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PLAN FOR HEALTH IMPACT EVALUATION OF THE HEALTH SECTOR II BILATERAL ASSISTANCE PROJECT IN THE DOMINICAN REPUBLIC

WASH FIELD REPORT NO. 23

SEPTEMBER 1981

Prepared For:
USAID Mission to the Dominican Republic
Order of Technical Direction No. 21

WATER AND SANITATION FOR HEALTH PROJECT

WASH

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September 30, 1981

Mr. Phillip Schwab
Mission Director
United States Agency for International Development
Santo Domingo

Attn: Dr. Oscar Rivera Rivera

Dear Mr. Schwab:

On behalf of the WASH Project I am pleased to provide you with fifteen copies of a report on a "Plan for Health Impact Evaluation of a Health Sector II Bilateral Assistance Project in the Dominican Republic." This is the final report by Mr. Paul Howard and Dr. Robert Struba and is based on their trip to the Dominican Republic from April 1 to April 24, 1981.

This assistance is the result of a request by the Mission on November 10, 1980. The work was undertaken by the WASH Project on January 26, 1981 by means of Order of Technical Direction No. 21, authorized by the USAID Office of Health in Washington.

If you have any questions or comments regarding the findings or recommendations contained in this report we will be happy to discuss them.

Sincerely yours,

Dennis B. Warner

Dennis B. Warner, Ph.D., P.E.
Director
WASH Project

DBW/RS
Enclosure

cc: Mr. Victor W.R. Wehman, Jr.
USAID/WASH Project Manager

WASH FIELD REPORT NO. 23

DOMINICAN REPUBLIC

PLAN FOR HEALTH IMPACT EVALUATION OF THE HEALTH SECTOR II BILATERAL ASSISTANCE PROJECT IN THE DOMINICAN REPUBLIC

Project No. 517-0120

Prepared for USAID Mission to the Dominican Republic
under Order of Technical Direction No. 21

Prepared by:

Paul F. Howard, P.E.
and
Robert J. Struba, Ph.D.

September 1981

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TABLE OF CONTENTS

Chapter		Page
	LIST OF ABBREVIATIONS USED	iv
	REPORT SUMMARY	v
	ACKNOWLEDGEMENTS	vii
	MAP OF DOMINICAN REPUBLIC HEALTH REGIONS	viii
1.	INTRODUCTION	1
2.	PROJECT BACKGROUND	2
	2.1 Project Evaluation	3
	2.2 Outline of the Report	4
3.	HEALTH INTERVENTIONS	6
	3.1 Water Supply Program	6
	3.2 Excreta Disposal (Latrine) Program	8
	3.3 Health Education Program	9
4.	GENERAL NATURE OF HEALTH IMPACT STUDIES	10
	4.1 What is an Impact Study?	10
	4.2 Significant Features of Impact Studies	10
	4.3 Types of Impact Studies	15
	4.4 Impact Study Conditions in the Dominican Republic	16
5.	EVALUATION ASSUMPTIONS	18
	5.1 Point of View	18
	5.2 Scope of Study	18
	5.3 Evaluation Guidelines	19
6.	STUDY DESIGN	20
	6.1 Background Statement and Chapter Outline	20
	6.1.1 Introduction	20

6.2 Evaluation Questions and Overview of Project..... 21

6.2.1 Evaluation Questions..... 21
6.2.2 Impact Assessment Model..... 21
6.2.3 Evaluation Overview..... 23

6.3 Available Institutional and Data Resources..... 24

6.3.1 Background Statement..... 24
6.3.2 Institutional Resources..... 24
6.3.3 Data Resources..... 25

6.4 Study Design and Research Methods..... 26

6.4.1 Background Statement..... 26
6.4.2 Study Design..... 27
6.4.3 Sample Size Considerations..... 33
6.4.4 Selection of Study Units..... 37
6.4.5 Data Collection and Processing..... 39
6.4.6 Data Analysis and Interpretation..... 49

7. MONITORING..... 56

7.1 General..... 56

7.2 Water Supply Program..... 58

7.2.1 Construction Considerations..... 58
7.2.2 Operation Considerations..... 63
7.2.3 Maintenance Considerations..... 64

7.3 Latrine Program..... 65

7.3.1 Construction Considerations..... 65
7.3.2 Operation Considerations..... 66
7.3.3 Maintenance Considerations..... 66

7.4 Health Education Program..... 67

7.4.1 Planning Considerations..... 67
7.4.2 Operation Considerations..... 69
7.4.3 Maintenance Considerations..... 71

8. RECOMMENDATIONS..... 73

REFERENCES..... 75

APPENDICES

A. Order of Technical Direction No. 21..... 79
B. Report of a Field Trip to Five Communities in the Provinces of Bani and Azua..... 84
C. Itinerary..... 95
D. Technical Information from Health Sector II Project Documents..... 100

FIGURES

1. Impact Evaluation Model for Health Sector Loan II.. 22
2. Evaluation Plan Study Design..... 28
3. SBS Health Data..... 35
4. Mid-Upper Arm Circumference (3rd to 5th percentile) 43
5. Improved Water and Sanitation as Related to Nutrition Status..... 44
6. Example of Precoded Data Gathering Form..... 50

LIST OF ABBREVIATIONS USED

GODR	-	Government of the Dominican Republic
SESPAS	-	State Secretariate for Public Health and Social Assistance, GODR
SBS	-	Basin Health Services program (began under Health Sector Loan I)
UAPODAN-SESPAS	-	Unit for Potable Water and Disposal of Wastewater, which is the SESPAS coordinating agency for Health Sector Loans I and II
UTOC-SESPAS	-	Technical Field Operations Unit
HSI	-	Health Status Indicators
SES	-	Socio-Economic Status
PVC	-	Polyvinyl Chloride
CDC	-	Center for Disease Control
psi	-	pounds per square inch

REPORT SUMMARY

The following report presents a detailed plan for a two-year evaluation study of the health impacts of the ongoing Health Sector II project in the Dominican Republic. The project proposes to provide water, latrines and health education in approximately 500 rural communities. It is recommended that a consultant be contracted to conduct the evaluation which is described in detail in Section 6.4 of Chapter 6.

Health status data gathered for the evaluation will be collected by the local health promoters in 130 communities organized in two categories of study groups. Data collection forms should be similar to those now used by the promoters although the present form should be modified, principally to facilitate the input of data for computer analysis.

The health impact evaluation consists of the analysis of the promoters' data in order to describe the relationships between the use of the proposed health interventions by rural villagers and changes which may occur in their health status. The plan presented in this report purports to do this in a statistically valid and scientific manner. A major goal of this report is to develop a fundamentally sound procedure for impact studies which is transferable to projects in other developing countries. This would make it possible to compare the results of impact evaluations between different projects and across national borders. The consequent increase in knowledge should provide the potential for improving project planning efficiencies for the benefit of both donor and recipient aid countries.

The first category of evaluation study groups, consisting of four groups of 25 communities each from one health region (i.e. category one communities), will be used to evaluate health impacts of the project in terms of its effect on infant and pre-school mortality and anthropometry (height, weight, and mid-arm circumference). It is not recommended that diarrheal morbidity be included as a measure in the evaluation. Each of the four groups will be provided with various combinations of the project's interventions: Group A with water, Group B with water and latrines, Group C with water, latrines, and health education and Group D with no interventions so as to serve as a control group. The control group communities should be randomly selected immediately if Region I is to be used for category one communities. If 30 percent of the project's target communities in Region I have already received potable water, however, then category one communities should be randomly selected from another region (preferably Region IV).

The second category of study groups, consisting of one group (Group E) of 30 communities (15 from each of the two health regions which are not included in the first category), will be used to measure operation and performance level indicators (see Figure 1, Chapter 6) in order to help generalize and interpret the evaluation results. Routine health data will also be collected by the promoters in this group of villages.

Project monitoring is essential for the success of the evaluation. Data gathered by promoters should be checked using the same procedure as that used in the Health Sector I project. New forms should be prepared to monitor the project's operation and performance indicators, which are described in detail in Chapter 7. The indicators include observations on the implementation, functioning and use of the health interventions. Monitoring should be done by consultants and not by project personnel, and it should be done soon after the evaluation begins and at regular intervals thereafter (see Figure 2, Chapter 6). Since the community as a whole is the basic unit of measure for the evaluation, entire communities should be monitored and not just portions of communities.

The major focus in data analysis will be differences in infant and preschool mortality rates and various comparisons of anthropometric measures. Section 6.4.6 of Chapter 6 describes the data analysis and suggests several more involved analytical approaches.

In installing wells, greater attention should be given to aligning the pumps vertically, allowing an inch of well casing to protrude above the pedestal, cleaning and disinfecting the wells, and monitoring water quality before placing in service wells which are especially susceptible to contamination. These and other characteristics of the health interventions which are important to monitor are discussed in Chapter 7.

The report recommendations are presented in Chapter 8.

It is estimated that approximately 2,500 person-days would be required to carry out the evaluation plan as presented herein, including the monitoring program. This level of effort estimate does not include time spent by promoters in gathering data nor by those who will summarize the data.

ACKNOWLEDGMENTS

The writers wish to acknowledge the assistance and guidance of Oscar Rivera Rivera, M.D., the Health Officer at the USAID Mission in Santo Domingo, who devoted his own time and that of his staff in order to facilitate and orient the work of preparing this report.

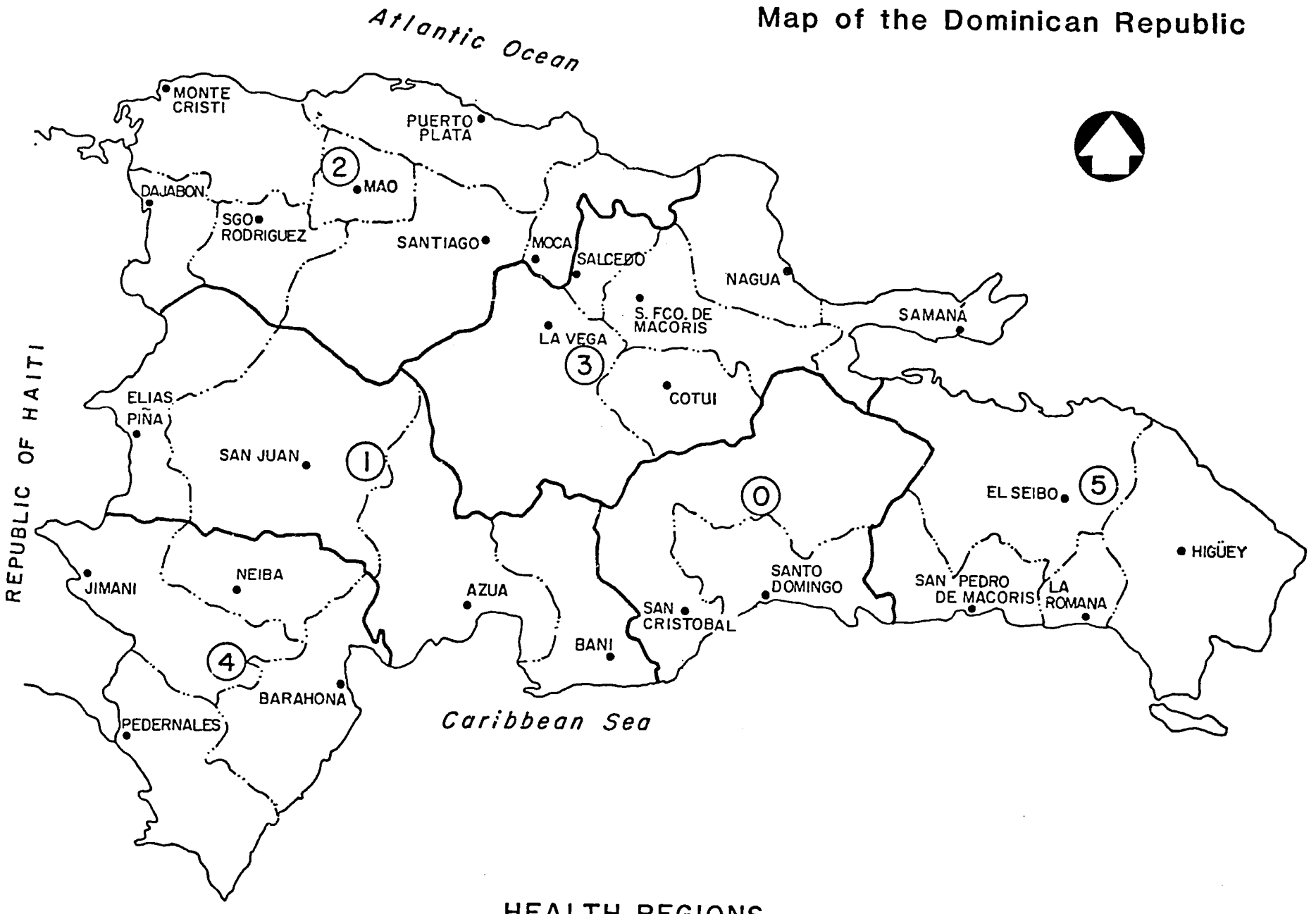
Ms. Dulce Jimenez, Mr. John Thomas and Eng. Elpidio Caba of the USAID Mission were also very helpful.

Dr. Jose M. Herrera Cabral, Director of the UAPODAN unit of SESPAS, and Oscar Hungria, Director of the UTOC unit of SESPAS, also assisted the writers in gathering information for the evaluation plan presented in this report.

The writers acknowledge the extensive logistical and secretarial assistance of Ms. Diana de Baez, Dr. Rivera's secretary, in conducting their work in the Dominican Republic.

The Health Sector I and II projects have been well thought out and address in a positive manner many problems which have made the success of similar projects in the past less than that desired. The people living in the rural communities of the Dominican Republic appear to be candid, confident and eager to help themselves.

Map of the Dominican Republic



HEALTH REGIONS
STATE SECRETARIAT OF PUBLIC HEALTH AND SOCIAL ASSISTANCE
DOMINICAN REPUBLIC

Chapter 1

INTRODUCTION

The USAID Mission in Santo Domingo has requested the assistance of the Water and Sanitation for Health (WASH) Project in order to design an evaluation plan to assess the health impact of the Health Sector II project on the rural population of the Dominican Republic.

The USAID Mission requested the assistance on November 10, 1980 in cable 8756 (see Appendix A). The WASH Project was authorized to undertake the work by the AID Office of Health in Washington under Order of Technical Direction (OTD) No. 21, dated January 26 1981 (See Appendix A). Between April 1 and April 24, 1981 two WASH consultants, Paul F. Howard, M.S., P.E., of Camp Dresser and McKee, Inc. (CDM) and Robert J. Struba, M.S., Ph.D., an epidemiologist at Research Triangle Institute (RTI), worked in the Dominican Republic with USAID Mission personnel to prepare a plan for the health impact evaluation of the Health Sector II project.

Concurrent with the preparation of this evaluation plan, another WASH consultant working in the Dominican Republic, Charles E. Llewellyn, III, M.P.H., a health education consultant for RTI, prepared a plan for the health education component of the Health Sector II project.

Chapter 2

PROJECT BACKGROUND

In August 1978 the U.S. Agency for International Development (USAID) approved Health Sector Loan II for bilateral assistance to the Government of the Dominican Republic (GODR) in a five-year project intended to improve conditions of health among Dominicans living in small rural villages.

It has been estimated that 30.2 percent of all infant deaths and 27.4 percent of all deaths in the one-to-four-year age group are due to diarrhea, gastroenteritis and parasitic disorders. It is assumed in the project paper, therefore, that provision of potable water, latrines and health education will reduce significantly the incidence of diarrhea and thus the mortality in the two age groups. The goal of the Health Sector II project, as stated in the project paper, is to reduce the mortality rates of infants and of children in the one-to-four-year age group.

The USAID share of the project is $8,000,000 and the GODR share is $2,100,000. The local villagers' share is $1,100,000 as either cash or in-kind contributions.

The Health Sector II project continues rural health improvement efforts which were begun under a Health Sector I project in 1975. The goals of the Health Sector I project, as stated in the project paper, were to reduce infant and pre-school mortality by 15 percent in three years and to reduce the crude birth rate by 15 percent in five years. The goals were to be met by improving the delivery of health services in rural communities with populations between 400 and 2,000 people through a Basic Health Services (Servicio Basico de Salud, SBS) program. The program was to operate in the six health regions into which the country is divided (see map on page viii). Before this program, only a limited number of rural clinics and hospitals offered health services, but they were under-utilized, in part due to their poor quality.

The SBS program trained auxiliary health workers, called promoters, who are residents of the communities where they work. Each promoter is charged with visiting the assigned families (usually 70 to 80 families per promoter) twice a month to record vital statistics (births, deaths, and migrations), immunize children against diptheria, pertussis, tetanus, polio and measles and provide basic orientation needed by the families in health, nutrition and family planning.

During their home visits the promoters distribute aspirin, cough medicine, antidiarrhetics, condoms and contraceptive pills as needed. They advise the family on the preparation and utilization of oral rehydration fluids, make referrals for IUD insertion and female sterilization and, if necessary, refer patients to the nearest rural clinic or hospital. In addition to recording vital statistics they record the weight, height and, at times, arm circumference of all children under five years old. The arm circumference measurements are now becoming a regular procedure for the promoters.

The promoter reports to a supervisor, who manages ten promoters, and the supervisor reports to a supervising manager who is in charge of twenty supervisors. The SBS program is administered by the State Secretariat for Public Health and Social Assistance (Secretaria Estadual de Salud Publica y Asistencia Social, SESPAS) of the GODR. To date about 5,350 promoters have been trained and are working in about 5,000 communities in the six health regions throughout the country. Each promoter was selected by a health committee formed by and composed of community residents. The committee is charged with reporting to the supervisors on the work of the promoters. The promoters were trained for three weeks in the basic services which they provide and for an additional week in nutrition.

The Health Sector II project will extend the work of the SBS program into additional communities to reach another 200,000 people and to provide the three health-related interventions listed below to 500 rural communities with populations between 400 and 2,000 people. The project is to operate in three of the country's six health regions. The three interventions are described in detail in the next chapter. They are:

1. Potable water systems
2. Sanitary latrines (pit privies)
3. Health Education

The SBS program will also be expanded to cover 100 communities already served by rural clinics, and the 100 rural clinics and 20 small hospitals will be upgraded so that patients referred to them can receive adequate care.

2.1 Project Evaluation

In order to monitor the progress of the project in delivering the three interventions listed above during the project's five-year duration, five progress-to-target evaluations will be completed by the tenth, nineteenth, thirty-first, forty-first and fiftieth months of the project. These evaluations will be designed and carried out by SESPAS, under the direction of USAID, and are not the subject of this report.

In order to assess the impact of the project in improving the health of the target population, a detailed goal evaluation will be undertaken to compare health status indicators (HSI) in communities receiving various combinations or all of the three interventions with HSI's in control villages, that is, in villages which will not receive any of the interventions. The project paper proposes that a "difference of proportions test" be used to determine the level of statistical significance, and proposes the use of 95 percent confidence limits. This is the principal evaluation concept in the project and is the main subject of this report. A preliminary report of the evaluation is to be completed during the last month of the project, and subsequent reports will be made thereafter. The intent of the impact (goal) evaluation is to [illegible] whether or not the three interventions have brought about a reduction in the mortality rates of infants and of the one-to-four-year age group. It is hoped that, in addition to measuring the impact of this project, the evaluation will make it possible to establish more clearly quantifiable indicators in future projects.

The Health Sector II project provides an opportunity to expand the state of knowledge concerning the relationship between infant mortality and the project interventions of water supply, excreta disposal and health education. As part of the impact evaluation, therefore, the project paper proposed to test two hypotheses as follows:

1. "two years after the interventions have begun to function infant and pre-school child (ages one to four years) mortality will be lowest in those villages receiving all three interventions, highest in those receiving water supply improvements only and will occupy an intermediate position in those villages receiving water supply and excreta disposal improvements, and

2. "two years after the interventions have begun to function the incidence and prevalence of diarrhea, as well as the mean duration of episodes of diarrhea, will be lowest in those villages receiving all three interventions, highest in those receiving water supply improvements only and will occupy an intermediate position in those villages receiving water supply and excreta disposal improvements."

The project paper proposed the use of analysis of variance to test for the level of significance of any differences observed in the parameters specified in the above two hypotheses between control villages and those receiving the health interventions.

The following report is a detailed description of evaluation methods, techniques and controls and the monitoring efforts required in order to insure a reasonable degree of validity in the results of the evaluation. The plan does not list specific villages to be selected for data collection nor does it provide a detailed questionnaire with specific directions for coding, collating, and statistically analyzing the data. This plan should serve as a guide, and its recommendations should be modified if actual field conditions warrant it.

2.2 Outline of the Report

This report describes the three health interventions proposed in the Health Sector II project: water supply, excreta disposal and health education. The report also discusses the general nature of impact studies and the practical assumptions made in them.* The evaluation design discusses the details of the study design, criteria to be used in the selection of communities, parameters to be measured and analysis of data. The details to be considered in monitoring the implementation, functioning and use of the three interventions is then discussed as they relate to the validity of the evaluation measures and, ultimately, results. A series of recommendations concludes the report.

---

*Much of the material in the chapters which discuss impact studies and assumptions was obtained with modification from a report entitled Proposals For an Impact Study of the Philippines Provincial Cities Water Supply Project, which was prepared for the USAID in January 1975 by Joan Silver, Jack Keeve, and Dennis Warner.

In order to insure that the evaluation plan was prepared with a realistic understanding of the project and the locales in which it is being carried out, several rural communities were visited before developing the plan. A report of these visits is included in Appendix B. A summary agenda of the activities of the WASH consultants in the Dominican Republic is included in Appendix C. Appendix D contains technical information from Health Sector II project documents.

Chapter 3

HEALTH INTERVENTIONS

3.1 Water Supply Program

The water supply program consists of both drilled wells with hand pumps and gravity-fed systems. Appendix D contains figures and other data concerning the water supply program. The project envisions the installation of 2,250 water supply outlets (i.e., either pumps or faucets). The drilled or driven wells consist of 6-inch diameter steel casings driven into the groundwater aquifer. A 1-1/2-inch galvanized steel drop pipe, with a pump screen on the bottom, is lowered deep enough into the casing so that the screen is about 10 feet above the bottom of the well and about 10 feet below the water level. There is a foot valve at the top of the screen. In the case of deep wells, those greater than 6 meters deep, a 3-inch diameter plunger pump is attached to the bottom of the drop pipe, between it and the pump screen. The plunger has two leather seals and a foot valve in the center. A 1/2-inch steel rod extends the entire depth of the drop pipe to connect the plunger with the hand pump handle above the ground. In the case of shallow wells, the plunger pump is contained in the pump assembly above the ground surface. In both types of wells a portion of the steel casing that is within the groundwater is perforated with vertical slits about 1/4 inch wide and one foot long which are burned through the wall of the casing in order to allow groundwater to enter the casing and be pumped up through the pump screen and plunger pump.

The steel casing extends approximately 18 inches above the ground surface. An unreinforced concrete apron, about 5 feet square, is constructed on tamped soil and centered on the well casing. The apron has a 3-inch high curb around its edges and is pitched to an opening at one corner for drainage. A reinforced concrete pedestal about 24 inches by 18 inches, in plan, is cast around the casing. The top of the pedestal is supposed to be about 1 inch below the top of the casing. The pedestal is positioned so that the casing is eccentric in it in order that most of the pedestal can serve as a platform on which to rest water containers while they are being filled. Four bolts, 3/8 inch in diameter, are cast into the concrete around the well casing in order to bolt the pump base to the pedestal after the concrete has been finished smooth and allowed to cure. The top of the casing is supposed to be closed with a plate welded to its opening from the time the well is drilled until the pump assembly is installed.

The hand pump assembly mounted on top of the pedestal is the AID-Battelle hand pump which uses a lever arm and fulcrum to provide the mechnical advantage necessary to move the piston rod up and down to suction water into the pump chamber and subsequently lift it to the faucet of the pump. The lever arm is attached to the fulcrum and piston rod by a 1/2-inch diameter steel rod which is held in place by cotter pins. The rod which connects the lever arm to the piston rod moves up and down in a vertical, lubricated guide about 10 inches long at the top of the pump assembly.

While the authors were in the Dominican Republic, a modification of the well construction was being tested by Mr. Robert Knight, also a WASH consultant to the USAID Mission. Instead of a 1-1/2-inch galvanized steel drop pipe, a 2-inch PVC drop pipe, with glued joints, is to be used. The drop pipe is connected to the base of the pump with a PVC-IPS (Iron Pipe Size) threaded adaptor. A PVC pump screen is glued to the bottom of the pipe with a PVC coupling. A plastic foot valve is fastened inside the coupling. The pump screen consists of a length of 2-inch diameter Schedule 40 PVC pipe which is slotted with a continuous, spiral cut around its perimeter. About one-half of the wall thickness is reamed out from the inside of the pipe, but six, 1/4-inch-wide longitudinal ribs of the full wall thickness are left inside for support. A 2-inch diameter plunger, with two leather seals and a poppet foot valve in the center, is connected to the 1/2-inch galvanized steel piston rod and lowered into the drop pipe. The advantage of this modification is that the plunger can be withdrawn from the well for replacement of the seals without removing the drop pipe. With the 1-1/2-inch galvanized steel drop pipe, the pipe, pump cylinder and screen have to be removed in order to replace the seals. Thus, the modifications should facilitate pump maintenance.

Each gravity-fed system consists of a mountain spring which is capped and from which water is conducted to a tank down slope which serves as a storage and settling tank as well as a pressure equalization tank. A graded sand and stone filter is constructed near the spring in order to remove gross particles from the water before it passes on to the tank. The filter is expected to be cleaned and renewed once a year. From the storage tank the water descends the hill in 2-inch diameter PVC pipe and is then distributed in smaller pipes to public fountains located throughout the villages served by the systems.

Each fountain consists of a 6-inch concrete block wall about 6 feet high with two lower 6-inch concrete block walls extending about 3 feet from the two ends of the high wall (back wall) and perpendicular to it. The lower walls, which are about 30 inches high, support a 5-inch thick reinforced concrete platform which spans from one low wall to the other along the length of the back wall. The concrete block walls are plastered with a cement stucco and are painted blue. The entire fountain is built on a concrete apron which extends about 1 foot beyond the structure at the front and the two sides.

The fountain is about 6 feet long where there are two faucets and 4 feet long where there is one. The faucets consist of brass globe valves and are set in the back wall about 4-1/2 feet above the ground. The faucets are supplied with water by 1-inch diameter PVC pipes which are embedded in the wall and are connected below ground to the pipe which distributes water from the tank on the hill. In the center of the platform is a 1-1/2-inch hole with a 1-1/2-inch PVC drain pipe which extends downward 12 to 18 inches and then bends 90 degrees and exits to a low point near the fountain.

A hydrogeological survey is conducted in each region before the water supply program begins. Based on the results of this survey the decision is made as to the type of supply to be provided to each village. In general, the mountainous villages will be supplied by gravity-fed systems and the

low-lying villages by wells. One well or one faucet is provided for every ten houses. In addition to the availability of groundwater, access to the villages by roads is necessary in order to bring in the equipment and material necessary to drill the wells or construct the gravity systems. In many cases the latter constraint excludes some villages from benefitting from the water supply program.

Maintenance of the pumps and fountains and replacement of worn and broken parts is the responsibility of the health committee in each village. In order to fulfill this responsibility, the committee collects 50 centavos (equivalent to US$0.50) from each family per month until 60 pesos (US$60) have been collected to establish a fund to be used to purchase parts and materials. The committee also appoints a maintenance crew.

In addition to providing convenient sources of potable water, the project also intends to provide each home with a 20-gallon covered plastic container with a faucet so that water can be stored in the homes in a sanitary manner. To transport the water from the source to the home 5-gallon plastic containers with handles will be provided to each home.

3.2 Excreta Disposal (Latrine) Program

The excreta disposal program consists of constructing pit privies (latrines) at each house in the villages to be served by the program. Appendix D shows the latrine design. The project envisions the installation of 22,500 privies. The privy consists of a hole dug in the ground about 1 meter square and 1.8 meters deep. Around the edge of the pit, at the ground surface, a stone wall is constructed about 20 centimeters high to hold back the excavated soil, which is mounded against the outside of the wall to provide drainage away from the privy. On top of the wall is placed a reinforced concrete slab 1.10 by 1.20 meters in plan and 5 centimeters thick. The reinforcing bars are 1/4 inch in diameter and are arranged in a grid in both directions in the slab. A pear-shaped hole about 26 centimeters wide and 36 centimeters long is located about 28 centimeters from the rear edge of the slab and centered on the slab in the side-to-side direction. The slab is cast in two pieces with the longitudinal joint coinciding with the long axis of the hole. The slab is assembled in the field by laying the two pieces side by side. The joint is not sealed. A small 3/4-inch diameter hole is also left in a corner of the slab for a vent pipe.

A molded concrete stool 36 centimeters high with a rounded, polished seat is set over the hole in the slab. A wood cover for the seat is attached to hinges set in the top surface of the concrete at the back edge of the stool. A rubber gasket made of an automobile tire inner tube is attached to the cover and positioned so as to provide a good seal with the rounded seat of the stool when it is closed. A metal U-shaped handle is attached to the top of the cover at the front so that the cover can be opened without touching the stool. As an alternative to concrete stools, fiberglass stools with plastic seats may be used.

The above-ground shelter built on the slab is 1.8 meters high at the rear and 2 meters high at the front, where the door is. A pitched roof drains rain to the rear of the privy. The space between the top of the two side

walls and the pitched roof is left open for ventilation and is not screened. The side walls are not built up to correspond to the pitch of the roof. A 3/4-inch PVC vent pipe extends from a hole of corresponding size in the slab to the top of the shelter and ends in a 90-degree bend directed outside the shelter. The choice of material used to build the shelter is up to the villagers. The walls may be of concrete block or wood, and the roof may be of corrugated sheet metal or thatched with palm fronds.

In addition to the type of privy described above, the project also intends to install some water-seal ceramic stools in some villages to see if they would be better to use than the molded concrete or fiberglass stools, which are not water sealed. The water-sealed stool requires that the user bring sufficient water to the privy to flush the stool.

