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**SMALL RURAL WATER SYSTEMS PROJECT
IN THE YEMEN ARAB REPUBLIC :
A MIDTERM EVALUATION**



**WATER AND SANITATION
FOR HEALTH PROJECT**

Operated by
CDM and Associates

Sponsored by the U.S. Agency
for International Development

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A Midterm Evaluation

Prepared for the USAID Mission to Yemen
under WASH Activity No. 256

by

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GLOSSARY OF ACRONYMS

CHDA	Central Highlands Development Authority
CPO	Central Planning Organizations
CYDA	Confederation of Yemeni Development Association
FAR	Fixed Amount Reimbursed
FLCCD	Federation of Local Cooperative Councils for Development
FYP	Five-Year Plan
LCCD	Local Cooperative Council for Development
LDA	Local Development Authority
MAF	Ministry of Agriculture and Fisheries
MMH	Ministry of Municipalities and Housing
MOH	Ministry of Health
MPW	Ministry of Public Works
NTF	New TransCentury Foundation
OPM	Office of Planning and Management
RWSD	Rural Water Systems Department
SURDP	Southern Uplands Regional Development Project
TDA	Tihama Development Administration
UNCDF	United Nations Capital Development Fund
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Program
YARG	Yemen Arab Republic Government

10.6 YR (Yemeni Rial) = \$1.00 U.S.

EXECUTIVE SUMMARY

This summary addresses itself to the findings and recommendations of a midterm evaluation for USAID/Yemen of Phase II of the Small Rural Water Systems Project, which was conducted from September 8 to 30, 1986. Phase II was designed to cover fiscal years 1985 through 1988. Phase I of the project was conducted from 1979 through 1984. The second phase was intended to provide institutional development services to strengthen the managerial, technical, and financial capabilities of the Rural Water Supply Department (RWSD) of the Ministry of Public Works (MPW) so that the department could effectively respond to the need for improved village water systems.

The contractor, New TransCentury Foundation (NTF), was to provide these services in addition to constructing 100 village water systems, to offer a wide range of training services to villagers and RWSD staff, and to construct 20 rural sanitation projects. The evaluation was conducted by a three-person team from the AID/S&T Bureau's Water and Sanitation for Health (WASH) Project and was assisted by the USAID Regional Economist from Amman, Jordan. During the course of the evaluation, members of the team visited a total of 18 randomly selected rural water systems in the project's four regional areas; conducted interviews with the USAID/Yemen Mission staff, members of the NTF project team, YARG officials, and other donors; and completed a comprehensive review of the Mission's project files.

The primary objectives of the evaluation were to provide the Mission with:

- An understanding of the magnitude of demand for rural water systems in the Yemen Arab Republic and the various factors currently affecting the installation of rural water systems
- An objective critique of the role that the USAID-funded project plays in supplying these systems
- An assessment of the continued validity of end-of-project status in view of progress to date and the likelihood of eventual achievement in full
- Recommendations for modification of project objectives, activities, budget, and timeframe within the changing framework of supply and demand for water systems in rural Yemen.

Findings:

- The project's field accomplishments may be classified as an unqualified success. NTF has overcome the combined constraints of logistics and terrain to produce 172 water supply systems that are well engineered and constructed according to high-quality standards. Further, approximately 180 persons in 90 villages have been trained to operate and maintain their systems.
- In reaching this level of field expertise, NTF has organized itself into a highly efficient turnkey construction unit, and its staff have mastered the intricacies and political sensitivities

of many elements of Yemen's rural society. These accomplishments have enabled NTF to involve the villagers in constructing their systems at physical and monetary levels rarely found in rural water supply around the world. NTF's field operation has become so efficient that the Phase II output of 100 systems will be reached two and one-half years ahead of schedule.

- The primary objective of Phase II, however, as stated in the Grant Agreement, was to provide institutional development (ID) services to RWSD. In this realm, the project is far from successful, as NTF has made little headway on its ID objectives vis a vis RWSD. This observation is not meant to imply RWSD was a willing partner in the process. RWSD operates as a pure development agency envisioning its mission almost exclusively as an agency to provide rural water supply infrastructure. This fact, together with a set of unclear institutional objectives in the Memorandum of Understanding between AID and RWSD, exacerbated the situation. Further, the fact that RWSD did not, as expected at the time of NTF's proposal, become an autonomous agency certainly did not improve the project's institutional development environment. Nevertheless, the work accomplished for this evaluation has convinced the team that NTF has not placed sufficient emphasis on the nonphysical aspect of its responsibilities.

Recommendations:

Thus, it is recommended that NTF change its mode of operation and concentrate on providing technical assistance (TA) to RWSD instead of constructing systems, to optimize RWSD's use of the private sector in constructing projects. RWSD, complemented by NTF, would act in much the same manner as it does currently, that is, providing survey and design functions and tendering contracts for construction by private-sector firms. With NTF's assistance, however, its efforts should be more efficient.

Specific recommendations include:

- USAID/Yemen should authorize no increase in the number of construction sites.
- NTF should start phasing back RWSD employees.
- NTF should formulate detailed plans which will allow its efforts to be concentrated on providing technical assistance to RWSD through a functioning office of Planning and Management; allow NTF to continue its training services to village and RWSD technicians; and provide TA to RWSD's efforts in tendering, inspecting, and supervising private-sector construction of water supply systems.

USAID/Yemen must become more involved in monitoring NTF's execution of the work. As a first step, AID, NTF, and RWSD should immediately begin a dialogue leading toward a new Memorandum of Understanding that will act as the project's basis of operations for the next two years. The Memorandum of Understanding should cover the issues presented in the findings and recommendations

presented herein. Provision should be made to include a detailed review of the project six to eight months after the Memorandum of Understanding is formulated. If USAID/Yemen believes substantial progress has been made, the mission could opt to sponsor construction of a limited number of systems (five annually per NTF region) from PL 480 funds. If no substantial progress has been made, AID should terminate the project as soon as it is feasible to do so.

Regarding the additional objectives of the evaluation, the following points are pertinent:

- The systems constructed are widely accepted by the villagers, and they are willing to pay a considerable portion of the capital cost and other ancillary costs in addition to providing village-financed O&M for the systems.
- The systems appear to be fostering a greater use of water; water use and storage practices, however, have not measurably changed in those villages affected by the project. For the most part, the level of service provided has relieved women and children of the water-fetching burden, and the additional time gained by women was used primarily in agricultural work.
- Other project benefits are difficult to quantify; in the villages served, however, the provision of adequate water supply will provide the firm foundation upon which sanitation and health educational efforts can be built.

USAID has played a significant role in YARG's rural water supply since the early 1970s. The 172 systems installed by NTF represent between 15 percent to 20 percent of the total number of systems provided through government sponsorship over the last ten years. In choosing to concentrate the remaining efforts of the project on institutional development within NTF, USAID will, in effect, shift the focus of this intervention from the short to the long term.

Chapter 1

INTRODUCTION

1.1 Authorization

This report represents the findings and recommendations of an interim evaluation for Phase II of the Yemen Arab Republic (YAR) Small Rural Water Systems Project sponsored by the United States Agency for International Development (USAID) Project 279-0044 (heretofore referred to as Project 044). The project was designed to cover fiscal years 1985 through 1989 and is an extension of the first phase, which was carried out through 1984.

The evaluation was authorized by a request of USAID/Yemen to the USAID-sponsored Water and Sanitation for Health Project (WASH). The Mission requested that WASH furnish a team of three consultants, to be assisted by an AID economist from the regional office in Amman to conduct this evaluation.

The timing of the request was generally coincidental with the Mission's plan for the first evaluation of the second phase of the project. Further, as the rate of rural water system construction was far greater than anticipated, the Mission was concerned about a possible slippage in the progress toward reaching the project's additional objectives. Thus, the evaluation team was asked to measure the general progress of Project 044; to identify potential problems and make recommendations which would resolve any problems; and to allow the Mission, if necessary, to redirect the future course of the project.

The WASH Operations Center mobilized the team of David Laredo, James W. Dawson, and Mouna Hashem to carry out this assignment, together with Mark Kraczkiewicz from Amman. The team represented expertise in water supply engineering, development administration, institutional development, social science, and economics. The three WASH consultants arrived in Sana'a, Yemen Arab Republic on September 8, 1986 (the economist about one week later, staying for ten days) and worked through September 30, 1985.

1.2 Project History

Phase II of the Small Rural Water Systems Project (279-0044) is a direct outgrowth of the two prior AID activities in the rural water sector, that is, the Rural Water Supply Project (279-0022), which was active between 1973 to 1979, and Phase I of this project which was carried out between 1979 through 1984. The initial project focused primarily on assisting the YARG's Rural Water Supply Division (RWSD) in developing its hydrological and water resources development (well-drilling) capabilities. In the process, it developed water resources for 24 villages. An ancillary project, the Rural Water Supply Project Support (279-022.1), provided staff salaries, project vehicles, maintenance, and supplies for the RWSD's village water system construction program. A total of \$6.1 million of U.S. assistance was provided under this project. Many people in and out of the Mission indicated that AID "...was the RWSD," as there was little in the way of local staff provided to complement the efforts described.

The first phase of the current project was initiated in 1979 as a logical follow-on to the earlier Water Supply Project (279-022). It provided the New TransCentury Foundation (NTF) with an initial grant of \$7 million to assist the YARG's Rural Water Supply Division in: (1) constructing 140 small rural water systems; (2) upgrading the RWSD's subproject selection procedures; (3) improving its water systems monitoring and maintenance capacities; and (4) instituting village-level training programs. In 1984, the NTF Cooperative Agreement was amended to provide an additional \$500,000 to allow the NTF to assist in constructing up to 50 villages in Dhamar Province that had been damaged by a major earthquake in 1982.

The primary difference between this project and the earlier Project 022 was that the earlier project was primarily limited to water source development, and not with village distribution systems, as is the case with the current project. During Phase I, this project constructed a total of 72 village systems, 17 of which were in the earthquake area. In 1984, at the end of Phase I, AID subsequently approved another grant of \$12.5 million to NTF to cover continued project activities from 1984 through 1989. Unlike Phase I, the current project was justified largely on actions that would strengthen the institutional capacity of RWSD.

1.2.1 Phase II, 1984 through 1989

This project is designed to improve access for Yemen's rural population to potable water, and therefore improve their health status and their quality of life. By 1989, according to the proposal, more than 70,000 rural persons were to have improved access to potable water through this project, and by 2004 an estimated 109,000 persons will be beneficiaries. (These projected values are approximately 101,000 and 151,000, respectively.)

The purpose of Project 044 was to strengthen the managerial, technical, and financial capabilities of RWSD, so that RWSD could effectively respond to the need for improved village water systems. Project 044, built on the experience of Project 022, has made significant progress toward creating a field construction capability under Departmental auspices. On the basis of work of the two earlier projects, Project 044 Phase II, planned to more fully address the institutional weaknesses within the RWSD.

The end-of-project status (EOPS) intended to increase RWSD's capabilities to:

1. Plan, survey, budget, and design rural water projects.
2. Implement the construction of rural water projects, in conjunction with local development associations, villagers, and the private sector.
3. Train villagers in the operations and maintenance of rural water systems and advise them on ways to deal with the public health benefits of improved water systems and the consequences of operating such systems.
4. Share its financial burden by developing effective ways of increasing village contributions and foreign donor support.

To achieve the project purpose, nine institutionally related and three physical construction activities were undertaken as follows:

1.2.2 Institutional Achievements

1. An Office for Planning and Management (OPM) was to be created within RWSD. Initially, the OPM was to be staffed with expatriate advisors to be replaced by trained Yemenis by the end of the project.
2. The RWSD was to be given advice and assistance so that it might reorganize and restructure itself.
3. Five staff were to be recruited or reassigned from other RWSD offices to assist with departmental administration, planning, and training. (Initially, these would probably have to be OPEX staff.)
4. Thirty Yemeni technicians would be in place as RWSD construction supervisors; 10 new Yemeni engineers and administrators or planners would become part of RWSD management; 24 private-sector contractors were to be carrying out construction activities; and 100 villages were to have individuals trained to perform operations and maintenance functions on completed projects.
5. A modified Fixed Amount Reimbursement (FAR) system was to be employed to reimburse RWSD for constructing 16 subprojects.
6. A rural water hydraulics laboratory was to be established to train RWSD technicians.
7. Three regional offices of the RWSD were to be established or expanded at Dhamar, Hodeidah, and Taiz.
8. Four in-depth village studies were to be completed, analyzing water usage patterns and community health practices.
9. The RWSD was to be reconstituted as an autonomous authority.

Construction

1. One hundred rural water systems were to be completed.
2. Twenty-two sanitation projects were to be completed.
3. Five small gabion check dams were to be constructed as part of a pilot conservation and erosion control program. (These would be included in the 100 subprojects.)

Inputs:

Inputs required to achieve these outputs included technical assistance, training, and commodities according to the following schedule:

Technical Assistance:

Thirty-four expatriate person-years and 83 local-hire person years.

Training:

1. Regional training

- Twelve fellowships for technical training for six person-years
- Ten fellowships for public administration and related disciplines for ten person-years

2. Short-term training (total of 1,566 person-weeks)

- A total of 450 person-weeks of short-term technical training
- One hundred person-weeks of short-term training in health
- Ninety-six person-weeks of training for private-sector contractors
- A total of 800 person-weeks of training for villagers in operations and maintenance of rural water systems

3. Training allowances for RWSD technicians for 30 person-years.

Commodities and Materials:

\$1.8 million

Equipment:

\$850,000

1.3 Evaluation Methodology

1.3.1 Objectives

USAID/Yemen's Scope of Work for this evaluation lists four major objectives, as follows:

1. An understanding of the magnitude of demand for rural water systems in the Yemen Arab Republic and the various factors currently affecting the supply of rural water systems
2. An objective critique of the role the USAID-funded project is playing in the supply of these systems
3. An assessment of the continued validity of project EOPS in light of progress to date and the likelihood of their eventual achievement in full

4. Recommendations for revision in project objectives, activities, budget and timeframe within the changing framework of supply and demand for water systems in rural Yemen.

These objectives required the evaluation team to:

- Determine whether the project was allowing USAID/Yemen to reach the objectives of this intervention by assessing, in an overall sectoral context, the effectiveness of Project 044's execution and its contribution to the rural water supply sector.
- Determine the specific status of Project 044 and an indication of its impact on the villagers and on RWSD.
- Assess NTF's performance in terms of providing quality rural water systems and provision of training and institutional development services to RWSD.
- Assess NTF's and the Mission's performance in terms of their management and administration of the project.
- Make recommendations for the future course of Project 044, including those to resolve any problems which may exist.
- Make recommendations for future USAID/Yemen actions related to the project and the rural water sector as a whole.

The entire Scope of Work is presented as Appendix A.

In addition, although not an explicit requirement in the Scope of Work, the relationship of the rural sanitation sector to Project 044 was included as part of the evaluation. This addition was prompted by the sanitation elements included in the project, the enormous needs of this subsector in Yemen, and the logical linkage between water supply and sanitation.

1.3.2 Methodology

The methodology employed for this evaluation consisted of a four-part framework.

The evaluation team first examined "hardware" elements of the project: the provision of water systems to determine whether NTF was providing well-engineered, well-constructed, high-quality systems which serve the needs of Yemeni villagers. Second, team members assessed the manner in which AID/NTF complied with the project's proposed outputs and their administrative responsibilities, together with the effect of their action on the effectiveness of the project and the future activities of RWSD. The third task involved determining the acceptability of the project by the beneficiaries, the Yemeni villagers, and their use of the systems. Fourth, a general determination of the project benefits was made.

The four-part examination described above was accomplished through several mechanisms:

- Interviews were held among team members and officials and staff personnel of USAID, NTF, the MPW/RWSD and other YARG agencies; representatives of other bilateral donors and international lending agencies; shaykhs; and members of local governing groups, villagers, and volunteers (USPC and ONV's).
- Field visits were made to 18 sites in all four NTF regions and to all NTF and MPW/RWSD branch offices. Observations and discussions during these trips, coupled with additional interviews in various villages, yielded valuable insight into the realities of providing such systems in Yemen.
- Reports, past evaluations, and general reference material were researched.
- A thorough examination of the USAID/Yemen project file was made.
- In-depth interviews were conducted with NTF's Project Manager, and almost every senior manager -- Yemeni and expatriate -- covering a wide range of issues.
- Three briefings with the USAID/Yemen Mission were presented (prior to the final briefing) to obtain feedback, additional information, and suggestions for further areas of investigation.

(Appendices B and C, respectively, present the list of persons interviewed and the bibliography used. Appendix D indicates the sites visited, their locations, and general project characteristics.)

1.3.3 Key Points

Two key points affected the conduct of this evaluation. The project officer for Project 044 was out of the country during the team's visit, thereby requiring various team members to interpret much project file data without the benefit of the project officer's intimate, day-to-day knowledge of the project. Mission staff in the General Development and Program Divisions and the General Development Officer were extremely cooperative in their interpretive efforts. The sheer mass of file data reviewed, however, in a filing system that was neither complete nor well maintained may have caused some minor misinterpretations to occur. Nevertheless, the team is confident that any such discrepancies will be corrected in the final draft.

Further, as a result of expected cuts in program budgets prompted by the Gramm-Rudman Deficit Reduction Act, the future year obligation levels for Project 044 were revised by the mission during the evaluation. Thus, the recommendations presented in Chapter 6 reflect the revised budget levels. This action was taken so that the recommendations presented herein would be logical within the framework of actual project budget conditions and allow a realistic

picture to be presented. The Mission would thus be presented with implementable recommendations that represented the "art of the possible," rather than recommendations reflective of a rhetorical situation.

1.4 Socioeconomic, Cultural, and Institutional Considerations

The Yemen Arab Republic is a country of diversification in its geographic landscape, socioeconomic settings, and institutions. Although the country has a traditional culture, significant regional differences are apparent in the role of tribal politics, the hierarchy of the social structure's male and female roles, and the pace of economic change and infrastructure development. Past interventions by AID, other donors, and international lending agencies have repeatedly shown that a principal ingredient to successful project implementation in the YAR is to design projects recognizing regional differences and to frame the project objectives to fit the sociocultural setting.

The following subsection will present a brief overview of various social, cultural, economic, and institutional factors affecting the implementation of Project 044.

1.4.1 Geographic Setting

The Yemen Arab Republic covers approximately 75,000 square miles and has an estimated population, given by the just-completed 1986 census, of 8.1 million (excluding emigrants) with an annual growth rate of approximately 2 percent since 1975. Stretching 300 miles east-to-west and 400 miles north-to-south, Yemen's topography may be divided roughly into three regions: the northern and central highlands, the eastern hills, and the Tihama coastal plain along the Red Sea (see Figure 1-1). The highlands and the innumerable valleys are fertile, receiving irregular rainfall. For centuries the Yemen plateaus and valleys have been terraced in order to use and re-use water many times before it finally reaches the desert. The winter climate in the highlands is moderately cool and dry, and in the summer rainy with warm temperatures. The lowlands (Tihama) are semidesert, with a hot, humid climate throughout the year.

1.4.2 Socioeconomic Considerations

The population is distributed unevenly between rural and urban dwellers. The recently completed census indicates a sharp rise in urbanization, with the five largest cities accounting for approximately 11 percent of the total population, approximately double the level (6 percent in these cities) given by the 1975 census. Despite the sharp rise in urbanization, the population is overwhelmingly rural (defined as population centers with under 2,000 persons), and the society in general agrarian-based.

On the basis of the 1986 preliminary census values, approximately 75 percent to 80 percent of the population is rural, spread over 30,000 settlements organized around 15,000 villages. The rural population can be characterized according to its geographic location between highland and lowland settlers. The people in the mountains are tribal and known to be austere, individualistic, and aggressive. Yemeni tribes are regarded as very conservative, and

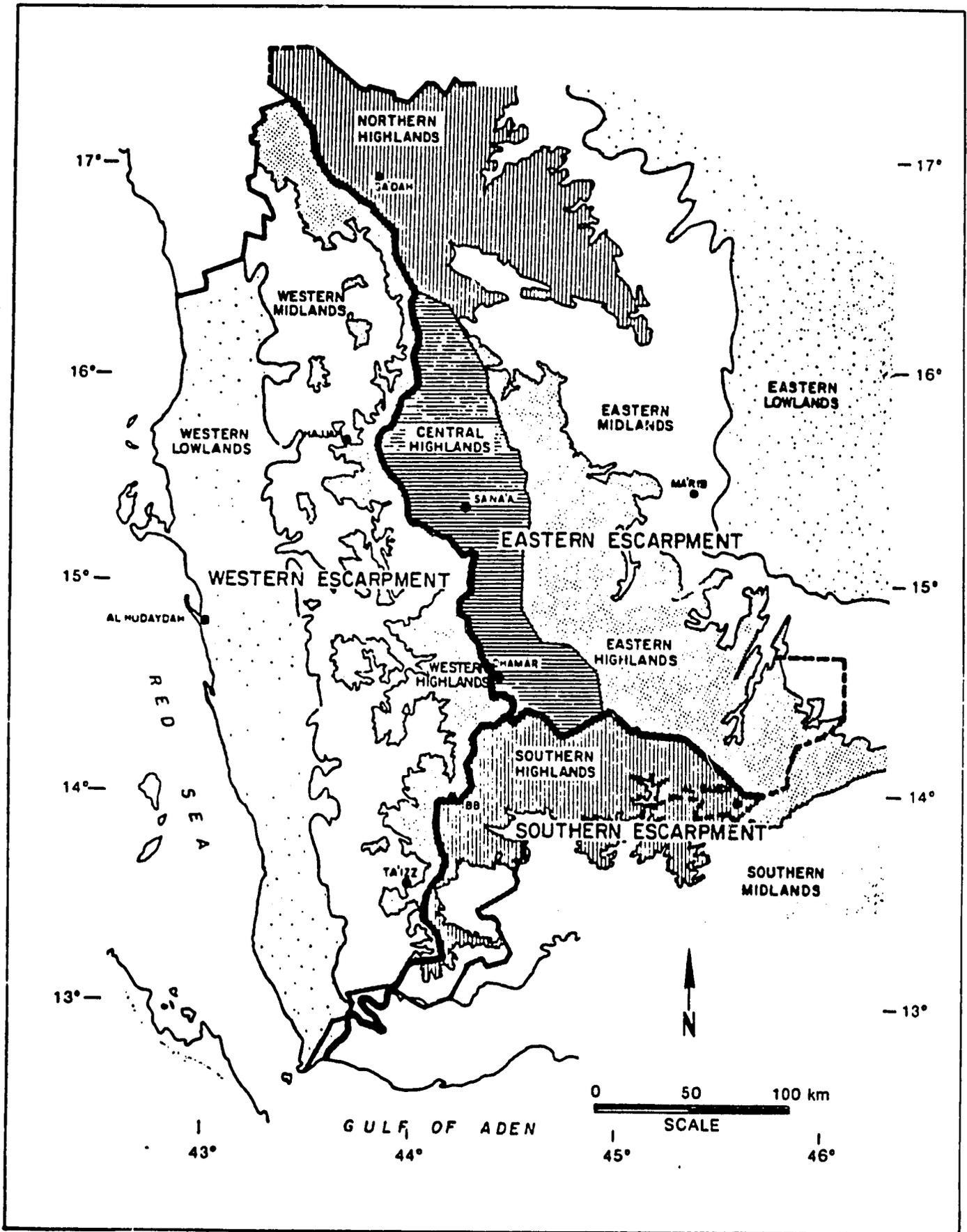


Figure 1-1. YAR-Major Geographic Divisions

any attempt to introduce administrative or socioeconomic innovations is regarded with suspicion. Practically speaking, each tribe is a small nation with its own boundaries, grazing grounds, wells, market towns, allegiances, and enemies. The economy of the highlands is based almost solely on agriculture. The people of the lowlands are more inclined toward commerce and manufacturing.

In addition to agriculture, the rural economy continues to be driven by remittances from Yemenis working abroad. The estimated number of such workers, and the total in remittances, has been a question of debate for several years. Little doubt exists, however, that a large percentage -- perhaps as high as 25 percent of the male working force -- is involved, and remittances have provided relative material affluence to hundreds of thousands of village-based families.

Further, remittances, either directly or through stimulating the development of cash crops, have caused many small farmers to have sufficient capital for investment. This is a unique aspect of the YAR's rural areas, especially when compared with other developing countries. The availability of cash in the rural areas has greatly stimulated local construction of rural infrastructure, including secondary roads, schools, and water supply systems.

The local provision of infrastructure is an example of the availability of services in Yemen's growing private sector. The rural populace, in the past always ready to provide for itself, often has the means to hire private contractors rather than wait for the government to act.

1.4.3 Cultural and Institutional Considerations

Project 044 has been implemented nationwide, but projects have been concentrated in the Tihama (western lowlands) and the northern, central, and southern highlands regions from Khamir in the north to Turbah in the south. These areas are composed of traditional, local, and regional organizational structures, which tend to tie the heterogeneous environment of the rural population to the Central Government.

