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NEW TRANSCENTURY FOUNDATION

Volume I & Volume III

Yemen Rural Water

OPG: Text and Appendices

Project Title:

Yemen Rural Water

Number 044

Project Location:

Sana'a, Yemen Arab Republic

PVO Name and Location:

The New TransCentury Foundation

1789 Columbia Road, N.W.

Washington, D.C. 20009

Central Headquarters:

Same

Contact Person:

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Date of Submission to AID:

Third Draft: 25 April 1979

Total OPG Request:

Three years:	$4,626,172
Five years:	$7,768,729

VOLUME I - OPG WITH SUMMARY FINANCIAL PLAN

VOLUME II - SCHEDULES FOR BUDGET

VOLUME III - APPENDICES

TABLE OF CONTENTS

		Page
I.	Facesheet	1
II.	Introduction and Summary Description of Project	2
III.	Methodology and Analysis:	5
	• social	6
	• economic	11
	• technical	12
	• administrative	14
	• environmental	16
IV.	Implementation Plan, with Beneficiary Criteria	17
V.	Financial Plan with Summary Budget	37
VI.	Evaluation Plan	38
VII.	Logical Framework	41

TABLES

		Page
I.	Project Surveys for Social Evaluation, 022	9a
II.	Time Saved & Benefits of Proposed Development	11a
III.	Cost per Beneficiary Ratio for Illustrative Sub-Project	11b
IV.	Project Surveys for Technical Evaluation, 022	13
V.	Distribution of Yemen's Population by Size of Settlement	21
VI.	Vehicles to be Procured under 044	33

CHARTS

I.	Present Functional Divisions within RWD	14a
II.	Possible Future Organization of RWD	32a

FACE SHEET

II. INTRODUCTION AND SUMMARY DESCRIPTION OF THE PROJECT

INTRODUCTION

This Operations and Program Grant (Number 044) addresses the lack of reliable drinking water supplies for rural villages in the Yemen Arab Republic. Approximately 90 percent of the population of Yemen live in rural villages, and the Ministry of Health states that access to water is extremely difficult for most of these people. Villages are often located on mountain tops for defensive purposes or to conserve agricultural land. Water sources are often distant from the village, and much time and energy is required to obtain household water. Domestic demand for water far outstrips supply.

This project is a continuation and expansion of USAID's ongoing rural water project (#022), although its scope has been substantially increased to incorporate the recommendations of the social and technical evaluations undertaken by the AID Mission in the winter and spring of 1978. This project now focuses primarily upon improving water supplies through adaptations and improvement of traditional methods. It will also rely heavily on indigenous rural contributions and capabilities. This project builds on the experience gained through 022, and continues the collaborative relations already established with the Rural Water Department (RWD) of the Ministry of Public Works, and the American Peace Corps.

Expressed in log-frame terms, the goal of this project is, "to improve the quality of life of rural Yemenis." This will be shown at the end of the project by:

- 140,000 people having access to improved water sources that are indigenously operated and maintained;
- a significant reduction in water-related diseases in those villages building improved water supply systems;

(continued)

- 40 to 50 percent of these villages also undertaking additional self-help activities; and
- a significant number of women-days of labor released from drawing and carrying water to pursue other more productive activities.

In support of these goals, the immediate purposes of this activity are to:

- assist 140 selected rural villages - through RWD - to construct, maintain, and manage their own water supply systems; and
- to provide the basis for institutionalizing the project by improving the administrative capabilities of RWD, and the participatory involvement and operational capability of beneficial villages.

As with the previous activity, USAID will continue to finance part of the project by funding approximately 50 percent of the costs of each village sub-project. Typically this covers the costs of cement, pipe, vehicles, and equipment. Local villages in Yemen will contribute approximately 50 percent of sub-project costs in the form of labor and materials. The RWD will provide office space and personnel. The Peace Corps will supply volunteers to work in the field supervising the construction of projects. Other donors will provide commodities and technical assistance for some sub-projects.

A five-person TransCentury team working with RWD, will be responsible for overall project implementation. Its work will include feasibility studies, technical designs, and establishing criteria for project selection. Members will take part in the selection procedure, draft agreements between RWD and local entities, and provide on-the-job training to counterpart staff. They will supervise Peace Corps volunteers in the field, purchase commodities, keep records and account for project commodities. In addition, in coordination with other donors,

they will help to establish a water quality monitoring unit, provide operation and maintenance training, and conduct research and testing of appropriate technology for improved village water systems. They will coordinate with existing health teams to provide water-related health education programs.

Sub-project designs will vary according to local conditions, but will include upgrading and new construction of cisterns, springs, hand-dug wells and distribution systems. It is estimated that 20 sub-projects can be completed the first year and 30 per year in subsequent years for a total of 140 sub-projects over the five year life of the project.

Projects will be undertaken in collaboration with the Rural Water Department. For an analysis of the administrative structure of the RWD, see "Administrative Analysis", page 15 of this volume. For an analysis of other YAR activities in the water sector, see Appendix II. page 4 of Volume III.

III. METHODOLOGIES AND ANALYSES

INTRODUCTION

USAID's first small Water Project, number 022, was evaluated by members of the USAID Yemen engineering staff and a social anthropologist working on contract with USAID. (See Volume III, Appendices III and IV, pages 9 and 59 for the complete text of the analyses.)

The evaluation recognized the political and social imperatives that make the provision of improved sources of drinking water in rural Yemen so important. It praised the project for its methodology and dual purpose - of supplying villagers with domestic water while at the same time strengthening the Government of Yemen's institutional capability to replicate activities throughout the country.

The evaluation concluded with a series of recommendations. These are:

First recommendation. *More precise project selection criteria should be established. For example, the project design should attempt to provide more equitable distribution of project benefits.* An integral part of 044 design has been to develop sound selection criteria.

Second recommendation. *Feasibility studies should include a social assessment of the village, an analysis of future water demands, and an appraisal of the village's commitment to provide inputs to the project.* Under 044, pre-feasibility studies of potential villages will include extensive social surveys to determine the needs, wants, and villagers' commitment to the sub-project. Questions addressing future water demands will also be included in the pre-feasibility study. In general, however, demand for water will usually exceed supply, even with 044 assistance.

Third recommendation. *Sub-project design should be compatible*

with the social environment. Both the feasibility surveys and the technical engineering designs will ensure that projects are compatible with the environment.

Fourth recommendation. *Close supervision of construction is required.* Peace Corps Volunteers (PCV) will serve as supervisors of sub-projects with primary responsibility for construction on all projects to be built under 044.

Fifth recommendation. *The Memorandum of Agreement committing RWD and the local village to the project should be more specific.* The format of the Memorandum of Agreement has been substantially changed (see VOL III, Appx VII, page 92) and has given greater emphasis to the specific responsibilities of village beneficiaries.

Sixth recommendation. *Local personnel should be trained in proper operations and maintenance techniques.* The PCV and RWD construction staff will provide one week of on-site training for a designated village pump operation and maintenance person in each village where projects are being built.

Surveys of the social, economic, technical, administrative and environmental analyses are given below:

Social Soundness Analysis

The Yemen Rural Water Project will provide a direct improvement in the quality of life for approximately 140,000 Yemenis over the life of the project. Villages range in size from a few hundred to a few thousand people. Given an average of 1,000 people per village, the project will complete 140 sub-projects; 140,000 persons therefore will be direct beneficiaries. By providing improved water sources and distribution systems, the project will have the following social benefits:

(continued)

- It will substantially reduce the time women and girls spend in fetching water for drinking and other household purposes, freeing them to undertake more remunerative and productive activities in support of the family's income.
- It will substantially increase the amount of water available to village families, which will lead to improved hygiene and personal health.

By involving village members in the construction of the water systems, the project will have the following institutional benefits.

- It will provide a focus for village self-help activities, with accompanying pattersn of village cooperation, opportunities for emerging new leadership, and the development of self-help precedents.
- It will provide a model for individual involvement in the destiny of the village welfare, and establish a basis for other participative activities.
- It will inculcate within the village a sense of responsibility for the system, and the capability to maintain and improve upon it.

The nature of the social impact of the project can best be understood by showing the analysis of a typical sub-project built under 022.

The village of Tina'am is located in Khawlan district, approximately 35 kilometers east of Sana'a City. Tina'am is situated at the head of a wadi which runs through a narrow defile to the north of the village and widens to a braod valley southward. The settlement sits on the hillside overlooking the wadi bed. The population was determined by the local headsman as 530 persons, half of whom are under the age of fifteen. Also, the village has many adult male migrants who are absent a good deal of the time either in Sana'a or Saudi Arabia.

The 022 Small Water Projects project in Tina'am was begun in 1975, and the AID involvement was completed fifteen months later. The project consists of an engine and pump which draw water from a pre-existing hand-dug well in the wadi bed. Two separate pipelines are connected to the pump, which run to two 7,000 gallon stone-and-cement tanks. The tanks were originally equipped with public taps, but the villagers have since installed pipes which connect the tanks to private household taps. At the present time every house has a tap either inside the building or in the courtyard.

At the time of the evaluation, the system was only semi-operational because water was not continuously available for the household taps. This was because the pump at the well was not powerful enough to fill the two tanks to capacity. Since the original evaluation, however, the villagers have installed a larger pump, and the system is now completely operational.

The well now provides sufficient water for household needs year-round, and the water is potable. Local people use the water for drinking and for all other domestic needs.

The most immediate impact of Tina'am's water project has been the increased availability of potable water. The distance from the source to the use point has been almost eliminated by the distribution system. This system benefits the villagers both in terms of time saved and reduced physical exertion.

The project has also reduced the cost of water in the village. Before the project, water was a precious commodity and was used sparingly so tl washing was almost a luxury. Now the new distribution system has allowed a substantial increase in the water used for domestic purposes.

The increase in the availability of water for domestic use clearly is reflected in improved levels of general health. Household water is

now significantly cleaner than under the previous system. Moreover, the reduced physical effort involved in obtaining water allows for the more regular and thorough washing of cooking and eating utensils. This has improved general sanitation within the houshold significantly.

In terms of local social organization, the project has also had an immediate and significant impact. Initiation and implementation of the project has required the creation of a new social group within the community to operate and maintain the new water system. The project was financed communally, with the villagers investing both labor and money in the project. Further, the village hired a paratechnician to lay and maintain the pipelines running to the houses. Presently, each private connection is paid for by the household it serves. Every person in each household is charged one Yemeni rial per month. This charge is used to pay the salary of the paratechnician and other costs incurred in maintenance.

Tina'am is an example of a typical successful project completed under 022, and is representative of the kinds of projects which will continue to be built under 044. The summary results of the social evaluation of 022 are shown in Table I on the following page.

TABLE I

PROJECTS SURVEYED

Figure #1.

Sample of 10 of 45 Completed Projects

Village	Village[1/] Type	Nature of Project	Status	Local Sponsor	Project Extension	Supervision	Success Rating
Manakha	A	Pipeline-Tank	Operating	LDA	Planned	Local	1.
Tina'am	B	Pipeline-Tank	Semi-Operating	Shaykh	In Place	Local	2.*
Magrish	B	Pipeline-Tank	Operating	Shaykh	None	PCV	1.
Hubshi	D	Cistern	Operating	Shaykh	None	PCV	1.
Qumama	D	Cistern	Operating	Shaykh	Planned	Local	1.
Al-Ghola	B	Cistern	Not Operating	Shaykh	None	Local	3. **
Dahlil	A	Pipeline-Tank	Not Operating	LDA	In Place	Local	3. **
Dhalma	A	Cistern	Operating	LDA	None	Local	1.
Hayma	B	Cistern	Not Operating	Shaykh	None	PCV	3. **
Aras	C	Pipeline-Tank	Operating	Shaykh	Planned	PCV	1.

Notes: 1. Village Types: A=Growing Economically; B=Migration w/ Cash Crop; C=Migration with No Cash Crop; D=Migration w/Non Agricultural Activity

2. Success rating based on achievement of project objectives. Symbols: 1.=Successful; 2.=Partially Successful; 3.=Unsuccessful

* with addition of new and larger pump, rating is now 1, and project is completely operational.

** for an explanation of difficulties experienced in these subprojects, see VOL II pp 41, 51 & 53. All these failures were rectifiable and will be avoided by 044.

Economic Analysis

Lack of water is a major constraint to productivity in Yemen. Water is inadequate in terms of quantity, quality, availability and reliability. The Ministry of Health estimates that only 8.4 percent of the population has easy access to water, and nearly all these people live in urban areas.

Often villages find their water source dry for long periods of the year. When this occurs villages must transport water by truck, camel or other means from a deep well which may be located at a great distance. Situations have been reported where the nearest reliable water source, located at the base of a mountain, requires the village women and children to spend 4 to 6 hours per day to obtain water for their households. At times of severe shortage, villagers are forced to pay watersellers exhorbitant prices as high as one dollar per gallon.

It is clear that there is an overriding economic need for improved village water systems throughout Yemen. This economic need is reinforced by strong political and social pressures to improve the quality of life for rural Yemenis. Given these political and social imperatives, this paper has not attempted the artificial exercise of quantifying the internal rate of return for the project.

However, Sir William Halcrow and Partners, a British engineering and construction company, working with the World Bank and the Government of Yemen, conducted a comprehensive study of small water systems at Wadi Surdud for the Tihama Region in Yemen. This study looked at a total of 60 villages within the project area to evaluate opportunities for improving their traditional water supply systems. Time saved in any one year in this study was estimated by comparing the total time it takes the women of the village to collect the water under the present system with the time it could be expected to take using the improved system.

The Halcrow study states that, "In a situation of underemployment, any time saved has zero marginal value. But where acute labour shortages occur periodically ... this saved time can have a real value." It is suggested that out of any time saved, a woman would spend 50% on household chores and leisure and the remaining 50% on additional productive work. Assuming productive work has a marginal value of 3 months per year and female labour is worth Y.R. 30 per day, then benefits following this model have been estimated as 7,500 days per year for a village of 1,000 people, or Y.R. 6,200 for the first year after installation. (4.53 Y.R. = U.S. $1.00) For 140,000 people, total time saved per annum would be a magnitude of 1,100,000 days, worth something like 4.1 million Rials or 911,000 dollars.

The Halcrow study suggests that costs and benefits for each village water supply schemes have an economic internal return rate (EIRR) on the order of 17%. If the benefits were reduced by 20%, then the EIRR would become 13%. The time saved and benefits of proposed development schemes are shown in tabular form in Table II below.

TABLE II

TIME SAVED AND BENEFITS OF PROPOSED DEVELOPMENT (AFTER HALCROW 1/)

(CONSTANT 1978 VALVES)

YEAR	POPULATION (People)	AVERAGE HUMAN/WATER CONSUMPTION (litres/day)	VILLAGE ANIMAL/WATER CONSUMPTION (litres/day)	ESTIMATED TIME SPENT COLLECTING WATER 2/			TOTAL TIME SAVED P.A. DAYS	VALUE IN RIALS/(US
				PRESENT SYSTEM	IMPROVED SYSTEM	SAVING		
				hour/day	hour/day	hour/day		
1	1,000	25	25,000	256	142	112	7,500	28,000 Rials 6,200 US $
⋮	⋮	⋮		⋮	⋮	⋮		⋮
n 3/	140,000	40	3,500,000	54,443	30,333	24,110	1,100,000	4.1 millic Rials 911,000 US $

1/ "Wadi Surdud: "Development of the Tihama" by Sir William Halcrow & Partners, Ltd., Vol. 8, p.67, August, 1978.

2/ Based on following equation (for definition of terms and assumptions, see Vol III, Appendix XI, pg. _____:

$$\text{Hours/Day} = \underbrace{\left[\frac{Pn \times Cpcn}{Wdr}\right]}_{\text{Drawing rate}} + \underbrace{\left[\frac{Tkm}{Hkm} + \frac{Cpcn}{Cpcb}\right]}_{\text{Collecting Time}} + \underbrace{\left[\frac{Ca}{Wa} + E\right]}_{\text{Animal Consumption}}$$

3/ Completion of project works approximately 5 years after commencement of project.

TABLE III

Estimated Costs for a Typical Sub-Project

Donor	Inputs	Yemeni Rial Costs	=	Dollar Costs	% of Costs
RWD	Well	70,000		$15,453	28
USAID	Pipeline & Storage Tank	62,600		13,818	25
VILLAGE	Labor & Commodities	73,680		16,264	30
UNICEF	Pump	25,000		5,518	10
PEACE CORPS	PCV	19,275		4,255	8
		250,555		$55,310	100%

Cost per beneficiary: Assuming an average village population of 1,000, the cost per beneficiary is:

250 Y.R. or $55.00

Technical Analysis

The evaluation of 022 appraised the technical aspects of design, construction, operations and maintenance. A form was prepared which included a general background of the village, a description of the water source before and after the project, a description and cost of the project, and an assessment of the project emphasizing design, construction, and O & M considerations. The completed Technical Evaluation is reproduced in Volume III, Apprendix IV, page 59 .

Table IV summarizes key data for each project and rates each project on technical aspects. A simple rating scale of 1 through 3 was used. A rating of 1 in this category indicates that the project is satisfactorily meeting the village's needs. A 2 rating indicates that something was either temporarily or permanently impairing its performance. A rating of 3 indicates that the project is not meeting the needs of the village.

Table IV indicates that three of the 10 sub-projects were not meeting the water needs of the villages. In all instances, sub-project failure was caused by rectifiable problems: lack of construction supervision, lack of engineering input to sub-project design, or lack of social or technical prefeasibility data. As previously indicated, project 044 will resolve each of these problems.

The technical evaluation reconfirmed many of the conclusions of the social evaluation. Additional recommendations of the technical evaluation have been taken into account in the design of 044:

- The feasibility of constructing pipes and taps for individual homes should be included in the prefeasibility studies of all potential sites. Designs, where technically appropriate, will include the provision of house connections to be made by local artisans and paid for by individual villagers.

(continued)

- An attempt should be made to get participation at the governate or other regional level offices in project selection and implementation. This recommendation has been adopted by 044, and regional level officials will be included in all project activities.

TABLE IV

Technical Evaluation of Small Water Projects

(N.B. The Technical evaluation looked at the same ten villates as the social evaluation, but reviewed projects on the suitability of sub-project design, construction, and operations and maintenance.)

Name of Village	Population	Type of Project	Supervision	Design	Construction	O&M	Overall Perform
1. Manakha	5000	Spring pipeline tank	local	1	1	1	
2. Tinaam	530	HDW pipeline tanks	local	2	1	1	
3. Magrish	250	DW pipeline tanks	PCV	1	2	1	
4. Hubshi	300	Cistern	PCV	1	2	1	
5. Qumama	800	Cistern	local	1	1	1	
6. Al Ghola	600	spring improvement	local	3	3	-	
7. Dahlil	800	DW pipeline tank	local	2	2	2	
8. Dhalma	800	Cistern	local	3	1	1	
9. Hayma	500	Cistern	PCV	1	3	-	
0. Aras	1,200	DW Cistern pipe	PCV	2	2	1	

Average size: 1078

NOTES: O = Operating DW = Drilled Well

N.O.= Not Operating HDW = Hand Dug Well

1 = Satisfactory

2 = Unsatisfactory in some respects

3 = Unsatisfactory

* Since improved to 1, by addition of more powerful pump

Administrative Analysis

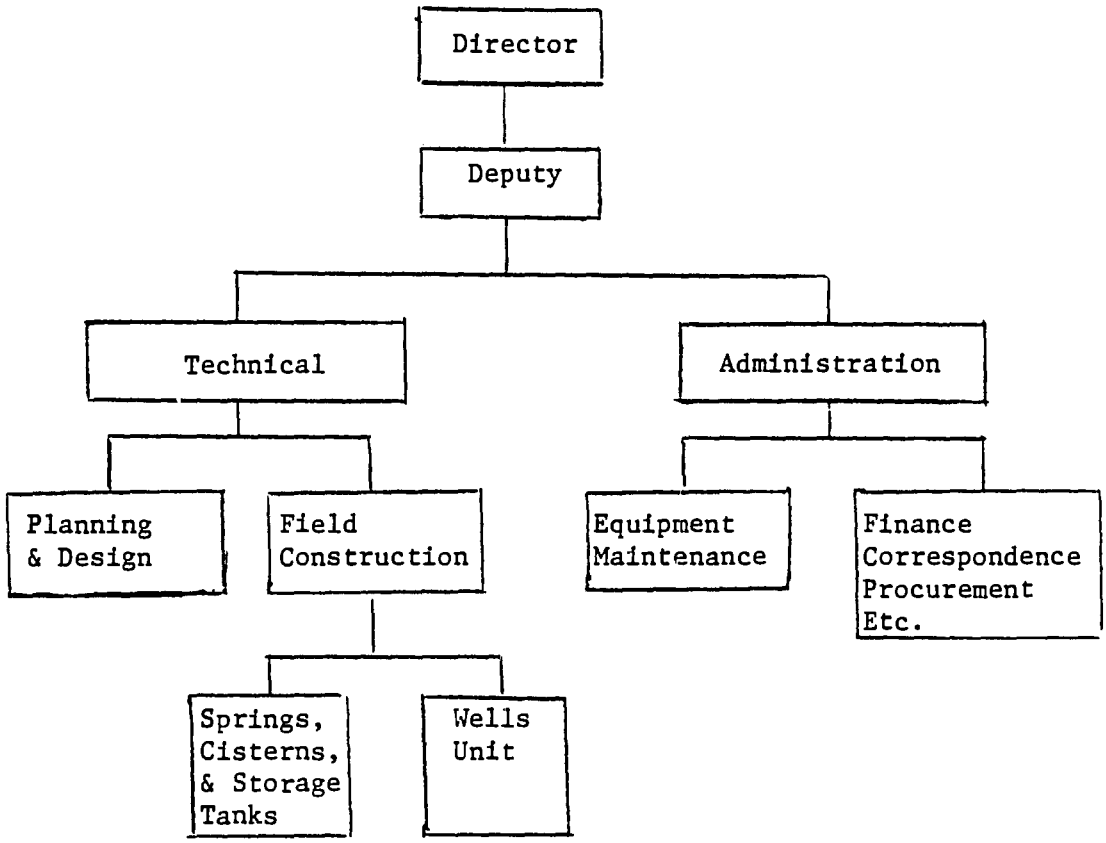
The RWD was established in 1972 to provide safe and adequate water supplies to rural villages. It receives requests for assistance from villages and other local entities throughout the country to perform studies, drill wells, and provide assistance in constructing improved village water supply systems.

Currently the staff of the RWD consists of a director and deputy director, three engineers, six technicians, 25 well-drilling personnel, and fifteen administrative and support personnel. The existing management capability of RWD, like that of most other Yemen government organizations, is very weak. The top administrative staff have no training in engineering or management. The workload and the demands on the organization have continued to grow, but the staff has not expanded to meet the needs.

Most of the functional areas or divisions within RWD currently lack division chiefs. The RWD has authority to hire third country nationals to fill these positions until there are trained and qualified Yemenis. At present, however, there are only two Sudanese advisors who function in this capacity. One step which RWD should take to build itself as an institution would be to fill these positions. Experienced men should be found from within the Arab-speaking world to supervise work in planning and design, field construction, equipment maintenance, and in several areas of administration.

The present de facto functional divisions within RWD are shown in the attached chart:

PRESENT DEFACTO FUNCTIONAL DIVISIONS WITHIN RWD



Administrative Analysis (cont'd)

The major assistance to RWD over the past five years has come from USAID through 022, and from the UNDP/Who Project. The UN currently has a four man advisory team assigned to work with the department, plus 2 UN Volunteers. The UNDP group has been directly concerned with the administration and management of RWD, and they have recently completed a management study of the Department. In addition to USAID and the UN, advice and assistance is received from a variety of other donors. The Dutch Government provides 2 advisors - one hydrologist and one surveyor - who work closely with the UNDP. The Saudis and Abu Dhabi have provided financial support for the department. UNICEF has provided capital equipment in the form of pumps and other assistance. A Japanese group originally built projects for the Saudis on contract, and now the Japanese Government has initiated direct turn-key assistance. The Iraqi Government has also pledged itself to provide turn-key assistance starting shortly.

Training

Numerous training opportunities are available to the Yemeni staff from USAID and from other donors. Under Project 022, approximately 30 technicians are in short-term training in Cairo. The RWD staff is well aware of the staffing and management problems. The senior staff of RWD, for example, recently informed USAID that they may hire a group of Egyptian engineers to meet their immediate needs. Progress in solving long-term needs is not encouraging, however. No candidates are currently in long-term training, and the government pay scales are too low to attract engineers and other qualified staff from the private sector, autonomous government agencies, or other donor projects.

Clearly RWD needs various kinds of in-service training, together with long-term participant training. The TransCentury team in implementing this project, will set up short-term training programs, and on-the-job training as necessary, and will identify candidates suitable for longer term training in the United States or in appropriate Third World universities and institutions.

At the same time, the team will explore the applicability of institutionalizing parts of 044 from the bottom up, working with appropriate village-level groups to ensure that they have the ability to operate, maintain, and repair their improved small water systems. For an analysis of training goals and methods to be used to further the institutional development of both RWD and the villagers, see pp. 26 of the implementation plan in this volume.

Health and Environmental Analysis

The Ministry of Health has prepared a list of health and environmental related problems which are of most concern to the government. The diseases in order of priority are (1) Diarrhoeal diseases, (2) Tuberculosis, (3) Malaria, (4) Schistosomiasis, (5) Maternal diseases, (6) Measles, (7) Respiratory diseases, (8) Inflammatory diseases of the eye, (9) Intestinal parasites, (10) Prenatal diseases, (11) Whooping cough, (12) PCM and avitaminosis, (13) Traffic accidents, (14) Bacillary dysentry and amoebiasis, and (15) Anaemiasis.

Clearly a number of these diseases are related to public water supply. The Ministry of Health states: "There is a strong evidence that the main causes of ill-health are ... water supply, waste disposal ... poor hygience, uncontrolled irrigation schemes and all socio-economic factors, (which) have created such an unsatisfactory situation." *

Specific objectives related to water supply between the years 1976 to 1981 include reduction of the incidence of intestinal parasites and dysentary. To meet these objectives the Ministry of Health states that interaction between sectors is necessary, particularly "better coverage of the population with an adequate supply of good water by the Ministry of Public Works."

The USAID Mission conducted an initial Environmental Examination and no negative environmental effects were identified. (See Appendix IX, page 115 in Volume III of this report.

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* National Health Programme 1977-1982, Ministry of Health, YAR August, 1976.

IV

IMPLEMENTATION PLAN

IV. Implementation Plan

1. Chronology of implementation over five years.

2. Sub-project implementation steps

   a. feasibility studies
   b. selection of sub-projects
   c. technical designs
   d. sub-project agreement
   e. construction
   f. supervision and monitoring
   g. operations and maintenance
   h. timing of construction for a typical sub-project

3. Institution Building

   - training
   - research and testing for appropriate technology
   - standards and specifications

4. Project Implementation Personnel

   TransCentury:

   Team leader
   Design engineer
   Well master
   Construction supervisor
   Administrative officer
   Diesel mechanic

   Local Hire Yemeni staff

   Peace Corps Volunteers

5. Project logistics

   - office space
   - transportation
   - procurement

6. Accounting Services

7. Additional Administrative Considerations

1. Chronology of Implementation Over Five Years

The following represents a detailed description of the various implementation steps to be taken over the life of the project, starting with the evaluation of 022 conducted by USAID in the Winter and Spring of 1978, and extending over the five year life of the project.

A. Completed Actions

- Social and Technical Evaluation, Spring, 1978.
- Request for expressions of interest from PVOs and site visits conducted by PVOs.
- Request for Peace Corps Volunteers (PCVs) and in-country training for PCVs.
- Approval of the extension of Project 022 to cover financing the initial stage of the Project, prior to arrival of TransCentury.
- Discussions with RWD regarding their commitment to the project; USAID and RWD review of the draft project paper.
- Program agreement signed.
- TransCentury Field Assessment.

B. Actions Pending

- Drafting final OPG document.
- Mission and RWD review and approval.
- AID/W review and approval.
- Funding
- Contract negotiation and signing with TransCentury.

C. First Project Year

- Once the pre-project activities are completed and the PVO contract is signed, the TransCentury 5 member team will be on site within one month.
- Vehicles, Equipment and Commodities Purchase: TransCentury, operating with an advance, is expected to purchase vehicles, equipment and initial project commodities.

- The second group of PCVs will be requested, trained and placed.
- Twenty sub-projects will have been completed with an estimated 20,000 beneficiary.

D. Second Year Project

- The other components of the project including pump testing, an operation O & M unit, and research activity are expected to begin.
- The first evaluation, emphasizing institutional and technical aspects of the project will be held.
- The third group of PCVs will arrive.
- The results of the evaluation will be used as input to AID/W documents and included in the implementation of the latter part of the project.
- The water quality monitoring and health advisory unit will be established.
- Fifty sub-projects will have been completed with 50,000 beneficiaries.

E. Third Project Year

- The second evaluation, concentrating on the social, economic and environmental impact of the project will be held.
- The fourth group of PCVs will arrive and be trained.
- Eighty sub-projects will have been completed with 80,000 beneficiaries.

F. Fourth Project Year

- One hundred and ten sub-projects will have been completed.

G. Fifth Project Year

- The end of project evaluation will be held, to determine if the project should be terminated, extended or a new project designed.
- One hundred and forty sub-projects will have been completed with 140,000 beneficiaries.

2. Sub-Project Implementation Plan

The following steps will be followed in the implementation of individual sub-projects:

a. Feasibility study
b. Selection of sub-projects
c. Technical design
d. Sub-project agreement
e. Construction
f. Supervision and monitoring
g. Operations and Maintenance
h. Timing and construction for a typical sub-project

a. Feasibility Study

Simple feasibility survey procedures to facilitate comparisons between and among various villages requesting assistance will be designed at the beginning of the project. These initial surveys will be standardized for routine use.

The feasibility study will be undertaken by the Senior Design Engineer together with Peace Corps Volunteers. The studies will concentrate on collecting technical data including the approximate population of the village, of near by villages which use the same water, sources of water by season, quality of water, water-shed and collection areas, and ways in which water from various sources may be combined in village use patterns.

Water from a cistern, for example, may be used primarily for watering animals and washing, while spring water may be used only for drinking. Social data will also be collected, describing the social structure of the village, the age and sex composition and the work patterns of its population so that an accurate assessment may be made of the village's ability to provide project inputs. A rough sketch will be attached to the study showing the relationships between water source(s) and the site(s) of village(s). A second sketch will show preliminary locations of structures and suggest estimates of required commodities,

as well as showing a rough estimate of total and AID financed project costs. Once the proper procedures are established, it will be possible to conduct this kind of feasibility survey within a few days.

b. Selection of sub-projects

Given the water shortages in Yemen and the limited resources available, a priority system must be arranged for selection of sub-projects. Ideally, as a first step, an inventory would be made of all villages along with an evaluation of current water systems. Unfortunately, there are 52,734 villages in Yemen, and the logistics of such a survey are beyond the scope of this project. As an alternative, the Rural Water Department has proposed to contact the governors and Local Development Board Coordinating Councils of each governate to request their lists of priority projects. From these lists, TransCentury and counterpart staff will conduct feasibility studies.

It is proposed, further, that the largest 25 towns and cities of Yemen be excluded from consideration of this project. Ninety-three percent of the population lives in settlements of less than 25,000. Based on the information presently available, 044 will concentrate most of its projects in medium settlements, large settlements, and small towns ranging in size from 250 to 2,000 people. In absolute terms, there are 2,683 such settlements in Yemen, with a combined population of 1,182,244 people representing more than 25 percent of the population of the country. We estimate that 140 rural water projects can address approximately 10 percent of the needs of this target group.

Table V

Distribution of Yemen's population by size of settlement

(From the National Cencus February, 1975)

Settlement Class		Total no. of inhabitants in each settlement class		
Designation	No. of inhabitants	Absolute	Relative	
Dwelling groups	under 50	681,613	14.5%	63.7%
	50-100	924,031	19.6%	
Small settlements	100-250	1,393,041	29.6%	
Medium settlements	250-500	669,120	14.3%	25.2%
Large settlements	500-1,000	403,098	8.6%	
Small towns	1,000-2,000	110,026	2.3%	
	2,000-5,000	99,723	2.1%	
Medium towns	5,000-10,000	69,942	1.5%	4.7%
Large towns	10,000-50,000	52,392	1.1%	
Cities	over 50,000	302,350	6.4%	6.4%
Yemen, total February 1975		4,705,336	100.0%	

One major consideration in choosing this target group is the issue of optimizing costs. Costs will vary from sub-project to sub-project, but a general rule is that per capita costs vary inversely with the size of the target population. The smaller the population served by a given project, the higher the per capita costs. Conversely: the larger the system, the greater the economics of scale possible.

Feasibility studies will be reviewed by a committee in Sana'a to select the best and rank them by priority The committee will consist of representatives from TransCentury, RWD, Peace Corps and concerned governorates. TransCentury, together with RWD, will be responsible for establishing this Review Committee, and the criteria for choosing projects.

The following criteria will be incorporated into the selection of sub-projects:

1. Present size of village(s)
2. How many people paid the Zaqat al Fotrah tax last year?[1/]
3. Kind of village (After Rick Tutwiler's study, see Vol III, Appendix 4, p 59)

   Type A Type B

   Type C Type D
4. Present source(s) of water:
5. Present quantity of water avaiable for people and for animals
6. Present quality of water: (on scale 1 to 5)
7. Prevalance of gastro-intestinal problems in village, (especially among children)
8. Measurable fecal or bacteriological contamination of water supply
9. Incidence of cholera or other water born diseases in village by year decade, etc.
10. Continuity of water supply (seasonally)
11. If proposed project were built, projected future quantity and quality of water available:
12. Requirements to safeguard purity of source:
13. Future needs, vs. future demands, vs. availability.
14. Village's estimated average per capita income to facilitate comparison between and among other villages.
15. Villagers' willingness/ability/eagerness to contribute to project, and evidence thereof:
16. Ability of the village to pay a) total or b) partial cost.
17. Ability to maintain system after construction:
18. Is the project technically feasible?
19. What percent of the residents of the village area will benefit from the project?
20. Will water from the system be used for other than domestic purposes?
21. Will the project staff, RWD and AID be allowed access to inspect the project during and after construction?
22. Other donor's contribution to project?

1/ Zaqat Al Fotrah is a tax of 5 Rials paid at the end of Ramadan by every person presently living in a village. It is a good informal measure of the real population.

23. Estimated cost of proposed project?

24. Needs: Criteria scale representing sum of above variables:

c. Technical design

Once the project has passed through the review committee, a final design will be prepared. It is intended that the technical designs will be done by the same people who do the feasibility surveys. This will ensure continuity and integration of the relevant socio-economic and technical considerations.

Technical designs will be simple, appropriate, and ecologically sound. Designs will also reflect the unusual labor short capital-intensive economic conditions of Yemen. The design unit will work toward standardization of designs as has already been done for cisterns, storage tanks, and pump houses.

Final designs for specific sub-projects will include land surveys and a detailed materials list. During the final design site visit, discussions will be held with local authorities concerning rights of way, the village contribution, and scheduling of construction. The general design criteria for the construction of small water projects is included in Appendix VI, p 90.

d. Sub-project agreement

After completion of the technical design, a draft sub-project agreement will be prepared, showing the specific obligations of all parties, and the timetable for project construction. It will include standard clauses on record keeping, inspections, settling of disputes and termination. The agreement will be negotiated and signed by:

- a representative of RWD
- the governor of the province, or his designated representative
- the village shaykh, or his designated representative

When appropriate, the agreement will include preconditions such as the village having local commodities on site prior to commiting AID funded commodities or comitments of a Peace Corps volunteer. Since the agreement is a key element

in the success of a project, it will be considered as a legally binding document. (For a draft of the Memorandum see Appendix VII).

e. Construction

Construction methods and materials will vary by type of sub-project and by the topographical considerations of individual sites. Given the extremely high costs of imported materials plus the expense of inland transportation, the use of local materials like stone, and other commodities will be encouraged whenever possible. Cost details of representative projects completed under Project 022 and proposed projects are presented in Appendix V, page 70.

f. Supervision and monitoring

In the early phases of 044, each individual project needs to be closely supervised by a Peace Corps volunteer. Some projects require more supervision than others. To optimize the use of volunteers, therefore, it would be ideal to coordinate different types of projects in a contiguous area so that one volunteer could supervise two or three different kinds of projects at the same time.

Later during the course of the project, it is expected that the project will stimulate a cadre of Yemeni contractors or village headmen who are competent to supervise both the technical and administrative aspects of projects. If such local capabilities can be developed, it will reduce the need for volunteers to supervise each project so closely, as well as furthering the institutionalization of the project.

Volunteers will coordinate work with the local shaykhs in each village. Volunteers will be supervised by TransCentury, as well as by Peace Corps Staff. The shaykhs are both traditional figures, as well as liaison persons with the Central Government. As such, the shaykhs are under the authority of Provincial Governors.

Monitoring of projects will be undertaken by TransCentury, RWD officials, and the USAID Project Manager. Once the project is completed and a final inspection made, TransCentury, through RWD, will issue a completion letter with copies to USAID.

g. Operations and maintenance.

