS, VILLAGES AND RURAL COMMUNITIES

| ACTIVITY | DESCRIPTION | RESPONSIBLE AUTHORITY |
|---|---|---|
| 1. Construct facilities in four towns | The water supply projects that are presently under detailed design for Rustaq, Ibri, Adam, and Bilad Bani Bu Ali, should be constructed as soon as the designs are completed and water supply sources are confirmed. | MEW |
| 2. Design and construct additional facilities in towns and villages | Detailed design, followed by implementation, should now proceed for water supply projects in selected remaining towns for which feasibility studies have been completed. For budget purposes, an additional number of six such communities was assumed. Priorities for selection will have to be established. | MEW |
| 3. Construct facilities at Sur | Desalination facilities will have to be expanded at Sur because of the unavailability of an adequate supply of potable water from groundwater sources. | MEW |
| 4. Construct facilities at Sohar | A desalination plant may have to be expanded at Sohar for the same reason. Additional transmission, distribution and storage facilities also should be constructed in accordance with the development plan selected from the options now under consideration for Sohar. | MEW |
| 5. Conduct feasibility studies in selected communities. | Feasibility studies and designs should be undertaken for additional towns and villages, based on progress with the implementation of activities 1 and 2 above. | MEW |
| 6. Construct water sypply systems for rural communities | Water supply facilities for rural communities typically include a well, an elevated tank, and not more than one kilometer of distribution lines with standpipes (public faucets) rather than piped connections to dwellings. MEW should continue its past rate of construction of such works. | MEW |
| 7. Investigate alternative energy sources for pumping | MEW should undertake a program for the study, installation and testing of solar and wind energy for small pumping facilities in remote areas. | MEW |

TABLE D. RECOMMENDED WASTEWATER ACTIVITIES

| ACTIVITY | DESCRIPTION | RESPONSIBLE AUTHORITY |
|---|---|---|
| 1. Prepare wastewater master plan for the Capital Area | The work of the four appointed consulting firms currently developing preliminary master plan concepts for four separate areas should be coordinated and integrated into an overall wastewater master plan for the entire Capital Area. The master plan should include a priority schedule for implementation. The relevant authorities involved, including the Ministry of Health, Ministry of Environment, Ministry of Electricity and Water and the Ministry of Agriculture and Fisheries should agree on policies and practices for effluent reuse/disposal. | CAM |
| 2. Implement wastewater projects in the Capital Area | Based on the priorities established, detailed designs should be prepared and construction should proceed on the extension and upgrading of the Darsayt treatment plant, including improved sludge disposal facilities. In addition, the recommended facilities to serve other areas should be designed and constructed. All plants should be designed to accommodate the established reuse/disposal practices and requirements. | CAM |
| 3. Actions to be taken for larger towns and villages having water supply | Studies should proceed to evaluate the needs and feasibility of providing wastewater collection, treatment, reuse/disposal of effluent or alternative simple and safe means of wastewater disposal for those towns already provided with water supply. The areas include (1) Sur (high water table and many houses connected to the water supply system.) (2) Sohar (potential major development and house-connections in progress) and (3) Nizwa (may not yet require full sewerage and treatment). The design and and implementation of study recommendations should then proceed, with particular attention being given to safe means of disposal and/or reuse of effluent and sludge.<br><br>Priority should be given to towns to which water will next be supplied: Rustaq, Ibri, Adam, Bilad Bani Bu Ali. Feasibility studies on the other towns and villages to which the Ministry of Electricity and Water plans to supply water in the third five-year plan are also required. | MRM |
| 4. Studies for other towns and villages | Studies should be conducted throughout the region regarding present sanitary practices and sewage disposal practices, and regarding potential public health hazards, potential pollution hazards, and adverse environmental impacts should be identified. Proposals can then be developed and implemented for appropriate improvements to the present situation, having regard to effluent disposal and the collection and dumping of septage. | MRM |
| 5. The key management actions | The provision of adequate wastewater collection, treatment and disposal (reuse) in the Capital Area will require major design and construction efforts during the last part of the third five-year plan. It is recommended that advisory services be provided to address implementation, management and operating issues, and to recommend required institutional development and training actions. | CAM |

TABLE E. ESTIMATED BUDGET ALLOCATIONS FOR RECOMMENDED WATER RESOURCES ACTIVITIES

| | Millions of R.O. | | | | | |
|---|---|---|---|---|---|---|
| | 1986 | 1987 | 1988 | 1989 | 1990 | Total |
| **A. Water Resources Activities (See Table A)** | | | | | | |
| 1. Provide effective support to the Water Resources Council (WRC) | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 1.50 |
| 2. Prepare a national water resources strategic plan | 0.50 | 0.23 | | | | 0.73 |
| 3. Construct aquifer recharge facilities (Say 10 @ R.O. 0.7m) | -- | 1.50 | 1.50 | 2.00 | 2.00 | 7.00 |
| 4. Establish an improved rainguage network | 0.20 | | | | | 0.20 |
| 5. Coordinate water supply planning | -- | | | | | -- |
| 6. Establish interim policies for improved control over use of water | -- | | | | | -- |
| 7. Prepare flood control design criteria | 0.10 | -- | -- | -- | -- | 0.10 |
| 8. Conduct ongoing and further studies | 0.50 | 0.75 | 0.75 | | | 2.00 |
| 9. Provide support to address institutional and training needs | -- | 0.10 | 0.06 | -- | -- | 0.16 |
| SUBTOTAL | 1.60 | 2.88 | 2.61 | 2.30 | 2.30 | 11.69 |
| **B. Water Supply Activities for the Capital Area (See Table B)** | | | | | | |
| 1. Prepare computerized model of water supply system | 0.09 | -- | -- | -- | -- | 0.09 |
| 2. Prepare a water supply master plan | 0.25 | 0.38 | -- | -- | -- | 0.63 |
| 3. Perform studies regarding Wadi Dayqah | 0.25 | 0.25 | 0.50 | -- | -- | 1.00 |
| 4. Complete and commission two new desal. units at Ghubra | SEPARATE SULTANATE OF OMAN BUDGET | | | | | |
| 5. Develop Barka wellfield | 0.50 | 1.00 | 0.50 | -- | -- | 2.00 |
| 6. Construct desalination facilities at Barka | 3.10 | 16.00 | 16.00 | -- | -- | 35.10 |
| 7. Continue efforts to reduce unaccounted-for water | 0.30 | -- | -- | -- | -- | 0.30 |
| 8. Construct transmission, distribution and storage improvements | 3.28 | 7.00 | 7.00 | 7.00 | 7.00 | 31.28 |
| 9. Provide support and facilities to address institutional and training needs | 0.08 | 0.35 | 0.33 | -- | -- | 0.76 |
| SUBTOTAL | 7.85 | 24.98 | 24.33 | 7.00 | 7.00 | 71.16 |
| **C. Water Supply Activities-Outer Towns and Villages (See Table C)** | | | | | | |
| 1. Construct facilities in towns and villages (portion only*) | 1.00 | 1.00 | -- | -- | -- | 2.00 |
| 2. Design and construct additional facilities | 0.25 | 0.25 | 2.00 | 3.00 | 4.00 | 9.50 |
| 3. Provide additional facilities at Sur | 0.50 | 1.50 | 3.00 | 3.00 | -- | 8.00 |
| 4. Provide additional facilities at Sohar | 0.50 | 0.50 | 3.00 | 3.00 | 3.00 | 10.00 |
| 5. Conduct feasibility studies for additional villages | -- | -- | 0.30 | 0.60 | | 0.90 |
| 6. Provide facilities for rural communities | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 6.25 |
| 7. Study alternative energy sources for pumping | -- | 0.10 | 0.25 | -- | -- | 0.35 |
| 8. Provide support and facilities to address institutional and training needs | 0.04 | 0.23 | 0.22 | -- | -- | 0.49 |
| SUBTOTAL | 3.54 | 4.83 | 10.02 | 10.85 | 8.25 | 37.49 |
| **D. Wastewater Activities (See Table D)** | | | | | | |
| 1. Prepare wastewater master plans for Capital Area | 0.25 | 0.38 | -- | -- | -- | 0.63 |
| 2. Implement wastewater projects in Capital Area | 7.00 | 35.00 | 44.00 | 26.00 | 25.00 | 137.00 |
| 3. Study/implement wastewater facilities in towns with water | 0.25 | 0.25 | 2.00 | 3.00 | 4.00 | 9.50 |
| 4. Studies in other towns and villages | -- | -- | 0.03 | .60 | -- | 0.90 |
| 5. Provide support to address institutional and training needs | -- | -- | 0.05 | 0.05 | -- | 0.10 |
| SUBTOTAL | 7.50 | 35.63 | 46.35 | 29.65 | 29.00 | 148.13 |
| Total without Capital Area wastewater project | 13.49 | 33.32 | 39.31 | 23.80 | 21.55 | 131.47 |
| TOTAL | 20.49 | 68.32 | 83.31 | 49.80 | 46.55 | 268.47 |

* Balance in second five year plan

ANNEX G

WATER RESOURCES DEVELOPMENT PROJECT

SUMMARIES OF SCOPES OF WORK FOR KEY CONTRACTS

A. Contract 1A - Executive and Technical Support Services to the CCEWR

B. Contract 1B - Preparation of National Water Resources Strategic Plan

C. Contract 2D - Masterplan for Long Term Water and Wastewater Improvements

D. Contract 3A - Selection, Design, Supervision of Construction and Evaluation of Pilot Water and Wastewater Projects in Towns

E. Contract 3C - Selection, Design, Supervision of Construction and Evaluation of Pilot Water and Wastewater Projects in Villages.

Oman Water Resources Development Project
Subproject I: Development of Water Resources Management and Planning organization

CONTRACT 1A

EXECUTIVE AND TECHNICAL SUPPORT SERVICES FOR THE CCEWR

Contract Summary

Problems Which This Contract Addresses

The large number of Government agencies with overlapping responsibilities for water resources has been a major factor in the country's inability to date to effectively develop, manage and allocate its scarce water resources. The recent establishment of the Ministry of Environment and Water Resources and the creation of a new Council for Conservation of Environment and Water Resources provides greater focus for addressing Oman's water resources problems but these organizations will require assistance to meet their responsibilities.

Objectives of the Contract

The principal objectives of the Contract are to:

(1) Provide executive support to the CCEWR to assist it in making policy and implementing decisions for the development, protection, conservation and allocation of the water resources of Oman.

(2) Develop and establish a self-sustaining Omani executive unit to continue the functions of the Consultant after the Contract has been completed.

(3) Optimize the use and control of the water resources of Oman in the overall interest of the economic, physical and social well-being of its people.

(4) Coordinate the relevant activities of the organizations and individuals who use, monitor or affect water resources.

(5) Implement and update as necessary the National Water Resources Strategic Plan being prepared under Contract 1B.

Relevant Omani Agencies

The contracting parties will be a qualified U.S. consulting firm (the Consultant) selected on the basis of competitive technical proposal and the CCEWR of the Sultanate of Oman.

The CCEWR will be responsible for the implementation of the Contract and the day-to-day working relationships with the Consultant.

## Schedule, Level of Effort and Budget

The Contract will be for a period of five years. The estimated starting date for services to be provided under the Contract is early 1987. The Consultant will maintain the equivalent of about five full-time staff members in Oman during this period and also will provide an estimated additional 90 man-months of specialist services throughout the Contract period to carry out needed services in Oman and the USA. A preliminary budget of $9.7 million (R.O. 3.7 million) has been estimated for this Contract.

## Summary of Services to be Provided

Overview. The Consultant will provide executive and technical staff for a new water resources management executive unit (the "Unit") acting on behalf of the CCEWR. This (Unit) will be headed by a full-time Omani senior official (the "Unit Head"). The Consultant's staff will act for, advise, represent and serve the CCEWR, and guide and assist the (Unit Head). The Consultant's staff will function as though they were employees of the Government.

Specific Duties. The Consultant's principal specific duties are as follows:

1. Propose, develop and assist in the implementation of policies and procedures for water resources management.

2. Act as CCEWR's executive secretariat by preparing agendas, proposing rules and regulations and maintaining records of all activities.

3. Assist in the coordination of water resources activities of other Government agencies, call meetings and propose actions as necessary.

4. Monitor progress in the development of the Water Resources Strategic Plan (the Plan) being prepared under Contract 1B, assist in its review, and work with the CCEWR in implementing its recommendations.

5. Propose and assist in the implementation of rules and procedures for the allocation and monitoring of water use, in accordance with the Plan.

6. Initiate measures for the protection of key aqulfers threatened by pollution.

7. Prepare an action plan for implementing measures to reduce damages caused by periodic flooding.

8. Prepare contingency plans for potentially harmful effects of contaminant spills, severe droughts, disruption of water supply and wastewater facilities or other potential disasters.

9. Develop and implement programs for public information in support of water conservation, protection of the environment and other goals and objectives of the CCEWR.

10. Recommend and assist in the installation of computer hardware and software for water resources data storage and retrieval, water resources modeling, and management and administrative information systems.

11. Prepare and implement a program for the development of a long-term institution to serve as the executive agency of the CCEWR and a human resource development program to staff this institution with competent Omanis.

12. Provide technical support and such other services as may be necessary to achieve the overall objectives of the Contract.

Oman Water Resources Development Project
Subproject I: Development of Water Resources Management and Planning Organization

CONTRACT 1B

PREPARATION OF NATIONAL WATER RESOURCES STRATEGIC PLAN

Contract Summary

Problems Which This Contract Addresses

The many Government agencies with interests and responsibilities related to water resources carry out their duties to the best of their ability. There are, however, no national water resources guidelines to assist them in avoiding possible duplication of effort or taking actions which may not be in the overall best interests of the country. The lack of a water resources strategic plan is a major factor in current weaknesses in the protection, enhancement, conservation and allocation of the water resources of Oman.

Objectives of the Contract

The principal objectives of the Contract are to:

(1) Provide a basis for the use and control of the water resources of Oman in the overall interest of the economic, physical and social well-being and health of its people

(2) Establish suitable bases for coordination of water resources-related activities by the organizations and individuals who use, monitor or affect water resources

(3) Establish technical criteria, guidelines, recommended policies and procedures, and other bases for decision-making for the protection, conservation and allocation of the water resources of Oman

(4) Identify potential sources of water and other means of augmenting water supplies such as aquifer recharge and wastewater reuse.

Relevant Omani Agencies

The contracting parties will be a qualified U.S. consulting firm (the Consultant) selected on the basis of competitive technical proposal and the CCEWR of the Sultanate of Oman.

The (Unit) of the CCEWR will be responsible for the implementation of the Contract and the day-to-day working relationships with the Consultant.

Schedule and Budget

The Contract will be for a period of 12 months. The estimated starting date for services to be provided under the Contract is early 1987. A preliminary budget of $3.4 million (R.O. 1.3 million) has been estimated for this Contract.

Summary of Services to be Provided

Overview. The Consultant will prepare a water resources strategic plan for northern Oman which includes provisions for water allocation, aquifer protection, augmentation of sources of supply, reduction of demands, estimates of water needs, policies on flood protection and such other measures as will provide for optimal management and use of water resources.

Specific Duties. The Consultant's principal specific duties are as follows:

1. Review, catalog and assess technical information pertinent to hydrology and hydrogeology.

2. Identify inadequacies in the above data and recommend programs for future data collection.

3. Evaluate the existing raingage network, recommend and design a comprehensive new raingage network, and prepare specifications for the purchase, installation and operation of the new facilities.

4. Prepare a report on flood control which proposes design criteria and flood protection policies.

5. Recommend policies and actions to protect groundwater resources from contamination.

6. Estimate current and projected water use, from all sources, for domestic, industrial, agricultural or other purposes.

7. Evaluate alternative means of reducing water use for domestic, industrial and agricultural purposes, including such demand modification techniques as process changes, water-saving devices, improvements in irrigation efficiencies and water pricing.

8. Evaluate alternative means of increasing water resources, including desalination, groundwater recharge, wastewater reclamation and reuse and other supply enhancement techniques.

9. Study and recommend policies for allocation of water among competing users.

10. Prepare an analysis of beneficiaries and the public and environmental impacts of the recommended plan.

11. Prepare and review a Water Resources Strategic Plan report with the CCEWR prior to printing the final report. The final report will include a summary in Arabic and English.

Oman Water Resources Development Project
Subproject II: Capital Area Water Supply
Improvements and Wastewater Planning

CONTRACT 2D

MASTER PLAN FOR LONG TERM WATER SUPPLY
AND WASTEWATER IMPROVEMENTS

Contract Summary

Problems Which This Contract Addresses

Development in the Capital Area has increased at an extremely rapid rate in the past ten years and shows no signs of decreasing. Water use doubled in the past four years and is expected to double again by 1990. Groundwater resources, even though being overpumped, now account for only about one-third of the supply. The rest comes from desalination. Only about 12 percent of the Capital Area population is presently served by a wastewater collection and treatment system. Responsibilities for water and wastewater are assigned to two separate government agencies. There are major needs for the expansion of facilities, institutional improvements, attention to operation and maintenance issues, and an overall need to address water and wastewater planning on a coordinated basis.

Objectives of the Contract

The principal objectives of the Contract are to:

(1) Provide a plan for the environmentally sound and socially acceptable development of water supply and wastewater disposal systems in the Capital Area at overall least cost

(2) Provide a long-term plan for coordinated water supply and wastewater system development

(3) Provide guidelines and standards for the future detailed design and construction of proposed first stage facilities, for their operation and maintenance, and for the institutional and financial management arrangements to ensure implementability and sustainability

(4) Provide a basis for decisions to fund those works found to have a high priority (proposed first phase works).

Relevant Omani Agencies

The contracting parties will be a qualified U.S. consulting firm (the Consultant) selected on the basis of competitive technical proposals, and the CCEWR of the Sultanate of Oman.

The Ministry of Electricity and Water (MEW) and the Capital Area Municipality (CAM) will be actively involved in providing data to the Consultant and in reviewing the Consultant's recommendations for water (MEW) and wastewater (CAM) improvements.

Schedule and Budget

The Contract will be for a perid of 16 months. The estimated starting date for services to be provided under the Contract is early 1987. A preliminary budget of $4.7 million (R.O. 1.8 million) has been estimated for this Contract.