The traditional household unit is the extended family. Even with exposure to other lifestyles, and with the great mobility in the male working class, extended family units continue to be the basic unit in rural areas. It is not uncommon to find men of all ages who have returned to their villages after working or studying abroad. Many such men were introduced to various team members during the course of the field work for this evaluation.

The kinship within villages is also exhibited by the cooperative ethic. All elements of village society pull together to aid the village as a whole, or village members in need. Such cooperative activity can be traced to both Islamic and tribal customary law and was evident during the execution of Project 044 in which hundreds of villagers provided thousands of person-hours of construction services.

Villages form the basic administrative units in YARG. Nahiyas, or districts, are regional areas which are comprised of clusters of villages. YARG's 168 nahiyas are combined into 40 sub-governorates (Quada'as), which are

subdivisions of the 11 governorates (Mouhafazas). Principal towns are governorate centers after which the governorates, themselves, are named. Places of more than 2,000 in population are considered urban and number approximately 106, including the governorate centers. Figures 1-2 and 1-3, respectively, indicate the principal cities and rough outlines of the governorates.

The nahiyas are "governed" by a traditional hierarchy upon which a more modern form of organization has been superimposed. The implementation of Project 044 was through these local structures, which are described in the paragraphs that follow:

The Shaykh, traditionally appointed by the region and recognized by the government, oversees all activities in the villages. The shaykh, as the shaykhdom, is inherited and is usually one of the most affluent people in the region in terms of land, family reputation, and prestige. He is the final decision-maker, but his decision can be appealed by the people to the government. But, tribal law, "al-gabialah," is usually the most effective and acceptable way the tribes attempt to resolve their problems and conflicts.

The akel is the shaykh's representative in a village. He is appointed by the people, based upon a strong background in religious knowledge and a thorough understanding of the region's customs and by-laws.

The formal organization is represented by LCCDs and their umbrella organization, the FLCCD. (Prior to 1985 these organizations were identified as Local Development Authorities [LDAs] and the Confederation of Yemeni Development Associations [CYDAs]. The former names are still referred to by most villagers and government officials.)

Some 213 local cooperative councils for development exist, throughout almost every nahiya. These councils are self-help organizations, comprised since 1985 of elected members. They organize many of the public works activities for cities and villages, including road construction and maintenance, water supply, and school construction. LCCDs develop three-year plans for priority projects and forward these for approval by the governor. Upon approval by the governor, the plans (projects) are forwarded to the FLCCD, who as the coordinating body for all LCCDs and, in some cases, recommends which government agency they should approach for help. In the case of rural water supply, the LCCDs invariably approach RWSD.

Every village is represented by one LCCD member, who is elected by the villagers for a six-year term. The LCCD responsibilities are: to identify village needs, to discuss these needs with the villagers and the shaykh, and to prepare proposals to submit to the concerned authority within the government by way of the LCCD of the nahiya. When a request for a project has been approved by the government, the LCCD collects money from the villagers to pay their agreed-upon contribution to the project.

The LCCD usually follows up the matter with side pressure often exerted by the shaykhs. This pressure is often the prime mover in obtaining project approval, especially in areas where LCCDs are relatively weak. The team was advised that the strongest LCCDs were in the Tihama region. The LCCD members there were

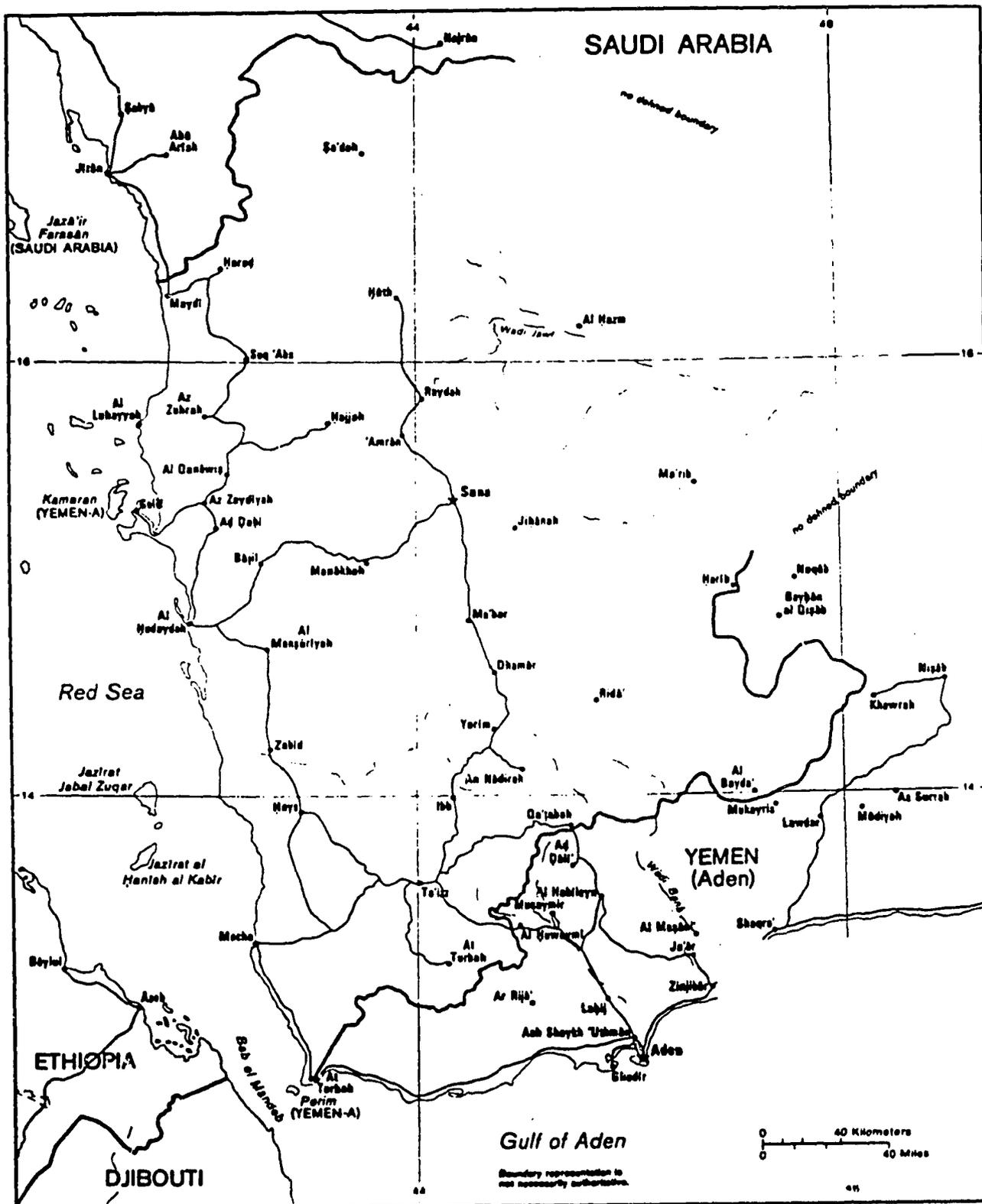


Figure 1-2. YAR-Major Cities and Roads

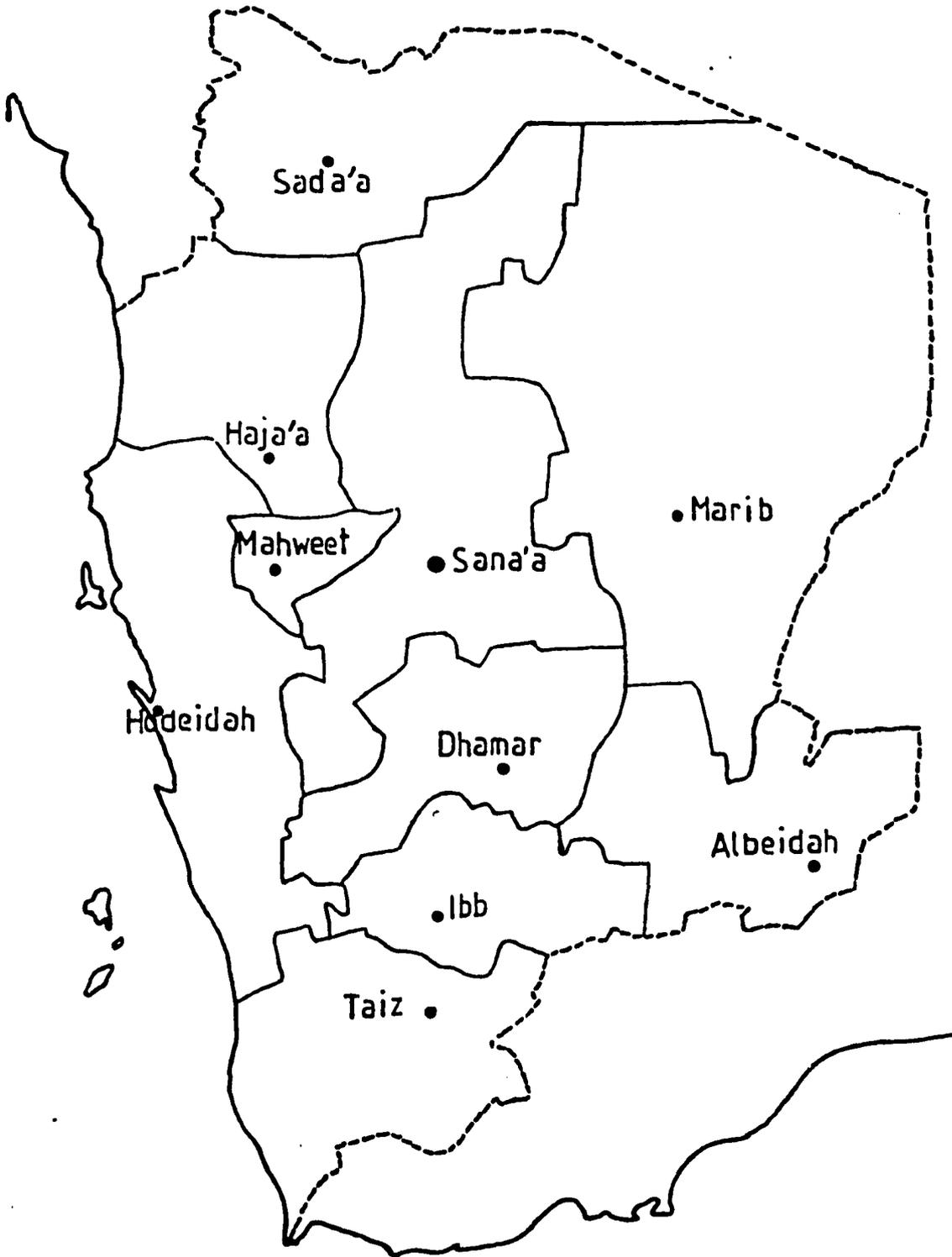


Figure 1-3. YAR-General Outline of Governorates

said to be younger and more progressive than those in the highland areas. This may be due to the weaker tribal affiliations in the area.

1.5 Organization of the Report

Following this introductory chapter, the report contains five chapters and seven appendices, as follows:

Chapter 2 presents an overview of the rural water supply and sanitation sector. It includes material on the status of the sector, estimates of required future investments, and a review of the institutions as well as past and projected assistance for the sector.

Chapter 3 provides a detailed status report on all elements of Project 044.

Chapter 4 sets forth the findings of the evaluation. In effect, this chapter reviews elements of Chapter 3, presenting what has occurred versus what has not, and the effect of the project on its beneficiaries.

Chapter 5 discusses project benefits and impacts.

Chapter 6 lists the team's conclusions and recommendations.

The Appendices are as follows:

- A. Scope of Work
- B. List of Persons Interviewed
- C. Bibliography
- D. Sites Visited and Cost Data
- E. Approximate Costs for Various Coverage Levels and Past Donor Interventions
- F. Input/Output Analyses and Data on Grantee Performance
- G. Detailed Discussion of Proposed NTF Activities.

Chapter 2

OVERVIEW OF THE RURAL WATER SUPPLY AND SANITATION SECTOR

2.1 Introduction

This section discusses the needs of the rural water supply and sanitation sector, vis à vis the sector as a whole, and YARG's national development objectives. The narrative and analysis are intended to develop an understanding of the magnitude of the problems in the rural sector in terms of short- and long-term investments in dollar and human resources, compared to various levels of rural sector coverage. Conclusions from the presentation will indicate the relative importance of various types of interventions in the sector, including those by YARG agencies, USAID, and other donors.

2.2 Rural Water Supply and Sanitation Sector

2.2.1 Overview

Village water systems in Yemen are provided by several ministries. The Ministry of Public Works (MPW), through its Rural Water System Department (RWSD), is YARG's primary agency for such service provision and has, by far, provided the largest number of systems of any governmental agency. The Ministry of Agriculture and Fisheries (MAF), through several integrated rural development agencies (the Tihama Development Administration [TDA], the Southern Uplands Regional Development Project [SURDP] and the Central Highlands Development Authority [CHDA]), has provided approximately 420 rural water systems of various types throughout their jurisdictional areas. The Ministry of Health (MOH) and the Environmental Health Unit in the Ministry of Housing and Municipalities also have provided, or are in the process of implementing, several small schemes.

Several key points are worth noting prior to the discussion presented in the following several subsections:

- RWSD is the prime YARG agency responsible for rural water supply. Indications are that no large governmental interventions in rural water supply will occur outside RWSD's aegis.
- The World Bank has been the prime mover in creating various integrated rural development agencies and plans to continue its support of their activities. In late August and early September of 1986, conversations in Washington, D.C., among several Bank officials responsible for programs in Yemeni rural and agricultural development, and the team leader for this evaluation, indicated that future World Bank interventions in agriculture probably will not include provision of village water systems. The concentration will be almost exclusively devoted to increasing agricultural productivity.

This change in World Bank policy is significant because its former sponsorship provided substantial input to the rural sector. (See Section 2.4.6.) Rural water supply interventions by other international lending agencies and

bilaterals linked primarily with health sector or rural development projects will probably continue, but will be of modest size.

The definition of a particular "rural water system" varies widely, depending upon the agency providing the system. RWSD's aim is to provide "total systems," which connotes a level of service providing potable water close to people's homes. Thus, the RWSD definition of total system can be generalized as one in which a safe drinking water source is pumped to a storage tank at sufficient elevation to distribute the water through a distribution system to a point close to people's homes (through yard taps, ground tanks in a compound or adjacent to homes, or to roof tanks). To reach the objective of total systems, RWSD often sponsors portions of projects, usually the most expensive portions, such as borehole development or installation of pumps and motors on boreholes or springs or cisterns developed by RWSD or others. In almost every case, however, the villagers provide the distribution system and individual connections. Thus, while its aim is "total systems," RWSD rarely furnishes an entire system as part of a single project. Exceptions exist, however, especially when donor aid provides full turnkey services (as is the case under programs sponsored by the Governments of Japan and the Netherlands) or in the earthquake redevelopment areas. Other notable exceptions have been RWSD projects serving clusters of villages. One such project, Manakha, was dedicated September 26, 1986. The service area covered a population of 7,500 in several villages and the water source [two wells] was pumped up 1,100 meters with four stage booster pumps through a 6 km transmission main. This project was financed completely with RWSD funds and took over four years to implement.

Villagers are always responsible for distributing water supply throughout the villages and for individual household connections. Often villages, in cooperation with LCCDs, will develop additional portions of the overall system, that is, purchase a pump and motor, sometimes to be installed by RWSD, sometimes by a private contractor (that is, mechanic) or provision of a borehole for which RWSD provides a pump and motor.

Villagers are willing to pay substantial portions of the cost of water systems. This is born out in Project 044 in which roughly one-third of the total construction costs were provided by the villagers, often cooperating with LCCDs, and in the village water supply components of the SURDP and CHDA projects. In these projects, domestic water supply was provided to points either in or close to villages. The villagers themselves sponsored projects, often in cooperation with LCCDs, to bring the water to points adjacent to their homes. In one village south of Taiz, visited as part of this evaluation, the villagers in conjunction with the LCCD improved the track providing access to the village (5 to 6 km) and paid for roof tanks and direct connections to almost every home. Costs for these facilities were estimated at approximately YR1,200 per household and did not include the contribution made to the system provided under Project 044. These types of costs, although not provided to the same order of magnitude for every Project 044 system, have been commonplace.

Private-sector contractors can provide construction services, mainly borehole and pipeline installation services and tank construction. All of the SURDP and CHDA water supply elements were done by private contractors, including the large irrigation components. RWSD uses private-sector contractor services in many of its projects (sometimes furnishing the contractors with various donor-

provided commodities). RWSD's Tender Manager indicated that the volume of private-sector work totaled approximately YR100 million over the last three years.

The last point concerns the rural sanitation sector. In fact, this sector does not appear to exist in any formal manner. Later subsections will discuss rural sanitation needs. The point is made here so that the reason for a lack of text on this subsector is clear.

2.2.2 Completed Projects and Coverage

Accurate data defining the extent to which the rural population is served by water supply systems are unavailable. The several agencies involved -- RWSD, MAF, and the LCCDs (who, prior to 1984, apparently received direct grants by way of CYDA, now known as FLCCD) -- do not have a common database, and individual contacts with these agencies produced data which can be described, at best, as rough estimates.

RWSD's data are presented in Table 2-1 on the following page. Data from MAF indicate that approximately 420 village systems, mostly comprised of wells and standposts, with few "complete" systems (that is, including storage and distribution) were installed in this same period, serving approximately 600,000 villagers at an expenditure of approximately YR125 million (1986 level). FLCCD (acting as CYDA) indicated that some 930 water projects were completed during 1982 through 1984, for which it donated about half of the estimated YR200 million expenditures. CYDA estimated that these schemes served 1.8 million villagers, a level which seems extremely high. In addition, CYDA data for the First FYP indicate that the "government contributed" to approximately 1,300 "water schemes." CYDA's numbers include "improvements" as projects.

2.2.3 Requirements for Additional Levels of Coverage

A detailed discussion and computations to support the data presented in the following subsection is included in Appendix E.

On the basis of the preliminary results of the 1986 census, Yemen's in-country population is estimated at approximately 8.1 million. An approximate analysis made as part of this evaluation (see Appendix E) indicates that roughly 75 percent of this total (6.1 million) can be considered as Yemen's rural population (that is, residing in villages of less than 2,000 persons). The range of 1.9 million to 2.3 million people served through government-aided rural water supply systems (rough estimate of Subsection 2.2.2) thus represents approximately 30 percent to 40 percent of the in-country rural population.

Investment requirements to provide full coverage to the existing rural population (6.1 million) are roughly estimated at YR4.6 billion to YR5.0 billion. If RWSD set a target of 50 percent coverage over the Third FYP, the investment requirements would be approximately 1.1 billion to 1.6 billion. This value is more reasonable than to the almost YR5 billion level mentioned above. It still, however, represents a level of expenditure almost equal in magnitude to the roughly estimated totals (YR1.6 billion) spent in the entire rural water sector by government and local sources (see Subsection 2.2.2).

Table 2-1
Projects Completed by Rural Water Supply Department, 1976 to 1985

Year	Number of Projects Completed	Number of Wells Drilled	Number of Pumps Installed	Popula- tion Served	Percent of Population Served (Cumulative) ¹	Investment YR (millions)
First Five-Year Plan					%	
1976-77	38	20	38	158,000	7.0	19.0
1977-78	55	30	61	102,000	8.4	24.0
1978-79	114	77	94	152,000	10.4	71.0
1979-80	156	47	28	155,000	12.5	42.0
1980-81	453	303	290	209,000	15.4	131.0
Subtotal, 1976 to 1981	816	477	511	776,000	15.4	287.0
Second Five-Year Plan						
1981-82	50	129	117	120,000	15.3	83.0
1982-83	48	141	117	178,000	17.3	113.0
1983-84	40	115	362	83,000	18.2	90.0
1984-85	32	244	86	53,000	18.8	60.0
1985, July to December	17	96	69	42,000	19.5	11.0
Subtotal, 1981 to December 1985	187	725	751	476,000	19.5	357.0
Total, July 1976 to end 1985	1,003	1,202	1,262	1,252,000	19.5	643.0
Bilateral Projects						
1976 to 1985	143	45	50	244,000	2.6	124.0
Total Projects by RWSD 1976 to 1985	1,146	1,247	1,312	1,496,000	22.1	768.0

¹ Estimated population in 1976 was 6.5 million. Estimated population served in 1976 was 305,000 or 4.7% of total population. Population growth from 1976 based on assumed annual increase of 2.5% per year.

Source: Rural Water Supply Department, Ministry of Public Works; data provided to CPO for use by consultants.

The investment level (that is, capital cost) is only part of the problem. The number of systems to be installed to reach the 50 percent level of coverage would be approximately 240 annually (average village size assumed 750 to 1,000 persons). This level appears too great for RWSD's absorptive capacity considering their low staffing levels, competition from other sectors, and YARG's budget constraints (see Subsection 2.2.4).

Obviously, much double and triple counting exists in the foregoing compilation. (This is due to the nature of how each agency tallies a completed project and its served population. For a project in which an RWSD borehole replaced a TDA hand-dug well and which was then fitted with a LCCD provided pump and motor, and completed with villager-installed pipelines, the statistics could indicate four projects, each benefiting the same population. Thus, the actual population served and number of "total projects" could be overstated by 300 percent.)

If, however, the RWSD's value of approximately YR800 million for expenditures in the First and Second FYPs are accepted, and MAF, CYDA, and local villager and LCCD contributions are assumed at an additional YR800 million, at unit costs of YR800 to 1,000 per capita, it could be assumed that approximately 1.6 million to 2.0 million villagers received water supply service since 1976. If approximately 300,000 were served in 1976 (as per RWSD), then the 1986 (crudely) estimated rural population served by village water systems would be approximately 1.9 million to 2.3 million.

2.2.4 Rural Sanitation Sector

A basic objective of improved water supplies is to enhance people's health. Improvement of water supplies by themselves, however, cannot produce public health benefits unless accompanied by improved sanitation and personal hygiene. Such matters, which should be the responsibility of the Ministry of Health (MOH), have largely been ignored in YAR. Rural areas have never enjoyed the benefit of any substantial governmental program directed at either improved sanitation or health education. Donors have rarely sponsored any specific programs in this regard, and the rural sanitation sector has hardly been mentioned in the Second FYP.

Concern on the local level, down to the individual villages themselves, have hardly broached the subject. The only mention of needed facilities the evaluation team came across was for the provision of "hamams" (pour-flush latrines and showers) located, for men's use, near mosques. Some women interviewed recognized the need for better information, but no urgency in their statements was perceived.

Most highland homes are equipped with the classic Yemeni toilet. Final disposal of solids is usually by hand and consists of disposal in fields or in the making of "paddies" for use as fuel. In the Tihama, such indoor sanitation facilities are said to rarely exist, and people's requirements are usually met by using convenient places outside their compounds. The general sanitary conditions of all villages visited was poor. There was, however, no indication given the team that these conditions were anything but normal or that they should be improved.

Officials of MOH did indicate their concern on these matters and claimed they were interested in working with RWS in their rural water program. The feeling expressed was that they were never approached on the matter. There was no indication, however, that the MOH was ready to take any initiative in this matter, as determined by the lack of any such programs included in the second FYP and the preliminary planning for the third FYP.

Needs in the sector have been estimated by the UNDP-sponsored consultant to CPO at approximately YR1 billion to provide 30 percent of the rural population with rudimentary sanitary facilities. This enormous capital cost represents only a part of the problem if the institutional and logistical problems are considered. The rural water supply needs are great; mechanisms are in place, however, to provide facilities through governmental and local initiatives. It appears almost impossible to conceive of YARG's mounting an effort that can dispense almost one billion rials for programs to benefit hundreds of thousands of families, starting from ground zero, especially when the competing needs of other sectors are considered.

2.2.5 YARG Planning - Second and Third Five-Year Plans

The macroeconomic environments in which the Second and Third Five-Year Plans were and will be implemented are considerably different. During the early years of the Second Five-Year Plan, Yemen enjoyed an economic boom fueled by high levels of remittances from Yemenis working abroad and by expanding governmental expenditures, financed by infusions of Arab donor aid and growing customs revenue (reflecting the rapid rise in imports). The softening in international oil prices that commenced in 1981 and which accelerated rapidly in late 1985 and 1986 means that remittance income may no longer be the major source of growth for the Yemeni economy. Gross Domestic Product (GDP) growth rates have fallen from an average of some 7 percent annually to an estimated 3.5 percent in 1983 and 2.4 percent in 1984. Such lower growth levels are likely to continue over the next several years, as the economy adjusts to the contracting effects of declining remittance income and lessened reliance on government deficit financing. While recent oil discoveries are being exploited, the initial volume of oil exports is likely to be low (in the 100,000 barrels per day range). With oil prices remaining depressed, oil exports, at best scheduled to begin in 1988, may only make up for declines in income from worker's remittances and Arab donor aid.