3.3 Health Education Program

The health education component of the Health Sector II project is designed to maximize the health benefits to the community of the water and sanitation programs and to train members of rural communities in health-related aspects of their lives. In order for the individual to realize the health benefits of the project, he or she must have (1) access to the water and latrines which are provided by the program, (2) information as to how to utilize these components most effectively and (3) the motivation and organizational support to do so.

The health education component will provide the latter two elements to the individual and the community through the infrastructure of the health committee, the promoter and the promoter's supervisor. A three-day workshop will be held in one of the communities for groups of five communities. The promoter and five members of the health committee, or other community members appointed by the committee, will attend the workshop.

The context of the workshop will center around these themes: technical information, methodology of transferring this information to the community and methods of organizing, supporting and motivating the individuals in the community to act on the information presented.

After the three-day workshop, a series of continuing one-day workshops will be held for groups of ten communities every three months. The purpose of these one-day meetings will be for supplementary training, problem solving in the water supply and sanitation program and presentation of information on other health problems in the community, especially family planning and nutrition.

The health education program will be conducted by the Technical Field Operations Unit of SESPAS (Unidad Tecnica de Operaciones de Campo, UTOC).

Chapter 4

GENERAL NATURE OF HEALTH IMPACT STUDIES

4.1 What is an Impact Study?

An impact study is essentially an evaluation of the effect of a project upon some conditions or states of being. It is more than a mere assessment of direct project output, for such an output (e.g., water supply) is likely to be only an intermediate step towards some ultimate goal (improved public health). Because of imperfect knowledge, sometimes it is assumed that the attainment of some level of direct project output automatically leads to the achievement of the desired ultimate goal. This violates the logical principle of post hoc non ergo propter hoc (i.e., just because condition B occurs after condition A does not necessarily mean that condition B occurs because of condition A). In order to avoid the implication of this fallacy, reports describing the relationships between project outputs and project goals should explicitly recognize the possibility of, and identify, if possible, tenuous and possibly even spurious relationships between outputs and goals.

The role of an impact study is to provide greater information about these relationships and judge whether initial assumptions concerning output levels and goals were correct. It is an evaluation of the changes occurring in some desired goals as a consequence of the project. This process is, however, no mere measurement. The relationships between the initial project and the ultimate goals are often extremely complicated and poorly understood. A sound evaluation probably will require elements of technical knowledge, logical perception and judgment.

In brief, impact studies can be used to determine the magnitude of project-induced changes in selected variables. This is an essential aspect of evaluating the success or failure of a completed project. In addition, impact studies also can be used to help determine the relationships which are expected between project outputs and desired goals. In this approach, the results are most applicable for the planning of future projects. Whichever approach is used, the essential feature of an impact study is that it involves the actual measurement of changes in variables either directly or indirectly related to the project outputs.

4.2 Significant Features of Impact Studies

Essential to most impact studies is the measurement of variables at at least two points in time in order to determine the net change. The magnitude or project-induced changes is the difference in measurements taken before initiation of the project and again some time after its completion. Thus, before and after measures are key elements in most impact studies. Single measurements typically are not sufficient for the determination of net changes.

Of particular concern in any impact study are the dimensions of time, causality, validity of measurement and occurrence frequency.

1. Time

This dimension refers to the length of time that must elapse between the introduction of an intervention and the resulting change in a variable. A water project which delivers highly polluted water, for example, is likely to have far more rapid (and adverse) effects on health than on agricultural development. Some variables require more time than others for project-induced changes to occur. Since project impacts can include both short-term and long-term changes, impact evaluation may require measurements at several points in time following project completion.

2. Causality

The second dimension, causality, refers to the cause and effect relationship between the project and the variable changes. A direct relationship requires no additional inputs to bring about the variable changes, whereas the need for complementary investments could indicate a degree of indirect causality. Thus, a relatively direct relationship exists between a piped water supply project and the variable of household water-collecting efforts, but a relatively indirect one is found linking such a water project to changes in household income.

3. Validity of Measurement

The third dimension consists of the amount of confidence that can be placed in the measurement procedures. The basic issue is whether such procedures accurately measure the essential characteristics of the goals in question. A measurement of (water-related) infant mortality is not valid if it does not truly describe infant mortality in the study population.

4. Frequency of Occurrence

This dimension refers to the probability that variable changes will occur. Because of the varying influences of project implementation, as well as time, causality and measure validity, expected goals are not always achieved. For example, a number of previous studies have indicated that the introduction of improved water supply leads to reduction in the incidence of certain gastrointestinal disorders. Evidence of a positive relationship between reduction in overall mortality rates and the introduction of improved water supplies is somewhat less direct. The investigation of such relationships, therefore, should be restricted to situations where significant differences are likely to be detected.

In carrying out impact studies aspects of data collection are also critical, especially those of measurement techniques, personnel, sources of data, seasonality, unit of data, and sampling. These are discussed below.

1. Measurement Techniques

There are several different ways to measure project impacts. One method is to measure the entire universe of effects; another is to measure only a selected sample. The former may provide more accuracy, but the latter involves less cost. The decision between the two methods usually is based upon the sizes of the study populations and practical realities in the field. Another aspect of measurement involves the distinction between random and purposive samples. The former type allows equal probability of selection to all members of a population, while the latter type modifies the selection process so that certain portions of the population are picked with greater frequency than others.

2. Personnel

Individuals conducting impact studies must have the technical expertise to understand the issues and resolve inevitable problems. For routine data collection, however, it is often worthwhile to develop technical skills in the investigators only to that level necessary to compile the required information. Additional training may be risky, since over-qualified data collectors sometimes attempt to second-guess or "improve" a standardized methodology.

3. Sources of Data

The four basic sources of data are verbal information, physical measurement, observation and recorded documents. Each has its own features of time, validity and availability. All four types can be found in health impact studies.

4. Seasonality

Water use patterns, as well as various other social and economic responses, are strongly influenced by periodic seasonal cycles, the most common of which is the year. In most parts of the world human activities tend to follow annual cyclical patterns. Water supply usage in agriculture, households and even many industrial and commercial operations is especially affected by the seasons. Furthermore, public health may be affected by seasonal changes in water quality and quantity. Consequently, seasonal and secular variations should be considered in developing an evaluation plan.

5. Unit of Data

In general, individual human beings form the most basic unit of data. Water projects are designed principally to benefit people rather than institutions or abstract communities. Ideally, therefore, the data should allow analysis down to the level of the individual, even if he or she can be described only in statistical terms.

6. Sampling

The accuracy of the conclusions obtained from a sample will depend in part on the size of the sample relative to that of the entire population. An optimal sample size is dependent, among other things, upon the maximum allowable error that can be tolerated in the conclusions.

Before and after studies can be based either upon a single common sample repeated in both studies or upon separate independent samples. Repeating measurements on the same units (i.e., households) in both surveys is more accurate since it allows each unit to act as its own control, thereby reducing the amount of sampling variation that would otherwise occur. The latter procedure, however, is more practical in field situations where many households measured in the first study are no longer available for the second. However, measurements repeated on the same units can be affected by seasonal variation and by other factors unrelated to the intervention under study. For this reason, control groups are often chosen from other communities in the same geographic area.

Finally, a variety of issues concerning data anlaysis are discussed in the following sections.

1. Data Processing

Information collected in an impact study may range from detailed qualitative explanations to numerical indicators. As the total amount of information increases, the problems of data handling and analysis expand. In general, the larger the study, the more advisable it is to restrict information to specific data, preferably those suited to routine hand processing or automatic digital computers. To achieve this end, pilot studies (or information from similar studies done elsewhere) may be necessary to define the likely range of impact results and to avoid open-ended inquiries as much as possible.

2. Level of Measurement

All data can be classified into either nominal, ordinal, interval, or ratio scales according to the degree of power and discrimination existing in the measurement. The least discriminating are the nominal scales which involve only unranked categories, such as colors. Ordinal scales consist of ranked categories, such as personal preferences for food; while interval scales assume both ranked categories and equal intervals between categories, such as the farenheit temperature scale. The most discriminating scales are the ratio scales which include all of the previous features plus a zero point, as is found in most monetary systems. With regard to impact studies, the higher the level of measurement, the greater is the usefulness of the resulting data for the analysis.

3. Sources of Error

Error can occur for either random or systematic reasons. Random errors involve unpredictable deviations from the correct value; hence, they tend to reduce the reliability, or reproducibility, of the data. Systematic errors involve built-in biases in the results; hence they tend to reduce the validity, or truth, of the data. Systematic error sometimes can be taken into account, but random error cannot after sample size is specified.

4. Reliability

The extent to which independent applications of a given measurement yield consistent results is termed reliability. If a measurement procedure is reliable, the independent results obtained by different investigators will have a high degree of agreement. Equivalence is another form of measurement reliability and refers to the amount of agreement that develops between different types of measurements of the same variable. The most common method of improving reliability is to use the most reliable measurement tool and to increase the number of measurements.

5. Hypothesis Testing

It is useful to test the prevailing assumptions regarding project consequences in the format of an hypothesis. Standard forms of hypotheses include "if X, then Y," or "the presence of X leads to the occurrence of Y." However, for purposes of statistical testing, an hypothesis is often stated in its "no effect" or "null" state. An example of an hypothesis stated in its null state would be "there is no association between X and Y." One then sets out to disprove this null hypothesis, thereby establishing that a statistically significant association between X and Y does exist. Judgments concerning the causal extent of this association and the importance of its magnitude will then follow.

An hypothesis is simply an unproven statement concerning the relationship of concepts. Data are collected to test this statement, which, if found false, is either modified to account for the test results or discarded completely. If the data support the statement, the hypothesis is said to be affirmed. In water supply impact studies, a typical hypothesis is "the availability of potable drinking water results in a reduction in diarrheal sickness." To make this hypothesis testable it is necessary to specify criteria for target populations such as the magnitude of diarrheal reduction, measurement techniques and hypothesis rejection levels.

6. Statistical Tests

The basis of rigorous hypothesis testing is statistical inference. Some statistical tests are parametric in nature, in that they utilize the more rigorous interval and ratio scale data, such as water consumption and money transfers. Other tests are nonparametric and utilize the less rigorous nominal or ordinal scale data,

such as social stratification or consumer preferences. In essence, statistical tests are intended to determine whether observed changes in a sample of data can be explained through random processes. If they can, the hypothesis is rejected as being false (i.e., one accepts the null hypothesis of no association).

7. Association vs. Causation

It is tempting to believe that the achievement of a project goal was "caused" by the project and to conclude, therefore, that future projects will produce similar results. It is unlikely, however, that much certainty can be placed on such beliefs. The number of intervening variables between the project and its goals and the continual changing of environmental conditions make causality an extremely difficult concept to demonstrate. Whether the ultimate results of projects are rigidly-controlled outcomes or merely the effects of temporal sequences is not very important. Given the imperfect state of existing knowledge concerning water supply impacts, the critical issue at the present time is the ability to predict and manipulate the effects of projects rather than to understand the full causal implications of the projects. As time passes, causality will be better understood, but the immediate need is for better predictive tools.

4.3 Types of Impact Studies

Since impact studies generally involve changes in certain variables over time, more than one set of measurements must be made. This has resulted in a variety of research designs intended to best measure the variable changes. Essentially, however, most designs can be classified as one of two types: horizontal studies and longitudinal (follow-up) studies. (For more discussion of this, see Chapter 6).

In the case of horizontal studies, two or more similar study populations (i.e., communities which supposedly differ only in the existence of a water supply project) are compared with each other at the same point in time. The population without the water project is considered to be the "before" case while the population with the project is the "after" case. The differences in the measured variables between the two groups are attributed to the presence of the water project in the second community. Horizontal studies have the advantage of providing impact results almost immediately, without the necessity of waiting for the actual impacts to develop. Unfortunately, sometimes the results of these studies are of questionable validity, since it is almost impossible to find areas which are not only similar in all important respects save their water supplies but also similar in their responses to the introduction of a water system. However, if enough information on important covariables can be obtained, adjustment for these differences can often be made in the statistical analysis.

Longitudinal studies can offer more validity but often present more measurement problems than horizontal studies. In the longitudinal case, a study area is investigated before the introduction of a project and again

after completion. Thus, where the horizontal study involves different places at the same point in time, the longitudinal study involves the same place at different points in time. In order to gauge the changes that would have occurred in the study area in the absence of the project, a control area without a project usually is established and investigated at the same times as the study area. The net change attributed to the project is taken to be the net change in the study area after adjusting for the net change in the control area.

Theoretically, longitudinal studies are an excellent basis for the determination of project-induced changes. Their main drawbacks in comparison with horizontal studies are higher costs, unpredictable future situations and the difficulties of maintaining a research effort over long periods of time. In actual practice, a number of variations of these two designs are used in evaluation research (See Chapter 6).

The importance of the control group in both horizontal and longitudinal studies cannot be overemphasized. Without a control group, there is no way that non-project induced changes can be measured.

4.4 Impact Study Conditions in the Dominican Republic

Health impact studies can be successfully carried out in the Dominican Republic. In the first place, the essential background of active host government support at both central (SESPAS) and local (promoters and health committees) levels exists, as described above in Chapter 2. Personnel at both the national and local level appear to support fully the Health Sector I and II projects and have confidence in their eventual success. All this augurs well for long-term impact studies.

As noted in Chapter 2 of this report appropriate consultants should be contracted either to process and analyze the data collected in the communities or at least to indentify the institutions and personnel in the Dominican Republic which could perform these tasks. Consultants should also be contracted to monitor periodically the Health Sector II project. The regular monitoring, however, should be conducted by personnel of the USAID Mission and SESPAS (both UAPODAN and UTOC) in conjunction with the local health committees and the supervising managers, supervisors and health education team. The subject of personnel and the tasks involved in evaluating and monitoring the project are discussed further in Chapters 6 and 7.

The direct implementation of the project and the data collection for the health-impact evaluation are the responsibility of the local promoters, who form the keystone of the entire project as it relates to individuals and families in the communities. The efforts of all others associated with the project should be directed to facilitate and make as effective as possible the work of the promoters.

Up to now the household surveys conducted as part of the Health Sector I program have been an effective means of collecting information. For the most part, rural Dominicans appear to be willing to give information on their personal health and household activities. The data collected by the promoters are evidence of this and are sought by various government

agencies as the most reliable data on rural vital statistics. It is expected that personal information on individual health will be given as long as the people in the study area understand the purpose of the investigation, and are familiar with the data collectors. (This issue is discussed more fully in Chapter 6).

Chapter 5

EVALUATION ASSUMPTIONS

5.1 Point of View

An impact evaluation represents a point of view regarding the project effects worth evaluating. This point of view may or may not be similar to that used to set out the stated objectives of the project. The problem thus arises as to whose point of view (i.e., objectives, set of values etc.) is to be followed in the evaluation. At least four distinct viewpoints can be utilized in an impact study of the Health Sector II project:

(1) the objectives of the Government of the Dominican Republic (GODR),
(2) the objectives of USAID,
(3) the objectives of the people to be served by the project, or
(4) the objectives of an outsider, who has no vested interest in the project, and therefore is free to search for an optimum set of objectives in the interest of all parties.

Although the project paper states the goals of the project and the purpose of the evaluation, it is necessary to insure that the goals are specified in readily measurable terms and to define and specify more exactly the purpose of the evaluation.

In addition, the USAID Mission intended that this report modify the evaluation approach described in the project paper, if necessary, in order to obtain the most thorough and valid evaluation possible and to establish a basis for planning and evaluating similar projects in the future. The methodology of health impact studies is still at an immature stage. Ideas and concepts developed for this project may have far-reaching effects on the planning and evaluation of future activities. Because of the lack of direction and the need for new ideas, the proper point of view to follow in setting up the impact study for this project is that of an outsider searching for the best overall solution for all concerned parties.

5.2 Scope of Study

Because of the particular point of view adopted, very few conceptual constraints are assumed in the initial stages of the research design proposed in the next chapter. As the evaluation plan becomes more specific through time modifications may occur where necessitated by realities in the field.

A major goal of this report is to develop a fundamentally sound procedure for impact studies which will be transferable to other projects in other developing countries. If this can be achieved, it will be possible to compare the results of impact evaluations between different projects and across national borders. The consequent increase in knowledge should provide the potential for improving project planning efficiencies for the benefit of both donor and recipient aid countries.

5.3 Evaluation Guidelines

The following guidelines were influential in the development of the impact study design presented in this report.

Measurement:

1. The design should contain measures of project performance.
2. The design should contain measures of project impact.
3. Measurements should be as quantitative as possible.
4. Measurements should be as simple as possible.

Application:

5. The basic design should accommodate narrower studies which are more detailed, and larger studies which are more comprehensive.
6. The basic design should be reducible to some smaller form for special purpose studies.
7. The basic design should be applicable to projects in other developing countries.

Potential:

8. The basic design should be capable of evolving to a more sophisticated level in the future.

Specific research assumptions that can have an impact on the validity of this study are discussed more fully in Chapter 6.

Chapter 6

STUDY DESIGN

6.1 Background Statement and Chapter Outline

6.1.1 Introduction

This chapter presents the plan for the health impact evaluation of Health Sector Loan II. The chapter is a focal point of the complete evaluation plan report. Nevertheless, much of the material presented here relates to topics discussed elsewhere in this report, in the original project paper (Ref. 1) and in other documents describing Health Sector Loans I and II (Refs. 2-6). These sources are frequently referred to in the text, particularly when they provide information on issues concerning study design and research methodology. In particular, aspects of Chapters 4 and 5 are further developed here. In addition, a number of reference texts and secondary data sources are cited throughout the discussion. It is hoped that these materials will serve to guide field investigators in implementing the recommendations on evaluation which follow.

This evaluation plan was developed after examining the needs and resources of the USAID Mission in the Dominican Republic. Consultations with mission and government health officials were most helpful in guiding the approach taken. Especially useful was information gathered during field visits (described in Appendix B). Practical realities seen in the field helped temper scientific expectations. The recommendations, therefore, represent those considered by the authors to be most appropriate for the Health Sector Loan II evaluation task in the Dominican Republic. However, these are recommendations, and the authors recognize that changes in the plan may be required as the project is implemented. To this end, alternative suggestions appear where appropriate.

In general, this report was written to conform with the most recent USAID evaluation policies as set forth in Design and Evaluation of AID-assisted Projects (Ref. 7). The evaluation plan addresses five of the following six important issues:

1. The number of evaluations that are required
2. When the evaluations should be scheduled
3. What hypotheses should be tested at each evaluation
4. What methods should be used to obtain the data required
5. Who will evaluate
6. The cost of the evaluation and who will fund it

Mission staff requested that the last of these questions not be addressed in this report. This chapter was written to be used as a reference document for conducting the evaluation. It is not written in "cookbook" detail, since Mission staff indicated that consultants will be engaged to implement the evaluation and to process and analyze the data so generated.

6.2 Evaluation Questions and Overview of Project

6.2.1 Evaluation Questions

The impact evaluation of Health Sector Loan II focuses on health outcomes as an important component of the overall "Project Purpose and Goal Evaluation." The impact evaluation questions were originally formulated in the Health Sector II Project Paper (Ref. 1) and were further refined during subsequent consultation visits (Ref. 2). These impact evaluation questions, to be re-stated later as formal statistical hypotheses, basically ask the following:

1. Have the water supply, excreta disposal and health education interventions had an impact in reducing infant and pre-school child mortality (and diarrheal morbidity)?

2. If these interventions do have an impact on these health status indicators (HSI), does this impact depend upon the particular mix of interventions?

Of course, these evaluation questions focus on health outcomes only. Clearly, if the interventions are to affect health status, they must actually occur in target communities and community residents must use them. It is further noted that causal associations between the interventions and health outcomes have been difficult to demonstrate scientifically (Ref. 2).

6.2.2 Impact Assessment Model

To address these issues in one conceptual framework, an impact assessment model is proposed for the evaluation of the Loan II program. As shown in Figure 1, the model sets out a sequential series of project consequences, starting with the actual project intervention and ending with the intended impacts, or benefits, of the project. The first level is the system operation, which is the actual construction of the water supply and/or latrine system. Evaluation at this level consists of determining if all technical features meet project specifications. This level is within the control of the project implementer.

The next level involves the performance of the system, which means the use and maintenance of the facilities by the community. There are two aspects of importance: the use of the water and sanitation facilities by individual households and the overall support and maintenance of these facilities by the community. Evaluation variables, such as water quantities, quality, behavioral patterns, maintenance routines, revenue collection and health education, can be defined to assess the overall performance of the system.

Since performance requires community participation, the changes observed at this level are only partially under the control of the system implementer. However, they are of great concern to program managers.

The third level in the model includes the ultimate health, economic, social and environmental impacts of the project. These impacts are almost completely beyond the ability of the system implementer to control. It is not

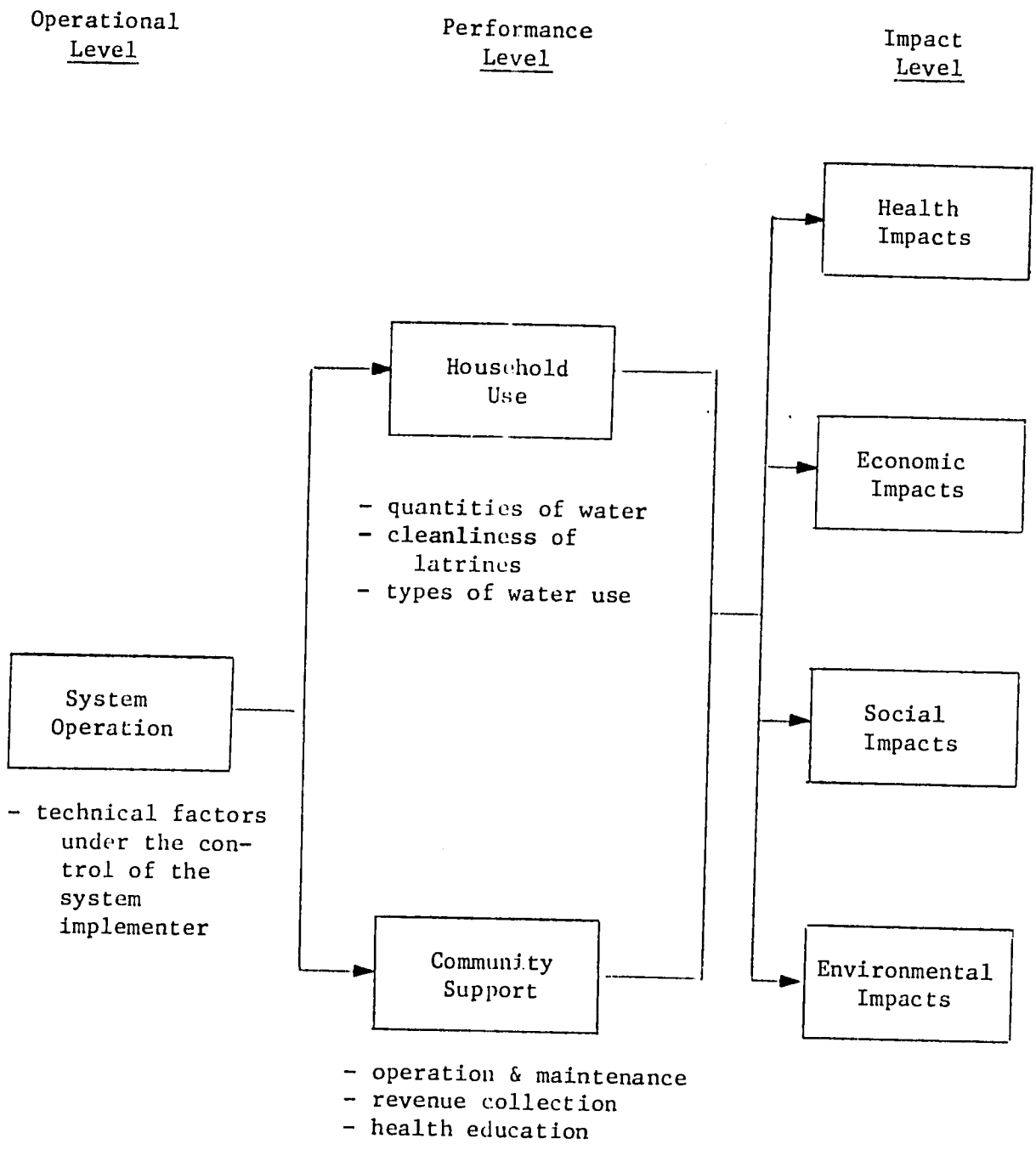


Figure 1. Impact Evaluation Model for Health Sector Loan II

Source: Warner, D.B., 1980 (Ref. 2, p. 7)

sufficient to simply provide potable water and sanitary latrines (level 1). The intermediate step of household usage and community support (level 2) must occur before the ultimate impacts, which are the project goals (level 3), can be achieved. To measure these ultimate impacts, therefore, it is necessary to establish measures for the intervening performance level.

Therefore, although health outcomes (level 3) have come to the forefront in the refinement of original evaluation questions described above, levels 1 and 2 retain their importance for reasons that are at once methodological and administrative. The task of the evaluator is then to incorporate all three levels in the design of an efficient evaluation plan.

6.2.3 Evaluation Overview

A study design for accomplishing this task is described in detail in Section 6.4 below. At this juncture, the strategy for doing so is simply highlighted in order to orient the reader. Level 1 (operational) measurements are already proposed as part of the annual project review (Ref. 1, p. 55, "Progress-to-Target Management Evaluation"). These will simply be coordinated with the "Purpose and Goal" evaluation plan proposed here. This coordination, however, will not only be useful for obtaining level 1 indicators for evaluative purposes, but will be used to insure validity of evaluation implementation with a minimum increase in the workload of field personnel (promoters, supervisors and evaluation officers). Similarly, periodic checks by field workers on level 2 (performance) indicators will occur, again for both evaluative measurement purposes and to insure validity of experimental design by "in progress" adjustment of interventions as the evaluation proceeds. Finally, level 3 (health impact) indicators will be collected in an ongoing fashion. These have been collected by field staff (promoters) for five years, apparently with acceptable validity (see Sections 6.3.3, 6.4.5.5 and 6.4.5.6), as a component of Health Sector Loan I. For communities in the evaluation study groups, however, data items will be slightly increased in number and organization. Again, periodic validity checks are proposed for this measurement level as well.

This evaluation design can efficiently accomplish several tasks. It will provide evaluation information on level 1 and 2 indicators for monitoring project progress and it will help to insure validity of intervention and outcome data measurement by periodic in-progress "check ups" and subsequent adjustment.* Finally, it will provide information to help interpret findings. All of this information will be useful for a final impact assessment of the program.

It will be noted that this design does not include non-health level 3 indicators, such as economic, social and environmental impacts (Figure 1). The measurement and use of these indicators is at least as complex as that for health status indicators (Ref. 8), and to include them in this evaluation would complicate a relatively streamlined and efficient data collection process only to provide data of questionable validity. With regard to other possible studies, however, see section 6.4.6.4. The restriction of the scope of this evaluation to health outcomes is consistent with the focus of

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*These periodic validity measurements are discussed in more detail in Section 6.4.5.5. and in Chapter 7.

the original project paper (Ref. 1) and subsequent project refinements (Ref. 2). It has also been cleared with Mission staff.

6.3 Available Institutional and Data Resources

6.3.1 Background Statement

A fair assessment of evaluation resources available to the USAID Mission Health staff is essential in developing a realistic evaluation plan (Ref. 7, p. 137). Original study parameters and protocols were described in the project paper. However, the availability of resources does change over time, and the evaluator should be aware of these changes. In general, with respect to evaluation resources, the Mission to the Dominican Republic was found to be in a very good situation. These institutional and data resources are briefly described in the next sections.

6.3.2 Institutional Resources

The USAID Mission should be able to provide assistance to those who will carry out the evaluation plan described in this report. Staff members have training and backgrounds which cover the fields of medicine, public health, evaluation research and demography. Furthermore, government, private and university resources exist for data gathering, processing and analysis. These resources should be reviewed by any group engaged to conduct the evaluation in order to assess their possible role in the evaluation.

The Mission has already demonstrated its ability to manage evaluations of Health Sector Loan I by coordinating mission and government resources (Refs. 4-6). While this present evaluation plan is somewhat more ambitious, the Mission's skills of research management are already in use and require little modification for evaluation of Health Sector Loan II. Finally, the Mission Health Officer (Dr. Rivera) appears genuinely interested in the evaluation of Health Sector Loan II from both an administrative and scientific viewpoint. He will assist in the conduct of the evaluation to insure compliance with methodological and logistic guidelines.

The Mission and local resource organizations are, however, somewhat lacking in sophisticated (i.e., computer) data management and analysis capabilities. These capabilities have already been obtained from external sources when needed (e.g., in the computer processing of data from a schistosomiasis prevalence survey), so the Mission is aware of channels for obtaining such assistance. In any event, the data processing called for here, while more easily handled with computers, can be done manually. This point, which is always of concern in AID evaluations (Ref. 7, p. 165), is discussed further below (see Sections 6.4.5.6 and 6.4.5.7).

6.3.3 Data Resources

6.3.3.1 Background Statement

In order to help design an evaluation plan, existing data available to the Mission were examined. These included both aggregate data (i.e., data expressed for groups of persons or geographic units) and disaggregate data (i.e., data which can be expressed for individuals). The distinction between these categories of data is quite important, since study design, analysis and interpretation depends greatly on which level of data is used (Ref. 7, p. 166; Ref. 17, Chapters 1 and 2). In general, disaggregate data are desirable for the questions to be answered in this evaluation. For example, in selecting study populations or in analyzing results, it would be useful to have information on potentially "confounding" factors,* such as socioeconomic status (SES) indicators for individuals in the study groups. Unfortunately, this ideal situation does not always obtain. The availability and usefulness of existing data are discussed in the next sections.

6.3.3.2 Aggregate Data

A considerable amount of data exists on covariables such as SES (Ref. 10), health status (Ref. 11), regional development (Ref. 12), agriculture (Ref. 13), nutrition (Ref. 14) and education (Ref. 15).** These aggregate (typically regional) data are useful in that they show that considerable differences exist between regions in these factors. However, they are less useful for actually designing a comparative study, since they apparently are not readily available for individual communities. Furthermore, the definition of "region" oftens varies by agency, and the relative validity of each data source remains to be investigated. For these and other reasons (see next section), this study will focus on data gathered on individuals at the community level.