Summary of Services to be Provided

Overview. The Consultant will prepare a master plan report on potable water supply and wastewater facilities for the Capital Area which will address such matters as:

- o Physical facilities
- o Institutional development
- o Operation and maintenance
- o Wastewater reuse
- o Pricing of water and wastewater services
- o Environmental and social issues
- o Overall technical, economic and financial feasibility of the recommended improvements

Specific Duties. The Consultant's principal specific duties are as follows:

1. Collect data and conduct basic studies related to (a) water and wastewater flows, (b) inventory and evaluation of existing facilities, and (c) sanitary and health conditions.

2. Develop alternative programs for staged water supply improvements

3. Develop alternative programs for staged wastewater improvements

4. Conduct special studies related to water supply and wastewater, including:

   a. Wastewater Reuse
   b. Economic Evaluations
   c. Development of Models
   d. Institutional Evaluations
   e. Financial Analysis
   f. Operation and Maintenance

5. Prepare preliminary designs and cost estimates for the various water and wastewater alternative programs and compare these alternatives on the basis of technical suitability and costs

6. Select specific water and wastewater programs on the basis of this comparison and review the recommended programs with the CCEWR

7. Following agreement with the CCEWR, prepare preliminary engineering design of the recommended first stage works for both the water and wastewater programs. (The first stage is defined as those facilities required to meet estimated needs in 1995.)

8. Prepare cost estimates of the recommended first stage works on the basis of these preliminary designs.

9. Conduct separate feasibility analyses for the water and wastewater components of the proposed first stage project. These feasibility analyses will include the following elements:

   a. Economic Feasibility
   b. Environmental Impact
   c. Public Acceptability
   d. Technical Soundness
   e. Financial Feasibility
   f. Institutional Feasibility

10. Prepare a schedule of implementation through the master plan period, with emphasis on the first stage construction program.

11. Make recommendations for the operation and maintenance of the proposed facilities.

12. Prepare a financial plan for capital funding and the generation of operating revenues for up to ten years after completion of first stage construction.

13. Prepare a plan for institutional development and training for the agencies responsible for the water and wastewater systems.

14. Prepare a summary implementation plan listing the steps required to carry out the master plan recommendation through the first stage construction program.

15. Coordinate the work of the master plan with appropriate Government agencies and consultants working under other contracts forming part of the Project.

16. Prepare and review the Master Plan with the CCEWR prior to printing the final Master Plan report. The final Master Plan will include a summary in Arabic and English.

Oman Water Resources Development Project
Subproject III: Town and Village Water
and Wastewater Pilot Activities

CONTRACT 3A

# SELECTION, DESIGN, SUPERVISION OF CONSTRUCTION AND EVALUATION OF PILOT WATER AND WASTEWATER PROJECTS IN TOWNS

## Contract Summary

### Problems Which This Contract Addresses

Outside the Capital Area there are about 24 towns in Northern Oman with an estimated total population of 200,000. There are piped water systems in only three of the towns and none of the towns have systems for the collection of wastewater. Water in the towns is obtained from a variety of sources, including the traditional falaj system, government or private drilled wells, dug wells, and, along the coast, some small desalination plants.

The lack of adequate water and sanitation facilities in the towns results in a high incidence of enteric diseases, hardships in obtaining adequate supplies of water within convenient distance, and generally degraded environmental conditions.

### Objectives of the Contract

The long-term objective is to improve the health and well being of the people living in Oman's towns by contributing to the provision of adequate and convenient supplies of potable water and the effective collection and disposal of excreta and wastewater. The specific objectives of this Contract are to:

(1) Provide guidance for the future design, construction and operation of suitable water and wastewater facilities in towns in Oman through the preparation of feasibility studies and recommendations for coordinated water, wastewater and reuse projects for three pilot towns,

(2) Make recommendations for institutional improvements to facilitate the development, operation and maintenance of such systems.

The detailed design of this pilot project will be undertaken through an amendment to this Contract, subject to the approval of the CCEWR. Construction of facilities and the implementation of institutional improvement recommendations resulting from this Contract will be through future contracts expected to be funded under the Project.

### Relevant Omani Agencies

The contracting parties will be a qualified U.S. consulting firm (the Consultant) selected on the basis of competitive technical proposals, and the MRM and MEW of the Sultanate of Oman.

The Ministry of Electricity and Water (MEW) and the Ministry of Regional Municipalities (MRM) will be actively involved in providing data to the Consultant and in reviewing the Consultant's recommendations for water (MEW) and sanitation and wastewater (MRM) improvements. The Ministry of Health is also expected to be a useful source of data and advice.

Schedule and Budget

The initial Contract for selection and design of pilot towns will be for a period of 16 months. The estimated starting date for services to be provided under the Contract is early 1987. A preliminary budget of $8.4 million (R.O. 3.2 million) has been estimated for this Contract.

Summary of Services to be Provided

Overview. The Consultant will conduct preliminary water and wastewater studies in 24 towns. Based on these surveys and studies, 3 towns will be selected for a pilot program. The Consultant will then prepare water and sanitation/wastewater feasibility studies for the 3 towns in the pilot program.

Specific Duties. The Consultant's principal specific duties are as follows:

Stage 1: Surveys and Prefeasibility Studies

1. Conduct field surveys for data collection in the 24 towns identified in the Contract:

   a. For the 11 "Group A" towns which have not been studied since 1980, extensive data are to be collected.

   b. For the 13 "Group B" towns for which more recent studies and designs have been prepared, data will be obtained principally from those studies and designs.

2. Prepare a report on the results of the surveys conducted in the 24 towns.

3. Identify current needs for water and wastewater improvements in the 13 Group B towns.

4. Based on these needs studies, select 3 towns from Group B for which prefeasibility studies are to be conducted.

5. Conduct prefeasibility studies of water and wastewater facilities for these 3 Group B towns and all 11 Group A towns.

6. Prepare a report for the Prefeasibility Studies noted above.

7. Based on the results of these studies, and using selection criteria agreed upon with the MEW and MRM, present recommendations in order of suggested priority for the 3 towns to be selected for the pilot program.

## Stage 2: Feasibility Studies for Pilot Towns

8. Obtain MEW and MRM approval of the towns to be included in the pilot program.

9. Develop alternative programs for coordinated, staged water and wastewater/sanitation improvements for the pilot towns.

10. Conduct special studies related to water and wastewater/sanitation, including:

    a. Levels of Service
    b. Reuse Studies
    c. Computer Modeling
    d. Effluent Quality
    e. Economic Evaluation
    f. Institutional Evaluation
    g. Financial Analysis
    h. Operation and Maintenance

11. Prepare preliminary designs and cost estimates for the various water and wastewater/sanitation alternative programs and compare these alternatives on the basis of technical suitability, public acceptability and cost.

12. Select specific water and wastewater/sanitation programs on the basis of this comparison and review the recommended programs with the MEW and MRM.

13. Following agreement with the MEW and MRM, prepare preliminary engineering design of the recommended first stage (1) works for both the water and wastewater/sanitation programs.

14. Prepare cost estimates of the recommended first stage works on the basis of these preliminary designs.

15. Conduct separate feasibility analyses for the water and wastewater components of the proposed first stage project for the towns.

16. Prepare a schedule of implementation through the study period, with emphasis on the first stage construction program.

17. Present alternatives and make recommendations for the operation and maintenance of the proposed facilities.

18. Prepare a financial plan which presents alternatives and makes recommendations for capital funding and the generation of operating revenues for up to ten years after completion of first stage construction.

19. Prepare a plan which presents alternatives and makes recommendations for institutional development and training for the agencies responsible for the water and wastewater systems.

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(1) First Stage is defined as works considered adequate to meet expected needs to the year 1995.

20. Prepare a summary implementation plan listing the steps required to carry out the recommendations through the first stage construction program.

21. Coordinate the work of the Contract with appropriate Government agencies and consultants working under other contracts forming part of the Project.

22. Prepare and review a Pilot Town Report with the MRM and MEW prior to printing the final report. The final report will include a summary in Arabic and English.

Oman Water Resources Development Project
Subproject III: Town and Village Water and
Wastewater Pilot Activities

CONTRACT 3C

SELECTION, DESIGN, SUPERVISION OF CONSTRUCTION
AND EVALUATION OF PILOT WATER AND WASTEWATER PROJECTS
IN VILLAGES

## Contract Summary

### Problems Which This Contract Addresses

Outside the Capital Region there are 1,300 villages in northern Oman with an estimated total population of 150,000. There are no piped water systems in any of the villages and none of them have community sanitation systems. Water in the villages is obtained from a variety of sources, including the traditional falaj system, government or private drilled wells, dug wells, and, along the coast, some small reverse osmosis plants.

The lack of adequate water and sanitation facilities in the villages results in a high incidence of enteric diseases, hardships in obtaining adequate supplies of water within convenient distance, and generally degraded environmental conditions.

### Objectives of the Contract

The long-term objective is to improve the health and well being of the people living in Oman's villages by contributing to the provision of adequate and convenient supplies of potable water and the effective collection and disposal of excreta and wastewater. The specific objectives of this Contract are to:

(1) Provide guidance for the future design, construction and operation of suitable water supply and sanitation facilities in villages in Oman through the preparation of feasibility studies and recommendations for coordinated water and sanitation projects for 20 pilot villages

(2) Make recommendations for institutional improvements to facilitate the development, operation and maintenance of such systems

The detailed design of these pilot projects is expected to be undertaken through an amendment to this Contract. Construction of facilities and the implementation of institutional improvement recommendations resulting from this Contract will be through future contracts expected to be funded under the Project.

### Relevant Omani Agencies

The contracting parties will be a qualified U.S. consulting firm (the Consultant) selected on the basis of competitive technical proposals, and the MRM and MEW of the Sultanate of Oman.

The Ministry of Electricity and Water (MEW) and the Ministry of Regional Municipalities (MRM) will be actively involved in providing data to the Consultant and in reviewing the Consultant's recommendations for water (MEW) and sanitation and wastewater (MRM) improvements. The Ministry of Health is also expected to participate in the contract and will be a useful source of data and advice.

Schedule and Budget

The study phase of this Contract will be for a period of 14 months. The estimated starting date for services to be provided under the Contract is early 1987. A preliminary budget of $5.4 million (R.O. 2.1 million) has been estimated for this Contract.

Summary of Services to be Provided

Overview. The Consultant will conduct surveys and preliminary water and sanitation studies in 80 villages. Concurrently with this work, surveys and water and sanitation feasibility studies will be conducted for an additional 20 villages to be selected for a pilot program.

Specific Duties. The Consultant's principal specific duties are as follows:

Stage 1: Surveys and Preliminary Studies

1. With the approval of the MRM and MEW, select a total of 20 villages t become part of the pilot program, using such selection criteria as geographical distribution, size and type of water supply. These 20 villages are to be selected from among a total of 100 villages identified by the MRM and MEW for study under this Contract.

2. Conduct field surveys for data collection in these 100 villages.

3. Prepare a report on the results of the surveys conducted in the 100 villages.

4. Conduct preliminary studies of water and sanitation for the 80 villages not part of the pilot project.

5. Prepare a report on the results of the preliminary studies of these 80 villages which presents the Consultant's findings and recommendations.

6. Conduct such additional studies as are needed to augment the data obtained during the field surveys.

Stage 2: Feasibility Studies for 20 Pilot Villages

7. Develop alternative programs for coordinated, staged water and wastewater/sanitation improvements for the 20 pilot villages.

8. Conduct special studies related to water and wastewater/sanitation, including:

   a. Levels of Service
   b. Financial Evaluation
   c. Public Education
   d. Institutional Evaluations
   e. Alternative Energy Sources



176

9. Select specific water and wastewater/sanitation programs on the basis of comparison of the alternative programs developed and review the recommended programs with the MRM and MEW.

10. Following agreement with the MRM and MEW, prepare preliminary engineering designs and cost estimates, and conduct a feasibility analysis of the recommended first stage(1) works for both the water and wastewater/sanitation programs.

11. Present alternatives and make recommendations for the operation and maintenance of the proposed facilities.

12. Prepare a financial plan which presents alternatives and makes recommendations for capital funding and the generation of operating revenues for up to ten years after completion of first stage construction.

13. Prepare a plan which presents alternatives and makes recommendations for institutional development and training for the agencies responsible for the water and sanitation systems.

14. Prepare a summary implementation plan listing the steps required to carry out the recommendations through the first stage construction program.

15. Coordinate the work of the Contract with appropriate Government agencies and consultants working under other contracts forming part of the Project.

16. Prepare and review a comprehensive Report on Water Supply and Sanitation Facilities for Villages in Oman with the MRM and MEW prior to printing the final report. The final report will include a summary in Arabic and English.

Future Services to be Provided

The Contract also provides for the future provision of design and services during construction for the water and sanitation facilities recommended for the 20 pilot villages. Since the extent of these services cannot be determined until feasibility studies have been completed for the pilot villages, these services will be provided under an amendment to the basic Contract. Designs are expected to be completed about 16 months after the start of the basic Contract. Water and sanitation facilities are expected to be operational within a year from the completion of designs.

(1) First Stage is defined as works considered adequate to meet expected needs to the year 1995.

ANNEX II

Recommended Functions

of the Proposed

Water Resources Management Executive Unit

Introduction

The Unit will operate under the direction of the Council for the Conservation of the Environment and Water Resources (CCEWR). It will be headed by a full-time Executive Director. It will initially be staffed by a team of experts provided by a consulting firm who will function as though they were employees of the Government of Oman. However, as quickly as possible, Omani counterparts will be recruited as counterparts and trained by the consultants.

Specific Duties of the Unit

1. Acting under the direction of the CCEWR and with its authority, the Unit will manage Oman's water resources by developing plans, policies and procedures for the review and approval of the CCEWR and executing or overseeing the execution of approved plans, policies and procedures.

2. The Unit will function as an executive secretariat for the CCEWR: preparing agendas; proposing resolutions and decrees for review and approval; providing the CCEWR with technical appraisals of resolutions, projects and other matters submitted to the CCEWR by other organizations; recording actions taken by the CCEWR; and generally providing the CCEWR with the data and documentation it requires to effective manage Oman's water resources.

3. The unit will provide centralized coordination for all water resources related activities of all other government agencies including rule-making, standard-setting, facility planning and construction, and facility operation activities. To accomplish this the unit may initiate meetings and conferences, establish reporting and record keeping procedures and supervise the exchange of information on water resources.

4. A major function of the Unit will be to supervise the preparation of the National Water Resources Strategic Plan which will be carried out by a separate consultant. (The consulting firm which provides the staff for the Unit will not be allowed to undertake any other water resources related contracts in Oman in order to avoid any possibility of a conflict of interest.)

5. The Unit will be responsible for supervising the implementation of the the Strategic Plan after the CCEWR has allocated responsibility for implementing its various parts to the appropriate Omani Government organizations. The Unit may directly implementing portions of the plan if there is no appropriate agency.

6. The Unit will be responsible for carrying out or employing consultants to carry out supplementary studies and planning activities required to continue the strategic planning process.

7. The Unit will prepare for CCEWR approval detailed rules and procedure for the allocation and monitoring of water use based on the strategic plan and supervise the implementation of such rules and procedures after approval by the CCEWR.

8. The Unit will work with other government organizations to review and develop improved measures for the protection of key aquifers identified as being at significant risk of catastrophic contamination by toxic and hazardous materials.

9. The Unit will have responsibility for assuring the adequacy of flood protection measures including the determination of risk, the planning and implementation of rules and procedures to minimize damage and loss of life and the planning and implementation of flood protection schemes.

10. The Unit will be responsible for coordinating the development of water resources related contingency plans for catastrophic events such as contaminant spills, severe drought, operation disruption of water supply and wastewater conveyance or treatment, etc.

11. The Unit will work with other government organizations to develop and implement public information activities both directly and through other agencies which will seek to enhance public awareness of the need for conservation, good health practices in relation to drinking water, the protection of water sources, etc.

12. The Unit will work closely with PAWR to identify data deficiencies, plan activities to obtain data, assure that all government agencies provide PAWR with all relevant data and assure the utilization of PAWR data and analyses by all organizations utilizing water resources.