Growing oil exports, however, will allow YARG to gain a new source of revenue to finance its expenditures. In the interim, however, government budgets will continue to be tight, as the government attempts to curtail reliance on deficit financing. Progress on this front has been positive, but has been slow to take hold.

Despite this progress, reliance on deficit financing continues to be excessive, thereby resulting in large monetary infusions and exerting considerable pressure on the exchange rate. Under these circumstances, over the medium term, the government has little choice but to continue to bring expenditure levels down. Arab donor aid has, of course decreased as Saudi Arabia and the Gulf States feel the pinch of declining oil revenues. Other donors are not in a position to make up the shortfalls left by declining Arab donor aid. In sum, the government's ability to dramatically increase funding for existing or new

programs is, over the medium term, extremely limited. Thus, programs, such as rural water supply, which do not enjoy a high priority among government planners, will increasingly be forced to find local or private sources of finance if their pace of implementation is to be either maintained or quickened.

2.2.6 Conclusion

On the basis of the discussion of the subsections above, the following are the evaluation team's conclusions concerning the rural water supply and sanitation sector:

- YARG budget constraints and the large needs of the sector indicate that rapid escalation in the number of villagers covered by RWSD programs may not occur over the third FYP (see further discussion in Section 2.4).
- Rural sanitation programs are extremely limited and may be so for the foreseeable future, as there is a strong indication that this subsector enjoys even less of a priority in government circles than the rural water supply program.
- Evidence indicates that the local efforts to construct water systems using the private-sector construction industry are greatest when "seed money" is provided by governmental programs. Villagers and LCCDs are able and willing to pay substantial amounts for water systems. The overall need of the sector, however, could easily outstrip the combined local and government resources.
- For greater coverage to occur, new directions in producing water systems may be necessary. Efforts directed toward this end are required by RWSD working in conjunction with the villages LCCDs and the private-sector construction industry.

2.3 Sector Institutions

The only significant YARG institution in the rural water supply sector is the RWSD. Its efforts, complemented by those of the LCCDs and villages, will comprise virtually all future sector activity. This section reviews RWSD's organization and activities as well as local institutions. It also sets forth conclusions on the sector institutions.

2.3.1 Rural Water Supply Department - Ministry of Public Works

General

The Rural Water Supply Department (RWSD) was established in the Ministry of Public Works in 1972. Initially, it was charged with the responsibility for implementing water supply projects throughout the nation, except for the cities of Sana'a, Taiz, and Hodeidah. Over the years, NWSA has assumed responsibility for more and more of the larger urban areas, thereby leaving the RWSD with prime responsibility for providing service to villages with

populations of under 2,000. Figure 2-1, on the following page, presents RWSD's organization and reflects the changes made in mid-1986.

RWSD's responsibilities include the design, construction, and inspection of village water supply systems. Its service population is thus comprised of approximately 75 percent of YARG's population (see Subsection 2.2.3 and Appendix E) spread over some 15,000 villages. Its staff numbers approximately 145 people (including expatriates and employees seconded to Project 044), and its activities are directed almost completely from its offices within the Ministry of Public Works in Sana'a.

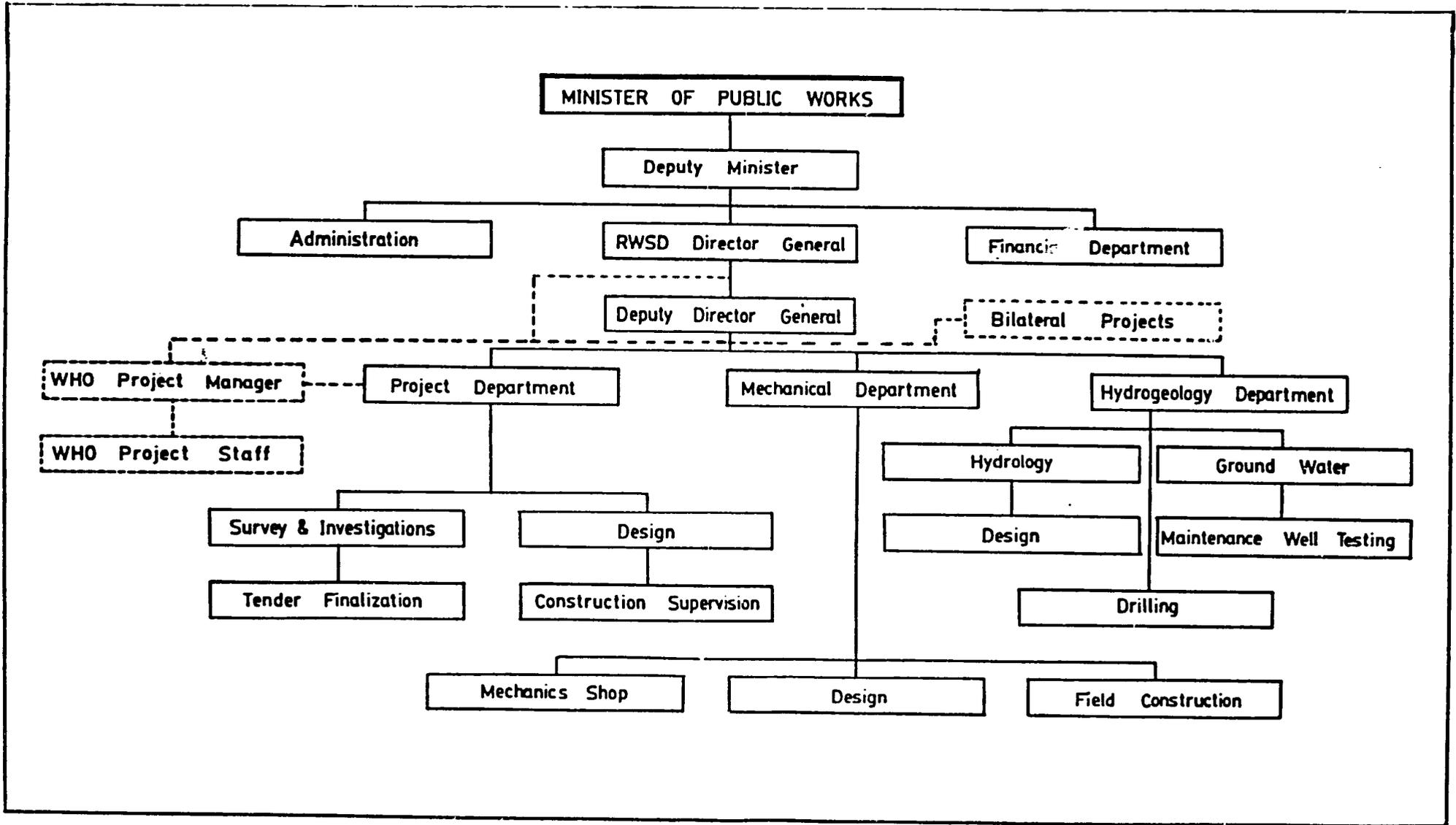
RWSD's mode of operation is that of a pure development agency, providing water supply infrastructure for villages, almost always in conjunction with local initiatives, including cost contributions. RWSD no longer drills wells using its own staff and equipment (this feature was prevalent through the 1970s when AID furnished RWSD with drill rigs) but relies on tenders with local contractors for all construction services except those associated with Project 044. The department's role on projects ordinarily ends with the completion of construction, because operations and maintenance of the village water systems are solely the responsibility of the villages.

RWSD has made tremendous organizational strides over the past several years. Its staff has more than doubled since 1982, and the number of villages receiving water supply from RWSD projects over the past few years is estimated at approximately two million (see Subsection 2.2.3). The Department is, however, operating under several serious constraints, including a lack of autonomy (it is part of the MPW) and extreme understaffing (NWSA serving Yemen's urban areas has almost 1,200 employees and is organized as an autonomous agency) and decreasing levels of donor aid and national budget allocations. Further, its annual programs are almost ad hoc in nature, with no master plan to guide its operations. In fact, the existing database for rural water supply facilities is really too poor to act as the basis for such planning.

RWSD Operating Groups

RWSD's operations are exclusively related to building systems, and the Department measures its success by the number of systems constructed and people served. No overall plan of operations is in force, and few formal procedures exist for coordinating activities among its working groups. Thus, RWSD appears to operate on a day-to-day basis rather than through formal management systems. Projects are assigned as they are approved by the General Director and within RWSD's various departments; major concerns are for the projects being worked on at the moment.

The Projects Department represents RWSD's largest and most active group. Departmental staff number 30 people, including 5 members of a WHO-sponsored team, including 3 engineers (2 of whom are volunteers), 2 technicians, and 3 NTF personnel (all engineers) and one engineer furnished through West German Technical Assistance working in the Office of Planning and Management (OPM, see below). The Department's Yemeni staff is comprised of 9 engineers, including the Director, 8 surveyors, 1 technician, and 3 other nonprofessional personnel.



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Figure 2-1. Organization Chart-Rural Water Supply Department,
Ministry of Public Works

Projects are assigned to various engineers for survey and design, and these engineers, for the most part, follow the projects through implementation. All designs are said to be verified by the WHO Chief Engineer prior to the preparation of tender documents. The WHO group is often assigned projects directly (ordinarily including those which include commodities provided by various United Nations agencies -- see Section 2.4).

The WHO engineer expressed deep concern over the quality of RWSD's technical work and that of its inspection of construction. (Engineers provide only part-time inspection on projects constructed by private contractors.) No mechanism was in place, however, for the Chief Engineer to implement in-house instructional or training programs, nor did he appear anxious to implement them.

The Office of Planning and Management (OPM) was established early by NTF as a requirement of Project 044. No RWSD or MPW documentation exists that formally establishes the OPM as part of RWSD. Thus, it could be said that the OPM has no official status. The OPM is informally divided into a design and survey subgroup and a management planning subgroup. The engineer provided by the West German Government's technical assistance program appears to have become a member of the OPM by default. It was stated that the Director General or other senior RWSD Managers did not provide this engineer with any official status, so that in effect this engineer assigned himself to NTF's group.

The OPM, as yet, has done little to implement its institutional development role as provided for in the NTF proposal. NTF's task, however, has been made difficult by the almost total lack of recognition shown this group by RWSD's management. Further, through discussions with the NTF employees in OPM, it appears there may be some confusion in their own minds as to what elements or issues concerning institutional development they should be concentrating on.

An excellent design manual has been prepared by the OPM group's structural engineer. It is now in RWSD's review process. The manual was prepared in an attempt to standardize a set of design criteria for RWSD's use. The manual is being used by several RWSD staff engineers but, as yet, the WHO group leader has refused to even provide comments on the draft. Because there has been little dialogue between the WHO team leader and NTF employees in OPM, the lack of comment is not surprising. The less-than-smooth relationship between these groups may be a manifestation of a "turf" problem on the part of the WHO engineer.

The Hydrogeology Department has 17 RWSD employees and 2 OPEX geologists. Of the 17 RWSD employees, 9 have the title of engineer/geologist, but few have four-year degrees. Other staff include six technicians and four administrative personnel. This group's responsibilities include determining borehole locations and supervising private-sector drillers in the installation of these wells. Like other RWSD groups, the Hydrogeology Department operates in an informal manner and exhibits poor record-keeping practices. Well tests are often perfunctory and, if run at all, operate for 12 hours rather than the standard 72 hours.

During the site visits, the evaluation team examined three sites with boreholes solely financed by RWSD. For all of these sites, NTF's well test records indicated that the wells were drilled to much shallower depths than specified in the tender documents (in one case 120 meters instead of 240, and

the two others to only about two-thirds of the specified 100- and 150-meter depth). In all cases, the wells were cased to only a few meters of depth rather than the entire length as specified. The 240-meter deep well referred to above actually collapsed, thereby requiring the villagers, because RWSD refused any further responsibility, to get a new well installed adjacent to the existing collapsed borehole. These examples of "horror stories" tend to verify the many indications given to the team that the quality of this group's inspection services is, at best, mediocre.

The Mechanical Department has 17 personnel, including one engineer from NTF and another funded by the UNCDF. The other 15 employees include two engineers, 10 mechanics or technicians, and three administrative people. This department's responsibilities include the preparation of specifications for purchase of pumps and motors and the supervision of their installation. (The supervision activity also includes providing this service for donor-provided commodities.) In addition, the mechanical shop has a variety of responsibilities, but this group is actually located at NTF's compound in Hasaba and is also listed on the NTF organization chart.

The Office of Bilateral Affairs coordinates donor aid to RWSD. The staffing chart indicates that 13 people are in this department. Only the director of this group, and one or two others, appeared to be specifically engaged in functions concerning bilateral aid. Most of the listed employees are funded by UNICEF, UNDP, or UNCDF and appear to be involved with tracking the projects that these agencies are supporting. No apparent activity was directed at coordinating aid. Rather, obtaining aid from various sources was the prominent activity.

Characteristics of RWSD Projects

RWSD's program is comprised of a series of decision points relating to project selection, implementation, and financing. Neither an overall master plan nor a development policy to guide RWSD's activities exists. As such, RWSD's program can be classified as a reaction to local initiatives and foreign donor activity superimposed upon the available budget provided by the Central Government. Local initiatives refer to approaches by LCCDs, individuals, or combinations of prominent people.

Projects implemented by RWSD may have various characteristics, as follows:

- (a) Boreholes (cased wells) can be provided new or as improvements (deepening) to hand-dug wells.
- (b) Cisterns or springs can either be improved or developed new.
- (c) Pumps and motors can be furnished to either existing, newly drilled, or improved wells.
- (d) Storage facilities can be provided as additions to projects described in (a) through (c) above.
- (e) Complete systems can be provided, including provision of a discrete source of supply (well, cistern, or spring), storage facilities, transmission, and distribution pipelines.

For the most part, RWSD provides portions of projects, rather than the entire system as described in (e) above. The actual type components of projects implemented depends upon the level of RWSD budget provided by the Central Government, the amount of local contribution, and available donor assistance. Thus, the characteristics of a particular project take the form of a matching process in which RWSD examines the project requirements and decides which elements fit its available budget or commodities, as supplemented by local-level contributions.

For instance, Project 044 protocol calls for systems to be constructed where an adequate source has already been developed. Storage, transmission, and distribution facilities are always constructed, and pumps and motors are sometimes provided. Thus, RWSD could provide the borehole or pump and motor, or provide these facilities in combination with LCCD or village contributions, and then assign the project to NTF for completion under Project 044. Other projects could be completed with RWSD using commodities provided by donors, or in combination with commodities provided by RWSD, financed by way of central governmental funds, all constructed by private contractors. Thus, RWSD's participation level in a project are completed by almost playing a matching game in terms of resources available with the requirements of particular projects.

RWSD Project Selection

RWSD's selection process for projects to be implemented is actually based upon a political reaction to local initiatives; the most formal form of local initiative is encompassed in the activities of the LCCDs as described in previous sections

The formal process described above is only part of the picture. Often shaykhs or groups of prominent individuals or families apply intensive pressure on RWSD directly. This action almost always occurs when LCCDs are relatively weak. Even in areas where LCCDs are relatively active, however, the lobbying efforts can be intensive. This is not a negative element of RWSD's program. Rather, the process represents a prime example of how the social fabric of Yemen's rural areas allows local organizations to exert their political clout on RWSD. Examples of such lobbying efforts are readily visible on a daily basis at the MPW's central office in Sana'a, as many such representatives can be found approaching RWSD's Director General in his office or attempting the approach through other senior people in RWSD. The scene is often vociferous and always colorful to expatriates unaccustomed to such activity. The personal style, patience, grace, and homage exhibited by RWSD's Director General in dealing with individual shaykhs or groups is testimony to the seriousness he places in their direct approach and the overall process.

RWSD can react to the approaches described above in one of several ways:

- It can order the project's department to prepare surveys and designs for particular projects.
- It can assign the project for implementation under Project 044.
- It can accept the project in principle, but delay commencing the implementation process.

- It can reject the project, or demand changes in the concept, and negotiate with the LCCD or sponsoring parties to effect a compromise to the original concept.

The last two actions are seldom used by the RWSD. Projects which RWSD considers as low priority, but for political reasons cannot be treated as such outright, are often put into the design and survey process. While the efforts on these projects are theoretically treated as any other effort, they actually become part of RWSD's growing backlog of designed projects. As of September 1986, RWSD had approximately 250 projects (including 55 assigned to NTF) in its backlog.

Accepted projects usually require an agreement of the parties concerned. The agreement process is similar to that used by NTF (see Section 3.2). The important point regarding the agreement is that all parties to the project -- the RWSD, LCCDs and any donors involved -- agree to the specific project elements to be financed by each party.

2.3.2 LCCDs and Villages

The activities of the LCCDs and villages constitute the second most significant institutional activity in the sector. Some would argue they are really the first. Because the activities of these groups have been heretofore discussed, it is not necessary to go into further detail. Some key points, however, are worth summarizing:

- The combined actions of LCCDs and villages represent an active and, in many cases, aggressive local effort to provide a rural infrastructure.
- The rural water sector has benefited from these efforts and will continue to do so especially if local contributions toward rural water projects are increased.
- The LCCD/village activities concerning rural water supply has often resorted to total reliance on the private sector to construct systems that are paid for locally. If RWSD can provide the technical resources necessary in terms of design and construction inspection services, and perhaps some seed money for a portion of the required commodities, many villages (by way of LCCDs) would probably arrange for their own systems to be constructed.

2.3.3 Other Institutions

The Central Planning Organizations and High Water Council are the only other significant agencies affecting the sector. The High Water Council and its lack of activity, and thus low level of effectiveness, has been discussed in many prior reports. The Director General, however, is a member of the Council, and, if the body ever became revitalized, RWSD could affect national water policy.

The CPO affects the sector in terms of resource allocation regarding the Third FYP. This plan has not been completed. Indications are, however, that the rural water supply sector will have the same relative priority as it possessed in the Second FYP. Thus, RWSD's budget will probably not substantially be increased, and the number of additional projects it can implement will be minimal.

2.4 Donor Assistance

Yemen's rural water supply and sanitation sector has benefited from active donor assistance since institutions were created by the government, with specific responsibility for furnishing these services. The assistance and nature of current activities and interventions are discussed in the following subsections. Past interventions are presented in Appendix E.

2.4.1 USAID

USAID assistance to the RWSD was discussed in Section 1. Continuation of Project 044 should provide 17 complete water systems in fiscal 1987.

2.4.2 Agencies Affiliated with the United Nations

The United Nations affiliated agencies have aided the sector since 1968 and include the United Nations Development Program (UNDP), the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the International Bank for Reconstruction and Development (World Bank).

In 1978, a UNDP/WHO-executed project provided institutional support to RWSD in the First Five-Year Plan (1977 through 1981). The grant actually established a technical expert in RWSD by providing a project manager to act as chief engineer, ten United Nations volunteers, two administrative staff, and a UNICEF management engineer. At that time, RWSD's national technical staff numbered approximately 14. Extensions of this grant now provide a five-man group working in RWSD's Planning Department.

The UNDP/WHO/UNICEF group continued its support to the rural water sector in YARG's Second Five-Year Plan (1982 through 1986) by providing a grant of U.S. \$2.8 million to provide supplies and equipment for 52 additional rural systems. By early 1986, 24 of the planned 52 projects had been implemented, with 15 under construction and expected to be completed by the end of 1986. Thirteen projects under this grant have not been started; 11 of the 24 completed projects require major renovations.

Future assistance to RWSD by United Nations Agencies includes the following:

- o UNDP. Through the United Nations Capital Development Fund (UNCDF), approximately U.S. \$5.2 million (approximately YR57 million) will be provided to furnish commodities (pumps and drives, pipe, and other materials and accessories) for 20 new systems and for completion of the 24 systems not yet operational under UNDP's first grant. Most of the 20 new projects will be

concentrated in either one or two southern governorates (RWSD to name sites), and the grant will provide funds for a storage yard and warehouse in Ibb. Technical assistance, as part of UNDP's grant, will provide two engineers, one ground water well-drilling specialist, and a mechanical equipment specialist.

- o UNICEF. This agency will act as the executing agency for ten small projects in the Dhamar area (approximate investment, YR5.5 million). Rather than providing new systems, the grant will be used to rehabilitate existing systems to make them fully operational. In addition, UNICEF will extend a past agreement so that 20 remaining projects from the original total of 50 to be provided in close proximity to UNICEF-financed primary health care centers can be completed.

2.4.3 Government of Saudi Arabia

The Government of Saudi Arabia has indicated its willingness to furnish approximately YR280 million over in the Third FYP. This aid will be for 50 "complete" projects (that is, commodities and construction funds), and the projects will be spread throughout all governorates in Yemen. A stipulation of the grant is that 11 projects, 1 per governorate, will be constructed in calendar year 1987. Most of these projects will be by Yemeni contractors, and others perhaps by expatriate firms, with RWSD and the Saudi Arabian government sharing inspection responsibilities.

2.4.4 Government of Japan

The Government of Japan has agreed to furnish approximately YR60 million in the Third FYP for ten projects. Both Yemeni and Japanese contractors will construct the project, providing complete turnkey service. These projects will be designed to provide water supply to clusters of villages, and thus the population to receive service in each project will be larger than the RWSD's "normal" project.

2.4.5 Government of the Netherlands

The Dutch government has agreed to furnish YR15 million for calendar year 1987 to finance 11 projects throughout YAR. The RWSD will furnish the designs, and Yemeni contractors will construct the systems under Dutch supervision. The Dutch government has indicated that this level of assistance may be continued yearly for three to four years after 1987. While there is no guarantee of the extension, RWSD strongly believes it will occur. Further, through its Volunteer Service, funding for several ONV's (Dutch volunteers) will be furnished RWSD. This technical assistance is now providing some 15 volunteers (5 on Project 044) to the rural water sector, and the indication given RWSD was that this level of volunteers will be continued.

2.4.6 World Bank

The World Bank is expected to have no role in the rural water sector during the Third FYP. Bank assistance to the sector has been substantial over the last 10 to 12 years. Some 420 rural systems have been constructed through integrated rural development programs of several special authorities or units under the MAF. The future programs of these integrated rural development agencies will provide little or no investment in the rural water supply sector as the focus will be the provision of water for irrigation purposes rather than domestic use. Because prior rural water sector involvement by the Bank has been significant, this new policy represents a drastic shift in the World Bank's posture on the sector.

2.4.7 Conclusions

Table 2-2, which follows, summarizes the discussion on donor involvement presented above. As per Table 2-2, a crude estimate of approximately YR100 million annually will be provided to the sector over the Third FYP. Table 2-2 shows donor aid for which definitive commitments (except for the Government of Netherlands) had been made (October 1986). It is possible that the U.N. agencies and Government of Japan or other donors could further commit over the life of the third FYP.

Thus, these investments are estimated to support a program level over the Third FYP, which would provide water supply to an estimated 198,000 additional villagers at 1986 population levels. Comparing these values to those presented in Subsections 2.2.1 and 2.2.2, the following conclusions can be stated:

- RWSD, the LCCDs and villages will be required to construct some 700 systems over the Third FYP (see Subsection 2.2.2) for 50 percent of the projected rural population to be covered.
- The total investment levels required, compared with the total probable investments provided by donors and past trends of RWSD and local sources, indicate a gap so large as to deem the 50 percent coverage target over the Third FYP as unrealistic, unless radical changes are effected in RWSD's organization allowing for a substantial increase in the number of systems constructed in the villages.

Table 2-2

**Projected/Probable Donor Assistance To RWSD
For The Third Five-Year Plan**

Donor	Projected/ Probable Assistance Level ¹	Estimated Average Population Served Per Project ²	Estimated Population Served Third FYP
USAID	17 systems	800	13,000
UNDP	44 systems	800	35,000
UNICEF (Dhamar)	10 systems	500	5,000
UNICEF (PHC)	20 systems	500	10,000
Saudi Arabia	50 systems	800	40,000
Japan	10 systems	4,000	40,000
Netherlands	<u>55 systems</u> ³	<u>1,000</u>	<u>55,000</u>
TOTAL	206 systems	8,400	198,000

¹Assistance in terms of investment level presented in text; total estimated for 156 systems over Third FYP = approximately YR500 million.

²Average population values shown are for population in 1987; values based upon past experience in similar subproject development by RWSD.

³Dutch assistance at 11 projects annually assumed to be provided each year over Third FYP.

Chapter 3

STATUS OF THE RURAL WATER SYSTEMS PROJECT

This third chapter describes the project in terms of the outputs reached for each component or group of work tasks. The outputs, when examined together, will provide the status of the project as a whole. In effect, this section presents the outputs which have been or are expected to be produced by the end of 1986 and what the additional outputs required are, based upon the NTF Phase II proposal as well as the USAID-NTF grant agreement covering NTF's services. A detailed discussion of the outputs versus those required by the contract, or subsequent agreements amending the contract, are presented in Chapter 4.