6.3.3.3 Disaggregate Data

A considerable amount of data has been collected on individuals in communities to be included in Health Sector Loan II. These are gathered regularly by the health promoters (Ref. 3). They include information on total village population, along with age- and sex-specific data on births, deaths, immunizations and migration. In addition, anthropometric data (weight, height and arm circumference) have been gathered for pre-school children, although with much less regularity.

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*Strictly speaking, a confounder will be associated with both intervention and outcome <u>in the data set</u> under study. Since it is difficult to specify such associations <u>a priori</u>, these variables will be referred to simply as "important covariables."

**These were offered as the most relevant and recent data sources available by Lic. Oscar Hungria, former assistant to the director of the Health Sector Loan II-SESPAS Coordinating Office, UAPODAN, and now director of UTOC.

Although some initial problems did exist with reporting and recording (Ref. 3, p. 57), recent sample evaluations indicate that the promoters can gather and record valid vital statistic data (Ref. 6). In fact, the government of the Dominican Republic has recently decided to use the promoters in gathering 1982 census data (Ref. 16).

One can generally find validity problems with any data gathering procedure. However, the use of data gathered by rural health promoters, with appropriate regular validity checks, has a number of distinct advantages over alternative approaches such as random surveys by trained interviewers. These advantages include:

- relatively inexpensive arrangement
- can be monitored and improved with small effort
- provides stable baseline data
- provides continued, repeated measurements over time
- provides data on individuals (although these can be aggregated, if necessary)
- provides total coverage of evaluation target population
- data collection accepted as "routine event" by population (reduces "intervention bias")

In fact, if continued validity can be assured, there are few disadvantages with this system. For these reasons, the data on health outcomes will be gathered by the promoters, although some minor changes are suggested to improve and increase the data. This approach also has the approval of mission staff and is in line with USAID evaluation policy (already discussed in Section 1.1).

6.4 Study Design and Research Methods

6.4.1 Background Statement

The most important feature of a sound design is the ability to furnish internally valid results (Ref. 17, Chapter 1). However, evaluators must work within the practical constraints of the "real world," and these often tend to compromise validity. The extent to which a given study will maximize internal validity within the limits of existing resources is a measure of its cost-effectiveness or efficiency; high efficiency is also a characteristic of good study design.

Internal validity refers to the degree to which a given study accurately provides answers to questions about members of the population under investigation. External validity refers to the extent to which such results can be generalized to other study groups. The former is more an issue of research methodology, while the latter invokes scientific judgment (and sta-

tistical inference if probability sampling is used). Again, these two issues often compete for consideration in study design, given the limitations of available resources. Ideally, both should be maximized. Nevertheless, when a choice must be made, internal validity should prevail since it makes little sense to generalize invalid findings.

In the following sections, the salient aspects of study design of this evaluation are discussed. These topics include choice of study design, sample size considerations, selection of study populations, and various aspects of data collection and analysis. Each of these study components will have an impact on the validity of the results, and each must be considered in light of practical conditions in the field.

This recommended study design and methodology embody the main features of the evaluation plan suggested during consultations between WASH and mission personnel on Health Sector Loan II (Ref. 2). Various refinements are specified here to maximize efficiency. In doing so, important assumptions are also critically evaluated. The evaluation plan was developed to be used in conjunction with the impact assessment model presented in Figure 1.

6.4.2 Study Design

6.4.2.1 Theoretical Issues

The type of design recommended in the following section incorporates features of both horizontal and longitudinal designs. This "hybrid" design allows for a number of different comparisons and was chosen to be used in conjunction with the impact assessment model (Figure 1). As such, it includes measurement of operation, performance and outcome indicators.

6.4.2.2 Choice of Study Design

Figure 2 displays the main features of the recommended evaluation study design, along with a suggested schedule of activities. In this section, each aspect of this design is discussed in more detail.

Study Groups

There are five study groups, and these can be divided into two categories. In the first category are those communities which will have different combinations of health interventions as follows:

Group A - 25 communities with only wells or gravity fed systems

Group B - 25 communities with water systems and latrines

Group C - 25 communities with water systems, latrines and health education

Group D - 25 communities with none of the above interventions.

Study * Groups	Number of Communities	Represented By The Symbol	1981 A M J J A S O N D	Begin Study T_0 J F M A M J J A S O N D	1982 J F M A M J J A S O N D	1983 J F M A M J J A S O N D	End Study T_1 J
A	25						
B	25						
C	25	+					
D (Control)	25						
E	30	0					
Measurements							
Mortality		MO	← Occur Throughout the Study →				
Morbidity**		MD		+	+	+	+
Anthropometry		ANT		+	+	+	+
Monitoring							
Water Systems (wells or gravity fed)				0 +	0 +	0 +	0 +
Latrines				0 +	0 +	0 +	0 +
Health Education				0 +	0 +	0 +	0 +
Health Measurements			0 +	0 +	0 +	0 +	0 +
Comparisons			← Occur Throughout The Study - See Text →				

* See Section 4.5.2 of Chapter 5 for description of the health intervention(s) for each group. The control group (Group D) will have no health interventions during the study period.

** These measures are not recommended. See Section 6.4.5.3.3.

Note: The operation and performance "measurements" will actually consist of monitoring the three interventions (viz, water, latrines, and health education). See Section 6.4.5.6

FIGURE 2 EVALUATION PLAN STUDY DESIGN

It is suggested, for reasons discussed below, that these communities be randomly chosen from one health region. In the second category are 30 communities (Group E) which will receive all three interventions and which should be randomly selected from the other two health regions served by Health Sector Loan II, as described below (see Section 6.4.4). These two groups of communities will be used for different evaluation purposes.

Timing

Figure 2 shows the suggested development of the evaluation study over a three-year period from 1981 to 1984. "Measurements," "Monitoring" and "Comparisons" should take place continuously, quarterly, or semi-annually as described below in the respective sections on these three topics. However, because of practical problems in selecting communities and instituting interventions (and coordinating gathering of data) these schedules should serve only as guidelines. Ideally, to generate more stable data, the study should run for at least one year and, if possible, for the full two years from T_0 to T_1 (January 1982 to January 1984).

There is approximately a six-month optional "lead time" between the present date and T_0. This time would be used to facilitate selection of communities, especially in Study Groups A-D, and to provide a period for adjustment of field staff (principally promoters and supervisors) to the minor changes in data collection suggested below (see Section 6.4.5.6). Since communities in Study Group E will come from the two regions that do not include Study Groups A-D, this six-month period may be too short for selecting Study Group E communities. Random selection of these 30 communities, therefore, can be done at a later date, preferably when all (or most) communities in the remaining two regions have been provided with the health interventions. It is expected, of course, that during this time (and throughout the entire program) the data normally collected by the promoters (population, migration and mortality) will continue to be gathered for base-line purposes in all 500 communities.

Measurements

The data normally collected by the promoters on population, migration and mortality since the start of Health Sector I will continue to be gathered for all 500 Health Sector II communities. For purposes of this evaluation several changes in data collection are suggested; the changes depend on the study groups involved (see Figure 2). In the first category of communities (Study Groups A, B, C, and D), the promoters will continue to collect data routinely on demographics (DEM), migration and mortality (MO), although some minor changes are suggested (principally in terms of validity checks - see next section).* In addition to this, there can be several surveys of diarrheal morbidity (MD) and anthropometry (ANT). This category of communities will be used to test hypotheses concerning the impacts of the various interventions on health indicators, all in an efficient manner. However, surveys of operation and performance indicators are suggested for this group of communities as well (Figure 1). If these surveys can actually

*The usefulness and practicality of examining diarrheal morbidity will be discussed further in Section 6.4.5.3.

be combined with the monitoring of the project (i.e., "validity checks"), this would increase efficiency and would aid in interpreting results.

No additional data on health impacts are planned for the second category of communities (Study Group E), other than those items routinely collected by the promoters. However, there will be a focus on measurement of operation and performance indicators in this group of communities. Since these communities will be randomly selected from the remaining two regions of Health Sector II, measurement of operation and performance variables in them will yield information on the whole project. This information will be used principally for level 1 and 2 evaluation purposes (see Figure 1).

In summary, communities in Study Groups A, B, C, and D will be examined from an hypothesis-testing viewpoint (health impacts) and will be restricted to one region to facilitate their selection and study (see Section 6.4.4.2) with a possible increase in internal validity as well. Communities in Group E will serve to provide information on operation and performance level indicators, and will do so for the remaining regions in the project by extension only. This latter information also will be useful for evaluative purposes, in the context of the total project. However, the distinctions made here between the two study groups should not be taken too literally, since there is a considerable redundancy in measurements proposed and since the design of this study suggests multiple group comparisons which may be informative under certain circumstances (see Comparisons below).

Interventions

Interventions refer to water (wells or gravity-fed systems), latrines and health education. These have been described elsewhere in this report (see Chapter 3). It will only be noted here that, for the purpose of the evaluation, the community is the basic unit of exposure. That is, communities are classified as "units" receiving a given type of intervention. This approach represents a compromise between validity and practicality of data measurement, and it has implications for sampling and analysis as well. It is recognized, of course, that community health status is a function of the health status of the individuals living in the community. One of the roles of project monitoring is to see to it that the health intervention(s) instituted in each community are actually and properly used by all of the individuals in the community. If they are not used, this situation at least should be recorded and, if possible, corrected.

Monitoring

As an integral part of the evaluation project, periodic monitoring is recommended. Figure 2 suggests that monitoring occur soon after the "start" of data measurement (T_0); suggested subsequent intervals are approximately three and six months, depending on the intervention and the category of study community. The actual interval is less important than the fact that some monitoring occur. For the monitoring component, periodic checks will be made both on the actual state of the interventions and on the gathering of health-impact measurements by the promoters. Ideally, these checks should be done by personnel other than those who routinely attend to such matters. This monitoring is described in more detail in Chapter 7. Again,

the purpose of this monitoring is twofold. It will help insure data validity (especially for Study Groups A-D) and it will provide periodic measures of operation and performance level indicators (especially for Study Group E).

Comparisons

This study design allows for a number of comparisons. These will be more formally stated later for purposes of statistical hypothesis testing. They are briefly presented here to provide the reader with an overview of the approach taken.

First, "before and after" comparisons on all variables (especially health outcomes) will be possible within each of the five study groups, including Group E, to determine the degree of any possible changes over time.

Next, comparisons will be attempted between the measures of health impacts of each of the Study Groups A, B, C, and D. This will be done initially to establish on what factors these villages actually can be compared at the end of the study. It is expected that selection of relatively large sample sizes in each of these groups from the same region will provide stable and similar average group rates of impact indicators so that multiple comparisons can be made. (Alternatively, these communities could be selected on the basis of the values of initial indicators, but this would be logistically difficult, at best.) Where such simple cross comparisons are not possible, more sophisticated statistical techniques can be used to facilitate comparisons (see Section 6.4.6).

Finally, data gathered periodically on operation and performance variables, while less useful for purposes of comparison, can aid greatly in the interpretation of any unexpected results. Such comparisons could be made among Study Groups A, B, and C to assess, for example, the impact of health education on operation and performance variables.

These comparisons address most of the topics of concern in conducting useful AID evaluations (Ref. 7, pp. 141-154). Of course, from a research point of view, numerous other comparisons (e.g., time series, correlation and regression analyses) are possible (See Section 6.4.6).

6.4.2.3 Advantages and Disadvantages of Chosen Design

The advantages of using this design have been discussed at various points in the presentation above. They can be summarized as follows:

- exhibits increased internal and external validity
- conforms to original concepts of project evaluation
- allows for multiple comparisons over time
- is based on health impact assessment model, so it includes operation, performance and outcome level measures

- controls for seasonal and unexpected secular changes

- includes periodic validity checks

- uses existing resources and data gathering system with few modifications necessary

- combines research and overall evaluation into one design package.

Nevertheless, there are some potential disadvantages with this design. Basically, these involve the logistical aspects of study implementation and the issue of effective control for important covariables. Both of these are discussed in the next section.

6.4.2.4 Alternatives

A number of alternatives exist for making the study easier to carry out. Smaller sample sizes could be used, validity checks (monitoring) could be reduced or done away with altogether, and the entire study could be restricted to only Study Groups A-D. However, these features were included with the Mission's capabilities in mind, and not to include them would compromise the validity of the study to an unknown degree. Some changes could be made in the timing of the interventions and periodic measurements and monitoring, although those suggested in Figure 2 are considered optimal. Of course, practical problems in the field can and will occur, but it is assumed that these will be overcome as the evaluation progresses. In fact, this design includes a six-month lead time before T_0, or the "start" of the study, for just these sorts of exigencies. If need be (as, for example, in selecting communities for Study Group E), the whole time axis in Figure 2 could be shifted to the right to allow for more options in community selection (see Section 6.4.4.3). This will be a matter of judgment on the part of the project coordinators. However, interventions and measurements in the various study groups should comply as closely as possible with those in the suggested schedule.

Other design alternatives than those previously referred to (Ref. 7, pp. 141-154) are unlikely to be more appropriate for the purposes of this evaluation. In fact, this design already incorporates the main features of the more powerful of these alternative designs. It would not be advisable to employ less rigorous methodologies, such as case study or cross sectional designs.

One issue does arise, however, for which alternatives may exist. The present methodology attempts to control for possible differences in important covariables (such as socioeconomic status, SES), by features of the design. Of course, it would be desirable actually to measure these variables in a valid fashion and to include them in the design or in the analysis. However, to do so would greatly complicate, and increase the cost of, data collection, and the data so gathered (say, on SES) would themselves need to be verified. It would also complicate the analysis to a considerable extent. The present design does address these issues, and it does so in a manner that uses existing resources in an efficient manner.

It may be possible, however, to obtain data on important covariables from the planned 1982 census. If such data are forthcoming and can be shown to be of acceptable validity, they may be included in subsequent (secondary) analyses of the data sets generated here (see Section 6.4.6.4).

6.4.2.5 Research Assumptions

The research assumptions for this project have been implicit in much of the preceeding discussion. Basically, these include the following:

- the evaluation plan will be coordinated by an outside consultant
- there will be continuous close monitoring of the evaluation by mission health officers
- there will be no major changes in the existing methods of data collection, other than those suggested herein
- there will be no major changes in the interventions, other than those proposed herein
- there will be no major changes in the goals and conduct of the project
- the Government of the Dominican Republic will continue to support the project.

6.4.3 Sample Size Considerations

6.4.3.1 Theoretical Issues*

The approach taken to determine sample size depends on the type of study design employed and on the types of variables measured. Classically, such estimates consider acceptable limits of Type I and Type II errors in hypothesis testing, along with information on "background" conditions in the study population, such as "differences considered important to detect." These inputs are often unclear and thus make matters somewhat judgmental. For this and other technical reasons, sample size determinations should be viewed as "ball park" estimates only. This is especially true for observational studies on free living human populations.

Other factors entering into sample size estimation are cost considerations and the type of analysis to be used. In effect, a sample size is often "set" when resources are limited. Also, some methods of analysis simply need a minimum number of observations in each cell to be effective. These and other factors further complicate the estimation of sample size.

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*For more technical discussions of sample size estimation, the reader is referred to Ref. 17 and Ref. 20.

6.4.3.2 Choice of Sample Size

Since communities in Study Group E are examined more for descriptive and administrative evaluation reasons than for hypothesis testing, and since little background information exists for these level 1 and 2 variables, the choice of sample size for this study group was based on practical considerations. It was decided that periodic gathering of operation and performance data in a random sample of 30 communities (15 each from the two regions not containing Study Groups A-D) would not overtax the present data collecting system and would provide a legitimate idea of conditions with respect to level 1 and 2 indicators.

For Study Groups A-D, more quantitative methods were used to estimate necessary sample sizes since these comparisons involve hypothesis testing. To do this, background data on the study population were examined. These are displayed in Figure 3. Data for Region I were chosen here since they have been gathered almost as long as those for Region IV (1977-1980 vs. 1976-1980) and since Region I is suggested for this aspect of the evaluation. (Actually, rates for both regions are quite similar.)

The year 1978 was used because it represents the most recent data which are probably most stable. The rates for 1979 drop precipitously,* and 1980 data are based on part of the year and were adjusted estimates at the time this report was written.

For the communities described in Figure 3, the average population per village is 525, and, at an average of 0.04 infants (aged 0-1) per person a total of 525 infants should be available in 25 study villages, or 1,050 if two groups of 25 villages are to be compared. The average mortality rate for this age group was 105.3 per 1,000 or approximately 11 percent.

Having this background information, it was necessary to specify alpha and beta levels, and a "difference important to detect." Although the project paper mentions 95 percent confidence limits, presumably for setting an alpha level at .05, it does not specify a corresponding acceptable level for Type II errors. The authors agree that for this type of research (i.e., simply adding new, but important knowledge) an alpha level of .05 is appropriate. The authors further agree with the criteria for selecting a beta level suggested by Cohen and described in Fleiss (Ref. 20) in which Type I error is considered to be some four times more critical than a Type II error.
Therefore, a beta level of 0.20 was chosen. The project paper further states that the project should bring about a 15 percent reduction in diarrheal morbidity and infant mortality although a 35 to 40 percent reduction was considered more reasonable for purposes here (see next section). Statistical tests are assumed to be two-tailed.

Using these background data, the method described in Fleiss (Ref. 20) was used to show that 25 villages in each group sample (i.e., approximately 525 children) from Study Groups A-D, would be adequate for purposes of this study.

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*The reasons for these changes are unclear, but may represent the effect on data collection of two tropical storms.

REGION I

	1977	1978	1979	1980*
Total Population	23517	25398	34018	36516
Less than 1 year	1151	962	1351	1440
1 - 4	3692	4003	5050	5346
5 - 9	4084	4446	5835	6022
10 - 14	3283	3566	4769	5231
15 - 49 (females)	4665	5179	7035	7565
15 - 49 (males)	4661	5116	7185	7723
50 or more	1981	2126	2793	3189
Live Births	978	931	1106	1302
Birth Rates	41.6	36.6	32.5	35.6
Infant Deaths	93	98	40	116
Infant Mortality Rates	95.1	105.3	36.2	89.1
Deaths - 1-4 years	41	50	39	76
Age Specific Death Rates (1 - 4 years)	11.11	12.5	7.7	14.2
Total Deaths	195	218	141	342
General Mortality Rates	8.3	8.6	4.1	9.4

* Adjusted for shorter period of observation.

Figure 3. SBS Health Data

Source: Health Sector Loan I (SBS) Evaluation Data

6.4.3.3 Alternatives

There are several caveats with the method just employed beyond the general problems involved in estimation of sample size. First, background information was based on average values, although these values were obtained for the population to be studied. Next, these calculations do not adjust for the so called "design effect." That is, although some 500 children are to be compared in each sample, most of the statistical tests proposed will compare groups of 25 villages. This has the effect of increasing the sampling error. The extent of this increase is difficult to assess, since there is little available information on the homogeneity within each cluster. However, since the number of clusters used is large relative to the number of available clusters, the design effect problem is less likely to be critical. Furthermore, since some comparisons in this study involve before and after measurements on the same populations, this would tend to reduce the number of independent observations. On the other hand, the fact that sample sizes in each group would be similar tends to increase the sensitivity of statistical tests.

There are, then, a number of factors which affect the suitability of the sample sizes chosen in this study. While their exact effects are difficult to quantify, there is some tendency for them to counter each other. It is also noted that sample-size calculations were done only for the infant mortality rate, since this was assumed to be the most useful of morbidity and mortality indicators (see Section 6.4.5.3), and since background data on morbidity and anthropometry are lacking. The sample sizes suggested here may be less appropriate for use with the preschool mortality rate, although large differences and certainly any trends should be detectable. These sample sizes are also likely to be appropriate for anthropometry, given the large number of children being studied.

It is noted that a 35 to 40 percent decrease in infant mortality was chosen as a "difference important to detect," instead of the 15 percent decrease originally stated in the project paper. This does not mean that differences of less than 35 percent are not detectable here, but only that the chances of declaring them statistically significant are somewhat diminished. In fact, it is quite difficult to detect (with high confidence) small differences with this type of study design when the background rate of the disease under study is also small (as is the case here). For example, using the same criteria and approach described above, well over 2,000 children in each study group would be needed to detect differences of 15 percent. This would require approximately 100 communities in each study group, which is clearly impractical for the evaluation of the impact of the different Health Sector II interventions. The sample sizes chosen for this study allow for detecting meaningful differences with a reasonably high probability of doing so. At the same time, they represent expenditures in time and effort which are acceptable to the Mission.

6.4.4 Selection of Study Units

6.4.4.1 Background Information

The community (i.e., village) is the basic sampling unit in this evaluation plan. There are several reasons for this. First, selecting and monitoring entire villages for a given type of health intervention is administratively easy, and SESPAS has been doing so (as recommended in the project paper) for some time now. Second, valid interventions can take place at the village level. That is, villages are typically somewhat isolated from each other, but interventions on the sub-village level could easily affect parts of the same village not specifically chosen for a given intervention. This is more likely to be a problem for health education interventions, but it could also occur in the case of latrines and water systems. Finally, rates generated for a whole village are based on larger numbers and thus are more stable than those generated for sections of a village or, indeed, for individual families. Actually, however, the analyses of these data need not be restricted only to comparisons of proportions or means on the village level (see Section 6.4.6.4).

The selection of individual villages for receipt of various interventions should be done in a random fashion. This will insure against conscious or unconscious selection biases. It is important to note that this is possible, in practice, because of the manner in which the selection of communities to be part of Health Sector II has been carried out so far (see next section).

6.4.4.2 Choice of Sampling Units

There will be 500 communities selected for Health Sector II interventions. The communities will be chosen from three regions, each averaging 167 communities per region. Selection of communities has already begun in Region I. At present, 128 villages have been selected from Region I and, of these, 35 already have some level of water intervention (wells drilled, pumps installed or gravity flow system functioning or under construction).

It is recommended that Study Groups A-D be chosen from Region I. Theoretically, these groups should be randomly chosen before interventions are initiated. Practically, this is not possible, since some communities have already been selected.* However, latrines and health education have yet to be introduced, and each of the A-D Study Groups will have water interventions anyway, except of course, the control group. Therefore, it is recommended that the 25 control villages (Study Group D) be randomly selected as soon as possible from all selected Health Sector II communities in the one region chosen for study (probably Region I). This will then allow for quasi-random selection and assignment (of the remaining study group commu-

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* Because of the ongoing procedure for drilling wells and installing pumps, it is unlikely that this ideal situation will exist in Regions II or IV either.

nities) to Groups A, B or C, since these will all have at least water interventions anyway. Random selection for latrines and health education can then be performed. All random selection should be done according to procedures described in statistical reference texts (e.g., Ref. 20, Chapter 4). Group E communities should then be randomly selected from the Health Sector II participating communities in the remaining two regions.

The reasons for focusing on Region I for Study Groups A-D are that it is closer to the capital city (Santo Domingo), and such work in Region I can begin immediately. These are administrative concerns, however, and should not supersede consideration of randomization (see next section).

6.4.4.3 Alternatives

Alternatives to the scheme proposed above will be guided by conditions in the field and by ethical concerns. The main advantages to using Region I to select Study Groups A-D are that work has already begun there and that the region's proximity to the capital should facilitate project coordination. However, it is also possible to use Regions II or IV for selection of these study groups. If one of these is chosen,* the random selection procedure described above should be used. In fact, one of these other groups might be used if this evaluation is begun after more than, say, 30 percent of the 167 villages in Region I have already received wells or gravity flow systems, since random selection of the 25 control villages will then be problematic.

It is important to choose control communities randomly. For example, if the 25 control communities were to be chosen because they were the last to be reached (i.e., furthest from the capital) there would be at least two problems. First, these would most likely be communities with lower socioeconomic status, given the decreasing gradient of such status as one approaches the Haitian border going west from Santo Domingo, and this would tend to compromise study validity. Second, these (poorer) people would thus be singled out for absence of health interventions, solely on the basis of their distance from the capital. This is in direct opposition to AID policy (Ref. 7, p. 240). Randomization distributes the burden in a more equitable fashion.

Another alternative to village selection is purposive sampling. For example, towns could be chosen for similarities in baseline data of, say, infant mortality. However, logistically this would be quite difficult to manage, given the manner in which the project interventions are progressing. Furthermore, the similarity in baseline indicators, while desirable, is not really necessary, since comparisons can also be made between the same groups of villages over time. Also, statistical techniques allow adjustment for baseline differences. Comparisons between intervention groups and control groups are therefore still possible although not as straight

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* Because of its relative proximity and longer availability of health data, Region IV should be preferred over Region II if Region I is not chosen for selecting Study Groups A-D.

forward as in the (ideal) "quasi-experimental" situation of comparing communities with similar baseline rates.

6.4.5 Data Collection and Processing

6.4.5.1 Background Information

The evaluation plan utilizes pre-existing data collection regimes as much as possible. The outcome data will be gathered by the promoters, and their accustomed routine will not be changed significantly. This includes use of similar data gathering forms. The plan also calls for progressive monitoring of the evaluation (i.e., "validity checks"), and the chosen health status indicators (HSI) ideally should be somewhat redundant in the information they provide (Ref. 7, pp. 143 and 166). This is the case here. Furthermore, this approach should introduce little "intervention bias" since such data are already being routinely gathered by the promoters in a study of this sort. Finally, the use of promoters to gather data is acceptable to mission project directors.

6.4.5.2 Exposure (Intervention) Data

There are three basic health interventions. They are water supply by means of wells or gravity-flow systems, latrines and health education. The exact nature of these interventions is described elsewhere in this report (see Chapter 3). Here, only certain statistical features of these interventions are discussed.

Figure 2 shows the combinations of interventions for the sub-studies of this project. For purposes of analysis, these interventions will simply be classified as dichotomous variables. This is done for simplicity and because more rigorous characterization of exposures may not be valid. For example, one could attempt to measure the quality or quantity of health education (or water) received by a community. However, such fine distinctions would require considerably more aggressive data gathering. Furthermore, it is not clear how one could validly measure such distinctions in a study of this sort. Finally, the analyses suggested below are appropriate for use with dichotomous independent variables (i.e., presence or absence of a given intervention).

There is, however, one possible exception to this scheme. Since there are two types of water intervention (i.e., wells and gravity systems), it might be interesting to compare the effects of the two. However, this was not called for in the project paper, was not mentioned as an important consideration in discussions with mission staff and will, therefore, only be suggested as a possible secondary analysis. Specifically, the study design does not include provisions for rigorously comparing the effects of the two types of water interventions.

6.4.5.3 Health (Outcome) Data

There are several types of health outcomes to be used in the evaluation. These include:

- infant mortality (age 0-1 year)
- preschool mortality (age 1-4 years)
- total mortality
- preschool anthropometry (age 1-4 years)
- infant diarrheal morbidity (age 0-1 years).

These indices are discussed next. Topics covered include the statistical features of the measure, its appropriateness and its operational aspects. Much of this discussion is adapted from Ref. 21.

Infant, Childhood and Total Mortality

Mortality can be expressed as simple count data and as a proportion of the specific population at risk during a specific time period (i.e., one year). Because the present data collection system includes age- and sex-specific population and mortality data, gathered on a biweekly basis, other epidemiologic measures could also be generated. These are discussed below (see Section 6.4.6.4). The major focus for this study, however, will be comparisons of proportions, such as the infant and childhood mortality "rates."

The infant mortality rate appears to be a particularly useful measure of the impact of improved water and sanitation facilities. Since the burden of diarrheal disease (including shigellosis or bacillary dysentery) and the associated mortality from dehydration falls disproportionately upon infants, who are particularly prone to dehydration, any significant diminution in fecal pathogens in the environment brought about through improved access to water or reduced fecal contamination should affect infant mortality (Ref. 21). This relationship of course assumes that other (often cyclical) causes of infant mortality (prematurity, neonatal tetanus, bronchopneumonia and malaria) remain constant or can be controlled for.

Since diarrhea and dehydration account for a lesser proportion of the total mortality in the preschool age group (ages 1-4), the rate will reflect improved water and sanitation but is probably less useful than the infant mortality rate. Furthermore, the stability of this rate is lower than that for the infant mortality rate (see Figure 3). The same can be said for the total mortality rate.

For these reasons, the infant mortality rate is probably the most useful mortality measure, followed by the preschool and total mortality measures. The analysis (and sample size estimates) therefore focus on this first rate. However, since the project paper calls for examination of preschool mortality, and since total mortality is available for each village, comparisons of these other two rates also can be done. The limitations just described should be kept in mind.

Obtaining these measures in the field needs no discussion since they have been gathered by the promoters for several years now. No changes are therefore recommended in the data collection form, except those that might aid in computer analysis of these data (see Section 6.4.5.7).

Preschool Anthropometry*

Age-specific anthropometric measures (height or length, weight, and mid-arm circumference) in infants and small children may be useful in estimating the impact of improved water supply and sanitation. These measures offer the following distinct advantages over the health measures:

1. The measures themselves require a minimum of equipment for field use, can be readily applied by persons with a little training and give reasonably reliable results.

2. Undernutrition, which most frequently takes the form of deficient weight for height, is prevalent among infants and young children in rural areas of developing countries. Thus, they measure a prevalent rather than an esoteric health condition.

3. Although the usefulness of the measures is dependent upon an assumed relationship to improved water and sanitation through reduced diarrheal morbidity, several studies reported in the literature strongly suggest the validity of this assumption.

Implications for field application of anthropometry can be drawn from each of these advantages. The following sections discuss the anthropometric measures themselves, their use in the field and computation and reporting of results. The interpretation of results with respect to the evaluation of water and sanitation improvements will be discussed in Section 6.4.6.5.

Application of Anthropometric Measures in the Field

The reader is referred to King *et al.* (Ref. 22), Jeliffe (Ref. 23) and Zerfas (Ref. 24) for a more complete discussion of methodology. These authors and many others agree that two simple anthropometric measures, height (or length) and weight form the essence of what is needed for an adequate field assessment of overall nutritional status. Mid-arm circumference gives an additional insight into the degree of soft-tissue wasting, but the same can be deduced from weight/height ratios.

Height or length should be taken by using a locally manufactured measuring board following specifications obtainable from the Center for Disease Control (CDC) (Ref. 25). The infant is measured lying down, and the young child is measured while standing, with the measuring board against a flat surface.

Weight is estimated using any standard scale. Great practical use has been made of suspended spring balances to which a harness for the infant or child is attached (Ref. 26). These are already available to the promoters.

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* Most of this section is adapted from Ref. 21.