(8)

Annex I

COST ESTIMATE

CONTRACT IA - EXECUTIVE AND TECHNICAL SUPPORT SERVICES TO CCEWR

TABLE IA-1

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | | | | | | | |
| Chief of Party | 5,000 | 2.75 | 13,750 | 750 | 14,500 | 60 | 870,000 |
| Environ. Eng. | 4,500 | 2.75 | 12,375 | 675 | 13,050 | 60 | 783,000 |
| Water Res. Planner | 4,500 | 2.75 | 12,375 | 675 | 13,050 | 60 | 783,000 |
| Ag/Irr. Eng | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 60 | 696,000 |
| Economist | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 60 | 696,000 |
| Subtotals | 22,000 | 2.75 | 60,500 | 3,300 | 63,800 | 300 | 3,828,000 |
| Medium Term Residents | | | | | | | |
| Senior Specialists | 4,500 | 2.75 | 12,375 | 675 | 13,050 | 6 | 78,300 |
| Specialists | 3,500 | 2.75 | 9,625 | 525 | 10,150 | 6 | 60,900 |
| Subtotals | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 12 | 139,200 |
| Short Term | | | | | | | |
| Senior Specialists | 4,500 | 2.75 | 12,375 | 675 | 13,050 | 29 | 378,450 |
| Specialists | 3,500 | 2.75 | 9,625 | 525 | 10,150 | 29 | 294,350 |
| Subtotals | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 58 | 672,800 |
| Home Office | | | | | | | |
| Officer-in-Charge | 8,000 | 2.86 | 22,880 | 0 | 22,880 | 2 | 45,760 |
| Coordinator | 3,500 | 2.86 | 10,010 | 0 | 10,010 | 4 | 40,040 |
| Senior Specialists | 4,500 | 2.86 | 12,870 | 0 | 12,870 | 4 | 51,480 |
| Specialists | 3,500 | 2.86 | 10,010 | 0 | 10,010 | 4 | 40,040 |
| Drafters/Secretaries | 2,500 | 2.86 | 7,150 | 0 | 7,150 | 6 | 42,900 |
| Subtotals | 22,000 | 2.86 | 62,920 | 0 | 62,920 | 20 | 220,220 |
| Totals - Personnel | | | | | | 390 | 4,860,220 |
| Total - Direct Costs (See separate table for details) | | | | | | | 1,031,630 |
| Total - In-country Support Costs (See separate table for details) | | | | | | | 1,615,000 |
| Total - Personnel, Direct Costs and Local Costs | | | | | | | 7,509,850 |
| Contingency (10 percent) | | | | | | | 750,985 |
| Escalation (20 percent) | | | | | | | 1,501,970 |
| TOTAL - AID | | | | | | | 9,762,805 |
| GHANI GOVERNMENT CONTRIBUTION | | | | | | | 1,153,247 |
| Contingency (10 percent) | | | | | | | 115,325 |
| Escalation (20 percent) | | | | | | | 230,649 |
| TOTAL GHANI GOVERNMENT CONTRIBUTION | | | | | | | 1,499,221 |
| TOTAL CONTRACT COST | | | | | | | 11,262,026 |

Annex I

CONTRACT IA - EXECUTIVE AND TECHNICAL SUPPORT SERVICES TO CCEWR

Table IA-2

Direct Costs

| Item | Unit Descript. | Unit Cost | No. of Units | Total |
|---|---|---|---|---|
| Travel | | | | |
| Domestic | Trips | 300 | 10 | 3,000 |
| Internat. | Trips | 3,000 | 95 | 285,000 |
| Subtotal | | | | 288,000 |
| Per Diem | | | | |
| Trvl to Oman | Days | 100 | 285 | 28,500 |
| Trvl-U.S. | Days | 100 | 30 | 3,000 |
| Temp. Lodge | Days | 140 | 400 | 56,000 |
| Subtotal | | | | 87,500 |
| Educ.Allow | Tuition Yrs. | 6,000 | 40 | 240,000 |
| Ship. & Store | Shipments | 6,000 | 14 | 84,000 |
| medical, visas, etc. | per person | 300 | 90 | 27,000 |
| Home Offices Supplies | per month | 1,250 | 60 | 75,000 |
| Defense Base Insur. | 2.67% of overseas salaries | | | 19,130 |
| Cost of Living Allow. | 10% of overseas salaries | | | 184,000 |
| Subtotal | | | | 659,130 |
| Total Direct Costs | | | | 1,034,630 |

Annex I

Table IA-3

CONTRACT IA - EXECUTIVE AND TECHNICAL SUPPORT SERVICES TO CCEM
IN-COUNTRY CONTRACT SUPPORT COSTS

| | |
|---|---|
| HOUSING,UTILITIES - 372 RENTAL MONTHS X $2,250/MO | $837,000 |
| CAR PURCHASE - 6 NEW CARS X $8,000 | $48,000 |
| CAR O&M - 6 CARS X 15,000 KM/YR X $.30/KM X 5 YRS. | $135,000 |
| HOME FURNITURE - $15,000 X 8 | $120,000 |
| OFFICE EQUIPMENT | $100,000 |
| LOCAL SUPPORT STAFF | $375,000 |
| TOTAL LOCAL COST | $1,615,000 |

LOCAL SUPPORT STAFF

| | |
|---|---|
| 2 SECRETARIES - RO400/MONTH FOR 60 MONTHS | 124,675 |
| 2 TRANSLATORS - RO500/MONTH FOR 60 MONTHS | 155,844 |
| 2 DRIVERS - RO300/MONTH FOR 60 MONTHS | 93,506 |
| TOTAL | 374,026 |
| SAY | 375,000 |

OMANI GOVERNMENT SUPPORT COSTS

| | |
|---|---|
| OFFICE RENT EQUIVALENT RO1600/MONTH FOR 60 MONTHS | 280,519 |
| 8 COUNTERPARTS AT RO700 FOR 60 MONTHS | 872,727 |
| | 1,153,247 |

Annex I

Table 1A-4
PROJECTED EXPENDITURE TABLE

| COST ELEMENT | TOTAL COST | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|
| PERSONNEL | 5,832,264 | 555,336 | 1,194,293 | 1,333,493 | 1,180,373 | 1,041,173 | 527,546 |
| DIRECT COSTS | 1,241,556 | 124,156 | 248,311 | 248,311 | 248,311 | 248,311 | 124,156 |
| LOCAL SUPPORT | 1,938,000 | 193,800 | 387,600 | 387,600 | 387,600 | 387,600 | 193,800 |
| OMAN GOV'T | 1,383,896 | 138,390 | 276,779 | 276,779 | 276,779 | 276,779 | 138,390 |
| CONTINGENCY | 866,310 | | 86,631 | 173,262 | 173,262 | 259,893 | 173,262 |
| TOTAL | 11,262,026 | 1,011,732 | 2,193,614 | 2,419,445 | 2,266,325 | 2,213,756 | 1,157,154 |

NOTES: Escalation included in cost figures
Assumes contract will begin mid-1987 and end mid-1992

Break down of personnel cost

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LONG TERM | 4,593,600 | 459,360 | 918,720 | 918,720 | 918,720 | 918,720 | 459,360 |
| MED. TERM | 167,040 | | 83,520 | 83,520 | | | |
| SHORT TERM | 807,350 | 69,600 | 139,200 | 278,400 | 208,800 | 69,600 | 41,760 |
| HOME OFFICE | 264,264 | 26,426 | 52,953 | 52,853 | 52,853 | 52,853 | 26,426 |
| TOTAL | 5,832,264 | 555,386 | 1,194,293 | 1,333,493 | 1,180,373 | 1,041,173 | 527,546 |

Annex I

COST ESTIMATE

CONTRACT 1B - NATIONAL WATER RESOURCES STRATEGIC PLAN

Table 1B-1

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | | | | | | | |
| Water.Res.Planner | 5,000 | 2.75 | 13,750 | 750 | 14,500 | 12 | 174,000 |
| Environ. Eng. | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 6 | 80,040 |
| Water Res. Eng. | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 6 | 69,600 |
| Ag/Irr. Eng | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 12 | 149,640 |
| Water Res.Economist | 4,500 | 2.75 | 12,650 | 690 | 13,340 | 9 | 120,060 |
| Hydrologist | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 12 | 149,640 |
| Social Scientist | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 9 | 112,230 |
| Pub.Admin/Inst.Devel | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 9 | 112,230 |
| Subtotal | 35,400 | 2.75 | 97,350 | 5,310 | 102,660 | 75 | 967,440 |
| Short Term in Oman | | | | | | | |
| Soil Scient./Agron. | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 3 | 40,020 |
| Geologist | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 2 | 24,940 |
| Chemical Eng. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 2 | 24,940 |
| Environmentalist | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 2 | 24,940 |
| Officer-in-Charge | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 1 | 23,200 |
| Subtotal | 25,500 | 2.75 | 70,125 | 3,825 | 73,950 | 10 | 138,040 |
| Home Office | | | | | | | |
| Officer-in-Charge | 8,000 | 2.86 | 22,880 | 0 | 22,880 | 1 | 22,880 |
| Project Coordinator | 3,500 | 2.86 | 10,010 | 0 | 10,010 | 1 | 10,010 |
| Water Res. Spec. | 4,500 | 2.86 | 12,870 | 0 | 12,870 | 3 | 38,610 |
| Misc. Sub-profess. | 2,500 | 2.86 | 7,150 | 0 | 7,150 | 3 | 21,450 |
| Subtotal | 13,500 | 2.75 | 52,910 | 0 | 52,910 | 8 | 92,950 |
| Totals - Personnel | | | | | | 93 | 1,198,430 |
| Total Direct Cost (See separate table for details) | | | | | | | 492,070 |
| Total - In-country Support Costs (See separate table for details) | | | | | | | 500,000 |
| Total - Personnel, Direct Costs and Local Costs | | | | | | | 2,190,500 |
| Contingency (10 percent) | | | | | | | 219,050 |
| Escalation (8 percent) | | | | | | | 175,240 |
| TOTAL - AID | | | | | | | 2,584,790 |
| OMANI GOVERNMENT CONTRIBUTION | | | | | | | 208,831 |
| Contingency (10 percent) | | | | | | | 20,883 |
| Escalation (8 percent) | | | | | | | 16,706 |
| TOTAL OMANI GOVERNMENT CONTRIBUTION | | | | | | | 246,421 |
| TOTAL CONTRACT COST | | | | | | | 2,831,211 |

Annex I

Table 1B-2

CONTRACT 1B - NATIONAL WATER RESOURCES STRATEGIC PLAN

Direct Costs

| Item | Unit Descript. | Unit Cost | No. of Units | Total |
|---|---|---|---|---|
| Travel | | | | |
| Domestic | Trips | 300 | 3 | 900 |
| Internat. | Trips | 3,000 | 34 | 102,000 |
| Subtotal | | | | 102,900 |
| Per Diem | | | | |
| Trvl to Oman | Days | 100 | 136 | 13,600 |
| Trvl-U.S. | Days | 100 | 10 | 1,000 |
| Shrtterm/Temp | Days | 140 | 500 | 70,000 |
| Subtotal | | | | 84,600 |
| Educ.Allow | Tuition Yrs. | 6,000 | 12 | 72,000 |
| Ship. & Store | Shipments | 3,000 | 16 | 48,000 |
| medical, visas, etc. | per person | 300 | 34 | 10,200 |
| Home Offices Supplies | per month | 1,500 | 12 | 18,000 |
| Defense Base Insur. | 2.67% of overseas salaries | | | 11,880 |
| Cost of Living Allow. | 10% of overseas salaries | | | 44,490 |
| Equipment (Computer hardware and software) | | | | 100,000 |
| Subtotal | | | | 304,570 |
| Total Direct Costs | | | | 492,070 |

Annex I

Table 1B-3

CONTRACT 1B - NATIONAL WATER RESOURCES STRATEGIC PLAN
IN-COUNTRY CONTRACT SUPPORT COSTS

| | |
|---|---|
| HOUSING-84 RENTAL MONTHS X $RO850 ($2,250)/MO | $189,000 |
| HOME FURNISHINGS - 7 X 15,000 | 105,000 |
| CAR LEASE - 8 CARS X 12 MONTHS X RO2370 | $49,247 |
| OFFICE EQUIPMENT | $75,000 |
| LOCAL SUPPORT STAFF - 10 X 15,000 | $96,623 |
| TOTAL | $514,870 |
| SAY | 500,000 |

LOCAL SUPPORT STAFF

| | |
|---|---|
| 3 SECRETARIES - RO400/MONTH FOR 12 MONTHS | 37,403 |
| 2 TRANSLATORS - RO500/MONTH FOR 12 MONTHS | 31,169 |
| 3 DRIVERS - RO300/MONTH FOR 12 MONTHS | 28,052 |
| TOTAL | 96,623 |

OMANI GOVERNMENT SUPPORT COSTS

| | |
|---|---|
| OFFICE RENT EQUIVALENT RO3200/MONTH FOR 12 MONTHS | 99,740 |
| 5 COUNTERPARTS AT RO700 FOR 12 MONTHS | 109,091 |
| | 208,831 |

Annex I

Table 18-4

CONTRACT 1B - NATIONAL WATER RESOURCES STRA
PROJECTED EXPENDITURE TABLE

| COST ELEMENT | TOTAL COST | 1987 | 1988 |
|---|---|---|---|
| PERSONNEL | 1,294,304 | 647,152 | 647,152 |
| DIRECT COSTS | 531,436 | 265,718 | 265,718 |
| LOCAL SUPPORT | 540,000 | 270,000 | 270,000 |
| OMAN GOV'T | 225,538 | 112,769 | 112,769 |
| CONTINGENCY | 239,933 | 119,967 | 119,967 |
| TOTAL | 2,831,211 | 1,415,606 | 1,415,605 |

NOTES: Escalation included in cost figures
Assumes contract will begin mid-1987
and end mid-1988.

Annex I

COST ESTIMATE
CONTRACT 2D - CAPITAL REGION WATER AND WASTEWATER MASTERPLAN
Table 2D-1

| Item | Basic Salary | Multiplier | Subtotal | Overseas Different. | Monthly Rate | Person Months | Project Total |
|---|---|---|---|---|---|---|---|
| AID CONTRIBUTION | | | | | | | |
| Personnel Costs | | | | | | | |
| Long Term Resident | | | | | | | |
| Proj. Mgr. (Env.Eng) | 5,000 | 2.75 | 13,750 | 750 | 14,500 | 16 | 232,000 |
| Environ. Eng. | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 16 | 213,440 |
| Wtr.Sup.Eng.(Distrb. | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 14 | 162,400 |
| W/Wtr. Eng. | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 14 | 162,400 |
| W/Wtr Util. Eng | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 12 | 139,200 |
| Wtr.Qual.& Treatmt. | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 6 | 80,040 |
| W/Wtr. Treatmt. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 6 | 74,820 |
| W/Wtr Reuse Spec. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 6 | 74,820 |
| Drafters | 2,800 | 2.75 | 7,700 | 420 | 8,120 | 24 | 194,880 |
| Subtotal | 37,600 | 2.75 | 103,400 | 5,610 | 109,010 | 114 | 1,334,000 |
| Short Term in Oman | | | | | | | |
| Officer in Charge | 8,000 | 2.75 | 22,000 | 1,200 | 23,200 | 1 | 23,200 |
| Ins't Dev/HRD Spec | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 6 | 74,820 |
| O & M Spec. | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 6 | 69,600 |
| Utility Fin. Anal. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 6 | 74,820 |
| Economist | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 6 | 80,040 |
| Marine Disp. Spec. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 3 | 37,410 |
| Desalination Spec | 4,600 | 2.75 | 12,650 | 690 | 13,340 | 3 | 40,020 |
| Social Sci. | 4,000 | 2.75 | 11,000 | 600 | 11,600 | 5 | 58,000 |
| Envirn. Spec. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 2 | 24,940 |
| Misc. Tech. Spec. | 4,300 | 2.75 | 11,825 | 645 | 12,470 | 5 | 62,350 |
| Subtotal | 46,700 | 2.75 | 128,425 | 7,005 | 135,430 | 43 | 545,200 |
| Home Office | | | | | | | |
| Officer-in-Charge | 8,000 | 2.86 | 22,880 | 0 | 22,880 | 1 | 22,880 |
| Project Coordinator | 3,500 | 2.86 | 10,010 | 0 | 10,010 | 2 | 20,020 |
| Misc. Eng./Spec. | 4,500 | 2.86 | 12,870 | 0 | 12,870 | 8 | 102,960 |
| Misc. Sub-profess. | 2,500 | 2.86 | 7,150 | 0 | 7,150 | 5 | 35,750 |
| Subtotal | 18,500 | 2.75 | 52,910 | 0 | 52,910 | 16 | 181,610 |
| Totals - Personnel | 102,800 | | 284,735 | 12,615 | 297,380 | 173 | 2,060,810 |
| Total Direct Cost (See separate table for details) | | | | | | | 781,900 |
| Total - In-country Support Costs (See separate table for details) | | | | | | | 799,000 |
| Total - Personnel, Direct Costs and Local Costs | | | | | | | 3,641,710 |
| Contingency (10 percent) | | | | | | | 364,171 |
| Escalation (10 percent) | | | | | | | 364,171 |
| TOTAL - AID | | | | | | | 4,370,052 |
| OMANI GOVERNMENT CONTRIBUTION | | | | | | | 369,870 |
| Contingency (10 percent) | | | | | | | 36,987 |
| Escalation (10 percent) | | | | | | | 36,987 |
| TOTAL OMANI GOVERNMENT CONTRIBUTION | | | | | | | 443,844 |
| TOTAL CONTRACT COST | | | | | | | 4,813,896 |

Annex I

CONTRACT 2D - CAPITAL REGION WATER AND WASTEWATER MASTERPLA
Table 2D-2

Direct Costs

| Item | Unit Descript. | Unit Cost | No. of Units | Total |
|---|---|---|---|---|
| Travel | | | | |
| Domestic | Trips | 300 | 4 | 1,200 |
| Internat. | Trips | 3,000 | 58 | 174,000 |
| Subtotal | | | | 175,200 |
| Per Diem | | | | |
| Trvl to Oman | Days | 100 | 12 | |
| Trvl-U.S. | Days | 100 | 482 | 4 |
| Shrtterm/Temp | Days | 140 | 1,290 | 1 |
| Subtotal | | | | 230,000 |
| Educ.Allow | Tuition Yrs. | 6,000 | 12 | 72,000 |
| Ship. & Store | Shipments | 3,000 | 10 | 30,000 |
| medical, visas, etc. | per person | 300 | 40 | 12,000 |
| Home Offices Supplies | per month | 1,500 | 16 | 24,000 |
| Defense Base Insur. | 2.67% of overseas salaries | | | 18,700 |
| Cost of Living Allow. | 10% of overseas salaries | | | 70,000 |
| Equipment (Computer hardware and software) | | | | 150,000 |
| Subtotal | | | | 376,700 |
| Total Direct Costs | | | | 781,900 |

Annex I

CONTRACT 2D - CAPITAL REGION WATER AND WASTEWATER MASTERPLAN
Table 2D-3

IN-COUNTRY CONTRACT SUPPORT COSTS

| | |
|---|---|
| HOUSING/UTILITIES - 144 RENTAL MONTHS X $2,250/MO | $324,000 |
| CAR LEASES 10 CARSX16 MONTHS | $82,078 |
| HOME FURNISHINGS - 9 X15,000 | $135,000 |
| OFFICE EQUIPMENT | $100,000 |
| LOCAL SUPPORT STAFF | $157,922 |
| TOTAL LOCAL COST | $799,000 |
| SAY | $800,000 |

LOCAL SUPPORT STAFF

| | |
|---|---|
| 4 SECRETARIES - RO400/MONTH FOR 16 MONTHS | 66,494 |
| 2 TRANSLATORS - RO500/MONTH FOR 16 MONTHS | 41,558 |
| 4 DRIVERS - RO300/MONTH FOR 16 MONTHS | 49,870 |
| TOTAL | 157,922 |

OMANI GOVERNMENT SUPPORT COSTS

| | |
|---|---|
| OFFICE RENT EQUIVALENT RO4000/MONTH FOR 16 MONTHS | 166,234 |
| 7 COUNTERPARTS AT RO700 FOR 16 MONTHS | 203,636 |
| | 369,870 |

Annex I

PROJECTED EXPENDITURE TABLE
Table 2D-4

| COST ELEMENT | TOTAL COST | EXPENDITURE IN 1987 | 1988 |
|---|---|---|---|
| PERSONNEL | 2,266,891 | 850,084 | 1,416,807 |
| DIRECT COSTS | 860,090 | 322,534 | 537,556 |
| LOCAL SUPPORT | 878,900 | 329,588 | 549,313 |
| OMAN GOV'T | 406,957 | 152,571 | 254,286 |
| CONTINGENCY | 401,158 | 150,434 | 250,724 |
| TOTAL | 4,813,896 | 1,805,211 | 3,008,685 |

NOTES: Escalation included in cost figures
Assumes contract will begin mid-1987
and end the end of 1988

ANNEX J

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ANNEX - K

# THE FALAJ SYSTEM

## Introduction

The aflaj (plural of falaj) systems of Oman have provided communities with water for irrigation and domestic purposes for over 15 centuries. Many of the systems presently in operation are over a thousand years old. Well established social and financial structures that address the administration and maintenance of the systems have evolved and have contributed to their longevity.