3.1 Summary of Project Status

A comparison of project inputs and outputs is contained in Appendix F. In summary, the overall project status is as follows:

- As of September 30, 1986, it is estimated that 84 of the 100 planned village water systems will have been installed. The remaining 16 should be completed on or about December 31, 1986, two and one-half years ahead of schedule.
- Only 3 of the 22 planned sanitation projects have been completed, with 3 more under construction.
- Of the project's 12 planned institutional outputs, only three have been fully accomplished. Four other institutional outputs range between 17 percent and 90 percent complete, and five have not been started.

A detailed discussion of the status of each of the institutional objectives is contained in Section 3.5.

3.2 Project Development Process

The manner in which subprojects were developed for Phase II of Project 044 is an improved version of the process developed by NTF in Phase I. Basically, NTF is assigned projects by the MPW through RWSD, and thus NTF becomes part of the implementation process after MPW has made the decision regarding which project to implement. NTF applies five project criteria, and only those subprojects to which all five criteria positively apply will be implemented.

The five criteria are as follows:

- The population to be served at project startup must be between 250 and 2,000 persons.

- The source of water must be adequate in terms of quantity and quality (quality includes meeting standard bacterial and chemical levels).
- Site access must be reasonable, with no distance being more than one-half hour from the access road (that is, a track in almost all cases).
- The estimated development cost, not including the source, should be under YR900 per capita, and the total cost should not exceed YR900,000.
- The village(s) involved must indicate its (their) willingness to share capital costs with MPW-RWSD and agree to provide the resources necessary to be solely responsible for the system's O&M.

Source adequacy is determined by testing the source (for example, borehole, hand-dug well, spring, or cistern) to obtain an estimate of the capacity. In the case of a borehole, a standard 72-hour step-drawdown pump test is performed. The value obtained by way of the test is compared to the design value of demand. The design value is the maximum daily demand for year ten of the project.

It is computed for the subprojects as follows: design population is determined by increasing the population at the time of the survey (originally computed by assigning an average value of five persons and eight persons per house in the Tihama and Highlands, respectively. The five and eight person value is approximately the average given by the 1981 census) by 2 percent annually and computing the average day for year 10 by multiplying the population value by 40 or 60 liters per capita per day value for the mountains or Tihama area, respectively. This value of average day is adjusted to design maximum day by multiplying by 1.25. The value obtained is compared to the quantity measured in the source test and is deemed acceptable only if the test value is higher than the computed future maximum day value. Thus, the design maximum day, computed by: $\text{survey population} \times [1.02]^{10} \times 1.25 [= 1.5 \times \text{survey population}]$ must be greater than the value given by the source test.

Villager involvement is easy to determine as the villages must be willing to provide at least 30 percent of the project's capital cost for the project. The actual average village contribution for Phases I/II of Project 044 is approximately 33 percent.

Villager willingness to accept responsibility for operating the system is also easy to determine because most villages are willing to discuss how they will collect the funds needed for O&M and to produce candidates to undergo O&M training for the system. Willingness to accept O&M responsibility has always been accepted by the villagers. This issue, therefore, has never hampered project implementation. All data for applying the criteria can be obtained by way of the project's initial survey. In addition, the survey provides virtually all data needed for design of the system.

The subproject survey represents NTF's first official act after being assigned a project from RWSD. The responsible village leaders are contacted and informed of the Ministry's assignment of the project to NTF, and a date is set

for the survey. NTF's regional engineers usually conduct the survey (volunteers or other senior staff members sometimes substitute) with survey technicians, together with the village's responsible party -- usually the shaykh. Operating in this manner, NTF can prepare a preliminary layout of the system without worry of proposing pipeline routes which violate long-standing differences between landowners or villages. The shaykh also guarantees obtaining any personal data needed. A preliminary, rough cost estimate is prepared as part of the survey. The general layout, the level of service, and the village's cost responsibility are approved, in a preliminary manner, prior to design. Design commences if the source quantity or quality tests are positive.

After design, an agreement is prepared describing in detail the responsibilities of all parties. The agreement has five signatories -- representatives of the village, the LDA, the Governor's office, MPW-RWSD, and NTF. It is well to note that NTF negotiates the agreements on behalf of RWSD. There is little active RWSD participation in the project after it is assigned to NTF. In actuality, NTF once assigned a project would in turn assign it to one of its regional offices for implementation, and the procedure as described above is carried out. The four regions are shown in Figure 3-1 on the following page.

The project is put into NTF's construction cycle, and subject to the constraints of budget and commodities availability, the project is scheduled for construction. As of late September 1986, NTF had a backlog of approximately 50 projects designed and ready for construction. This backlog is due to MPW/RWSD assigning projects to NTF at rates greater than could ever be constructed under Project 044. Apparently, neither RWSD nor NTF considered the implications in designing sites at so great a rate.

3.3 Systems Completed and Those Under Construction

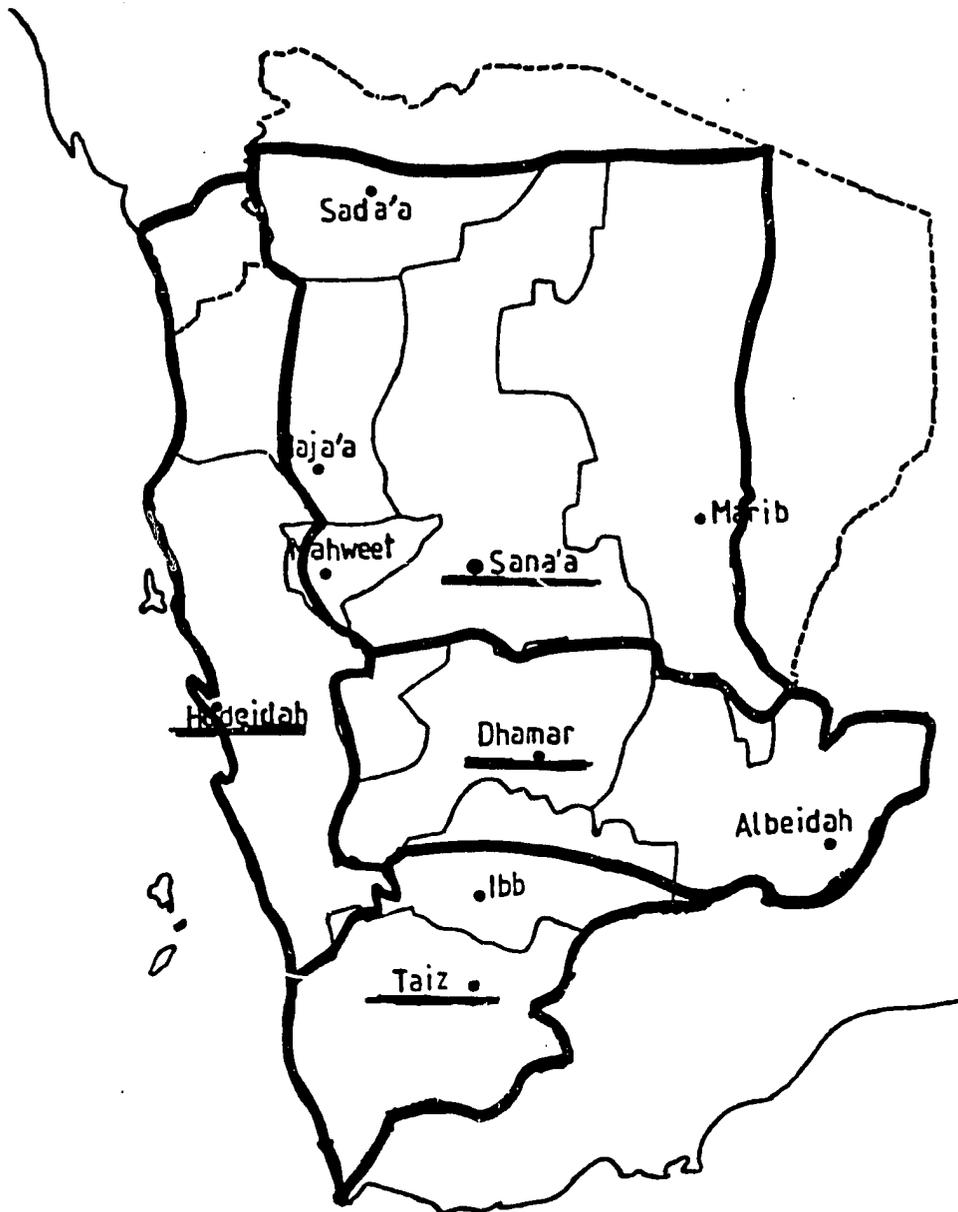
As of September 1, 1986, 156 systems had been completed, 11 more are under construction and five are ready to be started. Figure 3-1, on the following page, indicates the project status by NTF district and general location. Figure 3-2 indicates the date of project completion. A listing of these sites accompanies the text in the following subsection.

3.4 Component Costs

NTF installed systems always have the following components:

- Pump house
- Transmission line to storage tank
- Storage tank(s) (ground or elevated)
- Distribution lines
- Necessary fittings and appurtenances.

In certain cases, NTF has also installed pumps and motors for a source developed by others. General cost data for these systems are shown in Table D-2 of Appendix D. A statistical analysis of these data is shown in Table D-3 of Appendix D. Table D-3 assumed all costs, except material and equipment, as foreign exchange costs.



Note:
 Regional Offices
 Underlined

Projects Completed As
 Of September 1, 1986 :

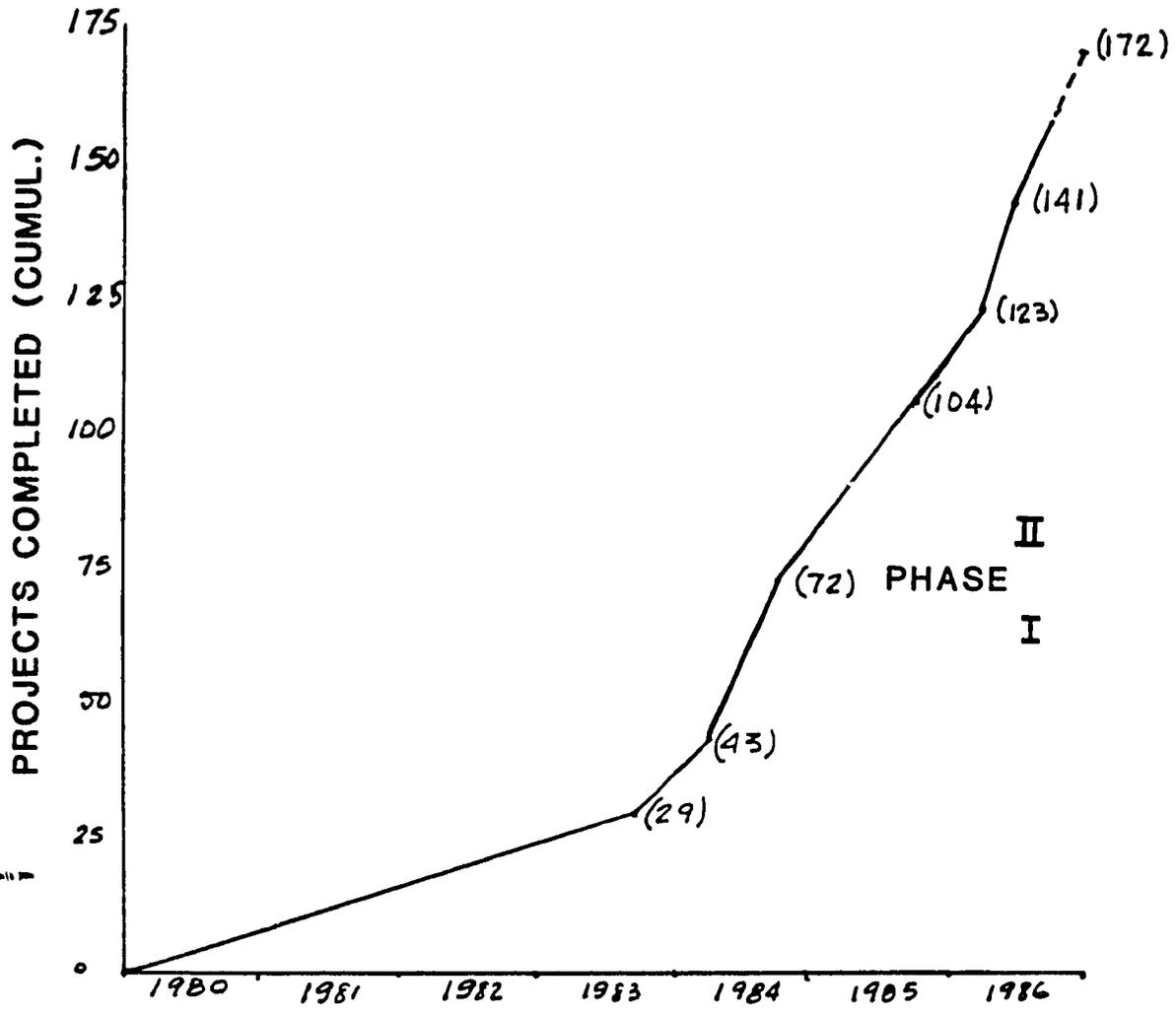
SANA'A : Phase I - 21
 Phase II 13

HODEIDAH: Phase I - 25
 Phase II 16

TAIZ: Phase I - 4
 Phase II 17

DHAMAR: Phase I - Reg 5
 Earthq. 17
 Phase II Reg 6
 GerCom. 2.

Figure 3-1. NTF Regions and Regional Offices



YEAR Source: NTF Quarterly Report

Figure 3-2. Rate of System Completion
Phase I and II

Some general numerical comparisons are as follows:

- The average per capita cost (1986 population) for distribution and storage was approximately YR300/cap with approximately 67 percent of the systems falling between YR200 and YR500/cap.
- The average per system cost was approximately YR250,000 with about 80 percent of the systems falling between YR100,000 and YR400,000.
- Local contribution averaged approximately one-third of the total cost.
- Comparing these costs to those developed for sector coverage (in Subsection 2.2.2) it becomes apparent that villagers are willing to provide the substantial portions of the project cost. In the case of NTF projects, however, the largest component of the costs (borehole plus pump and motor) are not included. If the value of borehole pumps and motors or other source development were added to the NTF costs, the value per system would be three to four times the levels shown above.

3.5 Institutional Development Activities

NTF's institutional development activities as required by the proposal or project agreement, are summarized, by item, in the following discussion.

3.5.1 Create an Office of Planning and Management within the Rural Water Supply Division

NTF has recruited and placed two expatriate engineers in the RWSD's Project Office, where they are beginning to function as the division's planning organization. Three Yemeni technicians to be assigned to the new office have been identified, but are not yet in place. In fact, it was reported that one has departed for the United States for long-term training. Further, to date there has been no official YARG administrative order issued to create the new Office of Planning and Management. See discussion pertaining to the OPM in Subsection 2.3.1.

3.5.2 Reorganize and Restructure RWSD

The major objective under this action was to locate the division together. This has not happened due to space constraints, but may occur when NTF begins to phase out its operations at the Hasaba compound.

3.5.3 Recruit Five Additional Staff (OPEX) to Assist with Departmental Planning and Management

This activity has not occurred to date. NTF did recruit three Third Country National (TCN) engineers, but they are working in the Project Office's design sections and do not fill the requirements set forth in the Project Proposal.

3.5.4 Establish Sixteen Projects Using the FAR System

This activity has not yet occurred, and it now appears questionable whether it will happen at all. USAID and the project have still not reached agreement on FAR procedures. With only 16 more systems left to complete under the project, it is questionable whether agreement can be reached in time to employ the FAR system before all project-funded construction has been completed.

3.5.5 Establish Hydraulics Laboratory

The laboratory has been completed and is being operated by NTF staff.

3.5.6 Establish Three Regional Offices

All three regional offices have been established and staffed with project personnel headed up by an NTF expatriate engineer. All three offices are fully operational, even though they are not yet up to the full level of proposed staff.

3.5.7 Complete Four Village-Level Studies on Water Usage and Community Health

Only one study has been completed; no others are planned.

3.5.8 Reorganize RWSD as an Autonomous Agency

This activity has not taken place, nor are there any strong indications that it will occur before the project's completion.

3.5.9 Recruit Thirty Yemeni Technical Staff as Supervisors

NTF has recruited and provided on-the-job training for 32 Yemeni technicians seconded to them by RWSD. Plans are being made to phase them back into the regular staff of the RWSD.

3.5.10 Two New Yemeni Engineers and Eight Planners Will Become Part of RWSD Management

NTF was unable to provide any information on the status of this action, and it is assumed that no such action has taken place.

3.5.11 Train Twenty-Four Private-Sector Contractors

The NTF proposal specified that the contractor training courses would range between four and six weeks and would be conducted under the auspices of the Rural Water Training Center at Hasaba. To date, NTF has worked with nine contractors in constructing elevated tanks. All of the training afforded these

contractors, however, has been in the form of on-the-job training and not according to either the form or type outlined in the NTF proposal.

3.5.12 One Hundred Villages Trained in the Proper Operations and Maintenance of Village Water Systems

Approximately 180 persons from 90 villages have received four weeks of classroom and hands-on training in the operations and maintenance of village water systems. Additional training is planned to ensure coverage of all project-funded systems.

3.6 Training Activities

With only one notable exception, virtually none of the project's planned training activities has taken place to date. None of the 22 person-years of fellowships for regional training has been used, and only 47 percent of the short-term in-country training has been carried out. The vast majority of the in-country training, however, has been in systems operations and maintenance with only 3 percent of the planned training in administration, health, sanitation, and technical areas having been accomplished. (See Appendix F for a detailed breakdown of planned versus actual training.)

Chapter 4

FINDINGS

This chapter presents a detailed review of all of the findings as they relate to project implementation. Where applicable, it will compare what has been produced to what should have been produced, based upon NTF's proposal and grant agreement. The overall analysis of this chapter will cover the three elements of the four-part framework outlined in Subsection 1.3.2 -- "Methodology." Thus, this chapter will discuss findings pertinent to:

- Provision of services to construct water systems as units in themselves
- AID and NTF compliance with the administrative elements of Project 044 (and in NTF's case how it complied as per the proposal and agreement)
- Village acceptability and use of the project.

4.1 Community Selection Criteria

NTF does not select the communities in which it works. Instead, NTF accepts assigned projects from RWSD and applies a stringent, five-part criteria test prior to system implementation (see Section 3.1). RWSD has rarely forced NTF to accept a project which violated any of the agreed-to criteria.

On the basis of interviews, field observations, and general engineering practice, the criteria applied by NTF represent a technically sound and logical framework with which to initiate the subproject process. The initial survey, carried out with the shaykh, in effect guarantees the NTF team acceptance by the village.

4.2 Community Participation

No examples of nonparticipation by villagers exist in any of NTF's projects. The project cycle requires each village to be party to an agreement which clearly spells out the responsibility of the villagers and all other parties. Villagers ordinarily contribute their labor and local materials as their portion of the project cost. Materials include stone, gravel, sand, cement block, and common tools used in the villagers' everyday life.

Thus, the system is installed on a community basis. The evaluation team was literally bombarded with good wishes for merely being associated with NTF "...who had given them water." The good wishes changed to trading stories among those who worked on the system, as if to give the evaluation team a history of the great feats required to perform one portion of the work or another. The pride in the system was evident, and the villagers, designated as the official caretakers of the system, were treated with great respect. (In fact, in several villages the shaykh demanded that the caretaker answer

all of the "technical" questions, that is, pertaining to the physical features of the project posed by expatriates.)

4.3 Level of Service and Community Coverage

4.3.1 Service Standard

The level of service provided in NTF/RWSD projects can be described as providing an adequate water supply most of the time in close proximity to the user points. To accomplish this end, groundwater from wells, cisterns, or springs is pumped to storage tanks at sufficient elevation so that they may discharge to the distribution points. Depending upon the size of the village and the use patterns, the storage tanks are filled once or twice a day. Connections to day tanks in compounds or on roofs (or through a spigot near the home) are financed by the individual homeowners. Tanks are almost always of the elevated variety in the Tihama and rarely so in the highlands (where tanks are placed at elevations to ensure sufficient pressure throughout the system). Sufficient connection points are provided so that villagers can construct their house connections. Public taps are provided for those who cannot afford the connections and at mosques and -- if provided -- public bathhouses or latrines (also near the mosques to allow a ritual bathing before entering).

The service standards appear to fit the villagers' needs perfectly. Individual connections to the system are often rapidly made, (in one site visited, the connections were being made prior to the system going on line) and in most systems there was little use of public taps. The connection level seemed to exceed 90 percent in almost all villages visited, and NTF personnel indicated that this was the case for all projects on line, with almost all connections being made in the early months of system operation.

4.3.2 Technical, Financial, and Social Feasibility

The village systems' technical standards appear perfect in every case. The systems appear well maintained (even those on line for several years), and the villagers extolled the virtues of the training they received. The formal training provided by NTF for the pump and system caretakers appeared to be well applied in the field, and the pipefitting skills acquired in the system construction apparently have taken hold, as few leaks were observed.

All villages visited collected monthly fees from each family. The most popular rate was approximately one rial per day per family (YR25 to 30 per month) and three of the systems visited had installed water meters collecting some YR15 per cubic meter used. The water meters, including the value of installation, were YR250 to 300 each, and were installed in villages to avoid arguments over flat-rate charges; that is, the meters would differentiate the larger family use from the smaller ones. This method of "cost recovery" made the use of the systems consistent with the tenet of Islamic Law, which states that water is owned on a community basis and one group should not overuse it to the detriment of others. Further, in keeping with the Islamic tenet of nondenial of water to anyone, poorer families believed unable to pay the monthly fee were allowed to use the water free, with more affluent families paying higher fees.

Fees collected were used to run, operate, and maintain the systems, with the caretaker's monthly stipend (YR900 to 1,000 per month), diesel fuel, and lubricants making up almost all of the costs involved. Surplus amounts collected were saved for unexpected requirements.

Thus, the systems appeared to fit all technical, financial, and social constraints, while providing a vastly popular service. It is well to note that RWSD is totally uninvolved with the systems, once installed. Any extraordinary repairs are handled by the villagers themselves, usually through hiring mechanical or electrical technicians to make repairs. No complaints were received regarding RWSD's absence, and when asked if this were an irritant to them, the villagers indicated they had not even thought of the need for RWSD's presence.

4.4 System Design and Construction

The design and construction of these systems is NTF's greatest triumph. NTF has installed an orderly, highly efficient construction operation that has:

- Allowed materials and equipment to be delivered on schedule, often to sites requiring hours of extremely rough track-driving - and on terrain and grades that, in some instances, almost defy the imagination.
- Allowed an orderly pattern of extremely high-quality construction to take place, often on extremely rough terrain and steep slopes.
- Allowed a great deal of on-the-job training to occur both for technicians and villagers. In the case of villagers, this training appeared to be paying dividends in proper system operations and maintenance.

The engineering criteria and design procedure used (available at the Mission in NTF Design Manual) are technically sound and well suited for application in Yemen. Further, the materials used are of high standards in almost all cases -- the exception being, in a few systems, lighter-than-optimum gauge pipelines being installed due to the unavailability of the heavier gauge. In the two systems visited where light gauge pipe had been used, however, no problems were apparent. In summary, all facets of the design and construction efforts on Project 044 are of high standard, and this portion of the project can be considered an unqualified success.

4.5 System Operations and Maintenance

Several references to system operations and maintenance are in the preceding sections. In summary, it suffices to say that this phase of Project 044 is also a great success. Two representatives from some 90 villages received formal training in operations and maintenance practices and other related subjects at the NTF center in Sana'a. The system and pump caretakers, as they were referred to by the villagers, spoke highly of the training they received. The systems appeared to be in good working order, and villagers questioned claimed they had no complaints about the water systems and always had water.

Another unique feature of NTF's program is the system of follow-up and evaluations they have developed. Some 20 sites have been evaluated so far. These evaluations cover a wide range of topics, but focus upon the system's O&M and village use of the system. Recommendations and advice for improvements are noted and discussed with the villagers prior to NTF personnel leaving the scene.

The team visited two sites for which evaluations were made. This personal observation verified that the evaluations were well thought out and carried forth in a complete and professional manner.

4.6 Training

4.6.1 Introduction

To date, project training has fallen far short of what was originally planned. The description of the project training element in the grant proposal appears to be clear, that is, 22 person-years of regional training and 1,566 person-weeks of short-term, in-country training. The accompanying proposal budget for training, however, is highly incongruent with and does not support the program contained in the project description (See Table F-1, Appendix F). By the second year of the project, the nature and character of the training has again become even more ambivalent, as reflected in the budget presented in support of the project's second-year training plan (see Table F-2, Appendix F). By Year 2, more than 58 percent of the training budget will be used for types of training that are not included in the approved project proposal. Given the foregoing situation, it should, therefore, be of no surprise that the project's official training objectives as per the grant proposal, are not being achieved.