Mid-arm circumference should be measured using fiberglass or laminated tapes with clear numerals printed along the axis of the tape. The mid-point of the left upper arm is identified, and the circumference is measured with the arm hanging loosely. It is important to maintain a correct tension on the tape so that it remains closely applied to the skin. All of these measures can be applied by relatively untrained field staff. A brief period of technical training followed by continuous supervision and quality control will usually suffice.

Computation and Reporting of Results

Weight and height are computed in absolute terms and then may be expressed individually on a percentile scale in which each is compared with a reference population (Ref. 27). It is more helpful, however, to compute and plot on a standard reference scale the weight/height ratio. It is generally more useful to compare weight with linear growth rather than with age, since weight is less a function of age than height. An additional ratio, therefore, comparing height with age, is sometimes used. This ratio is an estimation of the progress of linear growth, dependent as it is on genetic and hormonal influences, with expected height at a given age. These ratios are usually expressed in the aggregate as the percent of the childhood population falling over or under certain percentiles.

Arm circumference is reported in centimeters and compared with a reference table such as that presented in Figure 4. Although not specifically stated in the project paper, anthropometry should be measured on children from 0 to 5 years.

For purposes of evaluating water and sanitation projects, it is recommended that the percentage of children in each village whose weight/height ratios are over a certain percentile (for example, the sixtieth percentile) be compared with the percentage of children from other villages whose weight/height ratios are over the same percentile. This could then be supplemented by comparisons of mid-arm circumferences. The rationale for this recommendation becomes apparent in the next section. Alternatively, the actual mean anthropometry values among villages could be compared.

Interpreting Results

The assumption that improved water and sanitation leads to corresponding improvement in nutrition status as expressed by weight/height ratios is based on a two-step cause and effect relationship, illustrated simply in Figure 5.

The second step of the relationship has been rather firmly verified (Ref. 28-30). Studies in the Gambia have revealed a striking effect of infection, especially diarrheal disease, on the weights of young children (Ref. 31). During the prolonged drought (1974-78), a surprising diminution in both mortality and seasonal weight-faltering occurred. Whereas the rainy (growing) season had usually been associated with a precipitous fall in aggregate weight/height ratios and a rise in child mortality, both these seasonal curves were considerably flattened during the drought. Despite a general lack of food, a reduction in diarrheal disease and malaria had resulted in an overall improvement in nutrition status (Ref. 32). The

Age	Centimeters
0 months	9
3 months	10
6 months	11.5
9 months	12
12 months	13
2 years	13
4 years	13.5
5 years	13.5

Figure 4. Mid-Upper Arm Circumference
(3rd to 5th percentile)*

* Under this value suggests undernutrition (i.e. below 60% of Standard).

Source: adaptation of Zerfas (Ref. 24)

Of note is the relative constancy of the lower limit from ages 1-4 years.

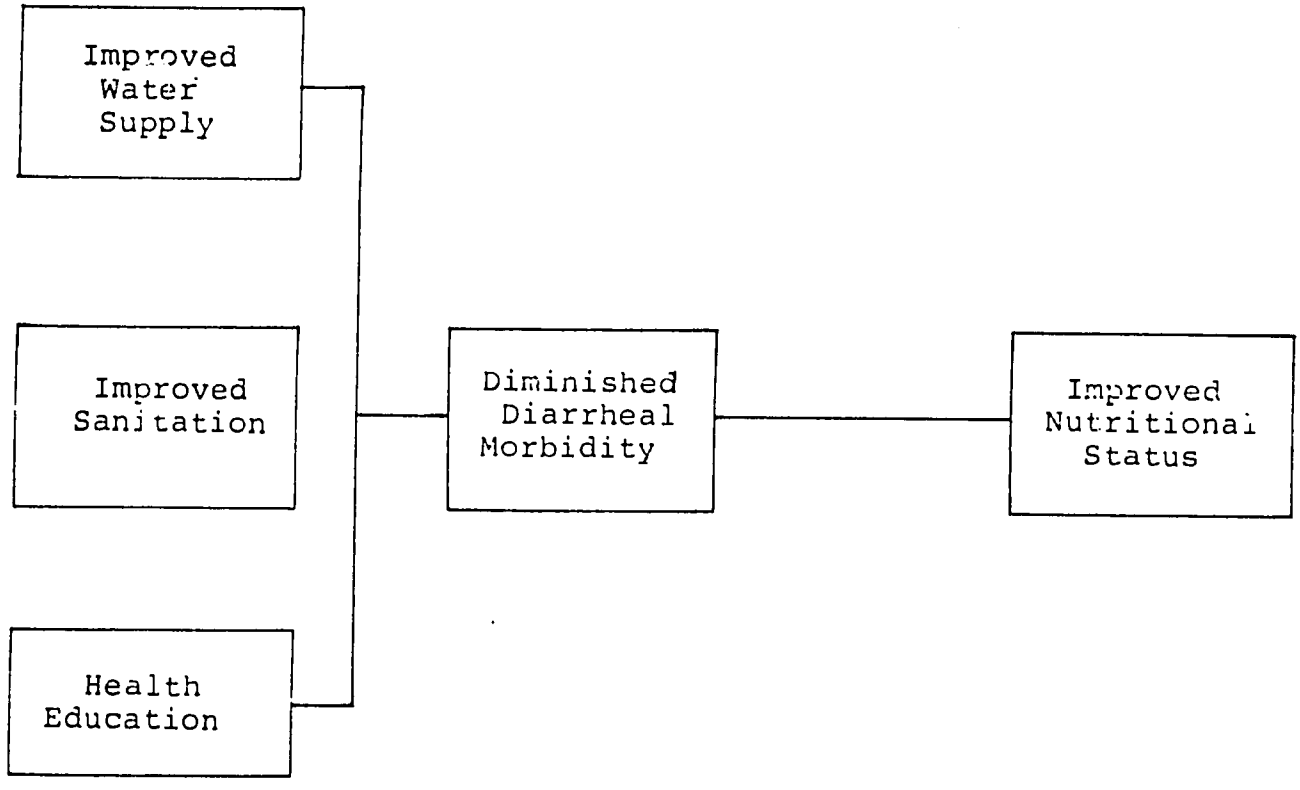

Figure 5. Improved Water and Sanitation as Related to Nutrition Status

effect of diarrheal morbidity on nutritional status is therefore considerable. The relationship of infection to nutrition is, of course, inverse (Ref. 33). Well known are the ravages of measles, tuberculosis and shigellosis in the undernourished child.

Support for the first step in the relationship is less firm. Because diarrheal morbidity is difficult to measure and interpret, as discussed earlier, attempts have been made instead to use nutritional status because of its strong causal relationship to infection as a substitute in the field for a direct measure of disease incidence. It stands to reason that if diarrhea contributes heavily to undernutrition, then any improvement in nutrition status correlated with improved water supply and sanitation may be attributed indirectly to a reduced diarrheal incidence. A study in Northern Nigeria has recently shed some light on this assumption (Ref. 34). Tompkins et al. demonstrated better weight/height ratios among young children using a protected copious source of water than among those served by a scanty unprotected source. The differences were statistically significant ($p<0.01$).

Infant Diarrheal Morbidity

This measurement was called for in the project paper. Basically, the measure involves recording the number of incidents of diarrheal morbidity occurring per child aged 0-1 years in a given time period. This can also be expressed per family. As this requires relatively constant attention on the part of the observer, this is not a measure to be made by the promoters. Rather, the mother or other responsible family member must perform this data collection. The promoters could then gather the family data and it could then be summarized for the entire community. The data would thus be expressed as a proportion or an average number of incidents of diarrheal morbidity per child, per period of observation. The data could also be expressed for whole communities. This would be repeated (see Figure 2) at several periodic intervals during the evaluation, and each observation period would last a maximum of one week (preferably five days).

It should be noted, however, that serious problems exist with using diarrheal morbidity as a measure of health status in an evaluation project of this sort (Ref. 21). These include:

- added complexity of data gathering and processing
- questionable validity of data
- the fact that good data are already being gathered (i.e., mortality and anthropometry).

For these reasons, it is not recommended that diarrheal morbidity be included as a measure in this study. However, if it is included, the above scheme for gathering the data should be used, and the schedules in Figure 2 should be adhered to. A scheme for analysis of such data is also discussed below (see Section 6.4.6).

6.4.5.4 Important Covariables

Any study of environmental exposures and health outcomes should consider a number of covariables. These variables are of two basic types. The first group can be called sociodemographic variables. This category includes socioeconomic status (SES), size of the villages, type of occupation and economy, and other similar measures. The second group can be called "life style" variables. This includes life style as it relates to exposures (i.e., individual differences in the use of health interventions) and to outcomes (i.e., differences in proximity and availability of health clinics, aspects of health behavior, occurence of disease epidemics). Ideally, these variables should be controlled for before valid comparisons can be made, and such control should be done on individual (disaggregate) basis. This can be done either in the design or in the analysis stages of a project, or at both of these points. To do so in the analysis would require collection of expensive and complex data on these covariables and would considerably complicate the analysis of these results. This was decided to be beyond the scope of this evaluation, especially since a large number of villages are being studied.

Instead, control is recommended in the design stage of this study (except for two possible exceptions which are noted below). This control is being effected in several ways. First, the hypothesis testing study is being restricted to one region, and a large number of villages is being randomly chosen from this region. Next, one important set of comparisons will involve before and after measurements of the <u>same</u> villages. Finally, the study calls for periodic monitoring of the interventions and data gathering to insure (as much as possible) that these activities are done properly. Together, these features of study design should control for both types of important covariables, at least to the extent that this is practically possible in an evaluation using large sample sizes and existing resources.

There are, however, two possible ways to control for differences in covariables <u>between</u> groups of villages, if such comparisons are to be attempted. One is to use baseline health data to adjust statistically for initial differences between study groups. One assumption here is that, all things being equal, infant mortality is an indicator of socioeconomic status (among other things). Another is to use census data, if these are shown to be valid and available on the community level, to control for differences in socioeconomic status. Both of these are, however, considered secondary analyses, since they would involve considerably more resources. These options are briefly described below (see Section 6.4.6.4).

6.4.5.5 Validity Issues

The two issues of validity are measurement and analysis. These have been discussed in various parts of this report and therefore will only be highlighted here. The features to insure validity include the following:

- control for important covariables in the design (and possibly in the analysis, see Sections 6.4.5.4 and 6.4.6.4); and

- monitoring of interventions and data gathering activities (see Chapter 7).

The latter is expected to do more than merely guard against validity problems caused by substandard interventions or poor data collection. Periodic validity checks of the promoters in all study communities should also help insure that intervention bias is kept to a minimum. This bias could occur if the interventions caused promoters to be more (or less) aggressive in data collection (or their other duties) in intervention villages than in control communities. Monitoring should reduce this possibility.

6.4.5.6 Data Collection

Data should be collected as described in Figure 2. These include outcome data and monitoring data.

Outcome Data

In Study Groups A-D, data on all health outcomes (mortality, anthropometry and, if chosen, diarrheal morbidity) will be gathered. In Study Group E, only the same data normally gathered by the promoters (i.e., mortality) will be collected. Mortality data can and should continue to be gathered on the promoters' standard (green) form, since this will provide continuity with established data collection routines.

For anthropometry, although forms apparently have been used already in the field, it will be useful to redesign a new data collection form. The new form could parallel the layout of Figure 4 and would also include weight-to-height ratios (see Ref. 27). This data collection activity is somewhat involved, but it will only occur occasionally (Figure 2) and is important enough to justify the added expense and time of the promoters.

It is not recommended that diarrheal morbidity be studied. However, if it is studied, data should be gathered by mothers and should then be summarized by the promoters or by project staff visiting the communities. Data on the number of incidents of diarrhea per child for a period of up to one week (preferably five days) should be gathered periodically as suggested by the timetable in Figure 2.

The above scheme requires minimum changes in established data collection procedures. Further modifications would only be required if the data were to be gathered in "field-automated fashion" (i.e., coded data gathering forms - see Section 6.4.5.7).

Monitoring Data

The monitoring aspect of this study is essential for reasons of validity in Study Groups A-D. It is also to be used as a method of gathering data on operations and performance level indicators in all study groups. For these tasks, which will occur periodically throughout the evaluation, it is recommended that persons be used other than those who normally gather health data. These may be SESPAS or mission people or independent consultants.

There are two principal monitoring activities. The first is to determine whether the health interventions have been implemented and are functioning properly, and the second is to determine if the data gathered are valid.

Figure 2 shows the suggested timing of these monitoring activities. The actual timing is less critical than the fact that monitoring actually occur at regular intervals throughout the evaluation. It is important, however, that monitoring occur once shortly after the evaluation project is begun to insure that the project is started properly.

The topics to be covered in the monitoring activities are suggested by Figure 1 and are described in detail in Chapter 7. Data gathering forms should be developed to be used in both Study Groups A-D and Group E for monitoring health intervention data. In addition, materials should be developed to validate the gathering of health outcome data (i.e., checking on the promoters). Since this has already been done during Health Sector I (at least for mortality and population data - Refs. 4-6), it may be possible to use the same form, but to include information on anthropometry and, possibly, diarrheal morbidity. Again, however, this last measure will be as problematic to study as to validate, and its use is not recommended.

Figure 2 suggests that the validity checks (i.e., monitoring) be performed regularly in all study villages, as described above. Mission staff indicated that such a regimen would not be too expensive. However, if resources are a problem, the monitoring could be reduced to less than that recommended in Figure 2. Also possible, but less desirable, would be to monitor random samples of study communities. In any event, if such reduced schemes are adopted, villages themselves should not be subdivided for monitoring purposes. It is suggested that entire communities be monitored.

The resulting data should be used in several ways. They can be expressed as percentages (i.e., percentage of functioning pumps or percentage of latrines being used) for descriptive analysis (see Section 6.4.6.2). These data can then be used as such to give an indication of the effect of the Health Sector II health interventions as measured by intermediate (operation and performance) variables. They can also identify the interventions or the data-gathering procedures that need to be corrected as the project proceeds. Furthermore, they can be used to evaluate how effective these corrective actions were. Finally, they may help explain any unexpected results concerning outcomes.

6.4.5.7 Data Processing

Data processing includes the handling of the data from collection to analysis. The types of measures (i.e., counts, percentages, proportions) that each variable will take have already been described. It is not possible here to outline all of the procedures for data reduction. It is assumed that the capability to summarize the date will be obtained by the Mission. In fact, such activities have already been carried out by SESPAS and the Mission, as evidenced by summary data tables such as that displayed in Figure 3.

One aspect of data processing does remain to be covered, however. Mission staff indicated that it would be desirable, if it is not too costly, to collect the data in a fashion that would facilitate computer processing and analysis of the data. In fact, the manner in which the data are to be gathered can be modified to fulfill this requirement, and the modifications

are relatively minor. They basically involve precoding of all data-collection instruments so that data can be keypunched for storage and analysis by computer. For a full discussion of this topic* see Ref. 35. Here, some aspects of precoding are simply highlighted.

Figure 6 is a sample page from precoded data-gathering instrument (i.e., questionnaire). The basic principle in precoding is to design the instrument so that the information entered corresponds to that which can fit onto computer cards. Each computer card has 80 spaces ("fields") and each space is used to enter a number from 0 to 9 (integers only). Therefore, every response on an instrument should be able to be entered or converted as a number from 0 to 9. For example, in question 3 of figure 6, the responses can be yes, no or DK (don't know). These have been coded 1, 2, or 9 respectively. For question 5 the responses will be numbers of months. Since three spaces are furnished for the response, this number is expected to range from 0 to 999 months. Note that in each space, only numbers from 0 to 9 are possible. Questions 3 and 5 would then require a total of four spaces (= 3 + 1) on the computer card. A total of 76 (= 80 - 4) spaces would be left. The process continues until all spaces are used up and another card image is started. Any number of card images can be used for a given instrument. These can then be linked when the data sets are rearranged on the computer.

It is useful to indicate somewhere on the instrument exactly which spaces will be occupied by a given response. This is indicated in Figure 6 by numbers in parentheses to the far right.**

The coded information is listed to the far right so that the person transferring this information from the instrument to the computer (either directly or via another "coding sheet) can do so more easily. Note also that some information (such as a name) may be difficult to code. However, the information gathered in this evaluation should not be a problem in this regard, and in any case it is not always necessary to store non-numerical (i.e., "alpha-numeric") information such as names. These variables are usually dealt with by assigning unique identifiers to the entire data set on the computer.

6.4.6 Data Analysis and Interpretation

6.4.6.1 Approach

In this section suggestions are made for the analysis of the data to be generated in the evaluation of Health Sector II. The general approach is to suggest important analyses that should and can be done with mission re-

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* "Field Automated Data" is the term AID uses to refer to this concept of precoding data for computer entry, Ref. 7, p. 162.

** Actually, the logic of a given instrument will often allow grouping of these spaces to conserve space. The more redundant case is shown here for purposes of illustration.

SECTION A

MOST RECENT PREGNANCY

First I would like to ask you a few questions about your most recent pregnancy.

1. What is the name of the father of this pregnancy?	_____	
2. Where were you living when you became pregnant this time? City _____ County _____ State _____	* [ ][ ][ ] * [ ][ ][ ]	(1-3) (4-6)
3. Did you want to have a child when you became pregnant this time	Yes..... 1 No..... 2 DK..... 9	(7)
4. Did you plan this pregnancy?	Yes..... 1 No..... 2	(8)
5. For how many months did you try to start this pregnancy?	# months [ ][ ][ ]	(9-11)
6. About how often were you having sexual relations with the father of this pregnancy around the time you conceived? [RECORD VERBATIM.]	* [ ][ ][ ]	(12-14)
7. During the 6 months prior to this pregnancy, were you or the father of this pregnancy using any form of birth control--that is, either rhythm or something to delay or prevent you from becoming pregnant?	Yes..... 1 No..... 2 DK..... 9	(15)
8. Which birth control method were you using most often?	Pill..... 1 IUD..... 2 Foam, jelly..... 3 Diaphragm..... 4 Rhythm..... 5 Condom..... 6 Other (SPECIFY) _____ 7	(16)
9. Did you use this method regularly?	Yes..... 1 No..... 2	(17)
10. Did you stop using this method in order to become pregnant?	Yes..... 1 No..... 2	(18)
11. How many months after you stopped using this birth control method did you become pregnant this time?	# months [ ][ ]	(19-20)
12. Did you become pregnant this time while using a birth control method?	Yes..... 1 No..... 2 DK..... 3	(21)
13. How soon after you became pregnant did you stop using a birth control method?	# weeks [ ][ ]	(22-23)
14. How much did you weigh at the beginning of this pregnancy?	Pounds [ ][ ][ ]	(24-26)

Figure 6. Example of a Precoded Data Gathering Form

Source: modified after Ref. 36

sources to answer major evaluation questions. Next, more demanding (i.e., secondary) analyses are highlighted which will make more use of existing data, and data that may be forthcoming (e.g., census data). Finally, some general comments are offered on the interpretation of the results. The sections covering these topics are, respectively, descriptive analysis, hypothesis testing, other possible analysis, and interpretation and use of evaluation results.

6.4.6.2 Descriptive Analysis

There are three purposes of this part of the analysis which are essential to further analytic work. The first is to display the data graphically to indicate possible trends, directions of differences and whether initial differences between study groups exist in the variables measured. As indicated above there may be some variables for which statistical tests do not show significance between groups. However, if certain trends show up repeatedly and are internally consistent in several respects, support for a given hypothesis can thus be achieved. This point cannot be overstressed. For example, if infant mortality is significantly lower in Study Group C at the end of the study, but preschool mortality in the same group of communities, while also lower, does not reach statistical significance, both of these results taken together are supportive of the importance of the Health Sector II interventions on children's health.

The techniques for the first descriptive analysis can be found in any elementary statistics text (Ref. 37, Chapter 1). Basically, they involve graphic presentation of the data (line and bar graphs, frequency distributions, etc.) and numerical comparisons of differences over time in rates, means, and proportions among the study populations.

The second focus of the descriptive analysis can actually be combined with the first part just described. The distributions of dependent variables (i.e., all outcome variables, such as mortality rates and anthropometry readings) should be examined to see whether they fit a normal distribution pattern. This will help guide further analyses (see next section). Graphic display of the data will probably suffice for determining the normality of the distribution. Alternatively, there are a number of statistical tests for the examination of distributions, such as the Chi Square tests for goodness-of-fit. Again, these are described in detail in elementary statistics texts (Ref. 37, pp. 177-208), usually under "goodness-of-fit tests."

The third aspect of the descriptive analysis relates directly to the data to be gathered in Study Group E communities. In essence, these communities are being examined to extend the evaluation of Health Sector II interventions to all three regions of the country,* as measured by intermediate variables (level 1 and level 2 indicators - see Figure 1). Therefore, the

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*Recall that these intermediate variables will not only be measured in Study Group E communities per se, but they will also be measured in Study Group A-D communities. However, in these latter groups, the focus is to assure the validity of health interventions rather than actually measure intermediate variables.

analysis will not focus on hypothesis testing as much as displaying the results obtained by measuring the intermediate variables. Again, the methods for measuring variables are described elsewhere (Ref. 37, Chapter 2). These should include, for example, comparisons among regions of percentages of wells functioning, of persons using latrines, or of the presence of health education. The results of these comparisons will help clarify any associations detected for outcome variables. One hypothesis testing comparison that is possible, however, would be to see if health education has an effect on water and latrine interventions. This could be done, for example, by testing for the significance of any differences between intermediate variables in Study Groups B and C over time. For example, it might be of interest to compare the percentage of latrines being used in these communities over time. Again, a graphical display of these data should be the first approach, and may in fact suffice without further analysis for purposes of this study.

6.4.6.3 Hypothesis Testing

This is the main section outlining the analysis suggested for health outcome data. The statistical tests can be done by an outside consultant or by Mission or governmental personnel in the Dominican Republic. One test is proposed for each comparison. However, two points should first be considered in each instance. If the data are not normally distributed, they should first either be transformed (Ref. 19, Chapter 16), or the nonparametric analog of the suggested statistical test chould be employed. Second, when "before and after" comparisons are made between the same groups of villages, the "matched sample" test should be employed instead of the one normally used for comparing independent samples. These schemes are next discussed for each type of outcome variable.

Infant mortality, preschool mortality and general (total) mortality can all be expressed as proportions. The comparisons between them could therefore be done by tests for differences in proportions. These are clearly described by Fleiss (Ref. 20, especially Chapter 9).

Anthropometry measures can be analyzed in a number of ways. Since the approach recommended here involves comparing the values obtained with those of a reference population, one analysis would compare percentage changes over time in the proportions of children above a given percentile rank on this reference scale (Ref. 24, and 27). This could be done both for weight/height ratios and for arm circumference. Another analysis would be to compare the mean anthropometric values for villages in each study group over time. In this case, the statistical test would determine the significance of differences in means (Ref. 37, pp. 125-156).

Although it is <u>not</u> recommended that diarrheal morbidity be measured, if this <u>is</u> done, these measures could be expressed as mean numbers of episodes of diarrhea per child per village for each period of observation (i.e., five days). The statistical test could then be for a difference in means in groups of study communities before and after treatment.

All statistical tests should be performed by precisely stating the hypotheses in their "null" or no effect form (Ref. 37, p. 125). For example,

"there is no difference between the proportions of infant mortality among residents of Study Group A communities before and after the water interventions."

While there are a number of comparisons that can be made between the five groups of study communities, the following ones should, as a minimum, be performed:

- "before and after" comparisons within each group (i.e., A_0 A_1, B_0 B_1, C_0 C_1, D_0 D_1) for all health measures;
- "before and after" comparisons of normally collected health measures in communities of Study Group E; and
- comparisons, at the end of the study, between Groups A, B, and C, and the Control Group D. However, simple comparisons of rates, proportions and means can be made only if these groups do not differ in baseline data (see Section 4.6.2). Otherwise, see next section.

6.4.6.4 Other Possible Analyses

In addition to the basic analyses suggested above, several other analyses could be performed. These "secondary analyses" may require more demanding technical resources than were available to the Mission at the time of the completion of this report. However, they could be quite useful in interpreting the results of this evaluation.

Before and after comparisons will be made between the same villages in each study group (i.e., A, B, and C); a group of non-intervention control villages (i.e., D) are also being examined. This arrangement should control for external factors (such as disasters, epidemics, etc.) and secular changes (i.e., changes over time), at least to the extent that this is possible with the validity of data gathered here. Nevertheless, it may be useful to compare final differences in health outcomes between Study Groups A, B, and C and their "control" communities (i.e., Study Group D). This can be done by the more straightforward techniques just described, if initial differences in the health outcome variables are not statistically significant.*

If such differences are obtained, comparisons can still be made, but these will require the use of more complex analytic techniques, such as the analysis of covariance, to adjust for these differences. There are several approaches to this type of analysis, but the authors recommend those based on regression models (Ref. 19, Chapter 14).

If the village level census data become available, and these can be shown to be of reasonably high validity, it may be useful to use these to adjust for any differences in such variables between groups of study communities. For example, census data may yield an index of socioeconomic status. This could then be entered as a control variable in a regression analysis, or a regression-based analysis of covariance.

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* Alpha here can be high, i.e. 10 percent.

Other potentially important covariables could be studied or controlled for using these methods. Such variables might include the following since these data already exist or can already be derived from Health Sector II data banks:

- population of villages
- distance from clinic or other source of sophisticated health care
- rates of immunization
- isolation from other villages
- types of water supply (well vs. gravity-fed)

Finally, there is one other type of analytic approach that could be attempted for study Groups A-D. The comparisons suggested throughout this discussion have already been between (groups of) communities. This is appropriate, since the community was the chosen sampling unit and unit of intervention. However, since data are being gathered on individuals in each community, the study also could be viewed as a large epidemiologic "cohort" study. The water and latrine interventions could then be evaluated as "exposures." The main advantage of evaluating the interventions as "exposures"* is that such analysis would tend to be more powerful than comparing groups of villages.

A number of analytic schemes exist to evaluate such data, including methods for assessing confounding and interaction effects, "dose-response" associations (i.e., levels of health interventions), etc. A detailed discussion of these topics can be found in Ref. 17.

6.4.6.5 Interpretation and Use of Evaluation Results

In addition to the analyses outlined above, there are a number of other (secondary) analyses that can be performed on these data sets. However, those just described should suffice for the purposes of this evaluation, and the comments in this section will be restricted to the more straightforward anlaytic schemes.

The interpretation of these results has been implicit in the basic comparisons of the various health outcome measures to be made in this evaluation. Since many comparisons are suggested, it is anticipated that some results will not be internally consistent with each other. Because of this, results should be interpreted as a whole. That is, a given hypothesis should be evaluated by using more than one or two specific statistical tests on the differences in health outcomes. Specifically, the information gathered on all variables and, in particular, on the intermediate level variables (Figure 1) should be examined to help support or reject a given hypothesis. For example, if infant mortality decreases (but not significantly) in Study Group C over time, yet measures on intermediate variables show little use

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*Although exposures are typically viewed as detrimental to health in epidemiologic studies, they also can be evaluated as beneficial. Alternatively, the control villages could be considered as "at risk" of exposure. It should be noted, parenthetically, that the health impacts of water and latrine interventions are not always beneficial (Ref. 38).

of water and latrine interventions by villagers in these communities, the differences in mortality will be less likely to be attributable to the health interventions. Of course, this interpretation should be made in view of the changes that occurred in Study Group D communities (i.e., the controls), since such decreases may have occurred in the absence of water and latrine interventions. However, all such interpretations will, strictly speaking, be restricted to the region from which Study Groups A-D are chosen.

The monitoring and validity check components of this design should thus be considered in the interpretation of these data. Measurements in communities in Study Group E will focus more on intermediate variables than on health outcomes, although some routine information on health outcomes will also be gathered there (i.e., age an sex-specific mortality). Together these data can then be used to extend interpretations from the Group A-D region to the other two Regions in Health Sector II. As mentioned earlier, this is an example of generalizing results from a (it is hoped) more valid sub-study to a larger population. To do so calls for knowledge of the similarities and differences between the respective regions and scientific judgment. Therefore, the information gathered in Study Group E communities, while not as informative with regard to health outcomes as that gleaned in Study Groups A-D, can be used to help generalize results, to aid in interpretations and as an administrative (i.e., Operation and Performance level) evaluation as well. These are the main reasons for employing the impact assessment model (see Figure 1).

These results need not, of course, be restricted to use in the Dominican Republic. In fact, the same logic for generalizing internally-valid results can be extended to include other countries where rural health interventions will occur. Again this calls for familiarity with existing conditions (i.e., climate, geography, social organization, etc.) and scientific judgement. For a more complete discussion of the many uses of evaluation results, see Ref. 7, especially pp. 242-244.

Chapter 7

MONITORING

7.1 General

In order to be effective, health interventions must not only be properly planned and implemented but must also be properly operated and maintained on a continual basis. One of the common reasons for failure of health interventions to achieve the desired effect of improving health, especially in rural areas, is the lack of proper operation and maintenance. Sometimes this is due to failure to plan an operation and maintenance program at the start of a project but sometimes it is also due to failure, during the design and implementation phase, to consider the limitations in skills and/or the availability of funds, materials and tools for operation and maintenance in rural areas. The role of project monitoring is to ensure that proper and possible operation and maintenance is considered during design and implementation and that it is carried out throughout the life of a project.

The role of monitoring in relation to the evaluation plan presented in this report is critical because it serves as a check on the implementation and functioning of the health interventions and the validity of the data gathered for the impact evaluation.

The monitoring program seeks to answer such questions as:

Have wells, fountains and/or latrines been installed?
Do they work?
Do the people use them?
Are health education sessions being conducted?
Are people participating in the health education sessions?
Are health education sessions addressing local health problems?

Only through proper monitoring can it be assured that the health interventions being evaluated are actually operating in the communities. If, for example, a community is reported to have been supplied with wells and hand pumps but in actuality the pumps are broken or are not being used, the attempt to compare the impact of the improved water supply on community health as compared with the health of a control community would be invalid because the improved water supply does not actually exist. The monitoring program would record this defect, and timely maintenance could be performed to correct the problem. If the maintenance is <u>not</u> performed, the monitoring program would still serve the useful purpose of recording the absence of an effective improved water supply so that this information could be used either to explain the results of the evaluation or to eliminate the particular community from the analysis of the sample being evaluated.