## Social Importance

The falaj system is an intergral part of village life. It provide water for crops and domestic use and because the community depends upon it, codes of social behavior with regard to its use have become well established. Ideally, one user does not pollute the system for another. Typically the uppermost access point in the village is set aside for the collection of drinking water; followed by a mosque and the main washing point for men; followed by points for the women to wash, clean clothes, and wash cooking and eating utensils. The last point on the channel before it divides to take water to crops is the washing place for the dead. In actual practice, uses of water from some aflaj are not kept in the above pure sequence because of the distances involved.

## Physical Structure

Long before the advent of pumps and motors, the falaj system of water supply was developed at the higher elevations where surface flow from streams or springs could be intercepted by small dams and diversion structures and conveyed in small open channels to meet the water needs of the village served. Another type of falaj utilizes ground water by constructing a system of tunnels to intersect the hydraulic grade line of the ground water upstream of the village. Ground water flowing into the tunnel is conveyed to the surface by gravity. Excavation to achieve this objective was a major task, particularly without modern equipment and technology. Vertical shafts were constructed from the ground surface to the tunnel to facilitate the removal of materials excavated during construction and periodic maintenance. Water is conveyed to and distributed within, the village by small open channels. The agricultural areas of aflaj consist of small plots, and surface irrigation by flooding is typically used.

Dug wells have recently been employed to supplement aflaj water supplies. The well is generally located near the discharge point of the tunnel system and discharges either to the tunnel or directly to the conveyance channel. Dug wells are also used in areas where the depth to ground water is such that is cannot be intercepted by the typical falaj tunnel system. Use of dug wells is limited to areas where the depth to ground water is not greater than about ten meters. Water is extracted from the well by means of centrifugal pumps driven by internal combustion engines.

Most aflaj have no control over inflow to the distribution system although a few have been constructed in small (3 x 5 x 1 meter) concrete storage reservoirs near the upper end of the system. Aflaj having wells have more flexibility in controlling water distribution.

The area encompassed by a falaj varies from year to year and is a function of water supply. Parcels extend outward from the distribution system and the extremities are not irrigated in water-short years. This method is also reflected by the cropping pattern within the falaj. Permanent crops (dates, limes, alfalfa, etc.) are planted closest to the conveyance system, where the supply of water to the parcel owner is more reliable, and annual crops with short growing seasons are planted farthest away.

## Operation and Maintenance

Each system, while simple in concept, is complicated to operate and maintain. To keep the system working, to ensure the availability of relatively unpolluted drinking water, and to distribute the water equitably to all who own water rights to the falaj, requires the cooperation of the whole community. An institutional arrangement has therefore evolved in each community to organize the water supply system, and to fund regular maintenance and intermittent repairs.

### Operation

Available water is delivered in rotation on an 8 to 12 day schedule to each member of the falaj based on units of time rather than volume. The minimum unit is one-half hour of flow which is called an athar. The right to use the available flow is vested in individual owners, the falaj itself (for use on lands held for the benefit of the falaj), and the mosque area. Individuals of the falaj may sell their rights to the available flow and auctions are held to bring the buyers and sellers together. The right may be sold on a long or short term basis.

Generally, irrigation of individual parcels is only practiced during daylight hours and, during the night, flow is diverted to communal lands or to the mosque. Night deliveries may be scheduled by mutual agreement.

### Maintenance

Historically, maintenance of the falaj systems has been the responsibility of the members of the village served by the falaj. Many aflaj have deteriorated to the point where extensive maintenance, beyond the capability of the villagers, is required for them to remain operational.

The Ministry of Agriculture and Fisheries (MAF) is providing substantial assistance to rehabilitation of aflaj but cannot instigate a project unless requested to do so by the falaj owners. Assistance is financial as well as design and construction supervision. Projects undertaken by MAF are related to the intake works (tunnels and surface diversions) and to the main conveyance facilities. Rehabilitation of small distribution laterals is generally not included in MAF programs. (The reason given for this is that the more influential members of the falaj own lands near the

upstream end of the system and benefit from seepage losses from the earth ditches as deliveries are being made downstream). MAF would undertake projects to improve distribution system efficiency if requested to do so.

Magnitude of Falaj System in Oman

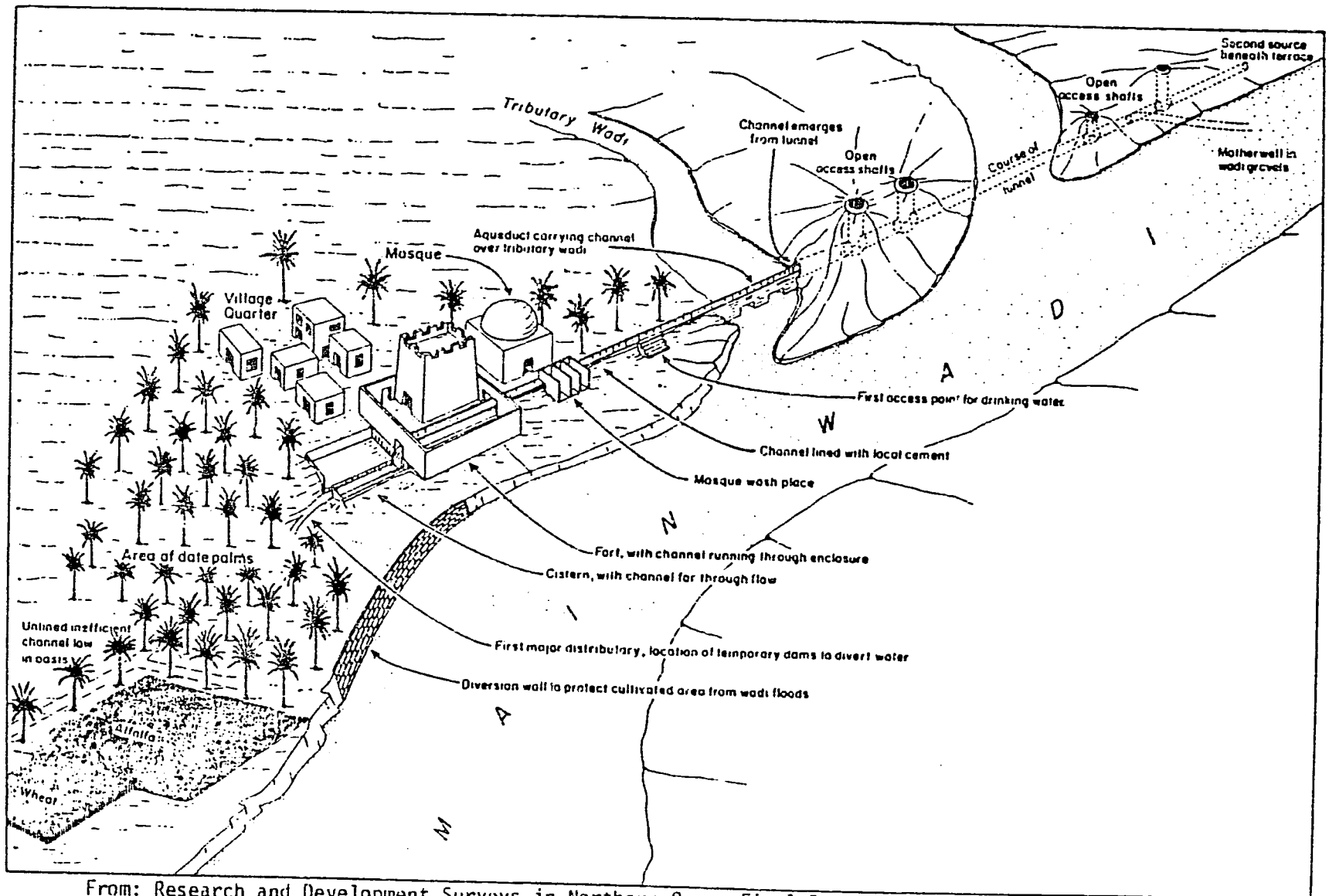
There are an estimated 11,000 aflaj in Oman, of which about 7,000 have been abandoned. Of the remaining aflaj, 4,000 were reported operational as of 1980. About 80 percent of those operational were reported to be in need of substantial improvement or repair. There have been no recent inventories of aflaj to update the 1980 information.

Effectiveness

Agricultural practices of aflaj, while not advanced by today's standards, optimize the productivity of the lands under cultivation within the constraints of water supply and existing patterns of land ownership and social structure. The traditional aflaj and villages are not experiencing the growth seen in other sectors of Oman because; (1) utilization of the available water supply is near maximum using current practices; (2) younger men are moving away from the village environment to seek higher pay in work in the city; and, (3) there is a general reluctance to change traditional irrigation practices.

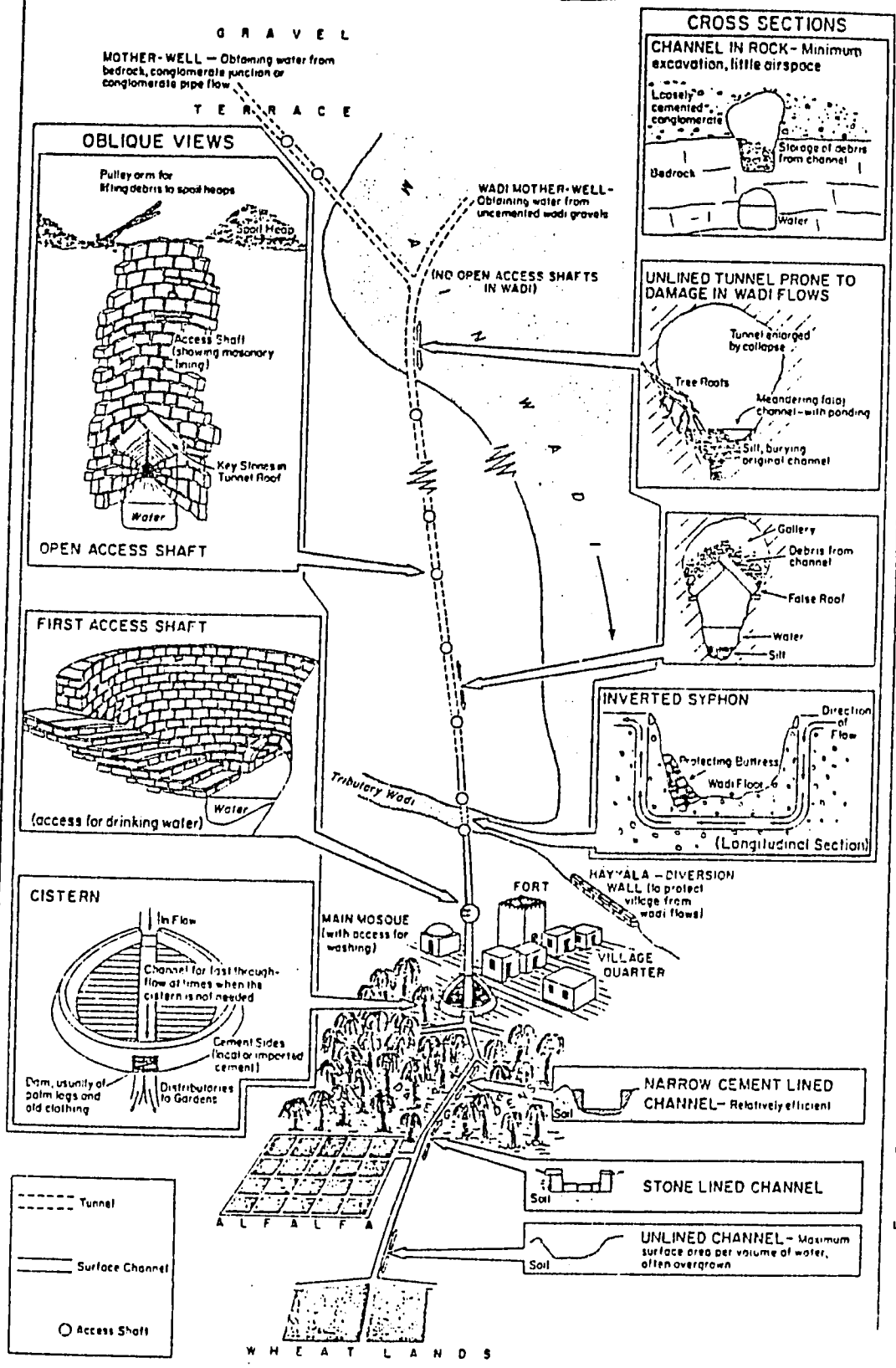
Water use efficiency, defined as consumptive use divided by total water extracted, averages about 35 percent, according to MAF representatives. Most of the water lost for effective use occurs as seepage from the conveyance facilities and deep percolation caused by over-irrigation. If these losses were reduced by improved irrigation practices and concrete lining of conveyance facilities, the agricultural area of the falaj making such improvements could be expanded. However, other aflaj using the same water source would experience a decrease in water supply equal to the increase in consumptive use of the improved falaj. While it is possible that water right controversies could be resolved, it would clearly upset traditional water allocations and would require much public education to be implemented and may, in fact, not be practical.

FIGURE 1: Sketch of a Typical Small Falaj




From: Research and Development Surveys in Northern Oman, Final Report 1978. Volume II, Water.
H. Bowen-Jones, Project Director

FIGURE 2: Anatomy of a Small Falaj




From: Research and Development Surveys in Northern Oman, Final Report 1978, Volume II, Water.
H. Bowen-Jones. Project Director.

ANNEX - L

AGRICULTURAL WATER USE

IN OMAN

Agricultural development in Oman is totally dependent on irrigation since rainfall is inadequate to meet crop water needs. Water is applied to crops every 7 to 14 days and a certain portion of the applied water is stored in the crop root zone to meet the consumptive use requirements of the crop.

The amount of water transpired by crops during the growth process, stored in plant tissue and evaporated from soil and plant surfaces during and shortly after irrigation is called consumptive use or evapotranspiration. Consumptive use is variable and is dependent on the type of crop and local climatic conditions.

Applied water is the amount of water delivered to the farm and is the sum of the consumptive use requirement and losss that occur during irrigation. These losses include deep percolation (water which percolates beyond the crop root zone) and tailwater (surface runoff from the low end of a field during irrigation).

Water applied to crops for irrigation contains a certain amount of dissolved salts. The crop removes water from the soil as it grows but the uptake of salts dissolved in the soil solution is negligible. This has the effect of concentrating the salts in the crop root zone and these salts must be leached from the soil profile for the land to remain productive. Salts contained in the agricultural return flows (leach water and deep percolation) and those that are dissolved from the soil by weathering tend to degrade the quality of the underlying ground water.

Water is conveyed from the source to the farm by means of small unlined channels, unless a well is located on the farm. Water is lost from these channels by seepage and by evaporation.

The total agricultural water demand is defined as the sum of (1) seepage losses from the conveyance facilities; (2) evaporation losses from the water surface of the conveyance facilities; (3) deep percolation losses on-farm; (4) tailwater losses; and, (5) crop consumptive use. The total agricultural water demand is the amount of water that must be diverted from the surface supply or extracted from ground water.

The relative effectiveness of agricultural water use can be evaluated by estimating the efficiency of the delivery or conveyance facilities and the efficiency of on-farm irrigation. The delivery system efficiency is defined as the ratio of the total farm delivery to the amount of water at the upstream end of the conveyance facility, expressed as a percent.

On-farm irrigation efficiency is defined as the ratio of consumptive use to farm delivery or applied water, expressed as a percent. The product of the delivery system efficiency and the on-farm irrigation efficiency is the system efficiency. The MAF uses the term "water use efficiency" synonymously with system efficiency and estimates that the water use efficiency of aflaj ranges from 25 to 40 percent. The estimated average system efficiency is 35 percent.

Typically, modern, well designed and managed irrigation projects could achieve system efficiencies in the 65 to 80 percent range depending on the type of distribution system, distance from the water source and methods of irrigation used within the project. The method of irrigation usually has the greatest influence on overall system efficiency and can be as high as 80 to 90 percent for sprinkler and drip type systems. Historically, surface irrigation methods using gravity (flooding, furrows, checks etc.) achieve irrigation efficiencies in the 60 to 75 percent range depending on management, soil type and field layout. Recent developments in leveling using laser techniques have greatly increased the potential for achieving high irrigation efficiencies with gravity methods. The method, known as "dead level irrigation", requires high volumes of water for each farm delivery. Water is applied to level basins quickly and is cut off when the basin is full. Deep percolation losses are reduced, tailwater losses are eliminated and the on-farm irrigation efficiency can approach 85 percent.

In the agricultural context, there are two basic kinds of "losses": those that are recoverable and those that are not. Losses due to evaporation from the water surfaces of the conveyance facilities or from tailwater accumulation areas are clearly not recoverable by downstream users. Seepage losses from the conveyance facilities, water used for leaching, on-farm deep percolation and percolation from tailwater areas are recoverable if the area where they occur overlies an aquifer containing ground water of suitable quality and where there is no impediment to the downward flow of these waters, such as an impermeable strata.

The agricultural lands within the Study Area generally overlie aquifers containing ground water of suitable quality for agricultural and domestic purposes. Impermeable stratas may exist in some localized areas but they are generally not extensive enough to prevent agricultural return flow from reaching the underlying ground water. Consequently, the use of water for agriculture depletes the overall regional water supply by the consumptive use associated with the agricultural development, not the amount extracted, diverted or applied.

# ANNEX M

To: H.E. The Minister of Electricity & Water

From: R. Leidholdt P.E., DTA/DGW

Date: 12 May 1986

Sub: Monthly Production And Consumption Report, April 1986.