The primary reason for this generally poor performance appears to be related primarily to budgetary issues. Comments from the grant's quarterly reports such as "...Budgetary constraints which became painfully apparent during the quarter forced a reappraisal of the project's successful villager training program ..." support this view. It appears, however, that NTF brought this problem on itself by using approximately 50 percent of the training funds for "topping-off" the salaries of the RWSD employees seconded to the NTF, thereby causing a shortage of funding for training activities more closely related to those contained in the grant proposal.

4.6.2 Training Methodology

The most successful training undertaken to date has been a one-month program in the operations and maintenance of the village water systems implemented by the project. This training was held at the project's training center in Sana'a, and combined short lectures and hands-on training. Approximately 70% of the course content is focused on diesel engine and pump maintenance, with the remainder on systems design and installation, water resource development and basic hydrology, electrical applications, sanitation, and safety. At the time this evaluation was undertaken, NTF was restudying its methodology for this course, for both substantive and budgetary reasons. As currently conceived, the training would be undertaken in the field, with trainees from

several villages gathering at a centrally located village as the training site. The course content would be modified to respond to certain requirements noted as the result of the project's recently installed evaluation system.

The other limited short-term training provided to date has consisted of three-day, in-service courses for projected staff conducted at the project's training facilities in Sana'a. To date, the project has conducted in-service training only in basic surveying and sanitation (see Table F-2, Appendix F).

Although it was not explicitly stated in the project's training plan, NTF considers the day-to-day work experience gained by the seconded employees of the RWSD as highly relevant and effective on-the-job training and, on this basis, has justified the payment of monthly training stipends. One could reasonably challenge the effectiveness of this approach, however, on (1) the fact that some RWSD employees have been in on-the-job training for more than five years, and (2) no indications exist that any of the seconded employees have been phased back into the RWSD organization. This situation could imply that NTF has placed more importance on building up the NTF staff rather than on strengthening the RWSD organization.

4.6.3 Operations and Maintenance Training

As noted above, the project's most effective training to date has been in the area of system operations and maintenance training, which is provided for two persons from each village receiving a water distribution system. In fact, the provision of two persons to receive this training is one of several criteria used in project selection. To date, 180 persons, or approximately 90 percent of the planned target, have received this training. On the basis of limited field observation, the evaluation team has determined that this training has been highly effective.

4.7 Project Utilization

4.7.1 Domestic Water Use

Domestic water use in Yemen, as everywhere else, depends on the climate, terrain, and water availability. It is difficult to generalize even among villages in the same region; a distinction between the highlands and lowlands is possible. Data on water use patterns were obtained for this evaluation by informal interviews and observation. The team was fortunate to have one member welcomed by several women into their homes.

Water Use in the Tihama

The Tihama is an area of semidesert conditions. Homes are connected to the system through a courtyard tap. Typical village housing finds clusters of huts surrounding a courtyard, with the housing consisting of brush and mud walls, topped by a conical thatched roof that covers a single room. Cooking and washing are carried out at the side of the house. The single room, which is impeccably clean and tidy, is used both as a sitting and sleeping area. Those who can afford it have a storage tank at the side of the hut.

In the villages visited, water is stored in various tanks or containers much the same as when hauled from long distances. Many people commented positively, however, about having water "all of the time." On one continuing project expected to be completed September 1986, women and children still haul water in jerrycans on donkeys from the well site (a borehole on an old hand-dug well). The people seemed impatient about the completion of the water project. When asked about their expectations from having more water available, the common response (from women) was: "We have to see it to believe it, first."

Water Use in the Highlands

The rough highland terrain makes hauling water, which is almost always found at lower elevations, a more strenuous task. Women and children are the predominant water-providers, with women carrying 20-liter plastic jerrycans, and children 10-liter jerrycans on their heads. Water supply in the highland systems is based upon filling day tanks, either adjacent to homes or more predominantly on rooftops from the main storage tank provided as part of the project. The actual water tap is located in one room, usually the kitchen or washroom. If "traditional" bathrooms are provided, they are usually located in the back of the house. The washrooms are used for personal washing and washing clothes and tend to be very clean. A general observation for the highland water systems is that women continue to store water in a traditional manner, even though water is readily available

General Observations on Water Use

- Villagers are using more water for washing clothes and household utensils after the advent of the project made water more accessible.
- Villagers also now tend to use more water for personal hygiene beyond the customary use at ablutions for prayers.
- Even with greater availability of water, traditional habits have held sway so that one finds water stored as before the project, and carefully conserved, sometimes used two or more times before being thrown out. Villages where water meters have been installed still tend to use water more conservatively, in quantities only slightly higher than before the project.
- Accessible water facilities have considerably relieved the work burden on women and children.
- People in villages where water projects are located generally express satisfaction with the results and anticipate no problems with the ability of local, trained technicians to maintain the system.

4.7.2 Role of Women

Women are the primary carriers, users, and managers of domestic water supply. Children, both boys and girls, also assist in transporting water. Prior to the water project, women made several trips a day to a cistern, spring, or

well to fetch water, the water being hauled in 20-liter plastic jerrycans carried on their heads. A few used donkeys. Sometimes these trips extended to the next village if insufficient water was available in an area. Water-fetching responsibility appears to be accepted by women as part of their work because it is used for "her needs," that is, the performance of household chores.

Women have meticulously calculated the amount of water supply needed for different purposes: cooking, cleaning, washing, and animals. The household routine revolves around water use and therefore women are very observant of water quality in terms of taste, smell, and clarity. Women repeatedly noted how much the water project relieved them of a great deal of physical exertion and spend most of the time saved from hauling water either doing other household tasks or working in the fields.

Even though women's roles are predominant in water use, it appears that they were not consulted on either the placement of the water taps or on connection points. In certain villages, these locations could have significant cultural and social implications. The project also may be missing an opportunity in promoted village sanitation by locating various sanitary facilities only at mosques for use by men. Only one such facility has been constructed for women, who expressed a strong desire for such facilities.

The water project also saves time and energy of young children, which could potentially be put to more constructive use in schooling. Unfortunately, however, in 10 of the 12 villages visited, no schools were available. Once schooling is available, however, Project 044, in part, could carry some credit in removing at least one household burden from children.

4.7.3 Health Education

Health education represents a small part of Project 044. NTF's sanitation engineer recommended that health education be integrated into the pilot sanitation projects, but the suggestion was not considered. Many villagers interviewed both in the Tihama and the highlands expressed an interest in knowing more about water-related diseases and their prevention. One villager said, "We now know that water is a double-edged sword; it could help you survive but it could also kill you." Consequently, it appears that there is receptivity to health education that has not been exploited in this project.

4.7.4 Acceptability of the Projects by Villagers

Project 044 facilities appeared extremely popular with the villagers. While a few negative comments were heard ("water too expensive" or "too poor to connect directly to system"), most reactions were overwhelmingly positive with the NTF employees, recognizable by the villagers, treated as local heroes. Often LDA members or prominent villagers would approach NTF personnel with requests to either make certain improvements or extend the system to other villages.

Most villagers indicated that the best feature of their new systems was having water "all of the time." There was little indication, however, that use

patterns had changed considerably. Indications were that there was more water being used for personal use, especially in the Tihama.

Another strong indication of system acceptability is the rate at which householders connect to the system and the willingness of the villagers to pay for O&M of the system. These factors have been discussed in detail in previous sections; it is well to note them again, however. The level of village participation in capital and O&M cost makes the rural water supply program in YARG almost unique, compared to those in many developing countries.

4.8 Project Administration and Management

4.8.1 Introduction

If the measure of sound administration and management is the ability to achieve agreed outputs within prescribed timeframes and budget levels, the management of this project has been at best mediocre. While NTF is achieving the project's primary physical objective - the construction of 100 village water systems - this objective may have been achieved at the expense of the project's institutional objectives, which were intended to be the primary focus of Phase II. For example, funds that were budgeted for training have been used for salary-topping purposes for construction technicians, and funds budgeted for short-term consultants for the development of training programs were used to fund long-term personal services contracts. These are indicative of other perceived management shortcomings by both the grantee and AID that are discussed in detail in the following sections.

4.8.2 Project Administration by the Grantee

Numerous indicators exist that the grantee's administration of the project has been less than adequate. These include:

- a. A study conducted by the Mission Controller's Office in early 1985 cited 34 instances where AID felt the grantee was not in full compliance with good management practices or the provisions of the Grant Agreement. In fairness to NTF, however, it should be noted that a subsequent Mission review approximately 12 months later found that almost all of the deficiencies noted in the earlier Mission Management Report had been corrected. Nevertheless, there may have been a six- or seven-year period between 1979 and 1985-86 when sound management controls were not used.
- b. The grantee has had difficulty in recruiting and keeping an expatriate executive officer. This position was not filled until December, 1985 (15 months into the project), and this person was subsequently discharged by the grantee only nine months later in August 1986 for reasons that were never made fully clear to the evaluation team. It is the evaluation team's perception that this individual was highly involved in installing and maintaining the improved management practices noted in (a) above. A continued absence of a qualified person in this position would be detrimental to overall project management.

- c. NTF has incurred sizable cost overruns in some areas of the project budget that are above and beyond the 15 percent line item flexibility provided in the Grant Agreement (GA). For example, the grantee has spent all of the project's Length of Project budget item for other direct costs within the first two years of the project and exceeded the budget item for commodities and supplies by approximately \$500,000 (16 percent overrun). Both of these actions exceeded the 15 percent flexibility provision, and there is no evidence that the grantee either requested or received approval to exceed those limits. This situation indicates that proper financial management controls are still lacking.

Numerous other less dramatic indications exist of less-than-adequate management by the grantee, but the evaluators feel that most of the grantee's management problems could be satisfactorily resolved if a strong candidate is recruited and assigned to the Executive Officer's position as soon as possible.

During the course of the evaluation, one of the team members made a cursory review of the project's procurement and warehousing records. The team member randomly checked a sample of warehouse records with the actual inventory in stock. In all cases, the inventory on hand checked with the warehouse records.

4.8.3 AID Oversight and Mission Management

The evaluation team found that there were several basic faults or weaknesses in present grant agreement or agency management procedures that impinge heavily on the effective management of this project. A basic fault in the agreement itself is the lack of the rather standard requirement for the grantee to furnish AID with routine status reports.

A more fundamental flaw is the dichotomy created by the split in management responsibility versus financial control, the Mission having the responsibility for day-to-day management of the project, but AID/Washington controlling the funding. A prime example of the problems caused by this type of arrangement was the grantee's ability to expend approximately \$2 million during a period when there was no approved annual implementation plan budget, in spite of a specific grant provision that states, "Until the Recipient's Annual Implementation Plan has been reviewed and approved by USAID/Sana'a, funds for the work plan year may not be disbursed without advance written approval of the Mission Director or his designated representative." A careful review of the project files indicates that the grantee continued with normal expenditures from January 1, 1986 until June 16, 1986, in spite of the fact that: (1) the implementation plan was not approved until March 3, 1986; (2) the implementation budget was not approved until June 16, 1986; and (3) there was not advance written approval by the Mission Director.

A related, but somewhat more minor, problem regards the timing and method of Mission approval of project expenditures. AID's Office of Financial Management in Washington forwards a copy of the grantee's quarterly voucher for post facto approval by the Mission. In most instances, this arrives at the Mission at least 30 days after the end of the quarter and in about 50 percent of the cases it arrives without the necessary expenditure information attached; that

is, it contains only a total quarterly expenditure figure without any breakdown of expenses by budget item. This made it extremely difficult for the Mission to stay on top of project expenditures, as it could take several months to determine specific expenditure data. In the case of Project 044, these anomalies appear to have been at least partially responsible for the project's lack of complete financial control.

Internal mission management of the project appears to be lacking in at least two aspects. First, there has been an inordinate turnover of primary project managers on this project. Within a period of less than two years, the project has had three different project managers, and it appears that the present project officer may be leaving within the next six months. A review of project correspondence strongly supports a conclusion that by the time a new project officer gets up on the learning curve and becomes involved in substantive issues, he or she moves on for one reason or another, and the process begins all over again. The net result is that instead of having a person with two plus years of experience and knowledge, you end up with nine months of experience times three. By any management norms, this is not a sound approach to the management of one of the Mission's major projects.

Another weakness in Mission management of this grant has been its apparent willingness to approve annual implementation plans that do not contain information explicitly requested in the grant agreement, that is, that the "...implementation plan will specifically: (1) address the institutional building efforts and targets for the forthcoming year; (2) include a description of efforts to be taken to encourage greater capital cost recovery and plans for the exploration of alternatives to this end; and (3) provide estimates of YARG contributions to ongoing activities; the impact on YARG budgets should be made explicit and comprehensible to all concerned parties."

The evaluation team has reviewed the implementation plans approved for the first two years of the project and finds that most, if not all, of the foregoing information is completely lacking.

4.9 Institutional Development

4.9.1 Introduction

For a project that was justified largely upon institutional development during the second phase (1984 through 1989), the team finds little progress in this area to date. At this time, NTF has still not submitted the institutional development plan that was requested by the Mission in 1985. In a letter dated as recently as March 26, 1986, NTF's Chief of Party wrote to USAID requesting an extension of the April 1, 1986 submission deadline and for "...clarification from USAID/Yemen on the exact focus of this plan." The letter further stated that a consultant was needed to assist in preparing the plan. In addition to finding it somewhat incredulous that the grantee's Chief of Party still needed guidance on program focus 18 months into the project, the team found that the services of the consultant were never provided, nor has the plan ever been developed. Instead, it appears that there has been a mutual agreement between NTF and the Mission to further delay preparation of the plan until after this evaluation. In retrospect, one can reasonably question NTF's ability to come up with such a plan if it has not yet done so.

The team also feels that a major factor affecting the slow growth of institutional development is the lack of a clear understanding between the Mission and the YARG on the shift in program direction between Phase I and Phase II of the project. The official Memorandum of Understanding between the two governments does not, in the opinion of the team, adequately reflect the intended shift from physical to institutional objectives.

4.9.2 Institutional Development within RWSD

Sections 3.1 and 3.5 briefly summarized the status of progress toward 12 planned institutional development outputs. It was noted that three outputs had been fully achieved, four partially achieved, and five with no progress to date. What was not stated, however, is that the items that were fully accomplished were activities undertaken primarily by NTF and achieved through the use of project resources, that is, the hydraulics laboratory, establishment of the regional offices and the recruitment and training of Yemeni technicians. Those items for which no action has been taken to date are basically items that require YARG action or resources, and cannot be effectively achieved by NTF actions. These actions include, among others: (1) creating RWSD as an autonomous agency, (2) reorganizing and restructuring of RWSD, (3) use of the FAR system, and (4) RWSD staff assigned for administration, planning, and management. The significance of the foregoing needs to be fully understood so that an examination of the statistical data will not be misleading. One measure of institutional development is the degree to which a given organization's budget is growing in relationship to that of the larger organization to which it belongs, that is, in this case, the national budget. Table 4-1, on the following page, indicates that in the period between 1981 and 1984, there was a positive growth in the RWSD's budget in relationship to the national budget, but since 1984 it has been declining rather significantly. Also, the foreign exchange relationship, to the degree that it is relevant, has been even more severely affected by the devaluation of the Yemen rial.

One positive institutional trend in the case of RWSD has been the growth of its staff. Between 1984 and 1986, there appears to have been a positive trend in this regard, as indicated by the following:

- A 10 percent increase in overall staffing
- A 24 percent increase in Yemeni staff
- A 39 percent increase in professional Yemeni staff. (Note that all values include the RWSD staff seconded to Project 044.)

It should be noted, however, that most of the increase in Yemeni staffing (see Table F-4, Appendix F) has occurred as the result of Project 044 and is currently on secondment to NTF, where they are receiving a supplement to their salary in the form of a training allowance. The degree to which these technicians are integrated back into the RWSD and effectively used will be the ultimate test of whether the salary-topping scheme has been worth the \$250,000 plus investment. NTF has indicated that it plans to phase out training allowances between January and early June 1987.

Further, evidence exists that RWSD has had only marginal success in improving the quality of its operation over the past several years. While this has little to do with the NTF's responsibilities under their agreement, the

Table 4-1
**Comparative Growth of RWSD Budget
 Versus National Budget**

Year	National Budget (millions of YR)	RWSD Budget (millions of YR)	Percentage Relation- ship (%)	RWSD Budget Equivalent in U.S. \$\$
1981	6,304	70.9	.011	
1982	8,474	86.5	.01	
1983	8,719	115.9	.013	
1984	8,123	118.4	.015	22.7 million
1985	8,895	83.7	.009	
1986	-	74.2	-	6.8 million

grantee may have fallen into a situation in which it was attempting to provide institutional development services to an agency which was not ready to receive it.

Table F-3, Appendix F provides a comparative analysis of project staffing between 1984 and 1986; and Table F-5, Appendix F provides a status report and financial analysis of project expenditures to date.

Chapter 5

PROJECT BENEFITS AND IMPACTS

5.1 Introduction

This chapter describes the benefits and impacts of Project 044. The presentation is the last portion of the four-part framework of the methodology (see Section 1.3.2) and will indicate the value of the project outputs. This type of analysis is often difficult without establishing benchmark data, especially for health and social parameters, and often the benefits from such projects are intangible and cannot be accurately quantified. Thus, as per the methodology, the presentation is qualitative and should be interpreted as an analysis which will provide future project planners with a hierarchy of perceived benefits from the standpoint of the users.

5.2 Health Impact

Project 044 was intended to provide more accessible potable water to rural villagers. By eliminating the need to travel long distances to sometimes open water sources, the project has reduced the drudgery to women and children caused by fetching water (10 to 20 kilos at a time).

Because of the lack of baseline data, it is not possible to determine definitely whether the project has effectively improved health conditions in the villages. Boreholes, however, are much less prone to contamination than either hand-dug wells or cisterns. The project's use of these facilities, bringing water closer to the villagers' use points, probably will cause less use of sources prone to pollution.

5.3 Social Impact

Almost without exception, the village projects are socially acceptable, especially in villages where water supply has been either limited or distant. This has been demonstrated in the extent to which communities cooperated with project personnel in the planning and implementation stages and in the extent of the capital costs provided by the villagers. In all of the villages visited, people expressed gratification with the increased convenience and accessibility of water supply provided by the project. The villagers repeatedly commented on how the project had improved their daily lives.

The traditional governing system of the villages was a satisfactory way to rally the necessary local assistance needed for carrying out the project (this example should be recognized by RWSD in its non-NTF program elements), and the project itself had no deleterious effect on these sociopolitical relationships or on the cultural environment of the villages. In providing a link with the central government, the project seems to have had a positive effect in fostering the villagers' view toward the government. Villagers seem to believe that the project is a response by the central government to their needs. Overall, the project clearly illustrated the cooperative ethic in village life and may

have reinforced the notion that cooperation between the villages and the central government can work effectively.

5.4 Economic Impact

Villagers have demonstrated a remarkable willingness to share a substantial portion of capital costs for the water supply projects constructed by NTF and others (see Section 4.3). Further, they have assumed all costs for system operations and maintenance of household connections, roof, or ground tanks and, in some cases, water meters. Further, many instances were cited by RWSD, NTF, the LCCDs and the villagers themselves, where villagers paid for the purchase and installation of pumps and motors and improvements to access roads. These last two items often were done in conjunction with the LCCDs. This record, by itself, demonstrates that villagers place an extremely high value on the benefits derived from improvements in rural water supply delivered into or close to their homes.

A benefit often cited in rural water supply projects is the economic benefit, due to reduction in time spent by women and children hauling water from pre-project existing water sources to their homes. Given the exodus of many males to jobs in Saudi Arabia and other countries, women and children constitute a considerably more important source of Yemeni farm labor than previously. Hence, there is a higher economic value to the labor contribution of women and children to agriculture, and time saved fetching water is spent in part in the fields. Thus, in many cases, through Project 044, the boring of new wells bringing water closer to homes can be said to be responsible for the major reduction in time spent in securing water for domestic use and allowing more time to grow food. This finding is more valid for highland areas since, in the Tihama, some wells were only a few minutes from most homes.

Through installing rural water supply and distribution systems, Project 044 has made a heavy expenditure in local labor. As a result, the economic impact of construction expenditures on the local economy may also be considered a benefit. Considering the labor force could have been employed elsewhere and that much village labor was donated to the project, this increment of benefits is probably very small.

In conclusion, the net economic benefit of Project 044 probably represents a break-even case, and the use of theoretical economic analyses may not, in itself, be able to justify the project. Nevertheless, the high value (represented by local investments directly to the project and associated appurtenances) placed in obtaining these systems and the other benefits cited in Subsections 5.2 through 5.4 appear to be sufficient in themselves to justify the project.

5.5 Conclusions

The team believes that Project 044 is having a positive effect and providing many benefits to the villagers. This contention is, however, difficult, if not impossible, to prove. Perhaps the greatest long-range benefit of Project 044 is the opportunity provided by the introduction of such a highly acceptable commodity as accessible potable water. Future government programs in

hygiene, sanitation, and health education will have much greater potential for success, as they can be built upon successful water supply interventions.

Project 044 elements pertaining to rural sanitation and health education may do little in the way of providing real benefits when RWSD's manner of operation and philosophy on providing rural sanitation services are recognized. It is an issue over which RWSD has almost no concern.

Some specific projects may be individually helpful to a few villages. The impact on the rural health sector, however, will be minimal. Rural health interventions would be best provided by the MOH and/or MMH. Future activities similar to Project 044 should be designed so that coordination of these two agencies is effected.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

This final chapter of the evaluation summarizes the team's conclusions of the evaluation and recommendations for the last two years of Project 044. Subjects which should be included in a policy dialogue among AID, NTF, and RWSD are also included.

6.1 Conclusions

The evaluation team's conclusions relating to Project 044 are discussed in the following paragraphs. If Project 044 were to be measured by its physical accomplishments -- providing complete water supply systems and training a cadre of villagers to maintain them -- it would be classified as an unqualified success. From a poor start, with virtually no construction for almost two years, Project 044 has risen to become, in the words of many persons interviewed, one of the most prominent USAID interventions in Yemen.

NTF has overcome the combined constraints of logistics and terrain to produce 172 water supply systems that are well engineered and constructed to high-quality standards. In reaching this level of field expertise, NTF has organized itself into a highly efficient turnkey construction unit, and its staff have mastered the intricacies and political sensitivities of all elements of Yemen's rural society. This accomplishment has enabled NTF to involve the villagers in constructing and providing continuing operations and maintenance for systems at physical and monetary levels rarely found in rural water supply around the world. NTF's field operation has become so efficient that the Phase II output of 100 systems will be reached two and one-half years ahead of schedule.

As stated in the Grant Agreement, however, the primary objective of Phase II was to provide institutional development services to RWSD. In this realm, the project is not nearly as successful as the field operations. While NTF has institutionalized its operations internally to become a highly efficient "hardware and community development" provider, it has not transferred these skills to RWSD. This observation is not meant to imply RWSD was a willing partner. The general modus operandi of RWSD and its philosophy of its mission (that is, that of a pure development agency), together with a set of unclear institutional objectives in the Memorandum of Understanding between AID and RWSD, exacerbated the situation. Also, the fact that RWSD did not become an autonomous agency as expected at the time of NTF's proposal has had a deleterious effect on the project "environment." Nevertheless, on the basis of the interviews conducted by the evaluation team, the many file documents it has reviewed, and its general observations of NTF's operations, the team is convinced that NTF has not placed sufficient emphasis on the nonphysical side of its mission.

On the basis of the above, the team concludes that there are three options that should be considered by USAID/Yemen for Project 044's final two years of operation. AID can:

1. Allow the project to continue along its present track and concentrate on providing as many physical systems (probably 30 to 50) as the budget will allow.
2. Recognize that significant institutional development for RWSD has a low probability of success and terminate the project when the physical targets (that is, 100 systems) are completed.
3. Reorient the remaining project resources toward increasing RWSD's capabilities to significantly improve its ability to:
 - o Effectively plan its program and optimize the use of donor assistance
 - o Develop technical standards and design procedures for rural water supply systems
 - o Effectively supervise private-sector contractors in the construction of rural water systems.

Option 3 is recommended. Specific recommendations related to adopting this option are presented in the following subsection. It must be recognized, however, that the adoption of the recommended Option 3 implies, at a minimum, the following:

- o No new systems should be authorized from project funds when the Phase II total of 100 systems are completed by NTF.
- o A new Memorandum of Understanding must be formulated by AID with both RWSD and NTF, articulating new objectives for the remainder of the project, responsibilities of each party, and a schedule of measurable milestones.
- o A review of the project should be scheduled to verify progress on the new agreement, objectives, and milestones. This review should be six to eight months after the new agreement is reached (July or August 1987).
- o If the review shows that significant progress has been accomplished, AID should consider the authorization of a minimum number of new systems (five annually per NTF region), using PL 480 funds.
- o If there is little evidence of significant progress, AID should terminate the project within a reasonable time period.

