WATER AND SANITATION PROJECT

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PRELIMINARY DESIGN FOR HANDPUMP INSTALLATION PROJECT IN EL SALVADOR

WASH FIELD REPORT NO. 187

JULY 1986

Prepared for
the USAID Mission to El Salvador
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by

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and
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July 1986

Water and Sanitation for Health Project
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Table of Contents

APPENDICES

TABLES

FIGURES

ACRONYMS

ANDA	Administratión Nacional de Acueductos y Alcantarillados (National Administration for Water Supply and Sewers)
DIAAPS	Decenio Internacional de Abastecimiento de Agua y Saneamiento (International Drinking Water Supply and Sanitation Decade)
DIDECO	Dirección de Desarrollo Comunal (Ministerio del Interior)
FOSEP	Fondo Salvadoreño para Estudios de Preinversión (Salvadoran Fund for Investment Studies)
HOPE	Project of People-to-People Health Foundation, Inc.
BID (IDB)	Banco Interamericano de Desarrollo (Inter-American Development Bank)
MSPYAS	Ministerio de Salud Pública y Asistencia Social (Ministry of Public Health and Social Aid)
ORE	Oficina de Recursos Especiales (Office of Special Resources)
PAHO (OPS)	Pan American Health Organization (Organización Panamericana de la Salud)
PLANSABAR	Plan Nacional de Saneamiento Básico Rural (National Basic Rural Health Plan)
PMA	Programa Mundial de Alimentos (World Food Program)
PNUD (UNDP)	Programa de las Naciones Unidas para el Desarrollo (United Nations Development Program)
PVO	Private Voluntary Organization
UDI	Unidad de Desarrollo de la Infraestructura (Unit for Infrastructure Development)
WASH	Water and Sanitation for Health Project
WHO (OMS)	World Health Organization (Organización Mundial de la Salud)

ACKNOWLEDGEMENTS

WASH would like to thank Mr. Charles Brady and Mr. Leopoldo Reyes from the USAID Mission in El Salvador for their guidance and support during this assignment.

PLANSABAR and ANDA are engaged in the development of water supply to rural and fringe areas of the country. Mr. Roberto Arturo Arguello from PLANSABAR was particularly helpful to the team work.

In addition, WASH is grateful for the assistance given by representatives of the private civil engineering sector in San Salvador, particularly to Mr. Orlando Flores, General Manager of Pozos y Riego S.A. de C.V.

EXECUTIVE SUMMARY

USAID/El Salvador has been assisting ANDA and PLANSABAR in developing water supply projects in some urban-fringe areas and in rural communities using gravity water supplies and community well/pump systems. USAID is now focusing on the additional development of groundwater supplies using handpumps. In December 1985 the USAID Mission in El Salvador requested WASH assistance to develop a rural water supply program using handpumps.

The Office of Health, Bureau for Science and Technology of the U.S. Agency for International Development in Washington, D.C., and the WASH Project proposed a three-person technical assistance team for a two week period authorized under WASH Activity No. 227. However, one team member, the handpump specialist, could not participate in the assignment. Upon arrival in San Salvador the team discussed the scope of work with the USAID Mission and modified it to incorporate a second component requested by the mission: to identify technical assistance for ANDA and PLANSABAR that would expedite the preparation and implementation of projects already being funded by USAID assistance.

Following the program for suggested contacts arranged by the USAID Mission, the team had working sessions with several national institutions, private consulting engineering firms, construction and well drilling companies and a private voluntary organization. During these sessions, data was gathered related to the scope of work. The team also reviewed several documents provided by the national agencies and reviewed additional references. Finally a draft report was produced, discussed with the mission, and typed.

Based on the analysis of the existing situation at ANDA, PLANSABAR and other national institutions and the private sector, WASH evaluated the capacity of each one to carry on a new nationwide program for handpump installation using the existing private drilling companies.

At the same time, to comply with the mission request, WASH evaluated the existing workload and institutional capacity of PLANSABAR and ANDA to assess what assistance would be needed to speed up the preparation and implementation of projects that are currently using USAID funding.

ANDA is the national organization responsible for urban areas. Due to organizational constraints and insufficient internal capacity, ANDA created a special project unit (UDI) to develop projects in a short time. The unit is managed by a local consultant. This arrangement is working smoothly but is still experiencing some delays in the disbursement of funds.

PLANSABAR is the national organization responsible for rural areas of the country. A great deal of PLANSABAR's activities are devoted to meeting the requirements for the implementation of IDB funded projects. They are now completing the second phase of the IDB project and preparing for the third which covers 100 new projects to be implemented over four years at a cost of US $2.1 million.

PLANSABAR's existing capacity to implement new projects is, without any doubt, overtaxed. The agency is finding it difficult to plan or implement any other kind of project, old or new, with its existing institutional resources.

The availability and experience of local consultants, construction contractors, and drillers is remarkable in El Salvador. This fact could be used to strengthen the government organizational efforts if a sufficient market is opened to them.

Based on its evaluation results the WASH team presents a two-fold program to comply with mission expectations.

The first project proposes the installation of 1,250 handpumps in selected rural and periurban areas over a program schedule of three years. It is estimated that 750 handpumps could be imported from selected supply sources and the remaining 500 could be manufactured in country for use in the third year of the program. The total fixed cost for 1,250 wells of medium depth finished with handpumps is estimated at US $7,625,000. An allocation of US $200,000 is also suggested to import five drilling rigs to strengthen the drilling capacity of local contractors. A third subcomponent of this project is the training of community handpump caretakers, 15 regional trainers and the implementation of 15 regional maintenance workshops equipped with vehicles, tools, spare parts, and health education materials. Total cost of the project is estimated at US $9,996,600 which includes 20 percent for contingencies.

The second project proposes an immediate program of technical assistance for PLANSABAR to:

a. complete designs for nine or ten ongoing projects;
b. identify and prioritize new rural communities to be served with water supply systems; and
c. to design, with private consultants, 160 new projects over a period of two years.

The total cost of this program is estimated at $612,000, including 20 percent for contingencies.

A final report was produced which contains nine chapters, including summary chapters for Conclusions and Recommendations. This last chapter has five principle recommendations which are:

a. Construct 1,250 wells with depths from 15 to 30 m, operated with handpumps; train caretakers and supervisors; and install regional O&M warehouses.

b. Select, if possible, a PVO to manage the program.

c. Construct wells and install pumps through private companies.

d. Implement a follow-up study to determine the most appropriate drill rigs and handpumps for the country and to conduct feasibility studies on local manufacturing of the pumps.

e. Provide technical assistance to local institutions in preparation of designs and construction of water supply systems using the private sector capacity existing in El Salvador.

Chapter 1

BACKGROUND

In December 1985, the USAID Mission in San Salvador requested WASH assistance to develop a rural water supply program for El Salvador. Because of the scarcity of surface water supplies and USAID's concern about constructing regional supply and distribution facilities that might be subject to sabotage, USAID is focusing on the development of groundwater supplies using handpumps.

AID's Office of Health, Bureau for Science and Technology (S&T/H) and WASH suggested in its proposed scope of work that the mission also would consider other local types of water supply technologies (i.e., groundwater pumping or rainwater catchment) subject to an analysis of the ease of implementation of these systems. S&T/H and WASH proposed to the mission that technical assistance be provided through a three-person team for a period of two weeks.

1.1 Scope of Work and Work Plan

The proposed scope of work and work plan for the WASH consultants was as follows:

1. Assist the mission in determining the feasibility and scope of a water supply program for rural and some urban areas of El Salvador.

2. Provide criteria and program goals for source development (drilling shallow and medium depth wells) and source improvement (enhancing and disinfecting existing wells).

3. Assess alternative water supply technologies including handpumps, well pumping, and rainwater catchment.

4. Determine community and institutional capabilities to accept, implement, and maintain water supply facilities.

5. Develop a preliminary project design that incorporates the following items:

    - institutional arrangements
    - provides O&M management, community participation, and health education components in the plan
    - provides water quality testing of new sources and ongoing monitoring for completed systems
    - provides training (based on the assessment of community and institutional capabilities) to include, but not be limited to, pump installations, disinfection practices, O&M, and water testing.

6. Assist mission in determining need for and type of drilling equipment required to support project implementation.

7. Assist mission in identifying consultants and private voluntary organizations (PVOs) who can work in the implementation and management of the project.

8. Prepare a draft report in English to be left with the mission before leaving El Salvador. The mission wishes to place maximum emphasis on needs assessments and developing a project plan. The report should be written to provide basic support for conclusions and recommendations.

Based on the initial meeting in El Salvador and the desire of the mission to focus on a handpump program, the review of alternative technologies for water supply (i.e., rainwater harvesting) was deleted from the consultant's scope of work.

1.2 Team Planning Sessions

On February 6 and 7 (prior to the start of the assignment in El Salvador) a team consisting of two persons (the third member was unavailable for the assignment) participated in a planning session in order to:

- Provide the team with background information
- Review the scope of work
- Prepare a preliminary table of contents for the report to be left with the USAID Mission in El Salvador
- Prepare a preliminary work plan for the team.

1.3 Modified Scope of Work

On February 10 the team met with Mr. Charles Brady, general development officer, USAID Mission in El Salvador, to discuss the scope of work, the preliminary table of contents of the report, and the team work plan.

During this meeting two major points were discussed:

- USAID Mission concern about the urgent need for supplying drinking water to some selected periurban areas and to an important rural population living in small communities, camps, and cooperatives for the displaced population;

- USAID Mission interest in providing technical assistance to PLANSABAR and ANDA to identify small community projects and to speed up the preparation of designs and construction of a significant number of rural water supply schemes that are backlogged.

  The team pointed out that one of the team members was not able to come to El Salvador, reducing the capacity, but agreed that the team would cover the modified scope of work as much as possible within the time limit.

During the meeting, Mr. Leopoldo Reyes was introduced as the USAID Mission contact for the consultants and arrangements were made for interviews with institutions and private sector consultants and well drillers.