1. FOR APRIL 1986

| | | Production |
|---|---|---|
| a) Water Produced by Ghubrah Plant | 411,298,140 gals. | 68.3 |
| b) Water Produced by Wells. | 183,339,860 gals. | 30.5 |
| c) Water Purchased from ORC | 7,317,304 gals. | 1.2 |
| Total Production | 601,955,304 gals. | 100.0 % |
| Average Daily Production | 20,065,177 gals. | |

| | |
|---|---|
| d) Water Consumed in April 1986 | 595,966,340 gals. |
| e) Peak day in April - 22 April | 23,042,080 gals. |
| f) Average daily demand | 19,865,545 gals. |
| g) Peaking factor for April 1986 | 1.16 |
| h) Peaking factor for 86 (accumulative) | 1.18 |

2. PEAK DAYS

| | |
|---|---|
| 22 April | 23,042,080 gals. |
| 24 April | 22,327,650 gals. |
| 31 March | 21,989,550 gals. |
| 20 April | 21,729,280 gals. |
| 23 April | 21,660,830 gals. |

3. MISCELLANEOUS

| a) Greater Muscat Water System | April 1986 | April 1985 |
|---|---|---|
| Total Water Produced | 601,955,304 gals. | 498,423,633 gals. |
| Average daily production | 20,065,177 gals. | 16,614,121 gals. |
| Total water consumption | 595,966,340 gals. | 497,609,540 gals. |
| Average daily demand | 19,865,545 gals. | 16,586,984 gals. |
| Peak day in April | 23,042,080 gals. | 19,107,640 gals. |
| b) Total Water Produced thru April | 2,134,205,300 gals. | 1,804,124,438 gals. |
| Total Water consumption thru April | 2,140,517,420 gals. | 1,802,635,886 gals. |

c) Annual maintenance on Unit No: 2 at Ghubrah was completed in April. Units No: 3 and 4 were under final testing during April. Units No: 1 and 2 were shut down from 24 April thru 1 May for cleaning and repair of the sea water pit serving these units.

d) NIZWAH - APRIL 1986

| | |
|---|---|
| Total water produced All Systems | 2,790,360 gals. |
| Total water consumed All Systems. | 2,778,380 gals. |

e) SUR - APRIL 1986

| | |
|---|---|
| Total water produced | 12,604,658 gals. |
| Total water consumed | 13,098,338 gals. |

الى معالى وزير الكهرباء والميـــــاه — الموقر

من المستر / رالف ليددولت - - مدير الشؤون الفنيـــه

التاريـــخ: / /١٩٨٦م

الموضوع: التقرير الشهرى عن انتاج واستهلاك المياه فى أبريل ١٩٨٦م

١ - خلال أبريل ١٩٨٦

النسبة المئوية للانتاج

| | | | |
|---|---|---|---|
| أ - أنتاج محطة الغبره من المياه | ٤١١٢٩٨١٤٠ | جالون | ٦٨/٣ |
| ب - أنتاج الابار من الميـــــاه | ١٨٣٣٣٩٨٦٠ | „ | ٣٠/٥ |
| ج - المياه المشتراه من محفاة عمان | ٧٣١٧٣٠٤ | „ | ١/٢ |
| جملة الانتاج | ٦٠١٩٥٥٣٠٤ | „ | ١٠٠ ٪ |
| متوسط الانتاج اليومى | ٢٠٠٦٥١٧٧ | „ | |
| د - أستهلاك المياه خلال ابريل | ٥٩٥٩٦٦٣٤٠ | „ | |
| هـ - أيام الذروة فى أبريل ٢٢ أبريل | ٢٣٠٤٢٠٨٠ | „ | |
| و - متوسط الاستهلاك اليومـــى | ١٩٨٦٥٥٤٥ | „ | |
| ز - عامل الذروة خلال أبريل | ١و١٦ | | |
| ح - عامل الذروة خلال عام ٨٦ (تراكمى) | ١/١٨ | | |

٢ - أيام الذروة

| | | |
|---|---|---|
| ٢٢ أبريل ١٩٨٦ | ٢٣٠٤٢٠٨٠ | جالون |
| ٢٤ أبريل ١٩٨٦ | ٢٢٣٢٧٦٥٠ | „ |
| ٣١ أبريل ١٩٨٦ | ٢١٩٨٩٥٥٠ | „ |
| ٢٠ أبريل ١٩٨٦ | ٢١٧٢٩٢٨٠ | „ |
| ٢٣ أبريل ١٩٨٦ | ٢١٦٦٠٨٣٠ | „ |

٣ - متنوعـــات

| أ - شبكة مياه منطقة العاصمه | أبريل ٨٦ | أبريل ٨٥ |
|---|---|---|
| الانتاج الكلى للميـــاه | ٦٠١٩٥٥٣٠٤ جالون | ٤٩٨٤٢٣٦٣٣ جالون |
| متوسط الانتاج اليومـــى | ٢٠٠٦٥١٧٧ „ | ١٦٦١٤١٢١ „ |
| مجموع أستهلاك المياه | ٥٩٥٩٦٦٣٤٠ „ | ٤٩٧٦٠١٥٤٠ „ |
| متوسط الطلب اليومـــى | ١٩٨٦٥٥٤٥ „ | ١٦٥٨٦٩٨٤ „ |
| يوم الذروة فى أبريـــل | ٢٣٠٤٢٠٨٠ „ | ١٩١٠٧٦٤٠ „ |
| ب - جملة أنتاج المياه حتى نهاية ابريل | ٢١٣٤٢٠٥٣٠٠ „ | ٨٠٤١٢٤٤٢٨ اجالون |
| جملة أستهلاك المياه حتى نهاية أبريل | ٢١٤٠٥١٧٤٢٠ „ | ١٨٠٢٦٢٥٨٨٦ „ |

ج - اكتملت الصيانة السنويه للوحدة الثانيه بالغبره فى أبريل كما أدخلـــت الوحدات الثالثة والرابعة الاختبار النهائى فى شهر ابريل . أغلقـــت الوحدات الاولى والثانية لمدة اسبوع أعتبارا من ١٩٨٦/٤/٢٤ الى ١ مايو ٨٦م وذلك لتنظيف وصيانة البيارة التى تخدم الوحدتين .

- مياه نزوى فى أبريل ١٩٨٦م

| | | |
|---|---|---|
| الانتاج الكلى للشبكة القديمه والجديده | ٢٧٨٠٣٦٠ | جالون |
| جملة الاستهلاك الكلى للشبكة القديمة والجديدة | ٢٧٧٨٣٨٠ | „ |

- مياه صور فى أبريل ١٩٨٦

| | | |
|---|---|---|
| مجموع أنتاج الميـــاه | ١٢٦٠٤٦٥٨ | جالون |
| مجموع أستهلاك المياه | ١٣٠٩٨٣٣٨ | „ |

Ministry of Electricity & Water
Directorate General of Water

وزارة الكهربـــاء والميـــاه
المديرية العامة للميـــاه

To: H.E. The Minister of Electricity and Water

From: R. Leidholdt P.E., DTA/DGW

Date: 19 April 1986

(REVISED)

Sub: Monthly Production and Consumption Report, March 86

الى : معالى وزير الكهربـاء والميـــاه - الموقـــر

من : المستر / رالف ليدهولت - مدير الشؤون الفنيـــة

التاريخ : ١٩ / أبريل ١٩٨٦م

الموضوع : التقرير الشهري لانتاج واستهلاك المياه خلال مارس /٨٦ (معدل)

1. FOR MARCH 1986

| | | % Production | النسبة المئوية للانتاج |
|---|---|---|---|
| a) Water produced by Chubra | 466,521,220 gals | 84.4 | ٨٤ر٤ ٪ |
| b) Water produced by wells | 75,475,620 gals | 13.7 | ١٣ر٧ ٪ |
| c) Water purchased from ORC | 10,983,982 gals. | 1.9 | ١ر٩ ٪ |
| Total water Produced | 552,980,822 gals. | 100 % | ١٠٠ ٪ |
| Average daily Production | 17,838,091 gals. | | |
| d) Water consumed in March 86 | 567,039,230 gals. | | |
| e) Peak day in March - 31 March | 21,989,550 gals. | | |
| f) Average daily demand | 18,291,588 gals. | | |
| g) Peaking factor for March 1986 | 1.20 | | |
| h) Peaking factor for 86 (accumulative) | 1.18 | | |

١ - انتـــاج المياه خلال مـــارس / ١٩٨٦م

| | |
|---|---|
| أ - محطة التحليـــة بالفـــــبره | ٤٦٦ر٥٢١ر٢٢٠ جالون |
| ب - انتـــــاج الابـــــار | ٧٥ر٤٧٥ر٦٢٠ ،، |
| ج - ميـاه مشتراة من محطة عمـــان | ١٠ر٩٨٢ر٨٢٢ ،، |
| جملـــــة الانتـــاج | ٥٥٢ر٩٨٠ر٨٢٢ ،، |
| متوسط الانتـاج اليومـــــى | ١٧ر٨٣٨ر٠٩١ ،، |
| د - استهـــلاك المياه خلال مارس / ٨٦ | ٥٦٧ر٠٣٩ر٢٢٠ ،، |
| هـ - يوم الذروة خلال مـــارس ٢١ مـــارس | ٢١ر٩٨٩ر٥٥٠ ،، |
| و - متوسط الاستهـــلاك اليومـــى | ١٨ر٢٩١ر٥٨٨ ،، |
| ز - عامل الذروة خـلال مـــارس / ١٩٨٦ | ١ر٢٠ |
| ح - عامل الذروة خلال عام ٨٦ (تراكمى) | ١ر١٨ |

٢ - أيـــــام الذروة خـــــلال ١٩٨٦م

| | |
|---|---|
| ٢١ / مـــــارس | ٢١ر٩٨٩ر٥٥٠ ،، |
| ٢٩ / مـــــارس | ٢٠ر٩٣٧ر٠٠٠ ،، |
| ٢٢ / مـــــارس | ٢٠ر٣١٤ر٩٠٠ ،، |
| ٢٥ / يناير | ١٩ر٦٧٢ر١٠٠ ،، |
| ١٢ / مـــــارس | ١٩ر٥٢٠ر٨٧٠ ،، |

متنوعـــــــات :-

| أ - منطقـــة العاصمة | مارس / ٨٦ | مارس /١٩٨٥م |
|---|---|---|
| جملـة الانتاج الشهرى | ٥٥٢ر٩٨٠ر٨٢٢ | ٤٦٦ر٣٥٢ر٧٤١ ،، |
| متوسط الانتاج اليومى | ١٧ر٨٣٨ر٠٩١ | ٠١٥ر٠٤٣ر٦٢٧ ،، |
| جملة الاستهلاك الشهرى | ٥٦٧ر٠٣٩ر٢٢٠ | ٤٦٧ر٨٦٣ر٥٢٠ ،، |
| معدل الاستهلاك اليومى | ١٨ر٢٩١ر٥٨٨ | ٠١٥ر٠٩٢ر٣٧٢ ،، |
| يوم الذروة فى مارس | ٢١ر٩٨٩ر٥٥٠ | ٠١٧ر٧٨٢ر٧٤٠ ،، |
| ب - جملة انتاج المياه حتى نهايـــــة مارس | ١ر٥٣٩ر٢٦٣ر١٥٦ | ١ر٣٠٥ر٧٠٠ر٨٠٥ ،، |
| استهلاك المياه حـــتى نهايـــــة مارس | ١ر٥٥١ر٦١٤ر٢٤٠ | ١ر٣٠٥ر٠٢٦ر٣٤٦ ،، |

3. MISCELLANEOUS

| a) Capital Area. | 1986 March | 1985 March |
|---|---|---|
| Total water produced | 552,980,822 gals | 466,352,741 gals. |
| Average daily Production | 17,838,091 gals. | 15,043,637 gals. |
| Total water Consumption | 567,039,230 gals. | 467,863,520 gals. |
| Average daily demand | 18,291,588 gals. | 15,092,372 gals. |
| Peak day in March | 21,989,550 gals. | 17,782,740 gals. |
| b) Total water produced thru March | 1,539,263,156 gals. | 1,305,700,805 gals. |
| Total water consumption thru March | 1,551,614,240 gals. | 1,305,026,346 gals. |

( يتبع )



٢٠٩

c) With increased production capability at Ghubra, the wellfields are being used as little as possible to rest them.

d) NIZWAH - MARCH 1986

Total water produced:

All systems 2,436,560 gals.

Total water consumed:

All systems 2,418,240 gals.

e) SUR - MARCH 1986

Total water produced 12,645,264 gals.

Total water consumed 12,682,374 gals.

c.c. to: H.E. The Under Secretary
Director General of Water
Director General of Projects.
Mr. Bob Stach
Mr. George Mammen
Mr. Osman
Public Relations.

جـ - بزيادة الطاقة الانتاجية لمحطة مياه الغبره انخفض استغلال حقول الابار الى أقل قدر ممكن لاراحتها .

د - مياه نزوى مارس / ١٩٨٦م

جملة انتاج الشبكة من المياه ٢ر٤٢٦ر٥٦٠ جالون

جملة استهلاك الشبكة من المياه ٢ر٤١٨ر٢٤٠ ،،

هـ - مياه صور مارس / ١٩٨٦م

جملة انتاج الشبكة من المياه ١٢ر٦٤٥ر٢٦٤ ،،

جملة استهلاك الشبكة من المياه ١٢ر٦٨٢ر٣٧٤ ،،

رالف ليدهولت
( مدير الشؤون الفنية )



205

Ministry of Electricity & Water
Directorate General of Water

وزارة الكهرباء والمياه
المديرية العامة للمياه

To: H.E. The Minister of Electricity and Water

From: R. Leidholdt P.E., DTA/DGW

Date: 19 April 1986

(REVISED)

Sub: Monthly Production and Consumption Report, March 86

الى : معالي وزير الكهرباء والمياه - الموقر

من : المستر / رالف ليدهولت - مدير الشؤون الفنية

التاريخ : ١٩ / أبريل ١٩٨٦م

الموضوع : التقرير الشهري لانتاج واستهلاك المياه خلال مارس /٨٦ (معدل)

## 1. FOR MARCH 1986

| | | % Production | النسبة المئوية للانتاج |
|---|---|---|---|
| a) Water produced by Ghubra | 466,521,220 gals | 84.4 | ٨٤ر٤ ٪ |
| b) Water produced by wells | 75,475,620 gals | 13.7 | ١٢ر٧ ٪ |
| c) Water purchased from ORC | 10,983,982 gals. | 1.9 | ١ر٩ ٪ |
| Total water Produced | 552,980,822 gals. | 100 % | ١٠٠ ٪ |
| Average daily Production | 17,838,091 gals. | | |
| d) Water consumed in March 86 | 567,039,230 gals. | | |
| e) Peak day in March - 31 March | 21,989,550 gals. | | |
| f) Average daily demand | 18,291,588 gals. | | |
| g) Peaking factor for March 1986 | 1.20 | | |
| h) Peaking factor for 86 (accumulative) | 1.18 | | |

١ - انتاج المياه خلال مارس / ١٩٨٦م

| | |
|---|---|
| أ - محطة التحلية بالغبره | ٤٦٦ر٥٢١ر٢٢٠ جالون |
| ب - انتاج الآبار | ٧٥ر٤٧٥ر٦٢٠ ،، |
| ج - مياه مشتراة من محطة عمان | ١٠ر٩٨٢ر٩٨٢ ،، |
| جملة الانتاج | ٥٥٢ر٩٨٠ر٨٢٢ ،، |
| متوسط الانتاج اليومي | ١٧ر٨٣٨ر٠٩١ ،، |
| د - استهلاك المياه خلال مارس / ٨٦ | ٥٦٧ر٠٣٩ر٢٢٠ ،، |
| هـ - يوم الذروة خلال مارس ٢١ مارس | ٢١ر٩٨٩ر٥٥٠ ،، |
| و - متوسط الاستهلاك اليومي | ١٨ر٢٩١ر٥٨٨ ،، |
| ز - عامل الذروة خلال مارس / ١٩٨٦ | ١ر٢٠ |
| ح - عامل الذروة خلال عام ٨٦ (تراكمي) | ١ر١٨ |

٢ - أيام الذروة خلال ١٩٨٦م

| | |
|---|---|
| ٢١ / مارس | ٢١ر٩٨٩ر٥٥٠ ،، |
| ٢٩ / مارس | ٢٠ر٩٣٧ر٠٠٠ ،، |
| ٢٢ / مارس | ٢٠ر٣١٤ر٩٠٠ ،، |
| ٢٥ / يناير | ١٩ر٦٧٢ر١٠٠ ،، |
| ١٢ / مارس | ١٩ر٥٢٠ر٨٧٠ ،، |

## 2. PEAK DAYS - 1986

| | |
|---|---|
| 31 March | 21,989,550 gals. |
| 29 March | 20,937,000 gals. |
| 22 March | 20,314,900 gals. |
| 25 January | 19,672,100 gals. |
| 12 March | 19,520,870 gals. |

متنوعات :-

| أ - منطقة العاصمة | مارس / ٨٦ | مارس /١٩٨٥م |
|---|---|---|
| جملة الانتاج الشهري | ٥٥٢ر٩٨٠ر٨٢٢ | ٤٦٦ر٣٥٢ر٧٤١ ،، |
| متوسط الانتاج اليومي | ١٧ر٨٣٨ر٠٩١ | ٠١٥ر٠٤٣ر٦٢٧ ،، |
| جملة الاستهلاك الشهري | ٥٦٧ر٠٣٩ر٢٣٠ | ٤٦٧ر٨٦٣ر٥٢٠ ،، |
| معدل الاستهلاك اليومي | ١٨ر٢٩١ر٥٨٨ | ٠١٥ر٠٩٢ر٣٧٢ ،، |
| يوم الذروة في مارس | ٢١ر٩٨٩ر٥٥٠ | ٠١٧ر٧٨٢ر٧٤٠ ،، |
| ب - جملة انتاج المياه حتى نهاية مارس | ١ر٥٣٩ر٢٦٢ر١٥٦ | ١ر٣٠٥ر٧٠٠ر٨٠٥ ،، |
| استهلاك المياه حتى نهاية مارس | ١ر٥٥١ر٦١٤ر٢٤٠ | ١ر٣٠٥ر٠٢٦ر٢٤٦ ،، |

## 3. MISCELLANEOUS

| a) Capital Area. | 1986 March | 1985 March |
|---|---|---|
| Total water produced | 552,980,822 gals | 466,352,741 gals. |
| Average daily Production | 17,838,091 gals. | 15,043,637 gals. |
| Total water Consumption | 567,039,230 gals. | 467,863,520 gals. |
| Average daily demand | 18,291,588 gals. | 15,092,372 gals. |
| Peak day in March | 21,989,550 gals. | 17,782,740 gals. |
| b) Total water produced thru March | 1,539,263,156 gals. | 1,305,700,805 gals. |
| Total water consumption thru March | 1,551,614,240 gals. | 1,305,026,346 gals. |

( يتبع )

To: H.E.The Minister of Electricity & Water

From: R. Leidholdt P.E., DTA/DGW

Date: 4 March 1986

Sub: Monthly Production & Consumption Report - February 1986.

