PN-AAT-137

WATER AND SANITATION FOR HEALTH PROJECT

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TECHNICAL ASSISTANCE FOR HANDPUMP COMPONENT OF THE HEALTH SECTOR LOAN II PROJECT IN THE DOMINICAN REPUBLIC

WASH FIELD REPORT NO. 101

JANUARY 1984

Prepared For:
USAID Mission to the Dominican Republic
Order of Technical Direction No. 48

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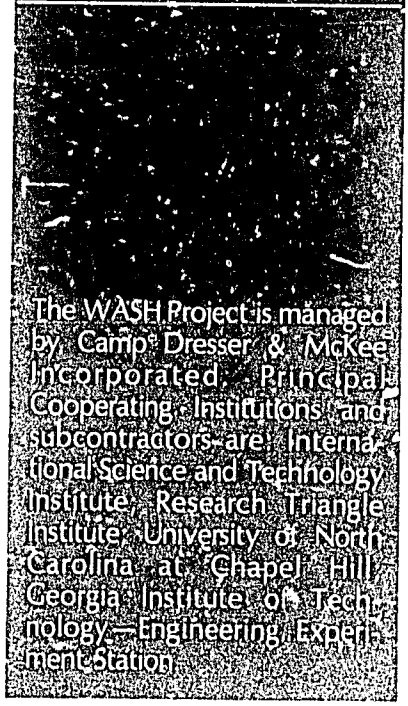

23 January 1984

Mr. Philip Schwab, Director
USAID Mission/Santo Domingo
(DOMINICAN REPUBLIC)

Attention: Dr. Oscar Rivera-Rivera

Dear Mr. Schwab:

On behalf of the WASH Project I am pleased to provide you with ten (10) copies of a report on Technical Assistance for Handpump Component of the Health Sector Loan II Project in the Dominican Republic.

This is the final report by the WASH Project and it summarizes the results of several missions to the Dominican Republic during the period of June 1981 thru 1983.

This assistance is the result of a request by the Mission in June of 1981. The work was started by the WASH Project on 24 July 1981 by means of Order of Technical Direction No. 48, 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,

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

cc: Mr. Victor W.R. Wehman, Jr.
S&T/H/WS

DBW:da

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Prepared for the USAID Mission to the Dominican Republic
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Prepared by:

The Water and Sanitation for Health (WASH) Project

January 1984

Water and Sanitation for Health Project
Contract No. AID/DSPE-C-0080, Project No. 931-1176
is sponsored by the Office of Health, Bureau for Science and Technology
U.S. Agency for International Development
Washington, DC 20523

TABLE OF CONTENTS

FIGURES

ACRONYMS

AID	-	U.S. Agency for International Development
CDM	-	Camp Dresser & McKee, Inc.
DIMECO	-	Diseno Mecanico y Construccion, a tool and die maker in Santo Domingo
ETINCA	-	Equipo Tecnico Industrial, C. por, A, the foundry where the pumps are being manufactured
GODR	-	Government of the Dominican Republic
HSL II	-	Health Sector Loan II
INAPA	-	National Institute for Potable Water and Aqueducts
IRWRDL	-	International Rural Water Resources Development Laboratory, University of Maryland
ISTI	-	International Science and Technology Institute, Inc.
OTD	-	Order of Technical Direction
PVC	-	Polyvinyl Chloride
SESPAS	-	State Secretariate for Public Health and Social Assistance, GODR
TMP	-	Tuberias y Materiales Plasticos, manufacturer of PVC foot valve and strainer assembly and drop pipe stabilizers
TORNICA	-	Manufacturer of Pins and Bushings
UTOC	-	Technical Field Operations Unit
WASH	-	Water and Sanitation for Health Project

EXECUTIVE SUMMARY

As part of its comprehensive rural health project under Health Sector Loan II (HSL II), the State Secretariate for Public Health and Social Assistance (SESPAS) of the Government of the Dominican Republic (GODR) planned to install 2,050 AID-type Handpumps in several hundred rural communities in order to improve water supply and reduce water-related morbidity and mortality. The project was financed by $2.1 million from the GODR, $1.1 million from the project beneficiaries in money or in kind, and $8 million from an AID loan.

Several times in the course of carrying out the project SESPAS and the AID Mission in Santo Domingo have requested various types of technical assistance from the Water and Sanitation for Health (WASH) Project, which is a centrally-funded project operated for AID/Washington's Office of Health (S&T/H/WS) by Camp Dresser and McKee, Inc. (CDM), an environmental engineering company headquartered in Boston, Massachusetts.