Operations and maintenance is both a social and technical issue, and these two areas must be closely synthesized. The feasibility surveys, for example, must analyze operations and maintenance considerations before the project is designed. Once constructed, the water system becomes the responsibility of a local entity. For elaborate projects it will often be necessary to create Village Water Companies to insure that there is an authority competent to operate and maintain the system. This entity will control recurrent and other costs as they occur, and will designate O & M personnel and collection rates for water users as appropriate. On the technical side, too, it is important to see that the villagers understand how to maintain equipment which is part of the project. If there is a pump, for example, someone in the village will be named pump operator to be responsible for its operation and maintenance. PCVs and UNDP personnel will be responsible for training village O & M personnel in association with the UN's training program.

If the water system requires some sort of taxing authority, it is important that appropriate figures in the village understand, be responsible for, and be accountable for this revenue collection and allocation. The social evaluation of 022 concluded that the villagers have been able to establish appropriate social forms sufficient to run improved water systems.

Finally, there need to be yearly maintenace checks of each completed system by the O & M unit within RWD, and 044 staff to check on both mechanical and social aspects of the system.

h. Timing of construction for a typical sub-project

With project implementation well underway, it is expected that the average sub-project will undergo the following phases.

a)	Feasibility study and review	week 1
b)	Sub-project selection and review	week 3
c)	Technical design completed	week 5
d)	Sub-project agreement drawn up and signed	week 8
e)	Construction begins	week 9
	Construction finishes	week 21

Depending on complexity, location, availability of materials and labor, season of the year, and other considerations, completion of sub-projects will take from 12 - 30 weeks. An average project is estimated to take approximately three months for field construction.

3. Institution building

The second purpose of Project 044 is to strengthen the institutional capability of the RWD. In this connection, the following activities will be undertaken:

- Training -- both short and long term
- Research and testing
- Standards and specifications
- Improved criteria for sub-project selection
- Training at the village level
- A coordinating council
- RWD's contracting and maintenance capabilities

Training

TransCentury and the Rural Water Department both appreciate the need for institution building to ensure that the RWD has the long term capability to build improved water systems after the completion of this project. At the same time, RWD officials are well aware of the limited capability of the existing RWD staff and the increasing demands being placed on the organization. Yemen's acute shortage of skilled manpower and the low payscale of government ministries makes it difficult to attract qualified staff. The prospects are not good for obtaining young graduate counterpart staff over the life of the project. What the project will attempt, therefore, is to design a basic organizational structure endorsed by MPW. WIthin such a structure, TransCentury will assist RWD to identify key personnel requirements, and to develop a recruitment and detailed training plan to support such an effort. A modest goal has been set for six or seven counterpart professional staff during the life of the project. AID has already set aside money in a separate project for long-term participant training, and the UN is presently establishing a program to train villagers in the operations of rural water systems and appropriate technical equipment. We propose that 044 address the remaining needs of the department through a variety of training techniques.

The project is based on the belief that the best training occurs when the participants have a personal interest in the outcome. To define areas of interest with some specificity, the project will begin with a systematic assessment of the long-term personnel needs of the RWD. Some months after the project starts, a two person training team will come to Yemen on TDY to design the assessments. This will identify common interests between the TransCentury staff and their Yemeni counterparts. By the time of the assessment, TransCentury staff may have identified various operational bottlenecks within the department. Alternatively the Senior staff of RWD may see a need for specific kinds of training in appropriate aspects of project administration or technical areas.

Based on this assessment, training goals will be established, and an operations plan will be designed. We expect that training will focus primarily on mid-level administrative personnel within the Department. Training could be either operational, emphasizing project administration, or technical, emphasizing design and construction techniques. Another area to explore would be community level training. This could focus on community organization, mobilization, or administration techniques.

The Peace Corps volunteers will also develop counterpart relations with local construction supervisors. A typical relationship could involve training a local supervisor who had worked on a particular village project, to afterwards be hired by RWD or other villages to supervise other construction. We expect that approximately 20 such technicians will be selected and trained over the life of the project.

Research and Testing for Appropriate Technology

The project will establish a modest research and development capability for the RWD, by undertaking various investigations:

- experiments with cistern covers to determine if water quality is improved;
- experiments with filtration of cistern water;

(continued)

- experiments with structural measures to limit access to cisterns;
- testing of solar stills.

Investigatory work will be undertaken primarily by TransCentury staff, assisted by PCVs, as time permits, After the second year, however, it is hoped that RWD personnel will be able to devote at least 10 percent of their time to research and testing activities. Such activities will take place in the field as well as in the RWD offices in Sana'a.

Standards and specifications

During the course of this project, the TransCentury Team Leader, Design Engineer, Peace Corps volunteers and RWD staff will develop a simple and applicable set of standards and specifications which will lay out relevant criteria for rural water construction projects. A draft of such a document is shown in Appendix VIII, page 90. Standards and specifications will be prepared in English and Arabic, and given to the local construction foremen and PCV supervisors as tools for on-the-job training to continually upgrade construction quality. These standards will be routinely used in all sub-project construction. It is expected that these standards and specifications will also be used in other RWD public works projects.

"Criteria for Sub-Project Selection

"TransCentury, in collaboration with RWD and other foreign donors, and with the assistance of Peace Corps Volunteers, will develop, field test, and standardize simple survey procedures and instruments for choosing between and among potential rural water projects. The design of these procedures, instruments, and criteria will build upon existing bureaucratic patterns and cultural practices and become formalized within the Planning Unit of RWD within the first three years of the Project for routine use.

"Surveys will be done at the village level to evaluate and compare villages' water needs and resources. The surveys will assess the approximate population of the village, of related villages which use the same water, analyze sources of water by season, look at water-shed and collection areas, and review the ways in which water from various sources may be combined in village-use patterns. A rough sketch will be attached to the survey showing the relationships between water sources and the sites of villages.

"Selection criteria will be established in conjunction with other foreign donors working within the rural water sector to optimize resources and preclude duplication of efforts, in addition to enhancing the benefit incidence of particular subprojects.

"Village Level Training

"Village level training will have three specific aspects: water systems' management, water systems' maintenance, and public health and sanitation.

"First, water systems' management. As the Trans-Century Team achieves greater familiarity with the specific realities of local communities and their management capabilities, it will provide training and assistance to establish functioning Village Water Companies. (See Vol. III, Appendix III, page 10, for an analysis of Village Water Companies as they are part of the Social Analysis of Project 022.) In the first two years of the Project several models will be tested in appropriate villages, and by the end of the third year sample charters will be drafted for replication and further testing. The charters will focus upon the Village Water Companies' organizational structures, and decision-making, and fiscal processes.

"Second, water systems' maintenance. The UNDP is responsible for training village diesel mechanics, who are responsible for the maintenance of pumps and equipment, and has already organized a training program. TransCentury will coordinate closely with, and assist the UNDP team to ensure that appropriate candidates are identified and recruited for training, and to ensure that the training curricula is relevant and scheduled in a timely fashion. During the first year of the project, TransCentury will assess the need for additional maintenance training. As required, TransCentury will recommend new or expanded training opportunities to the UNDP, or establish them in concert with other donors or unilaterally.

"In addition, we envisage the use of TransCentury staff and consultants for continued on-the-job skill training in the area of maintenance.

"Third, public health. Improved availability and access to water for villagers requires that they receive education in public health and sanitation. In the first two years of the project TransCentury will assess the scope and content of education and training methodologies consistent with tranditonal knowledge and beliefs. In the third year educational systems will be tested for widespread replication.

Training will target village-wide participation but focus on women, children, and resident heads of households. We envisage using community institutions to train village people such as teachers, mullahs, village leaders and respected women to optimize local resources, legitimize training content, and to gain sustained widespread impact.

"Finally, we anticipate and will encourage the growth of local private contractors. In constructing village water systems with RWD personnel, TransCentury staff, and Peace Corps Volunteers, villagers will expand their knowledge of engineering and construction techniques such as proper cement mixtures, how to lay and align pipe, and how to plan and operate simple water systems. Some villagers will acquire entrepreneurial skills. By the end of the second year of the Project, we believe as many as 10 local contractors will be spawned by the Project and operating unilaterally in certain phases of the rural water development business.

"Further, by the end of the second year, RWD will have an Office of Contracts within the Technical Division. To the extent possible, this office will contract or sub-contract with the newly generated local contractors for sub-project construction.

"A Coordinating Council

"In order to institutionalize RWD's capability to monitor foreign donor assistance to rural water development, a Coordinating Council will be formed. In concert with RWD leadership and the UNDP, TransCentury will establish the Coordinating Council with membership from RWD, UNDP, the Japanese and Iraqi programs, UNICEF, and Peace Corps. Other relevant donors such as the Saudis and Abu Dhabians will also be invited to participate. The Council will be established by the sixth month of the Project, meet monthly for the second six month period, and be chaired by the Deputy Director of RWD. At the end of the first year, meeting schedules, agendas, information-flow systems and participation will be formalized on the basis of the six-month trial experience.

"RWD's Contracting
and Maintenance Capabilities

"TransCentury will explore the possibility of expanding RWD's outreach to the rural sectors of Yemen through the creation of a Contracts Office within the Department. If this approach is found to be feasible, this office will sublet contracts for the construction of individual subprojects. To this end, the TransCentury team and Volunteers will be

instructed to identify and work with the local Yemeni construction supervisors who seem to have the ability to function as contractors under the auspices of the RWD. Training programs for potential contractors--either formal or OJT--will be held as necessary and appropriate."

4. Project Implementation Personnel

This project calls fo_ the construction of 140 rural water projects over a five year period. Based on the existing capability of RWD and the prospects for improving that capability, the desired outputs of the project, and USAID/Yemen's experience gained under 022, the following personnel are required:

TransCentury

The TransCentury Team will consist of five expatriates and eleven Yemenis. For job descriptions see Volume III, p. 144.

Team Leader The team leader will report to the Director General and Assistant Director General of RWD and manage the project. In particular, he will review feasibility studies prepared by other team members, assist in project selection, schedule personnel, supervise the procurements of commodities, maintain financial records, make inspections and prepare reports.

Design Engineer The Design Engineer will be responsible for feasibility studies and technical designs of proposed sub-projects including storage tanks, transmission and distribution lines. He will also supervise pump tests, select pumps and engines, and perform other engineering duties under the project.

Well Master The Well Master will assist the design engineer as well as making site visits to completed systems to verify operations and maintenace procedures. This individual will also be involved with monitoring water quality, supervising pump tests, and conducting the research and testing aspects of the project.

Construction Supervisor The Construction Supervisor shall work primarily as a liaison and coordination person between and among RWD, USAID, the Peace Corps Volunteers and staff, and the villagers of Yemen. He shall assist, as necessary, with the negotiations of Memoranda Agreements with the villages, RWD, and USAID. His primary responsibility shall be to provide logistical field support to Volunteers in the form of tools, commodities, and other necessary construction materials. He shall undertake other duties as assigned by the team leader.

Administrative Officer This staff member will be responsible for all aspects of routine office management, from typing to filing to the preparation of normal and routine office reports. S/he will be experienced with office procedures, and much of his/her work will focus upon the formal preparation of written documents necessary for AID, Peace Corps, and TransCentury/Washington. In addition, it is hopedthat this person will have the opportunity to work in the field from time to time to participate with the formulation of future program activities. A former Peace Corps Volunteer from Yemen is envisioned for this position.

Diesel Mechanic (TCN) This person will assist with the maintenance of both pumps and vehicles. He will serve in a line capacity with 044 and also in a training and supervisory capacity with RWD mechanics and village technicians. He will be assisted by one or more Peace Corps Volunteers. This man will be recruited at the discretion of the team leader and AID Project Manager and it is expected that he will come from somewhere in the Arab world.

Local Hire Yemeni Staff

1. Procurement Officer
2. Bookkeeper/Accountant
3. Translator
4. Clerk/Typist (English)
5. Drivers (3)
6. Warehouse Person (1)
7. Guards (3)

The Yemeni support staff will keep files and accounts, prepare vouchers, procure commodities, maintain the warehouse and keep warehouse records under the supervision of the TransCentury Team.

Fifteen Peace Corps Volunteers

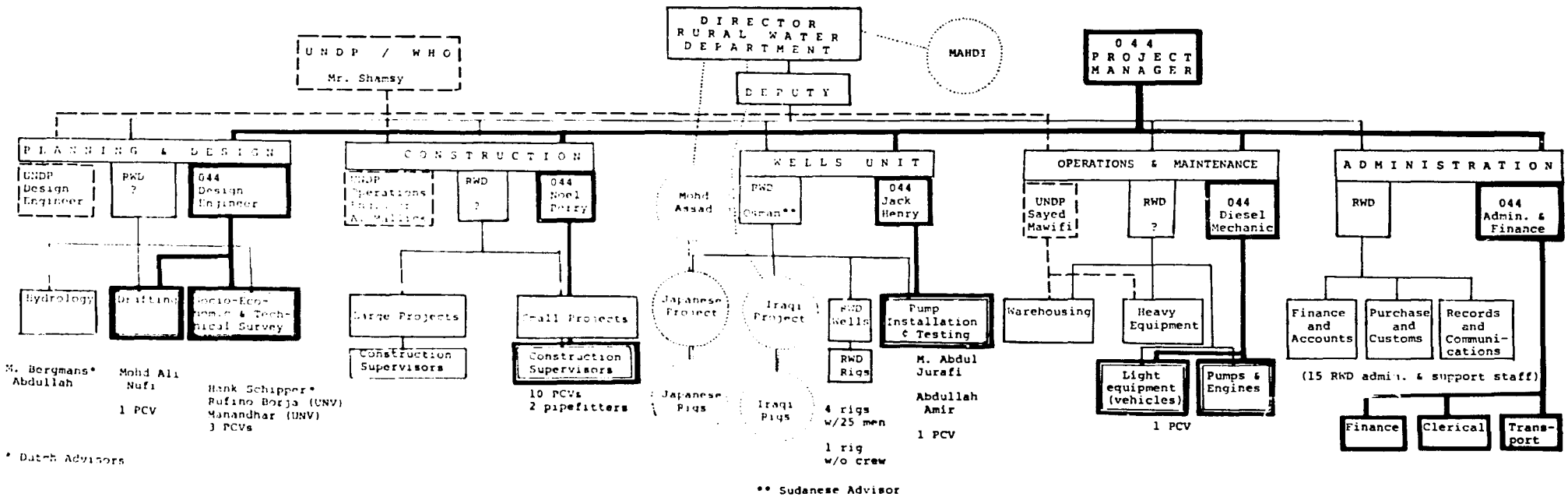
Ten Construction Supervisors It is estimated that one project will average approximately three months to complete. To construct an average of 30 sub-projects each year will require an average of 10 volunteer construction supervisors per year over the life of the project. With normal contingencies inevitable in a country like Yemen, one supervisor will probably be able to manage 3 sub-projects per year.

Three Surveyors One Peace Corps Surveyor Designer can support and back stop approximately three construction supervisors.

Two for Equipment Maintenance Two Volunteers to work with equipment. One Volunteer will be in charge of pump installation, testing, and maintenance. The second volunteer will have primary responsibility for small vehicle maintenance and repair.

During a latter phase of this project, volunteers -- especially female volunteers -- may be able to do some follow-up work in villages which have received improved community water supplies. These volunteers would be working i· the areas of sanitation, nutrition and health education.

TransCentury and Peace Corps will be organizationally integrated within The Rural Water Division. The organizational chart on page 32a represents such a possible alignment. (The chart on page 14a depicts the existing structure of RWD). The expanded organizational chart attempts to show how both people and programs might fit into the on-going operations of the Rural Water Department. It includes U.N. personnel, and where the Japanese and Iraqi bilateral aid programs fit. In addition, RWD receives assistance from Saudi Arabia, Abu Dhabi, and UNICEF. At present, however, this latter assistance is limited to cash and material support, and does not include staff assistance.


DIRECTOR RURAL WATER DEPARTMENT
MAHDI
DEPUTY
044 PROJECT MANAGER
UNDP / WHO
Mr. Shamsy
PLANNING & DESIGN
UNDP Design Engineer
RWD ?
044 Design Engineer
Hydrology
Drafting
Socio-Economic & Technical Survey
M. Bergmans*
Abdullah
Mohd Ali Nufi
1 PCV
Hank Schipper*
Rufino Borja (UNV)
Manandhar (UNV)
3 PCVs
* Dutch Advisors
CONSTRUCTION
UNDP Operations Engineer
Al Mahdi
RWD ?
044 Noel Perry
Large Projects
Construction Supervisors
Small Projects
Construction Supervisors
10 PCVs
2 pipefitters
Mohd Assad
Japanese Project
Japanese Rigs
WELLS UNIT
RWD Osman**
044 Jack Henry
Iraqi Project
Iraqi Rigs
RWD Wells
RWD Rigs
4 rigs w/25 men
1 rig w/o crew
Pump Installation & Testing
M. Abdul Jurafi
Abdullah Amir
1 PCV
** Sudanese Advisor
OPERATIONS & MAINTENANCE
UNDP Sayed Mawifi
RWD ?
044 Diesel Mechanic
Warehousing
Heavy Equipment
Light equipment (vehicles)
Pumps & Engines
1 PCV
ADMINISTRATION
RWD
044 Admin. & Finance
Finance and Accounts
Purchase and Customs
Records and Communications
(15 RWD admin. & support staff)
Finance
Clerical
Transport

5. Project logistics

- Office Space

  The RWD is moving to temporary quarters and office space will continue to be minimal. Contiguous space in the new office building will be rented to serve as TransCentury's Project Operation's Center.

- Transportation

  PCVs in the field will be provided with trail bikes to commute from their residence to field sites. Groups of volunteers would be backed up by four wheel drive vehicles for extremely rough or distant sites and for delivery of minor project commodities. Fifteen trail bikes will be purchased. Project vehicles will include nine four wheel drive vehicles, and one five ton truck. TransCentury will purchase the vehicles. Purchase will also include a stock of spare parts. Maintenance of the vehicles will be done at the RWD shops at the USAID Project site with RWD employed machanics. Major repairs may be performed by locally contracted mechanics.

Table VI

Initial Purchase (Local Procurement)	1st Year (U.S. Procurement)	After 18 Months
2 short wheelbase 4 wheel drive vehicles	4 pickups (4 wheel drive)	2 pickups (4 wheel drive)
10 trail bikes	1 Suburban (4 wheel drive)	5 trail bikes
spare parts	1 5-ton truck	spare parts
	spare parts	

TransCentury proposes to purchase 2 short-wheelbase 4 wheel drive vehicles "off the shelf" in Sana'a, Yemen at the beginning of the project, and trail-bikes and parts as necessary over the life of the project.

Procurement and Project Commodities

TransCentury will stock a supply of cement, pipe and fittings, reinforcing bars and lumber for sub-projects. This will allow economics of quantity purchasing. To the maximum extent feasible purchases will be made in the United States.

Because of intermittant problems of congestion at the port of Hoidaida, a blanket waiver for local offshelf purchase to $25,000 per transaction is requested. This will allow local purchase of Code 935 source commodities particularly at the initiation of the project. Under this blanket waiver pumps and engines will also be purchased when required. Pumps and engines generally will be purchased from local suppliers who will also provide guarantees, servicing, and installation. Importation of individual pumps as needed is not practical and stocking a complete range of pumps would not be economical. Pumps and engines donated by UNICEF to RWD will be used to the extent possible. It is planned for TransCentury to purchase commodities acting for RWD under a Letter of Credit, Letter of Commitment or a Direct Reimbursement Authority with an advance from AID.

TransCentury will have an account for other project related goods and services. This account will finance items listed below required for the overall implementation of the project but not charged to a specific sub-project. Items under this category could be included under the same DRA under an advance with monthly voucher submitted and approved for reimbursement by the AID Project Officer and USAID Controller.

1. Vehicles, Spare Parts, and O & M Expense.
2. Surveying and Drafting Equipment and Office Supplies.
3. Project Equipment and Supplies.
4. Research and Testing Equipment.

A Servicio

"During the first year of the Project, TransCentury will explore the possibilities of creating a Servicio to facilitate institution-building. Servicios have been used with considerable success in Latin America to create new departments or institutions which were outside the constraints of traditional bureaucratic systems. They have been very effective in building institutions to build rural infrastructural projects.

"At the beginning of Servicio operations in Yemen, this new administrative unit will be led and managed by TransCentury staff, both expatriate and Yemeni. In the course of the Project, this administrative support unit would become increasingly nationalized and by the end of the Project would be a fully functioning part of the Yemeni administrative structure, managed by Yemenis."

"The Servicio would have special exemption from taxes and import duties, and will be independent from the civil service salary scales of the Government of Yemen. A major component of the Servicio's work during its earliest phases will be the importation of commodities. The Servicio will be given full authority to procure all commodities necessary for the construction of rural water projects including pumps, cement, pipe, casings, and miscellaneous equipment."

6. Accounting Services

An accounting and management services sub-contract will be negotiated with a chartered accountant's firm in Sana'a or adjacent area. The TransCentury Controller, or his designee, will come to Sana'a to set up the initial record keeping and warehousing systems. Thereafter it will be the responsibility of the chartered accountant's group to:

- review and appraise the internal control, procurement, and accounting procedures;
- observe physical inventory procedures; and
- independently confirm and physically verify selected assets.

Quarterly unannounced audits will be performed by this group.

7. Additional Administrative Considerations

Water Quality Monitoring

A water quality monitoring unit within Yemen's water sector is essential to assure the potability of water. This unit does not rightly belong in the small water project section of RWD or under TransCentury, since it should serve all projects completed by RWD. The Department of Hydrology assisted by AID Projects 025 and 043 is also involved in this area, but is questionable whether it will be able to provide water quality monitoring services for the entire country in the foreseeable future.

To perform accurate bacteriological tests, the sample should be tested within 24 houses of collection. With this constraint the only feasible means is to have field teams collect samples during the day and return to Sana'a or Taiz in the afternoon, and run the test the next morning. Staffing and supervising such a process is under the general direction of the UNDP/WHO. For the requirement of the Small Water Project, however, TransCentury will

collect initial samples at the feasibility stage of sub-projects, and make collections at random during subsequent sub-project site visits.

Test Pumping

Another key project component upon which the Small Water Project will depend is the creation of a test pumping unit within RWD. Wells drilled by private contractors and often those by foreign concerns are often not test pumped. This test is essential in determining the safe yield of the well to insure an adequate project design. An electric submersible pump with truck mounted generator and tripod is the preferred equipment. RWD currently has an operating unit which will need replacement (except the generator) during the life of the project. It is estimated that the unit can perform an average of one pump test per week and thus the unit would be under utilized if used solely under the Project. The Project proposes to purchase two test pumps of varying capacities and a replacement vehicle (1 5-ton GHC truck) for general use by RWD with the stipulation that it is to be made available to the project as needed. Provision of driver, technician crew, and miscellaneous equipment should be the responsibility of RWD with possible training to be provided by TransCentury or WHO advisors.

Surveys Outside the Scope of the Project

In the past the Director of RWD has been required to provide surveys and/or designs outside the scope of his ongoing activities and consequently project personnel have been instructed to participate in non-project related activities. These activities should be condoned, providing they do not interfere with normal project activities, providing there is justification for the activity under the general scope of the duties of RWD, and providing that the activity can serve as a training activity for personnel of RWD.

On the following pages targets and schedules setting forth quantifiable bench marks are presented. These deal with:

- Subproject selection criteria
- Village level training
- Coordinating Council
- RWD's maintenance capability
- A Servicio

Targets	Schedule Years				
	1	2	3	4	5
1. Subproject Selection criteria.					
Benchmarks:					
a. RWD to use TC/044 project feasibility and socio-economic survey forms for reviewing their own or other donor's projects (percent of time used)	0	25%	50%	60%	75%
b. 044 feasibility studies conducted by Trans-Century and Peace Corps	60	90	90	90	90
c. RWD planning and design section chief designated to review socio-economic prefeasibility studies	--	--	one man in third year		
d. RWD junior technicians names to conduct field feasibility surveys.	--	--	one man in third year, two men in fourth and fifth year		

Targets	Schedule Years 1	2	3	4	5
2. Village level training					
Benchmarks:					
a. training programs for diesel mechanics under UN auspices.					
programs held	3	5	7	9	12
b. Village Water Companies provided with organizational and management training					
No. of companies receiving assistance	10	20	30	40	40
c. Public health and sanitation					
No. of PCVs scheduled, trained, and in country	0	2	5	10	15
d. Contractors trained	0	5	10	15	20

Targets	Schedule Years 1	2	3	4	5
3. Coordinating Council					
Benchmarks:					
a. Number of times convened	6	12	12	12	12
b. RWD Planning and Design Office established	--	--	year three		
c. Planning Office staffed with Chief Engineer	--	--	one man by year 3		
d. Construction Section headed by one engineer	--	--	one man by year 3		
e. Wells unit, engineers	--	one man by year 2, 2 men in year 4, 3 men by year 5			
f. Wells unit, technicians	--	one man in 2nd year, two men in year 3, three men in year 4			
g. O & M unit, technicians	--	one man in year 2, two men in year 3, three men in year 4			
h. Admin. sect-on, senior staff	--	--	one man in year 3		

Targets	Schedule Years 1	2	3	4	5
4. Improvement of RWD's delivery and maintenance capabilities					
Benchmarks:					
a. 044 projects constructed	20	30	30	30	30
b. RWD projects unilaterally constructed over and above 044	10	15	20	25	30
c. Office of Contracts established within RWD	--	--	x		
d. Contractors working with RWD	0	2	4	6	8
e. No. of finished projects checked for operations and maintenance problems	5	10	20	40	40
f. Appropriate technologies identified	0	1	2	3	3
g. Appropriate technologies functioning in villages	0	0	5	7	10

Targets	Schedule Years				
	1	2	3	4	5
5. A Servicio					
Benchmarks:					
a. Idea approved by CPO	--	x			
b. Professional staff seconded to Servicio	0	3	3	4	5
c. Commodities imported (Millions of dollars)	0	.5	1	1.5	2
d. LDAs serviced	0	5	10	20	40
e. No. of RWD contractors provided with commodities	0	2	4	6	8

V

Financial Plan

The total project costs for Project # 044 are divided between TransCentury, RWD, village contributions and the inputs of other donors. These financial plans follow:

1. TransCentury [1/]

AID	Years 1-3	Years 4&5
TransCentury		
Salaries & Fringe	$ 938,569	$ 758,092
Travel & Transport	172,405	83,601
Allowances	445,497	280,439
Consultant Fees	58,778	25,012
Other Direct Costs: [2/]		
(equipment, supplies, and commodities)	2,473,341	1,528,109
Overhead	202,550	150,358
G & A	335,032	216,946
Subtotal	$4,626,172	$3,142,557

Notes:

1. TransCentury's costs in both columns include realistic inflationary factors and are derived from the OPG (revised) budget, Volume II.

2. Other direct costs cover capital items procured by TransCentury for the project on RWD's behalf. (The development of RWD's capability to take over this procurement function through the servico mechanism is described elsewhere in this paper).

2. RWD, Villagers and Other Donors

The contributions of RWD, villagers and other donors are presented in two forms, at constant prices, and with 25% annual inflation.

The overall costs are as follows:

a. At constant prices

	Years 1 - 3	Years 4 - 5
Villagers	$1,319,928	$996,120
RWD	662,920	432,200
Other Donors	675,000	500,000

b. With 25% Annual Inflation

Villagers	$1,805,554	$2,188,742
RWD	803,491	916,210
Other Donor	921,875	1,098,632

Costs for skilled and unskilled labor, commodities and transportation have been broken down by years.

a. At Constant Prices

	1979	1980	1981	1982	1983
Village	332,808	498 060	498,060	498,060	498,060
RWD	59,220	84,600	84,600	84,600	84,600
Other donors	175,000	250,000	250,000	250,000	250,000

b. With 25% Annual Inflation

	1979	1980	1981	1982	1983
Village	404,760	622,575	778,219	972,774	1,215,968
RWD	74,025	105,750	132,118	165,235	206,594
Other Donors	218,750	312,500	390,625	488,281	610,351

Additional project contributions in terms of RWD personnel and RWD administrative support (rent for housing PCV's, office rent, furniture and supplies, warehousing & fuel) are also presented over the five years:

a. At Constant Prices

	1979	1980	1981	1982	1983
RWD personnel	75,000	75,000	75,000	75,000	75,000
RWD administrative support *	56,500	56,500	56,500	56,500	56,500

b. With 25% Inflation

Additional project support					
RWD personnel	75,000	93,750	117,188	146,485	183,106
RWD administrative support *	56,500	67,800	81,360	97,632	117,158

* The costs for project contributions from RWD, Villagers and other donors are derived from the figures presented on pp. 72-77 of volume III, appendix V, as derived by the AID/Yemen Mission Staff.

3. Total Costs

The overall project costs for the five year period are presented below:

	At Constant Prices	With 25% Annual Inflation
	(million U.S. $)	
Contributions		
RWD, Villagers, Other Donors	4.54	7.73
TransCentury	7.77	7.77
TOTAL	12.31	15.50

4. Project Per Beneficiary Costs

At constant prices, the LOP costs per beneficiary for Project # 044 are $88; with 25% annual inflation, the LOP per capita costs rise to $111. These costs, when amortized over 20 years, are reduced to $4.40 and $5.55 respectively.

These derived per capita project costs, are high in relation to project/beneficiary ratios in most LDC's. In Yemen, however, as per beneficiary costs are directly affected by the excessively high cost of labor and commodities with skilled labor commanding $50 - $66 per day and unskilled labor at least $20 per day. Therefore, in the Yemen context --- as distinct from other LDCs --- the per capita beneficiary costs can only be seen as low. AID's contribution, $7.7 million divided by 140,000 beneficiaries, amortized over 20 years, yields a beneficiary cost of $2.78 per rural villager.

Evaluation Plan

As indicated in the overall implementation plan, there will be three evaluations over the five year life of the project. The first will be undertaken during the Fall of 1979, and the second during August-September, 1980. The final evaluation will be during the fourth year. Each evaluation will have slightly different focus. Evaluations will refer back to the measurable indicators given in the log frame of this OPG. They will also examine progress against the records of RWD, TransCentury and Peace Corps personnel.

- First Evaluation Fall, 1979

  This evaluation will stress social, institutional, and technical aspects of the project. The evaluation team will investigate the current structure and capability of RWD to review its needs for consultation, training, or other methods of strengthening the institution. In the field the team will investigate a sample of water supply systems to ascertain the appropriateness of the technical designs, materials used, and distribution systems. They will also ask questions about the village social patterns that have been created to tackle water distribution, and operations and maintenance for the new structures.

  It is anticipated that this evaluation will require 12 person/weeks of technical services. A possible composition for such a team would be one member from the government of Yemen, one from TransCentury/Washington, one from USAID/Yemen and one from AID/Washington. Details regarding this evaluation, specifically project objectives to be evaluated, will be developed by the end of Year 1.

- Second Evaluation -- Year 2

  This evaluation will focus on all aspects of the project, including the village beneficiaries. The evaluation team will investigate any changes in work patterns, life styles, or health and productivity that have resulted from new or improved water systems. The investigators will visit some non-project sites to use as controls. The team will rely on initial sub-project intervention questionnaires and any other relevant surveys.

The team will also investigate the structure of RWD, with particular emphasis on its long-term program and training needs and capabilities. It is anticipated that this evaluation will take about 16 person/weeks. The team might include the following members: one rural sociologist with an understanding of the role of women, one micro-economist, one health specialist, and one person experienced with rural works project management. Recommendations from this evaluation will be incorporated in the implementation of the later parts of the project. The team will also review general progress towards end-of-project objectives.

Final Evaluation -- Year 4

This end-of-project evaluation will determine whether the project should be terminated, extended, or a new project designed. It is anticipated that this evaluation will last 16 person weeks, with two representatives from AID/Washington on the team. Its main focus will be to assess the degree to which project objectives were attained, the potential for further institutional support or training for RWD, and the provision for supplemental preventive health teams for RWD water projects.

VII. PROJECT DESIGN SUMMARY (LOG-FRAME)

GOAL

Narrative Summary:

"To improve the quality of life of rural Yemenis."

OVI - Measures of Achievement - One year following end of project.

1. Approximately 140,000 persons having access to improved water sources within close proximity to residences. (Ability to operate and maintain systems substantiated).
2. Improvement by a significant factor in statistics of key water-related diseases in villages assisted.
3. Evidence of additional self-help activities undertaken in 40-50% of villages assisted.
4. Women freed for more productive employment.

MOV -

1. EOP evaluation, on-site visits, contractor reports.
2. MOH/WHO recors at national and district level where available; contract team survey records.
3. EOP evaluation, on-site visits, contractor reports.
4. EOP evaluation, on-site visits, contractor reports.

Important Assumptions:

1. Designs will be adequate to serve targeted demand, i.e. future needs.
2. Villagers maintain quality of water source; records can substantiate improvement/deterioration in health.
3. Self-help nature of water project will encourage village participation in meeting other development needs.
4. Productivity viewed as preferable to leisure.

PURPOSE

Narrative Summary:

1. To provide improved domestic water supply in selected rural villages.
2. To provide the means for institutionalization of the project within RWD.

End of Project Status:

1. 140 village water systems operational and meeting existing village population consumption needs; new technologies developed and functioning in five to ten villages.
2. a. Basic Organization Structure established to include: Planning and Design Construction, Administration, Wells, Operations and Maintenance Sections. Certain positions staffed, additional positions needed, identified, and requisite training requirements established.

   b. Other Donor - RWD Coordinating Council established and functioning.

   c. O & M Section fully operational and maintaining systems installed under this project.

MOV:

1. EOP evaluation, on-site inspection, contract reports.
2. a. Organizational chart, RWD budget, EOP evaluation indicating that:

      Design section staffed by 1 engineer.
      Construction section staffed by 1 engineer
      Wells Unit section staffed by 3 pump engineers and 3 technicians.
      Administration section staffed by Chief of section, accountant and procurement.
      O & Maintenance section staffed by 3 maintenance/repair technicians.

   b. Organization chart, EOP contract reports.

   c. Three maintenance engineers training and maintaining existing systems as indicated by EOP, spot visits by USAID personnel.

Important Assumptions:

1. Designs adequate, implementable in timely fashion, and selection process workable. Other technologies applicable.
2. RWD receptive to institutionalizing capability within RWD proper; it can locate trained personnel or provide means for training/upgrading skills.
3. Increase salary scales leads to improved retention rate.

OUTPUTS

1. 140 projects designed and constructed with following sub-outputs:
   a. Feasibility surveys conducted and include basic socio-economic data.
   b. Village selection process established.
   c. Periodic water quality testing.
   d. Village health attitudes canvassed and elementary sanitary hygiene education provided.
   e. O&M capability established within all sub-project villages.
   f. Appropriate technologies developed and employed to enhance supply, sanitation in selected villages.
   g. Standardization of design/construction for simple systems replicability, e.g., cisterns.

2. Improved RWD organizational structure endorsed by MOPW with accompanying revised pay scales.
   a. O&M section fully staffed.
   b. Additional staffing requirements identified and plan developed for recruiting-training such personnel.

Magnitude of Outputs:

1. Reliable and improved water supply system in 140 villages, meeting demand of existing population with capacity for indigenous expansion.
   a. Approximately 420 feasibility studies performed by EOP Maintenance.
   b. Criteria established for rational selection by RWD.
   c. Water source tested before, during and after sub-project intervention.
   d. Prior to sub-project selection villagers questioned regarding health attitudes and problems, and guidance provided in terms of basic sanitary hygience. During third year of project, follow-up survey in villages assisted to date will provide trends.

(continued)

Magnitude of Outputs: (cont'd)

e. Two people trained/functioning in each village - total 280 trained by EOP.

f. Appropriate technologies identified of which 2-3 functioning in 5-10 villages.

g. Such designs presented in pamphlet format and disseminated in villages assisted as well as adjacent areas.

2. Five functioning divisions with official MOPW approval and functioning coordinating committee.

a. Three trained maintenance engineers.

b. Comprehensive recruitment/training plan developed in cooperation with RWD.

MOV -

1. Periodic and EOP evaluation, contract reports, USAID on-site observation, Memorandum of Agreement, Peace Corps Volunteers' reports.

2. RWD organizational chart, budget, contractor and USAID reports.

Assumptions:

1. a. All technicians on board, functioning in timely adequate manner.

b. Feasibility and designs meet village requirements, construction supervision adequate, and projected construction timetable - 1 per supervisor per quarter is attainable.

c. Cooperation from UNDP/WHO forthcoming.

d. Contractor has expertise to devise and implement surveys and follow-up.

e. Villagers can be trained/retain ability.

f. Contractor has expertise to adequately address

g. Contractor and villages can develop, apply respectively.

2. MOPW accepts RWD expansion, supports increased budgeting.

INPUTS

Contractors:

Technical Assistance - 25 person years consisting of:

1. Team Leader
2. Design Engineer
3. Wells Master
4. Construction Supervisor
5. Maintenance Advisor
6. Administrative Assistant

Commodities to consist of:

Cement, pipe, reinforcing steel, lumber, pumps.

Training: Local in-country on-the-job of RWD O&M personnel and village operations.

Peace Corps: 10 construction supervisors and 3 design support volunteers, plus 2 mechancial support volunteers.

RWD: Personnel
Office
Commodities

Villages: Self-help contribution

Implementation Target (type and quantity):

see previously submitted budgets, and supplementary financial data.

RWD:

see previously submitted budgets, and supplementary financial data.

Villages:

see previously submitted budgets, and supplementary financial data.

MOV:

USAID, RWD budgets, Contractor, USAID reporting, Memorandum of Agreement, PCV reports.