Chapter 2

EXISTING CONDITIONS

2.1 Project Area and Population

El Salvador is one of the five Central American countries. To the north and east, El Salvador has borders with Honduras; to the east and southeast with the Gulf of Fonseca; to the south with the Pacific Ocean; and to the west with Guatemala. The country is approximately 21,041 km^2 in size with an estimated total population of 5,235,673 inhabitants in 1985. There are three well-defined geographical areas -- the coastal areas along the Pacific Ocean, the central plateau, and the mountainous region with elevations up to 2,700 m. above sea level.

One chain of mountains runs from rio Lempa valley to the north along the Honduras border; a second chain of mountains goes from the Guatemalan border to the Gulf of Fonseca between the rio Lempa Valley and the low lands or coastal area on the Pacific shore. The coastal plateau comprises the low lands along 321 km of sea shores and has an average width of 20 km.

The dry season in the country normally occurs from mid-November to mid-April with one month of transition to the rainy season which begins about mid-May and ends in mid-October. The average yearly precipitation value is reported to be 1,182 mm. having a 90 percent concentration during the rainy season.

The country is divided into 14 "Departamentos", 261 "municipios", 2,061 "cantones", 7,754 "caserios" and 29 "distritos". Urban population is considered to be that which lives in the municipal capital cities while the rural population lives outside those limits and in the "cantones", "caserios" and outlying areas.

Population estimates and distribution by "departamentos" are shown in Tables 1 and 2 below. Such information is taken, with permission, from a paper delivered by Mr. Walter Pedrosa de Amorin, PAHO/WHO engineer to the First Seminar Workshop on Water and Sanitation for Fringe Areas, December 16 to 20, 1985.

Available information on percentages of rural and urban-fringe population that have easy access to any kind of drinking water facilities shows the variations listed in Table 3.

Easy access is defined as those schemes that provide drinking water by means of public standposts, handpumps, and any other facility except house connections.

As shown in Table 3, the percentage of the rural population with water services of any kind (easy access plus connections) was estimated to be 43.1 percent (1,253,422 persons) in 1983. The team feels that the last reliable year for estimated coverage is 1983 because data beyond that point is not well known.

Table 1

Population Estimates for El Salvador and Urban and Rural Distribution for 1950 to 2000

Year	Total	Urban	%	Rural	%	Average Population Growth Rate
1950	1,930,641	700,618	36.3	1,230,023	63.7	
1960	2,542,148	984,236	38.7	1,557,912	61.3	2.79%
1970	3,397,642	1,384,732	40.8	2,012,910	59.2	2.94%
1980	4,539,515	1,902,507	41.9	2,637,008	58.1	2.94%
1984	5,090,954	2,142,704	42.1	2,948,250	57.9	2.89%
1985	5,235,673	2,204,868	42.1	3,030,805	57.9	2.76%
1990	5,997,034	2,524,100	42.1	3,472,934	57.9	2.66%
2000	7,730,402	3,213,819	41.6	4,516,583	58.4	2.66%

Table 2

Population Distribution by Departments in El Salvador, for 1986

Department	Total	%	Urban	%	Rural	%
El Salvador	4,539,515	100.0	1,902,507	41.9	2,637,008	58.1
Ahuachapán	224,937	5.0	45,686	20.3	179,251	79.7
Santa Ana	405,063	8.9	189,356	46.7	215,707	53.3
Sonsonate	305,218	6.7	109,925	36.0	195,293	64.0
Chalatenango	204,513	4.5	61,134	29.9	143,379	70.1
La Libertad	371,389	8.2	131,848	35.5	239,541	64.5
San Salvador	1,050,256	23.1	830,907	79.1	219,349	20.9
Cuscatlán	182,322	4.0	50,308	27.6	132,014	72.4
La Paz	227,533	5.0	60,646	26.7	166,887	73.3
Cabañas	154,314	3.4	29,056	18.8	125,258	81.2
San Vicente	186,008	4.1	52,786	28.4	133,222	71.6
Usulután	358,548	7.9	92,989	25.9	265,559	74.1
San Miguel	406,697	9.0	146,653	36.1	260,044	63.9
Morazán	181,627	4.0	37,246	20.5	144,381	79.5
La Unión	281,090	6.0	63,967	22.8	217,123	77.2

Table 3

Percentage of the Population Living in Urban-Fringe and Rural Areas Having House Connections and/or Easy Access to Drinking Water Facilities

Area Inhabited	Percent of Population 1980	1981	1982	1983
Urban fringe (easy access)	5.8	5.5	5.4	5.2
Rural (easy access)	32.8	33.9	33.3	36.9
Rural (house connection)	6.9	7.6	7.9	6.2
TOTAL RURAL	39.7	41.5	41.2	43.1

SOURCE FOR TABLES 1, 2 AND 3: PAHO/WHO DIAAPS. Paper presented to the First Seminar on Water and Sanitation for Fringe Areas in El Salvador. December 1985.

Nevertheless, there is still a large number of rural inhabitants (approximately 1,650,000) without water facilities of any kind that need to be served in order to at least match the rural population growth.

Recent studies and data analysis made by the Project HOPE (People-to-People Health Foundation Project) demonstrate that access to water in appropriate quantities and quality has deteriorated in the camps where by 1985 a single tap was serving up to 2,870 inhabitants.

Furthermore, studies made by different institutions document the fact that population migration pressure to San Salvador and other cities has increased during the last years. It is estimated that some 500,000 persons live in fringe areas of San Salvador, nearly 50 percent of the total population of the metropolitan area of the capital city. Some 40 percent of such population lives in "colonias ilegales" and other sectors around San Salvador without ANDA water distribution system service. That population is getting water from private vendors, public standposts, or ANDA water trucks. Additional efforts are needed to provide easy access to drinking water for the population living in fringe areas of the principal cities and for the displaced persons in camps and cooperatives.

2.2 Institutions

Several institutions participate in the water and sanitation sector in El Salvador. Some were contacted in order to determine institutional capabilities, to learn about their capacity to provide water-quality testing and monitoring and to identify consultants who can assist in the implementation and management of a handpump project. The persons interviewed are listed in Annex A.

The institutions visited were the following:

- Administratión Nacional de Acueductos y Alcantarillados, (ANDA).
- Plan Nacional de Saneamiento Básico Rural (PLANSABAR).
- Dirección de Desarrollo Comunitario (DIDECO)
- Organización Panamericana Sanitaria (Pan American Health Organization) OPS(PAHO)
- Banco Interamericano de Desarrollo (Inter-American Development Bank) BID(IDB)
- The People-to-People Health Foundation, Inc. (Project HOPE)
- Consulting Engineers and Well Drilling Contractors
- Instituto Ricaldone.

The WASH team derived the following information from the persons interviewed and some reference material (Annex B) was provided.

2.2.1 ANDA

ANDA is the institution responsible for the planning, financing, execution, maintenance, and administration of the water and sewer works in the urban centers in the country. ANDA was created on October 17, 1961, to make the urban water and sewer systems self sufficient from a financial viewpoint. The municipal systems have been taken over by ANDA as much as possible, and by 1983 ANDA managed 125 of the 261 municipal systems in the country.

ANDA is using funds provided by USAID through the Oficina de Recursos Especiales (ORE) to expand its water distribution networks and sanitary sewers in some cities in order to provide services to the periurban population (colonias informales). It also provides services to people that have been resettled or displaced by the internal conflict (reubicados y desplazados) when they happen to be in a city served by ANDA. In order to speed up the projects, ANDA created a special project unit, named UDI, managed by a local consultant, with the responsibility for coordinating the whole effort; preparing contract documents for consulting and construction firms, and supervising the work done by these contractors. This approach is felt to be effective, even though the administrative and financial management are retained by ORE. The eligible neighborhoods are those that own the land and are willing to repay the investment. ANDA has installed handpumps in some cases, and feels that they could be appropriate for "colonias informales". Due to its large deficit, however, ANDA is not interested in giving support to an activity that would not be self-financing. ANDA's capacity for O&M in the system is already overtaxed. ANDA has only one central laboratory for water analysis. There is no effective control of the water quality that is supplied, due to a lack of the chemicals needed for water analysis.

Until recently, ANDA has been forced to do its own design and construction. For the seventh phase of ORE, design work will be done partially by local consultants, and about half the construction will be done by local contractors. The procurement of pipes and equipment is done by ANDA and supplied to the contractors.

2.2.2 PLANSABAR

This institution, part of the Ministry of Public Health and Social Welfare, is responsible for introducing potable water and for basic sanitation works in rural communities, as part of an integrated medical concept. PLANSABAR was charged with executing the National Plan for Basic Rural Sanitation in October 1980. PLANSABAR'S main objective is to support the economic and social development process in the rural area, by improving health conditions through basic sanitation programs and community education. PLANSABAR has executed two rural water system programs financed by IDB and is about to start a third program that will build 100 water systems to supply about 230,000 people, and will install 75,000 latrines for 450,000 people at a cost of US $21 million over four years. The community size for this program is between 300 and 2,000 people. It is expected that 60 percent to 70 percent of the water systems will require pumping. Because all of the design work and construction has to be done by PLANSABAR itself, PLANSABAR is forced to use all of its institutional capacity in this project.

As part of the program there is a technical assistance that will provide short-term consultants on financing and in operation and maintenance. Also, visits to other countries will be financed. PLANSABAR is building water systems using USAID funds from ORE, but implementation is delayed by the lack of personnel to do the design work, by insufficient gasoline for field work (even though there are enough surveying crews) and by strikes.

In order to speed up the design work, ORE has contracted local consultants that are designing water systems to go with studies done by PLANSABAR. PLANSABAR is supervising the consultants and the construction. ORE is buying the materials and paying for the construction labor. PLANSABAR has asked for ORE to pay for the construction supervision (because PLANSABAR personnel already have to supervise IDB, ORE and other projects), but to no avail.

Procurement of materials is a stumbling block in the construction of the systems whether PLANSABAR or ORE are responsible. In order to begin the construction on nine water systems to be financed by ORE, PLANSABAR has requested that at least 50 percent of the materials be delivered at the work site before construction begins.