Assistance was first provided in 1980 under WASH Order of Technical Direction (OTD) No. 1 to help with pump manufacture in Santo Domingo, which was contracted by SESPAS to a local foundry, Equipo Tecnico Industrial, C. por A., (ETINCA).

As this technical assistance effort was nearing completion in 1981, the Mission requested further and longer term assistance with the handpump maintenance component of the HSL II Project. This assistance was provided under WASH OTD No. 48, and is the subject of this report. In addition to helping with the manufacturers and maintenance programs WASH helped SESPAS arrange for the local manufacture of components for a pull-through-the-base model of the AID handpump which it was felt would facilitate installation, maintenance, and repair. The assistance also helped improve the quality of the pump being manufactured by ETINCA and provided some guidance in administrative, managerial, and institutional aspects of the HSL II Project.

The work was carried out in four visits to the Dominican Republic between November 1981 and October 1982. The work done in the field under OTD 48 and the recommendations made to the Mission and SESPAS are described in WASH Interim Reports 48-1, 48-2, and 48-3 (see the appendices of this report for the recommendations in the earlier reports).

Continued efforts are needed to improve the HSL II Project to ensure that the benefits from the locally manufactured handpump will be long lasting. Quality control, testing, and acceptance procedures should be continued and should be extended to other areas of the project as needed. The pump installation crew needs training in order to reduce the number of pump failures in the field and to help increase the communities' participation in the handpump program.

The present work of the health education team (UTOC) is expected to improve community involvement in the project. Once the community maintenance personnel are properly trained and once SESPAS can establish the necessary logistical system to provide them with grease and spare parts, the communities should be able to keep the pumps lubricated and maintained. This effort will also assist the communities to know whom to contact and where to obtain more extensive maintenance and repair services.

ACKNOWLEDGEMENTS

WASH would like to express its appreciation for all the assistance that was provided to its consultants during the course of this project.

Special thanks go to Dr. Oscar Rivera-Rivera, Health Officer for USAID/DR, for without his patient understanding and wholehearted support the objectives of this task would have been impossible to achieve. His cheerful manner and deep concern for those who were to benefit from the handpump program made the normal frustrations of the effort all worthwhile.

WASH would also like to thank Dr. Jose M. Herrera Gabral, M.D. who, as Director of the Health Sector II Coordination Unit, gave so freely of his time and advice, as well as providing guidance to the various teams visiting his project.

One would be remiss if mention were not made of the fine support that was always provided by USAID/DR and SESPAS staff. In particular we feel that Mr. John Thomas, Ms. Dulce Jimenez, and Engs. Elpidio Caba, Perez y Perez, Manuel Casanova, and Oscar Hungria deserve special mention.

Last, but never least, we wish to express appreciation for the fine logistical and secretarial assistance of Mrs. Diana de Baez of the AID Mission.