Thus, USAID/Yemen must take a much more active role in the project. This participation includes, as required, aiding in defining specific objectives and strategies NTF will pursue, and RWSD will accept, and fostering intensive coordination among itself, NTF, and RWSD, while checking progress against defined performance indicators.

6.2 Recommendations

On the basis of the foregoing recommendations, the team feels that NTF must revise its mode of operation so that it will provide technical assistance to RWSD rather than acting as a construction arm in RWSD's operation. The aim of Project 044's final two years would be to optimize RWSD's use of the private sector to construct projects. RWSD's own forces would act in much the same manner as it now functions, that is, providing survey and design functions, tendering projects to contractors for construction of distribution systems, storage facilities, boreholes, and pump and motor installation. RWSD's operation aided by NTF's technical assistance efforts should, however, be more efficient. Specific recommendations are given below.

6.2.1 Recommendations Specific to Project 044

The following points are specific as to the project recommendations made above:

- USAID/Yemen should not authorize any new construction efforts by NTF after the total now provided for (that is, 100 systems) is reached.
- NTF should start phasing back to the Ministry the seconded RWSD technicians now working as part of NTF's staff; concurrently, salary top-offs should be phased out so that the remaining overall project budget can be optimized.
- NTF should concentrate on preserving the Office of Planning and Management, the provision of training for village-based and RWSD technicians (that is, those who may not have worked on Project 044), and short-term regional training.
- NTF's staff engineers and technicians should be used as trainers, in the efforts of the OPM, or as construction inspectors, providing construction supervision as RWSD's agent. The construction supervision or inspection efforts would be directed toward ensuring contractor compliance to the plans and specifications, not directing laborers on how work should be done.
- NTF should prepare detailed work plans for implementing the efforts described above. USAID/Yemen should, in conjunction with NTF and RWSD, set the schedule for submission of these plans. Further, NTF should reassess its needs in view of the above and submit a phaseout plan for its own staff.
- USAID/Yemen should immediately commence the process, as described in Section 6.2 above, to set new objectives, performance criteria, and schedules for the project's final two years. As discussed in Section 6.2, if over the next several months, a review of the performance indicators present USAID/Yemen with evidence that the NTF and RWSD's institutional development efforts are taking hold, AID could attempt to provide outside

funds for constructing additional systems. Examples of performance indicators are:

- o The ability of RWSD to phase back into its organization the technicians seconded to NTF
- o The ability of RWSD to obtain additional staff, including any NTF technicians phased out of Project 044
- o Positive evidence that the OPM is functioning as per plan, in terms of NTF action and RWSD's cooperation, relating to training and the development and installation of new management and planning systems
- o The ability of RWSD to use NTF's staff to complement its efforts in tendering and supervising of construction services
- o Greater use of private-sector contractors to pick up any slack due to a decrease in NTF's construction activity.

6.2.2 Recommendations for the Office of Planning and Management

The evaluation team would recommend that the OPM be structured to:

- Provide technical standards and training to RWSD engineers and technicians in design and survey skills and project implementation procedures.
- Provide RWSD with a management and planning capability that will at least allow projects to be planned and tracked in an orderly manner, with requirements for manpower and budget to be predetermined.
- Provide RWSD with a follow-up capability, that is, a system which will allow RWSD to quickly evaluate problem systems and plan for its repair or rehabilitation (55 such sites are said by RWSD to be in need of repair or rehabilitation).

Additional comments, including some suggested areas of concentration for the OPM, are presented in Appendix G.

6.2.3 Recommendations Concerning Training

The training referred to in this chapter is that to be provided to village-based personnel. It should be directed toward providing skills to keep their water systems operative, and, if possible, a portion of the training should be on their specific systems.

Short-term regional training should be for no more than six months. Inclusion of this type of training as part of NTF's activities over the next two years should be subject to budget limitations. (See further discussion, Appendix G.)

The training mentioned as part of the OPM's work is intended to be semiformal, on-the-job training. It should be planned, however, in terms of target numbers of RWSD employees and the skills to be perfected.

6.2.4 Other Recommendations

The sanitation elements of this project, while laudable in their intent, represent a misplaced effort. The facilities provided may be valuable to the few villages receiving them, but they do little for the sector as a whole. The village-level training efforts proposed for health and sanitation are seemingly impossible to implement, especially considering RWSD's lack of desire to pursue rural sanitation and the cross-ministerial requirements to get such project elements implemented.

In addition, NTF has no personnel assigned to Project 044 with the experience to carry out rural sanitation and health training. It is recommended that this portion of the project be dropped from consideration in Project 044's last two years, unless the necessary cooperation among RWSD, MOH, and MMH for the sanitation elements of Project 044 to be carried out can be effected without sapping either NTF or RWSD resources. As a result of the complex nature of the grant for this project and since several budget items have been overrun, the evaluation team would strongly recommend the project be subject to full AID audit.

6.3 Policy Dialogue

Obviously, the recommendations above will cause a drastic change in the RWSD/NTF relationship. RWSD is using NTF as a contracting arm of the Ministry and has little to do with project implementation after assignment to NTF (and none with operation once a project is constructed). The recommendations require a new arrangement based upon RWSD's use of NTF resources, together with its own forces in a technical resource and inspection and supervision mode. This arrangement should cause more projects to be implemented by RWSD.

Specific dialogue is required so that institutional objectives for the next two years can be specifically defined. The dialogue should include AID, NTF, and RWSD and should concentrate on the following issues:

- NTF's proposed operation of the OPM and training efforts to be effected over the next one or two years
- Integration of RWSD's technicians being phased back to the Ministry
- Integration of NTF's technical staff to complement RWSD's efforts.

APPENDIX A
Scope of Work

Scope of Work for External Evaluation
of Small Rural Water Systems Project

(279-0044)

I. Background: Since 1979, USAID/Sana'a has funded the Small Rural Water Systems Project under a cooperative agreement with New TransCentury Foundation (NTF), a private, non-profit organization. The original 1978 unsolicited proposal by NTF was amended in 1984 to cover an additional five-year period through FY 1989, and provided the basis for the current project activities and budget. The amended NTF proposal incorporated the findings and recommendations of the 1984 external evaluation which concluded that, although the project has succeeded admirably in providing rural water systems, much more remained to be done to institutionalize this capacity within the Ministry of Public Works' Rural Water Supply Division. In 1985, the Small Rural Water Systems project was one of five projects or subprojects selected as case studies for the Mission's Institutional Development Assessment preparatory to a new Country Development Strategy Statement. That Assessment concluded that, although project 044 has been relatively successful in comparison with some other Mission institutional development efforts, there remain a number of severe stumbling blocks to institutional, or organizational, development within the Ministry of Public Works' Rural Water Supply Division.

II. Objectives: The major objectives of this evaluation are:

- A. An understanding of the magnitude of demand for rural water systems in the Yemen Arab Republic, and the various factors currently affecting the supply of rural water systems;
- B. An objective critique of the role the USAID funded project is playing in the supply of these systems;
- C. An assessment of the continued validity of project EOPS in light of progress to date and the likelihood of their eventual achievement in full; and
- D. Recommendations for revision in project objectives, activities, budget and timeframe within the changing framework of supply and demand for water systems in rural Yemen.

III. Statement of Work: The Small Rural Water Systems evaluation is to reach the objectives outlined above by examining the overall sectoral context of the project, comparing and contrasting the short and long-term objectives of USAID, the contractor, the YARG, and other donors in the rural water sector, and re-examining the assumptions made by the

various parties at the various stages of project design and implementation. In particular, the evaluation should answer the following questions, categorized below under the objective they are designed to accomplish.

Objective A.

1. How many water systems will be required before 100% of Yemeni citizens in rural areas will have access to potable water?
2. How many adequately functioning water systems currently exist? Of these, how many have been provided under the auspices of the Ministry of Public Works' Rural Water Supply Division (MPW/RWSD)? The Confederation of Yemeni Development Associations (CYDA)? The Ministry of Agriculture and Fisheries (MAF) including the regional development authorities, e.g. Southern Uplands, Central Highlands, Tinama? How many have been funded totally by villages themselves?
3. What is the magnitude, composition and future plans of other donor assistance in the rural water sector?
4. What are the relevant cost factors associated with Yemen's objective of providing 100% potable water

coverage as soon as possible? Do these cost factors suggest alternative approaches to the financing of rural water systems, and if so is there a likelihood of widespread acceptance of these alternative approaches by the YARG? By the donor community?

Objective B.

1. What are the various roles of MPW/RWSD, CYDA, MAF and other YARG Organizations in the delivery of potable water systems? Do they serve different segments of the population? If so, on what basis? Is any organization truly preeminent in the supply of systems?
2. To what extent has project 044 succeeded in helping MPW/RWSD meet its short-term objective?
3. To what extent is project 044 helping to create within MPW/RWSD an organization that will function effectively after project assistance is completed? Is this possible by the current PACD of 1989?
4. What factors constrain the project's ability to develop MPW/RWSD's capability?

Objective C.

1. Given the dynamism of the Yemeni private sector, and the widespread availability of financial resources at the village level, what should be the future role of MPW/RWSD? To what extent is 100% potable water coverage in Yemen dependent upon the organizational development of RWSD?
2. In light of the conclusions in response to I., what should be the future role of project 044?
3. Are there areas in the rural water sector where policy dialogue with the YARG may be needed? What is the prognosis for success?
4. Is it realistic to expect transfer of a significant part of NTF/RWSD's role in constructing rural water systems to the private sector, particularly in upland areas of the country? By the end of the project?

Objective D.

1. To what extent has NTF developed adequate project implementation workplans and materials?

2. Has NTF provided qualified, experienced personnel in a timely manner?
3. To what extent has the contractor been in the position of trying to serve two masters with conflicting objectives? How has this affected the project's relationship with the Ministry? With USAID?
4. What is the current status of water systems already constructed, i.e. are they continuing to function? Are there consistent patterns why projects are no longer functioning? How has NTF's villager training program for operations maintenance affected the efficiency of water system operation?
5. Are there elements of the current NTF scope of work which have proven not to be cost effective?
6. Has NTF established an effective system for regular evaluation of project activities?
7. Has NTF followed good fiscal management practices and adhered to AID policies, regulations and contractual provisions regarding expenditures?

APPENDIX B
List of Persons Interviewed

USAID/YEMEN

Charles F. Weden, Jr.
Bobby Allen
Howard C. Thomas
Geraldine Donnelly
Rufus Long
Mohammed al-Najashi

Director
Acting Deputy Director
General Development Officer
Program Officer
General Development
Program Assistant

NEW TRANSCENTURY FOUNDATION

Mohammed Sediq, V.P.
Bonnie Ricci
Michael Cullen

Douglas Craig
Rama Krishna
Mark Levenson
Ibrahim Pearose
Vernon Phillips
Kelly Yoon

Somabat Prasometch
Abdul Razak

Abdul Salam Zuberi

Chief of Party
V.P. TransCentury
Technical Director and Regional Engineer,
Sana'a Region
Training Officer
Structural Engineer
Regional Engineer, Hodeidah Region
OPM
OPM
PCV, (Assigned to NTF as Sanitation
Specialist)
General Services Officer
Acting Executive Officer and Regional
Engineer, Dhamar Region
Deputy Regional Engineer, Taiz Region

U.S. PEACE CORPS

Dr. George A. Doumani
PCV's

Director
All those assigned to Project 044

MPW/RWSD

M.K. Korshumi
Abdul Bari Saleh
Ibrahim A. al-Shami

M. M. Mahdi
Abdul Ghani El-Gazali

Julian Kozinski
Hans Koenig

Minister, MPW
Director General, RWSD
Deputy Director General and Chief, Office of
Bilateral Affairs
Director Planning Department
Supervisor, Tender Finalization Group,
Planning Department
WHO Advisor
Dutch Volunteer, MPW/RWSD, Hodeidah

C.P.O.

Anwar al-Harazi

General Director, Project and Loans

MINISTRY OF HEALTH

Dr. Ahmad al-Hamly
Yahya al-Thari

Director of Planning
General Director, Public Health Services

APPENDIX C
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25. Project Implementation Plan and Budget, Year #2, NTF
26. Project Quarterly Status Reports and Expenditure Reports, October 1, 1985 - June 30, 1986, NTF
27. Cooperative Agreement No. NEB-0044-A-0-4107-00
28. Project Quarterly Review Reports, USAID/Yemen, October 1, 1985 - June 30, 1986
29. Project Correspondence and Report Files, Project 279-0044, Small Rural Water Systems Project, USAID/Yemen

APPENDIX D

General Location of Sites Visited
Characteristics of Sites Visited
General Cost Data

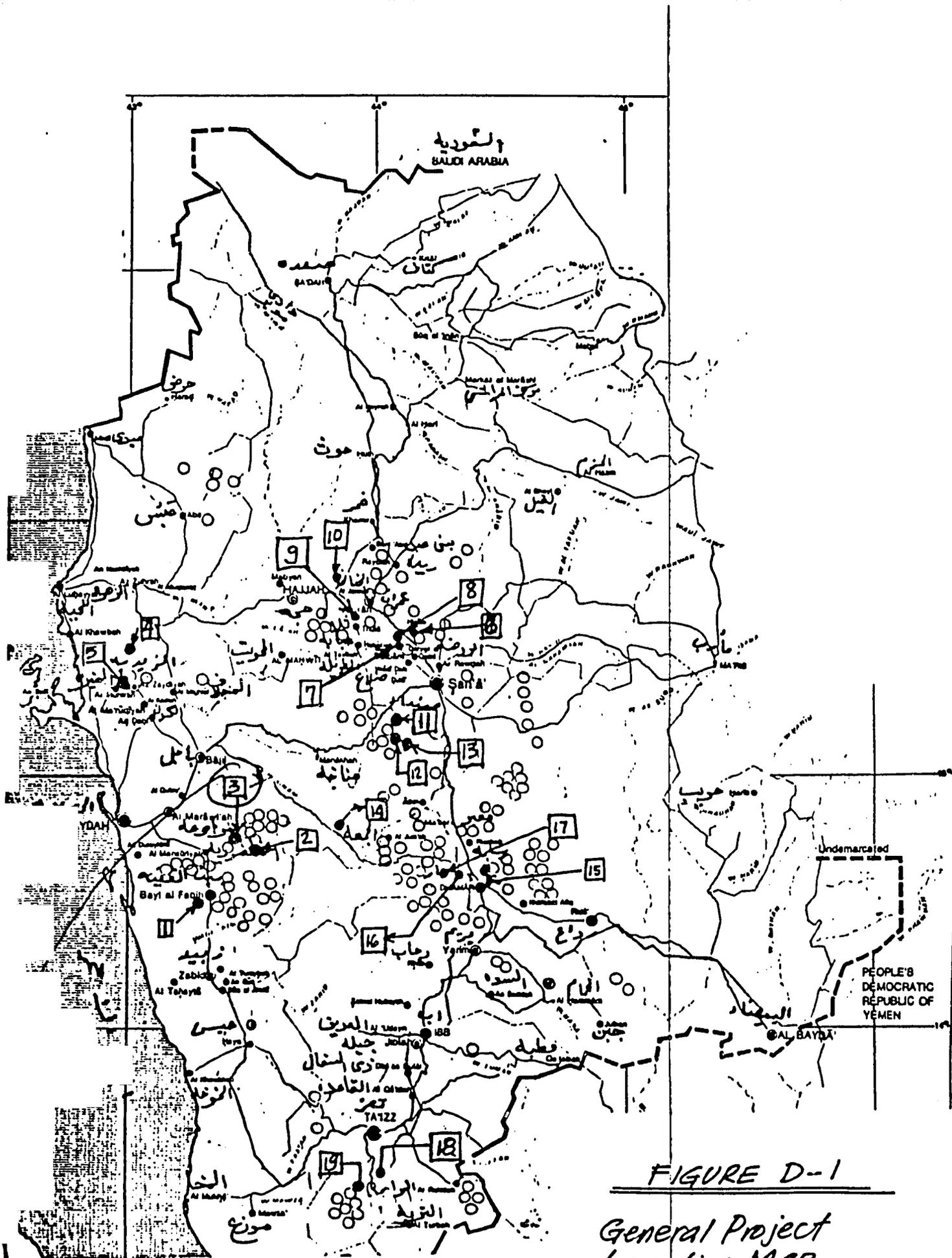


FIGURE D-1

General Project
Location Map
With Sites Visited

- SITES VISITED DENOTED
BY 9 (SEE TABLE D-1)
(NOTE SITES NOT INSPECTED DUE TO

Table D-1

Sites Visited With Selected Characteristics

No.	System	Nahiya	---Population---		-----Source-----		---Storage---		Pump Type	Remarks
			Survey	Design	Type	Depth (m)	Type	Vol. (m ³)		
1.	al-Sa'adiyan	Bayt al-Fagi	700	1,050	Impr. hand-dug well	60	Elev.	15	Vertical turbine belt drive	LCCD impr. hand-dug well; provided pump and motor; sanitation project
2.	al-Hadjama	Mansouria	500	750	Impr. hand-dug well	50	Elev.	15	Vertical turbine belt drive	Same as (1); (no sanitation)
3.	Dar Kamana	Mansouria	980	1,470	Impr. hand-dug well	57	Elev.	15	Vertical turbine belt drive	Same as (1); (no sanitation)
4.	Dar Keuzaba	Qanawis	1,700	2,550	Impr. hand-dug well	70	Elev.	50	Vertical turbine belt drive	RWSD impr. hand-dug well; provided pump and motor (pump house not finished)
5.	Dar Anwash	Qanawis	1,200	1,800	Bore hole	60-70	Elev.	25	Vertical turbine belt drive	Same as (1); system under construction; well serves many surrounding villages, siphon from day tank
6.	Bayt al-Dahulaay	Ayal-Surayah	250	375	Spring (with dam)	--	Ground	25	Electric submersion	Solar pump to be installed at dam; sand filters installed

Sites Visited With Selected Characteristics cont.

No.	System	Nahiya	---Population---		-----Source-----		---Storage---		Pump Type	Remarks
			Survey	Design	Type	Depth (m)	Type	Vol. (m ³)		
7.	Digrari	Ayal-Surayah	500	750	Bore hole	400	Ground	50	Electric submersion	Old cistern caused outbreak of disease; sanitation project installed (latrines and shower)
8.	Bayt Amar	Ayal-Surayah	n.a.	n.a.	Bore hole	320	Elev.	25	Electric submersion to day tank; centrifugal to elevated tank	Sanitation project at mosque 1/2 km from village; one of few "mountain" villages with elevated tank
9.	Bayt Murdick	Ayal-Surayah	600	900	Bore hole	200	Ground	25	Electric submersion	Only project with no distribution system; safe yield on source too small; therefore built day tank only
10.	Al Darbal Alaswad	Amran	1,200	1,800	Bore hole	200	Ground	50	Vertical turbine direct drive	Village has installed meters for all directly-connected houses
11.	Nub	Al Jaadib	420	630	Bore hole	70	Ground	25	Vertical turbine belt drive	RWSD installed pump and motor on existing village well

Sites Visited With Selected Characteristics cont.

No.	System	Nahiya	---Population---		-----Source-----		---Storage---		Pump Type	Remarks
			Survey	Design	Type	Depth (m)	Type	Vol. (m ³)		
12.	Dar Al Qadhi	Al Jaadib	320	480	Bore hole	100 (est.)	Ground	25	Vertical turbine belt drive	Existing village well used as source; old cisterns now dry; Hamams installed both at men's and women's mosques
13.	Bayt Juman	Al Jaadib	500	750	Bore hole	160	Ground	25	Vertical turbine direct drive	Village self-financed new well after collapse of old well; as part of RWS project, NTF installed new pump and drive; village has installed meters on directly-connected houses
14.	Duman Aniz	Imwran Aniz	2,500	3,750	Bore hole	150 (est.)	Four ground tanks (steel)	15-50	Vertical turbine directly connected, plus three centrifugal pumps to provide 750M of lift	Project involves ten villages; carried by ministry and NTFAS four projects; highest village 750 M from valley floor; German commodities installed; plans have been made by villages (VIALCCD) to install water meters

Sites Visited With Selected Characteristics cont.

No.	System	Nahiya	---Population---		-----Source-----		---Storage---		Pump Type	Remarks
			Survey	Design	Type	Depth (m)	Type	Vol. (m ³)		
15.	Hijdrat Man Kadah	Filaabah	2,000	3,000	Bore hole	50	Two ground tanks (steel)	50 each	Electric submersion	Typical "earthquake village" installation; two villages involved (Hijdrat and El Markadah); old villages partially abandoned due to earthquake plus new villages served; spread of new village required second storage tank; German commodities used
16.	Al Qumah	Filaabah	700	1,050	Bore hole	100 (est.)	Low elev. tank (3-4 M high)	30	Vertical turbine belt drive	Bad earthquake damage; new bore hole constructed by villagers for project; German commodities used
17.	Afq	Filaabah	1,400	2,100	Bore hole	85	Ground	60	Vertical turbine belt drive	AID rehabilitation project as part of earthquake assistance; large number of public taps (34) provided

Sites Visited With Selected Characteristics cont.

No.	System	Nahiya	---Population---		-----Source-----		---Storage---		Pump Type	Remarks
			Survey	Design	Type	Depth (m)	Type	Vol. (m ³)		
18.	Jurjur	Al Mawasit	1,200	1,800	Bore hole	120	Two ground tanks	15 & 50	Electric submersion	Two villages included in project -- Jurjur and Al Aridha; (RWSD-installed lift station acts as intermediate booster to Al Arida;) total lift (well to village) about 500 M; villagers improved road, installed roof tanks plus meters in addition to contributing to project cost
19.	Al Madhaf	Al Shamaatatyn	1,000	1,500	Bore hole	75	Ground	60	Electric submersion	Several villages included in project; pump and drive installed as part of project

TABLE D-2

NEW TRANSCENTURY FOUNDATION/USAID ACTIVITIES 1981-PRESENT

1981-1982 SUB-PROJECT
DIRECT YEARLY COSTS

NAME	VILLAGE COSTS					IC/MPW COSTS					CONTRIBUTION		
	POPULATION	MATERIAL	LABOR	OTHER	SUB-TOTAL	MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP	TOTAL
1. Al-Hillah	1,088	69,303	16,072	-0-	85,375	60,273	166,198	42,402	29,417	5,000	303,290	22%:78%	388,665
2. As-Sa'adiyah*	1,240	91,208	30,277	-0-	121,485	91,208	64,211	29,352	36,514	5,000	226,285	35%:65%	347,770
3. Al-Muradifah*	891	69,303	21,891	-0-	91,194	65,541	57,785	28,510	44,629	5,000	201,465	31%:69%	292,659
4. Al-Khadhariyah	970	66,407	21,012	-0-	87,419	57,219	28,110	25,433	40,530	5,000	156,292	34%:66%	243,711
5. Al-Mahad	1,100	65,402	16,192	-0-	81,594	65,541	23,767	9,586	-0-	3,000	101,894	44%:56%	183,488
6. Marwan	1,125	19,200	9,450	-0-	28,650	37,460	54,696	1,728	4,250	5,000	103,134	22%:78%	131,784
7. Bayt Al-Hindi	200	13,530	17,150	-0-	30,680	22,086	52,985	1,728	4,400	3,000	84,199	27%:73%	114,879
8. Bayt Al-Ansi	300	15,380	16,750	-0-	32,130	38,318	42,692	1,728	-0-	3,000	85,738	27%:73%	117,868
9. As-Sayh	600	5,830	18,850	-0-	24,680	29,661	13,977	1,728	-0-	8,483	53,849	31%:69%	78,529
10. Unayziah*	895	10,575	68,900	21,000	100,475	97,850	37,000	12,685	35,000	3,200	185,735	35%:65%	286,210
11. Bayt Muftah	825	12,500	47,630	-0-	60,130	119,495	37,190	12,900	-0-	5,000	174,585	10%:90%	234,715
12. Al-Maweer	750	830	23,170	10,380	34,380	111,764	53,148	8,750	-0-	7,000	180,662	16%:84%	215,042
13. Dar Al-Qadhi*	480	10,500	14,966	3,950	29,416	42,155	15,145	17,400	-0-	3,000	77,720	27%:73%	107,136
14. Nub	630	605	10,690	2,110	13,405	28,314	7	5,928	-0-	3,000	44,985	19%:81%	58,390

14 Sub-Projects 1981 - 1982

*Received Sanitation Project, costs not included.