Assumptions:

1. Personnel can be obtained/retained by contractor.
2. PCVs can be obtained/retained.
3. Waivers can be obtained for local procurement.
4. RWD personnel - budget forthcoming in timely manner.
5. Villagers' contribution not adversely affected by weather, harvest, etc.

Volume III, Yemen Rural Water OPG

Appendices

		Page
I.	General Background	1
II.	Other Activities in the Water Sector	4
III.	Social Analysis of Project 022.	9
IV.	Technical Evaluation, 022	59
V.	Cost Analysis and Technical Data	70
VI.	Design Criteria	90
VII.	Memorandum Agreement	92
VIII.	Standards and Specifications	98
IX.	Environmental Impact	115
X.	Site Report, Kohol Project	126
XI.	Assumptions and Definitions for Cost and Beneficiary Studies	140

Appendix I

"General Background"

APPENDIX I

General Background

"Today's Yemen is a contradiction. If development were measured solely by GNP, Yemen would be one of the world's fastest developing countries. Per capita GNP was only $172 in 1973/74 while in 1976/77 it was a respectable $469, an increase of 40% per year over the three year period. In almost any otehr terms -- infant mortaility, education, life expectancy -- Yemen is still one of the least developed countries in the world."*

Yemen's economy must be classed as oil related, since migration to oil rich countries and the resulting remittances are the most important phenomena affecting it. The rapidly increasing GNP has been fueled by increases in workers' remittances from Saudi Arabia the the Gulf, officially $1.1 billion in 1976/77."*

The above facts pose unique problems in Yemen's development. On the one hand, with 90% of the population being rural and liviing in villages with minimum services and a huge amount of remittance money held by individuals, the carrying out of development projects would seem a simple matter. Viewed from teh other hand, the shortage of labor, particularly skilled labor, the inherent weakness of the central government and its ministries, a high inflation rate, virtually non-existent infrastructure particularly lacking in roads over the rough topography and a fierce independence of the populace, all of these facts work against implementing self help type development projects to benefit the rural population.

With these facts in mind, AID has choosen a strategy for the next five years, which given primary emphasis to education, but also places substantial emphasis on rural development. Two projects are planned for FY 79 which approach the problem of improving the living conditions of the rural Yemeni. The first of these, Local Resources for Development (0045), will attempt to provide assistance

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* Country Development Strategy Statement, Y.A.R., USAID/Yemen, March, 1978.

in the design and construction of locally initiated rural infrastructure projects proposed through Local Development Authorities (LDSs). The project will work at building several selected LDAs with initially little emphasis on the central government organization, CYDA. The second project, the Small Rural Water Project (0044) will attempt also to provide assistance in the design and construction of locally initiated rural projects, limited, however, to domestic water supply in rural villages.

the projects differ in their approach to providing assistance. While the first will attempt to work with grass roots organizations, the second will attempt to work with the established central government organization, attempting to make it a more effective organization and more responsive to the needs of the population. From the institutional point of view, it will be interesting to track these two projects and compare their relative success in delivering improved services to the rural population. From the institutional point of view, it will be interesting to track these two projects and compare their relative success in delivering improved services to the rural population. Useful information should be generated in determining the direction of future projects in the rural development sector.

There is much scope for the construction of the project and, in particular, there is scope for developing a central agency which can provide feasibility and design services for villages desiring an improved water supply. Even the major wadi projects could well be served by a central governement organization capable of conducting surveys and designs. Building such a strong service is viewed as a major component of this project. It has not been tackled by other donors, and i could have an effect long after the project has been completed.

Through financing by the Dutch government, the RWD currently is provided two WHO advisors who are working primarily on institutional development particularly in the training area. The WHO is considering extending this project and USAID will be working to coordinate with this project. Additional staff support is provided by several UN Volunteers and several additional volunteers are expected. Finally, UNICEF has provided RWD with a supply of commodities, primarily pumps and engines which will be available for subproject use.

Appendix II

"Other Activities in the Water Sector"

APPENDIX II

Other Activity in the Water Sector

In addition to this involvement of USAID, other donors have been active in the rural water supply secotr. Catholic Relief Services has been involved with approximately ten small village water supply projects. A Japanese firm completed 36 turnkey village water projects involving drilled well under contract to the Saudi Arabians. Currently the Japanese government is sponsoring the drilling and construction of imately 18 additional systems. The Germans and the Dutch intend to complete a number of village water projects in conjunction with their rural development projects in Rida and Amran. The Iraqi government has recently agreed to drill twenty-five wells for rural village water supply systems. The projgram will drill wells in areas including Kholan, Phamar, Annis, Hamdan, and Sana'a. The program will only drill wells, leaving construction of the storage and distribution system to RWD and the rural villages. The Tihma Development Authority with donor assistance from the World Bank and others is planning or is working with a number of village water supply projects in its project area, primarily in the northern Taiz and Ibb governates. Other wadi projects which presumable would include rural water supply components for which feasibility studies have been completed are Jauf, Bana, Rasyan, Sihan and Kharid. Timetable for financing and implementing these proejcts are flexible at the current time.

Although these projects cover a good percentage of the country (see map App. it is not conceivable that they will meet the total needs of villages in their areas. The major wadi projects will generally concentrate on the wadi bottom areas where irrigation is practicable. Villages in the upper reaches of drainage areas have tended to have little contact with the projects.

Yemen has three institutions directly involved in the water sector: these are the National Water and Sewerage Authority (NWSA), the Rural Water Division of the Ministry of Public Works (RWD) and the Cooperative of Yemen Development Associations (CYDA). This section will abalyses MWSA and CYDA as they related to the proposed Small Water Project.

The NWSA is responsible for providing water and sewerage service to the major cities of Yemen. It is currently undertaking projects in the five largest cities of the country with assistance from outside donors including the World Bank, AID, the Saudi Fund, the Abu Dhabi Fund and others. The precise limit of the scope of NWSA's interest has never been established. However, USAID is

planning for another project, estimated that NWSA would not assume responsibility for any more than 15 additional cities over the next five years. Clearly NWSA has only a marginal interest in proposed project 044.

The other institution involved in the water sector is CYDA. CYDA and the LDAs undertake a wide variety of development projects, including water systems, irrigation systems, roads and schools. As with RWD, CYDA's technical ability is weak. At the present time, CYDA has only two engineers, plus assistance from the Irish volunteer group CONCERN. In the project development phase a decision was made to implement the project through RWD, the following is a summary of the arguments leading up to this decision.

The weakness of both institutions, particularly in the management and technical sides, is apparent. Because RWD is within the Ministry of Public Works, however, it has a pool of draftsmen and surveyors to draw from and also has some warehouse space, purchasing facilities, and experience with an established accounting section. Placing the project within CYDA would mean substantial work in each of these areas, particularly the accounting area, where CYDA has not been involved operationally with projects, particularly in the sense of purchasing and warehouseing commodities. Rather CYDA has served more of a coordinating function, performing studies and providing funding and bureaucratic assistance such as tax (?) exemptions for LDAs. Establishing an operational small water project within CYDA appears to be outside the scope of the organization's operational mandate.

CYDA's relation to the government is also a large question mark. CPO does not consider CYDA a government organization. Instead it is considered a semi-autonomous or autonomous orgazation, although it does have a budget provided by the central government. CYDA'a influence with government ministries and the President is not known. In experience with small water projects, LDAs bring their projects to RWD directly or through the governor rather than through CYDA. For an LDA road project which needs a road grader for a short period, for example, it is more likely that the LDA would go directly to the highway authority rather than CYDA. Thus coordinating role CYDA plays between the LDAs and the government is not really known. Again, an example from the small water projects: the director general of RWD has at times gone directly to the President of Yemen to solve problems involving village projects. It is not known whether the head

of CYDA has this kind of direct relationship.

A third point relates to the scarcity of skilled manpower in the country. The argument here is that whatever skilled manpower Yemen possesses in the rural water field should be placed in one agency. If placed in CYDA, the group would serve LDA projects, presumably those with an effective LDA. If within RWD, the group could serve the same LDAs as well as villages not represented by an LDA. The argument on the other side, of course, is that because RWD is a government organization, it performs only projects for villages having political influence. The evaluation of the small water project did not discover this to be the case, however, since the objective of the project and a stated goal of the YARG is to provide improved water supplies to the rural population, the project should be placed where it can serve the widest audiences and make most efficient use of available manpower. At this time the AID Mission has determined that the Rural Water Division of the Ministry of Public Works is the appropriate institution.

Appendix III

"Social Analysis of Project 022"

By Richard Tutwiler

APPENDIX III

A REPORT ON SMALL WATER PROJECTS IN YEMEN:

Aspects of Social Impact and Recommendations for Future Actions

Submitted under Contract Number AID-279-78-414

March 2, 1978

by

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CONTENTS:

I. The Nature of Small Water Projects.
II. The Implementation of Small Water Projects.
III. Survey of Socio-Economic Aspects of Small Water Projects.
IV. Conclusions: Impact of Projects.
V. Recommendations for Future Actions.
Figure #1. Completed Projects
Figure #2. Projects Planned or Under Construction.
Figure #3. Success Ratings by Category.
Annex #1. Site Report: Village of Qumama.
Annex #2. Site Report: Village of Magrish.
Annex #3. Site Report: Village of Tina'am.
Annex #4. Site Report: Village of Dahlil.
Annex #5. Site Report: Village of Manakha.

I. The Nature of Small Water Projects.

USAID/Yemen Rural Water Supply Project 022 was begun with the stated objectives of improving the water supplies of rural communities through well-drilling and local self-help projects. The project is slated to end in the present fiscal year (1978). The project is placed in the Yemeni Government through the Ministry of Public Works (MPW), in the Rural Water Division (RWD).

Project 022 is divided into two separate activities. The first is the drilling of tube wells. The second is the design and construction of village water storage and distribution systems. This report is concerned with the aspect of the project, hereafter called "Small Water Projects."

The Small Water Projects component of Project 022 may be divided into two kinds of water systems. The first is the construction and renovation of village cisterns. These cisterns are characteristically open, cemented excavations below ground level which collect run-off water from rainfall. Although these cisterns do have settling basins which remove a proportion of sediment, the water in the cisterns themselves is not potable by anyone's standards. Cistern water is used by villagers for watering animals and for such domestic uses as the washing of kitchen utensils, food, and clothes. Other uses include construction and, in some instances, irrigation. The primary objective of AID assistance to cistern development is to increase village water supply through increased storage capacity. In most cases, AID undertakes cistern projects which will provide sufficient storage capacity for year-round use.

The second type of Small Water Project (SWP) seeks to develop simple systems for the storage and distribution of potable water in villages. These projects transport water from an already existing source to stone masonry storage tanks. In most cases this involves the laying of a pipeline from source to tank, the construction of a tank (or tanks), and the installation of water taps allowing access to the water. In situations where a tube well is utilized, AID and the MPW usually attempt to provide a pump and engine. Projects utilizing springs require improvements in these and sometimes also a pump and engine, if the springs are at a lower elevation than the storage tank. These pipeline-tank projects seek to provide for all of the potable water needs of the communities which they serve.

The SWP objectives of providing rural communities with reliable and potable water supplies fall under the overall new directions policy of AID. In particular,

these projects address a basic human need in Yemeni communities. In Yemen's arid climate, water supply and quality are an ever-present environmental constraint. In the typical village, the water supply is insufficient for the community's needs either because of dependence on rainfall collection or the scarcity of non-contaminated ground water sources. Moreover, the potable water source for most villages is not located in the settlements themselves, but some distance away. Often, villages are located for defense and agricultural reasons on rocky outcroppings and water is either gathered in open cisterns or drawn from wells or springs in the valleys below. Procuring water in these situations requires women to walk to the source and handcarry filled containers back to their homes.

Thus the provisioning of water sources in the villages is meant to reduce the cost of water by increasing its availability and accessibility. This, in turn, it is reasoned, results in substantial savings of time and energy for village women while increased use of water for domestic purposes should improve general health among the total population. Ultimately, it is hoped that these changes will enable villagers to invest their resources and time in more economically productive activities. For example, reduced water costs may result in higher participation of women in agriculture or other directly productive activities.

Finally, the implementation of self-help water projects is seen as a stimulus to further community improvement activities in the villages. The initial project may be expanded and improved, for example. The organization and mobilization of resources and expertise which project construction and maintenance require may be drawn upon for other community projects such as school construction, road building, or agricultural cooperatives. Successful projects demonstrate to villagers their own capacity for initiating improvements in their living conditions by using local resources and give them a handle on how they may proceed to obtain resources from outside, such as the government or foreign donor agencies.

II. The Implementation of Small Water Projects.

Project 022 Small Water Projects are by their nature limited in scope. The objective of the program is to provide modest and technologically simple water systems to small populations. The projects remain the property and responsibility of the communities which directly benefit from them.

In order for AID/Yemen to agree to support a project, certain conditions must be met. First, the project must provide a public water system to which all villagers, regardless of social or economic status, have equal and unrestricted access. The water provided must be for domestic use only; the project's water must not be allocated for irrigation or commercial use. Secondly, the villagers themselves must contribute the required labor and local materials for construction of the system. This contribution, at least for projects not requiring a pump and engine, is usually over fifty per cent of the total cost. Thirdly, the system must be publicly owned by the village as a communal body, and the village must take responsibility for the care and maintenance of the system after it has been completed or AID's committment has been fulfilled, whichever comes first.

If a proposed project meets these requirements, AID/Yemen's support constitutes the following donations: 1) the technical design of the system to be built and 2) non-local materials such as cement for cisterns and pipe, cement, and fittings for pipeline-tank projects. AID does not supply dynamite or blasting powder for cistern or tank excavation. If these items are needed, they must be acquired by the villagers.

The Yemeni MPW is also involved in all Small Water Projects. The MPW usually supplies a pump and an engine if these are required by the project, but their main job is the selection of projects for implementation from among the proposals they receive. This usually means that MPW makes recommendations to AID/Yemen concerning which projects AID might support. Villages desiring AID and MPW support for a project which they are proposing must initially go to MPW-Rural Water Division and obtain its approval and recommendation before AID becomes involved. The selection process which MPW follows is based upon the size and feasibility of the project and circumstances relating to the population to be served.

Once a project has been approved by MPW and AID/Yemen a Memorandum Agreement specifying the contribution of each party is signed by AID, MPW, and the local sponsor representing the village. The local sponsors of projects are of two types, either a Local Development Authority (LDA) or the shaykh of the village. The local sponsor takes responsibility for delivering to the project the items indicated in the Agreement as village contributions. In some projects, the local sponsor also takes responsibility for the supervision of actual project construction, although this is not specified in the Agreement. In other cases, MPW or AID undertakes to supply a project supervisor (most often a Peace Corps Volunteer (PCV)). If the supervisor is not a local person, then the village takes responsibility for his

housing and maintenance on the site. Memorandum Agreements do not specify a beginning date for projects, nor do they include a date by which the project must be completed. More often than not, the actual relations among the three parties are based upon informal committments among individuals, and not upon the provisions stated in the Agreements. As far as can be determined, these Agreements are not legally binding contracts.

III. Survey of Socio-Economic Aspects of Small Water Projects.

AID/Yemen is currently considering continuing the Small Water Projects component of Project 022 as a separate project (Small Rural Water Systems 044) after 022 expires. As part of the preparation of this new Project Paper, a survey of existing and planned Small Water Projects was undertaken during December, 1977 and January and February, 1978. The survey was aimed at evaluating the successfulness of existing projects and analyzing the social impact of these activities.

Teh bulk of the survey consisted of making field visits to eight projects for which AID's committment has been fulfilled and to four sites for which AID is considering projects. In addition, the supervisors of two other completed were interviewed as to the scope of these projects, their current status, and their "fit" with the local socio-economic environment. The following statements are based upon this sample of ten completed projects and four proposed ones.

Although every village surveyed displayed unique social and economic characteristics, a typology of three village types emerged from the thirteen settlements considered (note: the town of Manakha has both a completed and a proposed project, see Annex #5). These general types are as follows: Type A is a village with expanding economic opportunities in various sectors; Type B is a village with a high rate of labor out-migration but with cash cropping opportunities and Type C is a village with a high rate of migration but with a subsistence agricultural base. Categorization of the villages surveyed according to these types may be found in figure #1 below.

In terms of general characteristics, Type A settlements are clearly the wealthiest and the most developed economically. More detailed descriptions of such settlements may be found in Annexes #4 and #5. Type A settlements are regional market centers which serve the needs of their surrounding rural areas. They are

invariably located on either main highways or primary rural access roads. Because of their growing commercial enterprises (e.g., stores, restaurants, hotels, car service centers, etc.) and the large numbers of non-residents who use the services located in them, these settlements have the highest water demand levels of all the rural settlements which Small Water Projects serve. In fact, the three type A settlements surveyed all had demands exceeding the capacity of their projects. Moreover, these demands will continue to increase in the foreseeable future.

Type B villages are not commercial centers and do not have high percentages of non-agriculturally employed full-time residents. These villages are, however, very much integrated into the market economy because of their cash crop agricultural base and because of their labor migration and resulting cash remittances. The agricultural potential of these villages allows substantial local investments in productive activities (mostly grape, qat, or vegetable cultivation). These investments include clearing new fields, hiring wage labor, and providing sufficient irrigation facilities for the crops. Thus Type B village water demands are two sided Domestic water needs will increase as a function of increased population and desire for improved living conditions and agricultural water needs were increase as a function of new agricultural investments. In many of these villages the water supply is a serious environmental constraint, and villagers face a real trade off in allocating water for the type of activity. The village of Magrish, for example (see Annex #3), is currently dividing their water between their new project and the needs of their grape and vegetable crops. Although the AID-supported projects are specifically not aimed at irrigation, agriculture in Type B villages is a factor which must be seriously considered in Small Water Project design and impact.

Type C villages represent the "poorest of the poor" in terms of current and potential growth. These villages are only partly integrated into the market economy. This partial integration is primarily a result of labor migration by young males who leave in order to earn money which is sent back or saved to support their families (see Annex #1). Type C villages have a local economic base firmly rooted in subsistence agriculture, and the crops they produce are almost wholly consumed by the households which produce them. The ever-present water scarcity is most acute in these villages, where the local environment barely contains enough water for domestic use and almost none for irrigation purposes.

It is not surprising, therefore, that of the six Type C villages surveyed four supplement marginal agriculture with other economic activities (two have nearby quarries, one has several plaster ovens, and one has salt collection and fishing). Also, due to the lack of springs or streams these villages currently rely upon collecting rainfall run-off and bringing in a drinking water by truck for their domestic needs.

To say the least, living conditions in Type C villages are rough by any standard and have only marginally improved recently because of the remittances sent by migrant workers. These villages characteristically are populated by women, old men, and children. Thre are very few local investment opportunities which could act as incentives for the young men to stay. AID-supported projects in these villages have the highest visible impact of all the Small Water Projects.

Not surprisingly, the strength and complexity of village institutions which become involved in community self-help activities varies with the three types of socio-economic situation. In analyzing the role of local institutions in Small Water Projects initiation and implementation, the "local sponsors" of the projects were surveyed. For the purposes of this report, a local sponsor is defined as those people (or the institution they represent) who (1) proposed the project to MPW-Rural Water Division; (2) took responsibility for supplying local materials and, in some cases, construction supervision; and (3) took responsibility for project maintenance and/or extension after AID's involvement ended. Local sponsors are of two types. The first is the Local Development Authority of the village's district or a member of the LDA who lives in the village, and the second is the shaykh of the village or sub-district. (For an example of LDA sponsorship see Annex #5, and for shaykh sponsorship see Annex #3).

The local sponsors' role is critical for the initiation of projects, for they are the people who are empowered to speak for the people of the village. The local sponsor brings the project proposal to the MPW for the initial evaluation, and they must continue to follow the project proposal through the various stages of negotiations, feasibility studies, etc. until the Memorandum Agreement is signed. With respect to the site itself, the local sponsor must obtain the materials which the village is to supply according to the terms of the Agreement and the verbal exchanges made in the negotiating process. This requires a great deal of work at the village and household levels, for the shares of the cost must be determined and collected from each household. In most cases, the local sponsor also acts as the construction supervisor, although he may not have the required technical capability to adequately complete the job.

The capabilities of the sponsors vary greatly from project to project and appear to be determined by the unique circumstances of each individual and each community. Moreover, the resources available to the sponsors for getting the project approved, begun, and completed are an important factor. For example, the sponsor often has to travel to Sana'a (i.e., to MPW or AID) to lobby for his proposal, and these expenses usually come out of his pocket. Also, the sponsor's position in his local community can determine whether or not he is successful in his efforts. Oftentimes influence in the local community is insufficient to get a project begun if the sponsor has no influence in Sana'a, and vice-versa.

IV. Conclusions: Impact of Projects.

The analysis of Small Water Projects presented below is based upon the relationships of various socio-economic factors found in project villages and the degree of project success in the villages. These factors and project success ratings are presented in figures 1,2, and 3.

A project was considered a success if the following conditions were met: (1) the completed system is operable, even if non-AID supported extensions have been added, and (2) the system achieves the objectives listed in the Memorandum Agreement. Thus, if, for example, a pipeline-tank has been installed, but the engine provided is insufficient to fill the storage tanks of a regular basis, then the project must be considered only partially successful. In terms of achieving the objectives of the project, such a situation can not be considered a success.

The ten completed projects surveyed are presented in figure #1. The overall success rating of these projects, accoding to the above criteria, is sixty per cent. The breakdown according to project characteristics is presented in figure #3 as ratios

of four planned or partially completed projects included in the survey. These projects in figure #2 are the projects most likely to be completed or undertaken in the near future.

Although the sample of only ten projects is small, it does provide a reasonably representative profile of the total Small Water Projects involvement. It appears that the nature of the project concerned (i.e., either cistern or pipeline-tank) does not significantly correlate with the project's chances of success. Therefore, one may conclude that both types of project are worthwhile activities, assuming that a sixty per cent success ratio is acceptable.

In terms of local sponsorship, the results are ambiguous. This is partly due to the small number of cases involved. For instance, only two LDA's actually participated in the sites surveyed. The manakha LDA demonstrated a high degree of proficiency in providing local materials, supervising construction, and planning extensions (see Annex #5). In contrast, experience with the LDA which handled both the Dahlil (Annex #4) and Dhalma projects was mixed. In the case of Dalil local planning and supervision were clearly inadequate, but the same LDA achieved success in the Dhalma project. Shaykh sponsorship was similar. In the cases of Magrish (Annex #2) and Aras the local sponsors acted with notable initiative and achieved clear successes (though they did have the help of PCV supervisors). In the cases of Ghola and Hayma the systems were never even built, although AID donated materials were delivered to the sites. The only conclusion from this comparison is that individuals vary in their capacities. Neither LDS nor shaykhs, as groups, appear to act as better local sponsors.

With regard to type of socio-economic situation, the only clear conclusion is that Type C villages achieve the best success ratios. Quite possibly the reason underlying this fact is that Type C villages have the greatest need for a minimal water system. These communities appear to be more unified in their carrying out of project plans. In part, this is due to less conflict over water distribution because the needs of individual households are pretty much the same.

In Type B villages, household needs vary according to a greater disparity in economic positions and according to the competing requirements of irrigation systems. Simply stated, Type B villages are in a state of socio-economic ambiguity. Some residents are in positions to strongly benefit from the changes in the wider society. They are making profits off their agricultural investments and investing in further improvements. Other residents are being left behind economically and also with regard to their social positions in the community. The traditional ideology of equality is being adversely affected by the growing economic disparity. Local communal decision-making mechanisms may be breaking down in these villages as a result. A final factor affecting these communities is a natural tendency to over-extend their capacities due to the relative surplus of monetary resources available. This is certainly the case in Tina'am (see Annex #3).

Type A villages are similar to Type B villages in that there is a good deal of money available for projects and also a high demand for water for purposes which are not strictly domestic. Consequently, there is a marked tendency for conflict among residents over use rights of the available water supply. However,

these rapidly developing settlements sometimes have relatively sophisticated institutional structures for dealing with these problems. The Manakha LDA is such a structure. It is well organized and experienced in carrying out large-scale projects. On the other hand, the Dahlil LDA itself was split over the proper distribution of project benefits with the result of an unfinished project (see Annex #4).

The most clear-cut conclusion reached in the survey comparison is that outside supervision helps to achieve successes. In the cases surveyed, the involvement of Peace Corps Volunteers was the most significant factor in making the difference between a fifty per cent success ratio and a sixty per cent one. Also, and this does not appear in the comparisons, PCV on-site involvement significantly reduced the time required to complete projects. It seems that the on-site supervision by a non-local is more important in pipeline-tank projects than in cistern projects. Perhaps this is due to the level of technological capabilities in the villages and the ability to follow project designs.

In terms of the impact of Small Water Projects, it is valid to say that the universal impact of projects which become operational is that there is an increased use and an increased demand for water in the communities which they serve. The benefits of such an impact are clear (i.e., decreased time and energy spent procurring water, potential for better sanitation and general health, improved quality of life, etc.). The negative aspects are less clear. A project which increases water use may result in irreparable damage to water resources and local ecology. Similarly, increased demand may result in higher levels of communal conflict over water use and access rights. And finally, the project may inevitably become the focus of political rivalries because it represents a new resource to be fought over in the local political arena.

The distribution of benefits is also a bit unclear. Granted, most systems allow for free and public access to water, but the very fact that the outlet taps of the system must be located in specific spot invariably gives an advantage to those who live nearby over those who live farther away. The distribution of benefits, then, is a function of the system's location.

In terms of the stated objective of freeing labor for non-water related activities may not have the impact that project designers envision. Reducing the labor of women in water procurement does not necessarily mean an automatic increase in their agricultural work. Particularly in Type C and Type A village women's

agricultural involvement seems to have reached a saturation point. In Type B villages increased time in social activities may be considered more beneficial investment than labor in the fields (see Annex #3).

Nevertheless, it must be concluded that the Small Water Projects are important because they do provide a basic need in the villages they serve. Water is perhaps the single most important item in village life, in fact it is necessary for the village's continued existence. Providing villages with adequate water supplies will have a most positive impact in improving their quality of life.

V. Recommendations for Future Actions.

The following recommendations are aimed at improving the efficiency and success ratios of future Small Water Projects, whether they fall under the existing Project 022 or under the proposed 044. These recommendations are drawn from the experiences gained from the sites surveyed, including successful, unsuccessful, and planned projects. In the following discussion, aspects of six areas of activity are discussed. These six areas, in order of presentation, are 1) project supervision, 2) training of local "para-technicians", 3) project design, 4) feasibility, 5) working agreements, and 6) selection procedures.

From the survey discussed in previous sections, it is clear that successful project implementation relies heavily upon full-time on-site construction supervision. The supervisor does not himself necessarily need to be a trained engineer. In fact, a generalist competent in basic technical skills is sufficient to carry out these projects provided the designs are adequate. The site supervisor should have a working knowledge of Arabic and a basic understanding of local water and property rights as they pertain to the project. Finally, the supervisor should spend time in order to sketch out the local social structure so that he conduct his task with an ability to anticipate implementation problems arising out of the initial impact of project construction and the less immediate, but no less important, implications of the new water system.

There is also a clear need for providing post-completion maintenance and repair of projects. Perhaps this provision could be undertaken by training local personnel during project construction. The training of such people may be most efficiently accomplished through close cooperation between the site supervisor and the local sponsor. The local sponsor could nominate and/or select people to work in a kind of counter-part capacity with the supervisor. The important elements of training would be (1) an understanding of how the system was designed and its capabilities, (2) the proper care and maintenance of the completed system, (3) the

knowledge of available local and non-local support facilities should help or advice be needed in the future. It is expected that adequately trained local "para-technicians" would serve as key personnel in the community's organizational structure for the project's future operations. This role is crucial should the project undergo a future extension through local initiative. Of the projects surveyed, half of those completed have either planned or in place extensions, all undertaken at local initiative. Unfortunately, there can be no assurance that these local para-technicians will remain working on the project, or even remain in the village, after completion. This is a matter that must be settled among the para-technicians, local sponsors, and the village populations.

The third activity is project design. Again, this is of fundamental importance and must be workable between village desires and the material and technical capacities of the donor agency. First of all, system design must be a function of the interaction between the needs of the community and the constraints of the environment's water resources. A system which meets total demand but puts a strain on local resources such that the ecology is permanently damaged benefits no one. Design must also fit into the local social environment. In this respect, previous experience indicates that tank site selection is critical, and a poorly located tank may seriously affect the equitable distribution of benefits. Finally, Small Water Projects should be designed to facilitate future extension of the system such thatpredictable additions will not adversely affect operation. Although all extension possibilities cannot be anticipated, enquiries into local aspirations and plans should be made to gain a picture of how the system may look in five to ten years' time, assuming continued local involvement in water system development.

As a complement to these comments on design requirements, feasibility studies prior to the design and implementation should answer questions pertaining to local water use, water needs, water resource potential, and the rate at which water demand will likely increase in the near future. These studies would be specifically undertaken to determine which design would provide an adequate system for the required task. Of course, the final project design must be technically feasible within the existing (and anticipated) constraints of the physical and social environments. A number of the completed projects have been clearly inadequate to meet local demands and expectations, and these seem to inevitably run high risks of total failure and wasted resources.

The fifth area in which improvements can be made is in the nature and use of the Memorandum Agreement. It is recommended that these agreements be used more in the manner of contracts in which the committments of each party involved are clearly specified and binding . In most projects surveyed, a strong contractual agreement publicly acknowledged by all parties would have saved a great deal of misunderstanding and, in some instances, hard feelings between various individuals and institutions. With regard to local contributions, it is suggested that rights-of-way for pipelines and public access to the project once completed be included as specified provisions. Stated dates for the delivery of materials and labor by all parties may facilitate project construction, but provisons for unforeseen circumstances should be included. There should also be provisons allowing parties to break the agreement if other parties do not fulfill their commitments. Finally, some provision should be made for setting up an institutional framework through which the project will be managed during and after completion. This may, in fact, be through the local sponsor (LDA or shaykh), but it may also be a new structure such as a small water authority or cooperative to which villages belong, hold shares, and take part in decisions regarding their water system.

The sixth identifiable area in which improvements can be made is in the routinization of the project selection process. First of all, AID and the MPW should determine guidelines that set boundaries on the scope of individual projects, at least in terms of the contributions of these two agencies for any single project. Such clear guidelines would reduce the possibility of donor over extension and may encourage local investments in village water systems. Secondly, the selection process should follow clear and regular procedures which specify the forms which village proposals should take and the actions which the MPW and AID will take in response to village applications. Guidelines for determining positive actions on proposals should be made known to village sponsors in advance of final decisions. Finally, AID and the MPW together should assign priorities to the expected project objectives. For example, evidence of need (e.g., poverty) or local willingness to become involved in cooperative efforts would seem to be more important in project selection than the village's proximity to a paved road.

PROJECTS SURVEYED

Figure #1.

Completed Projects

Village	Status	Nature of Project	Local Sponsor	Village Type	Project Extension	Supervision	Success Rating
Manakha	Operating	Pipeline-Tank	LDA	A	Planned	Local	1.
Tina'am	Semi-Operating	Pipleline-Tank	Shaykh	B	In Place	Local	2.
Magrish	Operating	Pipeline-Tank	Shaykh	B	None	PCV	1.
Hubshi	Operating	Cistern	Shaykh	C*	None	PCV	1.
Qumama	Operating	Cistern	Shaykh	C*	Planned	Local	1.
Al-Ghola	Not Operating	Cistern	Shaykh	B	None	Local	3.
Dahlil	Not Operating	Pipeline-Tank	LDA	A	In Place	Local	3.
Dhalma	Operating	Cistern	LDA	A	None	Local	1.
Hayma	Not Operating	Cistern	Shaykh	N	None	PCV	3.
Aras	Operating	Pipeline-Tank	Shaykh	C	Planned	PCV	1.

Notes: 1. Village Types: A=Growing Economically; B=Migration w/ Cash Crop; C=Migration with No Cash Crop; C*=Migration w/Non-Agricultural Activity

2. Sucess rating based on achievement of project objectives.
Symbols: 1.=Successful; 2.=Partially Successful; 3.=Unsuccessful

Figure #2.

Projects Planned or Under Construction

Village	Status	Nature of Project	Local Sponsor	Supervision	Village Typ
Hamera	Under Const.	Cistern	Shaykh	Local	C
Rabat Ash-Shari	Planned	Pipeline-Tank	Shaykh	PCV	C
Yakhtul	Planned	Pipeline-Tank	LDA (from Mocha)	LDA-PCV(?)	C*
Manakha Phase II	Planned	LDA	LDA-PCV (?)	LDA-PCV(?)	A

PROJECTS SURVEYED

Figure #3

Success Ratings by Category (N=10)*

Category	Type	Successful	Unsuccessful	Total
Nature of Project	Cistern	3	2	5
	Pipeline-Tank	3	2	5
Local Sponsor	LDA	2	1	3
	Shaykh	4	3	7
Village Type	Type A	2	1	3
	Type B	3	0	3
Supervision	PCV	3	1	4
	Local	3	3	6

* Based upon completed projects only.

ANNEX #1.

Site Report: Village of Qumama.

Location: The village of Qumama is located in Thula district of Sana'a Province, approximately 40 kms. north-west of Sana'a city. Qumama is in the arid highland zone of Yemen and is situated just below a rocky mountain ridge and above a small wadi which catches rainfall run-off. The terrain around Qumama has very little vegetation, particularly during the fall and winter months. Almost all available soil near the village is terraced, however, and the land produces an annual crop after the rainy months. Irrigated land, of which there is little (less than 10% of the cultivated area) can produce crops year-round.

Population: The village's population is estimated at 800 persons; about 140 adult men are migrant workers, however, and they are absent most of the time. These men work as stone-cutters and stone masons in Yemen's cities (principally Sana'a) and by large do not migrate to Saudi Arabia. A few families send their sons to schools outside the vicinity of the fillage. Some students are in nearby Thula (one hour's drive by car) and some further away in Sana'a or elsewhere. Nearest medical facilities are in Thula, where Irish volunteers operate a small clinic; the nearest doctor is in Shibum, about an hour and a half's drive by truck. The closest hospital is in Sana'a.

Project Description: The 022 Small Water Project in Qumama is a large, open cistern located 75 meters from the entrance gates of the village. This cistern is filled by rainfall run-off during the region's two short rainy seasons. The water is used for animal watering and domestic activities (primarily washing) and is not drunk by the villagers. Drinking water is obtained from a mountain spring located 500 meters from the village. This spring has been used for centuries, and its water flows through and underground canal (ganat) to a basin about 300 meters from the village. The output of the sping is low (during the dry season it is only a trickle), and the water is used exclusively for human consumption.

AID's contribution to the project was the design and cement for cistern enlargement and renovation. Agreement for these services was reached during fall, 1974 and the completion letter was sent to the Ministry of Public Works on January 5, 1977. Excavation and construction of the new cistern was undertaken by the

villagers themselves, and AID did not have an on-the-site supervisor.

Economy: The majority of the villagers' income is derived from labor migration. Most village men work in Sana'a or a few other towns north of the capital. They work as skilled laborers in the construction trade, where they can earn as much as 150 riyals a day (although they may not work every day). The money they earn is used to support their families in the village and is invested in a number of activities such as improving their houses in the village, renting or buying houses in town, buying electric generators, and purchasing trucks.

Agriculture in the vicinity of the village remains in the subsistance sector, supplementing household income. During the spring and summer months a crop of sorghum interplanted with beans is planted and harvested on mountain terraces. In a few of the most productive fields where ground water is available, alfalfa is grown for use as an animal fodder. The nearest powered mill for grinding local sorghum and imported wheat is in Thula, and flour is still ground by hand in village households.

Since the overwhelming majority of people permanently resident in Quama are women, children, and old men, it is tempting to view the village as little more than a "bedroom community" supplying workers for Yemen's towns. The able-bodied men are absent most of the time and return to their families for perhaps only three months out of the year. They come to Qumama to help the women in the peak agricultural periods such as planting and harvesting times, and they try to spend Ramadan and a few other religious holidays in the village. By and large, the women of Quama are all agriculturalists, and they consider themselves as farmers. Along with the children, they herd sheep and goats and take care of a few head of cattle. What they cannot produce themselves in the way of food or other needs they purchase with cash sent by the migrants, of which there is usually at least one from every household.

Not all men are involved in continuous labor migration. Some have worked outside the village and saved money which they have invested in local enterprises. For example, there are several tractors in the village and its vicinity, which their owner-drivers rent out for plowing and leveling of fields. Because of the nature of local agriculture, however, the demand for this service is limited. Other men have set up small shops, but again, their stock is limited and their market small. Large household purchases are invariably made in Sana'a or other towns, and the goods are then brought in by truck to Qumama by the purchasers.

Because of the scarcity of water for irrigation, the high price of local labor, and the low market demand, Villagers have made few investments in agriculture. Environmental constraints prohibit expansion into the lucrative cultivation of such cash crops as qat, grapes, or vegetables. People appear to spend the greater part of their cash income either for simple consumption or the building of new stone houses.