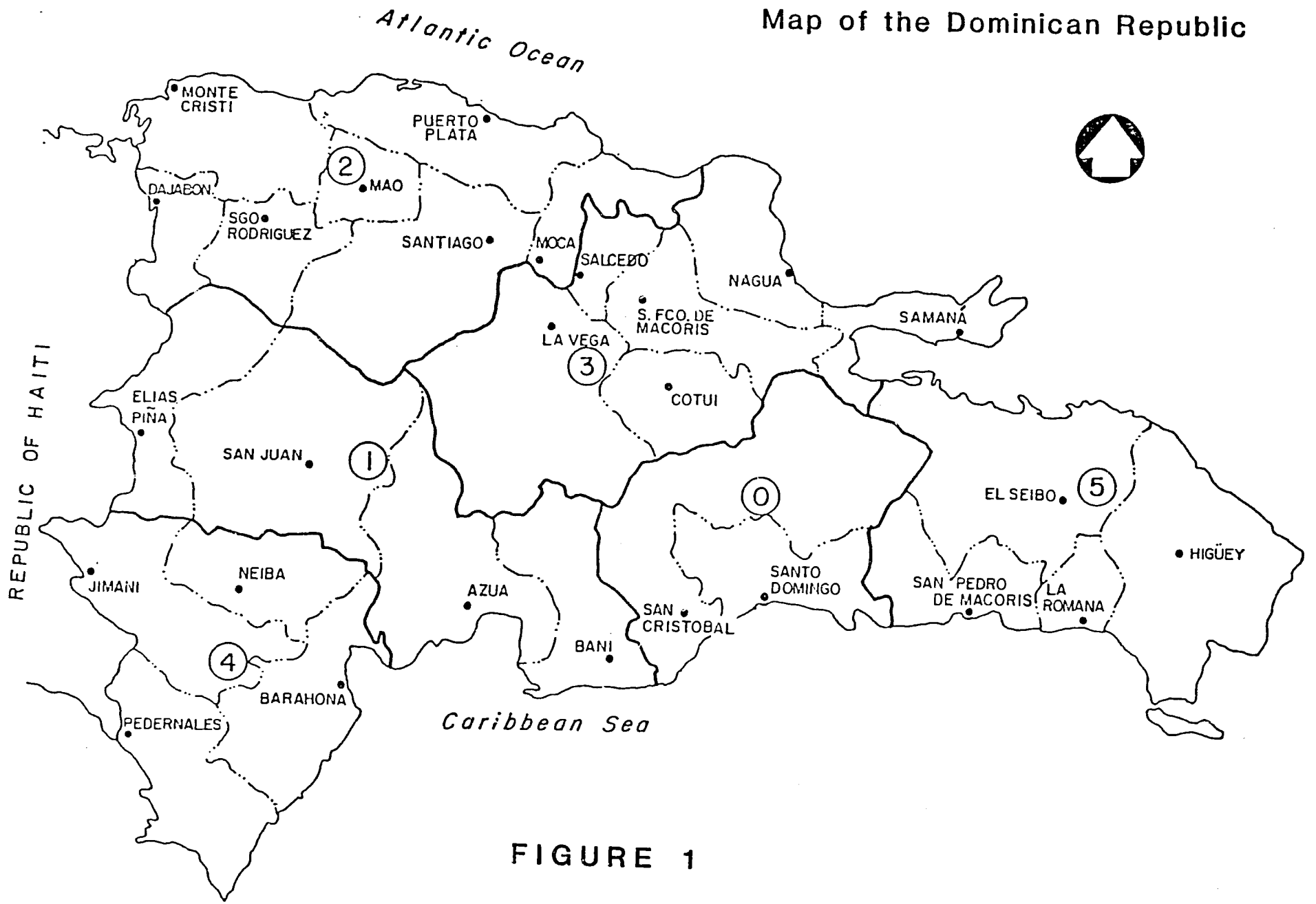

FIGURE 1

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

Chapter 1

INTRODUCTION

As part of its efforts to improve health in rural communities, the Government of the Dominican Republic (GODR) carried out the health Sector Loan II (HSL II) Project with assistance from the U.S. Agency for International Development (AID). One of the components of this project was the installation of 2,050 handpumps.

In the late 1970s, the Georgia Institute of Technology assisted AID/Dominican Republic in providing technical assistance to two handpump manufacturers in Santo Domingo, so that they would be prepared to supply the pumps needed for the HSL II Project which was to start in November 1978.

Due to GODR budget constraints and the impact of Hurricane David in August 1979, it was not until January 1980 that the handpump element of HSL II Project got underway. The bid advertisement for the first 1,000 handpumps was issued, and the contract was signed on March 17, 1980. The lowest bidder and winner of the contract was Equipo Tecnico Industrial, C. por A., (ETINCA) a foundry in Santo Domingo that had not received technical assistance from Georgia Tech.

The pump being used in the HSL II Project was the AID-designed handpump (see Figures 2 and 3). This pump had a histroy of local manufactured and field testing in at least three lesser developed countries (Nicaragua, Indonesia and Sri Lanka).

To assist in the local manufacture and field installation, it was felt that technical assistance was necessary, at least initially as ETINCA had not previously received such assistance. The Latin America Bureau of AID/Washington proposed to the Mission on April 29, 1980 that Georgia Tech provide technical assistance to ETINCA. The Mission concurred with this proposal, and on June 10, 1980 in Cable Santo Domingo 3974 the Mission requested that the assistance be provided in July and August.