The administration, operation, and maintenance of the water systems built by PLANSABAR is turned over to local administrative boards (juntas), under the guidance of PLANSABAR regional offices. The juntas collect the water bills, and deposit the receipts in a revolving fund. As there is a lack of payment PLANSABAR is facing a deficit. The deficit grew, in part, due to the O&M costs of the pumped systems. PLANSABAR is currently asking the juntas to pay the salaries of the pump operators.

Even though some of the systems have hypochlorination facilities, none of them disinfect, due to the lack of funds to buy chemicals. There are no PLANSABAR laboratories for water analysis in San Salvador or in the regional offices of PLANSABAR , so there is no water quality control. A project funded by the United Nations Development Program (UNDP), that began in January 1986 will provide laboratory equipment for the Ministry of Public Health and ANDA regional laboratories. UNDP is also funding technical assistance for hydrogeological studies. With the ongoing projects, PLANSABAR is overtaxed beyond its capacity, and does not seem interested in managing another project.

The PLANSABAR engineers feel that the handpumps could be used in areas with ample groundwater resources, high water tables, and scarce population. They do not feel PLANSABAR can give support in the maintenance of the handpumps under the present conditions.

It is interesting to note that the two main programs undertaken by PLANSABAR (the IDB and ORE programs) conflict on two basic issues:

a. ORE pays people to build the waterworks. IDB requires that the unskilled labor and local materials be provided free of charge by the community.

b. IDB-financed water system juntas (committees) charge a connection fee to the new users that do not contribute to construction. As ORE's systems do not require the community's collaboration, there is no basis for this type of charge in ORE projects.

It is recommended that criteria be developed to resolve these conflicts between the programs, otherwise communities will be reluctant to collaborate without payment for the construction of IDB systems, when they can be paid for the same work in the ORE systems.

2.2.3 DIDECO

DIDECO participates in some water system projects because it distributes the food in a PMA food-for-work program which works throughout several governmental agencies.

It is also responsible for community development, and as part of its work, it has had some limited experience in water-works construction. As part of their campaigns they recommend the boiling of water for human consumption.

It does not seem that DIDECO can play any significant role in the handpump project execution, but it could be important in selecting communities to be included in a project.

2.2.4 PAHO/WHO

PAHO is providing technical assistance to ANDA and PLANSABAR, especially the latter, and is managing the UNDP project to acquire laboratory equipment and conduct hydrogeological studies. It also maintains a long-term advisor for sanitation and is currently assigning short-term consultants to water quality control and operation and maintenance.

At the meeting with the WASH team, the PAHO personnel showed a mild enthusiasm for the handpump project, and provided some background information. They remarked that:

- The sector is facing difficulties in obtaining spare parts.
- Efforts by PAHO to improve operation and maintenance in PLANSABAR have been totally ineffective.
- There have been numerous experiences in other countries with handpump programs that have failed.

2.2.5 IDB

IDB has been financing projects for both ANDA and PLANSABAR. For ANDA, the last one was "Proyecto Zona Norte", a water supply improvement for San Salvador. The project, originally estimated at a cost of US $50 million was finished at a total cost of US $82.0 million. The construction time exceeded the original estimate.

The possibility exists that some new improvements for San Salvador's water and sewer works might be financed by IDB. Some other urban water systems might be rehabilitated.

For PLANSABAR, IDB has financed two rural water programs, and is beginning the third one. The execution of the second one, originally established at four years, was extended to six and a half years. The sector specialist feels that:

- The procurement in PLANSABAR is too slow.
- Some changes in PLANSABAR's organization will be needed.
- The design capacity of PLANSABAR is below that required to reach its goal of 70 projects in two years.

2.2.6 Project HOPE

Project HOPE, managed by "The People-to-People Health Foundation, Inc.", a non-profit organization, is providing primary health services to displaced persons in camps and to certain agricultural cooperatives. The project is funded through a USAID grant by means of a cooperative agreement.

HOPE employs 160 Salvadorans. Only the director and sub-director are expatriates.

HOPE coordinates its efforts with the Government of El Salvador in accordance with an agreement between the Ministries of Public Health, Agriculture, and

Interior and HOPE, the main counterpart being the Ministry of Public Health. The government provides office space, support services and guidance.

HOPE currently provides primary health care to 1,500 people monthly. To carry this out, HOPE has built 30 health posts (dispensarios) and provides the logistic support through two main offices, one in San Salvador and another in San Miguel. HOPE also is providing health education, epidemiological monitoring, and vector control.

HOPE monitors the water quality in the settlements where it works by using a Millipore portable incubator, and compares the results with the recommended limits established by "Agua del Pueblo" project in Guatemala. They feel the WHO standards are too stringent. Based on "Agua del Pueblo" standards, the water quality in most of the places shows acceptable coliform levels. A sanitary inspector is researching the feasibility of home water filtration units using sand and carbon. According to HOPE, the main water problem is not water quality but inadequate quantity and the lack of hygienic habits.

In the original project scope, presented to USAID in 1984, HOPE proposed "an integrated program including epidemiological studies, provision of primary health care and improvements in environmental sanitation". Due to budgetary constraints USAID was unable to fund the portions of the Project HOPE's proposal dealing with environmental sanitation.

In September and October 1985, HOPE hired a consultant to plan an environmental sanitation program for the displaced persons camps and certain cooperatives, showing the increased need of water and sanitation in these human settlements, presumably to be presented to USAID for additional funding. According to Project HOPE, recent data analysis and field studies document the fact that, while certain conditions have improved in the camps (specifically, an increased number of latrines, drainage improvements, and access to primary health care), the problem of access to water in appropriate quantities and quality has worsened.

According to HOPE, the displaced population is around 500,000 people. The settlements are constantly changing in size, and those that develop close to existing towns are overtaxing the capacity of existing water systems, creating problems for the regular customers. The Government of El Salvador and donor agencies say that the provision of adequate water supply would make the camps permanent and discourage the inhabitants from returning to their homes. Thus, using handpumps which could be removed, would be convenient as an interim solution for the camps.

2.2.7 Consulting Engineers

Meetings were held with two consulting engineers, Mr. Guillermo Imery and Mr. Carlos Montenegro. From these meetings it appears that:

- There are five to ten consulting engineering firms with experience in sanitary engineering design. ORE and FOSEP keep updated lists of qualified consultants.

- PLANSABAR has experience in contracting consultants for rural water system design work. Most of the systems are supplied by groundwater (wells or springs). It takes between *two and* three months to process a contract. The usual form of payment is a lump sum with a 10 to 15 percent advance payment.

- The normal design contract is between ₡4,000 (US$800) and ₡15,000 (US$3,000) per project (usually a project is designed to supply several communities). The previous figure does not include the topographic survey which costs between ₡1,000 ($200) to ₡1,500 ($300) per kilometer. Usually it takes two to three months to prepare the design work. The unit cost and time per project could be reduced if each consulting firm were contracted for five to ten projects in one area (the time for completion would be from six to eight months).

- The supervision of construction could be handled by local consultants; the approximate cost would be ₡10,000 ($2,000) per month per system.

- Individual services of professional engineers can be contracted at a salary cost of ₡8,000 ($1,600) per month.

- The preparation of the Terms of Reference for the consulting contracts should be prepared by experienced engineers to avoid vagueness, loopholes, and clauses that can interfere with the contract execution.

- The type of construction management contract that ANDA, through UDI, is using is seen as an effective way of developing a project.

2.2.8 Well Drilling Contractors

Two meetings were held with Mr. Orlando Flores. The following information was obtained:

- There are approximately five well-drilling contractors who own large- and medium-size rigs. For small diameter wells (4" casing) in rural areas with poor roads, small and easy-to-transport well drilling rigs are required. These small rigs cost approximately US $40,000.

- Some have experience with different kind of wells -- hand-dug wells, jetted well points, and deep wells drilled by cable tool and rotary rigs. The technology varies according to the geographical zone. There is a preference for imported well screens, but slotted PVC pipe has also been used as well casing in medium-depth wells (300 feet).

- For shallow- to medium-depth wells, the well contractors could drill 50 wells per year.

- The principal problems for well-drilling contractors is the scarcity of foreign currency to buy spare parts, equipment, and materials; the lack of financing to buy new rigs and drilling tools; and the delays in purchasing with letter-of-credit procedures, due to a lack of commercial credit in the United States, where they buy most of their supplies.

2.2.9 Instituto Ricaldone

Instituto Ricaldone is a high school that gives technical training in mechanics and electronics. The assistant dean, Padre Giuseppe Coro knows, and maintains working relations, with several industries in El Salvador that could be interested in locally manufacturing the handpumps. According to Padre Coro, there are approximately ten companies that could do the job. Padre Coro feels that the local industry is losing highly trained personnel due to the internal conflict and that its capability has been diminished in the last few years.

The WASH team is doubtful that a high quality handpump can be immediately manufactured locally. Nevertheless, in order to reach a final decision, it is suggested that a specialist in handpump manufacturing be assigned to study the feasibility of locally manufacturing an appropriate handpump in El Salvador.

2.3 Water Resources

Water resources in El Salvador are abundant, both on the surface and underground. Country water authorities have established five hydrogeological characteristics as follows:

1. Soil formations with good porosity and permeability characteristics with high values of transmissivity and storage. The water table is found between 2 to 20 m. depending upon the topography of the ground. Sediments, coarse and fine sand are common in this type of soil. Yield is reported to range from 500 to 1,000 GPM. Jetted wells are the most appropriate technology for water withdrawal.

2. Volcanic rocks and formations, likewise with secondary permeability values, belong to this classification. Yield ranges from 200 to 400 GPM and the water table is between 30 and 100m.

3. Volcanic sediments, ashes, and similar sediments with medium permeability and good porosity values. Water level is located at 60 to 100 m and yield could be 100 to 300 GPM.

4. Rock conglomerates and lava deposits; sometimes hydrological conditions are such that groundwater is seeping through small fractures. Yield could be between 15 and 100 GPM and water table from 80 to 100m.