Social System: Spending large sums of money on new houses fits directly into the existing social structure and its system of values. Like the rest of rural Yemen, Qumam's social structure is essentially based upon the household and the relations between households. The household organization and the kin or family relations among household members varies widely, but there is a general tendency for large households to contain extended or joint family groups. Within such a unit are a number of nuclear families (i.e., husband, wife, and children) which are socially, and often economically, subordinate to the larger group and its leader -- usually a senior-generation male. The new cash resources which can be earned through labor migration have enabled many young men of junior generations to separate themselves from large household units and set up smaller, independent households of their own. Setting up an independent household means a greater degree of social and economic freedom, but young men who aspire to head-of-household status must weigh these rewards against the costs. These costs are direct. First they must be married and have their own house. Secondly, they must command sufficient resources to provide food, clothing, and all necessary domestic items for the new household (which will have fewer working members than the larger household). Today in Qumama establishing a new and independent household almost invariably means labor migration expenditure of cash earned on marriage payments, house construction, furnishing,and food supply. The new housing style is distinctive: in contrast to the older large rambling structures, new houses are small and compact, generally of one storey with a small number of rooms and fewer occupants.

As more and more young men leave the village to work elsewhere, the old men of the village find themselves with less authority then they previously commanded. In Qumama, the old men tend to spend a great deal of time together in the mosque, which not only serves as a place of worship, but as a social center as well. The mosque and its enclosure serve as a scene for all types of activities. The children are taught there by a religious teacher, the village barber practices his trade there, and, until the completion of the project cistern, the mosque's cistern was the principal source of water for washing and animals.

The village has a shaykh who is the leader of the most influential household and who is responsible for relations with non-village people and institutions. The shaykh spends much of his time in Thulu, where he maintains another household. There is also an agil who is responsible for maintaining day-to-day affairs in the village.

Project Impact: The impact of the AID-supported cistern for Qumama is two-fold. In terms of immediate results, the village has been supplied with a much greater storage capacity for collecting run-off surface water. This means that non-imporable water is available year-round for domestic use. The small cistern adjacent to the mosque is no longer the only source of this type of water. The water in the cistern is accessible to all households in the village and is used according to need and the labor available to carry water to households. As a consequence of the new cistern, non-potable water can be used in greater quantity than before. This change in availability may have the long-term impact of improving general sanitation in the village. Other benefits include an increased water supply for animal consumption and a definite sense of an improved "quality of life" in the village because of the greater availability of water. An adequate water supply is the minimum requirement for the continued habitation of the village, and the cistern may, indrirectly, provide a stimulus for household s remaining in Qumama rather than permenently migrating to the towns.

The perceived improvement in the quality of life in Qumama lies behind the second social impact of the project. This impact is difficult to measure, but it manifests itself in the villagers' plans for future communual improvements. The villagers expressed a strong desire to extend the cistern project by running a pipeline from the cistern to several neighborhood water taps within the village itself. These taps would reduce the distances women have to walk to bring water home. If covered tanks were built along with the taps, storage capacity would be increased and water loss by evaporation would be reduced.

Such an idea is not new to Quama. Before the cistern was constructed, the villagers had themselves installed a pipeline which brought unused water from the spring which provides drinking water to the ancient cistern beside the mosque. Unfortunately, this spring's outflow is very small, but the pipeline did increase availability somewhat. The new cistern demonstrated the feasibility of such a pipeline scheme if rainfall run-off can be effectively trapped and stored. The

new cistern seems to have sparked a good deal of community spirit. The villagers also wish to initiate a project which would improve the mosque. we hope to enlarge and improve the present structure and possibly make provisions for a better village school housed in the mosque. The success of the cistern project (of which the village's contribution of labor and rock far surpasses the value of AID's donation of cement) demonstrated the potential benefits of investing resources in communual self-help projects. Although modest, this cistern project has clearly achieved its goals of both providing more usable water and giving the villagers a sense of what can be achieved through common effort.

Future Prospects and Recommendations: The cistern of Quama is fully operational and appears to have caused no social or economic problems. What it has done is to stimulate the desire to extend the water system of the village. This may cause unexpected problems if the pipeline scheme is undertaken without careful planning. Extension of the distribution system may result in increased water demands which may use up the village's present storage capacity and water resources.

It may be beyond the scope of the present 022 Small Water Project to conduct a feasibility study of the system the village intends to install, but the situation in Qumama indicates needs which should be addressed in the future design of similiar projects. First, all projects (even cistern) should be designed with future locally undertaken extensions in mind; and, secondly, completed projects should be periodically visited to study the impact of modifications which may be initiated and executed by the people who use the system.

ANNEX #2.

Site Report: Village of Magrish.

Location: Magrish is located in Bani Hushaysh district, Sana'a Province about forty kilometers northeast of the city. The village is an hour's journey from Sana' by car via the Marib road and an unpaved track running up Wadi Rijam.

The village is situated in the upper reaches of Wadi Rijam overlooking the broad wadi bed. Magrish sits astride the junction of Wadi Jijam and one of the numerous lesser wadis which flow into it.

Population: The population of the village of Magrish is two hundred and fifty people who live in approximately twenty-five households. For the most part, each household occupies its own house, but some facilities such as kitchens and latrines are shared by more than one household. The village is not walled and is not divided into physically distinct quarters. Magrish is of average size for villages in Wadi Jijam. There are two hamlets close (200 meters) to Magrish, but these are socially and economically distinct from the village and should not be included in its population.

As in other settlements in the area, Magrish has a high migration rate. Many, if not a majority, of the able-bodied males are absent a good deal of the time. These men either work in Sana'a or Saudi Arabia. The men who work in Sana'a, of course, visit their families more frequently than those in Saudi, but the visits of the Saudi migrants are of longer duration -- averaging between three and six months a visit. Migrants to Sana'a return during holidays and as personal needs dictate. The specific numbers of migrants in Magrish was not determined.

Project Description: The 022 Small Water Project in Magrish was begun in October of 1977 and completed in November of the same year. The project consists of a pipeline beginning at a drilled well five hundred meters from the village which terminates in a 7,000 gallon covered stone tank in the village center. The pipeline is connected to a pump which is used to fill the tank every other day. The tank is equipped with public taps at its base. There are no private pipe connections either to the tank or the pipeline.

AID's contribution to this project was the design, the pipe, and enough cement for the tank's construction. An expatriate construction supervisor who remained in

the village while work was in progress was provided by the Peace Corps. The village's contribution was the drilled well, labor, and rock and sand for the tank. The project agreement mentions no material inputs by the Ministry of Public Works.

The arrangement currently employed for pumping the water form the well to the tank is not clear. However, the pump and engine appear to be privately owned and are also used for providing irrigation water to nearby fields. The well itself was jointly financed by the village shaykh and a number of household heads, who hired a private company from Sana'a a few years ago. Actually, the village ended up hiring two companies to undertake the drilling, but the first one was unable to complete the well. So the second company was hired, and they drilled an entirely new well plus finished the one already started. Now there are two wells within twenty meters of one another, but one of them is capped and unused.

The village intends to acquire a pump and engine of their own which will be used on the capped well exclusively for the public water system. At present, the system meets the needs of the population, but the villagers feel that their domestic water consumption may rise in the future, and they do not want to be in a position of competing with irrigation requirements. At present, the water supply is contingent upon the cooperation of the pump owner. Opening the other well and installing a village pump on it would insure a constant supply of water to the tank.

No further plans to extend the system were elicited from villagers, but it is reasonable to assume that they may wish to add household connections to the system as presently constructed. Such a development would not be surprising if capital and a constant source of water are available.

This project replaces the previous village water source of a hand-dug well located just outside the area of settlement. Although women still have to carry water ot their houses, they no longer have to draw the water. Moreover, the water is protected from foreign matter by the new system's pipes and covered tank. There is also a common belief that water from a drilled well is cleaner and more healthy than water from an open, shallow hand-dug well.

Economy: Magrish's economic base is a mixture of wages from labor migration and cash earned from the sale of grapes, the areas principal cash crop. This cash income is supplemented by the cultivation of sorghum, a few vegetables, and alfalfa. The alfalfa and sorghum plants are used as fodder for the animals kept by each household. In recent years, grape and vegetable cultivation has been expanding at the expense of sorghum. With the growth of market demand emanating from Sana'a,

many farmers are devoting more of their resources to growing cash crops. They are also finding it easier to purchase their household food needs. Oat cultivation is minimal in Magrish because of the relatively cold winter temperatures, but further down Wadi Rijam oat is the principal crop.

Grapes and alfalfa are irrigated by a variety of means. Water is delivered to fields through a mazeway of dug channels, and comes from rain run-off, hand-dug wells, or, increasingly, from pump-equipped tube wells. Tube well water is usually purchased directly from the well owner, according to the needs of the farmer. The actual pipeline delivering water to the field may be owned by either the farmer, the well owner, or both. This situation is further complicated by rights-of-way for irrigation or domestic water pipes and the desire of people for independent access to water. On the ground, this all results in pipeline jungles and disputes over rights-of-way and the water itself.

During the late spring-summer-early fall growing season, grapes require watering once every two weeks. Sorghum and vegetables are planted between rows of grape vines and are irrigated along with the grapes. All the crops are harvested by hand, and the sorghum is threshed and winnowed by hand on rock-paved threshing floors near the village. Alfalfa is grown on year-round, but during the winter months it is the only crop cultivated in Magrish.

The labor situation and the actual division of Labor in Magrish are difficult to describe because the site was visited during the low point of the agricultural cycle. Nevertheless, it is fair to say that the overwhelming part of the permanently resident population is farmers. No merchants, vendors, artisans, or professionals are evident in the village. Moreover, the production of sorghum, vegetables, and alfalfa is predominantly taken care of by women.

The women in the village should be considered the bulk of the permanent labor force in agriculture. Similarly, animal husbandry is also in the domain of women's work. The two exceptions to these statements on women are the operation of irrigation systems and the cultivationof grapes which in nearby villages, at least, are the province of men.

Land tenure arrangements are unknown, but it is to be expected that tenancy incidence is provitively correlated with irrigated lands, which produce grapes.

Economic investments in Magrish are varied. Observation indicates that a good deal of money is spent on improving household conditions. Magrish has a number of new multi-storey stone houses equipped with electrical generators, television sets,

Western-style beds, etc. Also, a few households have purchased cars, but these do not appear to be used for commercial activities. In terms of productive investments, a small number of fields have been prepared for grape cultivation, but such an undertaking requires access to irrigation water and a waiting period of about four years before harvesting can begin. There is a potential for direct investments in water delivery systems, although initial capital costs are very high -- beginning with the drilling of tube wells and the purchasing of engines and pumps.

Social System: Like most rural Yemeni villages, the social system is based upon a number of socially related, but economically independent, households. In Magrish there are about 25 households. The village leader is called to "shaykh," and he is a member of the most influential household. The succession to this office usually remains in a single lineage. The shaykh has few coercive powers, and his tenure in office rests upon his ability to anticipate and articulate collective village decisions and maintain a cooperative relationship among the various households.

For reasons of kinship, collective decision-making, and propinquity, the village constitutes a distinct social group. It is set apart socially from neighboring villages and hamlets. On the ground, this situation becomes most clear in terms of rights to environmental resources. Only the people of Magrish have the right and the access to the village's water supply. This means that the AID supported project serves only Magrish, and other people must continue to rely upon their own water sources. In terms of irrigation water the situation water the situation is different. Irrigation water is sold to cultivators by the owner of the delivery system. In this case the delivery system is a well, a pump, or both. If a cultivator needs water, he makes a private arrangement with the owner and not with an entire community. But the entire community may become involved in water access rights if the private arrangement conflicts with a previous communal arrangement.

Project Impact: The project as presently in place does not substantially change previous arrangements for domestic water access. Water from the project tank is open for free access to all Magrish residents, just as the previously used open well was. As before, the Magrish water supply serves only the people of Magrish; others so not benefit from the project. Physically, the project has provided a better storage capacity for public water, and the water itself is cleaner. The project is a much improved delivery system which reduces the physical labor required in obtaining water and ensures a constant supply throughout the year. Minimally,

the project has resulted in a greater quantity of water available for use. The impact of this would be higher levels of water use within households.

The benefit resulting from cleaner water and higher levels of domestic use should be reflected, in the long term, by improved health conditions. This benefit is presumably shared equally in the village, although this may be skewed by the lack of elementary knowledge of sanitation among some households.

The economic benefits of the project are not directly observable. It may be argued that the project reduces the time required in procuring domestic water and therefore fees domestic labor for more productive activities. In effect, this reasoning, if valid, means that women will increase their agricultural activities and alleviate the current labor shortage resulting from male migration. It has not been determined if this process is currently underway, and it is clearly too soon to do so. However, there is an equally viable counter-argument that women will not increase their time spent in the fields, but will increase their leisure time spent in social activities. Moreover, an increase in leisure time and being able to escape from agricultural labor are considered to be improvements in living standards. When this is combined with the ability to live off migrant remittances, we may actually see a decrease in women's agricultural labor. Clearly, the fact of this modest project will not in itself dramtically effect the local labor situation

Nevertheless, people do perceive the project as a definite improvement in the quality of life in Magrish, and it is part and parcel of a whole range of ideas that people have of how their living conditions can be improved by initiating communal investment activities.

Future Prospects and Recommendations: In terms of the objectives of 022 Small Water Projects, the Magrish project is a success. The village now has a reasonably clean and constant water supply for domestic use. The execution of this project demonstrated a strong desire by the villagers for a better system and a willingness on their part to invest substantial resources in improvements.

The success of this project is a result of this attitude and, just as important, the donation by AID not only of materials but also the services of a supervisor until the project was finished. This supervisor served as an active participant in implementation at the site, and he also made sure that the design was faithfully followed. The experience of Magrish clearly shows the results which can be achieved through the use of an on-site construction supervisor who is willing to become involved in the local situation when necessary to get the project completed.

There are a few possibilities which the project designers may have not adequately anticipated. First, there may be a breakdown of the present arrangement between the village and the pump owner resulting in a stoppage of water from the well. The villagers have the financial resources to purchase their own pump and engine, but they may not have the technical knowledge to determine their needs in this respect. A well test would go a long way in assuring a continued supply from this end.

Secondly, the villagers (once they decide they have enough money) will probably want to add private house connections to the present system. The project's capacity to handle such a development is not known, but potentially this extension could adversely affect water delivery to the village. It is suggested that future small water projects, even of the simple pipeline-tank variety, should be designed with the capacity to handle future extensions and increased demand.

ANNEX #3.

Site Report: Village of Tina'am.

Location: The village of Tina'am is located in Khawlan district of Sana'a Province, approximately 35 kms. east of Sana'a city. Tina'am is two hours' journey from Sana'a via unpaved rural roads.

Tina'am is situated at the head of a wadi which runs through a narrow defile to the north of the village and widens to a broad valley southward. The settlement sits on the hillsides overlooking the waid bed.

Population: The population was determined by the local headman as 530 persons, half of whom are under the age of fifteen. Also, the village has many adult male migrants who are absent a good deal of the time either in Sana'a or Saudi Arabia. The number of migrants absent at any given time was impossible to determine.

Project Description: The 022 Small Water Projects project in Tina'am was begun in July, 1975, and the AID involvement was completed fifteen months later. The project consists of an engine and pump which draw water from a pre-existing hand-dug well in the waid bed. Connected to the pump are two separate pipelines which run to two 7,000 gallon stone-and-cement tanks. One tank is located 400 meters west of the well, opposite the village and next to an elementary school. The other tank is 200 meters east of the well and overlooks the settlement. These tanks were originally equipped with public taps as part of the AID supported project, but the villagers have since installed pipes which connect the tanks to private household taps. At the present time, every house has a tap either inside the building or in the courtyard.

The well provides a sufficient amount of water for household needs year-round and the water appears to be of potable quality both at the source and at the taps. Local people use the water for drinking and for all other domestic needs. As far as could be determined, the water is not boiled or filtered prior to drinking.

The system at present is semi-operational in the sense that wateris not available for the household taps on a continuous basis. This is due to the fact that the pump engine does not provice sufficient power to fill the two tanks to capacity. At present, water is drawn from each tank every third day. Women continue to draw some drinking water from the well source which, prior to the project's construction, was the village's only water source. Also, the women gather

at the well to do clothes washing.

It should be noted that AID's contribution to this project was the two pipelines from the well and cement for the two tanks only. The villagers supplied the well, the labor, and local stone and sand. The private connections and pipes running from the tanks were added by the villagers on their own iniative after AID's involvement had been completed. The pump and engine currently used were supplied by the Ministry of Public Works, Rural Water Division.

Ecology: The ecological envirobment of Tina'am is representative of the entire Khawlan area. Population and agriculture are concentrated along the wadi floors, with primary crops being grapes, sorghum, wheat, and qat. Yearly rainfall is small (approx. 383 mms.), and ground vegetation is sparce. Rainfall and run-off are supplemented with the well irrigation of crops in most areas.

Economy: The economy of Tina'am is based primarily on agriculture, although an increasing percentage of village income is derived from money either sent from or brought back by migrants working elsewhere. The principal cash crop of the area is grapes, which are harvested yearly during summer and early fall. About a third to forty percent of irrigated village land is planted in grapes, and the proportion of land planted in grapes has in recent years been increasing due to the high value of the crop and its relatively low labor demands. Other principal crops are sorghum, wheat, and qat but these are grown for domestic consumption and animal forage. Usually, fields are planted in sorghum during the spring-summer season and wheat during fall and winter. Like grapes, the majority of acreage in these other crops is irrigated by run-off and well water. Most households also maintain a small number of cattle, sheep, and goats for domestic use.

Non-agricultural pursuits include labor migration, car and truck operation, some shopkeeping, grain milling, and personal services. The village does not contain a marketplace, nor is there a weekly gathering of merchants, vendors, and buyers in the settlement. There are a handful of small shops which sell such items as cigarettes, matches, biscuits, canned goods, etc.; but most people rely on a nearby (4kms.) weekly market or on trips to Sana'a to purchase foodstuffs and domestic items which they cannot product themselves. There is one grain mill in the village to which people bring their sorghum and wheat to be ground into flour. The village has a small group of personal service people who perform such tasks as barbering, providing music for weddings, street cleaning, sanitation work, etc. There are also a few plowmen and laborers who are available for part-time work in agriculture or construction, but the majority of people work on their own lands or houses. The wage labor market,

both in terms of supply and demand, is small.

Apart from grapes, the most rewarding local economic investments are in transport and merchandizing activities. With the extension of the rural road network due to the efforts of the Local Development Authority, many men are now investing their migrant labor earnings in buying and operating trucks to haul passengers and freight. There is also a high local demand for meat, although pasturage is scarce, and fodder is very expensive.

In summary, Tina'am's economy is like many rural Yemeni communities. Labor migration to Sana'a and Saudi Arabia has greatly increased village cash incomes, which the local subsistence-based agriculture has been unable to absorb. Likewise, environmental constraints limit the expansion of the cash crop sector. The result has been a small amount of investment in cash cropping and larger investments in housing and domestic furnishing. The large cash supply in an underdeveloped market system has resulted in high inflation rates for both imported and locally produced goods.

Social System: The village of Tina'am displays social characteristics similar to other villages in north-eastern Yemen. The majority of village residents are cultivators and nominally, at least, members of a local tribal organization. This tribal organization exists more as a form of ideology than as a functioning social structure. In most instances, tribal membership amounts to a cultural value of the equality of members. In this sense, the population of Tina'am is not highly stratified nor divided along culturally recognized class lines. The prevailing social ideal is one of cooperation and equal prestige among village residents. The villagers do, however, make role distinctions among themselves. The two primary political roles are those of the shaykh and the agil. The shaykh is nominally chosen to represent the villagers in their communal dealings with outsiders and non-village organizations. The agil is a type of local magistrate who is responsible for maintaining peace in the village, solving local disputes, and taking care of internal legal matters.

The fundamental social and economic unit in the village is the beit, or household. The beit consists of either a nuclear family or an extended family with relatives from several nuclear families. In both cases, the beit is a residential unit which shares a common purse. Beits are cooperating groups which may form together, manage non-agricultural pursuits jointly, or pursue any combination of activities. The head of the beit, usually a male of the senior generation, is responsible for communal decision-making and for the actions of the people in his household.

In terms of the division of labor within the beit, there is a strong distinction between males and females. Men are responsible for the public affairs of the beit. It is they who must provide for the financial security of the members and manage the socio-political relations between households. The women's domain is that of the domestic economy. They run the day-to-day affairs which keep the household as a functioning unit. Women fetch water, prepare food, wash clothes, keep house, take care of household animals, and see to the proper upbringing and welfare of children.

Both sexes maintain an elaborate visiting and friendshop network with members of other households. Relations between households are a matter of concern for both sexes, for within the sexual division of labor both sexes rely upon the help and coordination with people outside their own households.

Personal success is locally measured with a strong bias towards a comfortable house, a well-appointed table, and a good deal of leisure time for visiting and the reciprocal display of hospitality to one's relatives and friends.

Project Impact: The most immediate and observable impact of Tina'am's AID supported water project has been the increased availability of and access to potable water for village household use. The distance from the source to the use point has been almost eliminated by the distribution system which provides taps in virtually every household. This system has obvious benefits in terms of saved time and physical exertion previously required to obtain water from the wadi well. Also, it appears that the new distribution system has allowed a substantial increase in the water available and used for domestic purposes.

The project has effectively reduced the cost of water in the village, if this cost is measured by the amount of labor previously required to obtain water for household use. Before the project, water was a precious commodity in the village and was used sparingly in households. The economic impact of increased availability of household water is extremely difficult to assess, and cannot be simply measured in money terms. It can only be stated that the time and labor women previously spent in procuring water is now used for other purposes. Since the men of the village stated that Tina'am women do not work in the fields (a debatable point), it must be expected that their saved time is spent in domestic and social activities. An increase in the time women spend visiting or attending social occasions is not unexpected. Throughout Yemen, trips to the local water source have been used as

occasions for short visits, the exchange of information, and gossip sessions with women of other households. With these trips no longer necessary, it appears in Tina'am that women use the spare time previously spent collecting water as social time. In the context of the social system, this behavior increases the prestige of the household and strengthens its social ties with other households.

The increase in the availability of water for domestic use may, in the long run, be reflected in improved levels of general health, but this is impossible to determine in the current survey. It is reasonable to assume that water at the use point is now cleaner than under the previous system of carrying water from an open well several hundred yards in open containers to houses in wich it is stored in open containers. Under the present system the water is protected from foreign matter by a covered well, pipes, a covered storage tank, and, finally, pipes directly to the houses. Moreover, the reduced physical effort involved in obtaining water allows for the more regular and thorough washing of cooking and eating utensils. This should improve general sanitation within the household.

In terms of local social organization and the mobilization of village resources, the project has had an immediate and significant impact. Initiation and implementation of the project has necessitated a new organizational form and has substantially modified the functions of existing authority roles. The project was initially the idea of several villagers who, together with the local shaykh and agil, lobbied with the Ministry of Public Works and USAID to receive technical and material help in realizing their goals. The project was financed communally, with the villagers (i.e., the beneficiaries) investing labor and money in the construction project. Further, the village hired an "para-technician" to lay and maintain the pipelines running to the houses (these were not part of AID's contribution). Presently, each private connection is paid for by the household it serves. Every person in each household is charged on Yemeni riyal per month. This charge is used to pay the salary of the para-technician and the other costs incurred in maintenance. The only public tap in use is located on the tank wich is adjacent to the village school. Other neighborhoods taps have been constructed, but are now shut off in favor of private connections.

Along with the forementioned benefits of the project, there has been one negative impact. The pump engine that is presently in operation is not powerful enough to meet current water demands. The storage tanks are often empty even before they can be filled. This has resulted in dissatisfaction with the project, particularly among women. However, this engine has not been replaced with a more powerful one because the managers of the project (the shaykh and the para-technician) believe they

have been promised a new engine (from whom is not clear), and they are reluctant to raise funds to purchase one on their own because they are not sure of their exact needs. This problem has caused a sharp cut-back in available water, and the system is now only working at about 50% of its capacity. At the same time, demands on the system are increasing due to the construction of new houses which are or will be connected to the tank's pipeline.

The benefits of the new water system seem to be distributed equally throughout the population. The costs of private connections and the monthly fee are low, and almost all the village's households are participating. Similarly, the disadvantages of the underpowered pump are shared by all. If a new pump is not installed, everyone's investment will suffer.

Future Prospects: The principal problem with Tina'am's water system is the insufficient power of the pumping system. If the distribution system and the water demand continue to expand at the current rate, the entire project may beome virtually inoperable unless a new, more powerful engine is installed. The solution to this problem is complicated and involves agencies outside the village. However, matters could be greatly facilitated if a qualified engineer would visit the site and make recommendations as to the specifications of the required engine and/or pump. Such a study would allow the villagers to make the decision on the most advantageous way to solve their problem.

The Tina'am situation points to a general shortcoming in USAID small water projects in Yemen. Specifically, it is recommended that future projects include a training component for local para-technicians who will be responsible for maintenance and supervision of the project after AID's involvement is terminated. By the same token, the original project designs made by AID or Ministry of Public Works personnel should be undertaken with the understanding that the project may be substantially modified by local people after outside involvement is finished. In the case of Tina'am, the installation of private connections and the subsequently increased water demands seriously affected the performance of the system as originally designed. Not unexpectedly, the local population did not possess sufficient technical resources to adequately anticipate this development nor to arrive at a satisfactory solution to the changed situation. In responding to the opportunities provided by the water project, the villagers created a new situation wich had been anticipated by neither the donors (USAID and the Ministry of Public Works) nor the villagers themselves.

ANNEX #4.

Site Report: Village of Dahlil

Location: The village of Dahlil is located in Al-Makhadir district of Ibb Governorate about 150 kms. south of Sana'a by way of the paved road between Sana'a and Ibb. The village is situated along the paved road just above a large wadi bed which has frequent floods of surface water after rains. The region of Dahlil is well watered by rains and has a high population density based upon the extremely productive agriculture of the region.

The village is divided into two distinct sections. One of these consists primarily of small shops, tearooms, and restaurants. This section is directly on the paved road and serves the vicinity as a regional marketplace which is open daily. The second section is residential and is located about 500 meters north of the market, slightly higher and overlooking the road.

Population: Together, both sections of Dahlil contain approximately 800 permanent residents. During the day, however, this figure is just about doubled by the people who come from surrounding areas to buy and sell in the market. In contrast to many villages in less productive or commercially strategic areas, Dahlil has a relatively low percentage of young men absent because of labor migration. The two factors of opportunities in profitable agriculture or merchandizing are incentives for men to stay in Dahlil. The two quarters of the town contain an estimated 70 houses. There are forty in the market section and thirty in the residential section. Also, there are four restaurants and perhaps fifty shops selling a wide range of goods

Project Description: The 022 Small Water Project in Dahlil consists of a pipeline running from a well dug in the wadi bed about 500 meters from the residential quarter to a 10,000 gallon storage tank in the residential quater. There is an engine and pump used to pump the water from the well through the pipelines up to the tank. AID's contribution to this project was one hundred lengths of 2" pipe, sufficient cement for the tank, and corrugated roofing for the tank. The village contribution (through the Local Development Authority) was labor, sand, and stone for the pipeline and tank construction. There was no AID or Ministry of Public Works supervision of this project's construction. Currently, the project is not completed nor is it

operating satisfactorily, although AID's commitment has been fulfilled. This is due to the facts the the cover of the tank has not been installed (although the materials have been delivered) and the drain for the tank was located a half meter above the tank's floor. The result is that the water in the tank is not drinkable and the tank can not be satisfactorily drained and cleaned. A further problem is that access to the water is not equitable. Three pipelines have been connected to the tank in lieu of the public tap originally planned. These pipelines provide private connections to the restaurants and twelve houses in the market quarter plus the mosque which is located there.

During the six-hour daily pumping period, drinking water is obtained by some residents directly from the pipe which empties into the tank. When the tank is full, the valves of the connected pipes are opened and those buildings with connections receive water.

The reasons why the system is not operating as originally planned were not adequately determined during the field visit, but it appears as though thre are disagreements among the members of the Local Development Authority over how the project should be completed and how the water should be distributed. Also, nearby villages have laid claim to some of the water and are actively engaged in planning ways to include themselves in the distribution system, which was originally designed to serve only the population of the residential quarter of Dahlil. Several alternative schemes have been proposed for completing and extending the project, but all of them require coordination and resources which do not appear available at the present time.

Economy: Dahlil's economy is based upon merchandizing activities in the market quarter. This is supplemented by a fair degree of locally managed agriculture. A typical Dahlil merchant operates a small shop in the daily market. Goods are purchased from wholesalers in Ibb, Ta'iz, or Sana'a and retailed to people from the region around Dahlil. The shops sell a wide variety of items, primarily those things used for household consumption. These merchant activities are highly profitable, and Dahlil residents have recently begun to build a large number of new, modern-style houses. In fact, in the immediate vicinity of the project's tank there are five new houses which have been built or begun within the past year.

All this activity has greatly increased the demand for drinking and washing water. The teashops and restaurants in the market are using great quantities of water, as do the numerous construction sites in the village. This demand is augmented

by the natural increase in population as young men tend to stay in the village and not migrate in search of employment.

Local cash availability and opportunities for investment are increasing at a rapid rate in Dahlil, and the village is quickly gaining all the characteristics of a town and regional commercial center. This phenominal growth is due in large part to Dahlil's location on the main road between Sana'a and Ta'iz. Transport costs are cheap, and the goods and services of the cities are within easy access. In addition, newly built roads to the interior are connecting Dahlil with the surrounding countryside, and people from the region are finding it convenient to shop in Dahlil.

These economic developments have greatly increased the expectatoins of Dahlil's inhabitants and their ability to afford a new style of life. Unfortunately, these activities have also put a great strain on the area's water resources. Water (even with the improvements made by the AID supported project) has become an extremely scarce and valuable commodity as it has never been before.

Social System: Dahlil's rapid growth and the expanded financial resources of its individual households has put a great strain on local social organizations. The traditionally large cooperating household structures are breaking up as the younger generatión is establishing their own households and commercial establishments. These expanded activities are comsuming resources which are becoming increasingly scarce. Primary among these is water, and the residents of the village are having a difficult time deciding communally how to cope with their new needs for drinking and washing water.

At the same time, many individuals are finding that the money they have for investment has greatly increased. The problem that they and the community face is determining which investments will be most advantageous in terms of the well-being of the entire village and the benefits which the potential investors, as individual household heads, will realize.

Social Impact: The principal problem with the 022 Small Water Project in Dahlil is that it was not designed to fit the needs of its economic and social environment. Consequently, the inadequacy of the project resulted in an aggrevation of a developing conflict-charged situation. Clearly, Dahlil's needs could not and can not be met by the project as presently designed. The installation of the three private pipelines to the tank demonstrates the scope of the problem quite well. Water demand is currently too high in Dahlil to be satisfied by the AID supported system. The result is

predictable. Those people with the resources and power to achieve their aims receive water; those without do not. The system now in place must be judged a failure according to its designers' expressed goals (drinking water with free and public access) and in terms of AID's overall mandate objectives (alleviating the plight of the most disadvantaged and an equitable sharing of benefits). However, determining how the project came to be a failure involves factors much more complicated than simply not making sure that the original designs were followed through and completed.

Future Prospects and Recommendations: Dahlil represents a different environment than the "typical" Yemeni rural villages described in the reports on Tina'am and Qumama. Dahlil is experiencing rapid growth and economic development. The regional economic function of the town is rapidly changing as is its own internal social structure. Future developments will certainly change the role which water has previously played in Dahlil, just as they will change the villagers' water needs and the resources available to them to satisfy these needs.

One recommendation which emerges from the Dahlil experience is that future AID sponsored undertakings in rural water projects must be cognizant of the fact of differential rates of growth in rural Yemen. Future changes must be anticipated, and water projects must be designed accordingly. Moreover, it is clear that the initiators of projects bear a heavy responsibility to provide adequate systems for present circumstances. The water demands of local populations must be adequately determined before the projects are begun, and the systems must be designed with an appreciation of future needs.

Another obvious problem with the Dahlil project was the lack of adequate supervision to make sure that the system design was properly followed during construction. Proper supervision would have insured that the roof of the tank was installed, the drain was placed properly, and perhaps that the problem of private connections would be avoided.

ANNEX #5

Site Report: Town of Manakha.

Location: The town of Manakha is located midway along the Sana'a-Hodaydah paved road. The town is two hours drive from Sana'a and is the capital town of the district of Manakha-Haraz in Sana'a Province.

Manakha Town: According to the 1975 census, Manakha town by itself has a population of 1,324 inhabitants, with a slightly higher number of males than females. Migrants absent at the time of enumeration are listed as being forty in number. The entire district of which Manakha is the economic and political center is counted as having 34,919 inhabitants. Local estimates of the town's current population are as high as a5,000 with about 1,000 more people living in villages within a kilometer's radius of the town.

Whatever Manakha's population, it is clearly an urban highlands settlement. Government offices, the Local Development Authority (LDA), two schools, and the region's largest marketplace are all located here. The economic base of the town is complex. Significant occupational categories include government employee, merchant, artisan, construction worker, transportation worker, and farmer. Also, there are a fair number of people engaged in agricultural and non-agricultural wage labor on a daily or seasonal basis. As in other highland towns, many young men have migrated to Saudi Arabia seeking to earn enough money to return to Manakha to set up their own businesses or to expand their families' economic activities. In Manakha these include commercial activities and the growing of coffee and qat in the district, which is famous for its high productivity. The result of recent developments such as migration, government activities, and location near the paved road has been a small economic boom in Manakha.

As a reflection of the increase in money resources, the Manakha LDA has undertaken a good number of projects. In particular, the LDA has built rural roads, schools, and an electric company for the town. Among its projects, the LDA arranged for and supervised the construction of the AID-supported small water project in the town.

Manakha's social system differs greatly from that found in rural villages. Although the basic social unit remains the household, Manakha displays a rudimentary class structure based upon the division of labor. The town also has a well developed administrative structure which has been functioning since the town was a provincial capital under the Turkish occupation. The town's elite includes government officials,

landowners, and, increasingly, merchants. The sons of these men are today attending modern schools and are in the forefront of taking advantage of the economic opportunities in the town. In relation to nearby rural villages, Manakha has a low migrat on rate. Rather than leaving a stagnant economic situation such as exists in much of rural Yemen, the men of Manakha appear to be staying and investing in the town's growth. Others are drawn from the region to the town, where they seek employment or undertake other economic activities.

Project Description: The Manakha 022 Small Water Project agreement was signed in November, 1976 and the commitment of AID was completed in December of the same year. Previous to the agreement, the Ministry of Public Works and AID personnel conducted surveys of the area and designed a water delivery system in which existing springs were developed and piped into two stone masonry tanks equipped with public taps. The springs are located about 1,000 meters from the town and above it on the slopes of Jebel Haraz. From the springs, a 2" pipe runs into a 62 cu.m. tank situated on high ground in the town next to a school. From this upper tank a pipeline runs about 200 meters down to a 96 cu.m. tank situated beside the new hospital which is under construction.

Contributions to the project came from the Manakha LDA, USAID, and the Ministry of Public Works (MPW). The LDA supplied all local materials for tank construction (sand, gravel, rock), all labor, and 1,000 meters of 2" pipe. USAID and MPW together supplied pipe fittings, 600 meters of 2" pipe, and 400 bags of cement. The construction itself appears to have been directly supervised by the LDA and periodically visisted by AID and MPW personnel.

Interestingly, the design of the project closely follows the route of a pre-existing, but unuseable, water system constructed by the Turks. This old system also used spring water and channeled it to and through the town by way of underground conduits. Other water sources in the vicinity which are used now include a large dam-cistern about 300 meters from the town and a pipeline-tank complex about 400 meters from the town. Prior to the project, these nearby sources were used by the people along with the spring which is now channeled through the pipeline built with AID support.

Shortly after the present system was completed, the LDA requested that the project be extended to provide a greater supply of water which would also serve the people of the villages immediately adjacent to the town. MPW engineers surveyed the possibilities and recommended actions similar to those undertaken during the present project. In their proposal different springs would be utilized. Renovation

of some parts of the old Turkish water system was also recommended.

Although the project currently in place is operating satisfactorily, it clearly does not meet the total domestic water needs of the town. This is indicated by the planned extension. The problem is not simply a question of convenience, because the LDA is not planning private household connections. The system providing tanks and neighborhood taps has been favorably received by the population, but more tanks and taps are needed. Simply put, Manakha needs more water. The LDA seems to be able to raise sufficient funds for the extension, but they do not have the technical capacity to design the new system, nor can they adequately anticipate the impact the system may have on the area's water resources.

Project Impact: The project was designed to improve existing water sources, transport the water to storage tanks in the town, and provide public access to the stored water. As far as can be determined, the project has achieved these objectives. A few of the people have complained about the quality of the water they receive from the project, and, in fact, these people filter the water in their homes and a distinct white sediment may be seen in these filters. However, no clinical analysis of the water has been made to date. A weak point in the project is that no provision for ongoing checks of water quality has been made. Similarly, the LDA of Manakha does not have the technical capacity to adequately clean out the system if such action is required.

The project was also initially designed to meet the domestic water needs of the town's population. Continued use of other nearby water sources by townspeople and the extension planned by the LDA indicate that the town's water needs have not been fully met by the project, although it is impossible to determine in quantitative terms the remaining need level. It can only be stated that the project does not serve the entire population, but all people have access to the system's taps. If there is an alternative source (e.g., another spring) closer to a household than the project's tanks, then the women will most likely use the alternative source to save time and energy. Thus, in terms of the distribution of project benefits, those people living closest to the tanks benefit the most. Those located some distance away (say over 200 meters) benefit much less and may, in fact, not use the project at all.

In a situation such as Manakha where there is a large population spread over a fairly wide area (Manakha town is about 800 meters in diameter), the location of public taps seriously effects the distribution of benefits, particularly if there are alternative water sources. The less fortunate people living close to alternative,

but less sanitary, water sources and far away from the project taps inevitably face a trade-off between convenience and better water.