الى : معالي وزير الكهرباء والمياه — الموقر

من : المستر / رالف لايدهولت - مدير الشؤون الفنيه

التاريخ: ٤ مارس ١٩٨٦م

الموضوع: تقرير الانتاج والاستهلاك الشهري عن فبراير ١٩٨٦

## 1. FOR FEBRUARY 1986.

| | | % production | النسبة المئوية للانتاج | | |
|---|---|---|---|---|---|
| a) Water Produced by Ghubra | 310,849,000 gals. | 68.2 | ٦٨/٢ | ٣١٠٨٤٩٠٠٠ جالون | ١ - خلال فبراير ١٩٨٦م |
| b) Water Produced by wells | 135,987,600 gals. | 29.9 | ٢٩/٩ | ١٣٥٩٨٧٦٠٠ جالون | أ - انتاج محطة الغبرة من المياه |
| c) Water Purchased from OMC | 8,722,911 gals | .9 | ١/٩ | ٨٧٢٢٩١١ ,, | ب - انتاج الآبار من المياه |
| Total Water Produced | 455,559,511 gals. | 100 % | ١٠٠ % | ٤٥٥٩٥١١ر٤٠٠ ,, | ج - مياه مشتراه من شركة محطاة عمان |
| Average Daily Production | 16,269,983 gals. | | | ١٦٢٦٩٩٨٣ ,, | مجموع أنتاج المياه |
| | | | | ٤٥٢١٨٠٥٢٠ ,, | متوسط الانتاج اليومي |
| d) Water consumed in Feb 86 | 453,180,530 gals. | | | ١٩٤٢٦٢٢٠ ,, | أ - أستهلاك المياه خلال فبراير ١٩٨٦ م |
| e) Peak day in February 12 February | 19,436,330 gals. | | | ١٦١٨٥٠١٨ ,, | هـ - يوم الذروة في فبراير - ١٢ فبراير |
| f) Average Daily Demand | 16,185,018 gals. | | | ١/٢٠ | و - متوسط الاستهلاك اليومي |
| g) Peaking factor for Feb. | 1.20 | | | ١/١٧ | ز - عوامل الزروه خلال فبراير |
| h) Peaking factor for 1986 | 1.17 | | | | ح - عوامل الزروه خلال ١٩٨٦م . |

## 2. PEAK DAYS 1986.

| | | | |
|---|---|---|---|
| 25 January | 19,672,100 gals. | ١٩٦٧٢١٠٠ جالون | ٢ - أيام الزروه خلال ١٩٨٦م |
| 12 February | 19,436,330 gals. | ١٩٤٣٦٢٢٠ ,, | ٢٥ يناير |
| 21 January | 19,033,360 gals. | ١٩٠٣٣٣٦٠ ,, | ١٢ فبراير |
| 18 January | 18,897,050 gals. | ١٨٨٩٧٠٥٠ ,, | ٢١ يناير |
| 23 January | 18,890,270 gals. | ١٨٨٩٠٢٧٠ ,, | ١٨ يناير |
| | | | ٢٣ يناير |

## 3. MISCELLANEOUS

| a) Capital Area. | Feb 85 | Feb 86 | | فبراير ١٩٨٦م | فبراير ١٩٨٥ | ٣ - متنوعات |
|---|---|---|---|---|---|---|
| | | | جالون | ٤٥٥٥٥١٥١١ | ٤١٤٥١٤٧٠٠ | أ - منطقة العاصمه |
| Total water produced | 414,514,700 | 455,559,511 gals. | ,, | ١٦٢١٩٩٨٣ | ١٤٨٠٤٠٩٧ | متوسط الانتاج اليومي |
| Average Daily production | 14,804,097 | 16,269,983 " | ,, | ٤٥٢١٨٠٥٢٠ | ٤١٠٤٩٨٦٨٠ | الاستهلاك الكلي للمياه |
| Total Water consumption | 410,498,680 | 453,180,530 " | ,, | ١٦١٨٥١٨٠ | ١٤٦١٠٦١٧ | متوسط الاستهلاك اليومي |
| Average daily demand | 14,660,667 | 16,185,180 " | ,, | ١٩٤٢٦٢٢٠ | ١٦١٦٢٤٥٠ | يوم الزروه خلال فبراير |
| Peak day in Feb. | 16,663,450 | 19,436,330 " | | ١٩٨٦ | ١٩٨٥ | |
| b) Total Water produced through February | 1985 839,348,064 | 1986 986,282,334 " | جالون ,, | ٩٨٦٢٨٢٢٣٤ ٩٨٤٥٧٥٠١٠ | ٨٣٩٢٤٨٠٦٤ ٨٣٧١٦٢ ٨٢١ | ب - جملة أنتاج المياه خلال فبراير<br>جملة استهلاك المياه خلال فبراير |
| Total water cosnumption through February | 837,162,826 | 984,575,010 " | | | | ج - تم تفريغ خزان الوطيه وفحصه وتنظيفه وتعقيمه وأعادته للخدمه بكامل طاقته خلال فبراير ١٩٨٦. |

c) Wattayah Reservoir drained, inspected cleaned and disinfected and returned to full service in February.

| | | | |
|---|---|---|---|
| | | ٣١٢٧٣٠٠ جالون | د - شبكة مياه نزوى خلال يناير ١٩٨٦م |
| | | ٣١٢٤٠٦٠ جالون | مجموع أنتاج شبكة المياه |
| | | ٢٦٤٢٦٤٠ ,, | مجموع أستهلاك شبكة المياه |
| | | ٢٢١ ٨٤٨٥ ,, | شبكة مياه نزوى خلال فبراير ١٩٨٦م |
| | | ١٢٧٨٠١٢١ جالون | مجموع انتاج الشبكة من المياه |
| | | ١٢٨٢٨٨٧٠ ,, | مجموع استهلاك الشبكة من المياه |
| | | ١٠٤٠١٠٦٠ ,, | شبكة مياه صور فبراير ١٩٨٦م |
| | | ١٠٤٥٥١٤٠ ,, | مجموع انتاج الشبكة من المياه |
| | | | استهلاك الشبكة من المياه |

d) NIZWAH - JANUARY 1986

| | |
|---|---|
| Total water produced all systems | 3,127,300 gals. |
| Total water consumed all systems. | 3,134,060 gals. |

NIZWAH - FEBRUARY 1986

| | |
|---|---|
| Total water produced all systems | 2,243,340 gals. |
| Total water consumed all systems. | 2,218,485 gals. |

SUR - JANAURY 1986

| | |
|---|---|
| Total water produced | 12,780,131 gals. |
| Total water consumed | 12,838,870 gals. |

SUR - FEBRUARY 1986

بسم الله الرحمن الرحيـــــم

Ministry of Electricity & Water
Directorate General of Water

سلطنة عمان
وزارة الكهرباء والمياه
المديرية العامة للمياه

To: H.E. The Minister of Electricity & Water

From: R. Leidholdt P.E., DTA/DGW

Date: 9 February 1986

Sub: Monthly Production & Consumption Report - January 1986.

الى : معالي وزير الكهرباء والميـــاه - الموقر

من : المدير / رالف ليد هولـــــــت
( مدير الشـــؤون الفنيـــة )

التاريخ : /٢/ ١٩٨٦م

الموضوع : تقرير الانتاج والاستهلاك الشهري
خـلال ينايـــــر/١٩٨٦ م

1. FOR JANUARY 1986.

| | | % Production |
|---|---|---|
| (a) Water Produced by wells | 179,803,580 Gals | 33.9 |
| (b) Water produced by Ghubra | 343,608,760 Gals | 64.7 |
| (c) Water Purchased from O.R.C. | 7,310,483 Gals | 1.4 |
| | | 100.0 % |
| Total Water Produced | 530,722,923 Gals. | |
| Average Daily Production | 17,120,091 Gals. | |

خلال ينايـر/١٩٨٦م

النسبة المئوية للانتاج

| | | |
|---|---|---|
| أ - انتاج الابار من المياه | ١٧٩ر٨٠٣ر٥٨٠ جالون | ٣٣ر٩ ٪ |
| ب- انتاج محطة الغبره من المياه | ٣٤٣ر٦٠٨ر٧٦٠ " | ٦٤ر٧ ٪ |
| ج- المياه المشتراه من مصفاة عمان | ٧ر٣١٠ر٤٨٣ " | ١ر٤ ٪ |
| جملة انتاج الميـــاه | ٥٣٠ر٧٢٢ر٨٢٣ " | ١٠٠ ٪ |
| متوسط الانتاج اليومي | ١٧ر١٢٠ر٠٩١ " | |
| د - الماء المستهلكة خلال ينايـر/٨٦ | ٥٣١ر٣٩٤ر٤٨٠ " | |
| هـ - يوم الذروة خلال ينايـر /١٩٨٦ | ١٩ر٦٧٢ر١٠٠ " | |
| و - متوسط الطلب اليومـــي | ١٧ر١٤١ر٧٥٧ " | |
| ز - عامـل الذروة خلال ينايـــر | ١ر١٥ | |
| ح - عامـل الذروة خلال عام ١٩٨٦ | ١ر١٥ | |

(d) Water Consumed in Jan. 1986 — 531,394,480 Gals.

(e) Peak Day in Jan - 25 Jan — 19,672,100 Gals

(f) Average Daily Demand — 17,141,757 Gals

(g) Peaking Factor for January — 1.15

(h) Peaking Factor for 1986 — 1.15

ايام الـذروة في ١٩٨٦م

| | |
|---|---|
| ٢٥ / ينايـر | ١٩ر٦٧٢ر١٠٠ جالون |
| ٢١ / ينايـر | ١٩ر٠٣٣ر٣٦٠ " |
| ١٨ / ينايـر | ١٨ر٨٩٧ر٠٥٠ " |
| ٢٣ / ينايـر | ١٨ر٨٩٠ر٢٧٠ " |
| ١٦ / ينايـر | ١٨ر٨٣٨ر١٧٠ " |

2. PEAK DAYS - 1986

| | |
|---|---|
| 25 January | 19,672,100 Gals |
| 21 January | 19,033,360 Gals |
| 18 January | 18,897,050 Gals |
| 23 January | 18,890,270 Gals |
| 16 January | 18,838,170 Gals |

متنوعـــــات

3. MISCELLANEOUS

a) For Comparison

| | Jan 1985 | Jan 1986 |
|---|---|---|
| Total Water Produced | 424,833,356 gals | 530,722,823 gals |
| Average Daily Production | 13,704,302 " | 17,120,091 " |
| Total Water Consumption | 426,664,146 " | 531,394,480 " |
| Average Daily Demand | 13,763,360 " | 17,141,757 " |
| Peak Day in January | 17,216,376 " | 19,672,100 " |

أ - للمقارنـــــة

| | ينايـر/٨٥ | ينايـر /١٩٨٦م |
|---|---|---|
| مجموع الانتاج الشهري | ٤٢٤ر٨٣٣ر٣٥٦ جالون | ٥٣٠ر٧٢٢ر٨٢٣ جالون |
| متوسط الانتاج اليومي | ١٣ر٧٠٤ر٣٠٢ " | ١٧ر١٢٠ر٠٩١ " |
| مجموع الاستهلاك الشهري | ٤٢٦ر٦٦٤ر١٤٦ " | ٥٣١ر٣٩٤ر٤٨٠ " |
| متوسط الطلب اليومـي | ١٣ر٧٦٣ر٣٦٠ " | ١٧ر١٤١ر٧٥٧ " |
| يوم الذروة خلال ينايـــر | ١٧ر٢١٦ر٣٧٦ " | ١٩ر٦٧٢ر١٠٠ " |

b) South half of Qurum Reservoir is drained, inspected, cleaned and disinfected, and returned to service on 25 January. West half of Wattayah Reservoir has been drained, is being cleaned and will be returned to service in February.

تم تفريـغ النصف الجنوبي من خزان القرم وبعد اجـراء الفحـــص والنظافة والتعقيم اعيد للخدمـة مرة ثانية بتاريخ ١٩٨٦/١/٢٥ كما تم تفريـغ النصف الغربي من خزان الوطيه وبعد النظافـة سيعاد للخدمـــة خلال فـبراير ان شاءالله

c.c. to: H.E. The Under Secretary
Director General of Water
Director General of Projects.
Mr. Bob Stach
Mr. George Mammen
Mr. Osman
Public Relation.
File.

رالف ليد هولـــت
( مدير الشـــؤون الفنية )

ANNEX N

## DESCRIPTION OF THE CAPITAL REGION WATER SYSTEM

The present water sources for the Capital Area are well fields at either end of the system (the Eastern and Western Well Fields) and a seawater desalination plant located about in the middle of the system at Ghubrah. At the present time, the western section of the transmission system is supplied only by the Western well field. The eastern section is supplied by the Ghubrah plant and the Eastern Wellfield which pumps directly in the mains near Wadi Aday. Source reservoirs with a total capacity of 61,250 M3 are located near the three primary water production sources to provide some storage in the event of short term production shutdowns. The two reservoirs at the well fields are not used because of system design problems.

The existing Capital Area water transmission system basically consists of a single 600 mm diameter transmission main extending east and west from the Ghubrah Desalination Plant and supplying the various transmission reservoirs. Eastern well field production enters the eastern transmission main near the Wadi Aday roundabout. Western well field production enters the western transmission main near the Mowallah roundabout. Subtransmission systems also exist, taking supply from the Seeb transmission reservoir in the western system to Seeb and the Rusail Industrial Estate and from the Mutrah transmission reservoir in the Eastern system to Wadi Kabir and al Bustan.

Transmission facilities in the eastern and western sectors can be isolated from each other by a closed valve.

The eastern transmission system consists of a 600 mm pipeline from Ghubrah to the Muscat reservoir, a distance of about 25 km. A second 600 mm pipeline runs parallel for a distance of 6.5 km from Ghubrah to the Intercontinental Hotel.

In order to produce water of an even quality, MEW had planned to transfer all well water to Ghubrah for blending. A reservoir and pump station was built at Wadi Aday and a 600 mm pipeline from Wadi Aday was installed and additional facilities were planned at Mowallah. The Wadi Aday facilities have not been put into services and the Mowallah facilities are not being constructed at this time. Serious consideration is being given to a revised plan whereby desalinated and well water would be blended in smaller reservoirs at several points in the system (i.e. local blending).

There are 11 major transmission reservoirs in the system with the total capacity of 105,060 M3. These reservoirs are filled at the top by the transmission system and are drawn off the bottom by the demand of the distribution system. Although the reservoir inlets are provided with large float valves, fill rates are manually controlled by balancing the individual inlet gate valves. Tank levels are not centrally monitored. Any change in sources production rates require readjusting the inlet valve position. The float valves are not used because some have insufficient pressure ratings to handle hand transmission system pressures. Also, system demand is met by manually controlling the number of well field pumps on-line. Without manually filling the various reservoirs evenly, some would receive more flow than others creating an imbalance of storage distribution. Although the reservoir level control method employed by the operation personnel is not sophisicated for a waterworks system of this size, it does work under normal conditions and near full reservoirs are usually available at 8:00 each morning.

There are three major distribution systems within the Capital Region: the Seeb system, the Qurm/Wattayah system and the Eastern Capital system (Muscat, Mutrah and Ruwi).

The Seeb system serves the communities of Seeb, Hail, Rumais and the low cost housing area of al-Khawd at the far western end of the Capital. This system is supplied by the Seeb pump station which pumps water from the Seeb transmission reservoir to the Seeb elevated tank. The distribution system consists of two major loops - one to the east and one to the west of the al-Khawd roundabout. Pipe diameters range from 100 to 600 mm.

The Qurm/Wattayah system is fed from the Qurm reservoir, Qurm elevated tank and Wattayah reservoir. This system serves the communities of al-Khuwair, Madinat Qaboos, Qurm, Qurm Heights, Wattayah and the Petroleum Development Oman (PDO) complex at Mina al Fahal. The Qurm section consists of about six loops with pipe diameters ranging from 100 mm to 600 mm. the Wattayah section consists of two dead ends 300 and 200mm in diameter and 1.5 km and .9 km in length repectively; both sections are connected by about 3 km of 300 mm main to form the combined system.

The Eastern Capital system is fed from the Greater Muttrah and Muscat reservoirs and directly from the Eastern well field through a 300 mm ductile iron transmission main converted to distribution. It serves the communities of Muscat, Ryam, Jibroo, Greater Muttrah, Darseit, Ruwi, Wadi Aday and Hamriyah. The system has multiple loops of small diameter (100-200 mm) mains within a larger loop of 300 mm main. A 300 mm main continues from Muscat reservoir to Sidab, about 4 km in length.

The Eastern Capital distribution system is connected to the Wattayah section of the Qurm/Wattayah distribution system via a 400 mm diameter main. A valve on the main is normally closed since the systems operate at different hydraulic gradeline elevations.

The oldest sections of the distribution system were constructed in 1968. Cast iron mains and galvanized steel service connections were used in these sections and they are suspected of being a source of significant leakage. Leakage appears to be due to high pressures in the system and corrosion at the joints. Current MEW standards call for ductile iron pipe with cement lining and polyethelene exterior shroud for transmission mains which are imported. Locally manufactured asbestos cement pipe with a bitumstic paint lining have been used for distribution mains. Galvanized steel pipe wrapped with Polyvinylchloride (PVC) tape are used for house connections.

Several special conditions prevail in the water system which influence its design and operation. Water temperatures can reach 35 to 40 degrees centegrade. Experience has shown that these high temperatures have a serious effect on PVC pipe and on water meters. The soil of in the Capital Area is very rocky. As a result cement pipes are easly damaged if great care is not taken in laying. Also the soil is corrosive so all metal pipes which require protection such as the polyethelene shroud on ductile iron pipe. Finally, desalinated water is also highly corrosive creating a need for lining pipes.