5. Hard rock formations with confirmed aquifers. It is possible to obtain yields of 20 to 200 GPM.

There is no doubt that with abundant rainfall, some of the rain percolates into the ground to recharge the aquifers. The yearly distribution of rain in El Salvador is shown in Table 4 below:

Table 4

Seasonal Distribution of Rain in El Salvador and Average Rainfall

	Duration Days		Average Rainfall mm	
Dry season	157	43.0%	77	3.8%
Dry to rainy season	31	8.5%	119	6.0%
Rainy season	149	40.8%	1,627	81.3%
Rainy to dry season	28	7.7%	177	8.9%
Totals	365	100.0%	2,000	100.0%

Source: PAHO/WHO DIAAPS. Paper presented to the first Seminar on Water and Sanitation for Fringe Areas in El Salvador.

There are a number of groundwater studies both in ANDA and PLANSABAR that can be used as a good source of information for establishing specific criteria for source development and to select well drilling depth requirements. PAHO/WHO is collaborating with the above mentioned institutions through a long-term groundwater study of hydrological conditions in selected areas of the country. Furthermore, ANDA and the private sector in El Salvador have good experience with groundwater source development and improvement. A large percentage of community, industrial, and agricultural schemes depends on groundwater development, especially when located on the central plateau and coastal area along the ocean. These experiences could be used by identifying in-country hydrologists through ORE and FOSEP.

Chapter 3

PROGRAM CRITERIA

3.1 General

The Salvador government estimates that approximately 80 percent of all common diseases are in one way or another associated with unsafe water and poor sanitation. Diseases such as diarrhea, cholera, typhoid, and paratyphoid fever, infectious hepatitis, amoebic dysentery, and others could be prevented through the use of safe water for human consumption.

Adequate, accessible supplies of water and proper sanitation facilities are the basic needs of primary health care.

A few liters of safe water per person per day are sufficient for drinking and food preparation; larger quantities are required when the water is going to be used for personal hygiene, laundry, house cleaning, and other related purposes.

Sometimes, water has to be carried over long distances particularly during dry periods. Scarcity of water may lead people to use sources that are contaminated by human or animal feces.

3.2 Water Quantity and Quality

Factors influencing the use of water include cultural preferences, standard of living, climate, cost, and quality of the water. These factors, along with the level of service (whether supplied by house connection, public standpipe, handpump, or other means) lead to great variations in the consumption of water for domestic use.

The use of water for domestic purposes may have the following categories:

- drinking
- cooking and food preparation
- personal hygiene
- washing
- house cleaning
- other uses

In El Salvador there is no historical consumption record for the population that is discussed in this report. PLANSABAR's general criteria is that the small rural communities will not consume more than 20 liters per capita per day.

For the purpose of installing handpumps in El Salvador to supply water to small rural communities and fringe urban areas, the team would recommend using 20 liters per capita per day as the typical domestic water consumption, when the walking distance to the source is less than 200 m in plain terrain. The number of households per well in a community is generally 30.

If the average size of a family is considered to be six persons, then the water demand for a village well would be:

water demand = 20 x 30 x 6 = 3,600 liters per day per well

The number of wells needed in a particular village is determined by dividing the number of families by 30. Sufficient surplus capacity is suggested to allow for future population growth and a higher use of water.

The basic requirements for drinking water are that it:

- be free from pathogenic organisms
- be fairly clear
- not be salty
- contain no compounds that have adverse effects on human health
- contain no compounds that cause offensive taste or smell
- not cause corrosion or encrustration or stain clothes washed in it.

The most important criterion for drinking water is the bacteriological quality, that is, the content of bacteria and virus. Water is examined for a specific type of bacteria which originates from human and animal excreta and is indicative of fecal contamination.

A suitable indicator for this kind of contamination are the coliforms known as Escherichia-coli (E.-coli).

Almost all small rural communities' water sources are likely to have some level of contamination, but it is not a good practice to reject all water supplies that present such conditions. Testing of bacteriological quality should examine the level of pollution in the water. Samples should be collected in sterile bottles according to standard procedures and methods. For all situations, the team recommends that the testing of water samples be based on accepted procedures established by WHO.

3.3 Source Selection

When a drinking water supply source is going to be selected, some factors need to be considered:

- Quantity: The source should be capable of supplying enough water over the long run for community use.

- Quality: An examination of water quality is essential to determine the organisms, mineral, and organic compounds contained in the water. Results should be within the limits suggested by WHO guidelines. Low levels of bacterial contamination, however, may be permitted in order to increase the quantity of water available to consumers.

- Protection: Careful consideration should be given to the protection of the source against contamination of any kind.

- Accessibility: People tend to use little water when it is too far away to be carried home in quantity. Sources must be within reasonable distance so the community may have easy access to it.

- Feasibility: In small rural communities, particularly in farming communities, the economy is that of a subsistence economy where it is hard to raise funds to pay for the operation and maintenance costs or to be able to obtain the investment capital without external assistance. Design and construction must take into consideration the local economy. In this context, a program for installing shallow or medium depth wells and handpumps is a feasible solution for communities with a subsistence economy and little or no development potential. It also helps to protect the source from contamination because these wells are usually located within the community limits or nearby so a caretaker could easily inspect them and perform the O&M routine to keep them functioning.

3.4 Well Installation Program

It will not be possible to include all small communities into a national or regional water supply program at once. In the case of El Salvador, a follow-up consultation project with the objective of selecting groups of communities that could be supplied by shallow or medium depth wells and handpumps is necessary.

The USAID Mission selected handpumps to supply water to rural communities, camps, and cooperatives for displaced people because El Salvador has groundwater resources that could be used. In addition, wells operated by handpumps are probably less subject to sabotage than regional water supply and distribution systems.

Two kinds of wells are the most suitable for a handpump installation program in El Salvador.

- Shallow wells: At present there is some experience with hand-dug wells, particularly in the coastal area; however, this practice is not fully accepted due to the difficulties in construction and maintenance (because of the loose soil prevailing in the region).

  Mechanically drilled wells using a percussion rig are commonly used in the country. Considerable experience exists both for community water supplies and for agricultural irrigation.

  In drilled wells, the borehole is encased with slotted 10 to 15 cm diameter PVC pipe with gravel-filter packing around the outside of the pipe. This is a quick method of construction and is probably a practical one when many wells must be produced in a short period of time. A shallow well could go as deep as 10 to 15 m and have sufficient yield to supply water for small communities.

- Medium depth wells: These are more appropriate to withdraw water from deeper aquifers, from 15 to 35 m, particularly on the central plateau in El Salvador. A handpump or a windmill could be used to operate the system.

There is also experience in the country using the hydraulic percussion method of driving a well point fitted to the lower end of a pipe section. The well point must be sunk to a depth below the water table for best results.

3.5 Handpumps

There are a number of handpumps suitable for El Salvador's rural and urban-fringe areas that could be manufactured using the facilities of the Ricardone Institute and some other private industries.

The two most appropriate types, with low care and maintenance, are the following:

- India Mark II handpump
  - has steel casing
  - has a motorcycle chain drive
  - can use Dempster or Clayton Mark cylinders
  - has been field tested and holds-up well under heavy use
  - has training material readily available
  - competitively priced with other pumps
- Battelle type handpump
  - It is a single action, reciprocating, positive display cement pump designed for long life under severe operating conditions.

The team recommends a follow-up study to select the most appropriate type of handpumps to be used. The team also recommends that USAID contact the World Bank which is presently conducting comparative field tests on handpumps in several countries in South America.

3.6 Community Involvement

An indispensable social component of rural water supply programs is the community participation; the success depends greatly on the extent to which the community is involved during the different stages of planning, design, construction, and operation and maintenance.

In El Salvador the communities are covering the cost of operation and maintenance for the small schemes. In construction, they provide unskilled labor and local materials. This contribution may be estimated in approximately 10 to 15 percent of the total cost.

3.7 Source Improvement

If the quantity of water is insufficient, another well site has to be found to replace or supplement the old one.

If contamination affects the source, improvements in the quality will affect only the waterborne diseases like cholera, bacillary dysentery, typhoid, and also water-related diseases such as skin and eye infections.

To improve a contaminated source, careful supervision and inspection should be carried out in order to assure that the well is at least:

- 50 m from a seepage or cesspool
- 30 m from soil absorption systems
- 30 m from pit or septic tank
- 30 m from animal pens, barns, or silos

Well sites should not be subject to flooding at any time. The site should be protected from flooding by building small dams or ditches.

3.8 Well Disinfection

All wells must be disinfected to eliminate the contamination from equipment, construction materials, and surface drainage.

Chlorine compounds are easily obtainable and the safest disinfectants used for water disinfection. These compounds have different concentrations of available chlorine. It is produced as calcium hypochlorite with 70 percent strength, bleaching powders with 25 to 35 percent, and available chlorine and common household laundry bleach which have approximately 5 percent available chlorine.

Table 5 shows the amount of chlorine compounds needed for well disinfection.

Table 5

Amounts of Chlorine Compounds for Well Disinfection

Water in Well (m^3)	Liquid Bleach 5% available chlorine (liters)	Bleaching Power 30% available chlorine (grams)	Calcium Hypochlorite (HTH) 70% available chlorine (grams)
0.1	0.2	33	14
0.12	0.24	40	17
0.15	0.3	51	22
0.2	0.4	68	29
0.25	0.5	86	37
0.3	0.6	100	43
0.4	0.8	133	57
0.5	1.0	170	73
0.6	1.2	203	87
0.7	1.4	233	100
0.8	1.6	267	113
1.0	2.0	334	143
1.2	2.4	400	173
1.5	3.0	500	217
2.0	4.0	670	287
2.5	5.0	860	367
3.0	6.0	1,010	433
4.0	8.0	1,330	507
5	10	1,700	730
6	12	2,000	870
7	14	2,300	1,000
8	16	2,000	1,130
10	20	3,300	1,430
12	24	4,000	1,730
15	30	5,000	2,170
20	40	6,700	2,870

Chapter 4

ALTERNATIVE TECHNOLOGY

4.1 Alternatives for Development Sources and Technology

From the data analysis and information gathered through team interviews with local professionals and technicians, it appears that El Salvador is a country rich in underground water resources, especially at the coastal area and central plateau. It has had good experience in withdrawing underground water by means of drilled and hand-dug wells for multiple purposes such as human consumption and irrigation. Private contractors advised the team that the productive water table at coastal area is found at approximately 16 m depth varying up to 60 m at the central plateau. Due to the rock formations encountered along the mountain ranges, the probabilities of finding water at a reasonable depth is uncertain in that area. The accessibility of groundwater in the coastal and plateau areas provides a basis for the development of appropriate low-cost technology to supply drinking water, in acceptable quantities and quality, for rural communities, and fringe areas by means of shallow and medium depth wells operated by handpumps.