The benefits resulting from the Manakha project are similar to those received by other settlements with pipeline-tank public access systems. The supply of available water has increased due to the construction of storage tanks and the protection from contamination and the shorter distances involved in human transportation. Certainly for many women the distance between house and water source has been greatly reduced. This results in less time required to procure water on a per unit volume basis. If more water is used, however, women may still spend the same amount of time and energy procuring their daily water supply. Still, the shorter distances involved allow children to fetch water. Before, the distances involved may have been too long for children to bring significant quantities of water to their homes.

If water quality and water use have indeed been increased, then general health conditions may improve over time.

Perhaps the greatest benefit from the project has been received by the Manakha LDA. The success of this project which the LDA initiated, partly financed, and supervised has greatly increased the stature and role of the LDA in the community. The experience of working with the MPW and a foreign donor (USAID) has encouraged the LDA to undertake similar joint projects. The LDA's involvement with the present project has directly resulted in their planned extension, which will probably be begun shortly. Still, the LDA has a long way to go before it obtains the capacity to determine the feasibility, design, and maintain water systems on a self-sustaining basis.

Future Prospects and Recommendations: In the immediate future, it appears as though the extension of the Manakha water system will be initiated under an arrangement similar to the existing project. This action is specifically meant to make up for the supply and distribution inadequacies of the present project. Whether or not this extension will fulfill the water requirements of Manakha remains to be seen, but the very fact of the extension shows the success of the previous action in this case.

It is specifically recommended that the extension be designed to provide further free and public access to water taps. Also, the design should allow for further extensions, if water demand is still not fully met.

In addition, this new action should include some type of provision for the periodic testing of water quality in the present system as well as the extension. Finally, the people locally responsible for the system's maintenance under LDA auspicies should be given sufficient information for the proper care and cleaning of the town's water system.

ANNEX #6.

A. The village of Hubshi.

The village of Hubshi is located approximately kms. north of Sana'a, which is about one and a half hours driving time from the capital. Hubshi is situated on an undulating arid plan which is criss-crossed by wide, dry watercourses. The principal agricultural activity in the area is the cultivation of a yearly sorghum crop, although qat and wheat are also grown where the land can be perennially irrigated from drilled wells.

Hubshi has an estimated population of 300 persons, some of whom are migrants who spend a great deal of time away from their families. The majority of people (men and women) are farmers to the extent that they produce an annual sorghum crop on marginal land. This agriculture is clearly insufficient to meet the needs of the population, and during most of the year the men pursue other activities. The alternatives are somewhat limited, and the men either migrate in search of work or find employment in the manufacture of locally produced plaster, called gauss. Producing gauss entails quarrying ababaster, transporting the mineral to a kiln, and baking it there until the heat causes the structural change which results in plaster. The village contains about fifteen of these gauss kilns, and during most of the year these operate regularly. The villagers are engaged in all aspects of the production process, except the retail marketing which is done in Sana'a. Despite the high labor costs involved, guass production is profitable, and the urban demand is far higher than the quantities produced.

The AID-supported project in Hubshi is the enlargement and renovation of a large (250,000 gal. cap.) cistern which stores the surface run-off from seasonal rains. The cistern is slightly below the village, about 100 meters from the farthest house. The waterin the cistern is used for watering animals and other domestic activities. The village' drinking water source is a spring located about five kilometers away. Drinking water form the spring is broughtdaily by tank truck. It was not determined how much this service costs, but villagers did say that sometimes the spring dries up if the rains are insufficient. In this case, the villagers either pay a great deal more or drink from the cistern.

Previous to the project's implementation, the villagers wished to enlarge their storage capacity and heard of Project 022 through Paramount Shaykh (a sub-district official), and they petitioned him to obtain RWD's help from Sana'a. Working through the village headman, the Memorandum Agreement was made and the

village contributed the labor and rocks for the cistern. AID contributed the design and 190 bags of cement for the cistern. On a comparative basis, the village's contribution was close to 70% of project costs.

Although the cistern is adequately supplied by run-off water, there are a couple of potential problems in its design. First, drainage to the cistern runs through an old graveyard, and, second, animals are presently watered at the entrance to the settling tank. Both these circumstances may result in the water's contamination by organic matter.

The villagers are please with the project, and say that its initiation and construction reflects well on themselves and their leadership. Donations by villagers are responsible for the construction of an elementary school which is being built just next to the cistern. The village does not yet have electricity, but plans are underway to jointly purchase a gasoline powered generator shortly.

Hubshi may be classed as a "type C" village by dint of its poor agriculture and simple material conditions, but it is clear that there has recently been a large cash flow into the area (due to migration and high gauss prices). To some extent, this money is finding its way into some communal self-help projects.

B. The Village of Al-Ghola.

The village of Al-Ghola is located about twenty kilometers west of the village of Qumama (see Annex #1) on the same road. This is approximately three and a half hours driving time from Sana'a, via Thula. Al-Ghola is situated high up in a preciptitous wadi at the base of a high cliff. The most striking aspect of Al-Ghola's location is in its proximity to a large spring which flows from the base of the cliff. This spring perennially produces a large flow of water which is carefully used to irrigate about four and a half hectares of terraced land cultivated by the villagers. Thus, even in the dry season, Al-Ghola is a veritable oasis among the barren mountain slopes of the region.

Al-Ghola has its share of migrants, but the majority by far of its 600 or so inhabitants are dependent upon agriculture for their livlihood. They truck farm on their irrigated lands, and periodically send harvests of vegetables and alfalfa to the market centers of the region. This activity produces income which is used to improve the agricultural base and to improve the living conditions in the village. The village's water problem is more transportation and storage than acquiring a reliab source. Because of their cash-cropping and higher standards of living, Al-Ghola is classified as a "type B" village.

The AID-supported project in Al-Ghola is veiled in mystery. The plans for the system indicate that a storage cistern for spring water and perhaps a pipeline into the settlement were to be built. The AID records show that cement for the construction were delivered, but site inspection reveals only a very small cement open tank near the spring. When villagers were questioned about the project, they either indicated this tank or claimed to have no knowledge of the project at all.

There is no direct evidence concerning the story behind the Al-Ghola project failure. One can only make guesses, since no on seems to know the story (including AID personnel). It would appear that the project's fate is related to two factors. These are that there was no on-site supervision and that the project the villagers seemed most interested in was not the one actually designed.

The villagers seem most interested in constructing a large dam across the wadi which would trap both the spring water and rainfall run-off. This water would then be used to enlarge the area under irrigation. A storage facility and transmission line for drinking water does not appear to be high among village priorities.

C. Village of Dhalma.

Dhalma is located about twenty kilometers west of Dahlil (see Annex #4) on the Yarim to Ibb stretch of the paved highway. Dhalma is reached via a gravel road from Dahlil. This road is a local LDA project. Dhalma is situated atop a mountain ridge and its nearest source of drinking water is a spring located about two kilometers below in a wadi.

Dhalma is a fast-growing commercial center of about 800 persons. Although there are a number of migrant absentees and a large proportion of farmers in Dhalma, the settlement should be classified as a "typeA" village by virtue of its pronounced commercial development and obvious prosperity. The village has over fifty shops in business now and perhaps another forty under construction. The AID-supported project in Dhalma is the enlargement and renovation of a large cistern which traps rainfall run-off. The original cistern is claimed to be a construction dating from Pre-Islamic times, but it was recently filled by an earth-slide.

The new cistern project was undertaken by the LDA, as the inscription on the cistern walls proudly proclaim. AID's contribution was five hundred bags of cement. Although the finished cistern has a great capacity, there may be some trouble in filling it. At the time of the survey visit in January, the cistern was completely empty.

Dhalma's growth has greatly increased local water demand, and the local prosperity has allowed significant cash contributions for pursuing the goal of a reliable and adequate water supply. In addition to the cistern project the LDA is independently working on a project which would bring drinking water from the wadi to storage tanks in Dhalma. This new project is an impressive expenditure and displays a high degree of local investment in communal water projects.

D. The Village of Hayma.

Hayma is located near the paved road about halfway between Sana'a and Manakha. The village is situated on a westerly descending mountainside that is comparatively well-watered by rainfall. The villagers here cultivate qat in large quantities because of the combination of favorable climate and easy access ot the high-demand Sana'a market. The settlement of Hayma and those around it are small (averaging about 500 people each), but are prosperous based upon the cash-cropping of qat. In marginal fields, people also grow sorghum, wheat, bareley and vegetables. Recently vegetables have also become a valuable market crop. Hayma, despite the relative lack of perennial irrigation, is decidedly a "type B" village.

The Hayma Small Water Project, like the one in Al-Ghola, was never completed. As in Al-Ghola, the reason for this is not at all clear, but seems to stem from a lack of enthusiasm and committment from the local sponsor and population. The project was designed to be a cistern which would store run-off, and there was a Peace Corps volunteer assigned as supervisor. Apparently the cement for the project was delivered, but actual construction was never seriously undertaken. After the PCV was withdrawn from the area (due in large part to other circumstances), the project progressed no further.

ANNEX #7.

Projects Planned or Under Construction

A. The Village of Aras.

Aras is located about twenty kilometers southeast of the town of Yarim in Ibb Province. The village is situated on a hillside which overlooks a broad shallow wadi. Aras has a population of about six hundred people, but nearby settlements just about double that number in the immediate vicinity.

The people of Aras and its neighboring villages are mostly farmers, although increasing numbers of young men are migrating to work in Saudi Arabia or Yemen's urban areas. The local agriculture is based on rainfall, and the people produce crops of sorghum, barely, and some wheat. Because of the relative isolation from the agricultural market and the low degree of potential for extensive cash cropping based on irrigation, Aras may be classed as a "type C" village.

The history of the AID-supported water project in Aras presents a clear picture of the kinds of problems which can be encountered in building a new village water system. The project was initiated by the Paramount Shaykh (a sub-district official) of the area, who petitioned the Govenor of Ibb Province to argue the proposed water system with RWD. The proposal was approved by RWD and AID, and a team was sent to Aras to design the form of the project. The project was designed to install a pump and engine on a previously drilled well located in the wadi floor. From the well a pipeline would run to a storage tank in the middle of the village. According to the plan, this tank would be equipped with a public tap. The villagers (through the Shaykh) agreed to supply the necessary labor and local materials for the project. RWD and AID sent a PCV supervisor and supplied the pump, engine, pipe, and cement for the project. This new system would replace the previous water source, which is a spring located in a nearby village on the opposite side of the wadi from Aras.

During the construction of the system, a number of not unexpected problems were encountered. First, there arose a dispute over right-of-way for the pipelines. The design called for a direct line which necessarily crossed land owned by a resident of one of the neighboring village which would not benefit from the project. This dispute had to be taken to court in Yarim before construction could proceed. Second, the villagers of Aras disagreed with the planned location of the tank. They wanted a location higher up in the village so that they could later install private household connections. This required the intervention of the Director of

of RWD so that the dispute could be resolved. Third, one of the neighboring villages asserted its rights to use the water of the well, and they demanded a similar project for their community. This last issue was resolved by a compromise in which a pipeline was planned to run from the Aras tank to a tank in the other village. The responsibility for constructing this extension was left unspecified.

Despite these obstacles, the system was finished during the survey's time period. Thus, the project ofr Aras appears as a completed project on Figure #1 in the accompanying report.

It is clear from the project's history that the presence of the PCV on-site supervisor was an important factor in project completion. The Aras case can be easily compared to the Dahlil case where the same kinds of problems over local expectations and water rights resulted in an unsuccessful project. In Aras, the supervisor became intimately involved in resolving the disputes and pushing forward with construction. His presence also served as a stimulus to the local population for the speedy resolution of disputes. In Dahlil, where there was no outside supervisor, the disputes remain unresolved.

B. The Village of Hamera.

Hamera is located about forty kilometers west of Sana'a, and is reached by car after a two-hour drive from the capital. The village is situated on an arid highlands plateau. The full-time residents are mostly women, children, and old men. The young men have just about all migrated to Sana'a or Saudi Arabia in search of work. The women cultivate rain-fed crops or sorghum and barley. Altogether, the village contains no more than one hundred people, including the absent migrants. Hamera is the best example encountered in the survey of a "type C" village with a subsistence agricultural base and a high migration rate.

The AID-supported project in Hamera was initiated by the Local Development Authority of the area, which made the first proposal to RWD. However, subsequent negotiations and responsibility for implementation were undertaken by Hamera's shaykh.

The project in Hamera consists of the excavation and construction of a large, rain-fed cistern beside the village. This cistern should provide a year-round supply of non-potable water for the village households. Drinking water will continue to be trucked in.

The cistern is almost totally a local project. AID has supplied a design and cement for the project, but the villagers themselves are providing labor, necessary rock blasting, and sand for the cement. They are also totally supervising the construction, with only periodic visists by a PCV.

Although at the present time construction work is not completed, no real obstacles to a successful project seem to lie ahead. The only factor impeding rapid completion is a lack of local labor. Given the high migration rate, the villagers are using children to move earth and stones. This necessarily means a long construction time.

C. The Village of Rabat Ash-Shari.

Rabat Ash-Shari is located about twenty-five kilometers south-west of Yarim, almost due west of the village of Aras. Like Aras, the village sits on a hillside overlooking a broad wadi. However, natural water sources are somewhat greater in this area, and the wadi contains several springs which are used to irrigate small patches of land. The predominate agricultural activity is still sorghum, barley, and wheat cultivation.

The population of Rabat Ash-Shari is about six hundred, but if one includes neighboring hamlets it would rise to around a thousand. The people are overwhelmingly engaged in agriculture, though this does not occupy them full time or during the entire year. Non-agricultural activities include quarrying, construction, and transportation. There is a high rate of migration to Saudi Arabia, and just about all young men have been in Saudi Arabia or are there now. Given this situation, Rabat Ash-Shari fits into the category of a "type C" village, with the proviso that there is alternative local non-agricultural employment.

The AID-supported project in Rabat Ash-Shari stems from a visit by the AID mission director to the area a couple of years ago. At that time, it was arranged that a well be drilled in the wadi below the village. This drilling was under the 022 drilling program. The present small water project is an extension of this previous effort. The local sponsors of the project are the village shaykh and the village magistrate, who works as construction foreman.

The project went from the planning stage to initial construction work during the time of the survey, and an on-site PCV supervisor has taken up residence in the village for the duration of work.

The project design calls for a pump and engine at the well, a pipeline, and a tank with public taps in the village. To date, only two problems have arisen, and they are interrelated. The first problem involved the location of the tank. The villagers' stated that a tank in the midst of the settlement (the easiest location in terms of work and access to the taps) would cause a social problem between those households above and those below the tank. As it turns out, this argument was based on an assumption of installing private household connections. The second problem is the villagers' desire to have these connections included in the AID-supported project.

The tank is now sited above the village, but the supervisor has made it clear that he will not install the connections. No doubt, the villagers will do this themselves after the project is finished.

D. The Village of Yakhtul.

Yakhtul is located fifteen kilometers north of the port of Mocha. The village is unlike any of the others surveyed in that it is a Tihama coastal fishing village and not a highlands farming or market community.

The village is situated about one hundred meters from the shore, and the people (about seven hundred in number) fish, harvest salt, or migrate to earn their incomes. The migration rate is high; certainly over fifty per cent of the men are away most of the time. The rest fish. The women tend the evaporation pools and gather the salt. There is no agriculture in the community although one household in attempting to get a date garden going.

The problem with agriculture is Yakhtul is the salinity of local well water. The households each have a well for washing, but the water is too salty for either animals or domesticated plants. Yakhtul has water trucked in everyday from a wadi about ten kilometers distant.

The AID-supported project in Yakhtul continues to be in the planning stages. The project effort was originally initiated by an employee of CYDA (the Confederation of Yemeni Development Authorities) who had worked in the area. Later, the idea of a project in Yakhtul was sponsored by the Mocha LDA, which is active in the area. To day, preliminary surveys of water resources have been made, and initial designs to exploit a number of wells have been suggested. If accepted, the project may draw water from a "well-field"of shallow, hand-dug wells five to seven kilometers from the village to a tank in the settlement.

Foreseeable problems in implementation do not include rights-of-way disputes because of the lack of agriculture, but certainly there is a question of high water demand and low supplies due to the salinization of wells so near the coast. In any event, there is no question of need in Yakhtul nor the willingness of the local population and LDA to get involved in the project.

Appendix IV

Technical Evaluation

of

Small Rural Water Projects

#022

Herbert G. Blank

USAID/Sana'a

April 9, 1978

APPENDIX IV

Technical Evaluation

In conjunction with the social evaluation of the Small Water Projects, a technical evaluation was also performed. The main purpose of this evaluation was to evaluate ten completed projects from the technical aspects of design, construction and operation and maintenance. An evaluation form was prepared which includes general background of the village, description of the water source before and after the project, a description and costing of the project, and evaluation of the project emphasizing design, construction and O&M. The completed forms are available from USAID/Sana.

In order to avoid duplication and since it was prepared in close cooperation with the social impact report of Mr. Tutwiler, this report does not include the background and project description which is adequately covered in the social impact report and thus this report should be read as a supplement to it.

Based on the technical evaluation form, Table I was prepared which summarizes key data for each project and rates each project from the specified technical aspects. A simple rating scale of 1 through 3 was used, with 1 indicating satisfactory, 2 unsatisfactory in some respects and 3 unsatisfactory. Each project was rated in terms of the parameters design, construction and Operation and Maintenance (O&M). A fourth rating is given which represents the overall performance of the project. In general, this rating is the minimum of the previous three, though examples could be presented where this would not be the case. A rating of 1 in this category indicates that the project is satisfactorily meeting the village's needs. A 2 rating indicates that there are some unsatisfactory aspects of the project that were either temporarily or permanently impairing its performance. A rating of 3, obviously indicates the project is not meeting the needs of village.

Following are brief discussions of the villages evaluated with comments on the ratings given:

Technical Evaluation of Small Water Projects

Name of Village	Status	Type of Project	Supervision	Date Project Agreement Signed	Need for Project	Design	Con-struction	O&M	Overall Performance
1. Manakha	O	Spring pipeline tank	local	11/76	yes	1	1	1	1
2. Tinaam	O	HDW pipeline tanks	local	7/75	yes	2	1	1	2
3. Nagrish	O	DW pipeline tank	PCV	3/77	yes	1	2	1	2
4. Hubshi	O	Cistern	PCV	3/77	yes	1	2	1	1
5. Qumama	O	Cistern	local	/74	yes	1	1	1	1
6. Al Ghola	N.O.	spring improvement	local	/74	no	3	3	-	3
7. Dahlil	O	DW pipeline tank	local	2/76	yes	2	2	2	2
8. Dhalma	O	Cistern	local	4/76	yes	3	1	1	3
9. Hayma	N.O.	Cistern	PCV	4/75	no	1	3	-	3
10. Aras	O	DW Cistern Pipe	PCV	7/77	yes	2	2	1	2

Notes: O = Operating DW = Drilled Well

N.O.= Not Operating HDW = Hand Dug Well

1 = Satisfactory

2 = Unsatisfactory in some respects

3 = Unsatisfactory

* Since improved to 1 by addition of more powerful pump

1. Manakha:

Manakha, due to its location in mountainous terrain, is difficult to serve with a public water supply. There are springs up the mountain that can be tapped but these eventually will be insufficient to meet the town's and surrounding village's demands. Eventually, as with many other mountainous commercial centers in Yemen, the main water supply will have to be obtained further afield, most likely from a drilled well located near a wadi at an elevation substantially below the town. The project in which AID participated appears to have developed the spring supply to its potential. The project is satisfactory in terms of design, construction and O&M. That the residents do not desire house connections is fortunate since the increased demand would most probably overtax the supply and likely result in a highly skewed distribution of the supply, i.e., only houses close to the main line would get water.

2. Tinaam

Tinaam has one major problem that is impairing the performance of the system. The problem is the pump and engine are not powerful enough to fill the tank. This could be classified as a design problem, the designer should have been able to calculate the required head and select a suitable pump and engine. The combination selected is marginal at best. The O&M may be contributory to the problem, since house connections have been made off the main line. In following projects this practice should be discouraged.

The O&M of the project is interesting. A local "Muhundis" (engineer) has been employed to operate the system and has extended it, including house connections to all residents. Also, the Sheik has a rudimentary organization for collecting water changes. The lack of public taps could be a concern if the village were a commercial center. Despite the relatively large population, the village (at the time of the visit) had no shops with the exception of a flour mill and commercial activity was taking place at a nearby weekly suk.

3. Magrish

The Magrish project was designed to connect to a well previously drilled for the village by a private contractor.

At the time of the inspection the pump and engine had not been installed in the well. The system was connected on a very temporary basis to a private irrigation well located nearby. Thus, the system is unsatisfactory in that the supply is dependent upon the whim of the well owner and the quality of the water is not assured due to the jury rigged connection with this well. If the system is eventually connected to the second well a new set of problems may arise; that is, the village well and the irrigation well are located so close together that interference will be likely, the two wells will compete for the same water. If at some time the aquifer is seriously depleted it is most likely that the village will lack water, due to the fact that their well is the shallower. The villagers should have been urged to make arrangements to connect to the irrigation well, reimbursing the owner for costs. Other aspects of the project, the pipeline, tank and public taps, were well constructed and were operating satisfactorily.

4. Hubshi:

The design of the Hubshi cistern appears appropriate for the catchment area and the cistern is large enough to meet the domestic water needs of the population. Mr. Tutwiler points out that the catchment includes an old graveyard, whether this would affect the quality of the water entering the cistern is questionable. At the time of the site visit the upper level of plastering of the cistern was not completed, stairs into the cistern had not been installed, there was no animal watering trough, and animals were being watered at the settling tank. For the above reasons, the construction of the project was rated as unsatisfactory in some respects. The project overall was rated as satisfactory in that it was meeting the needs of the population for a domestic water source.

5. Qumama:

The Qumama cistern is an example of a project successful in every respect. The cistern is well designed, it collects water from a large hillside and meets the domestic water demands of villagers and travelers. Potable water is obtained from nearby springs. The sediment trap and animal trough appear to work well. It did not appear that animals had been entering the cistern. The cistern was well constructed, the cistern itself and the channels leading into it were being maintained well.

6. Al Ghola:

The Al Ghola project apparently consisted of constructing a small tank (approximately 1 cu m) intended to store spring water. Unfortunately, there is no inlet for water to flow into the tank and the tank is located above the source. The project was apparently constructed by a local employee of USAID who has since migrated to greener pastures. The villagers expressed little knowledge of the project and little interest in improving their springs.

7. Dahlil:

The Dahlil project suffers from many ailments, not the least of which is high growth in a very congested area. With respect to design, the storage tank is located in an area where there is a high rate of home construction. The villagers have made house and business water connections in the lower part of the town and it would have been an easy matter to locate the tank higher and serve the entire area with house connections. The tank is unsatisfactory in that there is no drain outlet in order to clean the tank. The tank has never been covered, there are no public taps and,hence, nearby residents obtain water from dipping buckets from the top of the tank.

This project points out a basic problem in the small water project systems with regard to house connections. It appears that once the decision for house connections is made, the project must go all the way for house connections and collect the required operating fee from all users. A combination of house connections and public taps apparently will not work because disputes will always arise by those connected who will be asked to subsidize the operating expenses of the non-connected.

In the Dahlil case, where there is an abundant supply and no pumping problem, there are two alternatives: (1) raise the floor of the existing tank (so the existing drain will work) and install public taps or (2) construct a new tank at a higher elevation to serve the new building area and possibly repair the old tank by installing a drain and cover. It is recommended that the village construct a new tank and establish a system of complete house connections. This will facilitate establishment of a viable town water supply agency which can finance the O&M of the system.

8. Dhalma:

Dhalma, similar to Manakha, is a commercial center sitting on high mountains, difficult to serve by a water supply. The town has several large cisterns and a qanat system which no longer has the yield it once had. The AID project assisted the villagers in rebuilding an ancient cistern. The cistern was practically empty at each of three site visits. The catchment area of the cistern is extremely small for the size of the cistern and the project should not have been selected by AID involvement had an adequate Feasibility Study been performed. Apparently the village had begun construction prior to AID involvement and AID became involved without doing an adequate study.

9. Hayma (Degashir)

The Hayma cistern project was not completed, as Mr. Tutwiler states, because of uncertain reasons, but most likely from the lack of enthusiasm and commitment from the local population. A former PCV involved with the project reports that the paramount Sheik of the area was jailed and that his replacement was not responsive to the project. A contributing factor was the labor shortage of the area and the fact that there was no local mason to undertake the work. The project was designed to improve a spring and construct a cistern to store the spring flow. The project was apparently well designed and the need for the project to improve the available quantity and quality of the water is still present, although it is not certain that this need is perceived by the population. The paramount Sheik has recently been released from jail and the project may eventually be undertaken.

10. Aras:

The Aras project should have been a very successful straightforward project. A number of problems arose, however, the first being the selection of the pump and engine. A pump test had not been performed previously and a pump was installed by RWD with unknown characteristics. When the pumpline was laid to the desired elevation, the discharge was found to drop off rapidly. The decision was made to locate the tank at a lower site, which, of course, was not desirable

from the villager's viewpoint since at this location not all houses could be served by house connections. A second problem related to the construction was the securing of right-of-way for the pipeline route, as discussed by Mr. Tutwiler. This kind of dispute should be settled, if possible, prior to construction preferably by means of the project agreement, so that the construction is not seriously delayed as was the case in this project. A rating of two was given for construction, primarily because of the unduly long construction period, although the rating does not affect overall performance. The project has not operated for a long enough time to confidently make a rating for O&M and overall performance, but indications are that the system will operate at a not completely satisfactory level. The lack of complete house connections is a problem which is likely to affect the overall performance of the project.

Conclusions:

Of the ten projects evaluated, there was a definite need for the project in eight of ten cases. The remaining two cases, Al Ghola and Hayma, were old projects about which little was known. Had adequate reports and records been kept, they should have been eliminated from the files long ago. Of the eight where there was a definite need for a project, seven were operating and meeting the needs of the population. At the eighth, Dhalma, an inadequate project was designed. Evidence indicates that the project was underway by the local residents prior to the time AID was asked to participate and an adequate feasibility study was not performed.

Of the seven that are operating and meet the needs of the population, there are three that have been classified as operating satisfactorily and four operate with some problems. Tinaam merely needs a replacement engine or pump and engine. Magrish needs a permanent connection to the well head. Dahlil is probably the most marginally operating system, a new tank has been recommended. Aras' house connection vs public tap problem, if it exists as a problem, could be solved by a small upper level system.

The conclusion of this evaluation is that overall the sub-projects selected have been satisfactory, with a particularly

good record of selection of projects where a system was needed and where, with several minor exceptions, an adequate design was prepared. Several design problems have been due to lack of a pump test. This was not the fault of the designers and a problem which should be remedied in the follow-on project. There is only one instance (Dahlil) where the designer failed to adequately include provisions for the growth of the village.

Construction problems have varied widely over the projects evaluated. They have ranged from problems of obtaining rights of way (a preconstruction activity) to not completing the finishing touches of a project. As Mr. Tutwiler concluded, the full time on-site presence of a PCV seems to have a beneficial effect on the completion of subprojects. It is also beneficial from the USAID viewpoint in the monitoring of commodities.

Operation and Maintenance does not seem to be a major problem of the projects evaluated. Cistern projects, of course, require minimal maintenance with respect to the structure itself and there is not much an attendant can do to improve the water quality other than see that animals and small children do not enter the cistern and that the area is kept clean. The cisterns evaluated appeared satisfactory in these respects. The O&M of projects involving engines also appeared adequate though the sample was small to determine definitely whether operators are adequately trained or not. The O&M aspects will probably become more important as more projects are completed and more projects come in need for major maintenance.

Recommendations:

The following are recommendations of this evaluation. In general, they follow the recommendations of the social analysis as would be anticipated.

1. Supervision: Of the three projects rated unsatisfactory, all three lacked PCV supervision to carry the project through to a conclusion. Of the projects where there was full-time PCV supervision, indications are that the projects, although some still have problems, are better executed than had they not been supervised. Whether full time on-site supervision is required, is questionable. For example, at Aras the PCV

with transport could have easily supervised an additional project in the intervals when the local villagers were settling internal problems. The decision to employ a full time supervisor should depend upon the capability of the local entity and their ability to provide qualified skilled laborers and foremen.

2. Project Agreements:

As Mr. Tutwiler points out, the project agreement is an important document and should be accepted by local authorities as a legally binding document. The Agreement should be used to the extent possible to ensure the timely and proper construction of the project. If possible, the agreement should also include a party (such as the governor of the province) above the local level. This to ensure that should disputes arise between the PCV and the local entity, the third party has an interest in settling the dispute amicably.

3. Operation and Maintenance:

The proposed project should contain a component concerned with O&M. This is to ensure that local villagers are trained in the operation of the system and to ensure that backup maintenance capability is established. At some time RWD will be required to establish a workshop to repair pumps and perform major overhauls of diesel engines. An additional component of the O&M section should be the monitoring of water quality by a team which collects water samples regularly and has them analyzed. This program should be followed by a disinfection program, if feasible, or an education program which advises against use of the water for drinking purposes.

4. Public Taps vs House Connections:

Judging by the expressed interest in house connections in the villages visited, a revised policy should be established. If there is an abundant supply of water, the project should be designed for the provision of public taps. The decision to allow public taps should be made with care, however, with knowledge that house connections will stimulate increased water demand. The responsibility for making house connections should rest with the village who will employ a local "Muhundis," and charge individuals a connection fee and a monthly "use" fee.

5. Feasibility Analysis:

The feasibility analysis of a project should include a social analysis in addition to the technical analysis. The social analysis should attempt to determine the population to be served by the proposed system and establish an optimum village size for purposes of the system design. The analysis should also attempt to assess the capability of the local entity to construct, operate and maintain the system. The analysis should also be concerned with establishing the need for the project, particularly obtaining socio-economic, data of the population and determining the potential of the village to develop.

6. Criteria for Project Selection:

The proposed project should establish criteria for project selection. Although virtually all of the projects evaluated showed a need for a project, some evidenced less than whole-hearted eagerness to contribute to the project's completion. This report will not attempt to recommend specific criteria, but the criteria should be along the following lines:

1. Is the project technically feasible?

2. Does the village evidence a need for the improved water supply as compared to other villages in Yemen?

3. Does the village evidence willingness and ability to contribute to the project?

4. Will all residents of the village area benefit from the project?

5. Is it likely that the designed water system will be used for other than domestic purposes?

6. Is the socio-economic situation of the village such that the village can undertake the project with its own resources?

7. Will project, RWD and AID staff be allowed access to inspect the project during and after construction?

7. Pumps and Engines:

Several projects were evaluated which had inadequate pumps and engines. The USAID and RWD have never had an adequate pump testing program and it also appears that technical data on many of the pumps and engines in stock are lacking. Steps should be taken to remedy these situations.

8. Potability:

Of the projects evaluated, none had adequate measures to ensure the potability of the supply. For the deep well systems, a water quality monitoring program may be sufficient. Although the evaluation showed people do not drink water from cisterns, reports have indicated instances of people drinking from cisterns in some areas. Measures could be taken to improve cistern water quality. One of these is the use of the individual household solar still. A copy of a report describing this device has been made available to RWD.

Appendix V

"Cost Analysis and Technical Data on Individual Sub-Projects"

APPENDIX V

Cost Analysis and Technical Data

This Appendix includes a projection based on costs incurred in previous AID financed sub-projects, of the distribution of costs among AID, other donors, villages and RWD expected under Project 00k4. These costs are based on assumptions regarding the frequency of certain types of sub-projects and the quantities of other donor financed inputs available to the project. The major assumption is that approximately equal numbers of three types of sub-projects will be undertaken. Briefly these types are the following:

Type I cisterns

Type II installation of distribution and storage systems where a new well has been drilled

Type III installation of distribution and storage systems for an existing drilled or handdug well or spring.

The costs presented in this analysis do not include the cost of technical assistance, these costs are included in the financial analysis, Sec IV. The costs do include the cost of village supplied labor although this cost may in some cases be in kind.

Cost details for three representative sub-projects completed under Project 022 are included in attachments to this Appendix. The projected AID financed costs are higher than those shown for the completed projects. This is due to the AID imposed restriction of $5000 per sub-project under Project 022. No upper limit is proposed for the follow on project, the restrictions on types of projects to be undertaken as defined by the selection criteria and the types of inputs to be financed will essentially place an upper limit on the financing. The analysis shows the highest

cost system to be estimated at an AID input of $21,000 and an average AID input per sub-project of $14,000 in current prices. The local village input of local commodities, labor, transportation and in some cases financing of wells is estimated at $16,000 per sub-project or 40% of the total sub-projects costs, not including the cost of technical assistance.

Type I Cistern (Typical capacity 156,000 gallons or 600 m^3)

AID Financed Inputs:

Cement 1000 bags at YR35/bag		$7717
Steel 3.5 tonne @ YR~~13~~ 1800/tonne		$1400
	Subtotal AID	$9117

Village Supplied Inputs*

Sand		YR6900
Stone		YR42,460
Gravel		YR 4,200
Transportation		YR 5,511
Skilled Labor		YR42,000
Unskilled Labor		YR10,000
	Subtotal Village	YR112,621
	or	$24,834
	Total Type I	$33,951

* Based on Al Hamsra project cost, for details see Attachment 1.

Type II Installation of distribution and storage systems where a new well has been drilled.

Components: Well(financed by other donor, RWD or village), pump and engine, transmission Main, Storage Tank, Pump House, Primary Distribution, Public Taps

AID Financed Inputs:

Cement 500 bags @ YR 35/bag	$ 3859
Pipe 800 m @ YR 28/m	$ 4939
Pump and Engine (Assume AID finances pumps and engines to Type II projects)	$10,000
Fittings and Lumber	$ 2000
Steel 1 tonne @ YR 1800/tonne	$ 400
Subtotal AID	$21,198

RWD Financed:

Pump Test and Permanent Pump Installation	$ 480

Village Financed Inputs*

Sand (Inc. transport)	YR 5350
Stone " "	YR 8500
Gravel " "	YR 4500
Misc.	YR 8190
Skilled Labor	YR 7200
Unskilled Labor (in kind)	YR10,000
PC Support	YR 2000
Subtotal Village	YR45,640
	or $10,063

*Costs from Aras Sub-project, for details see Attachment 2

Type II contd.

Well (total/average cost estimated at $30,000)

Assumption:	Other Donor financed in 50% of cases	$15,000
	RWD financed in 25% of cases	$ 7,500
	Village financed in 25% of cases	$ 7,500
	Total Type II	$61,741

Type III Installation of distribution and storage systems for an existing drilled or hand-dug well or Spring improvement

Components: Same as Type II less ~~existing~~ well

AID Financed Inputs:

Cement 500 bags @ YR 35/bag	$ 3859
Pipe 800 m @ YR 28/m	$ 4939
Fittings and Lumber	$ 2000
Steel 1 tonne @ YR 1800/tonne	$ 400
Subtotal AID	$11,198

RWD Inputs:

Pump test and Permanent Pump Installation	$ 480

Village Financed Inputs*:

Sand (Inc. Transport)	YR 3000
Stone (Inc. Transport)	YR 7800
Gravel (Inc. Transport)	YR 4500
Misc.	YR 3550
Skilled Labor	YR 4750
Unskilled Labor	YR10,000
Subtotal Village	YR33,600
or	$ 7409

Other Donor:

Assume: Other Donor supplies pump and engine to Type III projects	$10,000
Total Type III	$29,087

* From Rabat A Shari Sub-project Cost, see Attachment 1.

The following table summarizes the projected financial input from various sources for the three types of projects.

Distribution of Sub-Project Costs ($s)

Source	Type I	Type II	Type III	Average	Percentage
AID	9117	21,198	11,198	13,838	33
Village	24,834	17,563	7409	16,602	40
RWD	-	7980	480	2820	7
Other Donor	-	15,000	10,000	8333	20
Total	33,951	61,741	29,087	41,593	100

Under the assumption of equal numbers of each type of project, the "average" column represents average sub-project costs. These figures serve as the basis of the budget presented in the Financial Analysis of Section IV. The final column gives the percentage estimate of sub-project inputs for an average project from the various sources. It should be noted that the AID financed commodities are generally based on current prices of "off shelf" items purchased in Yemen. This method of purchasing is recommended in the early phase of the project until an adequate supply of commodities can be purchased off-shore. The AID financed commodity costs are thus an upper limit of actual expected costs.

The major assumptions of the foregoing analysis should be restated, they are the following:

(1) Equal numbers of Type I, II and III sub-projects are expected to be undertaken

(2) New wells are expected to be drilled for approximately one-third of the sub-projects

(3) Financing of new wells will follow approximately this distribution:

Other Donor	50%
RWD	25%
Village	25%

(4) Other donors will finance pumps and engines to approximately 50% of the sub-projects requiring this equipment and AID will ~~will~~ finance the remaining 50%.