211

SUMMARY OF HUMAN FACTORS IN WATER RESOURCES PLANNING AND MANAGEMENT

| Resource Identification | Resource Development | Resource Allocation | Water Treatment | Distribution | Water Use |
|---|---|---|---|---|---|
| Access | Projected demand (population size, demand by class of water user, cost elasticity)<br><br>Existing water rights<br><br>Acquisition process | Impacts of proposed changes in allocations (intersectoral, inter-regional, inter-community and inter-household) on human habitation and livelihood<br><br>Process for acquisition, transfer and enforcement<br><br>Equity considerations | Cost and consumer acceptability of proposed levels of treatment<br><br>Facility siting<br><br>Site acquisition process<br><br>Construction-related disruption<br><br>Community participation in construction, operations, and maintenance (village level)<br><br>Acceptability of actual product | Rights of way<br><br>Construction disruption<br><br>Levels of access (convenience, cost, reliability)<br><br>Quantity per household/capita<br><br>Consumer willingness and ability to connect<br><br>Community participation in construction, operations, and maintenance (village level) | Demand modification (for public health or conservation purposes)<br><br>Modification of patterns of use<br><br>Consumer ability and willingness to pay |

SUMMARY OF HUMAN FACTORS IN WASTEWATER PLANNING AND MANAGEMENT

| WASTEWATER PRODUCTION | DISPOSAL | WASTEWATER COLLECTION | WASTEWATER TREATMENT | EFFLUENT DISPOSAL/REUSE |
|---|---|---|---|---|
| Modification of quantity or other qualities<br><br>Modification of practices | Existence or potential for household level disposal (secondary use of effluent, septic tanks, holding tanks, etc.)<br><br>Cost of alternatives to consumer | Rights of way<br><br>Construction disruption<br><br>Level of access (convenience, cost, reliability, etc.)<br><br>Equity considerations<br><br>Willingness and ability of households to connect (cost, materials, labor, etc.) and pay<br><br>System use (and misuse)<br><br>Community participation in construction, O&M (village level | Acceptability of levels of treatment (cost, public concerns, etc.)<br><br>Facility siting<br><br>Site acquisition<br><br>Operating characteristics (noise, odor, etc.) | Acceptability of effluent quality (public, religious, etc.)<br><br>Conditions under which effluent may be reused (public, religious and other restrictions)<br><br>Disposal / reuse siting<br><br>Operating characteristics |

ANNEX - P

SCOPE OF WORK

BARKA DESALINATION PLANT

Part I: Masterplan

It will be necessary for the Masterplan to prepare the detailed layout drawings for the full development of the Power and Desalination Plan as foreseen in the JICA study, and to define the scope of each phase of development. It is expected that the station will be developed in a maximum of four stages. Particular care is required in defining the interfaces between phases of development to ensure each phase can be individually bid by any international contractor, and subsequently installed with least interface to operating Plant.

The Masterplan shall study the most economic way the transmission system from Barka can be developed in the first phase recognizing the final development shall be to introduce 275 KV as a new transmission voltage.

The Masterplan shall also develop proposals for the economic development of the seawater intake system recognizing the phased development of the station.

The Masterplan shall define the scope of each phase of the work in sufficient detail to enable the MEW to prepare inquiry documents for consultants to bid against.

The consultants shall prepare capital cost estimates and cash flow for the recommended power and desalination complex, transmission system, and water distribution system.

PART II: Engineering, Design and Tendering Services (Phase-IA)

This part engages the consultant provide engineering design and tendering services for the Phase I-A.

The consultant shall establish the requisite project organization with adequate staff under the supervision of a resident project manager in Oman and supported by the consultant's head office.

Phase I-A of the development consists of the following:

a) Soil investigation for the full plot

b) Hydrological survey and investigation to enable the seawater intake to be optimized

c) Site preparation adequate for Phase-I development only

d) Water intake, pumping station, culverts and outfall. In Phase-I the pumping station and culverts shall be developed only to the level needed by Phase-I

e) Two 30,000 cu.m per day desalination units based on the MSF design

f) Two auxiliary steam boilers suitable to operate the desalination units for the first few years of operation and later integrating with back pressure steam turbines

g) Two open cycle gas turbines about 80 MW site rating each suitable for subsequent integration to a combined cycle unit

h) Administration buildings which can be expended to meet the full needs of the complete development

i) Control rooms for the above development, and to meet the needs of the full development

j) 132 KV switchgear (GIS) and generator transformer to enable the early power plant to be interconnected to the main system

k) Auxiliary electrical system

l) Product water storage reservoir

m) Mains water pumping station

n) Auxiliary systems to enable the above plant to operate satisfactorily

o) Site wall

The required engineering services shall include but not be limited to the following:

1) Perform field studies as necessary to determine design parameters:

2) Preparation of tender documents for soil investigation and site survey and assisting the client in awarding the contract for such work

3) Preparation of preliminary drawings, layout plans, proposed site facilities, engineering documents, cost estimates and outline design report for client's approval

4) Upon arrival of the report, prepare designs and draft technical specification, and tender documents for Phase-IA turnkey contractor for client's approval

5) Upon approval of the draft tender documents, prepare 20 sets of tender documents including drawings, specifications and bill of quantities to enable the client to seek tenders

6) Evaluate tenders received and advise the client of the most suitable tender

7) Assist client in contract negotiation with the chosen contractor and in preparation of the contract. Five sets of the contract documents shall be prepared for signature by the client and the contractor.

8) Assist client in all technical matters associated with this plant

Part III: Construction Supervision

This Part provides for the Construction Supervision. The required services shall include but not be limited to the following:

1. Provide engineers and construction supervisors experienced in power plant construction to staff an adequate construction supervision organization (minimum experience on similar projects shall be 10 years).

2. Preparing any further plans, designs and drawings necessary to carry out the works.

3. Review and approve the equipment manufacture drawings and detailed design drawings submitted by the contractor and/or subcontractors.

4. Make arrangement on behalf of the client for the inspection and testing during manufacture of such materials and equipment as are usually inspected and tested and issue inspection certificates to the client.

5. Issue instructions to the contractor and supervise the execution of the works.

6. Issue payment certificates and other information as required by the client.

7. Supervise acceptance tests on site.

8. On completion of the works revise the "as built" drawings in accordance with changes agreed to during the execution of the works.

9. Assist in settling disputes or differences that may arise between the owner and contractor except litigation and arbitration.

0. Issue weekly and monthly progress reports and other technical and financial reports associated with the works.

1. Review the operation and maintenance manuals and spare parts lists.

2. Provide required assistance to the client during the guarantee period of the project.

# CHAPTER 7

## PROPOSED BUDGET FOR IMPROVEMENTS

### 7.1 Improvements Required Within the 1995 Planning Horizon

Table 11 presents the estimated capital costs of the recommended improvements program assuming central blending. Costs are presented for source (excluding Wadi Dayquah), transmission and transfer, distribution service, and other system improvements included in the MEW's original Third Five-Year Plan which were not reviewed by the WASH team. The total budget for the central blending concept is RO 141,466,400. However, it is estimated by the WASH team that RO 2,400,000 for the new Mowallah booster pump station and transfer pipeline should be added to this total when comparing the central versus local blending scheme.

Table 12 presents the estimated capital costs of the recommended improvements program assuming the local blending strategy described in Section 6.13 was adopted by the MEW. The total budget for the local blending scheme is RO 139,157,150.

Estimated costs of the improvements are based upon recent contract bids from MEW as discussed in section 5.6 of this report, with a 6% per year inflation allowance and a 25% allowance for engineering and contingencies. These cost estimates do not include any allowance for administrative, legal, financing, land acquisition, or other legal procurement.

The estimated costs in both Tables 11 and 12 have been distributed as those costs in the MEW budget which were not reviewed by the WASH team, Phase 1 WASH team recommendations and Phase 2 recommendations. Phase 1 projects are those components that are urgently needed to meet the near future water demands and may have to be implemented under a turn-key design/construct arrangement as described in Chapter 8.

### 7.2 Improvements Required Immediately

Planned reductions in the Capital Budget developed as part of the Third-Five-Year Plan make it necessary for MEW to reevaluate all proposed projects. The following sections describe those projects which in the opinion of the WASH team rank highest in priority. Tables 14 and 15 list the projects and estimated cost in order of priority. Table 14

is based upon the assumption that all brackish well water will be blended at Ghubrah. Table 15 is based upon the assumption that the brackish wells will be blended as close as possible to the well site.

### 7.2.1 OBCO Line Connections

The 600mm transmission line (OBCO) has been available for blending Eastern Well Water at Ghubrah since late 1985, but the Wadi Aday pump Station has never been used to transfer water to Ghubrah.

At present, the eastern transmission system cannot meet the Top Water Level of the Muscat tank (i.e. fill the tank) at system demands greater than 100 Ml/day. In the first 6 months of 1986, maximum day demands have gone as high as 102 Ml/day. If an extended period of demand in excess of 100Ml/day were to occur, the Muscat tank would be without water.

Since the Wadi Aday station is being considered for use as an emergency facility, we have evaluated the possibility of conversion of the OBCO line to supplement transmission capacity to the eastern end of the system. With proper valving, the OBCO line could be used periodically as a central blending main, although it is the opinion of the WASH team that the costs of central blending far outweigh the benefits to be gained.

MMP has estimated that it will cost about R.O. 50,000 to make connections to the Ghubrah transmission main at either end of the OBCO line. This will effectively increase the transmission capacity by 50 % between Ghubrah and the Intercontinental Hotel and by 100 % between the Intercontinental Hotel and the Wadi Aday roundabout. The effect of the improvement is to reduce the hydraulic grade elevation required at Ghubrah to feed the reservoirs.

In addition to increasing transmission capacity, the conversion of the OBCO line will reduce power costs. For example, assuming an average daily flow of 106 ML/day (23.5 mgd) the difference in head required at Ghubrah is about 17 meters greater with the OBCO line out of service than it would be if the OBCO line were used for transmission from Ghubrah. The additional cost of power for one year without the OBCO line is about R.O. 45,000. Reduced power costs will pay for the OBCO connection in slightly more than one year.

MEW has budgeted approximately R.O. 1,400,000 for construction of the Ghubrah to Wadi/Aday segment of the eastern transmission pipeline as an alternative to

conversion of the OBCO main. This pipeline is discussed in more detail in Section 7.3.3. If the Planning Department alternative is constructed, the OBCO line will be used for central blending when modifications are made to the Wadi Aday Station to enable the transfer of water Ghubrah.

It is the opinion of the WASH team that conversion of the OBCO main is the lowest cost alternative to increase the flow to the eastern end of the transmission system.

From a practical standpoint, it is impossible to construct the Ghubrah to Wadi Aday pipeline before demands rise to unacceptable levels. For this reason we recommend that design be started immediately on the connections for the OBCO line and have included the cost in both the central blending alternative and the local blending alternative.

We recommend that ultimately some reinforcing be made between Ghubrah and Wadi Aday at least to Qurum. The timing and size of that improvement is highly dependent upon development plans in Medina Al Nahda, Ruwi and Qurum and is discussed in section 7.3.3.

### 7.2.2 Seeb Airport Diversion

The 600 mm line supplying the west from Ghubrah travels cross country parallel to the dual carriageway until Seeb Airport, crosses just east of the runway, and connects with the Seeb road near Mowallah. The cross country section is about 10 km long and is within 1900 meters of the Gulf at its closest point. A 300 mm (12 inch) ductile iron main parallels the 600 mm main for its entire cross country route.

The 300 mm main was originally used to supply western well field water to several consumers west of the Ghubrah plant when the Western Well fields were feeding the western transmission system. At present (July,86), the 300 mm main is not in service although the line can also be used to pump Western Wellfield water into the western transmission system if the Ghubrah pumps are throttled.

There were four pipeline breaks in 1985. The cost for repairs in 1985 averaged R.O. 1,500 per break including materials, labor, and equipment. Other costs which have not been estimated include damages, inconvenience, traffic delays (especially at the airport runway) and cost of water. It is estimated, for example, that a 2.5 cm leak lasting 8 hours at the pressures experienced in the transmission system could amount to 200 R.O. per break. This estimate assumes a cost of water of R.O. 2,000 per million gallons.

### 7.2.3 Ghubrah Storage

The Ghubrah desalination plant was constructed with two MSF units which have a combined production capacity of about 49 Ml/day. Available storage is a 54 Ml reservoir which is divided into two cells. In 1986, Ghubrah units 3 and 4 were completed. The combined production capacity for units 3 and 4 is about 51 Ml. Total net capacity is about 100 Ml/day.

Due to budget restrictions, MEW is considering the addition of a 5th unit at Ghubrah as a way to postpone development of the Barka desalination facility. With the completion of unit number 5, total capacity would be about 125 Ml/day. It is the policy of MEW to provide storage capacity equal to one day production capacity.

This policy is reasonable since storage serves to equalize the constant production of Ghubrah with the varying demands in the system.

Under the condition of a fifth unit at Ghubrah, the required storage is 125 Ml. The addition of an 80 Ml reservoir will meet the storage requirement for 5 units with sufficient volume to receive the Bosher wells.

Since a final decision on Barka construction versus Ghubrah expansion has not been made, it is the recommendation of the WASH team that only 54 Ml of storage is required immediately. The addition of 54 Ml storage will match current production capacity and provide an additional 8 Ml storage for the Bosher wells. In addition to storage, a seventh pump should also be added to the pump station.

The addition of storage at this time will have both short term and long term benefits. In the short term, because demand is less than supply capacity, it is possible under certain conditions to overflow the Ghubrah reservoir and return desalted water to the ocean. This could occur if the Ghubrah reservoir was full and a break occurred in the 600 mm transmission main east of the Intercontinental Hotel.

In the long term, the additional storage will meet MEW's policy goal whether or not Barka is constructed. If Barka is eventually constructed Ghubrah storage will provide flexibility for transferring Barka production.

Using MEW's cost data in Table 9, the estimated cost of 54 Ml storage at Ghubrah is R.O. 3,510,000. including 6 % inflation on a construction cost estimate of R.O. 2,700,000 and 25 % for engineering and contingencies.

Based upon discussions with MEW staff, it appears that the cause of the breaks is corrosion of the ductile iron main from either contact with seawater. It is also possible that the corrosion could be due to stray electrical currents coming from: impressed current cathodic protection of a nearby gas main, stray dc currents generated by electrical equipment at the nearby airport although this has not been substantiated.

The most seriously affected segment of pipe is a 4.5 km stretch just east of the airport. MEW staff have also reported that it is difficult to gain access to the line for repairs because it is on airport property. A water main break in the future could disrupt operations at the airport.

The proposed diversion of both the 600 mm and 300 mm lines around the airport was included in MEW's budget for the original Third Five Year Plan.

It is the opinion of the WASH team that the 600 mm line be diverted. However, a complete diversion around the airport would require about 10,000 m of pipe and cannot be justified on the basis of limited break experience. It is recommended that most of the MEW budget allocation be used to divert as much of the segment that has experienced the breaks as possible. The allocation for this work is R.O. 300,000. Approximately R.O. 250,000 should be used for the diversion and the remainder for a connection to the 300 mm main which is discussed below.

Diversion of the 300 mm main is not recommended at this time. The line is not currently in use, there are no plans to use the main for central blending and if the Barka desalination plant and transfer/transmission mains are ultimately installed, there will be adequate east-west transmission capacity.

The 300 mm is useful either to transfer water to Ghubrah for blending or as an addition to the distribution system. However, MEW proposes a new Mowallah main for transfer and additions to distribution along the dual carriageway at this location are not now necessary.

A more economical alternative to either the Mowallah main or the diversion of the 300 mm pipeline would be to connect the opposite end of the 300 mm line to the Seeb elevated tank (or Seeb Reservoir) at the point where the 300 mm line passes the Seeb compound. The estimated cost of the Seeb elevated tank connection is R.O. 16,500 versus approximately R.O. 110,000 to divert the same line around the airport. We recommend that MEW make the connection to the Seeb elevated tank and abandon the 300 mm line across the airport.

MEW's budget estimate for the addition of storage and related work at the Ghubrah facility is R.O. 2,000,000. This estimate converts to a unit cost of about R.O. 35/ metre cubed of storage. The estimate appears low.

### 7.2.4 Nature Reserve Diversion

The single 600 mm main supplying the Capital Area, east of the Intercontinental Hotel crosses through the nature reserve and beneath the dual carriageway just west of the Qurum roundabout. The cross country section is about 1 km long. At its nearest point it is 900 meters from the Gulf

There were 2 pipeline breaks in 1985. The cost of repairs in 1985 was about R.O. 1,500 per break including labor, materials and equipment. Other costs associated with the repair such as those described in Section 7.2.2 are also not included in this price.

It appears that the breaks are due to two causes: sea water corrosion and increased pressures in the line. The increase in pressure is due to an increased HGLE leaving the Ghubrah plant. The increased grade-line is necessary because of inadequate transmission capacity east of Ghubrah: there are two 600 mm mains between Ghubrah and the Intercontinental Hotel and a single 600 mm east of the Hotel.

It is the recommendation of the WASH team that this main be diverted around the nature reserve. The estimated cost of the line is about R.O. 100,000 including a 6 % allowance for inflation and 25 % for engineering and contingencies.

MEW has estimated the cost of the nature reserve diversion at R.O. 300,000. The MEW estimate appears high for such a short length of main.

### 7.2.5 Storage at Qurum

Consumption drawn off the Qurum reservoir during the period May 16,1986 through July 12, 1986 averaged about 26,000 cubic metres cubed per day with a maximum of 34,300 metres cubed per day. These figures are based on readings taken from recently reconditioned metres which were installed in May, 1986.

Existing storage in Qurum is 18,000 metres cubed. It has been MEW's policy to provide 48 hours storage in the transmission reservoirs. Based upon the period of record, the available storage in the Qurum system is about 17 hours, although pressure problems cited below effectively reduce this to about 9 hours.