4.1.1 Driven Wells

The soil formation that prevails in the coastal region is suitable for driven or dug wells. Driven wells are made by driving a pointed screen known as a "well point" into the water bearing formation. To prevent damage, the point at the lower end is made of hard material like hard steel. It is important to design driven wells properly to ensure a year round supply of water. This involves selection of a well point; choosing a method of driving; determining the required personnel, tools, and equipment, and determining the seasonal fluctuation in the groundwater level.

There are two categories of well points: the screen that consists of an open or perforated frame covered with one or more screens. It is a relatively less expensive type but less resistant to damage during driving or overpumping; the slotted type of well point is more expensive but less likely to become plugged during overpumping.

Driven wells are not suitable for hard rock or heavy beds of clay or coarse gravel; their practical depth is limited to approximately 8 m. Most well points have a diameter in the 30 to 50 mm. range. The yield from a driven well is generally small, somewhere between 0.1 to 1.0 l/s which would be sufficient to supply domestic water for a small community.

4.1.2 Jetted Wells

Jetted wells do not differ much from driven wells and are much faster. Mechanical force is not needed so that plastic instead of steel can be used for the casing and strainer. Unconsolidated formations and sandy aquifers are most suitable for this method. Jetted wells can be carried to depths of approximately 160 m. increasing the chances of reaching a good yield.

Constructing these wells requires a water pump, hoses, and other materials which raise the cost. El Salvador has had good experiences with the public and private sectors using this method.

4.1.3 Dug Wells

Dug wells are made by digging a hole in the ground. They can be satisfactory if the conditions are right and generally no special equipment or skills are needed for the construction. Usually the diameter of the well should be at least 1.2 m if two men are to work together. Further increasing the size of the well is seldom useful since the additional yield is likely to be very small. Dug wells provide both groundwater withdrawal and storage due to their large diameter. They can be constructed in almost any type of soil except hard rock. The practical depth is approximately 10 m but depending upon the type of ground and fluctuations of the water table, those for communal use are frequently between 20 to 30 m. Most dug wells need an inner lining made of brick, masonry, stone, concrete cast at the site, or precast concrete rings. The lining also provides a seal against polluted water seeping from the surface into the well. The well also has to be covered.

4.1.4 Cable Tool Wells

Cable tool wells require special drilling equipment and skills to operate it, but they are very fast in comparison with other methods. These wells can be sunk in nearly every type of soil and reach depths of 75 m or more increasing the chances of finding reliable groundwater sources. To select the most suitable equipment to be used in El Salvador would require the participation of an expert in geology and drilling equipment.

4.1.5 Alternative Technology

Where it is not possible to obtain surface or groundwater for household use at a reasonable cost, rainwater harvesting offers a simple and low-cost solution for supplying drinking water. Rainwater can be collected from house roofs that are made of tiles, galvanized, aluminum or plastic corrugated sheeting. Rainwater needs to be collected through roof catchments and stored in appropriate containers or household cisterns. With sufficient storage, the roof catchment could provide water during the rainy season, and during the two to three months of the dry season could provide some 40 liters per day, which is the basic drinking and domestic water requirement of a family of six persons.

4.1.6 Windmills

In some areas of El Salvador where handpumps are likely to be installed, the water table would probably be too deep to raise water by means of human effort. In such a case a windmill of proper size and design could provide an adequate and acceptable solution.

Chapter 5

PRELIMINARY PROGRAM DESIGN

5.1 Concept and Strategy

As can be seen from the previous discussion, ample groups of population in El Salvador need a water supply, especially in the small rural communities (less than 300 people); in the displaced persons camps; in the agricultural cooperatives, and in the periurban areas where informal settlements develop.

In order to cope with this need, USAID, through ORE, has been financing the construction of rural water systems and the expansion of existing systems, which in some cases has created a water shortage for the prior consumers. An IDB-funded project is aimed at rural communities that are willing to contribute approximately 20 percent of the water system cost, and are able to pay water rates to operate and maintain the system.

The conventional approaches now in use by PLANSABAR and ANDA require, even for small community systems, a very detailed study, a topographic survey of all the elements of the system, preliminary designs, cost analysis, selection of proposals and other related actions prior to construction that usually take a long time.

These conventional approaches suffer from two clear disadvantages:

a. The bureaucratic procedures require a long time for project execution through the governmental agencies responsible for the water supply sector (ANDA and PLANSABAR); and

b. The water supply systems go against the policy adopted by the government of keeping the displaced persons camps as temporary.

A program using wells and handpumps, as proposed by the USAID mission is a viable alternative to the conventional approach:

- It is an interim source of supply that can be used until a permanent system is implemented.
- It uses untapped hydraulic resources instead of creating conflicts with the present users of water systems.
- It provides, if the wells are properly protected, safe water for human consumption.

The project implementing organizations, ANDA and PLANSABAR, with all their resources committed to the ongoing projects, have started using private consultants and contractors to help with the project's execution. The lack of funds to pay for the project management efforts and for the private consultants' services still impedes timely execution. On the other hand, HOPE, a private voluntary organization project, is successfully implementing a primary health services program for displaced persons camps, and has expressed willingness to incorporate water and sanitation components as part of their project. The use of a PVO, like the People-to-People Health Foundation, for the handpump project could be very effective because:

- they work in areas where the proposed technology is suitable
- they have experience in dealing with rural communities
- they feel the need to complement ongoing efforts
- they have experience in dealing with USAID
- They have shown a disposition to work with local personnel, taking advantage of their knowledge of local conditions.

The technical capability exists in the country to develop the limited engineering and hydrogeological requirements of a handpump project. In addition, well-drilling contractors could be used to drill the wells and install the pumps.

With reference to operation and maintenance, PLANSABAR and ANDA are facing large financial deficits. The financing institutions devote all their resources to the construction of new water systems and limit their participation in O&M to the provision of technical assistance through short-term consultants which is clearly ineffective. To be successful the O&M activity in a handpump installation program should be considered as a project component without resorting to the existing institutions for support.

In summary, the project concept and strategy is to implement a water supply project for the small rural communities, displaced persons camps, agricultural cooperatives, and informal periurban developments using shallow- and medium-depth wells equipped with handpumps. The project management will be the responsibility of a non-profit organization, also responsible for monitoring the operation and maintenance to be done by the communities during the project's lifetime, including the quality control of the water supplied. The project will be directed by a steering committee formed by governmental organizations, USAID, and the PVO and will use local consultants and well-drilling contractors.

As a separate effort, technical assistance funds will be provided to pay consultants' services for designing water systems for PLANSABAR, using a scheme similar to ANDA's.

5.2 Objectives and Goals

On the basis of the team assessment and comments made by the USAID mission in El Salvador, the team would like to recommend the implementation of a program to supply drinking water to 225,000 persons living in the rural and fringe areas using wells and handpumps.

At the same time, to expedite the designs and construction of conventional piped water projects, to serve rural communities of medium size, the team recommends that a follow-up consultant look specifically at PLANSABAR and ANDA files to select groups of communities suitable for USAID technical assistance.

The objectives and goals of this program are listed below.

5.2.1 Handpump Program

a. Provide safe water with handpumps to approximately 225,000 persons by constructing some 1,250 wells (based on 30 families per pump and 6 persons per family) over a period of 3 years, as follows:

First year :	250 wells
Second year:	500 wells
Third year :	500 wells

b. Increase local well-drilling capacity from 250 wells to 500 wells per year. To achieve this goal, it would be necessary to finance the importation of drilling rigs during the first year of the program.

c. Develop a local capacity for manufacturing a good quality handpump. If that is possible, some 500 handpumps may be used for the third year of the program.

d. Provide tools, spare parts, equipment, and transportation facilities, as well as develop administrative and technical skills, at local and regional levels, to operate and maintain the following quantities of newly installed handpumps (cumulatively):

- During the first year	250
- During the second year	750
- During the third year	1,250

e. Build community interest and participation in the construction, operation, and maintenance of the wells and handpumps and provide health education to users.

f. Train community caretakers in operation and maintenance techniques.

5.2.2 Technical Assistance

a. Prepare (by contract with private consultants) the final designs for 9 or 10 rural water systems that PLANSABAR has already selected for implementation during 1986 with ORE assigned funds.

b. Develop PLANSABAR capacity to select and rank communities on its waiting list, giving local private contractors the job of final studies, design, and construction.

On the basis of observations and analysis of private capacity in El Salvador, the team estimates that some 80 small community projects could be given to private contractors per year, depending upon the size of the scheme.

Chapter 6

PROGRAM ANALYSIS

6.1 Technical and Engineering Analysis

6.1.1 Wells

Local public institutions and private companies are experienced in drilling medium-depth wells using the jetted method. The capacity of the public institutions to assume additional responsibilities is almost nil because of the present workload they have.

The team recommends that a program to supply drinking water to rural and urban-fringe populations be implemented through private contractors.

There are five private companies in El Salvador with actual capacity for drilling and finishing approximately 24 wells per year with depths ranging from 15 to 30 m. If a larger program is implemented, the private companies would increase their output to 50 wells per year according to the managers' statements. The team believes that this is possible if groups of communities are assigned to each drilling company by area. At present conditions the yearly output would be:

50 wells x 5 companies = 250 wells per year

To increase the capacity of the private companies further, the team suggests that USAID purchase five new drilling rigs, properly selected by a specialist, and make them available to the private companies under terms and conditions that need to be settled by the USAID Mission, the government and private companies. With this new input, the total output could be 500 wells per year.