Appendix C Attachment 2 Aras Project Cost Analysis

I. Basic Project Costs

A. Village Financed

Sand (Inc. Transport) 7 trucks @ YR 750	YR 5250
Stone " " 10 trucks @ YR 850	YR 8500
Gravel " " 6 trucks @ YR 750	YR 4500
Cement 110 bags @ YR 35	YR 3850
Misc. (forms, roofing, steel, etc)	YR 4340
Labor:	
1 Pipefitter 12 days @ YR 200/day	YR 2400
1 Mason 16 days @ YR 300/day	YR 4800
Unskilled Labor (in kind) 200 days @ YR 50/day	YR10,000
Peace Corps Volunteer Housing and Food	YR 2000
Subtotal Village	YR45,640
or	$ 10,063

B. AID Financed

Pipe 500 m 3" @YR23/m	$ 2534
Cement 150 bags @ YR 35/bag	$ 1194
Subtotal AID	$ 3728

C. Other Donor Pump and Engine (say)	$ 10,000
D. RWD Financed Pump Installer	$ 150
E. Well - Financed under AID Large Projects Cost of drilling, casing, screen, developing say	$ 30,000
F. Expatriate Technical Assistance (say)	$ 2,000

Total Subproject (Less Well and TA)	$ 23,941
Total Subproject (Less TA, Inc. Well)	$ 53,941
Total Subproject (Inc. Well and TA)	$ 55,941

The following information concerns project costs and it emphasizes village costs, AID inputs. It should be understood that small projects were limited to $5,000 per project. All costs are based on when the project was written.

Prices Known as of April, 1978

4,535 Rials = 1 US dollar

Pipe	Yemen Rials	US $
1 "	34.00	7.50
2 "	80,00	17.64
2½ "	120.00	26.46
3 "	135.00	29.77

*All pipes are 6 Meters long

Fittings		
3 " 90 degree elbows	70.00	15.36
3 " unions	80.00	17.64
3 " gate valves	120.00	26.46

*On any project unions are generally placed every 48 meters.

	Yemen Rials	US $
Cement/50 kg bag	34.00	7.50
Stone/cubic meter	150.300	33.08-66.15
Sand/cubic meter	100.00	22.05
Gravel/meter cu.	100.00	22.05

Reinforcing Rod	Yemen Rials	US$
6 mm	8.00	11.76
8 mm	15.00	3. 31
10 mm	19.00	4.19
12 mm	30.00	6.62
18 mm	60.00	13.23
20 mm	80.00	17.64

*Rod is sold in 12 meter lengths

Cost/ton Sana'a	YR 2,400.00	$551.27
Hodeidah	2,200.00	485.12
2nd Class Masnn	250 Yemen Rials/6hr day plus lunch and qat	
Helper	100 Yemen Rials/day	
Laborer	50 Yemen Rials/day	

A mason can build 2m3 of wall per day.

a laborer can excavate 1.5 - 2m 3 per day.

Wood Cost

Centimeters	Centimeters	Meters	Yemen Rials	US $
26	3	4	70.00	15.50
4.5	6.5	4	25.00	5.52
11	4.5	4.5	70.00	15.50
5	5	6	35.00	7.72
12	7	6	120.00	26.46
12	7	5	100.00	22.05
26	2.5	4	68.00	14.99
26	2.0	4	48.00	10.58
15	2.5	4	11.00	2.45

Zinc	Yemen Rials	US $
2.40 meters x .90 meters	25.00	5.51
2.50 meters x 90 meters	30.00	6.62
2 meters x .90 meters	20.00	4.41

May 5, 1978

Sana'a

Jack,

This list of projec ted tool requirements for 044 covers I think the majority of the tools the volunteers will need to do a good job. If I left something out, please add it.

In terms of quantities, I figured for a possible maximum of 5 men in the field.

I do not think we should go over-board buying a lot of the same type of tools for replacement purposes.

If each volunteer knows that they only have one of each tool, I think they will be less likely to lose tools and will feel more responsible for taking care and keeping track of those tools they have.

Noel.

May 5, 1978

Sana'a

044

Projected Tools

Field Work

Projected needs
4-5 men in field

TOOL	SIZE	QUANTITY	COST
PipeWork			
1. Pipe wrenches	36"	10	
2. Pipe threaders(metric)	1½" to 3"	5	
3. Hack saw		5	
4. Hack saw blades		50	
5. Metal chisels	½" blades	5	
6. Pipe cutter	3" pipe	5	
7. Pipe vise tables	3" pipe	5	
8. Metal files	suitable for 3"pipe	5	
9. Pipe reamers	" " " "	5	
10. Pliers(nose)	suitable for wire ticing	5	
CEMENT WORK			
1. Cement mixing boxes	1½ m x 1m	5	
2. Trowels	medium	10	
3. Finishing tool-flost 1"wood	medium	5	
(concrete work)		15	
4. Metal buckets(heavy duty)	5 gallon	15	
5. Levels(aluminium)	2' length	5	
6. Shovels	1 m long handle	10	
7. Line levels		10	
8. Wheel barrels		5	

TOOL	SIZE	QUANTITY	COST
Wood Work			
1. Claw hammer		5	
2. Saw	rip	5	
3. Square(s)	1 '	5	
Miscellaneous			
1. 30 meter tape	30 meters	5	
2. Tape	3 meter(staniley)	5	
3. String	100 meters	5	
4. Small metal tool boxes	1½ x 10 x 10	5 (small tools)	
5. Large tool boxes(wood)	3½ x 2½ x 2½	5 (all tools)	
6. Medium box (wood)	2" x 1½' x 1½'		
7. Water containers(metal)	20 liter	10 (clothes books)	
8. Gas containers	20 liter	10	

This report is being based on costs from March, 1977.

Village : Al Hamers

Population : 150 + Surrounding villages, total population to serve 500

Project Description: To construct 156,000 gallon cistern.

Village input:

1. Excavation:	800 m^3 to take one laborer 400 days at 25 YR/day - - - - -	YR 10,000
2. Rock:	193 m^3 at 220 YR/m^3 - - - - - -	YR 42,460
3. Sand:	115 m^3 at 60 YR/m^3 - - - - -	YR 6,900
4. Gravel:	70 m^3 at 60 YR/M^3 - - - - - -	YR 4,200

Village to supply 50 of the 1,100 bags of cement:

50 bags of cement at 31 YR/bag - - YR 1,550

Total village Material Input:

Rock - - - -	YR	42,460
Sand - - - -		6,900
Gravel - - -		4,200
Cement - - -		*1,550
	YR	55,110 + 10% for transportation
		5,511
Total YR		60,621 or $13,367.36

Labor

It will take one team (a team consists of one second class mason and four helpers) 280 days to complete project

Wage of second class mason	50 YR/8hr day
" " one helper	25YR/8hr day

Excavation:	YR	10,000
Masons :		42,000
Total :	YR	52,000

Total village Input:

Materials :	YR	60,621
Labor :		52,000
Total :	YR	112,621 or $24,833.74

USAID Contribution:

500 bags of cement at 30 YR/50 kg bag

YR 15,000 or $3,307.61

Plus support of one PCV 520.82 YR

Total YR 15,520.82 or $3,422.45

CRS also made a contribution

of 550 bags of cement at 31 YR/bag

or 17,050 or $3,759.65

Total outside contribution to project:

YR 32,570.82 or $7,182.10.

Thisproject has a total cost of YR 145,191.82 or $32,015.84.

The percentage of outside assistance was 22%.

PROJECT TYPE NO. 2

Village : Rabat A Shari

Population : 1,000

Rabat A Shari would actually be included as a large project because USAID drilled the well. In this report there are no costs on the well. As a small project it includes a 510 meter pipe line, 3", from the well to the village and 50 cubic meter water storage tank. This project also includes a pump test to determine the dynamic water level of the well so as to determine the pump specification and the depth it is to be set at.

Costs are based from February 1978.

Village Input: 50 m^3 water storage tank.

	Yemen rials	US $
1. Rock: 26 cu. meters x 300 YR/m3 -	7,800	$1,719.96
2. Sand: 30 cu. meters x 100 YR/m3 -	3,000	661.52
3. Gravel: 45 cu. meters x 100 YR/m3-	4,500	992.28
4. Cement: 16 bags at 34 YR ea.	544	119.96
5. Reinforcing Rod: 50 bars at 12 meters ea. (10 mm) x 19 YR =	950	209.48
6. Wood for Roof: 4.5 cm x 11 cm x 6 m (14 units) x 70 YR =	980	216.10
7. Form Boards for concrete slab: 3 cm x 26 cm x 4 m(7 units) 7 units x 48 YR=	336	74.09
8. Knee braces for forms: 5 cm x 5 cm x 6 m (2 units) 2 units x 70 YR=	140	30.87
9. 2 units of 3 " pipe at 135 YR ea.	270	59.54
0. 2 90° elbows 70 YR ea.	140	30.87
1. 1 3" T	90	19.85
2. Pipe Sealent 10 cans at 10 YR ea.	100	22.05

TOTAL MATERIALS INPUT:

18,850 YR or $4,156.56

Labor

Excavation 8 m^3

It takes only laborer 4 days to excavate 8 m^3.

4 x 50 YR/day = 200 YR.

Masonry:

It would take one team (one mason & helpers) 15 days to complete the the masonry work on the tank.

one mason gets 250 YR/6 hr. day

one helper gets 100 YR/6 hr. day

Each day will cost 650 YR

650 YR x 15 days = 9,750 YR

Pipe Line

It will take 4 days to complete pipe line with one pipe filter and 20 laborers.

Pipefilter 250 YR/day

Laborer 50 YR/day

Each day will cost 1,250 Rials

1,250 YR x 4 days = 5,000 YR

Total Labor Cost of Projects

50 m^3 tank	9,750 YR
Pipe line	5,000
	14,750 YR

Total village Input: 33,600 YR or $7,409.04

Total cost of 50 m^3 storage tank is:

Materials	30,010	
Labor	9,750	
	39,760 YR	39,760 YR or $8,767.37

RWD INPUT

1 truck & driver provided for 5 days

for pump test.

Truck 178 miles x $0.35/mile = YR 282.53 or $62.30

Driver 100 YR per diem 100 x 5 = 500.00

1 pump ¢ engine for well 90,700 YR or $20,000.00

Labor of instalation 4 days at 350 YR/day

4 x 350 YR 1,400 YR

Total RWD Input: 92,882.53 YR or $20,481.26.

USAID INPUT

510 meters of 3" pipe or 85 units

at 135 YR each. 85 x 135 YR = 11,475 YR

(10) 90° elbows at 70 YR each = 700

(10) 3"unions at 80 YR each = 800

(3) nipples at 50 YR each = 150

(300 bags)cement at 27 YR/bag= 8,100

zinc for roof 48 sheets @20 YR 960

USAID has bought cement for 27 YR/bag but the market price is 34 YR. The price of27 YR is about 9 YR over the world market price.

TA's hav e made 15 trips to village.

Auto expense 178 miles x $0.25/mile = $44.50/trip

15 trips = 3,028 YR or 667.50 US $

PLV is working twoprojects in area so his transport cost is divided in half:

178 miles x $0.25x20 trips=

$\frac{\$890}{2}$ = $445.00 or 2,018 YR

Total USAID Input: YR 27,230 or $6,004.41

Total Cost of project:

Village Input - 33,600 YR

RWD Input -	92,882.53 YR
USAID Input -	27,230 YR
Total	153,712.53 YR or $33,894.71

by Jack P. Henry (pac)

Mix for Masonary Cement Tanks

1. Concrete mix for roof slab should be 50 kilograms of ordinary portland cement.

Should be 50 kg. of ordinalry portland cement to 2.5 cubic feet fine sand or .07 cubic meters and 5 cubic feet. (.14 cubic meters) of 20 mm crushed stone 1:2:4. cement:sand:gravel.

2. Concrete mix for the floor slab should be 50 kilograms of ordinary portland cement to 2 cubic feet sand (.56 cubic meters) and 4 cubic feet (.112 cubic meters) of 20 mm crushed stone. 1:1.6:3.2

3. The water cement ratio should be about 20 liters per 50 kilograms of cement.

4. The motar plaster ratios should be 1:3 by volume.

NOTES:

Appendix VI

"Design Criteria for Sub-Projects"

Design Interia

A. Cisterns:

1. Per capita consumption: 30 led.
2. Yield: 50% of average annual precipitation over catchment
3. Evaporation rate: 0.5 cm/day
4. Check to assure yield is greater than evaporation + consumption over 9 dry months
5. Standard design includes sediment trapm stairs surrounding wall, animal trough
6. Construction: Stone masonry with concrete mortar lining

B. Storage Tanks:

1. Design base: on per capita consumption of 30 led without house connections and one day storage. With house connections design based on 60 led and the provision that storage may not be adequate for one day supply
2. Basic desig ns have been prepared for 11, 25, 50, 100, 150 and 200 cubic meter tanks, with the following typical specifications:
   a. Floor: 15 cm concrete slab resting on foundation, #3 steel at 30 cm.
   b. Walls: Masonry, typical base 66 cm tapering to 30 cm for 50 m^3 ta nk.
   c. Roof: Corrugated iron on 2 x 4s or reinforced concrete slab.
   d. Cement requirement: For plastering interior, 1.33 bags per square meter; for wall construction, 3½ bags per cubic meter of wall.

3. Tank includes upper inlet, outlet for public taps and/or distribution system, manhole and drain.

C. Pipelines

1. Pipe material: Calvanized steel, plastic considered for some applications.

2. Pipelines generally exposed over rock, buried at grade crossings and buried 1 meter in cultivated fields.

3. Mainline from well head to tank inlet includes non return valve, one union per ten lengths pipe, no house connections.

4. Friction losses calculated according to Wells Handbook, total dynamic head based on total availab le drawdown of well.

D. Public Taps:

1. Number of taps calculated at one per 10 households.

2. Taps at tank located approximately two feet above grade.

3. Standard public tap design includes masonry and mortar structure with 3 to 10 taps, filling stand at waist level, drainage to animal trough.

Appendix VII

"Memorandum Agreement"

MEMORANDUM AGREEMENT NUMBER _____

BACKGROUND

1) Project Location

_____

2) Project Description

_____

3) Construction Outline

_____

This agreement, made and entered on this _____ day of _____, 19_____, by the Ministry of Public Works, Rural Water Division, Sana, hereinafter called MPW, and _____, acting as representative of

_____

hereinafter called the village, witnesseth that the parties hereby do mutually agree as follows:

ARTICLE I: INPUT OBLIGATIONS:

Section I: Materials, equipment and technical assistance to be furnished by MPW through USAID, Rural Water Project: (Include quantities, unit prices, total cost to be financed by USAID).

_____

_____

_____

_____

_____

Section 2: The materials, equipment and technical assistance to be furnished by MPW through its own resources.

Section 3: The materials, equipment and technical assistance to be furnished by MPW through another donor. (Specify)

Section 4: The technical assistance to be furnished by MPW through the U.S. Peace Corps. (Include the number and estimated length of residence of Peace Corps construction supervisors.

Section 5: The transportation, materials, labor and facilities to be furnished by the village.

A. Transportation: The village will provide transportation for all commodities furnished by MPW and through its own resources.

B. Materials: The village will provide the following materials:

_____

_____

_____

_____

_____

C. Labor: The village will provide the the following:

1. One (1) experienced Mason for cistern or stone tank construction.

2. One (1) Pipefitter for construction of pipeline, if a pipeline is required.

3. A minimum of ten (10) laborers per six-hour work day and more as deemed necessary by the construction supervisor. It will be the responsibility of the construction supervisor to inform daily the village representative of the required number of workers for the following day's work.

D. Facilities: The village will provide board and lodging for U.S. Peace Corps MPW construction supervisors ors.

E. Other: (Specify)

_____

_____

_____

ARTICLE II: CONDITIONS OF AGREEMENT:

Section 1: The village shall solely bear the responsibility for any damage that may result from working circumstances, and the MPW shall not be responsible for any damages caused, and neither its employees nor its equipment shall be subject to any claims or demands in this relation.

Section 2: The village shall be responsible and held accountable for all materials and equipment delivered to the village, and for the work performed here-under, until the work is completed and accepted by the village. The village shall be held completely responsible for any loss or damage due to theft, pilferage, rust and weathering to the work and all materials, supplies and equipment furnished by MPW.

Section 3: All water produced by the system shall be solely for the domestic use of the village, and any financial charges or expenses for the water will be utilized solely for the operation and maintenance of this system. No individual or party will have the right in the present or future to make profit on the water from this system. The village representative will be held responsible for the operation and maintenance of the completed project, and for the establishment of any organization required to operate and maintain the system.

ARTICLE III: VILLAGE PRECONDITIONS AND AND OBLIGATIONS OF CONSTRUCTION

Section 1: Unless otherwise stated, the village will have on worksite, within 30 days of the signature of this agreement by all parties, 75% of each commodity that the village has consented to supply. (See Article I, Section 5.)

If after 30 days of the signature of this agreement by all parties, the village does not have 75% of each commodity on worksite, MPW will assume that the village is not interested in constructing the project and, hence, reserves the right to terminate this agreement.

Section 2: It is the responsibility of the village to obtain all property, rights of way, public access, etc., as deemed necessary by the MPW Design Engineer for the construction and operation of the project.

Section 3: Upon written notice from the Construction Supervisor of the village's failure to 1)follow original design specifications, or 2)procure project materials as stated in Article I, Section 5, or 3) procure land and property rights as stated in Article III, Section 2, the MPW reserves the right to terminate this agreement.

Section 4: Representatives of USAID and MPW reserve the right to inspect the project during and after construction and interview residents of the village with regard to the terms of this contract being upheld.

Section 5: Special conditions.

(E.g., if the project has any relation to or is dependent upon anyother project, state any conditions to which the village must agree.)

ARTICLE IV: COMPLETE AGREEMENT

This agreement constitutes the entire agreement between MPW and the village of

_____,

and there are no terms, conditions or provisions, either written or oral, between the parties mentioned, other than those herein contained, and this agreement supercedes any and all oral and written representation, inducement or understanding of any kind or nature between the parties mentioned relating to the particular construction project involved herein.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed the day and year first mentioned above.

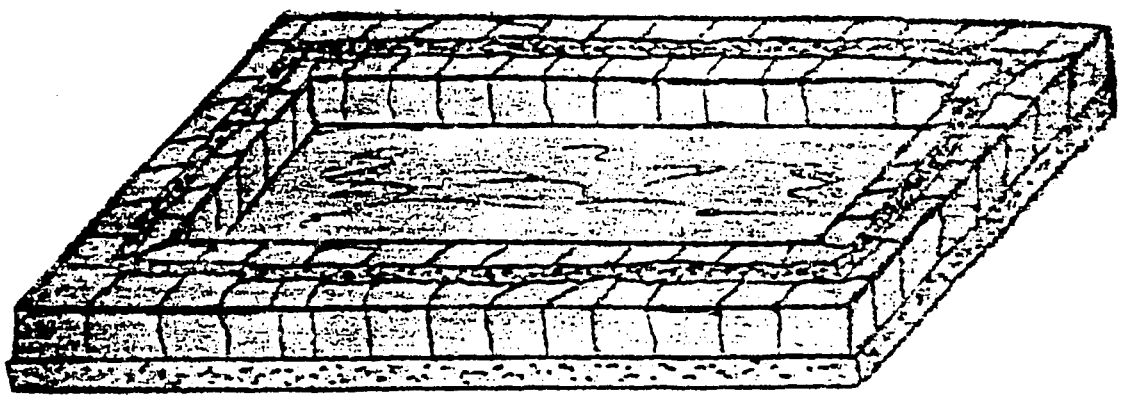
Appendix VIII

"Standards and Specifications"

SMALL WATER PROJECTS

CONSTRUCTION BOOKLET

TANKS AND PIPELINES



First course of water tank with
middle gap filled with chips and rubble
stone.

Prepared by F. Noel Perry

Illustrations by Betsy C. Wyse

I. TANK CONSTRUCTION

By the time the construction supervisors have reached the village, a site will have been chosen for the construction of the tank.

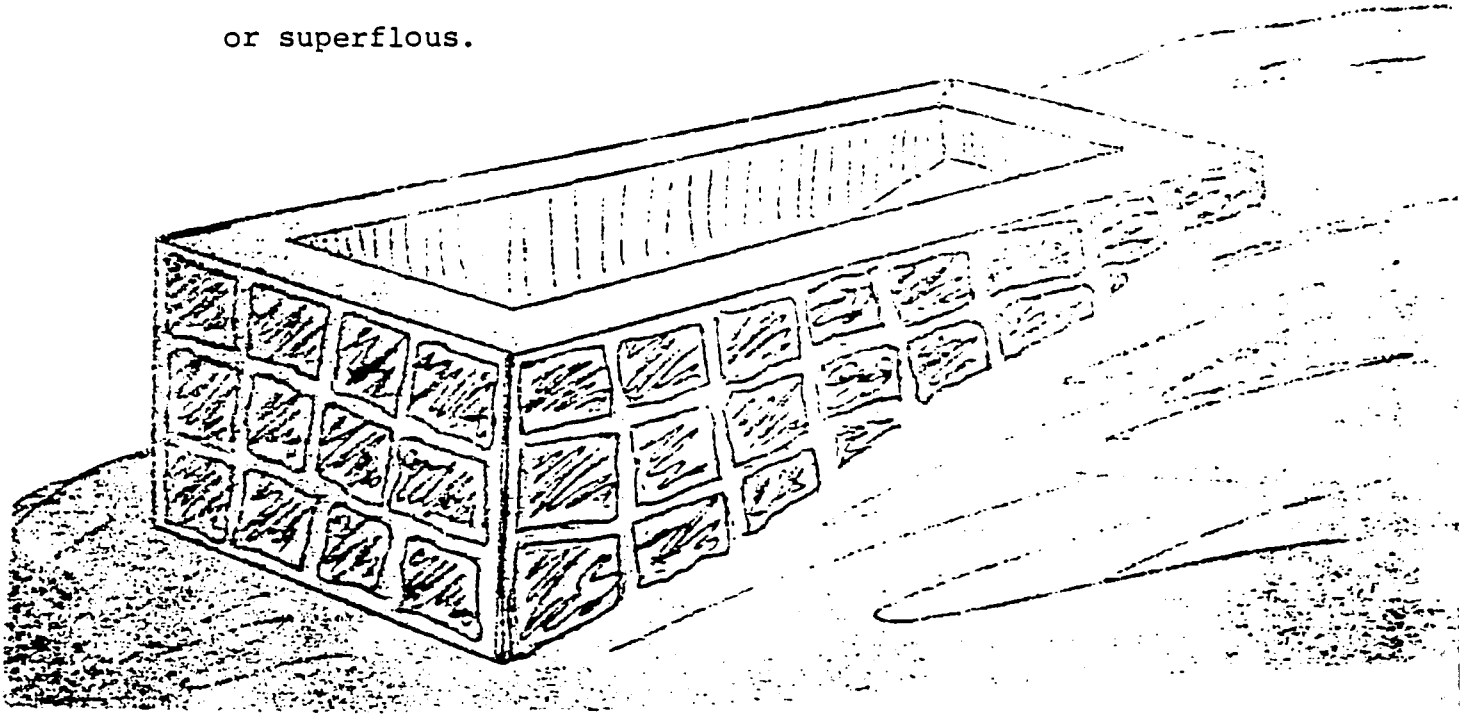
It is the responsibility of the village leader to provide a "mohandis" or "mooAAlem" to actually construct the tank. This man will usually be well skilled in building with rock and also have many years of experience behind him. He will probably have built many houses in the village and will be flattered if you ask him about the structures he has built in his lifetime. There are numerous similarities between the techniques used in building a yemeni storehouse and those techniques used in building our stone water tanks. The big contrast is the fact that cement, and not mud, is used as a bonding agent in our tanks. Some of the similarities between our tank and a yemeni stone house (technique-wise) are the following:

1) Four edges of the front face of stone are cut
2) Chips are sometimes used to level individual stones.
3) Outside course is first constructed, followed by inside course and finally a filling-in of the middle gap with chips and rubble stone.

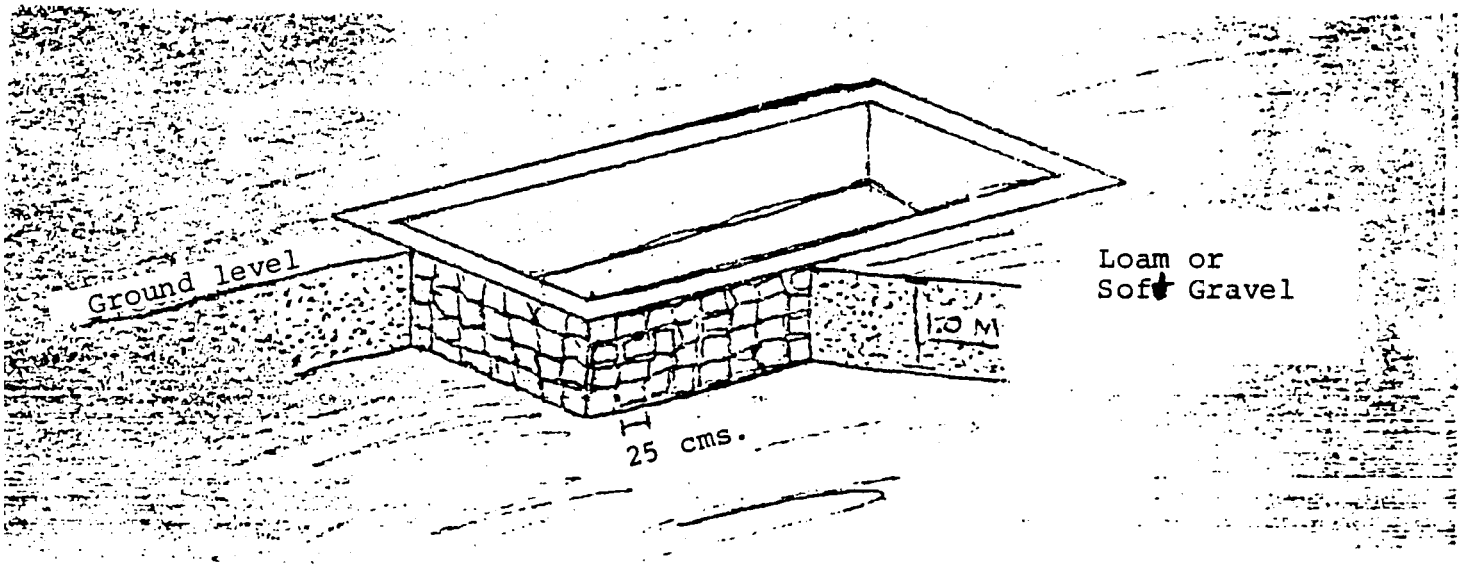
I have broken down the construction aspects of the tank into the following components and hope that the supplied information and diagrams will be helpful to you in your construction!

A) EXCAVATION WORK FOR FOUNDATION

1) The depth of the foundation will be determined by the type of earth (rock, sand, gravel, loam or clay) the tank will be built on. When constructing the tank on a hard surface of limestone, sandstone or hard packed clay, a minimum amount of excavation work will be necessary to level the foundation for the floor slab. For example, when building the tank on the slide of a mountain, the up side of the foundation may not need any course work, while the down side may require two courses to make the base level all around. Using your line levels (or a level with a straight edge) you can quickly determine where excavation work will be necessary or superflous.



2) When constructing a foundation in loam or soft, unpacked gravel, excavate at least 1m below the lowest point. The height of one course of stone usually averages between 25 and 30 cm. Hence, at 25 cm. per course, 4 courses of rock would bring a foundation to ground level.



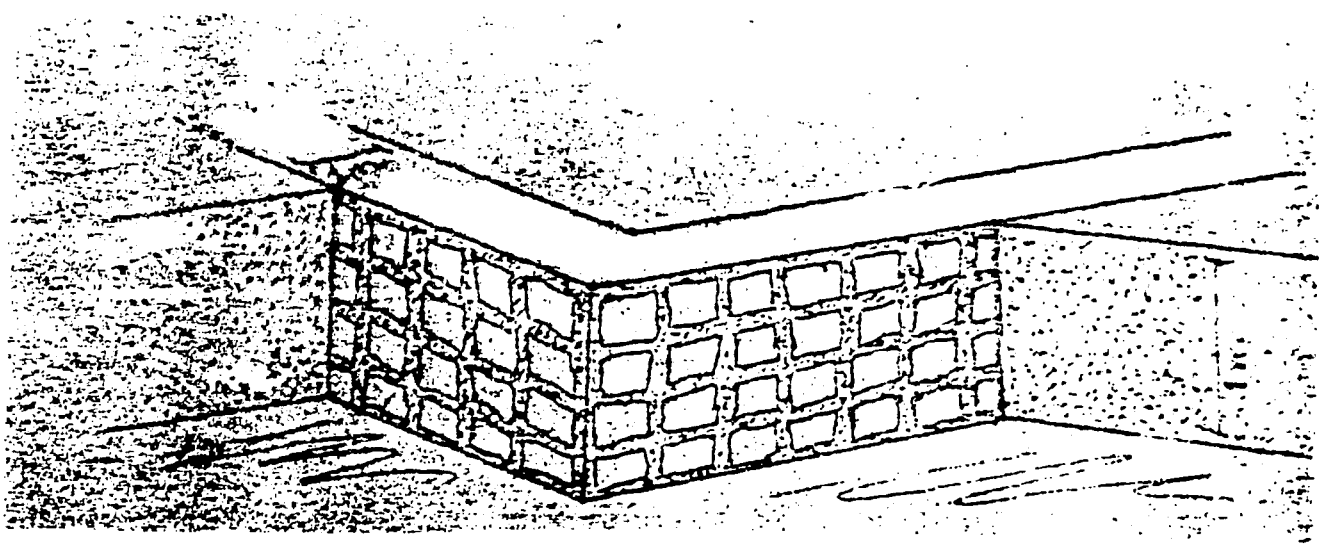
Cut-away view of foundation, 1.0 m deep, using a 1:3 cement/sand misture.

B) FOUNDATION

1) The width of the foundation walls will be (at least) 1 m.

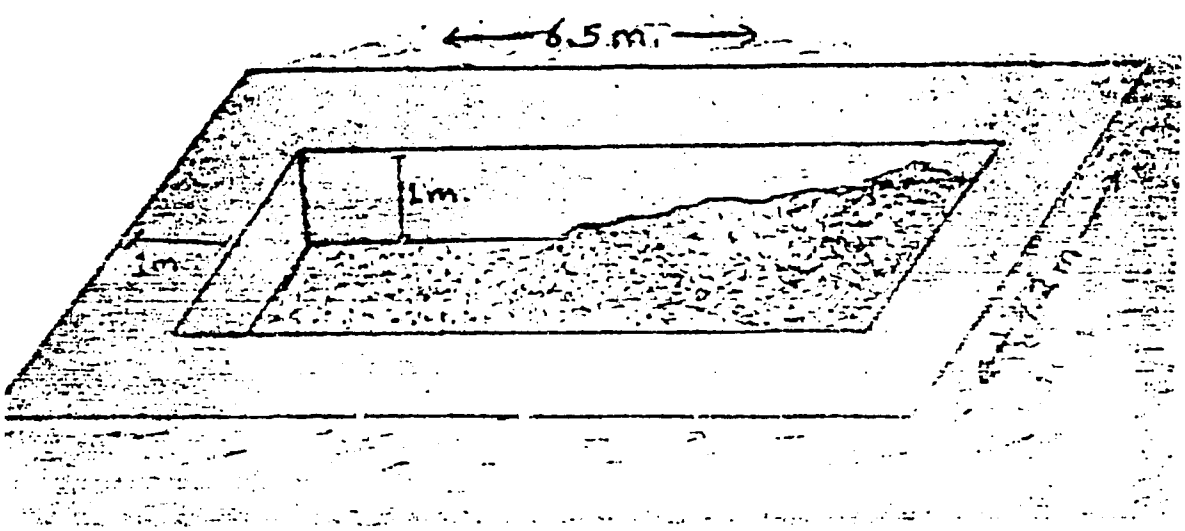
2) A 1:3 ratio (cement-sand) will be used for foundation wall construction.

3) Before filling in around the outside of foundation, it is important that the joints of the foundation course work be plastered. A 1:2 ratio is used for plastering.



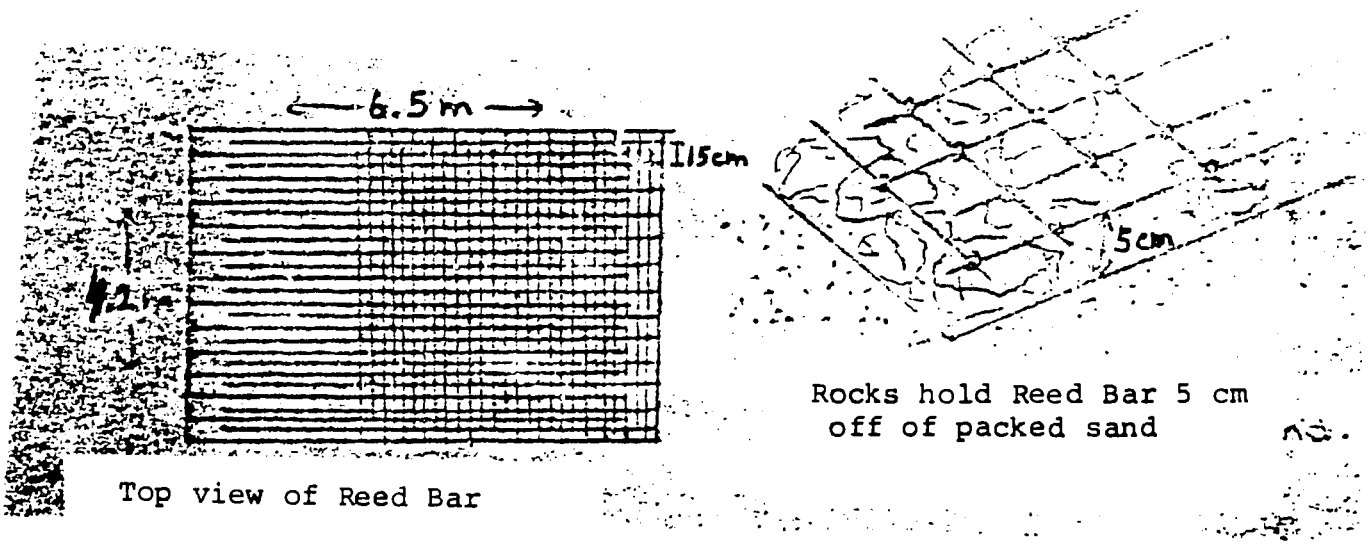
Cutaway view of foundation,
using 1:2 ratio (cement:sand) for plastering

4) Before preparation for the construction of the floor slab can begin, the inside area of the foundation must be level with the top course of the foundation. If the earth is above the foundation, level it. If the inside is lower than the top course, fill in with sand or small stones upon inside. Pack this mixture as well as you can to prevent any settling. Pouring water on the inside area of few days before pouring floor slab will help settle the mixture.



C) FLOOR SLAB

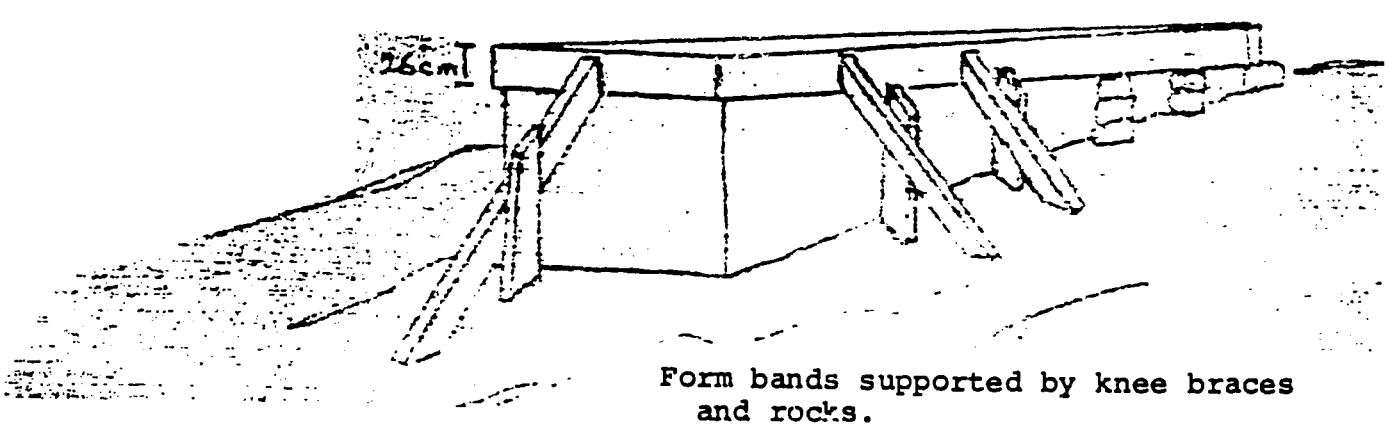
1) Lay your Reed Bar (12mm thick) 15cm. on center. If the bars are cut into 6m. and 4m. lengths for the 25m. tank, do not worry about the bars not meeting both edges. Stagger the bars so that every other bar will meet the edge. This will provide adequate reinforcement. Wire-tie all of the joints. The Reed Bar Net should sit 5-6cm. above the foundation. This can be accomplished by setting flat strong rocks (5cm. high) under numerous joints. (Note: Hook ends of Reed Bar 10cm. from edge)



Top view of Reed Bar

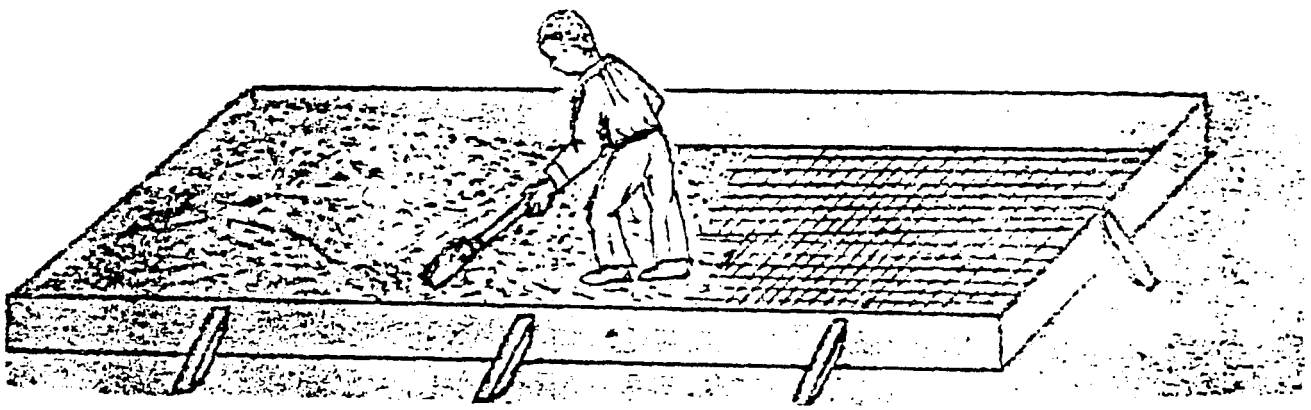
Rocks hold Reed Bar 5 cm off of packed sand

2) The Floor Slab will be 15cm. thick. The board slabs for forming the concrete slab should be at least 26cm. in height (4m. x 26cm. x 5cm.). The wood slabs can be supported at the proper height (15cm. above top edge of foundation) by knee braces or rubble rock. If possible, slope the floor towards the corner in which you will place your drain (3"). Choose that side of the tank where the water will best flow down and away from the tank without stagnation. Sometimes, the villagers willhave good, practical suggestions about where the water should drain to (aqatfield??).