Total Direct Sub-Project Costs 2,800,846

1983 SUB-PROJECT
DIRECT YEARLY COSTS

NAME	DESIGN POPULATION	VILLAGE				IC/MPW COSTS					CONTRIBUTION		
		MATERIAL	LABOR	OTHER	SUB-TOTAL	MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP	TOTAL
1.15 Bayt 'Idhaqah	1,710	45,100	55,200	3,500	103,800	58,185	20,250	1,728	-0-	3,500	83,663	55%:45%	187,463
2.16 Bayt Al-Faqih	1,020	7,930	53,630	10,360	71,920	207,370	40,270	15,095	10,800	8,000	281,535	20%:80%	353,455
3.17 Bayt Kahin	684	22,060	15,500	13,090	50,650	53,699	8,478	7,833	-0-	3,000	73,010	41%:59%	123,660
4.18 Al-Marbak*	2,175	12,700	33,320	6,600	52,620	59,173	23,692	10,230	-0-	2,384	95,479	36%:64%	148,099
5.19 Al-Husayah Al-Ulya	1,155	25,840	70,950	7,875	104,665	67,246	14,545	11,440	30,050	7,000	130,281	45%:55%	234,946
6.20 Al-Husayah As-Sufia	1,875	17,890	18,550	7,875	44,315	112,096	14,545	11,026	-0-	7,000	144,667	23%:77%	188,982
7.21 Al-Mahallah	1,350	10,750	9,000	20,315	40,065	114,232	30,447	19,850	30,500	5,000	200,029	17%:83%	240,094
8.22 As Sawlah	1,275	10,750	9,000	20,315	40,065	124,979	30,447	19,850	30,200	5,000	210,476	16%:84%	250,540
9.23 Ad-Damigh	1,095	4,150	17,440	1,800	23,390	62,990	14,350	1,728	-0-	7,450	86,518	21%:79%	109,908
10.24 Dayr Andam	2,070	72,880	24,120	5,400	102,400	130,037	30,160	5,500	-0-	10,000	175,697	37%:63%	278,097
11.25 Al-Mujamilah	1,300	30,000	35,000	3,900	68,900	110,185	37,535	13,315	34,400	10,000	205,435	34%:66%	274,335
12.26 Al-Wisabah	560	46,255	20,455	3,900	70,610	44,834	34,673	12,535	31,800	10,450	134,292	34%:66%	204,902
13.27 Al-Murabah	798	10,825	28,730	34,500	74,055	77,631	34,034	13,985	33,200	9,330	168,180	31%:69%	242,235
14.28 Al-Murabah	3,000	3,000	13,000	18,500	34,500	60,000	15,000	2,000	-0-	5,000	82,000	30%:70%	116,500
15.29 Al-Ma'een	375	19,870	21,795	-0-	41,665	111,785	16,220	10,220	-0-	5,000	143,225	24%:76%	184,890
16.30 Rubad	399	70,900	16,400	8,774	96,074	71,811	5,060	50,999	-0-	14,000	141,870	20%:80%	237,944
17.31 At-Turbah	530	12,300	21,455	36,700	70,455	71,462	22,802	8,775	38,500	11,000	152,539	32%:68%	222,994
18.32 Al-Muraba'	1,268	10,825	28,730	37,750	77,305	120,862	30,245	13,285	35,600	11,500	211,492	27%:73%	288,797
19.33 Kohlan	465	8,500	44,239	8,300	61,039	88,303	29,321	9,460	-0-	3,000	130,084	32%:68%	191,123

19 Sub-Projects 1983

*Received Sanitation Project, costs not included

Total Direct Sub-Project Costs 4,078,964

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1983 & 1984 DHAMAR SUB-PROJECT
DIRECT COST

NAME	DESIGN POPULATION	VILLAGE COSTS				SUB-TOTAL	IC/MPW COSTS				CONTRIBUTION		
		MATERIAL	LABOR	OTHER			MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP
1. Dhawran Anis	5,940	3,900	10,605	850	15,355	79,691	59,615	8,519	-0-	4,200	152,025	9%:91%	167,380
2. Al-Lahge	1,500	2,080	995	250	3,325	12,400	7,063	1,800	-0-	2,100	23,363	12%:88%	26,688
3. Ad-Darb I	1,800	11,950	24,200	23,500	59,650	153,660	61,100	9,500	-0-	10,000	234,260	19%:81%	293,910
4. As-Sayh	3,500	5,460	19,600	2,600	27,660	34,270	12,750	9,640	-0-	4,300	60,960	31%:69%	88,620
5. Bani Shaikh	2,250	11,280	21,570	2,300	35,150	22,380	14,680	1,390	-0-	3,800	42,250	35%:65%	77,400
6. Bani Saber	1,800	6,870	14,630	1,900	23,400	12,826	13,620	1,420	-0-	2,700	30,566	43%:57%	53,966
7. Al-JabJab	1,500	800	8,900	1,600	11,300	29,992	16,806	2,210	-0-	1,800	50,808	22%:78%	62,108
8. Yafa'	3,000	28,750	30,800	1,750	61,300	84,575	68,680	8,460	-0-	5,400	167,115	24%:76%	228,415
9. Bani Swede	950	25,460	54,042	8,508	88,010	80,260	40,460	2,300	-0-	3,700	126,720	41%:59%	214,730
10. Talab	2,000	74,490	54,510	9,290	138,290	183,334	52,975	14,760	-0-	6,700	177,769	44%:56%	316,059
11. Bayt Al-Akwa	450	2,900	10,900	450	14,250	22,130	14,350	1,790	-0-	750	39,020	27%:73%	53,270
12. Asherwes	1,750	14,640	40,800	37,800	93,240	218,559	95,668	13,606	-0-	12,500	340,333	21%:79%	433,573
13. Bayt Faraj & Rada'	675	5,800	22,500	12,050	40,350	34,620	30,220	6,390	-0-	5,130	76,360	31%:69%	116,710
14. Al-Khalaqah	750	9,330	30,000	34,700	74,030	59,607	45,770	8,900	-0-	2,890	117,167	39%:61%	191,197
15. Afq	2,100	9,000	39,500	19,500	68,000	173,863	58,210	8,992	-0-	6,000	247,865	22%:78%	315,856
16. Bayt Al-Umais	2,175	4,600	23,300	10,133	38,033	63,829	46,140	6,630	-0-	1,245	117,844	24%:76%	155,877
17. Burhan	750	14,160	31,400	18,300	63,860	79,475	49,325	4,920	-0-	5,600	139,320	31%:69%	203,180
18. Al-Breika	450	2,000	10,500	13,000	25,500	51,551	26,500	4,275	-0-	3,000	85,326	23%:77%	110,826

18 Sub-Projects in Dhamar for 1983 & 1984

Total Direct Sub-Project Costs 1983 1,529,276
1984 1,579,6891985 DHAMAR SUB-PROJECT
DIRECT YEARLY COST

NAME	DESIGN POPULATION	VILLAGE COSTS				SUB-TOTAL	IC/MPW COSTS				CONTRIBUTION		
		MATERIAL	LABOR	OTHER			MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP
1. Hanser	1,200	6,330	25,200	5,200	36,730	48,366	36,430	4,791	-0-	5,375	94,962	28%:72%	131,692
2. Al-Jayah	390	1,080	15,000	6,350	22,430	44,731	20,376	3,000	-0-	2,600	70,787	24%:76%	93,137
3. Bani Shajera	750	4,500	29,000	22,700	56,200	238,440	3,050	11,500	-0-	14,000	266,990	18%:82%	323,190
4. Al-Nowaid	2,250	17,000	30,000	28,800	75,800	220,214	27,600	9,500	-0-	8,000	265,314	22%:78%	341,114
5. As-Sillian	960	10,300	9,500	23,690	43,490	43,644	39,500	3,900	-0-	6,500	93,544	32%:68%	137,034
6. Rahah	535	2,500	33,600	23,840	59,940	192,278	29,000	15,500	-0-	18,000	236,778	20%:80%	296,718
7. Mariah	1,200	2,500	18,240	22,500	43,240	281,567	34,600	7,734	-0-	17,000	340,901	11%:89%	384,141
8. Al-Qa'mah	1,050	5,000	28,800	22,000	55,800	227,947	29,000	6,000	-0-	12,000	274,497	17%:83%	330,297
9. Bani Saif	2,000	-0-	19,000	7,000	26,000	79,098	15,000	5,000	-0-	10,000	109,098	19%:81%	135,098
10. Al-Thejaf	1,200	2,500	38,400	33,200	74,100	258,183	33,200	15,000	-0-	16,500	322,883	19%:81%	396,983
11. Jalab	675	2,500	31,500	23,900	57,900	226,919	33,900	15,000	-0-	14,000	289,819	17%:83%	347,719
12. Zerajah I	2,250	1,250	22,500	3,500	27,250	266,745	35,850	10,250	-0-	15,000	327,845	8%:92%	355,095
13. Zerajah II	2,250	1,250	22,500	3,500	27,250	266,745	35,850	10,250	-0-	15,000	327,845	8%:92%	355,095
14. Qa'wan	735	2,500	23,400	18,500	44,400	285,180	23,100	9,000	-0-	17,500	334,780	12%:88%	379,180
15. Al-Melha	1,500	2,500	20,800	24,700	48,000	102,000	22,860	4,587	-0-	28,000	457,592	10%:90%	505,592
16. Bani Morrah	375	2,500	12,000	20,200	34,700	54,444	20,600	7,000	-0-	10,000	92,044	23%:77%	126,744
17. Qahlan	2,400	2,500	28,800	26,000	57,300	118,719	31,877	7,721	-0-	35,150	393,467	13%:87%	450,767
18. Amed	1,500	2,500	24,960	38,300	65,760	147,736	31,916	7,500	-0-	29,000	416,152	14%:86%	481,912
19. Al-Haniya	675	2,000	14,720	22,600	39,320	113,996	17,299	5,707	-0-	17,000	254,002	13%:87%	293,322
20. Az-Zayedah	1,200	2,500	32,000	37,000	71,500	118,920	28,150	9,200	-0-	21,000	277,270	21%:79%	348,770

20 Sub-Projects in Dhamar 1985

Total Direct Sub-Project Costs 6,213,600

TABLE D-2 (continued)

1984 SUB-PROJECT
DIRECT YEARLY COSTS

NAME	DESIGN POPULATION	VILLAGE COSTS				SUB-TOTAL	IC/MPW COSTS				CONTRIBUTION		
		MATERIAL	LABOR	OTHER			MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP
1.34 Nibahan	1,500	2,000	21,000	4,000	27,000	130,000	30,000	3,000	-0-	5,000	168,000	14%:86%	195,000
2.35 As-Saba'	1,125	13,600	24,535	41,500	79,635	80,602	21,146	10,267	35,400	3,000	150,415	25%:65%	230,050
3.36 Suthan	545	20,705	27,400	46,600	94,705	114,345	38,250	2,131	-0-	24,040	178,766	35%:65%	273,471
4.37 Mahwah I	945	---	---	---	83,082	48,082	35,463	14,521	33,913	23,920	155,899	35%:65%	238,981
5.38 Mahwah II	945	---	---	---	83,082	48,082	35,463	14,521	33,913	23,920	155,899	35%:65%	238,981
6.39 Talab Ar-Rayashah	1,484	83,780	54,510	-0-	138,290	110,034	42,975	4,760	-0-	10,000	167,769	44%:56%	306,059
7.40 Al-Jarubah	1,200	27,100	32,600	15,000	74,700	125,383	28,464	2,000	35,900	26,904	218,651	25%:75%	293,351
8.41 Quba'ah	720	7,500	14,133	6,000	27,633	79,340	10,336	3,441	-0-	5,000	98,117	20%:80%	125,750
9.42 Al-Dha'if	1,800	7,500	18,226	11,000	36,726	158,074	20,172	3,882	-0-	10,000	192,128	15%:85%	228,854
10.43 Kawakirah	1,290	54,340	10,730	4,880	69,950	95,408	16,387	14,221	36,500	8,000	170,516	29%:71%	240,466
11.44 Dar Al-Hisi (East)	1,965	2,035	5,772	67,946	75,753	53,050	23,598	18,809	33,873	6,702	136,032	36%:64%	211,785
12.45 Dar Al-Hisi (West)	1,965	2,035	5,772	67,946	75,753	53,050	23,598	18,809	33,873	6,702	136,032	36%:64%	211,785
13.46 Al-Hisi Al-Jadidah	675	81,480	5,760	-0-	87,240	23,276	6,530	2,255	-0-	3,000	35,061	71%:29%	122,301
14.47 Bayt Al-Hawri (East)	870	50,000	9,450	5,625	65,075	100,990	16,627	3,693	36,500	5,000	162,810	29%:71%	227,885
15.48 Bayt Al-Hawri (West)	990	50,000	9,450	5,625	65,075	100,990	16,627	3,693	36,500	5,000	162,810	29%:71%	227,885
16.49 Todhan	2,250	35,840	6,900	-0-	42,740	68,554	57,119	10,299	-0-	5,000	140,972	22%:78%	183,712
17.50 Mayfa'ah	900	5,200	10,000	42,720	57,920	50,949	21,477	13,626	-0-	5,745	91,797	38%:61%	149,717
18.51 Bayt Shu'ayb	375	11,356	10,676	2,700	24,732	31,034	10,767	3,148	-0-	4,000	48,949	34%:66%	73,681
19.52 Bayt Juma'an	420	7,800	19,650	21,400	48,850	106,646	8,775	8,108	-0-	2,660	126,189	28%:72%	175,039
20.53 Kashah	630	31,330	37,020	5,200	73,550	79,545	18,750	2,200	-0-	2,500	102,995	42%:58%	176,545
21.54 Al-Makhadh	810	43,400	51,580	-0-	94,980	120,645	22,344	10,022	-0-	3,000	156,011	38%:62%	250,991
22.55 Bayn 'Urrayn	660	34,570	47,533	-0-	82,103	176,677	25,466	10,994	-0-	3,000	216,137	28%:72%	298,240
23.56 Asal	2,160	660	19,680	3,075	23,415	245,540	13,500	6,500	-0-	5,375	270,915	8%:92%	294,330
24.57 Jawajib	510	12,000	10,000	13,800	35,800	83,427	29,787	16,699	45,000	8,205	183,118	17%:83%	218,918
25.58 Labadah	567	64,350	9,600	5,000	78,950	65,670	21,316	9,545	36,250	9,664	142,445	36%:64%	221,393
26.59 Suq Ar-Rubu	465	14,200	15,600	51,800	81,600	51,928	19,728	7,648	36,500	13,200	129,004	39%:61%	210,604

26 Sub-Projects 1984

*Received Sanitation Project, costs not included

Total Direct Sub-Project Costs 5,625,776

1985 SUB-PROJECT
DIRECT YEARLY COSTS

NAME	DESIGN POPULATION	VILLAGE COSTS				SUB-TOTAL	IC/MPW COSTS				CONTRIBUTION		
		MATERIAL	LABOR	OTHER			MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP
1 .60 Al-Natiyah	1,080	22,400	40,313	5,000	67,713	54,926	17,067	12,712	-0-	7,598	92,303	42%:58%	160,016
2 .61 Hawqari	480	14,100	21,656	3,400	39,156	40,066	8,799	7,048	-0-	3,767	59,680	40%:60%	98,836
3 .62 Quhazah	450	14,900	10,250	9,160	34,310	41,150	27,045	350	-0-	8,050	76,595	31%:69%	110,905
4 .63 Ar-Ragah	1,410	26,400	48,500	6,375	81,275	225,420	30,500	1,500	-0-	6,500	263,920	24%:76%	345,195
5 .64 Maham Klihiin	750	17,300	28,000	5,200	50,500	50,840	11,070	1,500	-0-	11,500	74,910	40%:60%	125,410
6 .65 Bayt Shubail	950	22,200	30,980	9,900	63,080	89,025	22,500	1,200	-0-	13,000	125,725	33%:67%	188,805
7 .66 Al-Hussein	700	25,050	23,580	9,000	57,630	112,932	22,315	5,446	-0-	4,000	144,693	28%:72%	202,323
8 .67 Sa'awan	1,422	8,000	17,200	84,200	109,400	81,411	20,411	9,998	35,000	1,500	140,320	42%:58%	257,720
9 .68 Bayt Amr	1,090	5,900	12,800	3,400	22,100	160,285	15,200	6,300	30,000	6,027	217,890	9%:91%	239,990
10.69 Kharabet Qayfan	600	23,000	27,400	5,000	55,400	76,303	16,540	5,973	-0-	3,500	102,316	35%:65%	157,716

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1985 SUB-PROJECT
DIRECT YEARLY COSTS

TC/MPW COSTS

NAME	VILLAGE COSTS					TC/MPW COSTS					CONTRIBUTION		
	DESIGN POPULATION	MATERIAL	LABOR	OTHER	SUB-TOTAL	MATERIAL	LABOR	EQUIP	SUB-CON	TRANSPORT	SUB-TOTAL	V:TC/MP	TOTAL
11.70 Al-Mukaysha	2,350	:27,940	: 64,715	: 24,750	:117,405	255,719	:131,709	: 2,570	: -0-	: 25,512	: 415,510	22%:78%	532,91
12.71 Al-Quriyah	2,200	:36,875	: 49,288	: 9,950	: 96,113	141,874	: 49,547	: 3,160	: -0-	: 27,000	: 221,581	26%:70%	317,69
13.72 Hudhlan Sha'ab	1,650	:31,183	:100,575	: 14,010	:145,768	342,249	: 85,095	: 4,472	: -0-	: 21,317	: 453,133	24%:76%	598,98
14.73 Juhaya	1,750	:21,050	: 62,320	:32,660	:116,030	315,628	: 59,741	:82,610	: -0-	: 19,974	: 477,953	20%:80%	593,98
15.74 Ash-Shabayn	570	: 8,955	:139,000	:12,790	:160,745	410,128	: 71,494	: 2,410	: -0-	: 9,895	: 493,927	25%:75%	654,67
16.75 Al-Habeel	2,550	: 9,005	:151,165	:25,240	:185,410	439,875	: 82,196	: 2,680	: -0-	: 11,898	: 536,641	26%:74%	722,85
17.76 Jaabah	4,275	:25,980	: 74,675	: 9,465	:110,120	237,262	: 69,365	:146,365	: -0-	: 22,800	: 474,792	19%:81%	585,91
18.77 Jalaheef	375	:	:	:	: 97,290	:	:	:	:	:	: 120,470	%: %:	
19.78 Ash-Shuab	930	:49,600	: 67,125	: 3,150	:119,875	114,717	: 29,500	: -0-	: 36,000	: 8,100	: 188,317	39%:61%	388,19
20.79 Al-Ja'aminah	810	:56,280	: 12,000	: 4,000	: 72,280	51,744	: 18,700	:10,855	: 36,000	: 10,490	: 127,789	37%:63%	280,-
21.80 As-Sowlah	870	:54,800	: 45,875	: 3,000	:103,675	80,630	: 27,750	: 5,000	: 36,000	: 10,400	: 159,780	40%:60%	263,-
22.81 At-Tahabish	1,125	:42,000	: 21,000	: 3,000	: 66,000	90,044	: 22,580	: 9,531	: 30,000	: 12,500	: 164,655	29%:71%	230,6
23.82 Al-Kirnah	1,080	:39,500	: 21,000	: 3,000	: 63,500	92,005	: 15,200	: 9,531	: 36,000	: 12,100	: 164,836	28%:72%	228,3
24.83 AlQusaysah	1,305	:29,365	: 27,340	: 8,620	: 65,325	38,890	: 36,648	: 2,217	: 14,490	: 6,048	: 98,285	40%:60%	163,61

*Housing, Food, warehous, Equipment Transportation, etc.

TABLE D-3

NEW TRANSCENTURY FOUNDATION RURAL WATER SUPPLY PROJECTS, 1981-1985
(Total Costs in YR thousands, Per capita costs in YRs)

	Design Pop.	Current Pop	For. Ex. Per Costs Capita	Local Costs	Per Capita	TOTAL COSTS	Per Capita
1981-1982							
Al-Hillah	1,088	725	102.7	142	286.0	394	536
As-Saadiyah	1,240	827	120.6	146	227.2	275	421
Al-Muradifah	891	594	94.0	158	198.7	335	493
Al-Khadhariyah	970	647	82.6	128	161.1	249	377
Al-Mahad	1,100	733	75.1	102	108.4	148	250
Marwan	1,125	750	39.2	52	92.6	123	176
Bayt Al-Hindi	200	133	23.8	179	91.1	683	862
Bayt Al-Ansi	300	200	40.0	200	77.9	390	590
As-Sayh	600	400	31.4	79	47.1	118	196
Urayziah	895	597	110.6	185	175.6	294	480
Bayt Muftah	825	550	132.4	241	102.3	186	427
Al-maweer	750	500	120.6	241	94.4	189	430
Der Al-Qadhi	480	320	59.6	186	47.5	148	335
Mub	630	420	34.2	81	24.2	58	139
TOTAL	11,094	7,396	1,067	144	1,734	234	379
System Average			76.2		123.9		200.1
1983							
Bayt Idhaqah	1,710	1,140	59.9	53	127.6	112	164
Bayt Al-Faqih	1,020	680	222.5	327	131.0	193	520
Bayt Kahin	684	456	61.5	135	62.2	136	271
Al Marbak	2,175	1,450	69.4	48	78.7	54	102
Al Husayah Al Ulya	1,155	770	78.6	102	156.3	203	305
Al Husayah As Sufia	1,875	1,250	123.1	98	65.9	53	151
Al Nahallah	1,350	900	134.1	149	106.0	118	267
As Sawla	1,275	850	144.9	170	105.6	124	295
Ad Dawigh	1,095	730	64.7	89	45.2	62	151
Dayr Ahdan	2,070	1,380	135.5	98	142.6	103	202
Al Mujamilah	1,300	867	123.5	143	150.8	174	317
Al Misabah	560	373	57.3	133	147.6	395	549
Bunnah	798	532	91.6	172	150.6	283	455
Han Han	3,000	2,000	62.0	31	54.5	27	58
Al Maen	375	250	122.0	488	62.9	252	710
Rubad	399	266	122.8	462	115.1	433	894
Al Turbah	930	620	80.3	130	142.7	230	360
Al Murabah	1,268	843	134.2	159	154.6	193	342
Kohlan	465	310	97.8	315	93.4	301	617
TOTAL	23,304	15,669	1,986	127	2,093	134	260
System Average			104.5		110.2		214.7

TABLE D-3 (continued)

NEW TRANSCENTURY FOUNDATION RURAL WATER SUPPLY PROJECTS, 1981-1985

(Total Costs in YR thousands, Per capita costs in YRs)

	Design Pop.	Current Pop	For. Ex. Costs	Per Capita	Local Costs	Per Capita	TOTAL COSTS	Per Capita
1984								
Nibahan	1,300	1,000	133.0	133	62.0	62	195.0	195
As Saba	1,125	750	90.9	121	139.2	186	230.1	307
Suthan	545	363	116.4	320	157.1	432	273.5	753
Mahwah I	945	630	62.6	99	176.4	280	239.0	379
Mahwah II	945	630	62.6	99	176.4	280	239.0	379
Talab Ar Rayashah	1,484	989	114.8	116	191.3	193	306.1	309
Al Jarubah	1,200	800	127.4	159	166.0	208	293.4	367
Aubaah	720	480	82.7	111	43.1	90	125.8	262
Al Dhaif	1,800	1,200	162.0	135	66.9	56	228.9	191
Kawakirah	1,290	860	109.6	127	130.9	152	240.5	280
Dar Al Hisi	1,965	1,310	71.9	55	139.9	107	211.8	162
Dar Al Hisi	1,965	1,310	71.9	55	139.9	107	211.8	162
Al Hisi Al Jadidah	675	450	25.5	37	96.8	215	122.5	272
Bayt Al Hawri	870	580	104.7	181	123.2	212	227.9	393
Bayt Al Hawri	990	660	104.7	159	123.2	187	227.9	345
Todhan	2,250	1,500	78.8	53	104.9	70	183.7	122
Mayfaah	900	600	64.5	108	85.2	142	149.7	250
Bayt Shuayb	375	250	34.1	136	39.6	158	73.7	295
Bayt Jumaan	420	280	114.7	410	60.5	215	175.0	625
Kashah	630	420	81.7	195	94.8	226	176.5	420
Al Makhadh	810	540	130.6	242	120.4	223	251.0	465
Bayn Urrayn	660	440	187.7	427	110.5	251	298.2	678
Asal	2,160	1,440	252.0	175	42.3	29	294.3	204
Jawajib	510	340	100.1	294	118.8	349	218.9	644
Labadah	587	378	75.2	199	148.2	387	221.4	586
Sur Ar Rubuh	465	310	59.5	192	151.1	487	210.6	679
TOTAL	27,766	18,511	2,620	142	3,006	162	5,626	304
System Average			100.8		115.6		216.4	

TABLE D-3

NEW TRANSCENTURY FOUNDATION RURAL WATER SUPPLY PROJECTS, 1981-1985
(Total Costs in YR thousands, Per capita costs in YRs)

	Design Pop.	Current Pop.	For. Ex. Per Costs Capita	Local Costs	Per Capita	TOTAL COSTS	Per. Capita	