The team recommends that five new rigs be purchased by the end of the first year of the program so the output could be increased as follows:

First year	Second year	Third year
5 existing rigs End product: 250 wells	5 existing rigs 5 new rigs End product: 500 wells	10 rigs End product: 500 wells
Cumulative end product: 250 wells	750 wells	1,250 wells

Depth requirements could range from 15 m to 35 m, depending upon the region where the wells are going to be constructed. In any case, the institutions have good information on hydrogeological conditions all over the country. Also, El Salvador has good qualified geologists who can provide assistance in well selection. These professionals would be identified through ORE.

PLANSABAR has information and experience on wells of 150 mm in diameter and depths of 50 to 100 m. They do not have reliable information for small shallow wells. Nevertheless, according to PLANSABAR and private companies, the cost for a finished well of 100 mm diameter and depth from 15 to 30 m could range between $3,000 and $6,000 which includes a PVC casing and well point, with the necessary protection against contamination.

For budget estimates only, the team assumed a cost of $5,000 for the construction and finishing of one well with the characteristics established for the program.

6.1.2 New Rigs

The estimated cost of the new drill rig equipment suggested for the program is approximately $40,000 based on the information provided by PLANSABAR and a private contractor contacted by the team. The team recommends that a follow-up consultant study new rigs and select the most appropriate one for El Salvador needs.

6.1.3 Handpumps

The team recommends the use of imported handpumps for the first two years of the program. During those years, an indepth study should be made of the in-country capacity for manufacturing the same type of handpump.

Table 6

Budget for Handpump Installation

1.	Local materials sand gravel cement blocks iron rod pipe	300 dollars
2.	Handpump	350 dollars
3.	Well cover and protection	80 dollars
4.	Pipe connections	70 dollars
5.	Local labor	200 dollars
6.	Supervision	100 dollars
	TOTAL	1,100 dollars

The program should also consider the allocation of funds to purchase spare parts, in order to ensure the continuous functioning of the pumps.

Data gathered by PLANSABAR estimates the cost of one handpump at $1,100, which includes the cost of the pump, and the installation by local labor. A breakdown of this estimate is shown in Table 6.

The team recommends that a follow-up study be made in order to have definitive specifications for the most appropriate handpump for El Salvador, the possible sources of supply, and the feasibility of manufacturing them in the country.

6.1.4 New Wells Disinfection

Disinfection is a final stage in the well-finishing process; the object is to control organisms in the water that could produce diseases.

All new wells should be disinfected with a hypochlorite solution. The most easily obtainable and safest disinfectants are chlorine compounds. Calcium hypochlorite, 70 % strength is recommended for a solution of 0.2 % chlorine in 25 liters of water using 7 ml of HTH. Put the mixture down the well, then operate the pump until the water smells of chlorine; wait one hour before pumping again; repeat the procedure and wait 12 hours and then pump water until it does not smell of chlorine.

The amount of HTH needed for initial disinfection of 1,250 wells is estimated as 32 kg. with a cost of US $500.

6.1.5 Water Quality

Water should be examined for fecal pollution using appropriate guidelines to assess the suitability of the water source. Project "Agua del Pueblo" has proposed a maximum permissible level of six coliform/100 ml for rural water supply in Guatemala which could also be applied in El Salvador. Project HOPE in El Salvador is reporting their results using this criteria. Testing for fecal contamination could be carried out twice a year at wells where contamination is suspected. Yearly testing for the rest of the wells is desirable.

As for the chemical and physical characteristics, a yearly sample could be tested using the latest World Health Organization criteria.

6.2 Operation and Maintenance Analysis

The success of a handpump water program depends primarily on the operation and maintenance of the pumps. According to a World Bank document* "the record of handpump water supply programs is quite bad; failure rates of 30 to 70 percent

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*World Bank Technical Paper No. 12. Water Supply and Sanitation Project Preparation Handbook have been reported within two years after pump installation. Each time a system or handpump breaks down, the villagers will seek water elsewhere, often from unsafe and polluted sources."

The governmental institution responsible, PLANSABAR, cannot provide effective supervision and support to the water systems that are actually in operation. Some of the more obvious problems are listed here:

- lack of vehicles
- lack of repair materials (PVC pipe, solvent, fittings, etc.)
- lack of chemicals for disinfection.

Once the system is built, it is turned over to an administrative board of local villagers (junta), that is responsible for billing and collection, and for O&M. PLANSABAR provides support with regionally based plumbers and electricians, but the government funds are not sufficient. The other source of funds are the water rates that usually are enough to maintain gravity flow systems, but not enough for systems that need pumping, use electric power, and have high maintenance costs. In order to reduce its operating costs PLANSABAR has adopted the following measures:

- building systems where water sources do not need treatment
- only building systems that require pumping where there is a consumer base large enough to pay for the operating costs
- transferring the payment of the pump operator, (who is now paid by PLANSABAR) to the junta.

Since community participation in O&M is the usual practice in El Salvador, and PLANSABAR cannot give adequate support to the rural systems that have been built, the consultants recommend that the O&M scheme proposed rely on the community for local activities and on the PVO for initial regional support, adopting a three-tier system.

At the village level, the community will be responsible for administration and maintenance through a local junta similar to those adopted by PLANSABAR. A caretaker will be selected and trained to operate and maintain the handpump. The caretaker training should include how the pump is built, how it operates, a trouble-shooting checklist and the simplest rules for coping with drainage problems. As part of the training, a caretaker will learn about the waterborne diseases, the need for drainage and the need for hygienic habits. The caretaker will be provided with tools and a kit of spare parts by the program itself.

At the regional level, there will be a support office with a spare parts warehouse, and technicians to make repairs when the village cannot cope. The regional office technicians will also visit the installations periodically to check on routine maintenance and see whether the installation is in good repair. The regional level should also establish an organization formed by representatives from the local juntas to provide feedback to the PVO, and to serve as a nucleus for regional O&M cooperatives that could take charge when the project is finished, with minimum support from PLANSABAR.

At the third level, the PVO central office will be responsible for supervising and implementing the overall program -- budgeting, purchasing supplies of materials in bulk, and training second-level personnel. An agency with experience in this field should be contracted. Among its duties will be the development of a management information system, O&M procedures and manuals, training material and the training of trainers for O&M.

6.3 Community Participation, Health Education and Training Analysis

Community participation is essential in a handpump installation project. Participation in the early design stages greatly contributes to the general success of the project. If the installations are not accepted and supported by the community, they are likely to be misused. Communities can be motivated to help in the planning, construction, and operation and maintenance of the pumps. The most important community participation for the proposed project would be O&M responsibilities accepted by them. Primary responsibility for the continuous operation of a handpump lies with the community backed by regional and national levels. At least one caretaker should be trained for each handpump, not only to care for the pump, but also to help stimulate activities on health education, personal hygiene and adequate water use. For the whole project, 1,250 caretakers will need to be trained at the following schedule.

- First year 250
- Second year 500
- Third year 500

Local trainers would be trained in workshops designed for 30 participants over a three-day period. The team recommends that 15 training sites be selected and that the trainer at each site have the responsibility for training approximately 80 operators over the three-year program.

The training activity should be a responsibility of PLANSABAR, with the help of other institutions with training experience, PVOs in El Salvador, and perhaps the private sector.

It is also important that the caretaker or pump operators have a good knowledge of the system installed in their communities. Therefore, those selected as caretakers should participate at least in the final stages of construction to become familiar with the system.

At this stage it is estimated that approximately US $280,000 would be necessary for the courses.

The team recommends that a specialist assist in the design of the courses, the contents, duration, schedules, materials, and so on.

Health education is an important part of community motivation; a user motivation program may be started as early as possible during the construction phase for personal, household, public hygiene, and other selected health aspects. PLANSABAR and Ministry of Health specialists may provide support for this effort.

It is also important to prepare an inventory of the components and equipment installed in each community. This could be done by using a card for recording details of the wells, the handpumps, and its subsequent maintenance history. An example of such a card is given below.

Experience demonstrates that caretakers must be supervised periodically and assistance provided. At the regional level, there should be a trained supervisor, equipment, vehicles, tools, spare parts, and education materials. The team recommends setting up 15 regional warehouses at an estimated cost of US$15,000 each. A breakdown of costs appears in Tables 7 and 8.

SAMPLE EQUIPMENT HISTORY CARD FOR A SHALLOW WELL

FRONT OF CARD

District: | Name of Village:

Date of Installation: | Location of Well:

Well Identification No.: | Number of Users:

Water Quality Laboratory Reference Number and Date of Sample:

Location of Handpump Spare Parts List:

Technical Date:

A. Well

1. Hand dug/mechanically dug
2. Inner well diameter m
3. Depth of well: m
4. Average wet season depth of water: m
5. Average dry season depth of water: m

B. Handpump

1. Name:
2. Type:
3. Serial no.:
4. Cylinder diameter: mm.
5. Depth of cylinder: m.

SAMPLE EQUIPMENT HISTORY CARD FOR A SHALLOW WELL

REVERSE OF CARD

Record of Maintenance/Repair

Date	Work carried out	Materials, Spares, etc., used	Time of work	Cost	Signature

6.4 Cost Analysis

- Recommended Follow-up Studies

a. 4 weeks expert in handpumps and drilling equipment

- total cost	$8,000
TOTAL COST FOR FOLLOW-UP STUDIES	8,000

A summary of the cost analysis is presented in Tables 7 and 8.