In order to check the validity of data, the supervisors and health committees must assure, in written reports, that the promoters are collecting all of the data necessary, are doing it in the prescribed manner and are reporting any abnormalities in the data collection system. In addition,

routine "validity check" surveys are recommended similar to those conducted for the data gathered under the Health Sector I (SBS) project.

It is recommended that the following basic, factual data should be available in one place. For the most part the data are on file now at the UAPODAN office but they are not all compiled into complete community profiles which would be useful to monitors and to those who analyze the data and interpret the evaluation results.

- the name of the community
- the population (the numbers of both persons and households)
- the health region in which it is located
- whether there is a road for motor vehicle access
- its distance and direction from the provincial capital
- its distance to the nearest health clinic and/or hospital
- its characteristic as coastal, plain or mountain
- the number of SBS promoters
- whether there is a functioning health committee
- the number of wells or faucets for water supply
- the range of depths of the wells
- the range of depths to the water table
- the type of soil in which the wells are located
- the type of pump (piston in pump base or on drop pipe)
- the distance of the spring source (for gravity-fed systems) from the nearest house and animal grazing area
- the dates the water systems were installed and began functioning
- whether the systems were chlorinated
- whether the water quality was determined
- the number of wells or faucets functioning at the time of each monitoring check
- the number of latrine slabs delivered
- the date the slabs were delivered
- the number of privies constructed at the time of each monitoring check

- the number of privies being used at the time of each monitoring check

- the number of water containers delivered

- the date the containers were delivered

- the number of containers in use at the time of each monitoring check

- the number of health education workshops which have included participants from the community

- the dates of these workshops

- the names of the participants

- the locations of these workshops

Adequate project monitoring is an integral part of the evaluation plan presented in this report. Because of the large scale of the Health Sector II project, however, it would be too expensive to monitor completely every community in which the project functions. In order to assure validity of the health impact evaluation, the communities included in the evaluation study groups should be monitored in preference to other communities. However, even this restriction in the number of communities to be monitored may not be enough to lower the cost of monitoring to a reasonable or acceptable level. Thus, depending on resources, only a sample of the study group communities may actually be monitored. As stated in Chapter 6, however, it is more useful to monitor a smaller number of communities completely than to monitor only portions of a larger number of communities.

Full reports of all of the monitoring activities should be available to those charged with analyzing the data and interpreting and reporting the results of the evaluation. This chapter discusses the features which should be considred in the design, implementation, operation and maintenance of the three health interventions. In the case of the water supply and excreta disposal systems the design and implementation considerations are discussed under the heading "construction." In the case of the health education program they are discussed under the heading "planning." The recommended schedule for project monitoring was presented in Figure 2 of Chapter 6.

7.2 Water Supply Program

7.2.1 Construction Considerations

Wells and intake structures should be well drained and located as far as possible from sources of both surface and subsurface contamination. Avoidance of sources of subsurface contamination, such as privies and refuse dumps, is especially important in the case of shallow wells. The wells should be at least 50 feet, and preferably 100 feet, from these

sources of contamination, and should not be directly downhill from them. Locating wells near specific houses, as opposed to locating them in public or common areas, has been found to encourage cleanliness and proper maintenance because the nearby family may take on the responsibility to care for "its" well.

Wells which are abandoned should be backfilled and capped. If a well is drilled but no water is found, the driller should not be paid for his work until the well is backfilled, with the fill being thoroughly tamped every 3 feet, and the top 3 feet of the well filled with concrete. Of course, the driller should be paid extra for the backfill work. The entire operation should be observed by a competent engineer inspector. The same backfilling procedure should be followed for wells that may be used for some time and then abandoned. If, for example, the pump parts are irretrievably lost down a well during a maintenance operation, the well should be abandoned unless a new drop pipe and pump can be installed.

The well casing should be integral for the entire depth between the aquifer being tapped and the base of the pump. The section of casing which is slotted (well screen) to allow the groundwater to enter the well should not extend above the water table. The joints between lengths of casing should be welded all around unless threaded joints are used. The space between the casing and the soil outside it should be sealed by tamping grout into it. The grout should consist of a mixture of 20 pounds of cement, 2 pounds of hydrated lime and 1 to 1.2 gallons of clean water.

Between the time the well is completed and the pump is installed a steel cover plate should be welded over the opening of the casing above the ground to prevent contamination of the well or even the loss of the well due to stones thrown into it. This will also prevent people in the village from bailing water out of the well before it is cleaned, tested and disinfected.

The dirty water inside the casing should be pumped out before inserting the pump screen and drop pipe into the casing (as well as the pump cylinder and piston rod in the case of deep wells). After installing the pump but before the well is placed in service, the well should be disinfected using dry calcium hypochlorite (such as HTH) according to the instructions on page B-9 (see Appendix C) of the well-drilling specifications. The UAPODAN well-installation crew is not carrying out this procedure at the present time. This situation should be corrected. The well should also be disinfected after maintenance, if the maintenance has involved disassembly of the pump.

Another disinfectant which could be used for well disinfection is liquid sodium hypochlorite (laundry bleach). However, even though it is more readily available than calcium hypochlorite, sodium hypochlorite is unstable and should not be counted on to contain the full amount of originally-availabile active chlorine 60 days after the solution has been prepared.

Although for the sake of simplicity and economy the Health Sector II project does not include water treatment, it is important to be aware of the quality of the potential water supply. Before the well or spring is disinfected and placed in service, therefore, the water should be tested

for possible chemical or bacteriological contamination. In some cases it may be necessary to reject the supply as hazardous to health, but in others it may be found that the water is potable even though it contains chemicals which can induce gastrointestinal upsets or lessen aesthetic appeal.

Monitoring the quality of the water before wells are placed in service has fallen far behind the drilling of wells, and, therefore, many wells are being used without any sampling at all. The reason given for this is lack of laboratory capacity and capability to collect and analyze the samples. It is important that this be corrected either by obtaining protable kits for testing the water or outfitting mobile field laboratories. These could be used not only for the initial sampling but also for the subsequent semi-annual sampling that is recommended as a minimum for any water system.

As a general rule the quality of groundwater should be at least as good as that of a surface supply. In sand and gravel aquifers the probability of bacterial contamination lessens with greater depths, but it increases if wells or springs are located in soluble or fissured rock formations (such as coral or limestone).

The expense and logistics of sampling all of the water supplies are beyond the capability of the project. The sampling, therefore, should be confined to shallow wells and wells sunk into coral or other soluble or fissured rock, because contaminants can travel unchecked and unmodified for great distances in these materials.

Because of their danger to human life and health, the following chemicals should not be present in the water in greater than the following concentrations. If they are, the water source should be abandoned. These limits were taken from Freedman's Sanitarian's Handbook.

BASIS FOR REJECTION OF WATER SUPPLY

Arsenic (As)	0.05 mg/liter
Barium (Ba)	1.00
Cadmium (Cd)	0.01
Hexavalent Chromium (Cr^{+6})	0.05
Cyanide (CN)	0.20
Lead (Pb)	0.05
Nitrate (NO_3)	45.00
Selenium (Se)	0.01
Silver (Ag)	0.05

The bacteriological quality of water varies with time and it is therefore difficult to determine whether a particular source is acceptable on the basis of a single sample. To apply the normal criterion of a monthly average of less than one coliform bacteria colony per one hundred milliliters requires frequent sampling, but this is not envisioned, and probably not possible, in the Health Sector II project. Thus, despite its limitations, a single sample must be used in order to determine whether a particular well or spring should be rejected.

A total bacteria count would be more revealing for a single test than the coliform bacteria count, which would be used for the regular, frequent sam-

pling in more densely populated areas with adequate laboratory facilities available. The total bacteria count is determined by the membrane filter technique, but it uses a different dye and/or nutrient from those used in the coliform count. A 10-milliliter sample of the water should be obtained in a sterile manner and added to 90 milliliters of sterile, distilled water. The sterile, distilled water could be prepared in a laboratory in Santo Domingo and stored in individual sampling bottles. A 10 milliliter sample should be withdrawn for the membrane filter test. If the total bacteria count of this sample is greater than 50 colonies, the source should be resampled and rejected if contamination is confirmed.

Care should be taken to obtain a clean sample which is free of chlorine and of contamination introduced during well drilling or construction. The sample should be obtained, therefore, after the well has been pumped clean but before it has been disinfected.

Nitrates can cause death in infants by methemoglobinemia although they are apparently harmless to adults. Water high in nitrates (above 45 mg. per liter) should not be drunk by infants, nor should infants drink the milk of humans or animals consuming the water. In testing for nitrates it is important to keep in mind that a high chloride concentration in the water will cause an erroneously low value for nitrate and a large amount of organic matter will cause an erroneously high value for nitrate.

Sulfates in the range of 600 to 1,000 mg. per liter can have a cathartic effect, especially if magnesium (Mg) or sodium (Na) are present. Thus, high sulfate concentration should be recorded in order to help explain possible increases in the occurrence of diarrhea. Very high chloride concentrations (above 1,000 ppm) may also have a cathartic effect.

There are several other chemical constituents of water which may result in a supply not being used even though it may not be detrimental to health. Water with a bad taste, odor or color may be shunned in favor of a more pleasing, albeit more dangerous, supply. Hard water is frustrating to use for bathing and laundering. It is important to note that it may also cause soil salination if used for irrigation. Water with high iron and/or manganese concentrations may stain clothes.

The concrete apron around the well casing should be cast on firm, well-tamped soil. If the apron cracks, it may be necessary to remove it, together with the pedestal built on top of it, provide a better earth base and then recast it. If the apron was reinforced, there would be less chance of its cracking due to differential soil settlement.

The top of the concrete pedestal should be no less than 1 inch below the top of the well casing. The pedestal should be finished smooth with a very slight pitch away from the casing toward the apron. The anchor bolts for the pump should be bent before being cast into the pedestal in order to provide positive mechanical anchorage in addition to anchorage by friction. A bar welded to the head of the bolt, to form a "T," which is embedded in the concrete, would serve the same purpose, provided the weld is strong. In the future, "J" bolts should be bought. Due to the strain on the bolts, they should be of high strength material.

The UAPODAN pump installation crew has found that oftentimes the pump base does not fit over the well casing because the inside diameter of the base is almost exactly the same as the outside diameter of the casing. The UAPODAN crew, therefore, has been setting the top of the pedestal at the same level as the top of the casing rather than allowing the casing to protrude above the pedestal. In this way it is able to seat the pump base on the pedestal, but, in doing so, it is failing to provide protection against contaminated surface water from flowing down the well. It would be better to maintain the 1 inch of casing above the top of the pedestal even if the pump base does not rest on the pedestal. The pump base can be shimmed with small stones to level it and then the nuts can be tightened onto the bolts. Grout can be rammed into the space between the pump base and the pedestal to seal the space and support the base. In order to facilitate this, the bolts should protrude at least 2 inches above the pedestal. It may also be possible to machine out the inside of the pump base to accommodate the casing and/or have the pump installation crew file down the outside of the protruding casing to fit into the pump base.

The UAPODAN crew is planning to cast the pedestal with a step in it so that spillage will not flow under the base of the pump. It is recommended that the procedure described in the previous paragraph be followed rather than depending on a stepped base to keep water away from the well casing. The tiered pedestal of Los Ranchitos de Bani is stepped in a similar manner but does not keep water away from the base of the pump.

The eight holes bored in the pump base are only 1/16 inch larger than the diameter of the four bolts which are anchored in the concrete. Unless the four bolts line up exactly with four of the holes in the base, which is almost impossible to accomplish, the bolts have to be hit with a hammer to adjust their position. This tends to loosen the bond between the concrete and the bolts. It would be better for the manufacturer to bore holes 1/8 or even 1/4 inch larger than the diameter of the bolts in order to avoid disturbing them once they are anchored in the concrete.

In mixing concrete for the pedestal sufficient cement should be used to provide adequate strength. In some cases it appears the pedestals have too much sand in them. This can result in a poor bond between the anchor bolts and the concrete. The concrete of both the apron and the pedestal should be kept moist, or at least shaded, for at least 10 days after it is cast to allow the concrete to develop its full strength and to reduce the chances of the concrete developing hairline cracks. If large cracks occur in the pedestal, it should be removed and replaced, because contaminated water seeping down through the cracks could eventually reach the aquifer.

Even the UAPODAN installation crew of several experienced men is hard-pressed to manage the installation of the 20-foot lengths of drop pipe and piston rod in the wells. These pieces are simply too long to handle when they are vertical. Village maintenance crews will probably not be able to manage this task during a maintenance operation. Serious consideration should be given to installing the drop pipe and piston rod in maximum lengths of 10, rather than 20, feet.

It is very important that the pump be as vertical as possible. The installation crews should have spirit levels to be able to set the pump properly.

The considerations discussed above regarding disinfection and water quality sampling also apply to the gravity systems. The storage tanks should be cleaned, pumped out and then filled with water to which enough HTH is added to make a 100 parts-per-million (ppm) solution of chlorine. After the solution has been in the tank 24 hours, it should be flushed into the distribution system, with all of the spigots in all of the fountains open, in order to disinfect the system.

The structural considerations in the design and construction of the storage tanks are discussed in some detail in Appendix A under Los Corozos. It is most important that the access hatch in the roof of the tank have sufficient overlap so that water cannot enter the tank from the roof. It is also important to exclude animals and humans from the fenced lot around the tank.

Care should be taken in performing design calculations so that the pressure rating of the transmission pipes will not be exceeded.

In order that small children might use the fountains more easily, a step should be provided at the sides of the fountains so they can reach the faucets.

7.2.2 Operation Considerations

In operating the hand pump a full stroke should be used to obtain water as rapidly as possible and make complete use of the mechanical advantage provided by the lever arm.

Small-mouth containers should be used for carrying water in order to minimize the possibility of contamination. If wide-mouth containers are used, they should not be filled so close to the top that it is necessary to stick one's hands in the water in order to pick them up.

In order to keep the water containers clean, without having to use brushes or cloths, both the carrying containers and the home storage containers should be cleaned frequently at the wells or public fountains by swishing water in them and then pouring it out a short distance from the well or fountain. This procedure should prevent the build-up of sediment in the containers.

Water should not be poured down the hole in the top of the pump through which the piston rod passes. The pump does not need priming. This point should be included in the health education program.

Clothes washing and bathing should not be done at the pumps or fountains. Separate washing stations should be set up near the water supplies for laundering.

The project monitors should note whether the water systems and water containers are being used properly and whether problems with their construction or use are being reported to and addressed by UAPODAN.

7.2.3 Maintenance Considerations

The apron and pedestal should be kept clean and free of standing water.

The piston guide at the top of the pump should be kept lubricated with a little grease supplied by SESPAS. Oil should not be used because it could flow down inside the pump and contaminate the water. The villager(s) charged with pump maintenance should check frequently to be sure that the bushings and rods connecting the piston and the fulcrum to the pump handle are not worn. The cotter pins should also be in place.

UAPODAN should establish at least one full-time maintenance crew to perform major maintenance work on the water-supply systems in all of the 500 project communities. If the village maintenance personnel encounter a problem which cannot be handled locally, the UAPODAN crew should be called upon for assistance. The request could be channeled through the health committee and supervisors.

If the villagers find that the pump handle must be worked many times before water comes out of the spout, the leather seals on the pump piston may be worn or there may be a problem with the pump valves. The village maintenance personnel should be trained and equipped with tools and the necessary spare parts to dismantle the pump, remove the piston (and, if necessary the drop pipe), replace the worn parts and re-assemble the pump. The well should be disinfected before being placed in service again. (See the discussion of well disinfection above under Construction Considerations.) The first few times this is done, the UAPODAN crew should be present to assist the village maintenance personnel. The village maintenance crew should attend health education workshops for training in handling maintenance problems and to establish and maintain contact with other village maintenance crews.

Another possible cause of the failure to obtain water from the wells is clogging of the slits in the casing. This problem should be suspected if only a little water can be obtained from the well at any one time and a long wait between pumpings is necessary before more water can be obtained. If nearby wells continue to supply adequate amounts of water, this may well be the problem. To resolve this problem requires professional help. Either the bottom of the casing must be jetted in order to dislocate the material clogging the slits or chemicals must be used to remove the possible corrosion of the casing at the slits. Of course, the cause may also be that the water in the aquifer has dropped to an elevation below that at which the pump screen is located. In this case, either the well should be abandoned until the aquifer is replenished or the pump screen should be lowered by extending the drop pipe to a greater depth inside the casing.

Cleaning the filters and storage tanks of the gravity systems should be done only by the SESPAS crew and should be done periodically.

Village maintenance personnel should have a supply of washers and the necessary tools to replace the washers in the faucets at the public fountains.

7.3 Latrine Program

7.3.1 Construction Considerations

The latrine should be located so as to be convenient to the houses but not closer than 30 feet. It should be down slope from the nearest well or spring and at least 50 feet, but preferably 100 feet, away. To the extent possible the latrine should be located downwind of the nearest house. It should also be located away from trees in order to facilitate digging the pit. When first locating the privy, consideration should also be given to the possible relocation sites when the first pit fills up. The two locations should be close to each other to facilitate moving the slab and superstructure.

The latrine should also be convenient to a place where users can wash their hands after using the privy. It would be best to bring water to the privy for this purpose.

The pit should be deep enough for several years' use, between 8 and 12 feet. Wherever possible, the bottom of the pit should be at least 4 feet above the maximum ground water level. The pit should preferably be round because the walls will have greater stability. If the soil is unstable, the walls of the pit should be lined with stone. The stone wall should be solid but the joints between the stones should not be completely mortared. Some mortar can be used, however, to hold the stones together as long as most of the joints are left open.

The slab should not rest on the pit lining, if one is used. The slab should rest on a base consisting of a stone wall, built some 8 to 12 inches above the ground, with the same plan dimensions as the slab. The base should be on firm soil. The soil excavated from the pit should be mounded around the outside of the base to provide drainage away from the privy.

The slabs and stools are being tested at the UAPODAN engineering office in Azua. The slabs have been cast and underwent rupture tests the last week of April 1981 to determine their breaking strength. Although the slabs for this project have been designed to be 5 centimeters thick, the literature recommends that 6 centimeters be the minimum thickness. In a reinforced concrete slab the steel reinforcing should be located in the bottom portion in order to provide proper strength. But there should also be enough concrete below the reinforcing to protect the steel from corrosion. The placement of the reinforcing in such a thin slab, therefore, is critical.

The joint between the two sections of the slab should not be cemented in order to facilitate eventual relocation of the privy and to avoid the damage to the slab that could result if such a cemented joint had to be broken.

The stool (riser) should not be cemented to the slab in order to facilitate its removal for relocating the privy. Another reason for not cementing it to the slab is that it can be removed and not used if people decide they would rather squat than use the seat or find it too difficult to keep the stool clean.

In fabricating the concrete stools, the inside of the stool, as well as the seat portion, should be polished so as to facilitate proper cleaning.

If fiberglass stools are to be used, the joint at the bottom of the stool itself, not that between the stool and latrine slab, should be well sealed to preclude the development of germs in the inaccessible space between the outer and inner walls of the stool. The stool should not be cemented to the slab, however, for reasons already cited.

If this bottom joint between the walls of the riser is well closed, the fiberglass stool would be better than the concrete one because it is much lighter and is also easier to clean.

The superstructure should be portable, if possible, so as to make relocation easier. If it is made of concrete blocks, which seems to be a common material for privies in the Dominican Republic, relocating the privy will be a major operation. A lighter material would be preferred. If a lighter material is used, consideration should be given to anchoring the privy to protect it from damage in storms and also to protect it from vandalism.

The roof should overhang the superstructure enough to direct rain water well away from the privy. The roof should slope away from the front of the privy.

The ground in front of the door should be protected by a stone or wood path, which is well drained, in order to keep the slab of the privy from becoming muddy during the rainy season.

7.3.2 Operation Considerations

The pit should not be used for rubbish disposal.

The door of the privy should be kept closed so as to exclude animals.

The cover on the stool should be kept closed to exclude flies from the pit.

When the contents of the pit reach a level about one foot below the slab, the privy should be relocated. The dirt mounded around the base of the privy and some of that excavated from the new hole can be used to fill in the hole at the original site. If at least one year passes after relocating the privy, the original site can be used again when the privy is relocated a second time. The excavated material can be used as soil conditioner.

The project monitors should note whether the privies are being used properly and whether problems with their construction or use are being reported to, and addressed by, UAPODAN.

7.3.3 Maintenance Considerations

The privy should be kept neat and clean. The family should include in its daily chores the cleaning of the slab, stool (inside and out) and cover. A

stiff brush and water should suffice for this operation. Spider webs and insect nests should be broken up if they form inside the superstructure or at the hole in the slab. If the pit seems to breed mosquitoes, some kerosene should be poured into it. Disinfectants (e.g., bleach) should not be poured into the pit because they would kill the bacteria needed in the pit to break down the wastes.

A small supply of anal cleansing material (corn cobs or leaves) should be stored for use in the privy. The material should be disposed in the pit after use.

7.4 Health Education Program

While the conditions and use of water sources and latrines can be observed and measured, the health education program is much more difficult to monitor because the measure of its effectiveness is behavior change. Such changes are difficult to quantify. Nevertheless, it is important to monitor the health education program because, in addition to its direct benefit of improving health, it will affect the extent to which the water supply and latrine programs are effective in improving the quality of water used in the communities and the sanitary disposal of human wastes.

The principal tools for monitoring the health education program are the reports of the personnel and groups involved in the project and the communications between the communities and the Rural Health Office of SESPAS. The latter are a means now used by the promoters and health committees to inform SESPAS of the health needs and desires of the communities. If the health education program addresses these needs and desires, among other important topics, it should be successful in positively influencing health-related behavior.

The remainder of this chapter suggests the important questions and issues in monitoring the health education program. They are divided into planning, operation and maintenance criteria. The project monitors should be familiar with the details of the health education plan which is described in a separate report prepared concurrently with this report by Mr. Charles Llewellyn. Most of the following discussion is based on that report.

7.4.1 Planning Considerations

The health education program, especially the health education workshops, should be coordinated as much as possible with as many other institutions, both formal and informal, which work in the communities so as to reduce the chances that modification of health-related behavior might so conflict with the cultural settings of communities as to introduce tensions which can be detrimental to health rather than beneficial to it.

The community is the unit of health education practice. It is by means of community organization that health-related behavioral changes are promoted in the individuals living in the community. The nature and extent of community organization, therefore, should be described by the project monitors. They should also note what efforts are being made to improve community organization and should comment on the success of these efforts.

The program should be responsive to needs and desires which are recognized and expressed by the people in the communities. It should also address needs which health technicians recognize from their observations in the communities.

The health education team should maintain communication with local doctors, nurses and personnel of the SBS program so as to be aware of the most common locally-occurring diseases, conditions of health and nutrition in specific communities and other health-related issues which can vary among communities and can vary with time.

The simple transmission of information is not enough to effect improvements in health-related behavior. The program must be planned in order to effect change so that obstacles to change must be discovered and addressed. This is true not only at the level of the workshops but also among the SBS personnel and between the promoters and individuals in the communities.

It is important to communicate to the communities specific, factual information about the project as well as information intended to motivate behavioral change. Information such as when and where the wells are to be sunk, when and where the latrine slabs and water containers are to be delivered and how they are to be used and the purpose and the manner of collection for the water system maintenance fund should be explained well in advance of introducing any of these items into a community. If the community is expected to provide labor or materials for the program, the people need to know how, when, where and to whom they should provide them.

There have already been at least three instances of problems due to failure in communication. First, some communities were led to believe that the monthly 50 centavo payment, per family, was for the <u>use</u> of the water, although, in fact, it is for <u>maintenance</u> of the water systems (labor and materials). Second, in some communities the well-drilling crews, which are employed by private contractors, have demanded food from the people in the communities where they are working. Because they had received no prior explanation of the project, the people did not know whether they had to provide food to the crews. The project does not envision the necessity of food contributions by the communities to private contractors. It does envision the communities contributing labor to the UAPODAN crews which install the pumps and construct the gravity-fed water supply systems. The third instance of communication difficulties was a series of misunderstandings between the UAPODAN crew and the group of communities around Los Corozos which were to be supplied water by a gravity-fed system. At times the UAPODAN crew appeared at the job site, high up on a hill above Los Corozos, only to find that no villagers had come up to help them. At other times the villagers were there, but the UAPODAN crew was not. The local SBS supervisor recognized this as a problem to be resolved through the health committees in each village to be served by the system. Presumably, the problem was resolved satisfactorily.

The foregoing are examples of the issues and aspects of the project which the monitors should watch for. The monitors should keep careful and detailed notes of the problems, how they are dealt with in each community and especially how they affect the health-related behavior of the community.

In order to avoid problems similar to those described above and in order to organize and motivate the communities for positive changes in health-related behavior, the health education program should precede the introduction of water supply systems and latrines in the communities. Not only should the workshops precede these interventions, but also the efforts of the health committees and promoters to communicate to the communities information obtained in the workshops should precede them.

In order to be successful, the health education program should be closely coordinated with the schedules of the well-drilling crews, the UAPODAN crews, the delivery of water containers and latrine slabs, and other health-related interventions. The health education team should coordinate the workshops with UAPODAN so as to have technical personnel available for training the community maintenance crews.

The health education team should also coordinate with UAPODAN and the local hospitals and clinics in planning the workshops so that problems encountered in the functioning of the water systems and latrine program and also the commonly-occurring diseases in the communities can be addressed in the workshops.

The health education team should meet with the promoters and health committees of each community which is to be represented in a workshop before each workshop. The project monitors should note the number of meetings that are held for each community and should review the reports of the meetings.

Finally, the work of the health education team should be oriented primarily toward the goal of maximizing health benefits in the communities. The interest of improving the health of the communities should not be subordinated to the interest of maintaining a schedule, completing a certain number of workshops in a certain length of time or some other intermediate goal which, however necessary or well-intentioned, may not lead to health improvements in the communities. Not only should the members of the team be realistic, patient and flexible but also those in charge of the team and of the project as a whole should be realistic, patient and flexible in their expectations and demands. Changing patterns of behavior is slow, complex work. It should be done in a deliberate and thorough manner and cannot be rushed.

7.4.2 Operation Considerations

This section lists questions and issues for the monitors to be aware of in assessing the functioning of the health education program.

A list should be kept of the dates and locations of all of the workshops, those who attend them, the communities represented and the topics discussed.

The composition of the UTOC team will strongly influence the health education program. What criteria are used in selecting people for the UTOC team? Do the team members get along well? Are they cooperative, understanding, patient and eager to learn? Should additional criteria have been used in selecting them, or should some of the current criteria not be used?

Are the team members under contract? If so, to what organization and for how long?

Is the UTOC team identifying needs in each community? How is this being done? What problems has the team encountered in doing this? What has the team done about these problems both in preparing the workshops and in communicating these needs to those with the resources to address them? Are these measures effective in solving the problems?

Take note of the interaction between the UTOC team and the SBS supervisors, because both have a health education role. Do they cooperate? Do the supervisors have significant roles to play in the workshops? Do they communicate information to the promoters and health committees and motivate them to pass the information on to the communities?

Do the workshops include a discussion of community needs, as well as those of the promoters, health committees, supervisors and the UTOC team itself? Is there a sense of progression in discussing these needs, for example, by talking about them at the beginning of the workshop and again at the end so as to see if the group has progressed toward solving problems and addressing needs.

What sorts of activities characterize the workshops? Do introductory sessions help plan and orient the workshops and break down social barriers? Is there group discussion, problem solving and role playing? Does everyone participate? Are small discussion groups organized? Do they select a leader and a secretary? How are domineering people or ones who monopolize conversations dealt with? How are shy or inarticulate people dealt with? Are signs, posters, movies or slides used in the workshops? How? Are they a focal point or are they used to supplement and illustrate points made in discussion? Are the participants involved in preparing them?

Do food, lodging, transportation or other logistic arrangements help or hinder the participants' wholehearted involvement in the workshops? Are arrangements made for other members of the participants' communities, who are not attending the workshop, to look after the affairs of those who are attending?

Are written records kept of the activities and discussions of the workshops? Are records made of the participants' evaluations of the workshops? Do the UTOC team members evaluate the workshops and their own roles in them immediately after each workshop? Do they make use of the written records of the workshop in this evaluation? Do they make a written evaluation? Does the evaluation include at least an outline of a plan for the next workshop which will involve the same communities? The monitors should examine these records very carefully.

Have actual or potential conflicts in the communities been identified? How are they being dealt with? Are there any factions or groups in the communities that are being left out of the workshops or are not being contacted by the promoters and/or health committees?

What type of motivation characterizes the efforts of the health education team, supervisors, health committees and promoters in dealing with each

community; intrinsic or extrinsic? What efforts are being made to diminish extrinsic motivation (i.e., fear of sanctions) in favor of intrinsic motivation (i.e., desire to improve oneself).

Is technical information being passed along from supervisors to health committees to promoters to individuals in the communities? Do the people at these different levels assist or hinder the work of those at other levels?

Does the health education stress the importance and the use of water for personal hygiene and food preparation as well as for drinking? Are people taught to wash their hands after using the latrines?

What readily-observable changes have occurred in health-related behavior, in nutrition and in attitudes? Do people in the community view these changes as good, bad or inconsequential?

7.4.3 Maintenance Considerations

This section lists questions and issues for the monitors to be aware of in assessing the maintenance of the health education program.

Have any members left the health education team? How many? When? Why? Have new members been sought? How? Is the team expanding by training local health educators to continue the work?

What training, both initial and continuing, is provided for the UTOC team? Is the team afforded suitable vacation time? Is their pay scale satisfactory both to them and to SESPAS?

Does the UTOC team communicate and cooperate well with the rural health office of SESPAS, UAPODAN and the SBS personnel (supervisors, health committees and promoters)? Does the team also maintain contact with other government agencies operating in rural areas and with other groups working in the communities?

Does the team have the resources it needs to carry out its work? Are vehicles, projectors and generators provided, and are they maintained properly? Does the team have materials (paper, pencils, etc.) for the workshops? Are food and utensils provided for the meals to be served during the workshops? Is there adequate secretarial and clerical help for communications, copying, filing and data collection? Do the administrators and managers of UTOC, UAPODAN and SESPAS facilitate the work of the team by minimizing the time which the team members themselves must spend on support activities and by providing necessary resources promptly and in adequate supply? These same considerations apply also to the relationship between the UAPODAN crews installing water systems and their administrators and managers as well as to similar relationships involving SBS personnel.