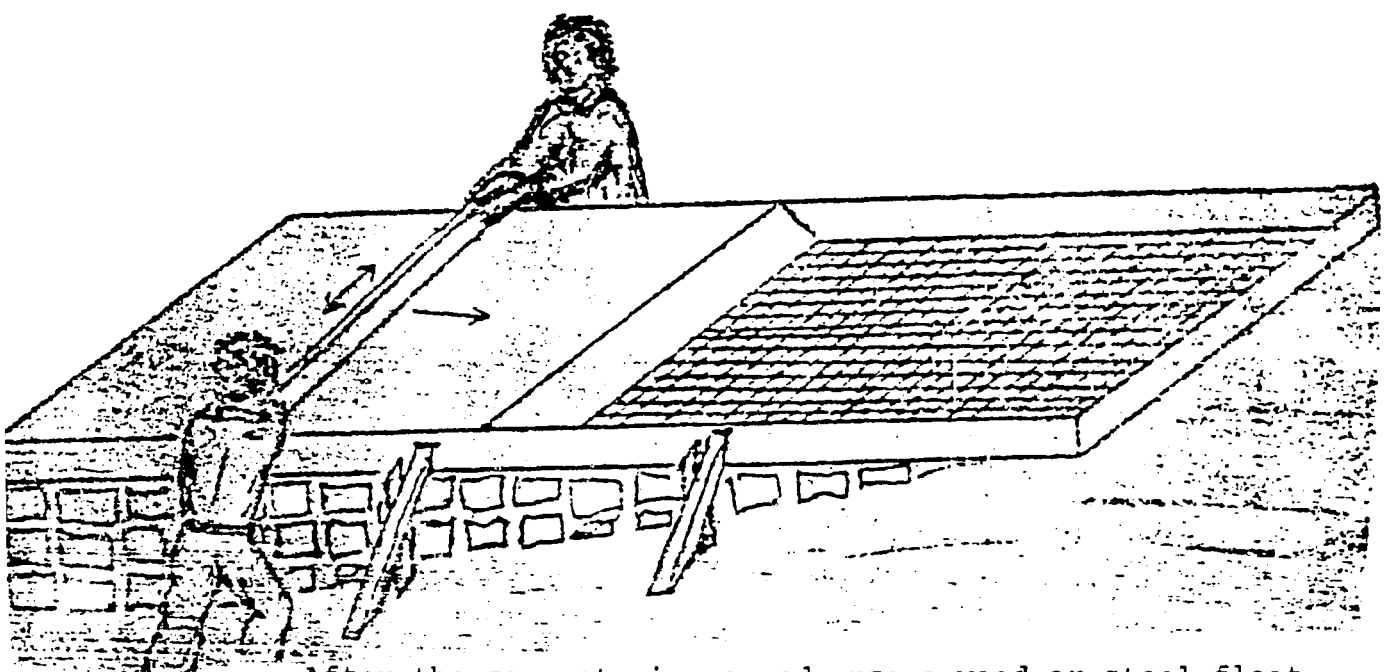


Form bands supported by knee braces and rocks.

3) After the Reed Bar and wood forms are set in place you are ready to pour the floor. The proper mixture for the floor is 3.2:1 (i.e., gravel, sand, cement). Try and emphasize the importance of pouring the floor all in one day so as to prevent cracking. It is, indeed, possible to mix your ingredients within the area of the foundation (that is, if you do not have mixing bins). Your mix should be as stiff as possible, i.e., 5-8 gallons per sack of cement. The less water the better. Sand and stone should not contain a lot of fine material (fine material weakens concrete). Writing your initials in the floor slab is not permitted!

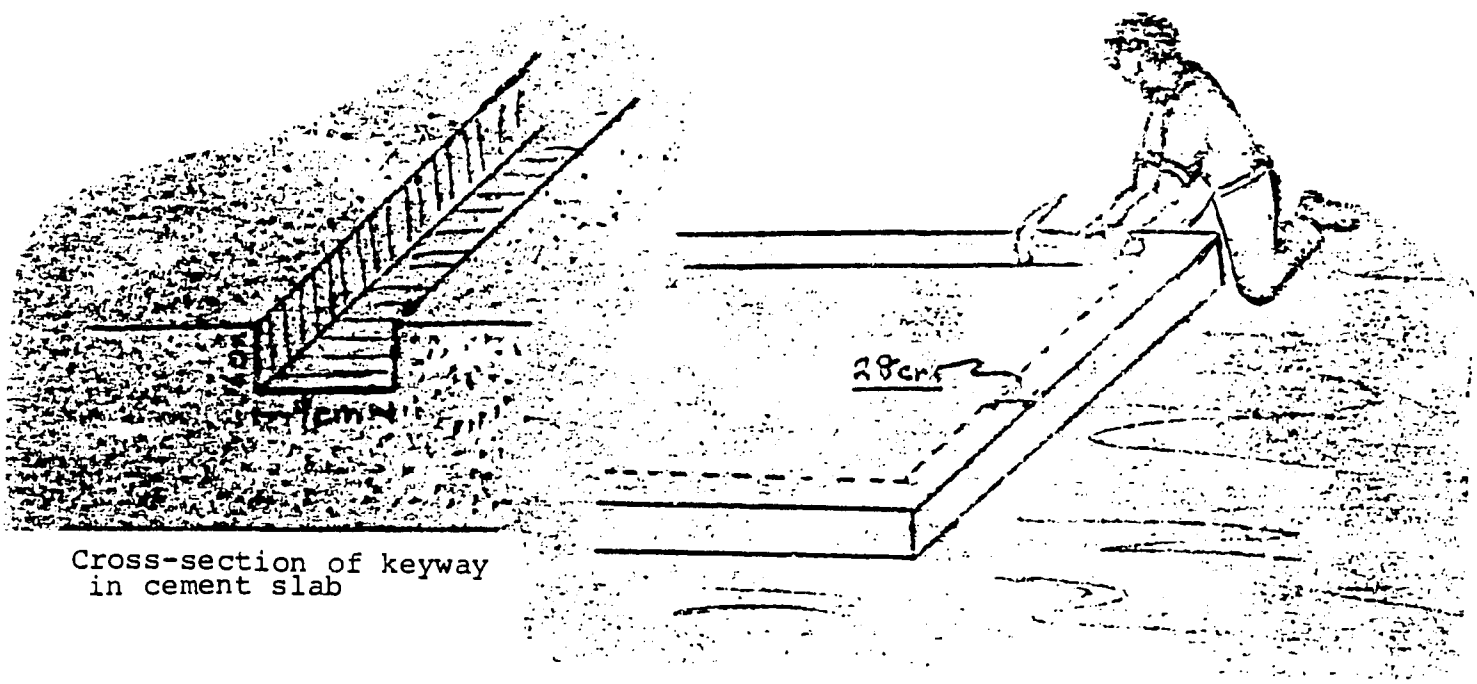


Always try and work as much water as is possible out of the concrete. One way of doing this is to work a 2"x4" (on edge) back and forth across the short side of the tank.



After the concrete is poured, use a wood or steel float to work the remainder of the water out of the slab and also to smooth out the surface.

4) You will notice that the design calls for a keyway around the perimeter of the tank 28cm. in from the edge. (Keyway dimensions are 9cm. width and 6cm. depth). The purpose of the keyway is to prevent leakage at the most vulnerable seam in the tank. They keyway can be cut into the floor while the floor is being paired and shortly after one can cut it in with a hammer and chisel, a trowel, or some other sharp instrument.



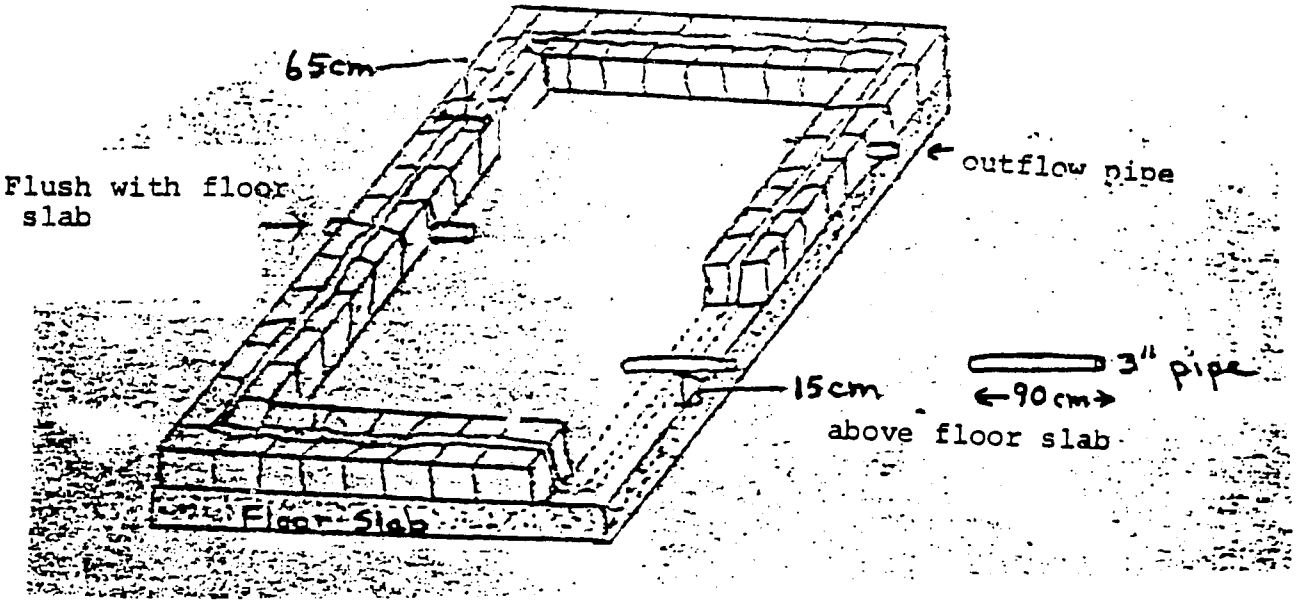
Cross-section of keyway in cement slab

D) WALLS: COURSE WORK AND PIPES

1) The first outside course of the tank will be recessed (inverted) 3cm. The first course keyway should be filled with mortar and rubble or chips.

2) The 3" (90cm. long) for the tank will sit flush on the floor slab at the point so determined. For a tight seat, it is best to wet pipe(s) before inserting into tank.

3) Any outflow pipes should be placed at least 15cm. above floor slab. The number of outflow pipes will be determined by the type of project you are doing (i.e., whether there will be a pipe manifold or gravity feed into village)

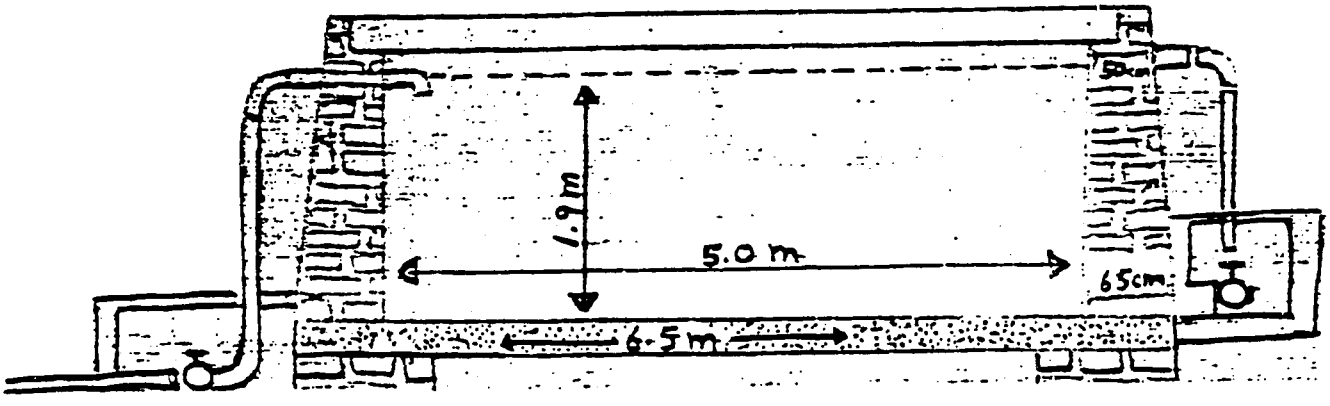


4) You will notice that the tank design has a taper, the base being 65cm. and the top 50cm. Your inside wall, however, must be straight.

5) Two lengths of pipe (90cm. long) are necessary at 1.9m.

a) Overflow Pipe: This pipe need not be threaded on either end.

b) Intake Pipe: Both ends must be threaded. 20cm. should extend outside of tank and at least 15cm. inside.



6) Roof:

Two types: a) Reinforced concrete

b) Zinc and beams (wood)

All villages do not have the money or manpower to build a reinforced concrete roof. For those villages which cannot built this type of roof, a zinc and wood combination serves the purpose well.

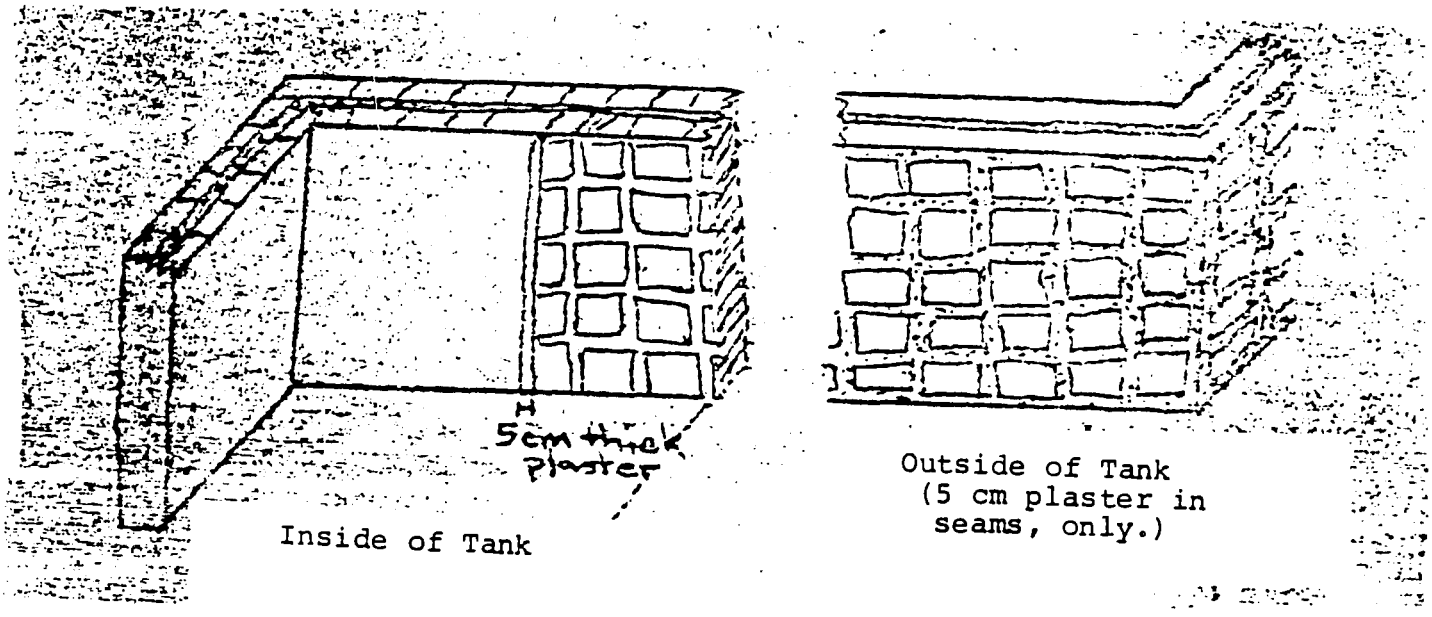
Since sheets come in various lengths and widths. The width of the zinc purchased will determine the spacing distance on your beams. Once you know the dimensions of your zinc, you can determine how many beams must be purchased for the size tank you are building.

7) Plastering:

a) Use a 1:2 mix for all plastering.

b) Plaster complete inside of tank

c) Outside only requires plastering between joints.



Inside of Tank

Outside of Tank
(5 cm plaster in
seams, only.)

II. PIPELINE CONSTRUCTION

You may find that the villagers have less experience working with pipe than they do with stone and cement.

Before beginning the pipeline, find out if there is a pipefitter in the village. If the village does have experienced pipefitter(s), tell the Sheik that he (or they) must help build the pipeline. If there are no experienced pipefitters in the village, it will be your responsibility to train a few men in the techniques of pipefitting. After the first couple of days working on the pipeline, there is a good chance that you will notice a few industrious men who seem to have a feel and sense for working with pipe. Tell the Sheik you wish to instruct these men and that you desire their presence daily. If these chosen men desire (demand) to be paid, tell the Sheik he must pay them.

By the time you have completed all the pipework in the village, hopefully there will be one or two men who have a good understanding of how to properly connect pipe, along with an understanding of fittings in a pipeline.

These men will be very effective in <u>maintaining</u> the pipeline after you leave.

Threading Pipe; Support trestles; Miscellaneous suggestions regarding the construction of village pipelines

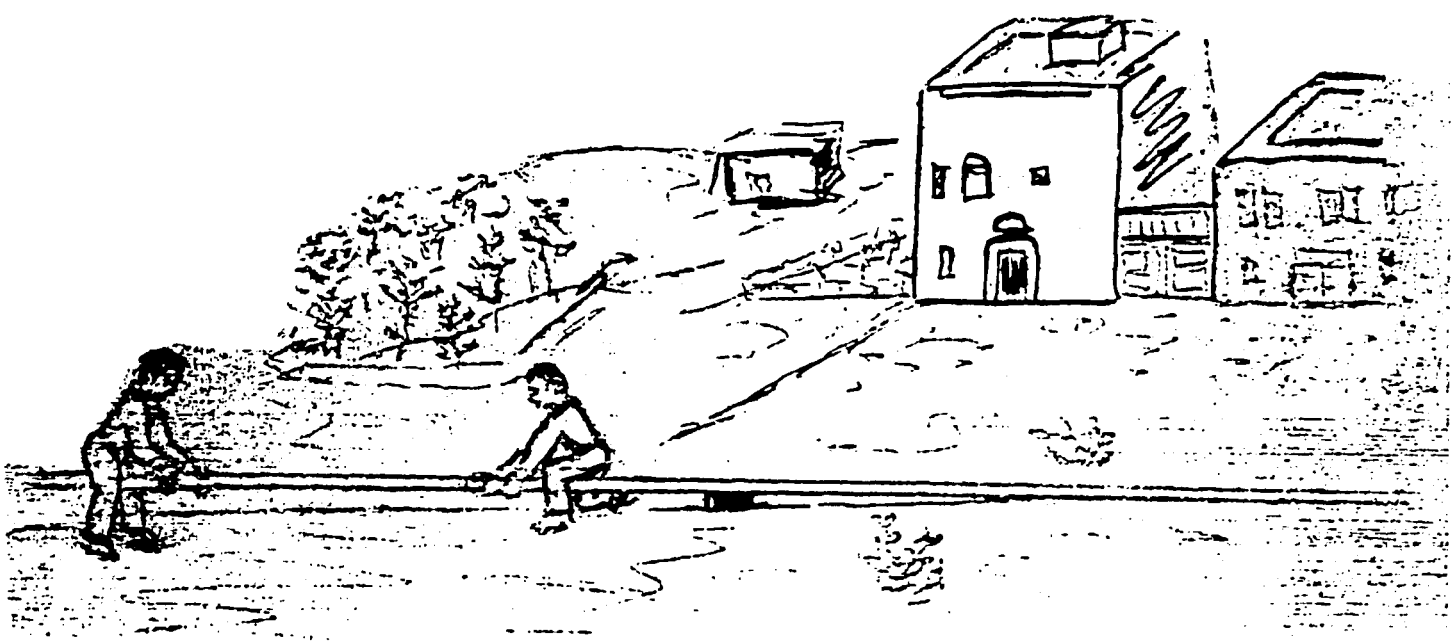
A) Threading Pipe:

Threading pipe can be quick and problem-free once the villagers have developed an efficient method. A method I found to be quite successful is the following:

1) Have one man place and then hold a length of pipe into the coupling.

2) Have a second man at the other end (you at the beginning for demonstration purposes) line the pipe up so that the pipe sits on the same plane as the preceding pipe.

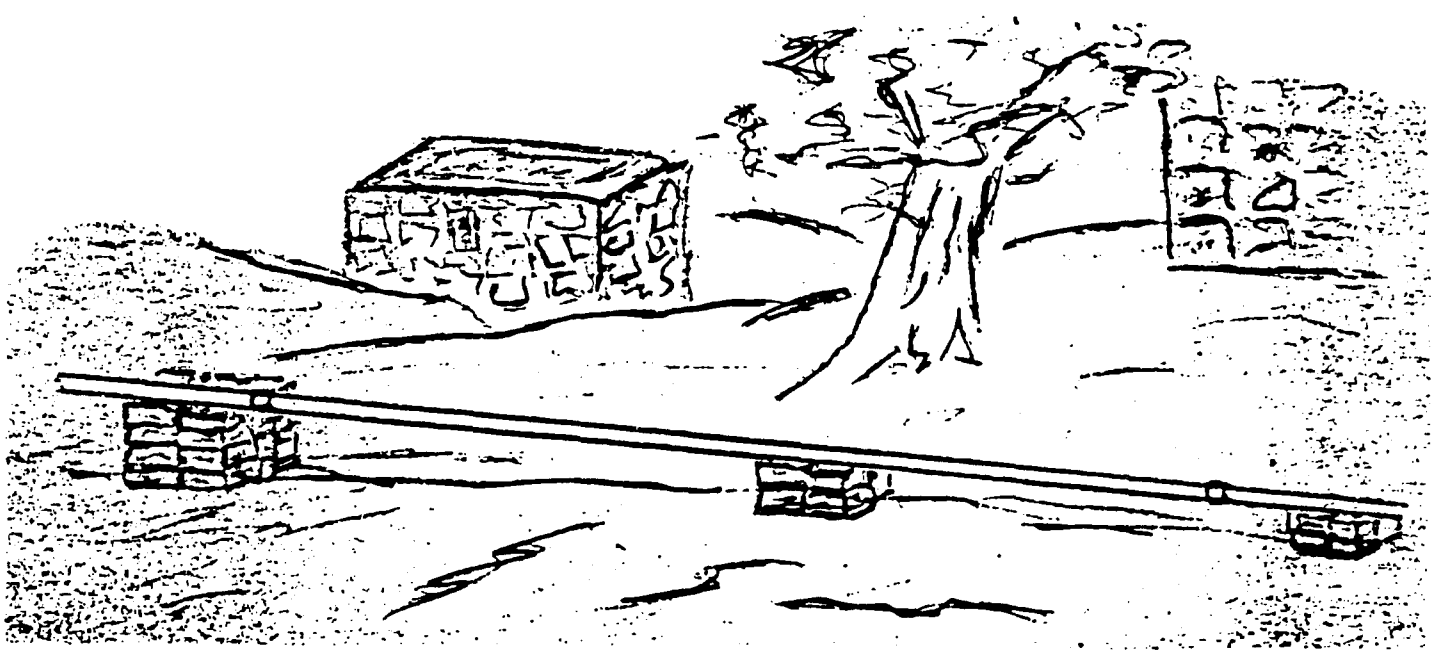
3) Man number 2 will, after eyeing both pipes on the same plane, screw the pipe into the coupling. Once the pipe has started to thread properly, a few other men can then assist turning the pipe.



This particular method is more efficient then having 10 men all at once attempting to thread pipe when no one can really see if the pipe is lined up properly (because of all the bodies in the way). (Note: Use rocks to raise pipe off ground for threading purposes)

B) Support Trestles:

Numerous times in the course of the pipeline it will be necessary to construct support trestles. Attempt to make these trestles strong and permanent the <u>first</u> time you construct them. The villagers may not want to make them strong at first because of their desire to complete the pipeline as soon as possible. However, it is to the villager's advantage to construct the trestles properly at the beginning because later on they may not want to return to them. A weak support trestle can eventually mean broken pipe joints.

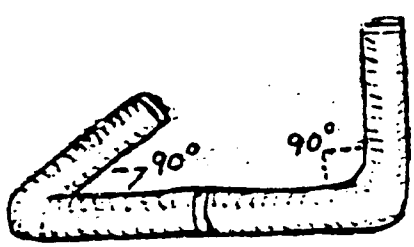


As you proceed with the pipeline, encountering rises and dips in the terrain, not to mention ...

and explain to the villagers the options there are in the actual route of the pipeline, along with the possible use or non-use of pipe fittings. By discussing the various options with the villagers, they will begin to get a feel for the problems one must solve in connecting a pipeline.

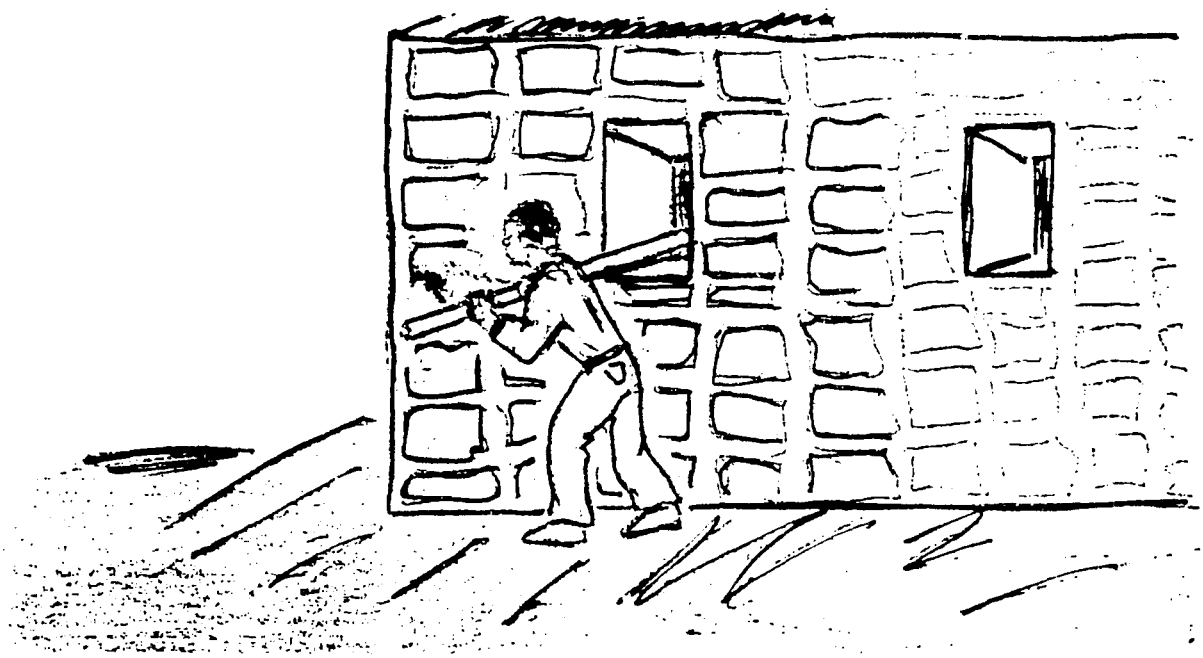
C-1) All fittings not supplied by Ministry or AID must be supplied by village. A general rule about fittings is: Do not use unless absolutely necessary.

C-2) Two 90°'s make any angle up to 180°

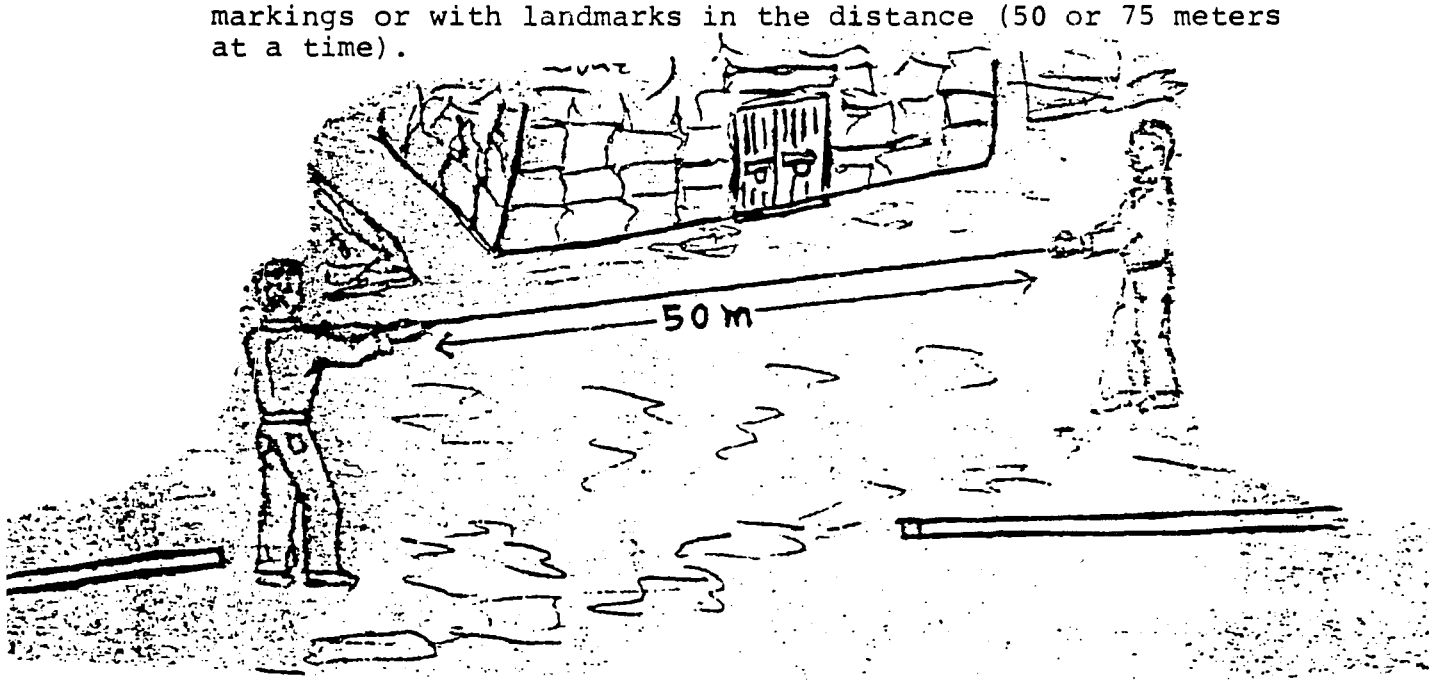


C-3) Use a union every 60 to 70 meters.

C-4) When necessary, bend pipe to achieve proper angle. Do not bend pipe more than 30°.



D) String can be very useful in keeping a pipeline on a straight course. One can line the string up with transit markings or with landmarks in the distance (50 or 75 meters at a time).



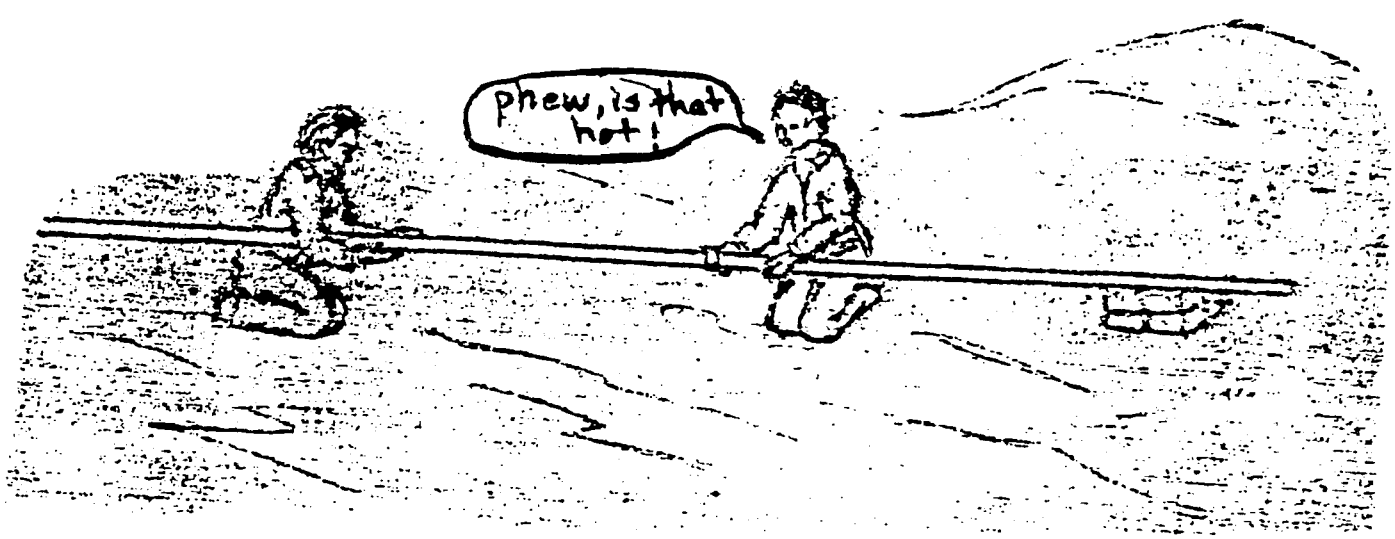
E) Do not run pipelines through area of raw sewerage or stagnant bodies of water.

F) A hacksaw and chisel or file can be instrumental in straightening out distorted pipe threads.

G) Always use adequate amounts of pipe sealing compound.

H) Always check each pipe for stones, cans and other debris before connecting it. Children have a great time stuffing artifacts into the pipe as it sits idle in the village.

I) A good method of determining if the pipe joint is tightened down enough is to feel the joint. If it is very warm, the joint is usually tight.



Appendix IX

"Environmental Impact Examination, with Negative Determination"

INITIAL ENVIRONMENTAL EXAMINATION

Project Location: Yemen Arab Republic

Project Title: Small Rural Water Project

Funding (000S) $	AID	YARG	Total
FY 79	1,528	280	1,808
FY 80	300	756	1,056
FY 81	2,103	1,531	3,634
FY 82	2,785	2,067	4,852
FY 83	3,700	2,790	6,490
Life of Project:	$ 10,416	$ 7,424	$ 17,840

IEE Prepared By: Herbert G. Blank March 19 ,1978

Environmental Action Recommended: Negative Determination

Mission Concurrence: R Huesmann 5/14/78

Robert Huesmann
Director

Date

For the NE Bureau:

Action Recommended: Negative Determination

Approval: [illegible] 6/13/78

Date

Disapproval: _____ _____

Date

Clearances: NE/GC GBisson [illegible] 6/12/78
NE/PD/ENGR JCassanos [illegible] 6/13/78
NE/PD LRosenberg [illegible] 6/13/78

SMALL RURAL WATER PROJECT - 0044

Project Description

The basic problem addressed by this project is the lack of reliable and potable water supplies for villages in rural areas in Yemen. Approximately 90 percent of the population is rural with the vast majority living in rural villages. The Ministry of Health estimates that only 8.4 percent of the population has easy access to water. Typical villages have populations under 1,000 with the majority of villages reliant on subsistence agriculture (rain-fed sorghum and millet) and the remainder dependent to some extent on cash crops, usually irrigated (grapes, tomatoes, and qat). The entire economy of Yemen is reliant upon labor migration with remittances forming a potential capital base to conduct development projects; however, the resultant shortage of labor within the country is a chronic problem.

Villages are often located on mountain tops for defensive reasons or to conserve agricultural land. Water sources are often distant from the village and a large time and energy expenditure is required for women and children to obtain water for the household. This situation results in minimal quantities of water being used domestically. The objective of this project is to provide improved water supplies to selected rural villages of the country, with emphasis on improved quantity, quality, access, and reliability of water supplies.