- Cost Summary

a.	Wells and handpumps program	$ 9,996,600
b.	Follow-up studies (rig equipment and pump specialist)	8,000
c.	Technical assistance to PLANSABAR	612,000
	TOTAL COST	$10,616,000

Table 7

Well Construction and Handpump Installation Program Cost

February 19, 1986

COMPONENT	1st. Year		2d. year		3d. year		TOTAL	
	Quantity	USD	Quantity	USD	Quantity	USD	Quantity	USD
1. Well construction	250	1.250.000	500	2.500.000	500	2.500.000	1250	6.250.000
2. Purchase Drill Rigs	5	200.000					5	200.000
3. USAID Hand Pumps Importation	250	275.000	500	550.000			750	825.000
4. USAID Hand Pumps Local Manufact.					500	550.000	500	550.000
5. New Well Desinfection, HTH, Kg.	6	100	13	200	13	200	32	500
6. Training Pump Operators workshops	250	50.000	500	100.000	500	100.000	1250	250.000
7. Training of trainers courses	15	30.000					15	30.000
8. Regional O & M Warehouses	5	75.000	5	75.000	5	75.000	15.	225.000
SUB-TOTALS		1.880.100		3.225.200		3.225.200		8.330.500
9. 20% contingencies		376.020		645.040		645.040		1.666.100
TOTAL ESTIMATED COST		2.256.120		3.870.240		3.870.240		9.996.600

Population Served - 225.000 unit Cost = 1.996.600 / 225.000 = 44.43

Table 8

Technical Assistance Program Cost

February 19, 1986

	1st Year		2nd Year		3rd Year		TOTAL	
	Quntity	$	Quantity	$	Quantity	$	Quantity	$
1. T.A. to PLANSABAR to complete design of identified projects	10	10.000					10	10.000
2. T.A. to PLANSABAR. 4 weeks sanitary engineer to identify and prioritise communities for rural projects	1	8.000					1	8.000
3. T.A. to PLANSABAR to design by contract with private consultants, new rural projects	80	240.000	80	240.000			160	480.000
4. Six weeks sanitary engineer for program evaluation					1	12.000	1	12.000
SUB-TOTALS		258.000		240.000		12.000		510.000
4. 20% contingencies		51.600		48.000		2.400		102.000
TOTAL ESTIMATED COST		309.600		288.000		14.400		612.000

Chapter 7

PROGRAM IMPLEMENTATION

There are two subprojects that can be implemented separately: the handpump subproject and the technical assistance subproject. The first provides a technological option to supply water to the very small communities in the rural area. The second subproject is directed toward the institutions (ANDA and PLANSABAR) responsible for the development of water supply and sanitary sewer projects in the urban area. In the following sections the two subprojects are discussed separately.

7.1 Handpump Subproject Implementation

This subproject is divided into two phases: the first one, to be implemented in the short-term, uses the existing installed capacity for well-drilling in areas with known groundwater resources and a need for water that cannot be supplied by other means. The first phase will involve the special studies to assess the applicability of handpumps in areas where there is little information about groundwater occurrence; recommends expanding the well-drilling capacity of local contractors by financing the purchase of small well-drilling rigs; assesses the feasibility of manufacturing the handpumps locally; and assesses the procedures used to organize the community to operate and maintain the wells and the pumps. The second phase, based on the results of the first one, expands the subproject to other areas and takes whatever measures necessary to increase the capability to drill or excavate the wells and to produce the handpumps.

7.1.1 Handpumps Subproject Breakdown Structure

In order to develop the handpump subproject the activities necessary are as follows:

A. Project Unit Establishment

- A-1. Project Agreement with PVO
- A-2. Funds Allocation to PVO
- A-3. Interinstitutional Agreement
- A-4. Project Unit Staffing

B. Community Participation

- B-1. Selection of area and eligible communities
- B-2. Community promotion and organization (1st phase)
- B-3. Community O&M training and health education (1st phase)

C. Engineering and Special Studies

- C-1. Field studies of the selected area (hydrogeology)
- C-2. Design and specifications of wells and pumps

C-3. Design of community participation campaign
C-4. Training material for operation and maintenance
C-5. Bidding documents for well-drilling contracts and materials purchasing
C-6. First phase evaluation and second phase design
C-7. Evaluation of local handpump fabrication capacity
C-8. Operation and maintenance organizational design
C-9. Purchasing operation and maintenance equipment and material
C-10. Operation and maintenance unit staffing

D. Physical Execution (1st Phase)

D-1. Well-drilling contracts
D-2. Construction materials purchasing (screens, casing, hp)
D-3. Well-drilling and handpump installation (FP)
D-4. Handpump operation and maintenance commissioning

E. Second Phase Community Participation

E-1. Selection of areas and eligible communities
E-2. Communities promotion and organization
E-3. Communities O&M training and health education

F. Second Phase Physical Execution

F-1. Well-drilling rigs purchasing
F-2. Local manufacture of handpumps and well screens
F-3. Second phase well-drilling and handpump installation
F-4. Handpump operation and maintenance commissioning

7.1.2 Project Unit Organization

Figure 1 shows an organization chart for the proposed project unit. At the first level are the PVO and USAID; the former is responsible for project implementation, and supports the project manager's efforts. USAID will provide the funding for the subproject and will give overall direction and follow-up to subproject implementation by the PVO. At the next level, are shown the project manager who is responsible for directing, organizing, planning, and controlling the project execution, and the coordinating committee. In this committee both ANDA and PLANSABAR, DIDECO, USAID, and the PVO will be represented. Its function is to give guidance to the project manager in order to avoid conflicts with ongoing projects in the subproject area, to provide standards for the subproject execution, and to be informed of the subproject development. This last aspect is most important, since at the completion of the project, the O&M of the installed handpumps will be turned over to ANDA and PLANSABAR.

Below the project manager are three functional department heads for engineering, community participation, and operation and maintenance; the particular role of each of these functional subdivisions is discussed in the following paragraphs:

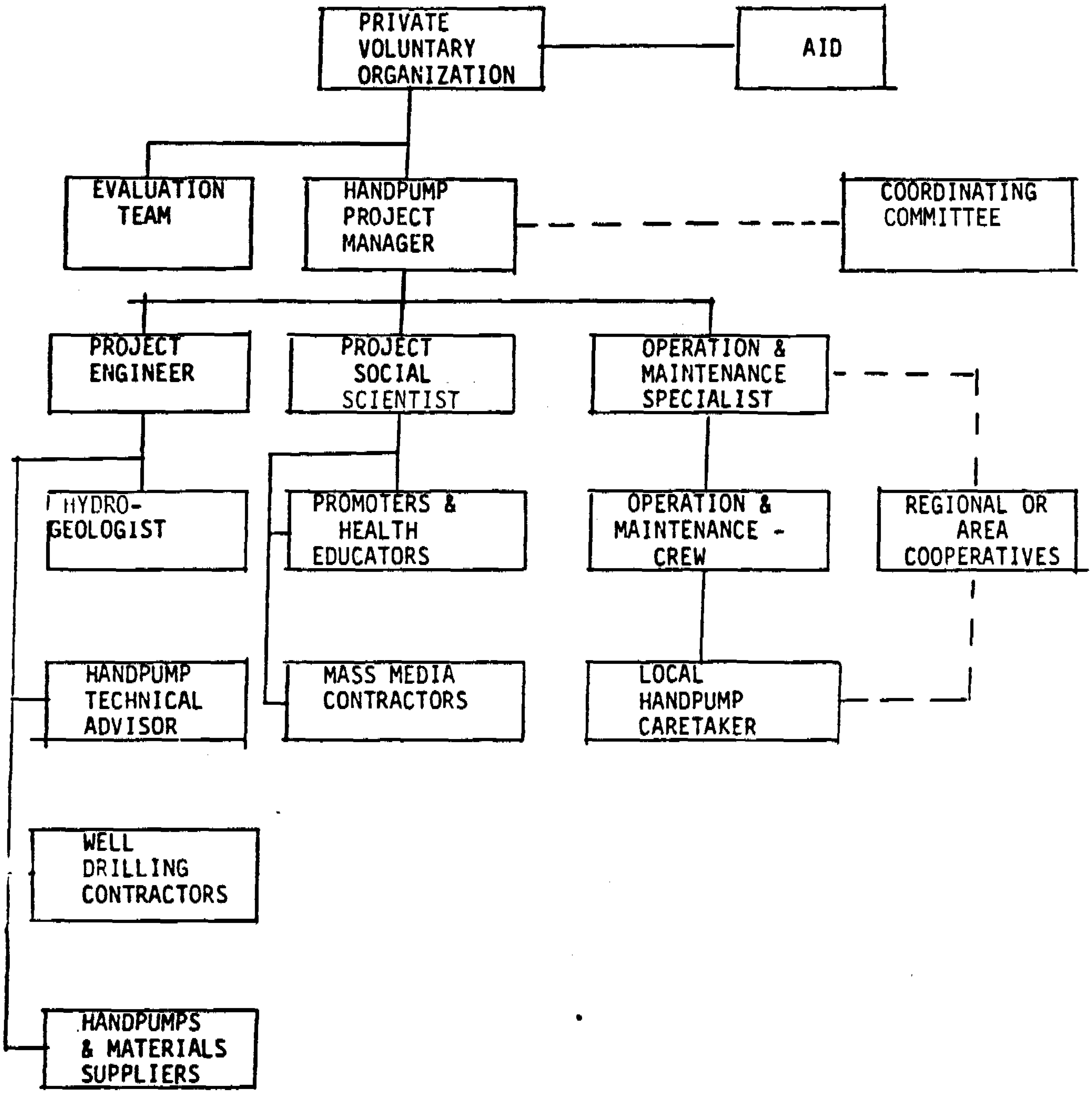

Figure 1. Organization Chart for Project Executing Unit

Engineering

A sanitary engineer will be in charge, with the collaboration of a hydrogeologist. This department will be responsible for:

- Developing technical criteria for community selection
- Field studies to select communities and to select well locations
- Design of wells, and specifications for drilling or excavation
- Bidding document preparation for purchasing of construction materials (screens, casing, handpumps) and well drilling
- Supervision of well-drilling and handpump installation
- Liaison between the handpump technical advisor and the PVO.

The handpump technical advisor could be an international institution or university, with ample experience in this field, to help in the selection of the handpump, the preparation of O&M manuals, and the training at regional and community levels, and to advise on the operation and maintenance system. They also could be responsible for the evaluation of local capabilities for handpump manufacturing.

The hydrogeologist should be a local professional with good knowledge of the geology in the project area, and could be contracted on a consulting or retainer basis.

All the well drilling should be done by local contractors. The construction materials acquisition should be done through international purchasing by the PVO.