Is technical information available in written form? Are there written handouts for the communities? Are there manuals for the supervisors, health committees, promoters and maintenance crews?

Do the health committees and promoters show an understanding of, and ability and desire to, communicate the information obtained in the workshops?

Chapter 8

RECOMMENDATIONS

This chapter summarizes some of the most important recommendations of this report, especially ones which require immediate attention. This chapter, however, does not substitute f a thorough study and understanding of Chapters 6 and 7 because it is not a summary of the evaluation plan.

A consultant experienced in the type of evaluation described in this report should be contracted by USAID to further assess the ability of institutions, agencies, groups or personnel in the Dominican Republic to process and analyze the data for the evaluations.

The SBS promoters should collect the data for the evaluation. They should continue to be monitored as they were for the Health Sector I project. If the consultant recommends use of Dominican Republic resources for processing and analyzing the data, these resources should be contracted in order to conduct and supervise the evaluation. If outside resources are recommended, USAID should immediately proceed to find and contract them.

It is not recommended that diarrheal morbidity data be gathered and analyzed for the evaluation, but the data may be collected if the SESPAS and/or the USAID Mission want them for possible future analysis.

The 25 communities which will comprise Control Group D (See Chapter 6) should be randomly selected as soon as possible. The consultant hired to assess the abilities of local resources should perform this task with the help of UAPODAN and UTOC.

Anthropometric data should be collected regularly by the promoters, at least in the study communities.

The UAPODAN engineers and pump installation crew should correct the problem of the top of the well casing being flush with the top of the pedestal, rather than being an inch or so above it. This problem is discussed under construction considerations for the water supply program in Chapter 7, and it should be addressed immediately.

The vertical alignment of the pumps should be assured by the use of a spirit level.

The UAPODAN engineers and installation crew should also follow the recommendations on page B-9 of the pump specifications (see Appendix D) in order to disinfect the wells and gravity-fed systems before placing them in operation.

Shallow wells, and wells sunk into coral or other soluble or fissured rock should not be placed in operation until the quality of the water has been tested. Portable water-testing kits should be obtained for this purpose.

Monitoring of the Health Sector II project in the study group communities is essential for the validity of the evaluation. The consultant should

have experience in the functioning and trouble shooting of simple rural water supplies and excreta disposal systems and health education and community organization programs. At the beginning of the evaluation period the consultant should define the tasks, prepare the data-gathering forms and select the personnel for the project monitoring program. All of the study communities should be monitored initially. Periodic monitoring during the evaluation should be done either in all study communities or in a random sample of them, depending on the availability of resources. It is more useful to monitor a single community in its entirety than to monitor only certain aspects of, or just some people in, several communities.

It is important that tasks and responsibilities be defined as early as possible so that everyone, from residents of the communities to officials of SESPAS and the USAID Mission, know what they are and are not responsible for and what resources they should depend on for assistance.

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APPENDIX A

January 26, 1981

WATER AND SANITATION FOR HEALTH PROJECT

ORDER OF TECHNICAL DIRECTION NUMBER 21

TO: WASH Contract Project Director, Mr. James Arbuthnot, P.E.

FM: AID WASH Project Manager, Mr. Victor W. R. Wehman, Jr., P.E., R.S. VWW

SUBJECT: Provision of Technical Assistance Under WASH Project Scope of Work for USAID/Dominican Republic

REFERENCES: A) Santo Domingo 08756
B) Santo Domingo 0082
C) State 013973
D) Rivera (USAID)/Wehman (AID/W)/Warner (WASH) phone call - 22 Jan 81 @ 1000 hrs

1. WASH contractor requested to provide technical assistance to USAID/Santo Domingo as per ref A and ref B scopes of work.

2. WASH contractor/sub-contractor/consultants authorized to expend up to eighty (80) person days effort over a five (5) month period to accomplish this technical assistance effort.

3. Contractor to provide draft final reports on completion of each element in ref A, para 2.A.1. and 2.A.2., 2.B.1., 2.B.2., 2.B.3. and 2.B.4. Final report due to mission within 30 days of completion of above field activities and final departure of consultants on each element.

4. Contractor to coordinate directly with USAID/Santo Domingo, with Dr. Oscar Rivera. Make sure Mr. Mathews and Ms. Brinneman and AID desk officer receive info copies of this order. WASH contractor should insure that above three personnel are informed before any consultant TDY takes place. WASH contractor must request and receive formal country clearance for all WASH personnel from mission prior to departing for country.

Make sure above three individuals are kept informed of mission, ETA's, country clearance and progress of activity throughout TA effort.

5. WASH contractor authorized up to $2,000 for various pattern and mold development costs necessary under ref A, para 2.B.3. and ref B, para 1.

6. WASH contractor authorized to allow WASH staff and consultants to make up to eight round trips in and out of Dominican Republic to his/her home base as appropriate during the technical assistance effort. Consultants can be brought to Washington for detailed briefings/preparation if deemed necessary as part of a RT to Dominican Republic.

7. Mission should be contacted immediately and technical assistance initiated as soon as possible and convenient to USAID/Santo Domingo.

8. Up to seventy-two (72) person days of international per diem, salary and misc. expenses are authorized to accomplish scope of works in para 3 of this OTD.

9. Local travel and misc expenses in Santo Domingo are authorized as necessary to accomplish mission.

10. Appreciate your prompt attention to this matter. Good luck.

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E.O. 12065: N/A
TAGS:
SUBJECT: WATER AND SANITATION FOR HEALTH (WASH) PROJECT
RESOURCE FOR AID

REF: STATE 278993

1. MISSION WELCOMES OPPORTUNITY PRESENTED BY WASH PROGRAM AND BELIEVES IT WILL PROVE TO BE AN EFFICIENT AGENT TO CARRY OUT KEY ACTIVITIES FOR HOST COUNTRY IN SUPPORT USAID'S HEALTH PROGRAM.

2. IN PARTICULAR, MISSION IS INTERESTED IN OBTAINING SERVICES FROM WASH IN THE FOLLOWING AREAS:

A. EVALUATION:

1. ASSISTANCE IS NEEDED IN ORDER TO HELP HOST GOVERNMENT DESIGN AN EVALUATION PLAN FOR THE $3 MILLION AID HEALTH SECTOR LOAN II (517-U-030) PROGRAM. THIS PLAN SHOULD PROVIDE FOR PERIODIC JOINT REVIEWS AND INCLUDE THE FOLLOWING POINTS:

A. EVALUATION OF PROGRESS TOWARD ATTAINMENT OF THE OBJECTIVES OF THE PROJECT;

B. IDENTIFICATION AND EVALUATION OF PROBLEM AREAS OR CONSTRAINTS WHICH MAY INHIBIT SUCH ATTAINMENT;

C. ASSESSMENT OF HOW SUCH INFORMATION MAY BE USED TO HELP OVER COME SUCH PROBLEMS; AND

D. EVALUATION TO THE DEGREE FEASIBLE, OF THE OVERALL DEVELOPMENT IMPACT OF THE PROJECT.

SINCE THE FIRST EVALUATION SHOULD BE COMPLETED BY DECEMBER 1980, ASSISTANCE TO DEVELOP THE PLAN SHOULD BEGIN WITHIN UPCOMING MONTH. IT IS EXPECTED THAT THREE WEEKS OF ASSISTANCE SHOULD BE ADEQUATE TO DEVELOP THE PLAN.

2. ASSISTANCE IS ALSO NEEDED IN CARRYING OUT THE PERIODIC PROGRAM EVALUATIONS. IT IS EXPECTED THAT THERE MAY BE THREE OR FOUR EVALUATIONS DURING THE PROJECT. EVALUSTIONS SHOULD PROVIDE FOR A SIGNIFICANT LEVEL OF STATISTICAL MEASURMENT AND SHOULD TAKE NO MORE THAN A MONTH OF FIELD WORK. REPORTS NEED TO BE IN SPANISH AND ENGLISH AND SHOULD CONFORM TO AID STANDARD REQUIREMENTS FOR EVALUATION (AID FORM 1330-15 AND 15A). HEALTH SECTOR II EVALUATIONS ARE TENTATIVELY SCHEDULED FOR DECEMBER 1980, 1981, 1982 AND 1983. IN ADDITION A FINAL EVALUATION FOR THE HEALTH SECTOR LOAN I (517-U-028) PROGRAM IS PLANNED FOR APRIL 1981. ASSISTANCE FOR THESE EVALUATIONS SHOULD BE TIMED ACCORDINGLY.

3. IT IS RECOMMENDED THAT THE KEY PERSONNEL OF EVALUATION TEAMS INCLUDE INDIVIDUALS WITH PRIOR EVALUATION EXPERIENCE IN SIMILAR HEALTH PROGRAMS. ALL KEY MEMBERS SHOULD BE FLUENT IN SPANISH.

B. PROJECT IMPLEMENTATION:

1 MISSION WILL REQUIRE PERIODIC ASSISTANCE UNDE HEALTH SECTOR II PROGRAM IN ADVISING GOOR ON THE QUALITY CONTROL PROCEDURES IN THE MANUFACTURE OF HAND PUMPS. UNDER THE PROJECT, A LOCAL FIRM HAS INITIATED PRODUCTION OF THE AID/BATELLE PUMP. GEORGIA TECH UNIVERSITY HAS PROVIDED ASSISTANCE IN THE DESIGN OF THE PUMPS AND IS CURRENTLY PROVIDING QUALITY CONTROL ASSISTANCE FUNDED BY AID/W. MISSION IS VERY SATISFIED WITH THIS ASSISTANCE AND PROPOSES THAT IT BE EXTENDED UNDR THE WASH PROGRAM TO PROVIDE

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QUALITY CONTROL ADVICE THROUGHOUT THE LIFE OF THE PROJECT.

2. UUNDER THE AID HEALTH II PROGRAM AN ESTIMATED 2,650 WELLS AND PUMPS WILL BE PROVIDED TO RURAL AREAS. IN ADDITION GRAVITY-FLOW SYSTEMS WILL BE CONSTRUCTED. MAINTAINING THE WATER QUALITY IN ACCORDANCE WITH HEALTH STANDARDS AFTER CONSTRUCSION OF THE SYSTEM IS AN ISSUE WHICH NEEDS TO BE STUDIED. THE HOST COUNTRY NEEDS TO FIND AN ECNOMICAL AND CONVENIENT WAY TO TREAT A GIVEN WATER SYSTEM IN THE EVENT IT IS NEEDED. IT IS RECOMMENDED THAT AN EXPERT WHO IS FLUENT IN SPANISH BE INCLUDED ON THIS ASSIGNMENT.

3. UNDER THE AID HEALTH II PROGRAM. PROCUEMENT OF 26,500 FIVE GALLON AND 26,500 TWENTY GALLON PLASTIC CONTAINERS IS CONTEMPLATED. THE CONTAIERS ARE TO BE USED BY PROJECT PARTICIPANTS TO CARRY WATER TO HOMES AND STORE IT IN A MORE SANITARY MANNER TO REDUCE ITS CONTAMINATION. SPECIFIC DESIGN OF THESE CONTAINERS DEPENDS ON VARIOUS LOCAL CONDITIONS (I.E., USE OF CHILDREN TO CARRY WATER, ETC.) GIVEN THAT THE FIRST SERIES OF WATER SYSTEMS WILL BE COMPLETED IN NEXT FEW MONTHS, ASSISTANCE IN PREPARING SPECIFICATIONS FOR THE PROCUEMENT OF THESE CONTAINERS IS VERY IMPORTANT AND SHOLD BE PROVIDED WITHIN THE UPCOMING MONTH. THESE SPECIFICATIONS SHOULD BE IN ENGLISH AND SPANISH AND SHOULD CONFORM WITH THE AID H.B. 11 REQUIREMENTS FOR HOST COUNTRY CONTRACTING.

4. IN ORDER TO SUPPORT THE POTABLE WATER AND SEWAGE DISPOSAL ACTIVITIES IN THE AID HELTH II PROGRAM, AN INTENSIVE RURAL HEALTH EDUCATION CAMPAIGN IS ALSO CONTEMPLATED. THIS CAMPAIGN WILL BE CARRIED OUT BY SBS HEALTH EDUCATIOPS. AN ESSENTIAL PART OF THIS CAMPAIGN WILL BE THE EDUCATION MATERIALS TO BE USED. ASSISTANCE IS REQUESTED TO DESIGN THESE MATERIALS. THIS ASSISTANCE SHOULD BEGIN WITHIN UPCOMING MONTH.
YOST

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BATAVIA
Mr Junkin

Let's Discuss
G.
Received Mr Junkin 11/12/8
" " WEHMAN 1/19/8

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FOR: DS/HEA - VIC WEHMAN

EO 12065: N/A
SUBJ: PROCUREMENT OF WATER SEALED LATRINES AND WATER CONTAINERS UNDER HEALTH SECTOR LOAN II

1. MIASSION INTERESTED IN GETTING INFORMATION AS TO SOURCE, COSTS, AND SPECIFICATIONS OF "WATER SEAL" LATRINES FOR A LIMITED PILOT STUDY TO DETERMINE THEIR ACCEPTABILITY IN RURAL COMMUNITIES UNDER HEALTH SECTOR LOAN II.

2. UNDER THE SAME LOAN THERE IS INTEREST IN PROVIDING FIVE AND TWENTY GALLONS WATER CONTAINERS TO EVERY FAMILY (TOTAL OF 26,500 OF EACH). THE FIVE GALLONS CONTAINERS WILL BE USED TO CARRY WATER FROM COMMUNITY OUTLETS AND SHOULD HAVE A NARROW NECT, A PROTECTIVE CAP WHICH WILL BE ATTACHED TO THE CONTAINER TO PREVENT ITS LOSS OR CONTAMINATIONBY DROPPING, AND A CARRYING HANDLE. THE TWENTY GALLONS CONTAINER WILL BE USED FOR HOUSEHOLD STORAGE, SHOULD HAVE A NARROW NECK, AN ATTACHED PROTECTIVE CAP, AND A TAP.

MISSION INTERESTED IN GETTING INFORMATION AS TO DETAILED SPECIFICATIONS, PROBABLE COST PER UNIT, SOURCES AND ANY OTHER INFORMATION CONSIDERED OF INTEREST FOR A POSSIBLE ADVERTISEMENT FOR BIDS.

3. MISSION WOULD APPRECIATE YOUR OPINION AS TO ADVISABILITY OF USING WATER FILTERS IN EVERY HOUSE, AS OPPOSED TO PURCHASING EXPENSIVE STORAGE CONTAINERS. EXPERIENCE WITH WATER FILTERS IN OTHER PROJECTS WILL BE OF INTEREST TO OUR PROJECT.
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APPROVED BY AID/DS/HEA: C. A. PEASE
AID/DS/HEA: F. E. MCJUNKIN
AID/LAC/CAR: S. MERRILL (PHONE)
AID/LAC/DR. ENGR. C. MATHEWS (INFO)
AUD/LAC/DR/HR. E; BRINNEMAN (INFO)
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E.O. 12065: N/A

TAGS:

SUBJECT: PROCUREMENT OF WATER SEALED LATRINES AND WATER CONTAINERS UNDER HEALTH SECTOR LOAN II
REF: A) 0082

1. AID/HEA (WEHMAN) RECEIVED REF. A) ON 14 JAN 81.

2. SUGGEST WEHMAN TALK TO HEALTH OFFICER ON PHONE REFERENCE INFO REQUEST. PREFERABLY ON THURSDAY 22 JAN 81 IF POSSIBLE AT 1000 HRS WASHINGTON TIME. WEHMAN WILL CALL HEALTH OFFICER AT MISSION TO DISCUSS REQUEST.

3. WE ARE WORKING ON REQUEST. MUSKIE

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APPENDIX B

Report of a Field Trip to Five Communities in the Provinces of Bani and Azua

On April 6, 1981 the three WASH consultants (Howard, Llewellyn and Struba) visited the five communities of Los Ranchitos de Bani, Los Ranchitos de Ocoa, El Naranjal (al Medio and Arriba), Los Corozos and Las Yayitas, all in Health Region I. The purpose of the visits was to inspect the physical features of the water supply program and to become familiar with the people and the environment of the rural communities.

The communities are in the southwestern portion of the Cordillera Central, the mountain range which runs southeast to northwest in the western part of the country and contains the highest point (10,000 feet) in the Caribbean. The communities are from 50 to 100 km. west of Santo Domingo and are all rural.

The communities were chosen for the field trip for the following reasons:

1. They have been or are being supplied with potable water through the Health Sector II project and they include both types of water supply being installed, gravity-fed public fountains and deep or shallow wells and with hand pumps;

2. They were within one day's journey of Santo Domingo; and

3. They represented varying degrees of success in the functioning and use of the water supply systems.

We went to the communities with the following people:

- Virgilio Aquino - UAPODAN staff driver
- Elipidio A. Caba - USAID Engineer Supervisor
- Oscar Hungria - UAPODAN Assistant Director (now UTOC Director)
- Dulce Jimenez - USAID Demographer
- John Thomas - USAID Public Health Advisor

1) Los Ranchitos de Bani

This village is located in the eastern foothills of the mountain range about 70 km. west of Santo Domingo, 25 km. northwest of Bani and 10 km. south-southeast of San Jose de Ocoa.

The village is on the stream called Arroyo de Caobas, which is an intermittent, rock-bottomed stream which separates this village from the neighboring village of Los Ranchitos de Ocoa to the west. This stream, which is tributary to the Ocoa River, was the former source of water for the village. The stream was dry when we visited, and we were told it has been dry for the past year.

In order to improve the quantity and quality of the water used by the villagers, a well was drilled to a depth of about 60 feet and an AID/Battelle hand pump was installed. This installation is now five months old and was the first well installed as part of the Health Sector II water supply program. Three more wells will be installed in this village.

There is a three-tiered (stepped) concrete apron around the well so that the base of the pump is about two feet above the ground. On one side of the apron there was a pool of standing water. The pump base is fastened to six anchor bolts set into the concrete of the top level of the apron, but the concrete is unraveling around some of the bolts so that water can enter under the base of the pump. The threaded joint between the base and riser stem of the pump is leaking. The drawings supplied to the manufacturer did not call for provision of any seal at the threaded joint. All later pumps were assembled with Teflon tape applied to the thread to prevent leakage.

The moving parts of the pump handle and guide were lubricated with grease, and all the rods and cotter pins were in place. Water delivery appeared to be ample with easy working of the pump handle. The pump seems to have been installed properly and is being well maintained. The vertical alignment of the pump appeared to be proper.

The pump is near the road and is within 30 feet of a clean, well-kept store. Several other houses appear to be within 100 feet of the pump. We did not determine the distance to the furthest house.

The store-keeper said that she and the community were very pleased to have this convenient, steady source of good water.

2) Los Ranchitos de Ocoa

This village is on the other side of the stream from, and to the west of Los Ranchitos de Bani. It seemed similar to Los Ranchitos de Bani, but appeared to have less shade. The village formerly used the same source of water as Los Ranchitos de Bani.

Nine shallow wells have been drilled in this community, but the pumps have not yet been installed. We inspected one well, the opening of which was covered with an 8-inch diameter tin can with a rock in it. The water level in the well appeared to be 6 to 8 feet below the ground. The wall of the 6-inch diameter steel well casing had longitudinal fissures about 1/8 inch wide and 1 foot long. When the concrete pedestal was cast around the casing, some of the liquid came through the cracks to the inside of the casing. Fissured pipes such as this are supposed to be installed below the water table only; the wall of the casing is supposed to be integral above the water table.

The top of the casing was flush with the top of the pedestal, whereas it should be an inch above it. One of the 4 anchor bolts was loose. The concrete appeared green, even though the apron was 4 or 5 days old. This may reflect insufficient cement in the mix. The concrete apron had a 3-inch high curb around it, and the apron was well pitched to an opening in the curb, draining the apron to a low point.

Given the shallow depth to groundwater and the fissured pipe, there is some concern about possible contamination of the well. The wells are supposed to be capped by welding a plate over the opening of the casing until the pump is installed.

We did not look any other wells in this village, but, from the car, we did see some which were also awaiting pump installation. The wells in general appeared to be within 50 to 100 feet of the nearest house and no more than 200 to 300 feet from the furthest house.

We spoke with the husband of the promoter. He seemed pleased that wells were being installed. He did say, however, that one of the wells was lost because someone filled it with stones, so the pump cannot be installed.

Note: In one of the communities that Mr. Llewellyn visited on April 11, people were drawing water from an unfinished well by means of weighted, plastic clorox bottles lowered with a rope. The water was very dirty. The well had not yet been cleaned. The well certainly made water more accessible to the people than it was from their traditional source.

3) El Naranjal al Medio and El Naranjal Arriba

These communities are on the eastern slope of a mountain west of the first two villages and are about 4 km. northeast of San Jose de Ocoa. They are on the stream called Arroyo Naranjal which discharges to the Arroyo de Parra which is tributary to the Ocoa River.

Formerly the villagers had to walk almost a mile up the hill to a spring to get water or had to depend on intermittent streams nearby. The spring had not been protected and was exposed to contamination. Under Trujillo, public water fountains were installed using the same spring as a supply for the gravity systems, and were still to be seen today throughout the village, but they were not working. Over the years the pipe had been pulled up and sold after the faucets broke and were not repaired.

Under the USAID program, UAPODAN has built a protective cover of concrete over the spring, piped the water in a 2-inch diameter PVC pipe about 20 feet to an enclosed sand and stone filter and thence to a storage tank about half a kilometer downslope. From the tank the water goes to several fountains scattered throughout the villages. There are 16 fountains in the two villages.

The filter at the spring has been in operation about 5 months and will probably be cleaned every year by removing and washing the sand and stone and then replacing it in the filter. UAPODAN will supervise this, and labor will be locally supplied. The wall of the intermediate basin (between the spring and filter) across the bottom of which the PVC pipe ran from the spring to the filter was cracked open and had separated entirely at one corner. The bottom of the basin was silted with eroded soil from the very steep slope above the spring. This basin had been the filter for the system installed under Trujillo.

The storage and distribution tank downstream of the filter was constructed of a reinforced concrete floor slab, 6-inch concrete block walls plastered with a cement stucco and a reinforced concrete roof slab. The exposed parts of the walls and roof on the outside of the tank were painted light blue, and the hinged metal cover at the access hatch and at the valve vault were painted black. A padlock secured the two hatches, and this arrangement provided good practical protection from interference with the water. The

space around the roof access hatch, however, was open enough so that we could see into the tank. Better protection of the water, therefore, might be provided by a better overlap at the hatch.

There were hairline cracks in the roof slab which went around the tank about 6 inches in from the walls and also defined the beam which spans the short dimension of the tank between the two long walls. If these cracks open up, water could penetrate the roof slab. Animal or human activities on top of the tank could then contribute to contamination of the water. This is of special concern because animal droppings were seen in the yard surrounding the tank. It did not seem that the roof is pitched to drain, so there could be standing water at some points on the roof. The tips of some of the reinforcing bars which are set vertically inside the cores of the blocks which make up the walls were protruding 1/2 to 2 inches above the roof slab. They were not cut off or bent over before the slab was cast. These could eventually rust and jeopardize the reinforcing inside the slab and walls.

The upslope wall of the tank is about 3 to 3.5 feet exposed above the ground, and the downslope wall is about 7 to 8 feet exposed. A concrete apron about 18 inches wide surrounds the tank. The apron appeared to be settling and separating from the tank wall.

The rectangular lot where the tank is located is fenced with barbed wire. The lot is about 30 feet by 70 feet. There is a wood gate at the road which is secured with a padlock. There is another gate, made simply of barbed wire attached to a loose pole, at the upslope end of the lot. The latter was open when we visited the site, but we closed it with the loops of barbed wire which were attached to a fixed gate post for the purpose of securing the movable post. There were animal droppings throughout the lot, some quite close to the tank. Since concrete, and especially the stuccoed, cement-block wall, is not impervious to the passage of water, rain water percolating through the ground after having contacted the animal droppings could eventually penetrate the tank wall and contaminate the water.

A further discussion of the structural features of the storage tank is included below under the discussion of Los Corozos.

The water from the distribution tank is distributed to fountains throughout the village by 2-inch PVC pipe. The fountains are spaced 200 to 300 feet apart, and there is one for every 9 or 10 families. We saw 10 to 15 fountains. The fountain consists of a 6-inch concrete block wall about 6 feet high. Two lower walls, about 3 feet high, support a 5-inch thick concrete platform which abuts the high wall and spans from one low wall to the other. The concrete block walls are plastered with a cement stuco and are painted blue. The platform is a smooth-finished concrete. The fountain is about 6 feet wide for 2 faucets and 4 feet wide for 1 faucet. The platform is about 3 feet deep (from front to back). The entire fountain is built on a concrete apron which extends a short distance beyond the stand. The faucets, which consist of brass glove valves attached to 1-inch PVC pipes embedded in the high wall, are about 4-1/2 feet above the ground. In the center of the platform is a 1-1/2 inch hole with a 1-1/2 inch diameter PVC drain pipe. The drain extends downward 12 to 18 inches then bends 90 degrees and exits to drain at a low point near the fountain.

The blue paint was observed to be chipping at some of the fountains. On one the corner of the platform had broken off. One fountain in particular was poorly located for drainage of water away from it. The faucets were too high for small children to reach without climbing on the platform or without the addition of a step at the side of the fountain. We saw one child on tip-toe in a pool of water at the side of the fountain stretching to reach the faucet. It appeared that the drain pipe could eventually be a problem because it can clog, and there is no way to clean it out.

The fountains are frequently and well used. We saw people washing clothes nearby, but not at the fountain itself. One of the needs which the national government wants to address is the construction of clothes-washing stations near the fountains.

Some of the containers used to transport water seemed hardly sanitary, although people did rinse them out before filling them.

The water coming from one of the faucets was white, but cleared rapidly on standing. This is probably due to high aeration of the water. This was the most downstream fountain in the system.

The faucet handle at a fountain right beside the filter (upstream of the storage tank) was missing, and the plastic pipe behind it was broken, as was evidenced by water running out of the hole where the faucet attaches to the water supply pipe. We were told that children take the handles and use them as weapons in fist fights.

We joined a conversation begun by Oscar, Dulce and Charles with a local politico (political leader) in Naranjal Arriba, who is the liaison between the health committee and the government. He said the faucets were not satisfactory, and the community has purchased better ones, which he showed us. He had them in a paper bag. (John Thomas said this was why USAID is looking into the use of a PVC valve which delivers water when a button on the valve is pressed. The valve operates on a buoyancy and pressure differential principle but has not been satisfactory when the pressure exceeds 60 psi.)

The politico also said that sediment was building up in the distribution tank. He thinks that, if a concrete slab could be installed in the intermediate chamber between the spring and the filter, the problem would be resolved. The UAPODAN engineers, he said, did not think there was anything that could be done. Oscar said he would talk with the engineers to see what can be done. Some accumulation of sediment is common in such tanks, so they must be cleaned periodically.

4) Los Corozos

There are 5 communities about 11.5 km. west-northwest of San Jose de Ocoa, on the slopes of the high hills that make up the Cordillera Central, which will be supplied with water by a gravity-fed system. The source will be a spring located some 1,300 feet (400 meters) above and 3.5 km. from the village of Los Corozos (the nearest one). The villages are Los Tramojos, Los

Corozos, Palmarito, Demajagua and La Cruz. The villages drain to the Rio Banilejo in various streams and thence on to the Ocoa River.

The spring, distribution tank and water supply fountains are under construction and are similar to the respective features of the gravity-supply system described above for Naranjal. A total of 35 fountains will be located in the villages. On the way up to see the construction of the distribution tank we saw several fountains which have been constructed but not yet plastered and painted.

The distribution pipes have been installed from the fountains up to the tank. The main supply from the tank to the villages consists of two 2-inch diameter PVC pipes. One will serve Los Corozos and Los Tramojos, and the other will serve the other three communities. The pipes were marked with a pressure rating of SDR 20 (60 psi) and were fabricated by Alambres Dominicanos. The wall thickness is 1/8 inch. The joints are bell and spigot and are glued with PVC cement. We were subsequently told that the pipes are supposed to be 160 psi pressure rating (SDR 26).

The workmen are now building the spring works, consisting of the protective structure for the spring and the sand and stone filter. The pipe from the spring to the storage tank will consist of about 4,200 feet of 2-inch diameter, Schedule 40 galvanized steel pipe (stamped ASTM A120).

The storage tank is also under construction. The approximate dimensions of the tank, in plan, are 16 feet by 25 feet. The floor slab and walls have been built, and the walls have been plastered. The roof slab has been formed, and the reinforcing steel has been placed, but the slab has not yet been cast.

The walls, made of 6-inch concrete blocks and plastered with cement stucco, have 3/8 inch diameter reinforcing bars (rods) in the cores, and the cores are filled with concrete (presumably from the bottom of the wall) up to within about 2 inches of the top of the wall. The top 2 inches of the cores are filled with concrete when the roof slab is cast. The vertical rods are of varying length. In some cases they are long enough to be bent over into the roof slab but in others they are too short for this. It is not known whether they will be bent over, but from looking at the tank in Naranjal, they may not only not be bent but may also not even be cut off if they are so long as to protrude above the finished roof slab. They should preferably be bent over into the roof slab.

The roof slab reinforcing consists of 3/8 rods spaced at 8 inches in both directions. They are well tied at their intersections. The rods are bent up about 3 inches between a point about 30 inches away from the wall up to the wall itself. The rods are bent in a return bend over the wall. In some cases the rods are tied to the verticl rods in the wall. The slab reinforcing will be supported on the forms by clean, washed stones so as to lift them and provide proper concrete cover under them when the concrete is placed. These stone "chairs" are not yet in place.

Spanning the 16 foot length between the two 25-foot walls is a reinforced concrete beam approximately 10 inches deep and 8 inches wide. The top reinforcing consists of four groups of three 3/8-inch rods tied together.

The bottom reinforcing consists of four groups of five 3/8-inch rods tied together. One bottom rod is bent up to the top for shear strength about 30 inches from the wall. The beam reinforcing is "caged" in stirrups at intervals of about 18 inches. The beam reinforcing extends over the wall to within a couple of inches of the outside face of the wall.