1985								
Al Madiyah	1,080	720	67.6	94	92.4	128	160.0	222
Hawqari	480	320	47.1	147	51.7	162	98.8	309
Qahazah	450	300	41.6	139	69.3	231	110.9	370
Ar Raqah	1,410	940	224.9	241	118.3	126	345.2	367
Mahaan Klibiin	750	500	52.3	105	73.1	146	125.4	251
Bayt Shubail	958	639	90.2	141	98.6	154	188.8	296
Al Mussein	708	472	118.3	251	84.0	178	202.3	429
Saawan	1,422	948	91.4	96	166.3	175	257.7	272
Bayt Amr	1,090	727	166.6	229	73.4	101	240.0	330
Kharabet Qaylan	600	400	82.3	206	75.4	189	157.7	394
Al Mukaysha	2,350	1,567	258.3	165	274.6	175	532.9	340
Al Quriyah	2,200	1,467	145.1	99	172.6	118	317.7	217
Mudhlan Shaab	1,650	1,100	346.7	315	252.2	229	598.9	544
Juhaya	1,750	1,167	398.2	341	195.8	168	594.0	508
Ash Shabayn	570	380	412.5	1086	242.2	637	654.7	1723
Al Habool	2,550	1,700	442.6	260	279.5	164	722.1	425
Jaabah	4,275	2,850	383.7	135	202.2	71	585.9	206
Jalaheef	375	250		0		0		0
Ash Shuab	930	620	114.7	185	193.5	312	308.2	497
Al Jaaminah	810	540	62.6	116	137.5	255	200.1	371
As Sowlah	870	580	85.6	148	177.9	307	263.5	454
Al Tababish	1,125	750	99.5	133	131.2	175	230.7	308
Al Kirnah	1,080	720	101.5	141	126.8	176	228.3	317
Al Qusaysah	1,305	870	41.1	47	122.5	141	163.6	188
TOTAL	30,788	20,525	3,876	189	3,411	166	7,287	355
System Average			168.5		148.3		316.8	

TABLE D-3

NEW TRANSCENTURY FOUNDATION RURAL WATER SUPPLY PROJECTS, 1981-1985
(Total Costs in YR thousands, Per capita costs in YRs)

	Design Pop.	Current Pop	For. Ex. Per Costs Capita	Local Costs	Per Capita	TOTAL COSTS	Per Capita	
Dhamar 1983 & 1984								
Dhawan Anis	5,940	3,960	88.2	22	79.2	20	167.4	42
Al Lahge	1,500	1,000	14.2	14	12.5	13	26.7	27
Ad Darb	1,800	1,200	163.2	136	130.7	109	293.9	245
As Sayh	3,500	2,333	43.9	19	44.7	19	88.6	38
Bani Shaikh	2,250	1,500	23.8	16	53.6	36	77.4	52
Bani Saber	1,800	1,200	14.2	12	39.8	33	54.0	45
Al JabJab	1,500	1,000	32.2	32	29.9	30	62.1	62
Yafa	5,000	2,000	93.1	47	135.3	68	228.4	114
Bani Sede	950	633	82.6	130	132.1	209	214.7	339
Talab	2,000	1,333	118.1	89	198.0	149	316.1	237
Bayt Al Akwa	450	300	23.9	80	29.4	98	53.3	178
Asherwes	1,750	1,167	232.2	199	201.4	173	433.6	372
Bayt Faraj & Rada	675	450	41.0	91	75.7	168	116.7	259
Al Khalaqah	750	500	68.5	137	122.7	245	191.2	382
Afq	2,100	1,400	182.9	131	132.2	94	315.1	225
Bayt Al Unaisy	2,175	1,450	70.4	49	85.5	59	155.9	108
Burhan	750	500	84.4	169	118.8	238	203.2	406
Al Breika	450	300	55.9	186	54.9	183	110.8	369
TOTAL	33,340	22,227	1,433	64	1,676	75	3,109	14
System Average			79.6		93.1		172.7	
Dhamar 1985								
Hanser	1,200	800	53.2	67	78.5	98	131.7	16
Al Jayah	390	260	47.7	183	43.4	175	93.1	35
Bani Shajera	750	500	249.9	500	73.3	147	323.2	64
Al Nowaid	2,250	1,500	229.7	153	111.4	74	341.1	22
As Sillan	960	640	47.5	74	89.5	140	137.0	2
Rahah	535	357	207.8	583	88.9	249	296.7	8
Mariah	1,200	800	289.3	362	94.8	119	384.1	4
Al Qawah	1,050	700	233.9	334	96.4	138	330.3	4
Bani Saif	2,000	1,333	84.1	63	51.0	38	135.1	1
Al Thjaf	1,200	800	273.2	342	123.8	155	397.0	4
Jalab	675	450	241.9	538	105.8	235	347.7	7
Zerajah I	2,250	1,500	277.0	185	78.1	52	355.1	2
Zerajah II	2,250	1,500	277.0	185	78.1	52	355.1	2
Bawan	735	490	294.2	600	85.0	173	379.2	7
AlMelha	1,500	1,000	406.6	407	99.0	99	505.6	5
Bani Morrah	375	250	61.4	246	65.3	261	126.7	5
Bahlan	2,400	1,600	386.4	204	124.4	78	450.8	2
Azed	1,500	1,000	353.2	355	126.7	127	481.9	4
Al Haniya	675	450	219.7	488	73.6	164	293.3	6
Az Zayeday	1,200	800	228.1	285	120.7	151	348.8	4
TOTAL	25,095	16,730	4,404	263	1,810	108	6,214	
System Average			220.2		90.5		310.7	

TABLE D-3

NEW TRANSCENTURY FOUNDATION RURAL WATER SUPPLY PROJECTS, 1981-1985
 (Total Costs in YR thousands, Per capita costs in YRs)

	Design Pop.	Current Pop.	For. Ex. Costs	Per Capita	Local Costs	Per Capita	TOTAL COSTS	Per Capita
GRAND TOTAL System Average	151,587	101,058	15,385.0	128.2	13,730.9	114.4	29,115.9	288



APPENDIX E

Requirements for Additional Levels of Coverage

Preliminary results from the just-completed 1986 census show Yemen's total population at 8,106,000, excluding Yemeni emigrants. According to this recent census, the five largest cities -- Sana'a, Taiz, Hodeidah, Ibb and Dhamar -- account for 11 percent of Yemen's total population as against only 6 percent in 1975. Despite this sharp rise in urbanization, Yemen remains overwhelmingly rural. However, a disaggregation of the preliminary 1986 census results by other than governorate or principal city is not yet available. Only the 1975 Census provides a breakdown of population by settlement size. According to the 1975 Census, the distribution of population by settlement size as shown below:

Table E-1

Population Distribution by Settlement

Settlement Size	Population (000's)	Percent of Total
10,000 +	354.7	7.5
5,000-10,000	69.9	1.5
2,000-5,000	99.7	2.1
950-2,000	643.2	13.7
0-950	<u>3,537.8</u>	<u>75.1</u>
TOTAL	4,705.3	100.0

The 1975 census indicates that some 89% of the Yemeni population resided in settlements of 2,000 population or less. As shown by the 1986 preliminary census data, in the intervening years there has been a rapid rise in the rate of urbanization, as evidenced in the growth in the five largest cities. Moreover, with the high earnings occasioned by the oil boom in the Gulf and Saudi Arabia, marginal agricultural lands have been abandoned.

As a result, it would be reasonable to presume that the proportion of the total population accounted for by settlements of 2,000 persons or less has declined. On this basis, the proportion of the resident Yemeni population residing in villages of 2,000 or less might be very conservatively estimated at 75 percent of the 1986 preliminary census total, or some 6.1 million of the total in country estimated of 8.1 million.

Estimates of Investments Required for Coverage of Total Rural Population

If the assumption is made that 1.9 to 2.3 million people in this rural population are already served by adequate water supply and distribution systems (see Section 2.2.2) an estimated 3.8 to 4.2 million persons residing in rural areas still require new or upgraded water supply and distribution systems. (This

value will increase from 500,000 to 1,000,000 if the number of Yemenis abroad are counted.) Capital costs for extending adequate water supply and distribution systems to a rural population roughly estimated at 3.8 million persons. Based upon NTF's work a typical system requires the following investment:

Bore hole at YR2000/m with average depth of 150 meters	YR300,000
Pump and generator set \$40,000 or YR450,000	YR450,000
Distribution System Cost NTF 1985 approximate average Cost per System, YR250,000	<u>YR250,000</u>
TOTAL	YR1,000,000

The 120 water supply projects completed by NTF between 1981 and 1985 served a total of 100,800 persons, or an average of some 840 persons. Assuming each future rural water supply system would provide service to this "average" number of beneficiaries, per capita capital costs (1986 level) are estimated at approximately YR1,200. Applying this estimated per capita investment costs to the estimated population of 3.8 to 4.2 million people requiring new or upgraded water systems results in a total capital cost for total coverage of YR4.6 to 5 billion.

Estimated Investments Required for Coverage of Fifty Percent of the Rural Population Over the Third FYP

If rural population growth rates are assumed at 2 percent a year, the rural population, by the end of the Third FYP, can be estimated at approximately 6.7 million. If growth is assumed constant in every village, the incremental 600,000 persons includes a component of about 200,000 due to growth in the 1.9 to 2.3 million persons assumed served in 1986. Thus, the number of rural villagers served in 1992 from systems existing in 1986 would be approximately 2.1 to 2.5 million (this assumes capacity has been included in the systems for growth -- a good assumption based upon the design criteria of many agencies, examined for this evaluation).

If YARG set 50 percent coverage as their service target for rural water supply by the end of the Third FYP, approximately 3.4 million people would have service, or an additional 900,000 to 1,300,000 villagers for whom new systems were required. Using the YR1,200 per capita value as discussed above, the 50 percent target would require an estimated YR1.1 to 1.6 billion investment over the Third FYP. This is more realistic than the investment levels required to

provide service to 6.1 million persons. However, it represents a level of expenditure almost equal to the roughly-estimated totals (YR1.6 billion -- see Section 2.2.2) spent in the entire rural water sector for the ten preceding years by all government and local institutions, and the villages themselves.

Other Considerations

The investment (capital) cost is only part of the problem. To reach 50 percent coverage by the end of the Third FYP, (or to provide water supply to 900,000 to 1,300,000 additional persons), approximately 1,200 systems would be required; (assuming each system serves roughly an average of 750-1,000 persons) or roughly 240 systems per year. Even if allowances are made for the systems villagers might install themselves, the absorptive capacity of RWSD with its present low staffing levels and great need for trained engineers would not be nearly high enough to implement these numbers of systems.

Thus, with growing needs in terms of staff and capital, RWSD finds itself in a dilemma in terms of the budget it can expect from the Central Government. (Competition for government resources is great from all sectors, especially the related urban water supply and irrigation sectors.) Further, other agencies appear to be "moving out" of the rural water sector. (Future MAF will not include rural water supply components and FLCCD appears not to have the budget to provide, directly, monetary aid to projects.

From the above, a 50 percent coverage target may be too ambitious. The only way it could be approached is if RWSD is funded at much drastically higher levels, allowing the organization both to contribute to projects and increase its staff.

(A note of caution should be given concerning the above analysis. It should be treated as an illustrative example, using preliminary census data and crude cost estimates presented to produce some very rough estimates of rural water sector investment needs. The analysis, while admittedly based on rough estimates, does indicate on a "ball park" basis the problems faced by RWSD.)

Table E-2

Past Donor Aid

Country or Organization	Cost (U.S.\$)	Components	Estimated Duration	Implementing Agency	Status
1. Saudi Project	26.1 million	50 complete systems, including wells, tanks, pumps, generators, pump houses, transmission and distribution lines for towns of 1,500 to 12,000	Phase I (drilling) 11-22-83 to 8-85, to be followed by Phase II--civil works-- and Phase III--pump installation; project expected to last about 5 years (completed)	Saudi Projects Office with al-Watari (Yemeni Construction Company)	Drilling phase expected to last 15-17 months, until Spring, 1985
2. Iraqi Assistance	4 million	30 deep wells, and sometimes the provision of pumps and generators	March, 1982 to May, 1984 (completed)	Iraqi contractors with 3 drilling rigs, 13 technical staff & 1 Chief-of-Party	34 wells drilled
3. UN Assistance					
UNICEF	1,984,000	50 water resource development projects, including tanks pipelines, pumps & generators	30 May 1982 to 31 December 1984 (extended)		50 systems for primary health care centers; 3 completed
UNCDF	2,087,000	45 projects--resource improvements, including tanks, pipelines, pumps & generators	30 May 1982 to 30 October 1984; agreement will probably be extended		52 projects surveyed; all commodities imported; project status unknown
UNDP	1.7 million	Technical assistance to RWSD	Concluded		Not to be continued
WHO	349,000	Technical assistance to RWSD	To end April 1986		2 advisors on board

Past Donor Aid cont

Country or Organization	Cost (U.S.\$)	Components	Estimated Duration	Implementing Agency	Status
4. Japanese Assistance					
Phase I (grant aid)	1,980,000	5 complete systems in Sana'a, Haffah and Taiz	10 August 1982 to 15 March 1984 (completed)	Nisshoiwai Corp. Nissako Corp.	
Phase II (grant aid)	2,009,000	2 complete systems for 17 villages	7 March 1981 to 15 March 1984 (completed)		
Phase III (loan)	<u>2,678,000</u> 6,667,000	3 projects for 16 villages	Consulting agreement signed 31 July 1981; duration unknown (completed)		
5. Arab Fund for Economic & Social Development	2,396,419 (200,000 Kuwaiti dinars)	10 projects, including pumps & fittings, pipelines, extensions, civil works, technical services, & establishment of regional offices			
6. Dutch Projects	2,787,456	14 projects, including civil works for wells previously drilled by Dutch project in Radah and Dhamar	4 October 1983 to August 1985 (extended)		2 staff in country; program being revised
7. German Assistance for Dhamar Earthquake Rehabilitation	2,192,982	45 sites to provide tanks, pumps, and distribution systems	12 March 1981 (continuing)	KPS Corp. has been selected as contractor	Some commodities used for projects in Dhamar under 044 supervision; two advisors arrived September, 1985

Past Donor Aid cont.

Country or Organization	Cost (U.S.\$)	Components	Estimated Duration	Implementing Agency	Status
8. American Government					
- USAID					
Phase I	6,900,000	55 projects	28 July 1980 to 30 September 1984 (extended)	New TransCentury Foundation	Extended for 5 years from October 1984 to September 30, 1989; emphasis to shift to institution building
Dhamar 1	500,000	18 projects			
Dhamar 2	<u>1,358,000</u>	<u> </u>			
	8,758,000	71 projects			

APPENDIX F
Input/Output Analyses and Data on
Performance of Grantee

Table F-1
Project Output Analysis

Outputs	Quantity	%	Achieved	Achieved	Remarks
1. <u>Physical</u>					
- Rural Water Systems	100				
Actual 6/30/86		69		69	
Estimate 9/30/86		84		84	
- Sanitation Projects	22		3	14	(1)
- Gabion Check Dams	5		2	40	
2. <u>Institutional</u>					
- Office of Planning & Management created	1		N/A	40	(2)
- Rural Water Supply Div. reorganized & restructured	N/A		0	0	
- RWSD staff assigned for admin., planning & training	5		0	0	
- Projects using FAR system	16		0	0	
- Establish hydraulics lab	1		1	100	
- Establish regional offices	3		3	100	
- Village studies on water usage & community health	4		1	25	
- RWSD becomes autonomous agency	N/A		0	0	
- Yemeni tech. as supervisors	30		32	106	(3)
- New admin/engineers	10		0	0	
- Private sector cont.	24		9	38	
- Villages trained in O&M	100		90	90	

(1) 3 under construction

(2) 2 of 5 positions filled; no YARG administrative order creating office

(3) RWSD staff seconded to NTF

Table F-2
Project Input Analysis

SMALL RURAL WATER SYSTEMS PROJECT

Input Item	Quantity Per Grant Agreement	Status as of 9/30/86	% Achieved
1. <u>Technical Assistance</u>			
- Expatriate (person years)	34	15	44
- Local hire staff (person years)	83	107	129
2. <u>Regional Training</u>			
- Fellowships - technical training (person years)	12	0	0
- Fellowships - public admin., etc. (person years)	10	0	0
3. <u>Short-Term Training</u> (person weeks)			
- Technical training	450	14	3
- Administrative training	120	0	0
- Health (sanitation)	100	6	6
- Private contractor training	96	4	4
- Systems O&M for villagers	800	720	90

Table F-3

**Project Staffing/Budget Analysis
(Excluding PCV's and ONV's)**

Category	Planned/Budgeted in Project Proposal for Year 2		Year 2 Implementation Plan/Budget		Change	
	No.	(\$000)	No.	(\$000)	No.	Change
<u>NTF Staff</u>	<u>No.</u>	<u>(\$000)</u>	<u>No.</u>	<u>(\$000)</u>	<u>No.</u>	<u>%\$Change</u>
NTF Expatriate Staff	9	428	10	457	+1	+7
NTF local Hire						
Technicians	11	130	23	175	+12	+35
Administration	17	199	16	159	-1	-21
NFT PSC's	0		3	71	+3	+100
NTF OPEX - TCN's	0		3	82	+3	+100
RWSD Seconded Staff						
Technical	18	73	32	82	+16	+12
Counterparts	2	15	4	12	+2	-20
TOTAL	57	845	91	1,038	+36	+23

Table F-4
Rural Water Supply Division Staffing
Comparative Analysis

Division Office	-----1984-----			-----1986-----		
	Total #	Total Yemeni	Total Yemeni Prot. & Tech.	Total #	Total Yemeni	Total Yemeni Prot. & Tech.
Projects Office	33	20	12	27	20	18
Drilling Section ²	19	15	15	19	15	15
Mechanich 1 Src. ²	26	23	18	24	21	18
Bilateral Affairs ²	28	20	11	27	24	11
Admn & Finance	21	19	3	25	23	3
Direction General's Office	4	4	2	4	4	2
Seconded to Project 279-044				18	18	18
TOTAL	131¹	101	61	144¹	125	85

¹Includes Opex and Volunteer staff

²Some staff seconded to project 279-044

Table F-5

**Financial Status and Analysis
Small Rural Water Systems Project**

(U.S.\$000)

Budget Item	Grant Budget	Funded to Date	Expenditures Actual and Estimated 9/30/86	Expenditures as % of Approved Budget (%)	Comparison of Planned vs. Actual Project Years 1 & 2				
					Planned in Proposal	Implementation Plan Budget	Actual Expenditures	% Expenditures vs. Planned	
								Proposal (%)	Imp.Plans (%)
Salary & fringe benefits	3,637	2,630	1,716	47	1,915	1,903	1,716	90	90
Overhead	734	541	354	48	347	355	354	102	100
Consultants	383	257	161	42	178	161	161	90	100
Travel & Transportation	1,016	650	556	55	636	725	556	87	76
Allowances	1,178	837	386	33	563	579	386	68	67
Vehicles	882	563	362	41	390	368	362	90	98
Equipment & Commodities	2,652	2,645	3,069	116	1,418	2,192	3,069	216	140
Training	413	290	323	78	239	425	323	135	76
Other Direct Costs	237	272	336	142	122	237	336	275	142
Total Direct Costs	11,181	8,685	7,265	65	5,799	6,945	7,265	125	104
G&A	1,319	1,024	846	64	684	819	846	124	103
TOTAL	12,500	9,709	8,111	65	6,482	7,764	8,111	125	104

Table F-6
Training and Education
Schedule XVII

(Costs increased @ 8 percent annually)

	Year 1 1985	Year 2 1986	Year 3 1987	Year 4 1988	Year 5 1989	TOTAL
1. 12 regional fellowships @ 6 months/fellowship for technical training @ \$4,000/fellowship	13,200	14,256	15,396	16,628	0	59,480
2. 10 fellowships in public administration @ 1 year/ fellowship @ \$8,800/ person/year	26,400	28,512	30,793	11,085	0	96,790
3. 1 international Bachelor's degree for undergraduate technical training @ \$22,000 per year	22,000	23,760	25,661	27,714	0	99,135
4. In-country training (pump and maintenance) 40 person months @ \$1,000/month	40,000	43,200	46,656	0	0	129,856
5. International seminars 2/year @ \$4,200/ seminar	8,400	9,072	9,798	0	0	27,270
Schedule XVII TOTAL	110,000	118,800	128,304	55,427	0	412,531

Table F-7

**Second Year Implementation Plan Budget
Schedule XVII: Training Programs**

Unit Cost Type of Training	(U.S. \$)	1986 Units	Expense
In-service training for NTF & MPW technicians	250 per course	10	2,500
Pump maintenance & repair training for villagers	400 per student	140	56,000
B.A. degree-level participant training	22,000/ student	4 FTE	88,000
Regional training: short- & long-term	10,000/ student	6.5 FTE	65,000
International seminars student	4,000 per 2	8,000	
Staff ESL training student	150 per 5	750	
Training allowances for MPW technicians	See attached subschedule		94,439
			<u>314,689</u>

APPENDIX G

**Suggested Areas of Concentration
for OPM and Training Programs**

Office of Planning and Management

The OPM can use the technical design manual it has prepared as the starting point for its technical training efforts. (This implies RWSD accepts this manual (or a revised version) as the basis for its project implementation.) In-house seminars and one-on-one instruction could be effected to train RWSD's engineers and technicians on how to use this manual as part of the project design and implementation process.

If possible, RWSD counterparts should be assigned to OPM to complement the training efforts and oversee implementation activities. Peace Corps volunteers could also be used in the training efforts, especially in elements concerning field surveys and design.

The 55 systems indicated by RWSD in need of rehabilitation and repair offer another vehicle which can be used for technical training. Planning the program to examine and repair these systems would be an excellent way to acquaint RWSD's engineers and technicians with program planning procedures and techniques. A subgroup could be established in RWSD's planning department to plan and implement the rehabilitation program for these 55 systems. (The subgroup could be staffed by two RWSD engineers and two technicians supplemented by two or three Peace Corps volunteers (water supply engineers or construction specialists. Supervision would be by NTF personnel and RWSD counterparts in the OPM.)

The work elements for this type of rehabilitation program are almost identical to those required for implementation of new systems. These elements include:

- o Identifying problems through field examination or surveys
- o Making required contacts with villagers and LCCD members
- o Negotiating agreements on needed repairs or rehabilitation work and design of same
- o Implementing, including the inspection and overseeing of required repairs or rehabilitation work
- o Record-keeping to track repairs and the systems' characteristics.

Thus, phasing several RWSD engineers and technicians into this proposed program would involve them in all elements of work required for actual system design and construction (albeit perhaps, on a somewhat limited scale).

The management and planning capability referred to in Section 6.3.1 concerns the development and establishment of systems which would allow RWSD to set its program limits by coordinating donor aid and commodities, with those available from central government funds. The system envisioned would be one which allowed RWSD to match various levels of commodities and budget requirements to the manpower needed to design, tender, and inspect construction of various numbers of water supply systems. (The planning and management systems required are those which would allow RWSD to determine the level of manpower and type of personnel required to install 50, 75, or 100 systems per year based upon a specified geographic distribution. Or, to determine, based upon

setting targets for new populations to be served per year (i.e., 50,000 or 100,000 persons per year throughout the Third FYP), the level and type of staff capabilities (and thus budget levels) required by RWSP.

A tracking system for projects could be effected employing the personal computer available in the OPN or others available to RWSD. A simple scheduling program could be established, updated on a regular basis, from field inspection reports. The data entered could include the normal data now entered into RWSD's individual project files, including the village name, Nahiya, governorate and general location, existing design and population, water sources, results of tests on source quantity and/or quality, cost of various system components, levels of village provided funds, commodities/funds from RWSD, and donors by system component, date for start and completion of surveys, design, and construction, dedication date, and any project repair or rehabilitation data. Reports from such a system could be used to form RWSD's badly needed central data base and used by RWSD in budget and program planning analysis.

Training

Training of village technicians to operate the systems has been discussed in several sections of the evaluation report. This successful continuance of this program must be carefully planned as the program's future activities may be constrained by NTF's available manpower and budget. (NTF's trainer is scheduled to leave the project in approximately six months. Moving the training to villages or points closer to villages will require careful planning and logistical control.)

NTF should submit a plan to accomplish this type of training as soon as is feasible. The plan should be flexible so that, if necessary, early efforts could act as pilot plans for future programs. It may be best to use contacts with the LCCDs to help select candidates. If possible, the use of the LCCD's facilities to aid in the provision of actual instruction should be exploited. (During the evaluation team's field work, such cooperative efforts were discussed on several occasions, especially as related to systems in Tihama.

The key element in this future program will be the personnel to be involved. NTF has indicated that they will attempt to replace their present training specialist with a Yemeni training specialist. This selection should carefully be monitored to ensure that the program starts on a positive basis. The actual composition of the training course material should be directly related to the equipment and facilities' needs of the systems. Material presented by NTF in earlier training efforts should provide the core material for presentation in this next round.