Community Participation

The head of this department will be a social science professional, supported by the field promoters and health educators. Responsibilities will be:

- Developing socio-economic criteria for community selection
- Developing training material, and training the field promoters
- Field studies to select communities from a socio-economic viewpoint
- Project promotion with the selected communities
- Community organization for participation during construction and for operation and maintenance
- Designing a health education campaign for the project area
- Supervising the health education and community participation campaign developed by mass media contractors
- Field studies to evaluate project impact, baseline study and annual evaluations.

The community participation and health education campaign will be developed by the promoters and health educators at the local level, supported by mass media messages designed by contractors working in the project area.

Operation and Maintenance

This department will be headed by a specialist in rural water systems, who will supervise the O&M crews that will work at the regional level, giving supervision and support to the local operators. The main responsibilities will be:

- Producing O&M training material
- Developing training sessions for the personnel at regional and local levels
- Bidding document preparation for purchasing of vehicles, equipment, tools, and spare parts for handpump maintenance
- Operation and maintenance organizational design
- Planning and scheduling preventive maintenance activities
- Supervision of preventive maintenance done by local operators and execution of corrective maintenance that cannot be done at the local level
- Handpump operation and maintenance commissioning to the local institution at the end of the subproject.

First Phase Project Evaluation and Second Phase Project Design

Before the end of the first phase, a team from an outside organization such as WASH will be charged with the task of evaluating the project first phase, and with designing the second one, so both will overlap.

During the second phase, several decisions will be made concerning:

- Expansion of the project to new areas
- Local manufacture of well screens and handpumps
- Need to increase the well-drilling contractors by acquiring new smaller well-drilling rigs that can be easily transported through narrow dirt roads.

Based on the previous decisions, the second phase of the project will be launched. For the purposes of this report, it was assumed that the project will continue, that the well-drilling contractors will need extra equipment, and that the handpumps will be locally manufactured. The second phase was scheduled and budgeted with these basic assumptions.

7.1.3 Institutional Arrangements

There must be an agreement about the following aspects of institutional arrangements:

PVO Selection and Contracting

Even though a PVO that could manage the project was identified (HOPE Project), the possibility exists that another more suitable one might be found. Some time should be allocated to make a final decision and some time is required to negotiate, approve, and sign the cooperative agreement between the PVO and USAID.

Coordinating Committee Creation Agreement

In order to make sure that the project will not conflict with ongoing efforts, it is proposed that a coordinating committee be created, with representation of the relevant national and international agencies. The coordinating committee will meet at least semi-annually to formulate policies, review progress, and serve as the official spokesman of the project. The committee will initially include representatives of the following institutions:

- ANDA
- PLANSABAR
- Pan American Health Organization
- Community Development Division of the Ministry of the Interior
- USAID
- National Committee of the Displaced Persons (CONADES)

Technical Assistance in Handpump Technology

As the use of handpumps in a widespread fashion has not been practiced in El Salvador; an institution with ample experience in this field should be contracted to assist in the project execution.

7.1.4 Project Scheduling

Table 9 shows the timing of the activities listed in Section 7.1.1 divided into three main time slices. The first one is a six-month period to start the project; the second one is a twelve-month period for the first phase of the project. The third one is a two-year period; during this time the handpump manufacturing will be started (providing half of the required pumps) and 80 percent of the handpumps will be installed.

7.2 Technical Assistance Subproject Implementation

USAID has funded, through ORE, the construction of water distribution network extensions in several urban areas. The managing of this effort is being done by a private consulting firm, acting as a coordinating unit, and the design and construction is being done by local consultants and contractors.

ORE is also financing the construction of rural water systems to be designed and supervised during construction by PLANSABAR. The design and construction supervision is being done by PLANSABAR regular staff, as this staff is also responsible for the design and construction of systems financed by IDB and by the government. Delays become larger because PLANSABAR faces gasoline shortages and worker strikes that slow down the design production.

In order to speed up the design work ORE has contracted with local consultants to design some systems that PLANSABAR has not been able to finish (the field work was finished but not the design work and drawings).

According to PLANSABAR, all the ORE funds would be committed with ten more water systems.

Table 9

Implementation Schedule

PROJECT START-UP March-August 1986	PROJECT FIRST PHASE September 1986 to August 1987	PROJECT SECOND PHASE September 1987 to August 1989
A.1 - Project Agreement with PVO	B.2 - Communities promotion and organization	E.2 - Communities promotion and organization
A.2 - Funds Allocation to PVO	B.3 - Communities O&M training and health education	E.3 - Communities O&M training and health education
A.3 - Interinstitutional Agreement	C.6 - First phase evaluation and second phase design	F.3 - Well drilling and handpump installation
B.1 - Selection of Area and eligible communities (ph 1)	C.7 - Evaluation of local handpump fabrication capacity	F.4 - Handpump O&M commissioning
C.1 - Field studies of the selected areas	D.3 - Well drilling and handpump installation	F.5 - Local manufacture of hand-pumps
C.2 - Design and specification of wells and pumps	D.4 - Handpump O&M commissioning	
C.3 - Design of community participation campaign	E.1 - Selection of Areas and eligible communities (ph 2)	
C.4 - Training materials for O&M	F.1 - Well drilling rigs purchasing	
C.5 - Bidding documents for well drilling contracting and materials purchasing	F.2 - Local manufacturing of handpumps	
C.8 - O&M organization design		
C.9 - O&M materials purchasing		
C.10- O&M unit staffing		
D.1 - Well drilling contracting		
D.2 - Construction materials purchasing		

The technical assistance subproject consists of financing, through ORE, the design of ten rural water systems with an estimated cost of ₡100,000 (approximately $20,000) over a six month period.

According to data provided by PLANSABAR, they have at present 10 uncompleted designs on the ORE/USAID line that could require an additional funding estimated at US$20,000 to complete them in a six-month period.

Due to a shortage of time, the team was not able to review all the unfinished and waiting list design projects. The team feels that PLANSABAR could prepare sets of eight projects each and contract out the designs to qualified private consulting firms. Ten of these packages could be released per year at an average cost of $24,000 each. The total technical assistance for this item would be $240,000 per year. To achieve better results, the team suggests that USAID provide four weeks of technical assistance with one sanitary engineer to help PLANSABAR identify and prioritize communities which do not have water systems or have systems that need to be improved. This technical assistance could help PLANSABAR answer USAID's request to speed up the preparation of projects to be implemented.

Furthermore, the team suggests that the construction supervision be contracted with private consultant firms. At this stage, the team has no basis to estimate the cost of that part of the component. As a result of the analysis, the technical assistance to the PLANSABAR component could be summarized as follows:

• Technical assistance to complete design of 10 systems. March to July 1986	$ 10,000
• Four weeks for a sanitary engineer to help identify and prioritize rural projects.	$ 8,000
• Design of 80 new projects through private consultants. July 1986 to June 1987	$240,000
• Design of 80 projects through private consultants. July 1987-1988	$240,000
• Six weeks for sanitary engineer to evaluate progress and design strategies for implementation and supervision activities. 1987	$ 12,000

Chapter 8

CONCLUSIONS

1. There is a need to implement a drinking water supply program to serve the rural population now living in small communities, cooperatives and camps for displaced people. The periurban fringe population needs to be served with a non-permanent supply until ANDA extends its distribution systems.

2. El Salvador has appreciable groundwater resources that could be utilized to supply drinking water for the population mentioned above. The country has a good knowledge of those resources, and has developed technical human resources within the institutions and in the private sector.

3. ANDA and PLANSABAR have all their resources committed to ongoing projects and have no possibility of taking on more responsibilities.

4. The country has institutional and private experience in drilling wells in the rural regions for different purposes. The private sector shows the capacity to increase production if sufficient projects are offered.

5. Following tradition, rural communities would be willing to participate in all phases of a water supply program and assume responsibilities for the O&M cost.

6. Training is necessary for all the community caretakers in the program under the supervision of regional institutional supervisors.

7. To have an adequate O&M service, it would be necessary to organize regional level warehouses with sufficient resources and flexibility.

8. To define what handpump and well drilling is the most appropriate for the country, a follow-up study is necessary and should include an indepth analysis of the local possibilities for manufacturing handpumps in the country.

9. Due to their present commitments, ANDA and PLANSABAR have a large quantity of unattended community requests for service. In order to expedite the preparation of projects and their implementation, both institutions need specialized technical assistance, particularly in the selection and prioritizing of projects.

10. El Salvador has high quality technical capability in the private sector to develop the engineering and hydrological requirements for the design and construction of rural water supply schemes.

11. The most appropriate way to supply low-cost drinking water systems to the rural and urban-fringe population in El Salvador (given the mission's criteria for quick implementation) is to drill wells of 15 to 30 m depth, operated with handpumps. These schemes are also easy to maintain by the community itself and are less subject to sabotage.

Chapter 9

RECOMMENDATIONS

1. The construction of 1,250 wells is recommended over a period of three years. The depth requirements will be 15 to 30 m and the water must be drawn by a handpump. The O&M procedures should be the responsibility of the same community through a trained caretaker and under the supervision of a regional office staffed with trained supervisors and provided with sufficient spare parts, tools, one vehicle, training materials, and other resources.

2. A PVO in El Salvador should be selected, if possible, to manage the program under a special agreement between USAID and government institutions.

3. To speed up program implementation, it is recommended that the construction of wells and pump installation be made through private companies.

4. It is strongly recommended that a follow-up study be conducted with WASH assistance to definitely select the most appropriate drill rigs and handpumps for the country. Also, feasibility studies should be conducted on the local manufacturing of the selected handpump.

5. Special technical assistance is recommended to enable PLANSABAR and ANDA to identify projects and use private consultants for the design and implementation of water supply systems for the communities that have already requested their assistance and are not included in the ongoing projects.

Additional details of the recommended program are discussed in Chapter 7 of this report.

APPENDIX A

Persons Interviewed

Interviewed Persons:

Mr. Charles Brady -	General Development Officer AID - Tel. 26-7100
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Leopoldo Reyes -	Program Specialist
John Cloutier -	Office of Projects
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APPENDIX B

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