This project will involve a technical assistance team working with the Rural Water Division (RWD) to select, design and construct improved village water supplies. The technical assistance team will be involved in the full range of project activities, including (1) performing feasibility studies and final designs of subprojects; (2) establishing criteria for project selection and taking part in the selection procedure; (3) drafting agreements between RWD and local entities; (4) providing on-the-job training to counterpart staff; (5) supervising Peace Corps Volunteers in the field; (6) purchasing, keeping records and accounting for project commodities; (7) establishing (or coordinating with another donor established) water quality monitoring unit; (8) providing operation and maintenance training and support for completed subprojects; (9) conducting research and testing of appropriate technology for improved

village water systems; (10) coordinating with existing health teams working in the field to provide water related health and hygiene education; and (11) establishing RWD's capability to conduct studies and designs of village water systems for projects not to be constructed under the project.

Subproject designs will vary depending on local conditions. Some villages rely on cisterns for capturing surface runoff, others rely on hand-dug wells, while in other cases, the only alternative is a deep drilled well. A typical cistern project may involve the cleaning and plastering of an ancient cistern or excavation and construction of a new one. A hand-dug well project usually involves a well that has been deepened and subsequently tested to prove its yield. The project may involve installing a pump and engine, constructing a pump house, transmission line, storage tank and public taps. Drilling wells will not be included under the scope of the project; however, constructing distribution systems for existing wells as described for hand-dug wells will be considered.

It is estimated that 20 subprojects can be completed the first year and 30 per year in subsequent years for a total of 140 subprojects over the five-year life of the project. Approximately 84,000 rural villagers are expected to benefit from improved water systems. Outputs of this level will involve a technical assistance team of at minimum three members and a Peace Corps team of five to six members and a counterpart staff of RWD including engineers, surveyors, and draftsmen. Under the former USAID/RWD project (022), villages selected for subprojects have been primarily in the northern highlands in areas reasonably accessible to Sana'a. Yemen's rugged terrain and lack of adequate roads has much to do with subproject selection, there are many areas where it would not be feasible to do a project and have reasonable assurance that it could be adequately supervised. The RWD intends to open offices in Hodeidah and Taiz and it is anticipated that under this proposed project the RWD will be able to expand its service area and meet the water supply needs in additional areas of the country.

IMPACT IDENTIFICATION AND EVALUATION FORM

Impact Areas and Sub-areas 1/	Impact Identification and Evaluation 2/
A. LAND USE	
1. Changing the character of the land through:	
a. Increasing the population	L
b. Extracting natural resources	L
c. Land clearing	N
d. Changing soil character	N
2. Altering natural defenses	L
3. Foreclosing important uses	N
4. Jeopardizing man or his works	N
5. Other factors	
_____	_____
_____	_____
B. WATER QUALITY	
1. Physical state of water	N
2. Chemical and biological states	N
3. Ecological balance	N
4. Other factors	
_____	_____
_____	_____

1/ See Explanatory Notes for this form.

2/ Use the following symbols:
N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

August 1976

C. ATMOSPHERIC

1. Air additives ———————————— N
2. Air pollution ———————————— N
3. Noise pollution ———————————— N
4. Other factors

_____ _____

_____ _____

D. NATURAL RESOURCES

1. Diversion, altered use of water ———————— L
2. Irreversible, inefficient commitments ———— N
3. Other factors

_____ _____

_____ _____

E. CULTURAL

1. Altering physical symbols ———————— N
2. Dilution of cultural traditions ———————— N
3. Other factors

_____ _____

_____ _____

F. SOCIOECONOMIC

1. Changes in economic/employment patterns ———— L
2. Changes in population ———————————— N
3. Changes in cultural patterns ———————— N
4. Other factors

_____ _____

_____ _____

G. HEALTH

1. Changing a natural environment ———— N

2. Eliminating an ecosystem element ———— N

3. Other factors

a) change in water supply affecting health or population ———— L

b) construction of project will result in change in accident rates ———— L

H. GENERAL

1. International impacts ———— N

2. Controversial impacts ———— N

3. Larger program impacts ———— N

4. Other factors

I. OTHER POSSIBLE IMPACTS (not listed above)

Project Location: Yemen Arab Republic
Project Title: Small Rural Water Projects
IEE Prepared by : Herbert G. Blank, March 19, 1978
Mission Director Concurrence: Robert Huesman, May 14, 1978

See attached Discussion of Impacts.

DISCUSSION OF IMPACTS

Items for which some environmental impact has been identified on the IEE checklist are discussed below:

A. Land Use

1.a. Increasing the Population: Improved quality and increased quantity of village water supplies is expected to have a positive impact on health, in particular on a possible decrease of the infant mortality rate. Establishment of the cause and effect relationship and quantification thereof would be extremely difficult due to the presence of so many other factors. It is not expected that improved water supplies will have any significant effect on increasing the rate of population growth.

1.b. Extracting Natural Resources: The construction of small water projects (SWP) generally involves the construction of small structures such as water storage tanks, pump houses, and cisterns which are designed to make use of locally available materials including sand, stone, and gravel. These materials are widely available throughout the country and are commonly used in local construction of homes and other structures. The extraction of these resources in the relatively modest amounts required for this project will not have a significant effect on the environment.

The purpose of the project is to increase domestic water supplies to villages, in some cases this will involve the "extraction" of the water resource. The subprojects planned under this project will increase village water supplies through the following methods: capturing runoff in cisterns, developing springs, and constructing distribution systems for previously dug wells or drilled wells. Cisterns do not "extract" water, rather conserve it. Cisterns are discussed under items A.2 and D.1. In the case of springs, possible beneficial environmental impacts may occur in the reduction of open standing water and the reduction of phreatophytes in the areas of previously undeveloped springs. Generally, hand-dug wells extract water from shallow alluvial aquifers which readily recharge. Extracting water during the dry season with subsequent replenishment in the wet season has little environmental impact. Some subprojects involve installing a pump and village distribution system in a previously drilled well. For a drilled or hand-dug well a pump test is to be performed as part of the feasibility study of the project to determine the well's safe yield. If

the test indicates the well cannot meet the reasonable foreseeable village demands, the project should not be considered for funding by AID and recommendations should be made for alternative sources of water.

2. Altering Natural Defenses: For a typical cistern project, a series of runoff channels are constructed across a bare mountain side to direct water to the cistern. These channels, being across the mountain face tend to reduce the velocity of the runoff thus decreasing the sediment carrying capacity and hence reduce the erosion. This process, in that it controls erosion, has a beneficial environmental impact, although the effect is small.

D. Natural Resources

1.a. Diversion, Altered Use of Water: A cistern system is designed to divert flood flows from a mountain side into the cistern. Diverting the flood flow will decrease erosion slightly as discussed above and may make less water available for agriculture downstream. This effect, however, is minor and is consonant with traditional practice. A cistern has negligible effect in terms of diverting water from downstream uses.

1.b. Wells: A typical village water project based on ground water may involve village initiative in deepening a hand-dug well or drilling a deep well. In either case water is used for domestic use instead of other uses including possibly agriculture. Considering the water short nature of Yemen, this is a tradeoff which must be made to meet the basic human needs of the population. the YARG has stated this priority on domestic water in the Five-Year Plan.

F. Socioeconomic

1.a. Changes in Economic/Employment Patterns: One of the impacts of the project is to decrease the amount of time and energy expended by women and children in obtaining domestic water for their households. The evaluation of completed small water projects has not revealed significant effects on the village society or economy as a result of completed subprojects. The evaluation concluded that women found alternative uses for their free time in social activities or in increased productive (agricultural) activities.

1.b. Economic: Some villages rely on water trucked in or carried by other means for some dry periods during the year. Providing an improved water system may eliminate the employment of the truck driver or camel herder, but this is a minor impact since there is a plethora of alternative employment opportunities available in the Yemen economy. More importantly, villagers will no longer have to pay for water.

G. Health

1. Change in Water Supply Affecting Health: Improving the quantity and in some cases quality of village water systems is expected to have beneficial impact on the health of the population. To date this impact has been accepted axiomatically in projects worldwide and has not generally been quantified. Where studies have been made the cause and effect relationship has been tenuous at best. Yemen's health services and statistics are so rudimentary and trained personnel are so lacking that it is highly questionable if a study of the health impacts of an improved water supply would be feasible or worthwhile. USAID/Sana'a has requested information regarding research under way by Drs. Bradley and Feachem of the Ross Institute of Hygiene at the London School of Tropical Medicine in the field of measuring health benefits of water supply. Of particular interest is how the incidence of water related health problems such as skin disease and trachoma are influenced by the introduction of increased water supplies. A study designed by these researchers may be worth considering as part of mid-project evaluation.

2. Accident Rates: No cistern has been observed which is adequately fenced so as to prevent small children from entering, but Yemeni children are generally closely supervised and no accidents involving people falling into cisterns have been reported. It would be advisable for designers to consider fencing (or at least a low wall around) cisterns to prevent accidents and prevent entry of animals and possible introduction of pollutants.

3. Potability: A final environmental issue which should be discussed in this examination is the question of potability and monitoring for bacteriological water quality. One component of the planned project is the establishment of a unit to monitor water quality, making use of existing laboratory facilities within Yemen. Potability will be discussed as it affects the types of subproject considered.

3.a. Cisterns: The evaluation of small water projects has concluded that villages do not consider water from cisterns as potable. The water from the cistern is used for other domestic uses (laundry, cooking, bathing, etc.) while drinking water is obtained from another source, usually a spring. If the SWP attacks the problem of upgrading cistern water quality to make it potable, the quality of the water should be monitored closely and an education program instituted in the proper operation and maintenance with the village naming an individual to be responsible for the cistern.

3.b. Springs: Springs, if properly developed and sealed can be excellent sources of potable water without further treatment. Regular water quality monitoring should take place, however.

3.c. Hand-Dug Wells: Hand-dug wells in Yemen generally are 4 to 6 feet in diameter, masonry lined with built up sides which prevent pollution by surface runoff. The wells are usually not covered so they are subject to contamination from pollutants entering from above (i.e. people throwing in debris). The proposed project should consider alternative designs for well covers. Since these wells usually draw water from alluvial aquifers, they may also be subject to contamination from infiltrated pollutants. In hand-dug wells examined during the evaluation of completed SWP, the static water level ranged from 20 to 60 feet. With wells this deep the possibility of contamination from infiltration is probably negligible. The evaluation did not reveal that villagers had had health problems which the villagers related to the well. Hand-dug wells should be monitored for quality frequently and villagers should be educated regarding the possibilities of contamination.

3.d. Deep Wells: This term refers to drilled wells which are generally sealed. Sealing prevents contamination from surface runoff and the wells generally reach deep aquifers which are relatively free of biological pollutants. Less frequent monitoring is required than with other sources.

The well-monitoring program is viewed as an essential component of the project, whether it is an AID-financed activity or is implemented as planned by the WHO. The project will be providing not only increased quantities of domestic water but also water which will be considered by the villagers to be potable. A monitoring program should be instituted to be followed by a disinfectant program (i.e. chlorination) if required and if practicable or alternatively villagers should be advised not to drink the water but to limit its use to other domestic purposes.

CONCLUSIONS: This examination has attempted to focus on the reasonable foreseeable effects on the human environment of the proposed project. To summarize, no major impacts have been identified in the areas of land use, water quality, atmosphere, natural resources, cultural or socioeconomic effects. A possibly more signigicant impact was identified in the health field concerning potability of water supplies,

particularly in the case of hand-dug wells. The project, however, is being designed to minimize possible adverse health impacts through the design and selection of subprojects and the establishment of a water-quality monitoring program. This examination has not found that the proposed project will have an adverse effect on the human environment and hence a negative determination is recommended.

Appendix X

"Site Report: Kohal Project"

APPENDIX X

KOHAL PROJECT

Presented To: Mr. Abdul Bari Saleh
Director of Rural Water Division

Note: This Report includes four individual small projects

By: Jack P. Henry
RWD Contractor

Village: Kohal

Location: This village is located just 10Kms North-east of Amran.

Population: Project to include four villages
Total Population: 2,200

Elevation:

Present Situation: The village of Kohal has a drilled well located in the Wadi just one kilometer North-north-west of the village. The well is equiped with a caprari pump type P6C/3/24/20. The pump has a capacity of 100 gallons per-minute and can pump to a head of 140 meters. The well itself has a total depth of 140 meters. The static water level is 80 meters. The assumed draw down is said to be 20 meters.

Project Proposal: This project is to be a 5 phase project. There are to be four villages to be served by the project. The villages are Kohal, Al-Hoosan, Bait Al-Agarri, Bait Aboo Saleh.

Population of the villages:

Kohal	1,000 Phase I & II
Al-Hoosan	400 II
Bait Al-Agarri	400 III
Bait Aboo Saleh	400 IV Not included

Phase I of the project is to pipe water from the well to a point 706 meters South-south-east of the well. At this point the pipe will branch off to Kohal, Al-Hoosan and Bait Al-Agarri. Bait Aboo Saleh will be on a line of its own.

Phase I technical data:

Yield (Q1) GPM 100 GPM

A. Draw down (M) A=20

B. Depth of ground water (or surface water) static water level measured from ground elevation at source m. 80

C. Maximum static head between ground elevation at source and at dry well. 12.21 Meters

Total static head = A+B+C = 112.21

Total Kenetic losses.

D. Friction losses on 3 pipe with a flow rate of 100 gallons per-minute. Pipe line is 706 meters long 21.89 Meters.

E. One gate valve .026

Total Kenetic Head = D+E = 21.92

Total head required to intersection 706 is 112.21+21.92 = 134.13m.

The pump is said to be able to pump 140 meters of head and therefore system is O.K.

Material Requirement for Phase I of project and cost.

Pipe & Fittings:

		Cost YR)
1)	118 PCS of 3 GJ Pipe	15,930
2)	One gate valve	40
3)	15 Unions	1,200
4)	10 cans pipe sealent	100
	Total cost of pipe & fittings:	17,270YR

Masonary Materials Cost for Dry Well:

48M3 stone x 150YR/M3	=	7,200
38M3 Sand x 100YR/M3	=	3,800
3M3 Gravel x 100YR/M3	=	300
28 PCS. of 10 mm steel rod 199 reach	=	532
Cement 273 bags x 27YR each	=	7,371
Total Material cost for dry well :		19,203YR

Labor cost for project phase I.

Pipe Line:

It will take 10 days to put down 706 meters of pipe with one pipe fitter and 20 labourers.

Pipe Fitter 250YR/day
Labourers 50YR/day
1,250YR x 10 days = 12,500YR

Construction of dry well

Excavation : 481 M3

I would take one labourer 320 days to excavate 481 M3 of soil.

320 x 50YR/day = 16,000YR

It would take one team (One mason and 4 helpers 45 days to construct dry well.

One mason gets 250YR/6 hrs.day
One helper gets 100YR/6 hrs.day
Total: 650YR x 45 days = 29,250YR

Total cost of Phase I:

1)	Pipe & Fittings	17,270YR
2)	Masonary Materials	19,203YR
3)	Pipe-line Labour	12,500YR
4)	Construction & Excavation	45,250YR
	Total:	94,223YR

I am requesting USAID donate pipe and fitting and cement for Phase I.

Pipe 118 PCS 3"	=	15,930YR
Unions (15)	=	1,200YR
Gate Valve	=	40YR
273 bags of cement	=	7,371YR
Total Cost:	=	24,541YR

This is to be divided among three villages.

PHASE II

Pipe-line from intersection 7+06 to village of Al-Hoosan.

Population: 400

Agle: Yahiya Mohamid Yahiya

This village requires the most highest head for pumping and fo. that reason it is placed in this section of the report.

Phase II discription

A pipe will go from dry well at PT 7+06 to village of Al-Hoosan at PT 15+97 a total distance of 891 meters. The total elevati: between the two points is 65.08 meters. There will be a 25 M3 water storage tank built in the village.

Technical data for pump:

Yield (0,) GPM 100 GPM

A) There should be no draw down because system should be in parallel with well system but will plan 2 meters.

B) Maximum static head between ground elevation at dry well and at water storage tank 65.08 Meters.

C) Maximum depth of water in tank 1.90 Meters.

Total Kenetic losses

D) Friction losses on 3 pipe with a flow rate of 100 gallons per-minute. Pipe line is 891 meters long 27.621 Meters.

E) (10) 90° elbows .28 meters

F) One Automatic gate valve .26 meters

G) Two gate valves .056 meters

Total Kenetic losses D+E+F+G = 28.22 Meters

Pump will be required to deliver 100 gallons per-minute to a total head of 97.20 meters.

Phase II Material Requirements:

Pipe-line 891 meters of 3" pipe, 149 Pcs	20,115YR
13 Unions	1,440YR
(10) 90° elbows	700YR
Two gate valves	80YR
One automatic gate valve	200YR
15 cans pipe sealent	150YR
Total cost of pipe-line materials:	22,685YR

Material requirements for 25 M3 water storage tank:

Rock 16 cubic meters x 150YR/M3	2,400YR
Sand 29 cubic meters x 100YR/M3	2,900YR
Gravel 5 cubic meters x 100YR/M3	500YR
Cement 240 bags, 27YR/bag	6,480YR
Re bar 10mm x 12 meter length (20)	380YR
Wood floor slab forms 26cm x 2cm x 4 meters(6)	288YR
Floor slab knee braces (wood), 5cm x 5cm x 6 meters (2)	70YR
Roof Joints (wood) 4.5cm x 11cm x 6 meters(6)	420YR
Corrugated Zink for Roof:	
2 meters x .90 meters (7)	140YR
2.40 meters x .90 meters (14)	420YR
Nails 2 ½ inch 6 pounds	16YR
Hinges (trap door) (6)	18YR
Hasps (trap door) (3)	9YR
Re-bar tie wire, 5 coils	50YR
(2) 3" Pipe Tee's	140YR
(2) 6 meter lengths of 3" pipe	270YR
(15) water fausets 3/4" at 30YR each	450YR
Total material cost of 25 cubic meter water storage tank is :	14,951YR

Labor cost of project

Pipe-line

It will take 13 days to put down 891 meters of pipe with one pipe-fitter and 20 labourers.

Pipe-fitter 250YR/day
Labourers 50YR/day
1,250YR x 13 days = 16,250YR

25 M3 Water Storage Tank

It will take one teamx (One mason and four helpers 25 days to construct the Tank.

One mason gets 250YR/6 hrs. day
One helper gets 100YR/6 hrs. day
Total: 650YR/day x 25 days = 16,250YR

Total Cost of Phase II

1)	Pipe & Fittings	22,685YR
2)	Materials for 25 Cubic Meter Tank	14,951YR
3)	Pipe-line labor cost	16,250YR
4)	Construction of 25 Cubic Meter Tank	16,250YR
	Total cost of Phase II is:	70,136YR

I am requesting USAID to donate pipe and fittings and cement for Phase II of this project.

Pipe 149 Pcs. 3"	20,115YR
Unions 18	700YR
Gate Valves (2)	80YR
Cement 240 bags	6,480YR
Total:	27,375YR

I am requesting RWD to donate a pump with a capacity of 100 gallons per-minute and a head of 100 meters. The pump will serve 3 villages a total population of 1,800 people. The project will also require automatic gate valve and 15 water fausets 3/4 .

PHASE III

Pipe-line from intersection 7+06 to village of Kohal.

Population: 1,000

Agle: Ali Gassum

Phase III description

A pipe will go from dry well at PT 7+06 to village of Kohal at PT 12+27, a total distance of 521 meters. The total elevatio between the two points is 62.75 meters. There will be a 50 Cubic Meter Water Storage Tank built in the village.

Technical data for pumping

Yield (O,) GPM 100 GPM

A) There should be no draw down because system should be in parallel with well system but will plan for 2 meters.

B) Maximum static head between ground elevation at dry well and at water storage tank 62.75 meters.

C) Maximum depth of water in tank 2.85

Total Static Head A+B+C = 67.60 M.

Total Kenetic losses

D) - Friction losses on 3' pipe with a flow rate of 100 gallons per-minute. Pipe-line is 521 meters long 16.15

E) (10) 90° elbows 28 meters

F) 1 Automatic gate valve 26 meters

G) 2 Gate Valves .056 meters

Total Kenetic losses

D+E+F+G = 16.746M.

Pump will be required to deliver 100 gallons per-minute to a total head of 84.35 meters. If pump is installed to provide Al-Hoosan with water there will be no problem getting water to Kohal.

Material Requirements for Phase III of Project and Costs

Pipe-line		Cost YR
1)	87 PCS. of 3 GI Pipe	11,930YR
2)	(2) Gate Valves	80YR
3)	(10) Unions	300YR
4)	(10) 90° elbows	700YR
5)	One Automatic gate valve	200YR
6)	Pipe sealent 10 cans	100YR
	Total cost of Pipe-line materials:	13,310YR

Material Requirements for 50 M3 Water Storage Tank

1)	Rock: 25 Cubic Meters x 150YR/M3	3,900YR
2)	Sand: 30 Cubic Meters x 100YR/M3	3,000YR
3)	Gravel: 45 Cubic Meters x 100YR/M3	4,500YR
4)	Cement: 316 bags x 27YR/bag	8,532YR
5)	Reinforcing Rod: 50 bars, 12 meters in length 10 mm DIA	950YR
6)	Wood for roof: 4.5cm x 11cm x 6m (14 units) x 70YR	980YR
7)	Form Boards for concrete slab 3cm x 26cm x 4m (7 units) x 48YR	336YR
8)	Knee braces for forms: 5cm x 5cm x 6m (2 units) x 70YR	140YR
9)	(2) 3" T's x 70YR	140YR
10)	Zink for roof 48 sheet, 90 x 2m, 20YR each	960YR
11)	(18) 3/4 Water Fausets x 30YR each	540YR
12)	(3) 6 meter lengths of 3' inch pipe	405YR
13)	(10) coils of wire	100YR
	Total material cost for tank:	24,483YR

Labor Cost of Project

Pipe-line

It will take 8 days to put down 521 meters of pipe with one pipe-fitter and 20 labourers.

Pipe-fitter 250YR/day
Labourer 50YR/day
1,250YR x 8 days = 10,000

50 M3 Water Storage Tank

It would take one team (One mason and 4 helpers) 35 days to completed Tank.

One mason gets 250YR/6 hours/day
One helper gets 100YR/6 hours/day
650YR x 35 days = 22,750YR

Total cost of Phase III:

1)	Pipe & Fittings	13,810YR
2)	Materials for 50 M3 Tank	24,483YR
3)	Pipe-line, Labor cost	10,000YR
4)	Construction of 50 M3 Tank	22,750YR
	Total Project Cost:	71,043YR

I am requesting USAID to donate pipe and fittings and cement for Phase III of this Project.

1)	37 Pcs. of 3" GI Pipe	11,930YR
2)	2 gate valves	80YR
3)	10 Unions	800YR
4)	(10) 90° elbows	700YR
5)	316 bags of cement	8,532YR
	Total:	22,042YR

I am requesting RWD to donate (18) 3/4" Water Fausets and one Automatic Gate Valve to Phase III of the Project.

PHASE IV

Pipe-line from intersection 7+06 to village of Bait Al-Agarri

Population: 400

Agle: Muzufur Barhari

Phase IV Description

A pipe will go from dry well at PT 7+06 to village of Bait Al-Agarri at PT 14+36, a total distance of 730 meters. The total elevation between the two points is 23.11 meters. There will be a 25 M3 Water Storage Tank built in the village.

Technical data for pumping

Yield (0,) GPM = 100 GPM

A) There should be no drawdown because system should be in parallel with well system but plan for 2 meters.

B) Maximum static head between ground elevation at dry well and at Water Storage Tank 23.11 meters.

C) Maximum depth of water in tank 1.90 meters.

Total Static Head A+B+C = 27.01 meters

Total Kenetic losses

D) - Friction losses on 3" pipe with a flow rate of 100 gallons per-minute. Pipe-line is 730 meters long. 22.62 M.

E)	(10) 90° elbows	.28 Meters
F)	(1) Automatic Gate Valve	.26 Meters
G)	(2) Gate Valves	.056 Meters

Total Kenetic losses
D+E+F+G = 23.22 Meters

Pump will be required to deliver 100 gallons per-minute to a total head 50.23 meters. If pump is installed to provide Al-Hoosan with water there will be no problem getting water to Bait Al-Agarri.

Material Requirements for Phase IV of Project and Cost

Pipe-line		Cost YR
1)	122 Pcs. of 3" GI Pipe	16,470YR
2)	(2) Gate Valves	80YR
3)	(10) 90° elbows	700YR
4)	(15) Unions	1,200YR
5)	(1) Automatic Gate Valve	200YR
6)	Pipe Sealent, 15 cans	150YR
	Total cost of Pipe-line Materials:	18,300YR

Materials required for 25 Cubic Meter Storage Tank:

1)	Rock: 16 Cubic Meter x 150YR/M3	2,400YR
2)	Sand: 29 Cubic Meters x 100YR/M3	2,900YR
3)	Gravel: 5 Cubic Meters x 100YR/M3	500YR
4)	Cement 240 bags, 27YR/bag	6,480YR
5)	Re bar 10mm x 12 meter length (120)	380YR
6)	Wood floor slab forms 26cm x 2cm x 4 meters (6)	288YR
7)	Floor Slab Knee Braces (Wood) 5cm x 5cm x 6 meters (2)	70YR
8)	Wood roof joints 4.5cm x 11cm x 6m (6)	420YR
9)	Corrugated Zink for roof: 2 meters x .90 meters (7)	140YR
	2.40 meters x .90 meters (14)	420YR
10)	Nails 2½ inch, 6 pounds	16YR
11)	Hinges (Trap door) (6)	18YR

12)	Hasps (Trap door) (6)	9YR
13)	Re bar wire, 5 coils	50YR
14)	(2) 3" Pipe Tee's	140YR
15)	(2) 6 meter lengths of 3" Pipe	270YR
16)	(15) water fausets 3/4"	450YR
	Total Material cost of 25 M3 Water Storage Tank is:	14,951YR

Labor Cost of Project

Pipe-line

It will take 11 days to put down 730 meters of pipe with one Pipe-fitter and 20 Labourers.

Pipe-fitter 250YR/day
Labourers 50YR/day
1,250YR x 11 days = 13,750YR

25 M3 Water Storage Tank

It will take one team (One mason and 4 helpers 25 days to construct the tank.

One mason gets 250YR/6 hr. day
One helper gets 100YR/6 hr. day
Total: 650YR/day x 25 days = 16,250YR

Total Cost of Phase IV

1)	Pipe & Fittings	18,300YR
2)	Materials for 25 M3 Water Storage Tank	14,951YR
3)	Pipe-line labor cost	13,750YR
4)	Construction of 25 M3 Tank	16,250YR
	Total Construction Cost Phase IV:	63,751YR

I am requesting USAID to donate pipe and fittings and cement for Phase IV of this Project.

1)	122 Pcs. Pipe of 3" GI Pipe	16,470YR
2)	(15) Unions	1,200YR
3)	(2) Gate Valves	80YR
4)	(10) 90° elbows	700YR
5)	240 bags of Cement	6,480YR
	Total:	24,930YR

I am requesting RWD to donate:

1) (1) Automatic Gate Valve - 3
2) (15) Water Faucets - 3/4

PHASE V

Pipe-line from intersection 0+00 at well to the village of Bait Aboo Saleh.

Population: 400

Agle: Saleh Mohamed Al-Goofaily

Phase V Description:

A pipe will go from Well PT 0+00 to the village of Bait Aboo Sal a total distance of 2,250 meters. The pipe rises only 3.57 meters at PT 2+50 and goes to a point which is 13.06 meters bel the Well head. Pumping water at 100 gallons per-minute will be no problem.

Material Requirements for Phase V

Pipe-line

1)	2,250 meters of 3" Pipe, 375 Pcs.	50,625YR
2)	(45) Unions.	3,600YR
3)	(2) Gate Valves.	30YR
4)	(2) 90° elbows	140YR
5)	35 cans of Pipe Sealant	350YR
	Total:	54,305YR

Materials for 25 M3 Water Storage Tank are the same as in Phase IV: 14,951YR

Labor Cost

Pipe-line

It will take 32 days to put down 2,250 meters of pipe with one Pipe-fitter and 20 Labourers.

Pipe-fitter 250YR/day
Labourers 50YR/day
1,250YR/day x 32 days = 40,000YR

Water Storage Tank 25 M3

	Labor Cost same as Phase IV =	16,250YR

Total Cost of Phase V:

1)	Pipe and Fittings	54,305YR
2)	Materials for 25 M3 Water Storage Tank	14,951YR
3)	Pipe-line labor cost	40,000YR
4)	Construction of 25 M3 Storage Tank	16,250YR
	Total:	125,506YR

Note: I feel that Phase V is good project, but I feel that we should wait on this until C44 where we will have more money to spend per project.

APPENDIX XI. ASSUMPTIONS, CALCULATIONS AND DEFINITIONS FOR COST AND BENEFICIARY STUDIES

HRS/DAY NEEDED TO DRAW WATER = DRAWING RATE + COLLECTING TIME + ANIMAL COLLECTING TIME

$$= \left[\frac{\text{Population in year n in people} \times \text{daily per capita consumption in litres}}{\text{average drawing rate well in l/hr (mix of hand and pump drawn)}} \right] + \left[\frac{\text{total distance travelled to well in km}}{\text{speed of travel in km/hr}} + \frac{\text{per capita consumption in year n}}{\text{per capita consumption in base year}} \right]$$

$$+ \left[\frac{\text{animal daily consumption}}{\text{average drawing rate/well in l/hr (hand drawn)}} + \text{\% of animal water drawn by hand} \right]$$

$$= \left[\frac{Pn \times Cpcn}{Wdr} \right] + \left[\frac{Tkm}{Hkm} + \frac{Cpcn}{Cpcb} \right] + \left[\frac{Ca}{Wa} \times E \right], \text{ where}$$

Page 1 of Appendix XI

Pn = population in year n

Cpcn = per capita consumption in year n in litres

Wdr = well drawing rate in litres/hour

Tkm = distance traveled to wells by total population in kilometers

Hkm = kilometers traveled per hour by one person

Cpcb = per capita consumption in base year

Ca = animal consumption

Wa = well drawing rate in litres/hour to satisfy animal consumption

E = % of animal water hand drawn

Notes

Wdr = assumes 50% of water hand drawn at a 300 l/hr rate and 50% pumped at a 600 l/hr rate for present system (450 l/hr) and 100% pumped for future (600 l/hr rate)

Tkm = assumed to be 0.5 km/person at present and 0.25 km/person in future

Hkm = assumed to be 3 km/hr

Wa = assumes all water hand drawn at present at a rate of 300 l/hr and all water pumped at a rate of 600 l/hr in future

E = 40%, with remaining 60% provided by watering holes to herds.

DRAWING	COLLECTING
Pn = population in year n Cpcn = per capita water consumption in year n in l.c.c. Wdr = well hourly drawing rate in litres/hour to satisfy (Pnx Cpcn). Assumes 50% of water hand drawn and 50% of water pump drawn.	Tkm = Total distance traveled to well by all people in village Hkm = number of kilometers traveled per person per hour Cpcn = per capita consumption in year n Cpcb = per capita consumption in base year
(number of well operating hours needed to meet consumption needs of population in hours)	(hours needed to travel to well to collect water: $\frac{Cpcn}{Cpcb}$ shows correction factor for consumption increases over time)

ANIMAL COLLECTING TIME

Ca = animal consumption

Wa = drawing time per well in l/hr necessary to provide water for animals. Assumes all animal water hand drawn.

E = % of animal water hand drawn, i.e.

total animal consumption:

100% = 60% + 40% (hand drawn and given to animals)

provided by taking animals to watering holes

J O B D E S C R I P T I O N

Team Leader

Scope of Work -- The Team Leader will supervise all aspects--social, technical, and managerial--of the project, as well as serve as a general advisor to the Department of Rural Water on all aspects of management and organization. He will review feasibility studies and assist in the selection of subprojects. He will supervise the preparation of technical designs, supervise and monitor construction activities, and supervise all TransCentury staff. He will schedule personnel and project construction activities. He will supervise the procurement of all project-related commodities, and see that financial records are maintained in proper order. He will advise the Rural Water Department on all aspects of management and training, including the institutionalization of project 044 technical assistance. He will design and assist with training programs. He will be available to support Peace Corps Volunteers in all aspects of their work.

The Design Engineer

Scope of Work -- He will be responsible for reviewing all technical and engineering aspects of all projects to be built under the auspices of 044. He will report directly to the Team Leader. He will be responsible for supervising the preparation of feasibility reports, and all technical designs of proposed subprojects including storage tanks, collection chambers, and transmission and distribution systems. He will be responsible for technical village surveys, and the preparation of material lists and quantity take-offs. He will supervise the construction of individual subprojects from a technical aspect, and he will be available as a technical resource to assist the Volunteer Construction Supervisors as necessary. He will review systems completed under 044 for operations and maintenance considerations. He will advise on the procurement of appropriate imported commodities. He will participate in research and testing of appropriate intermediate technological solutions to technical problems. He shall undertake other activities as directed by the Team Leader.

The Wells Master

Scope of Work -- He will work primarily with the Wells Unit within the Rural Water Department. The Wells Master will report to the Team Leader and the Design Engineer. He will be available as a general assistant to the Team Leader and the Director of RWD to work on all aspects of the Department's and the project's activities, from planning and design, to project construction, to operations, maintenance, and general administration. He will be responsible for assisting with the preparation of feasibility studies and technical designs of proposed subprojects. He will assist with the negotiations of proposed subproject agreements. He will advise and assist with procurement. He will participate as appropriate in training, research and development activities. He will make visits to completed systems to verify operations and maintenance procedures. He will be involved with monitoring water quality, both before and after construction of individual subprojects. He will be available to assist Volunteers with all aspects of project construction activities. He will be available to perform other duties as directed by the Team Leader.

Construction Supervisor

Scope of Work -- He will work primarily with the construction division within RWD, and he will report directly to the Team Leader. The Construction Supervisor shall function as a liaison and coordination person between and among RWD, USAID, the Peace Corps Volunteers and staff, and the villagers of Yemen. He shall assist with the preparation of feasibility studies, with the selection of subprojects, with the negotiation of subproject agreements and with the gathering of data for technical designs. He shall assist with the procurement of appropriate commodities. His primary responsibility shall be to provide logistical field support to Volunteers in the form of completed designs, tools, commodities, and other materials necessary for the construction of individual subprojects. He shall make periodic site visits to project under construction to review the projects for technical suitability, and to support the PCV construction supervisors. He shall assist the Team Leader with the scheduling of project construction activities. He shall, from time to time, review completed projects to evaluate them from the standpoint of operations and maintenance and continued utility to villagers, to assist in the refinement of project selection and design criteria. He shall be available to participate in training activities as necessary. He shall undertake other activities as directed by the Team Leader.

Diesel Mechanic

Scope of Work -- This person will assist with the maintenance of pumps, vehicles and installed village water systems. He will serve in a line capacity with 044 to maintain all project vehicles and equipment and also in a training and advisory capacity to work with the RWD mechanics and village technicians. He will participate as appropriate and directed in the UNDP/WHO Training Program for Yemeni Class III Diesel Mechanics. It is expected that he will be assisted by one or more Peace Corps' Volunteers. This man will be recruited at the discretion of the Team Leader. It is expected that he will come from somewhere in the Middle East. He shall undertake other activities as directed by the Team Leader.

Local Hire Professional Staff

Administrative Officer

This staff member will report directly to the Team Leader, and through him be responsible for all aspects of routine office management, from typing to filing, to the preparation of normal and routine office reports. He/she will be experienced with office procedures, and much of his/her work will focus upon the preparation of written documents necessary for AID, Peace Corps, and TransCentury/Washington. In addition, it is hoped that this person will have the opportunity to work in the field from time to time to participate with the formulation of future program activities. He/she will assist with procurement of commodities as necessary, and will be available to assist with training. A former Peace Corps Volunteer from Yemen is envisioned for this position. He/she will undertake other additional duties as directed by the Team Leader.

Procurement Officer

This person will report directly to the Team Leader, and be responsible for all local procurement in Yemen, and all field procurement from nearby countries. He will be responsible for tracking down sources of appropriate commodities--whether internationally or in Yemen--for letting out bids and for arranging for shipment of commodities into Yemen under 'least-cost' conditions. To the fullest extent possible, he will be expected to institutionalize the importation of water-related construction commodities into the private sector of Yemen. He will work with counterpart staff within the Rural Water Department and the Ministry of Public Works for normal coordination and liaison functions, and to advise and assist with the formulation of improved procurement procedures. Should a Servicio be established, he would assist with the formulation of relevant procedures for the Servicio. Upon its establishment under the laws of the Government of Yemen, he could be transferred to work full time with the Servicio. He will undertake additional duties as directed by the Team Leader.

Bookkeeper/Accountant

He/she shall report directly to the Team Leader, and shall be responsible for aspects of bookkeeping, cash recording, banking, and preparation of the trial balance and financial statements of the Project. He/she will be responsible for necessary banking, disbursements, and monthly bank reconciliations. He/she will prepare the payroll for all Project Staff. He/she will be in charge of the petty cash. He/she will assist in the clearance of bills of lading, commodities procurement and payments for these and related shipping costs. Every month, he/she will prepare a trial balance and draft financial statement for transmittal to TransCentury/Washington. He/she will conduct inventories, and will liaise with the external auditors during their periodic audits. The bookkeeper will prepare Project financial reports required by the local AID Mission, or by the YARG. He/she will analyze accounts and send other financial data as requested ty TransCentury/Washington.