The inside of the tank was accessible by ladder at the access hatch in the roof. The wall height inside the tank is about 7 feet. The joint between the floor and wall is filled with a triangular cement cornice, about 3 inches high, which extends onto the tank floor about 6 inches.

There are five pipes through the walls of the tank, all of 2-inch PVC. The inlet and overflow pipes are about 6 feet above the floor. The inlet pipe is on the upslope wall. The drain pipe ("mud" pipe) is at floor level on the same wall as, and below, the overflow pipe. Both pipes drain to a point on the hill about 25 feet from the tank. The two outlet pipes exit through the downslope wall, one about 4 inches and the other about 6 inches above the floor. About a foot outside the wall is a 2-inch bronze gate valve on each of the discharge lines. The valves will be housed in a concrete valve vault which will be covered with an access hatch.

Inspection of this tank under construction and the finished tank at Naranjal indicates that a potential problem may exist because of insufficient tie-in of the slab and wall. This may have led to the hairline cracks observed in the roof slab of the Naranjal tank. Bending the vertical wall rods into the roof slab would help prevent this.

The upslope portion of the tanks is well supported against the hydrostatic pressure in the tank by the fill placed against the wall, but the downslope wall is mostly above the ground. The only resistance to the force exerted by the water on the wall of the tank is the mortar between the blocks. The vertical reinforcing in the cores of the wall can help resist the tendency for the water to push out the wall along the vertical axis but, since there is no horizontal reinforcing in the wall, there is virtually no resistance against the tendency to push out the wall along the horizontal axis. Furthermore, even the vertical reinforcing is of limited value because it is not tied into the roof slab. Since the vertical rods are close to the middle of the cores of the blocks, they are resisting very little, if any, tensile stresses.

We have calculated that, when the tank is full of water, the pressure at the base of the wall would be about 2.6 psi, and the resultant force on the wall is about 375 pounds per foot along the wall exerted 2 feet above the floor. The overturning moment of the wall about its base is about 750 foot-pounds. The roof slab has to resist this moment. The reinforcing and other structural features described above may be adequate to withstand the applied forces and stresses but this should be verified in light of actual construction practice in the field. That is, the design may not be fully realized in the field.

Another point of concern, in addition to those noted above, is the ability of the 2-inch PVC pipe to withstand the static pressure exerted on it by the head of water established by the water surface in the tank. This water surface is from 200 feet to 525 feet above the water supply fountains in

the villages, which corresponds to static pressures of 85 psi and 225 psi, respectively. The static pressure will be reduced by the friction of the pipe wall tending to retard the flow of water, but this retardation (called head loss) may not be sufficient to reduce the pressure to within the pressure rating of the pipes and glued joints. If the pressure is excessive, the pipe can burst, the joints can come apart and/or the faucets can be blown off the fountains. If these accidents occur under very high pressure, persons nearby can be injured. To prevent these problems two pressure-reducing chambers will be built along the pipelines to re-expose the descending water to atmospheric pressure, rather than the higher pressure of the column of water above the chambers. If planned properly, these chambers will act as pressure reducers and will result in a safe system. In this regard it is important to ascertain whether the correct pressure rating of the pipe and glued joints is 160 psi or 60 psi.

We spoke at length with an SBS supervisor who was accompanying the UAPODAN engineers and work crew up to the tank. He said that a major problem during construction has been coordination of the work schedule between volunteers from the villages and UAPODAN. There have been times when the villagers have made the long, hard climb up to the job site only to go back frustrated because the UAPODAN crew was not there. At other times the UAPODAN crew has been there but the villagers have not. One of the UAPODAN crew told us that about fifty villagers had agreed to show up for work on a particular day, but only two actually appeared. We suggested to him that, if some of the village leaders were brought to Naranjal to see the water supply system in action, they may be more enthused about working to finish the tank. The local volunteer labor contribution usually consists in excavations, hauling materials, mixing mortar and concrete and the like. The supervisor said there would be a community meeting Wednesday afternoon (April 8) to discuss the labor problem and the formation of health committees.

On the way back down the hill we noticed that one of the PVC supply lines that has already been installed along the access road to the tank had been broken, with the broken end sticking out of the ground. Wherever the pipes cross roads or could be exposed by erosion the pipe should be protected by stones, a concrete encasement, deeper burial or other appropriate means.

5) Las Yayitas

This community is located on the western slope of the hils about 5.5 km. north of Azua, which is about 120 km. west of Santo Domingo. The village is on the Las Yayitas River, which is tributary to the Jura River.

The village at one time was served with public fountains installed under Trujillo as in Naranjal. There was no evidence that they still worked. Until the wells were installed by UAPODAN, the villagers obtained water from the Las Yayitas River which passes along the west side of the village. The people still wash their clothes there.

UAPODAN has installed eight wells in this community, all of them 100 feet or more in depth. All the wells have been completed, and AID/Battelle hand pumps have been installed and aprons built, similar to the curbed, drained apron described above for Los Ranchitos.

We inspected three of the wells. At the first one, which is in the shade of a large tree, the villagers had extended the concrete drainage swale to get water further away from the apron. There was a green, slimy growth growing in ponded water (1/8 inch deep) around the base of the pump at the top of the pedestal. There was a rectangular lip about 1/8 inch high around the base thay may have resulted from finishing the concrete pedestal while the wood template was still in place to hold the pump's anchor bolts in position. When the pump was operated, the ponded water flowed under the base of the pump. There was also an indication that the threaded joint between the pump base and riser of the pump was leaking. The pump's moving parts were lubricated and well maintained. The pump's action was easy and delivered ample water.

Two other pumps, however, had heavy action which would be difficult for a child to manage. In fact, one of the pumps the villagers said was just for the men to use. We looked at this pump, and it was obviously out of vertical alignment. If the well is as deep as it is said to be, then working the pump handle results in dragging the pump rod over at least a portion of the wall of the galvanized steel drop pipe. The friction can require a lot of force to move the rod. This might also result in eventual misalignment of the pump piston, which would cause premature wearing of the leather seals and even wear away the PVC wall of the pump chamber. The UAPODAN crew will be asked to come back and correct the vertical alignment of the pump.

The other pump was also difficult to work, although not as much as the one just described. When this pump was worked, we could hear a rattle in the well as though the piston rod was bent and was hitting the side of the drop pipe. The piston itself, therefore, may be misaligned.

All of the aprons seemed to be well drained.

The wells seemed to be readily accessible to the houses. It seemed that the greatest distance between a house and a well is about 200 feet.

The wells appear to be much used and appreciated. We filled many people's containers (5-gallon cans) while we examined the wells. The containers appeared to be clean, but the people filled them so much that their hands went into the water when they picked up the filled cans. This was common at the other villages too. One woman had a coconut husk as a dipper in the can when she filled it.

The local people appeared to be enthused about the wells and hand pumps. An older man repeated many times his explanation of how the pump works to lift water from below the ground. A young woman was explaining to us her understanding of the importance of clean water and of maintaining the pump and well so as to exclude "microbes" from the "aquifer" because they could cause diseases by contaminating the water. She recognized the importance of draining the pump site and explained that the community itself had improved the drainage at one of the aprons. This woman appeared to be a good possibility for a health educator.

We also spoke with the promoter, who owns a store near the entrance to the village. She visits each family in the village twice a month and vacci-

nates for diphtheria, pertussis, tetanus, polio and measles. She gathers vital statistics in the village and also dispenses common medicines for colds, etc. She said that right now there are a lot of colds (gripe) in the community. In addition to her visits twice monthly she visits families when she's needed.

The problems she is having with the SBS program is that there are too many changes in supervisors and she is getting tired of constantly "breaking in" new ones. She had not heard from her new supervisor, who is being trained, for two months. She has not been paid, and does not have any more medicine and vaccines.

She said that the community is in need of a nutrition center.

About 70 village families (about one-half) have privies. We saw one privy built of concrete blocks at a child care center in the village. The privy had a corrugated metal roof. We did not look inside it. It was located on a hill about 12 feet high and 30 feet from the child-care center. The slope of the hill was steep, and there should be some concern about liquid from the privy's pit coming out on the side slope.

CONCLUDING STATEMENT

1. - The purpose of the field trip was to give the consultants first-hand knowledge of some aspects of the Health Sector II project. This is important for the design and operation of a fair and valid evaluation.

2. - The descriptions in this field trip report are not necessarily representative of the entire project. It represents a sample, but does give some insight into the project. We were told that most other communities where the project is being implemented are similar.

3. - Our recommendations are useful for all 500 project communities, but they apply especially to the 100 or so communities which will be chosen for evaluation.

4. - Our recommendations are:

   a) pump installation should follow closely upon completion of the well;

   b) wells should be securely covered until the pump is installed;

   c) wells should be disinfected, and the water sampled, before the pump is put in service;

   d) deep wells are preferable to shallow ones because the latter are more susceptible to contamination;

e) the well casing should extend above the top of the pedestal, the pump should be properly aligned vertically, connections should be tight, the pump should be lubricated, worn rods, pins and seals should be replaced, the pump should be easy to operate and the well should be as far from sources of contamination as possible;

f) similar issues also apply to the gravity systems, but also check the pressure rating of the PVC pipes, install faucet handles that children cannot remove, either lower the faucet or add a step at the side of the fountain and include a clean-out fitting (Tee) in the fountain drain;

g) the system of promoters and supervisors seemed to be working well; if the promoters green recording form is to be modified to include additonal data for the evaluation, the form should be modified only slightly and it should be coded;

h) the community should have a functioning health committee and promoter before any of the Health Sector II interventions are begun in the community, and the community should know when and why an intervention will begin before a work crew arrives;

i) ideally the health education component should precede the installation of water supplies and latrines;

j) the families in a community should be aware that their 50-cent-per-month payment to the health committee is to establish a maintenance fund and is not a fee charged solely for the <u>use</u> of the water supply system; and

k) the altitude, location, size and disease rates of each community should be recorded because these factors will be important in choosing communities for the evaluation.

APPENDIX C

Itinerary

31 March - Dr. Struba left Chapel Hill at 4:00 PM and arrived in Washington, D.C. at 5:45 PM.

1 April - Mr. Howard left Boston at 7:15 AM and arrived in Washington, D.C. at 8:30 AM for a 10 AM briefing at the WASH office.

Messrs. Howard, Llewellyn and Dr. Struba left Washington, D.C. at 1:35 PM, changed planes in Miami and arrived in Santo Domingo at 8:00 PM.

We were met at the airport by a USAID Mission driver and were taken to the Hotel Santo Domingo Norte (formerly called the Hispaniola) where three reservations for the period from 1 to 22 April were waiting.

2 April - Left our names and hotel address with the U.S. Embassy Marine guard as we were directed to do by the WASH office. We met in the morning with the persons listed below to discuss the Health Sector II project in general and the evaluation and health education aspects of the project in particular.

Persons with whom we met April 2:

- Oscar Rivera-Rivera, M.D., M.P.H., Health Officer, USAID Mission in the Dominican Republic
- John H. Thomas, Public Health Advisor, USAID Mission
- Dulce Jimenez, M.S., Demographer, USAID Mission
- Lic. Oscar Hungria, Assistant Director of UAPODAN (which is the water and sanitation agency of the public health secretariat of the national government of the Dominican Republic)
- Eng. Manuel Casanova, Water and Sanitation Coordinator of UAPODAN
- Dr. Jose M. Herrera Cabral, Coordinator for Health Sector Loans I and II, and Director of UAPODAN, joined the meeting toward the end.

After the meeting we asked Diana de Baez, Dr. Rivera's secretary, to send a telex to Dr. Dennis Warner, the WASH project director, to inform him of our arrival and commencement of work.

3 April - We visited the offices of UAPODAN and examined the data that have been and are being collected in connection with the Health Sector II project. Dr. Struba requested data on health status indicators collected during the Health Sector I project, including data on size and location of Health

Sector II communities. We met with the supervisor of the UAPODAN engineering staff and a field engineer.

Except for the field trip on 6 April described below, Mr. Llewellyn's schedule differed from that of Mr. Howard and Dr. Struba from this point on. Mr. Llewellyn's responsibility was to research and plan the health education program. Continual and extensive cooperation and consultation occurred among the three WASH consultants throughout their stay in the Dominican Republic.

We consulted with Eng. Elpidio Caba, Engineer Supervisor at the USAID Mission, about the details of the water and sanitation program and discussed some of the problems that have been encountered in implementing the program of supplying water to rural villages.

4 & 5 April - We examined some of the project documents and the data provided by UAPODAN. We also researched appropriate engineering, medical and epidemiology texts and reports for orientation with respect to the project.

6 April - We visited five rural villages to see the water supply systems that have been installed. These systems consisted of both deep and shallow wells with hand pumps, wells which had been drilled but had not been completed with the installation of pumps, and gravity-fed systems. One of the gravity-fed systems had been completed and the other was under construction. A detailed report of this field trip is included in Appendix B of the report.

7 April - We prepared the report of the field trip (Appendix B) and listed some of the additional information we would need in order to define the scope of the evaluation study.

8 April - We obtained additional data and project information from Ms. Jimenez, Mr. Thomas and Eng. Caba and Dr. Rivera. Dr. Struba consulted with Dr. Rivera on the nature, validity, analysis and interpretability of health status indicator data gathered during the Health Sector I project. We began to prepare a scope of work for the report.

9 April - We reviewed the project paper to further refine the scope of work and then met with Drs. Rivera and Herrera to finalize the scope.

10 April - We prepared an outline of the report, clarified some points with Dr. Rivera and obtained some additional project information at the USAID office. Dr. Rivera left the Dominican Republic for two weeks.

11 & 12 April - We researched engineering and epidemiology texts and reports for additional and more specific information in light of the detailed scope of work and report outline. We began to outline and write the report.

13 April - Diana de Baez began typing the report. We continued to write the report and conduct the necessary research for it.

14 & 15 April - We continued writing and researching, and Diana continued typing. Additional data was sought on populations and villages selected to receive the health-related interventions. We contacted the WASH office by telephone to advise Dr. Warner of our progress after we discovered that the telegram sent on 2 April had not arrived at WASH. We later learned that the telegram had been sent to Dr. Wehman at the USAID Health Office in Washington, D.C. Dr. Struba met with Mr. Rick Bissell, a University of Colorado epidemiologist in training who is studying the epidemiology of disasters (hurricanes).

15 April - (Holy or Maundy Thursday) Many people worked half a day today.

Diana completed typing the portions of the report we had written to date.

We met with Mr. Thomas to discuss some of the problems with the pumps that have been installed and plans for pump maintenance. He asked for information about disinfection of the wells and about the availability of kits which field personnel could be trained to use in order to sample the chemical and bacteriological quality of the water before the wells are placed in service. To date he has seen water quality reports for the wells in only one community. The results of even that sampling are not complete enough to decide whether a well should or should not be used. The problem seems to be that there is only one laboratory in Santo Domingo that is available for performing the necessary tests, and the ability of the laboratory to conduct the tests properly and in a timely manner is questioned by the USAID personnel.

We also discussed with Mr. Thomas some of the modifications of the deep well pumps which have been recommended by Mr. Robert Knight, a WASH consultant from the University of Maryland. The modifications will be tested in the field here by Messrs. Knight, Thomas and Eng. Caba the week of 20 April.

We continued writing the report.

17 April - (Good Friday)
This was a holiday in the Dominican Republic. The USAID office was closed.

We continued our group consultations (especially on health education) and writing the report.

18 & 19 April - (Holy Saturday and Easter Sunday)

We continued our group consultations and writing the report.

20 April - Diana typed more of the report, and Dr. Struba continued writing.

We met with Messrs. Knight and Thomas and Eng. Caba to discuss some of the problems with the wells and some of the features of the pump modifications recommended by Mr. Knight. Mr. Howard, with Mr. Knight and Eng. Caba, then visited the foundry where the pumps are being cast and fabricated.

21 April - Mr. Llewellyn returned to the United States.

Diana continued to type the report, and Dr. Struba continued writing.

Mr. Howard went with Mr. Knight, Eng. Caba and Mr. Tobias Fernandez (owner of the foundry where the pumps are being manufactured) to the UAPODAN engineering office in Azua and then to the village of Boqueron (in Ocoa) where they helped install two pumps in order to test Mr. Knight's pump modifications. The modifications consist of using 2-inch diameter Schedule 40 PVC drop pipe rather than the 1-1/2-inch galvanized steel pipe used up to now.

22 April - We continued writing the report, and Diana continued typing.

23 April - We completed the preliminary draft of the report, which will be reviewed by the USAID Mission staff. We met with Mr. Phillip R. Schwab, the Director of the USAID Mission in Santo Domingo, and Mr. Ronald F. Venezia, Assistant Director. We discussed our impressions of the Health Sector II project, its strong and weak aspects, the highlights of the evaluation plan and our recommendations.

We left on Dr. Rivera's desk two copies of the Contractor Performance Evaluation Report (USAID Form 1420-43; 4-75) as we were instructed to do by the WASH office. One copy was for evaluation of the work of Mr. Howard and Dr. Struba in preparing the plan for the Health Sector II impact evaluation, and the other copy was for evaluation of Mr. Llewellyn's work in preparing the plan for the health education program.

We asked Diana to send a telex to Dr. Warner at the WASH office on Friday, 24 April, informing him of our return to the United States.

24 April - We left Santo Domingo at 8:25 AM and arrived in Miami at 9:31 AM.

Dr. Struba continued on to the WASH office, and Mr. Howard continued on to Boston.

WELL AND PUMP PARTS DESCRIPTION

1. WELL : 6 inch diameter drilled well with or without casing according to soil conditions.

2. CASING : Casing either steel ASTEM-120 or 140 or PVC middle grade.

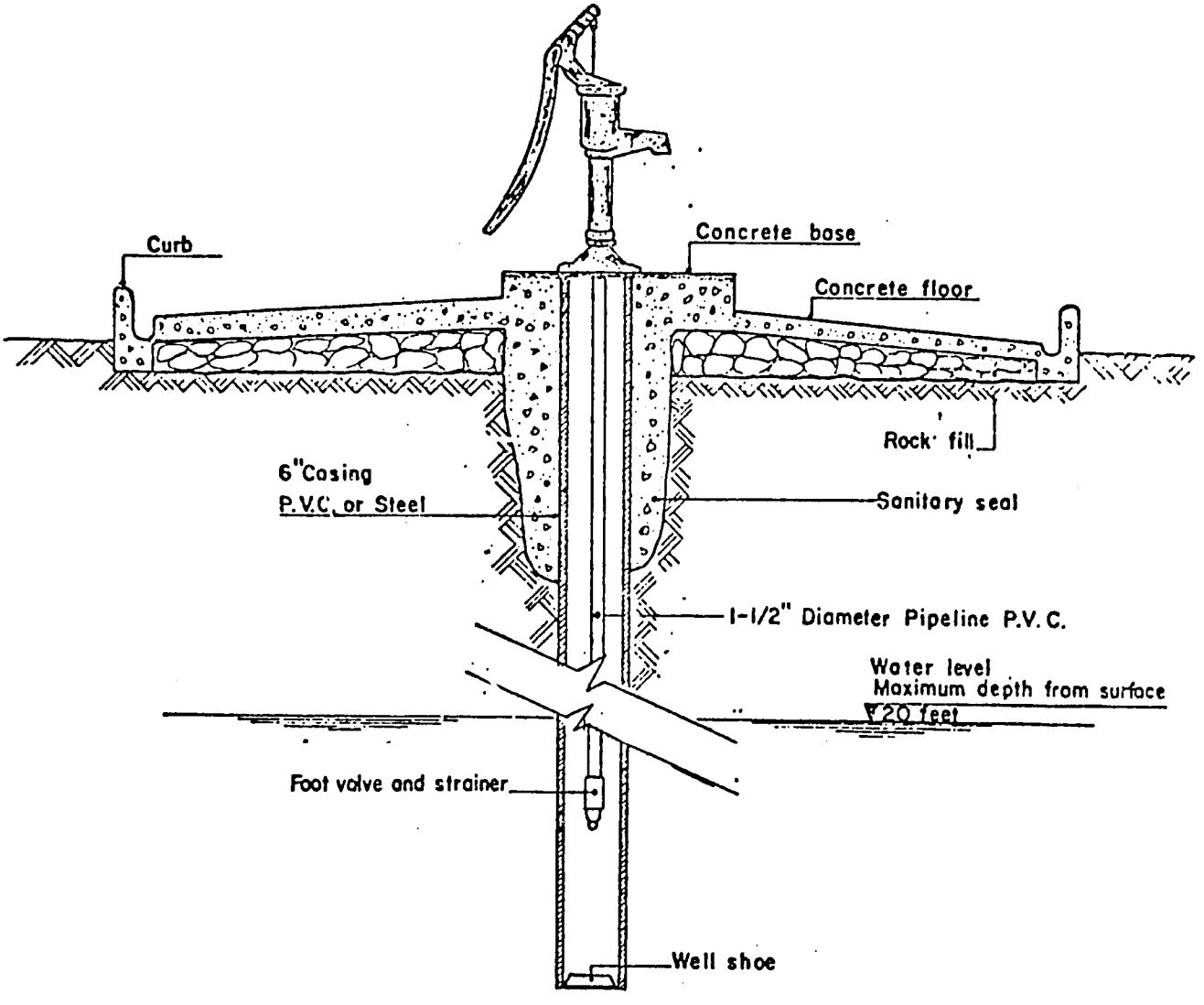
3. PUMPS : Shallow Well (for tapping water tables up to 20 feet deep): Shallow Well hand operated AID/Batelle water pump: includes body of the pump, approximately 25 feet of 1 1/2 inch PVC pipeline with a foot valve and strainer at the bottom of pipeline.

   Deep Well (for tapping water tables up to 100 feet deep): Deep well hand operated AID/Batelle water pump: includes body of the pump, approximately 125 feet of 1 1/2 inch PVC or galvanized pipeline, with 1/2 inch steel rod inside to operate a cylinder at the end of the pipeline. The cylinder has a foot valve and strainer at the bottom.

4. SANITARY SEAL : Concrete protection around well casing to a depth of 3 feet to prevent surface water from polluting the well.

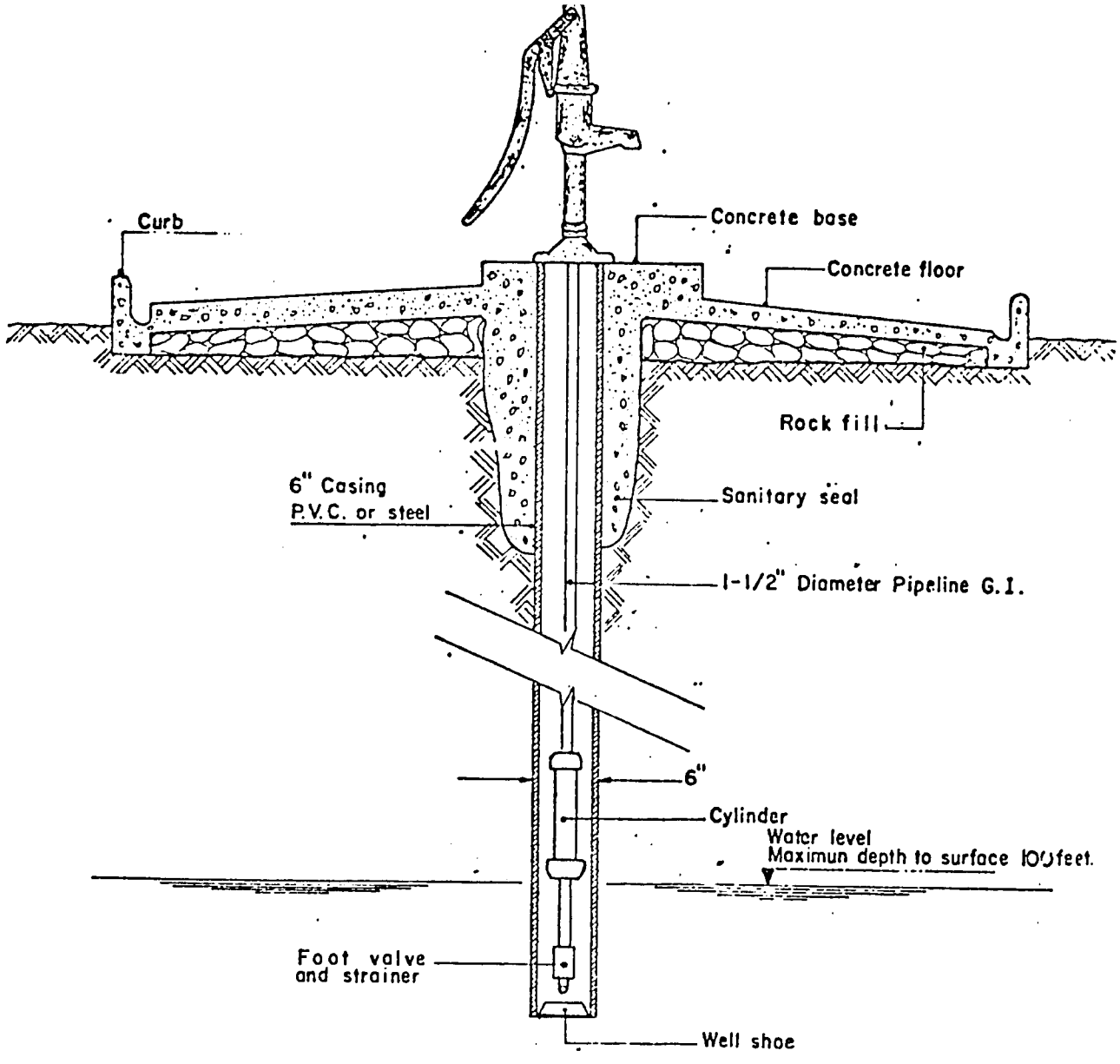
5. WELL APRON WITH RAISED PUMP BASE : To prevent the development of unsanitary conditions around the pump. Composed of (1) rock fill; (2) four-inch thick concrete platform; (3) protective curb; (4) drainage ditch; and (5) a concrete pump base.

TABLE I



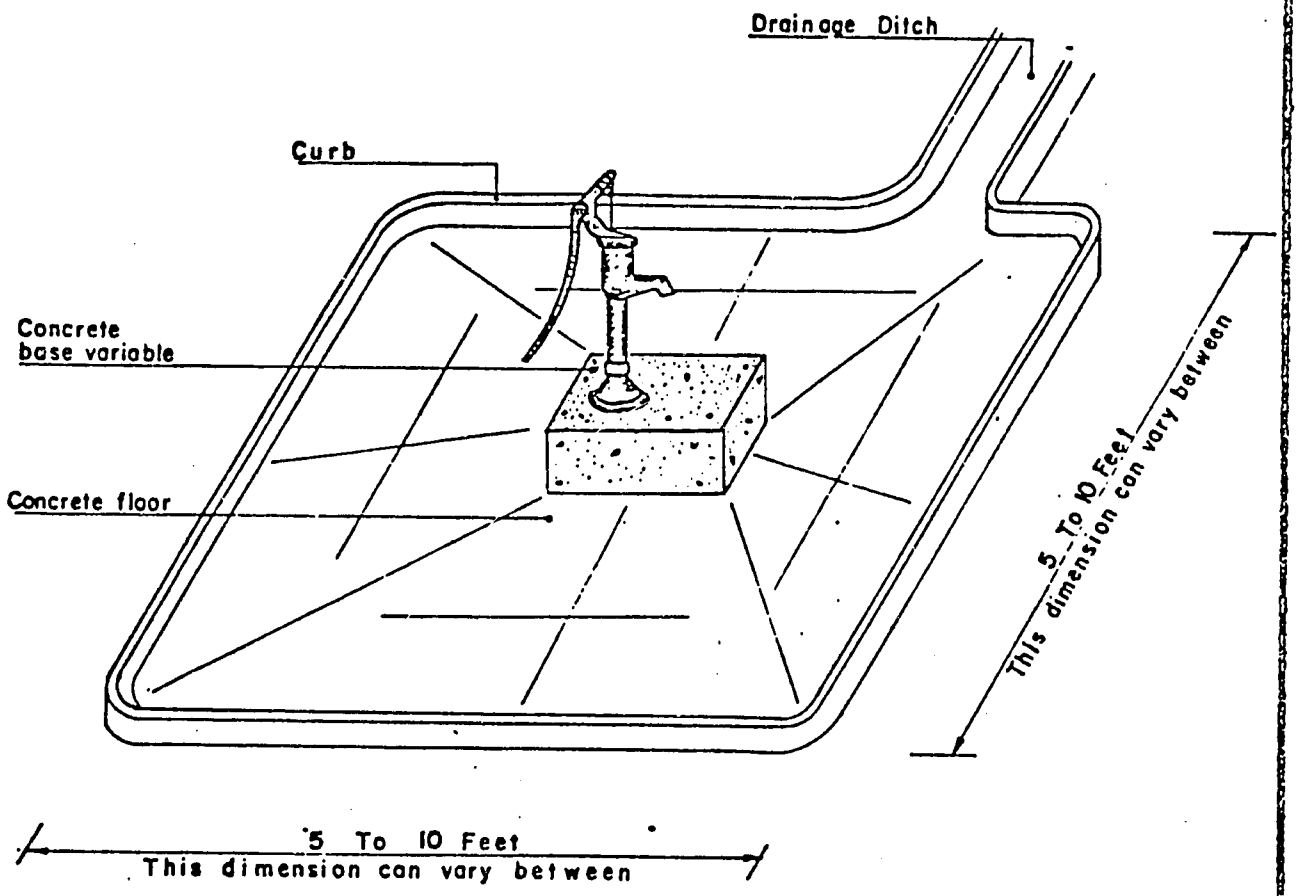
SHALLOW WELL

NOT TO SCALE



DEEP WELL

NOT TO SCALE



WELL APRON

NOT TO SCALE

GRAVITY SYSTEM FROM SPRING

PARTS DESCRIPTION

1. INTAKE STRUCTURE: Concrete structure to prevent contamination of water collected from spring. Composed of:

   a) COLLECTION CHAMBER: Filter and sand trap to remove suspended particles from water.