It is the opinion of the Wash team that additional storage is required to adequately serve the Qurum, Qurum Heights, Medinat Qaboos and Al Khuwair districts. As we understand it there will be an elevated water storage tank in the Shaty Al Qurum development now under construction. While the new tank will provide storage for the new development, it will not be available to supplement the Qurum reservoir since both systems will be hydraulically separate. As a minimum, 24 hours storage should be available at the Qurum reservoir

At present (July 1986) the minimum recommended storage is 9000 metres cubed, but ideally 18,000 metres cubed should be added to the current 18,000 metres cubed to allow for some growth in demand. The most economical location is at the site of the existing Qurum reservoir. The site already has a guard house and other related facilities. The Al Khuwair site, while suitable and required in the long term, would require additional transmission/distribution piping and complete site development.

The estimated cost to provide 9,000 meters cubed at the existing site is R.O. 670,000 which includes a 6% allowance for inflation and 25% for engineering and contingencies.

MEW staff have reported that there are two housing units in the Qurum Heights area which receive below minimum pressure when the Qurum reservoir drops 3 metres below top water level. The addition of storage will not entirely correct this problem. While additional storage will minimize fluctuation in the tank, and therefore reduce the number of occasions when the level will drop 3 metres, the housing units appear to have been constructed at too high an elevation to be served by the Qurum reservoir.

## 7.3 Other Priority Improvements

The following improvements are required in the near future but are dependent upon policy decisions by MEW prior to implementation.

### 7.3.1 Service to Amirat

As we understand it, MEW plans to provide limited service to Amirat. The estimated cost being used by MEW for the revised budget is R.O. 2,700,000. Two alternatives are under consideration. Under the first alternative, a new booster station will be constructed in the vicinity of the existing Wadi Adai pump station. Water will be pumpedblending out of a storage reservoir (TWL 20m) to a reservoir in Amirat (TWL 213m).



224

Under the second alternative, water is delivered to a new intermediate reservoir (TWL 70m) about 8,000 m up the Wadi It is then repumped approximately 5,500 m to the new reservoir (TWL 213m).

MMP reports that the range of demand used to size the proposed Amirat system is 10,000 $m^3$/day to 35,000$m^3$/day

During an earlier phase of planning for the original Third Five Year Plan, MEW estimated that demand in Amirat could total 24,000 metres cubed/day by 1995. Based upon this estimate, and the assumption that the maximum top water level to be served in Amirat would be 173m, the Wasi: team recommended use of the Wadi Aday pumps station and an 800 mm pipeline from Wadi Aday to the new storage tank in Amirat.

A review of topographic mapping of the Hajar Bowl indicates that the highest existing boulding served in the Amirat area is elevation 135m. There are large tracts of land at elevationswhich are less than 135m. In fact, there does not appear to be an easily accessable site for a ground storage reservoir with a TWL of 213m.
The WASH team has the following comments concerning the above alternatives:

1. The TWL of the proposed reservoir should be reconsidered. Obviously, the higher the TWL the greater area that can be served. However, the selection of 213m appears to be much higher than what is required for the anticipated service area.

2. Once the TWL has been reevaluated, the hydraulic gradeline has been established, the alternative which was originally recommended by the WASH team, should be reconsidered. It appears that the existing Wadi Aday pump station could be modified to pump to Amirat. At a reservoir TWL of about 175 m the pressure leaving the Pump station would be about 15 bar.

### 7.3.2 Barka Transfer Main

The original Third Five Year Plan included R.O. 60 million for construction of two units at the site of the proposed Barka Desalting Plant. In conjunction with the development of Barka, JICA proposed two new water mains. The first, for water transfer to Ghubrah, is 1200/1000 mm diameter and 35/25 Km respectively, in length.

The second line is proposed as a transmission main to about the Azaiba/Ghalla/Bosher Roundabout. Connections to the existing transmission system were proposed at Seeb, the

Airport and Azaiba. This line is proposed to be 1200/900/700 mm diameter.

Due to budget restrictions, MEW is considering the addition of a 5th unit at Ghubrah as a way to postpone development of the Barka desalination facility. If Barka is developed, we recommend construction of the single Barka transfer main and propose that the main be connected to the transmission system at Seeb, the Airport and Azaiba.

The JICA report indicated that the same product water pumps would be used for transfer and transmission. We recommend that separate product water pumps be used for transfer and transmission because the head requirements of the two functions are different. The transfer main requires about 20 metres of head to transfer approximately 30,000 metres cubed to Ghubrah. If pumping into the transmission system, the head requirements must more closely match the head conditions of the Ghubrah pumps (about 150 metres).

Hydraulic controls should be installed at the Ghubrah end of the system, at the Barka end of the system, and at each point of connection. If the Barka plant is selected as the alternative to increase supply, we recommend that the hydraulics of the pipeline be reevaluated for number of pipelines, size and HGLE requirements of the product water pumps.

MEW has located a source of brackish water near the site of the proposed Barka facility. The well field, Barka/Kaburah, has a potential yield of about 20 ML/day. If the Barka plant is constructed, the wells may be a cost effective source of water for local blending. We recommend that the well site be evaluated after the decision on the Barka plant has been made.

The estimated cost of the single Barka transfer main is R.O. 16,985,000 which includes an inflation allowance of 6% and 25% for engineering and contingencies.

### 7.3.3 Eastern Transmission System

During an earlier visit, the Wash team evaluated the ability of the eastern transmission system to deliver anticipated demands. The demand conditions used at that time were based upon the consumption projections in the original Third Five Year Plan. Since that time, the rate of increase in consumption has leveled off. The average daily demand for the first 6 months of 1986 is about 87.9 Ml/day. Assuming this average day holds constant for the remainder of the year, the average increase in consumption over 1985 will be 10 percent. If the 10 percent growth rate is extrapolated to



226

1995 the a total system consumption will be about 207 Ml/d versus a projected 260 Ml/d under the original projections. Projections by year are shown in Table 16 and Figure 15.

Table 16

Revised Consumption Estimates

| Year | 10% Growth | MEW Projection |
|---|---|---|
| 1984 | 62.0 | 62.0 |
| 1985 | 79.3 | 79.3 |
| 1986 | 87.9 | 101.4 |
| 1987 | 96.7 | 123.5 |
| 1988 | 106.4 | 145.7 |
| 1989 | 117.0 | 167.9 |
| 1990 | 128.7 | 190.0 |
| 1991 | 141.6 | 204.0 |
| 1992 | 155.7 | 218.0 |
| 1993 | 171.3 | 232.0 |
| 1994 | 188.4 | 246.0 |
| 1995 | 207.3 | 260.0 |

The effect on this reduction in the rate of growth of consumption is to push into the future the need for certain improvements. One of the improvements which was originally envisioned immediately under the original consumption projections was the reinforcement of the eastern transmission system. Under central blending conditions the segment of this line between Ghubrah and the Wadi Aday roundabout was required immediately.

Under reduced consumption projections, and assuming central blending (i.e. the OBCO line is unavailable for transmission use), the 900 mm segment from Ghubrah to Wadi Aday is required immediately.

If the OBCO line is available for transmission, the need for the Ghubrah to Wadi Aday segment can be delayed until between 1990 and 1991 (an average day of about 135 to 140 Ml/d) without creating hydraulic problems in the transmission system. The need for additional system reinforcing beyond Wadi Aday roundabout depends on the rate of growth of Muscat, Ruwi/Muttrah and Amirat.

The Wash team recommends that the OBCO line be converted for transmission use as discussed in section 7.2.1 and that the design of the Ghubrah to Wadi Aday segment of the

reinforcing line be delayed until 1988 (or when average daily demand approaches 110 Ml/d) when it can be reevaluated based upon actual consumption growth. In this way construction can be timed to coincide with the need for the pipeline.

The estimated cost of the segment of the eastern transmission system between Ghubrah and Wadi Aday is R.O. 3,005,500 and includes the crossing of the dual carriageway, a 6% allowance for inflation and a 25% allowance for engineering and contingencies.

## 7.4 Lowest Priority Projects

The following projects are either required to expand the transmission system to serve new areas such as Ghala/Azaiba and Airport Heights or system reinforcement such as expansion of storage or additional pipelines.

### 7.4.1 Wadi Kabir/Al Bustan Pipeline

The Wadi Kabir/Al Bustan pipeline was originally proposed as a second means to feed the area. This approach was more cost effective than expansion of storage at the Al Bustan reservoir. Since consumption is not likely to meet original planning projections, it is the recommendation of the Wash team that the project be delayed and reevaluated at approximately the same time that the eastern transmission mains are reevaluated.

The estimated cost of the 400 mm, 3000 m pipeline is R.O. 189,600. This cost includes a 6% allowance for inflation and a 25% allowance for engineering and contingencies.

### 7.4.2 Storage at Greater Muttrah

An expansion of storage was originally proposed at Greater Muttrah when MEW's policy called for 48 hours storage and when planning projections showed a greater potential for growth in the Muttrah than is now envisioned. At present (July 86) the average daily demand in the Muttrah distribution system is about 16,200 $m^3$/day and the available storage is 18,000 metre cubed.

It is the recommendation of the Wash team that planned storage in the Greater Muttrah area be delayed until MEW reevaluates its policy relating to expansion of existing reservoirs.

The estimated cost of 18,000 metres cubed of storage is R.O. 1,422,000 and includes an allowance of 6% for inflation and 25% for engineering and contingencies.

### 7.4.3 Al Khuwair Service

Service to the Al Khuwair water storage reservoir was proposed to be a 600 mm branch off of the 1000 mm eastern transmission line. The recommended hydraulic gradeline elevation of the reservoir (TWL) was in the range of 85 to 90m. As we understand it, the areas that are likely to develop in the short term are a section just south of the Al Khuwair commercial center and parallel to the roadway.

If in the short term, segments of the Al Khuwair district develop, it may be possible to extend the Qurum distribution system to serve the areas. If the distribution system is adequate, there will be no need to extend the eastern transmission main between Ghubrah and Wadi Aday.

### 7.4.4 Airport Heights

MEW had in its original Third Five Year Plan, proposed to establish a new service area, Airport Heights. The area was planned to be served by booster pumping from the new Seeb Airport tank. As we understand it, development plans in the area are uncertain at this time. It is our recommendation that no improvements be made to serve the area at this time.

### 7.4.5 Ghala/Azaiba Service

In June, 1986 MMP considered two water supply schemes for the Ghala/Azaiba service area. The recommended scheme included construction of one reservoir (TWL 65 m) on a site southwest of the Ghala Industrial Estate. The reservoir would supply both the section of the service area north of the Dual Carriageway and south of the Dual Carriageway.

The recommended size of the storage reservoir was 10,000 cubic metres. This was based upon an estimated 1990 demand of 10,000 metres cubed per day. The reservoir would be connected to the transmission system via a 600 mm main.

Also included was a pump station and a 50 cubic metre elevated tank which are reportedly needed to feed a few properties near the reservoir site.

The recommended alternative appears feasible. As a way to reduce costs, MEW may wish to consider an alternative location for the reservoir and raise the Top Water Level. The advantage of a higher TWL is that it may be possible to serve the entire area without the need for a booster pump station and an elevated tank.

It appears from inspection of the topographic mapping, that the highest elevation of an existing building is 65m. A TWL of approximately 80m would provide a minimum head of 15m.

As proposed by the WASH team the estimated cost of the Ghala/Azaiba service is R.O. 3,730,960. This cost includes a 6% allowance for inflation and 25% for engineering and contigencies.

Annex R

# WATER RESOURCES DEVELOPMENT PROJECT
## PROJECT IMPLEMENTATION SCHEDULE
## PHASE I

| Required Action | Aug 1 15 31 | Sep 1 15 30 | Oct 1 15 31 | Nov 1 15 30 | Dec 1 15 31 | Jan 1 15 31 | Feb 1 15 28 | Mar 1 15 31 | Apr 1 15 31 | May 1 15 30 | Jun 1 15 30 | Jul 1 15 31 | Aug 1 15 31 | Sep 1 15 30 | Oct 1 15 31 | Nov 1 15 30 | Dec 1 15 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FY 1986 | FY 1987 | | FY 1988 | | | | | | | | | FY 1988 | | | FY 1989 |
| OBLIGATIONS (O) AND EVALUATIONS (E) | | O | | | | | | | | O | | | | | | | E-1/88-> |
| Loan Agreement Signed | | : | | | | | | | | | | | | | | | |
| Engineering Services - Barka Desalination Plant | | | | | | | | | | | | | | | | | |
| Prep. RFP Addendum | | :--: | | | | | | | | | | | | | | | |
| Prep.& Submit RFP Amendments | | :--: | | | | | | | | | | | | | | | |
| Eval.& Select Firm | | | :--: | | | | | | | | | | | | | | |
| Negotiate & Exec. Cont. | | | :-------: | | | | | | | | | | | | | | |
| Prepare Plant Master Plan | | | | | :----------: | | | | | | | | | | | | |
| Final Design - Plant and Trans. Line | | | | | | | :----------: | | | | | | | | | | |
| Construct. Cont Tendering | | | | | | | | | | :----------: | | | | | | | |
| Plant & Trans. Line Construct. | | | | | | | | | | | | | :----------: | | | | 8/99-> |
| Engineering Services - Other Water Sys. Improvements | | | | | | | | | | | | | | | | | |
| Prepare and Issue RFP | | :----------: | | | | | | | | | | | | | | | |
| Prepare Prequal. Criteria | | :-----: | | | | | | | | | | | | | | | |
| Publish CBP Prequal. Ad. | | : | | | | | | | | | | | | | | | |
| Recieve Prequal Submissions | | | :-----: | | | | | | | | | | | | | | |
| Evaluate Prequal.& Short List | | | | :-----: | | | | | | | | | | | | | |
| Proposal Prep. | | | | | :-----: | | | | | | | | | | | | |
| Eval. Proposals Select Firm | | | | | | :-----: | | | | | | | | | | | |
| Negotiate Contract | | | | | | | :-----: | | | | | | | | | | |
| Contract Implementation | | | | | | | | :----------: | | | | | | | | | 3/90-> |

ANNEX S

Waiver No. _____

ACTION MEMORANDUM TO THE ASSISTANT ADMINISTRATOR

FROM: F. Gary Towery
AID Representative
Omani-American Joint Commission

Subject: Water Resources Development Project
Waiver of Handbook 11, Section 2.5.2
Advertising

Background

The Government of Oman has asked A.I.D. to finance engineering services required to strengthen and improve the water system of its Capital Region. One component of the proposed project is the design and supervision of construction of a multipurpose power and desalination plant at Barka. The Ministry of Electricity and Water (MEW) has already initiated the process of selecting a contractor using the Government of Oman's standard international tendering procedure. In January 1985, MEW issued an international tender for engineering services for a detailed masterplan for the phased development of Barka, final design of phase 1, tendering services and supervision of construction for the first phase of the plant. Associated power and water transmission facilities are included in the scope of work.

No prequalification stage was used in the process. A detailed request for priced proposals was prepared and the document offered to any firm seeking it. An advertisement was placed in the local newpapers and on the Tender Board's notice board. The widely distributed Middle East Economic Digest (MEED) published information on the tender for services. Companies had from January 19 to March 17, 1985 to obtain the request for proposals and submit their proposals. 24 sets of documents were distributed and 14 proposals were received. Apparently several major U.S. companies requested documents but did not submit proposals.

Of the 14 proposals, four were submitted by the following U.S. firms: Kuljian, Stone and Webster, Gibbs and Hill and Kellog. In keeping with Government of Oman procedures, proposals included a request for detailed price quotations with the award to be made on the basis of both price and technical qualifications.

Discussion

We believe the course of action setforth below will meet both AID and the Government of Oman's requirements.

1) MEW will reject all non-U.S. proposals;



232

2) MEW will prepare objective technical evaluation criteria with appropriate weights acceptable to AID;

3) AID and MEW will review the standard contract form included in the RFP and prepare a list of changes and additions to make it acceptable to AID;

4) MEW will issue an addendum to the four U.S. firms which advises them of the change in the procurement process, setsforth the criteria that will be used for evaluation and ranking of proposals, and transmits the changes in the standard contract form.

5) Each firm will be allowed two weeks to reconfirm its interest in the contract, extend the validity of its proposal, and provide any adddditional information it wishs to add in light of the change in evaluation criteria. Each firm will be allowed an additional two weeks to submit a price proposal in a sealed envelope.

6) MEW will remove the price sections of the four proposals, evaluate them, along with any additional information submitted by the firms against the technical criteria and rank them according to the numerical results of the evaluation and present its recommended ranking to AID along with supporting analysis.

7) AID will independently evaluate the proposals using the services of an independent consultant, review MEW's recommendations and concur or discuss difference.

8) MEW will initiate contract negotiations with the top ranked firm on receipt of A.I.D.concurrence.

To implement the above course of action, A.I.D. will have to waive Handbook 11 Chapter 1 Section 2.5. "Advertising" which requires the publication of an advertisement in Commerce Business Daily. Section 2.5.3 states "The requirement for advertising may be waived ... to avoid serious delay in project implementation provided that efforts shall ... be made to secure proposals from a reasonable number of contractors."

The plant is urgently needed under even the most optimistic circumstances and regardless of the outcome of other Water Resources Development Project activities. If MEW's higher projections of demand are accurate, there will be a supply deficit no matter how rapidly the plant is built. With lower projections of the growth of water demand, there is just enough time to get the plant into operation if it is built as quickly as possible. Therefore, MEW can not afford to lose time by retendering for engineering services using AID procedures. At minimum it will require 30 days to rewrite the RFP, 30 days for advertising and 30 days for preparation of proposals.

Although the Government of Oman's procurement procedure is quite different from the procedure specified in Handbook 11 in many respects, it does comply with the spirit of the advertising provision of Handbook 11. The procurement was given adequate publicity especially through MEED which is probably more widely read by firms interested in business in the Middle East than the Commerce Business Daily. The interested firms had adequate time to obtain the tender documents and submit proposals. The numbers of documents distributed and the number of proposals submitted to MEW attests to this.

Recommendation

Including the Barka Desalination Plant in the Water Resources Development Project is appropriate in the context of the project's goal and purpose and Joint Commission involvement in the construction of the plant is consistent with the Commission's approved strategy. The conditions required for a waiver of advertising are clearly met. The project is urgently needed and advertising will serious delay implementation and efforts have been made to obtain a reasonable number of proposal.

I, therefore recommend that you waive the requirement that the procurement of engineering services for the Barka Desalination Plant and related facilities be advertised in the Commerce Business Daily in accordance with Handbook 11, Sections 2.5.

Approved_____

Disapproved_____



234