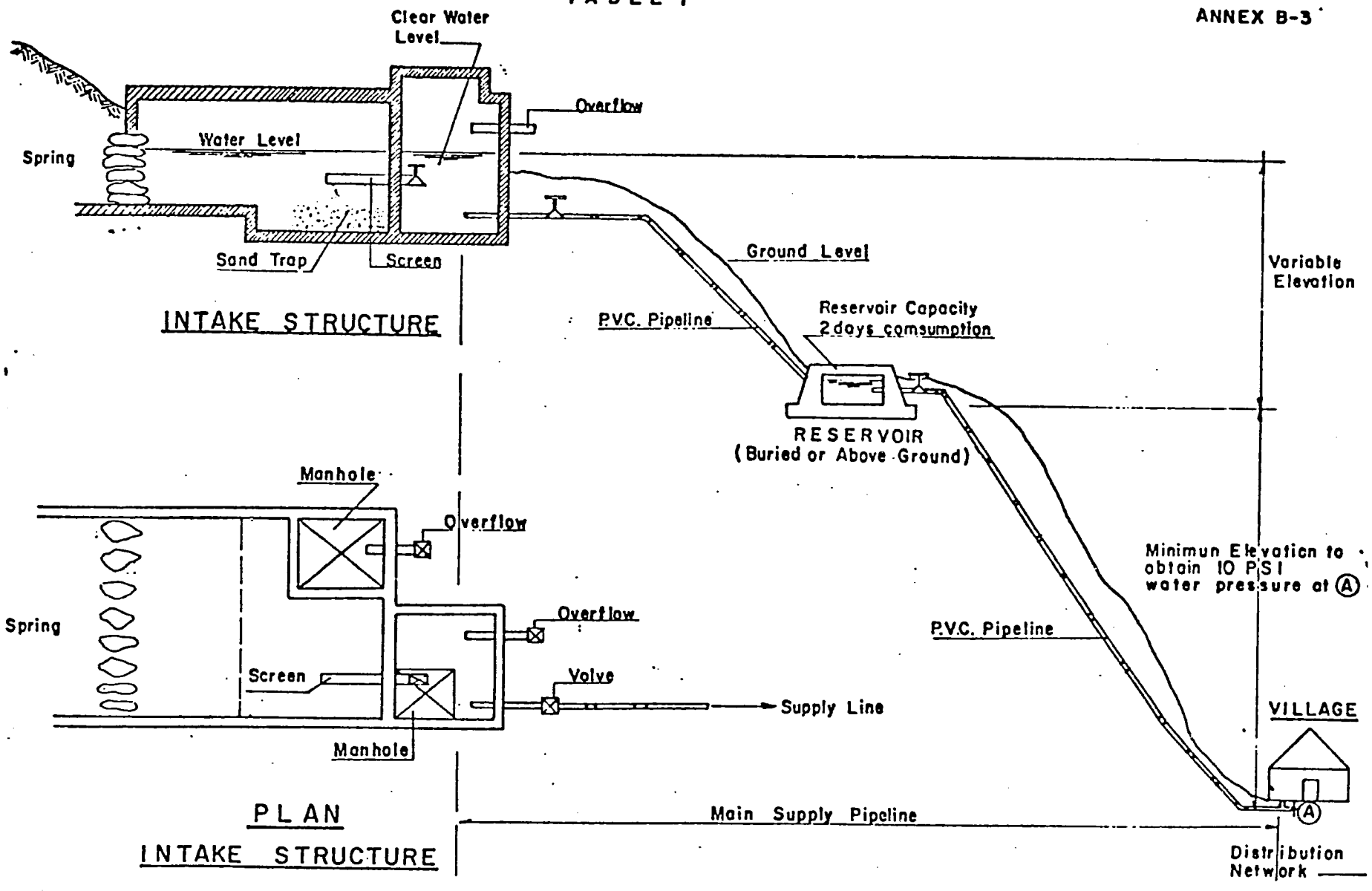
   b) CLEAR WATER WELL : Filtered water deposit where supply line starts.

2. SUPPLY PIPELINE: Generally PVC. Other material as physical conditions indicate. Diameter of pipeline to be based on consumption, supply, elevation, and distance of source from the reservoir and the community.

3. RESERVOIR: Water storage/pressure regulating structure with a minimum capacity of two days water consumption for the community.

4. DISTRIBUTION PIPELINE: Pipeline network in the community for water conveyance to public fountains.

TABLE I



GRAVITY SYSTEM FROM SPRING

NOT TO SCALE

DOSIFICACION PARA POZOS EXCAVADOS

(1 onza de HTH por cada 7 pies cúbicos de agua almacenadas resultando en una solución de 100 ppm de cloro)

Profundidad del Agua en el pozo, en pies	CANTIDAD DE HTH (HIPOCLORITO DE CALCIO), EN ONZAS				
	DIAMETRO INTERIOR DEL POZO, EN PIES				
	3 pies	4 pies	5 pies	6 pies	7 pies
3 pies	3 oz	5 oz	8 oz	12 oz	16 oz
4 pies	4 oz	7 oz	11 oz	16 oz	22 oz
5 pies	5 oz	9 oz	14 oz	20 oz	27 oz
6 pies	6 oz	11 oz	17 oz	24 oz	33 oz
7 pies	7 oz	13 oz	20 oz	28 oz	38 oz
8 pies	8 oz	14 oz	22 oz	32 oz	44 oz
9 pies	9 oz	16 oz	25 oz	36 oz	49 oz
10 pies	10 oz	18 oz	28 oz	40 oz	55 0z
12 pies	12 oz	22 oz	34 oz	48 oz	66 oz
14 pies	14 oz	25 oz	39 oz	57 oz	77 oz
16 pies	16 oz	29 oz	45 oz	65 oz	88 oz
18 pies	18 oz	32 oz	50 oz	73 oz	99 oz
20 pies	20 oz	36 oz	56 oz	81 oz	110 oz

Notas:

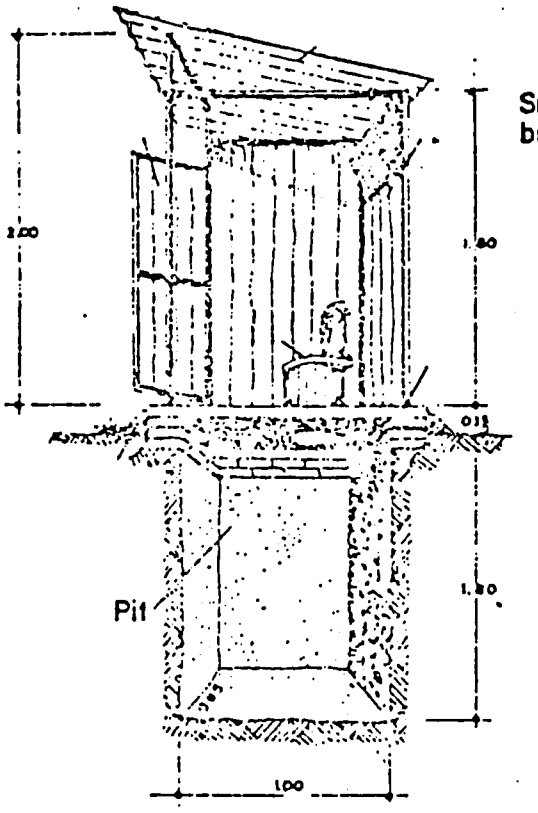
2 cucharadas soperas tiene 1 onza.

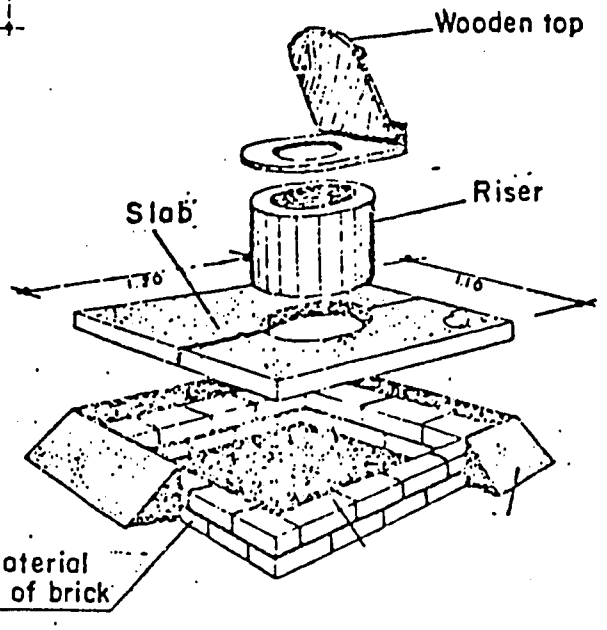
En pozos taladrados o hincados, son suficientes 2 o 3 cucharadas soperas por pozo, cualquiera sea la profundidad de agua y diametro.

El pozo debe limpiarse lo más completamente que sea posible, de substancias extrañas, antes de la desinfección. La desinfección se logra por la adición de una solución fuerte de cloro. Entonces, debe agitarse completamente el contenido del pozo y dejarse reposar durante varias horas preferiblemente 24. También debe tenerse cuidado de lavar toda la superficie sobre el nivel del agua en el pozo con la solución desinfectante. A continuación, debe bombearse agua del pozo durante suficiente tiempo para cambiar varias veces el contenido de éste y expulsar de él el exceso de cloro.

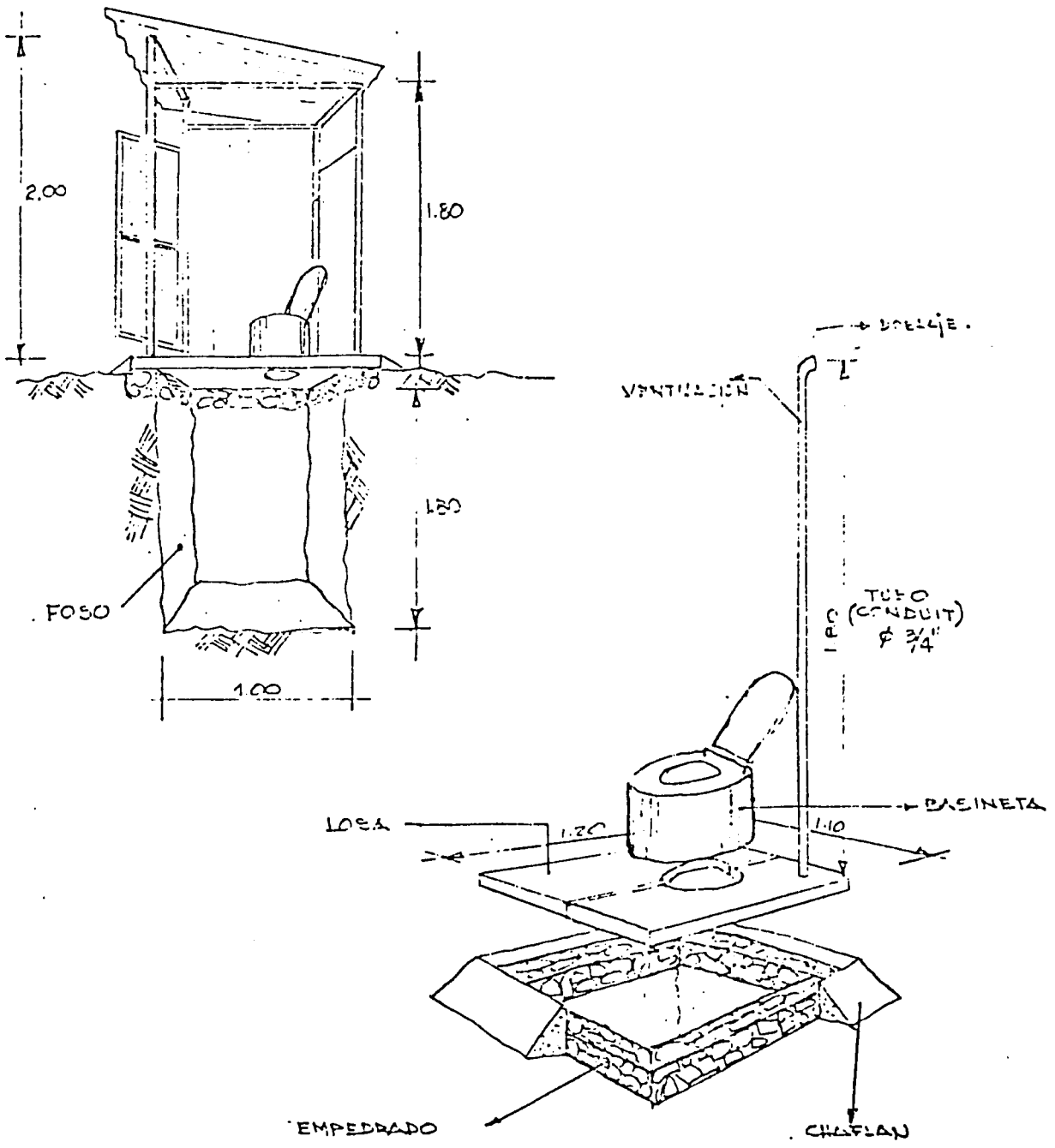
Una solución de aproximadamente 100 ppm de cloro se puede obtener agregando la cantidad de HTH presentada en el cuadro arriba. Usualmente, por conveniencia de aplicación, se hace una solución preliminar mezclando el HTH con una pequeña cantidad de agua para formar una pasta suave y, después, agregar esta pasta al agua en un recipiente (los recipientes de metal se corroen y deben evitarse). El recipiente debe contener por lo menos medio galón de agua por cada onza de HTH que se usa. Entonces debe echar en el pozo la mitad de la solución hecha en el recipiente. Con lo demás, debe mezclar suficiente agua adicional para usar en el lavado de las paredes interiores del pozo. Después del lavado, debe echar el sobrante de la solución en el pozo.

Por Ing. Andrés Karp, Georgia Institute of Technology, noviembre 1979.



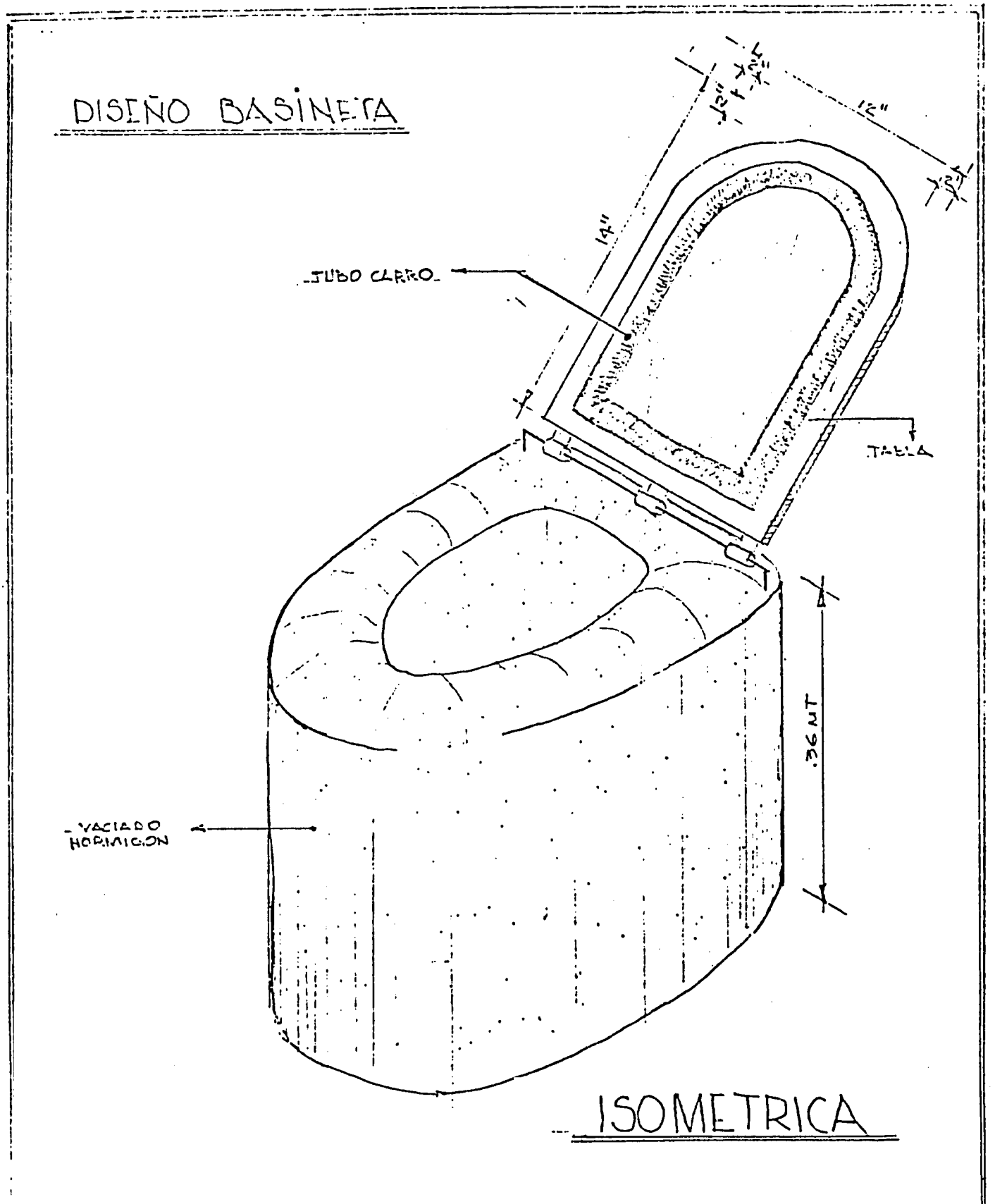


LATRINE DETAILS

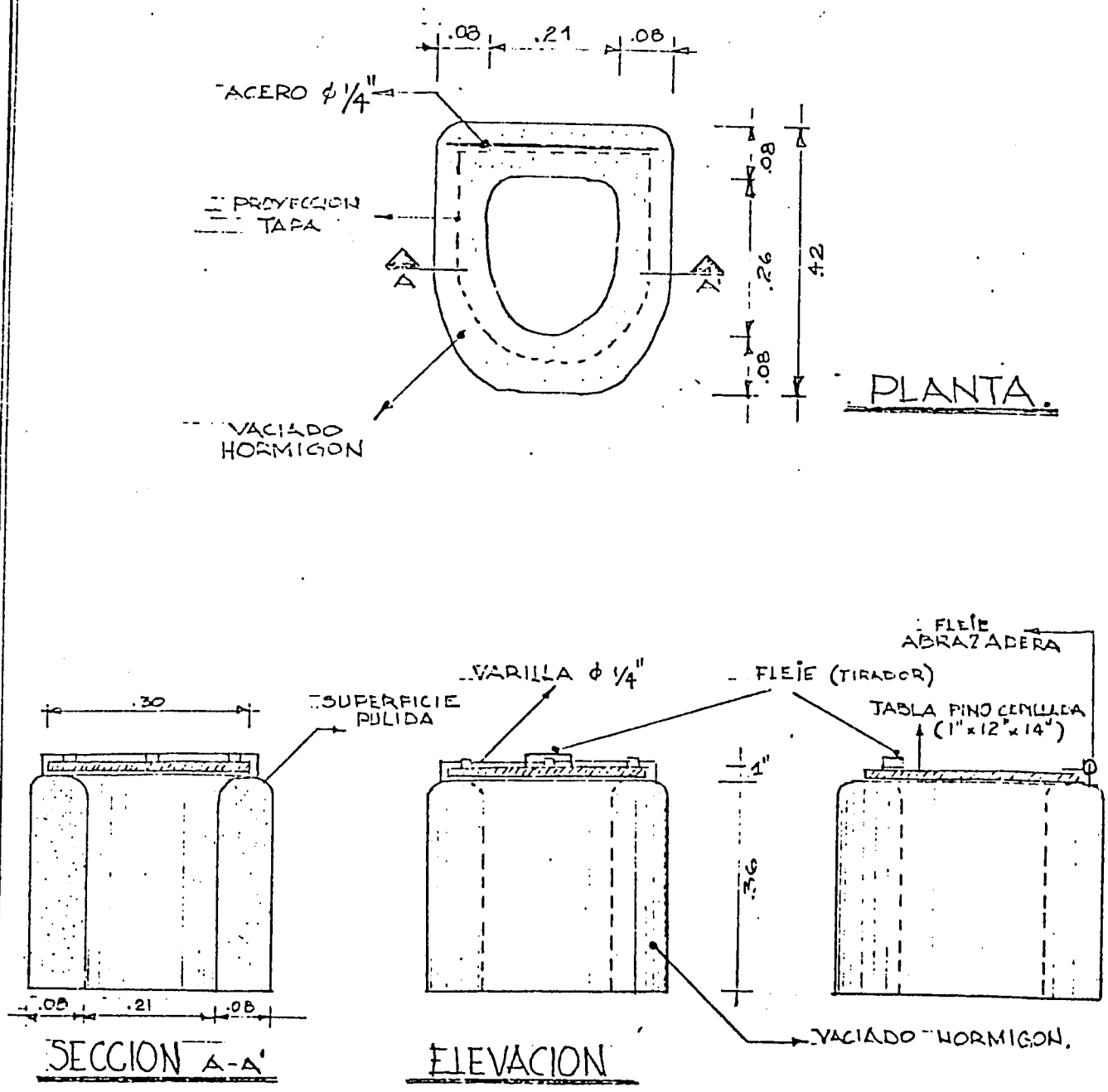


INSTALACION DE LETRINAS

SECRETARIA DE ESTADO DE SALUD PUBLICA Y ASISTENCIA SOCIAL UNIDAD DE AGUA POTABLE Y DISPOSICION DE AGUAS NEGRAS PLAN DE LETRINAS ELEMENTOS CONSTITUTIVOS	No. 1/5 Fecha: Escala: 1:50



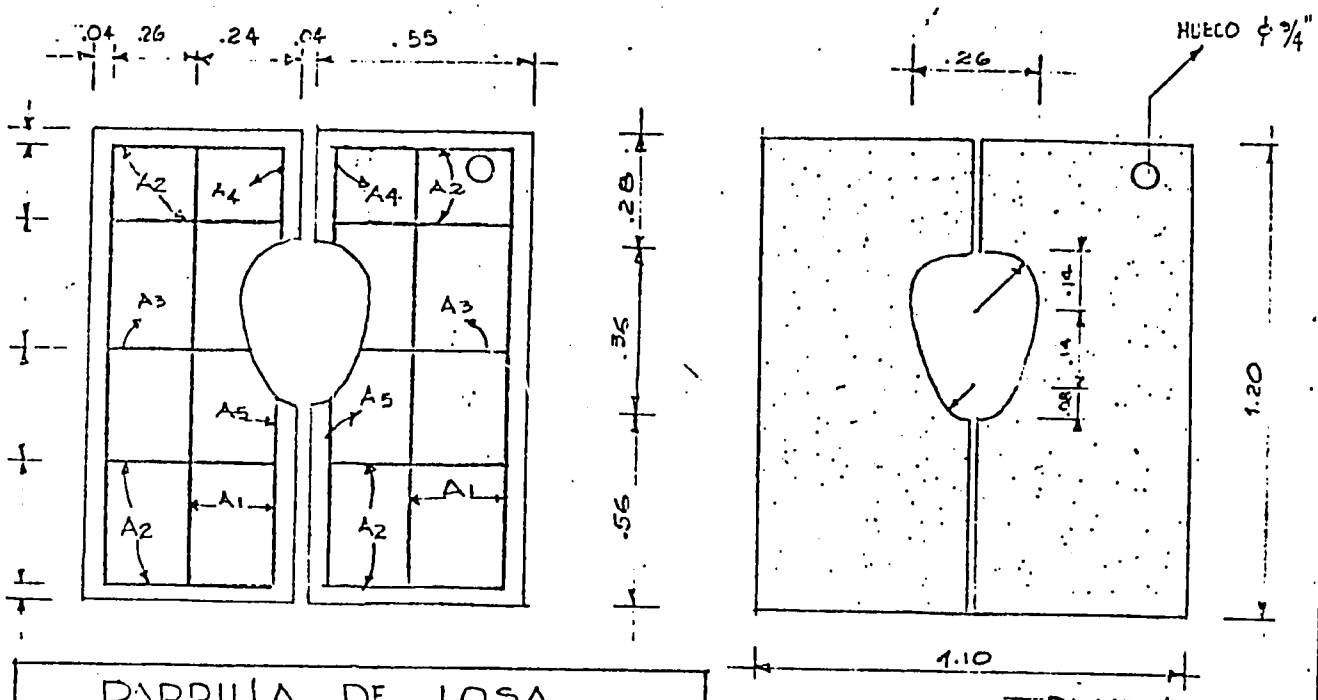
SECRETARIA DE ESTADO DE SALUD PUBLICA Y ASISTENCIA SOCIAL UNIDAD DE AGUA POTABLE Y DISPOSICION DE AGUAS NEGRAS PLAN DE LETRINAS BASINETA	No. 2/5 Fecha: Escala:



DISEÑO BASINETA

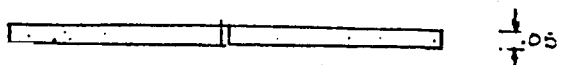
VACIADO HORMIGON SIMPLE
RESISTENCIA 60 Kg/CM²

SECRETARIA DE ESTADO DE SALUD PUBLICA Y ASISTENCIA SOCIAL UNIDAD DE AGUA POTABLE Y DISPOSICION DE AGUAS NEGRAS PLAN DE LETRINAS DISEÑO BASINETA	No. 3/5 Fecha Escala: 1:10



PLANTA.

PARRILLA DE LOSA
RESISTENCIA HORMIGON — 160 Kg/cm²
RESISTENCIA ACERO — 1200 Kg/cm²
* EL ACERO ES ϕ 1/4".

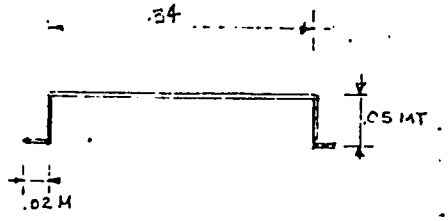


ELEVACION.

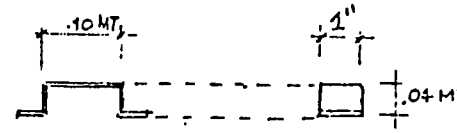
ARMADURA DE LA PARRILLA				CONCRETO		
HIERRO ϕ 1/4"			USO TOTAL REFUERZO	MATERIALES POR LOSA		
CLASE	Nº	LONGITUD CMS		CEMENTO	ARENA	GRAVA
A1	2	116				
A2	4	50				
A3	1	38	1.50 Kg	11.5 KG.	0.65 PIES³ = 0.02 M³	11 PIES³ = 0.01 M³
A4	1	24				
A5	1	55				

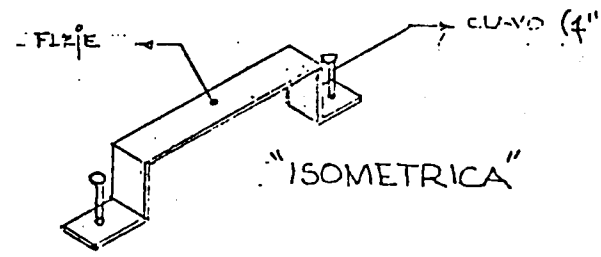
ALAMBRE RECOCIDO Nº 18 PARA AMARRES — 50 GRMS ≈ 2 ONZ.
ESPESOR DE LOSA — 5 CMS.
PESO POR UNIDAD (1/2 LOSA) — 69 KGS.

SECRETARIA DE ESTADO DE SALUD PUBLICA Y ASISTENCIA SOCIAL UNIDAD DE AGUA POTABLE Y DISPOSICION DE AGUAS NEGRAS PLAN DE LETRINAS "LOSAS DE DOS PIEZAS"	No. 4/5 Fecha Escala: 1:20



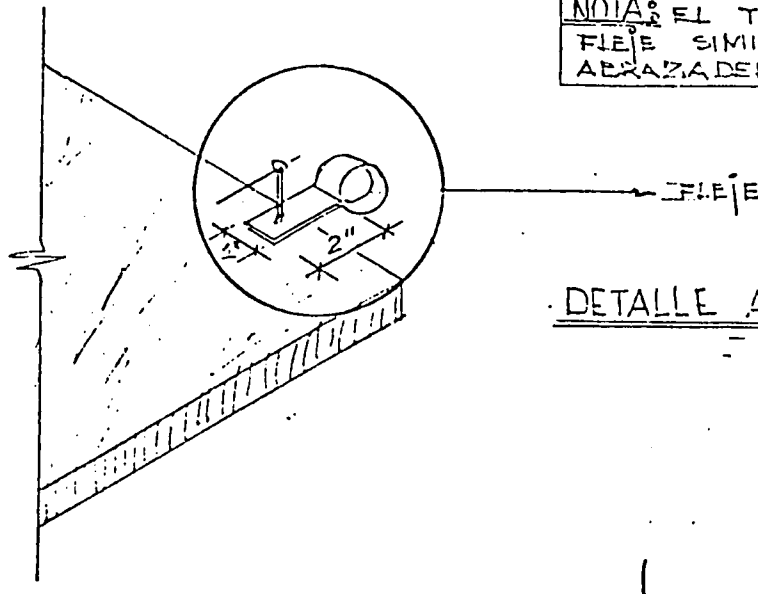
DETALLE VARILLA ESC. 1:10
(Φ 1/4")



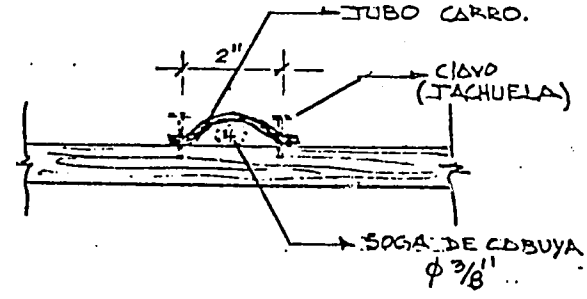


DETALLE TIRADOR ESC. 1:10

NOTA: EL TIRADOR SERÁ HECHO DE FLEJE SIMILAR AL USADO PARA LAS ABRAZADERAS.



DETALLE ABRAZADERA DE TAPA
ESC. 1:10



DETALLE
COLOCACION TUBO Y TAPA.

NOTA: LA IDEA DE COLOCAR ESTA SOGA ES MANTENER ABULTADO EL TUBO.

SECRETARIA DE ESTADO DE SALUD PUBLICA Y ASISTENCIA SOCIAL UNIDAD DE AGUA POTABLE Y DISPOSICION DE AGUAS NEGRAS PLAN DE LETRINAS DETALLE	No. 5/5 Fecha Escala