On September 23, 1980, the AID Office of Health in Washington issued Order of Technical Direction (OTD) No. 1 to Camp Dresser & McKee, Inc. (CDM), an environmental engineering company that operates AID's centrally-funded Water and Sanitation for Health (WASH) Project, to provide the assistance.*

As Georgia Tech personnel were not available to provide the technical assistance needed in the Dominican Republic, WASH assigned the work to Mr. Robert Knight, a consultant for the International Science and Technology Institute, Inc. (ISTI) and an engineering technician in the Civil Engineering Department of the University of Maryland. Mr. Knight had assisted Georgia Tech in the AID program in Tunisia, Honduras, Ecuador, and the Philippines.

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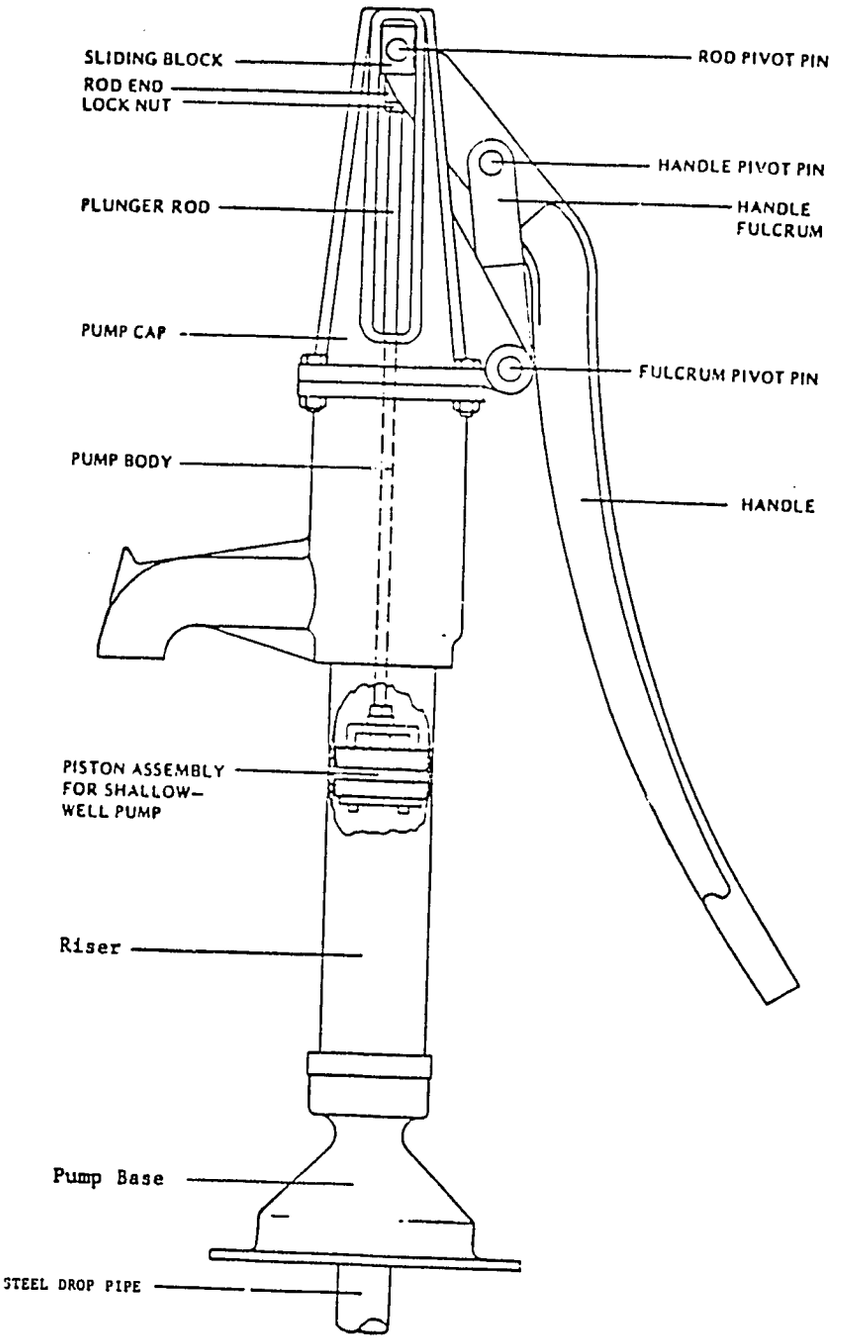
* The WASH contract between AID and CDM had been sighed at the end of August 1980.



Pump Stand

Figure 2

Typical
AID Shallow-Well Handpump
(For wells in which the water level is within 25 feet of the ground surface.)

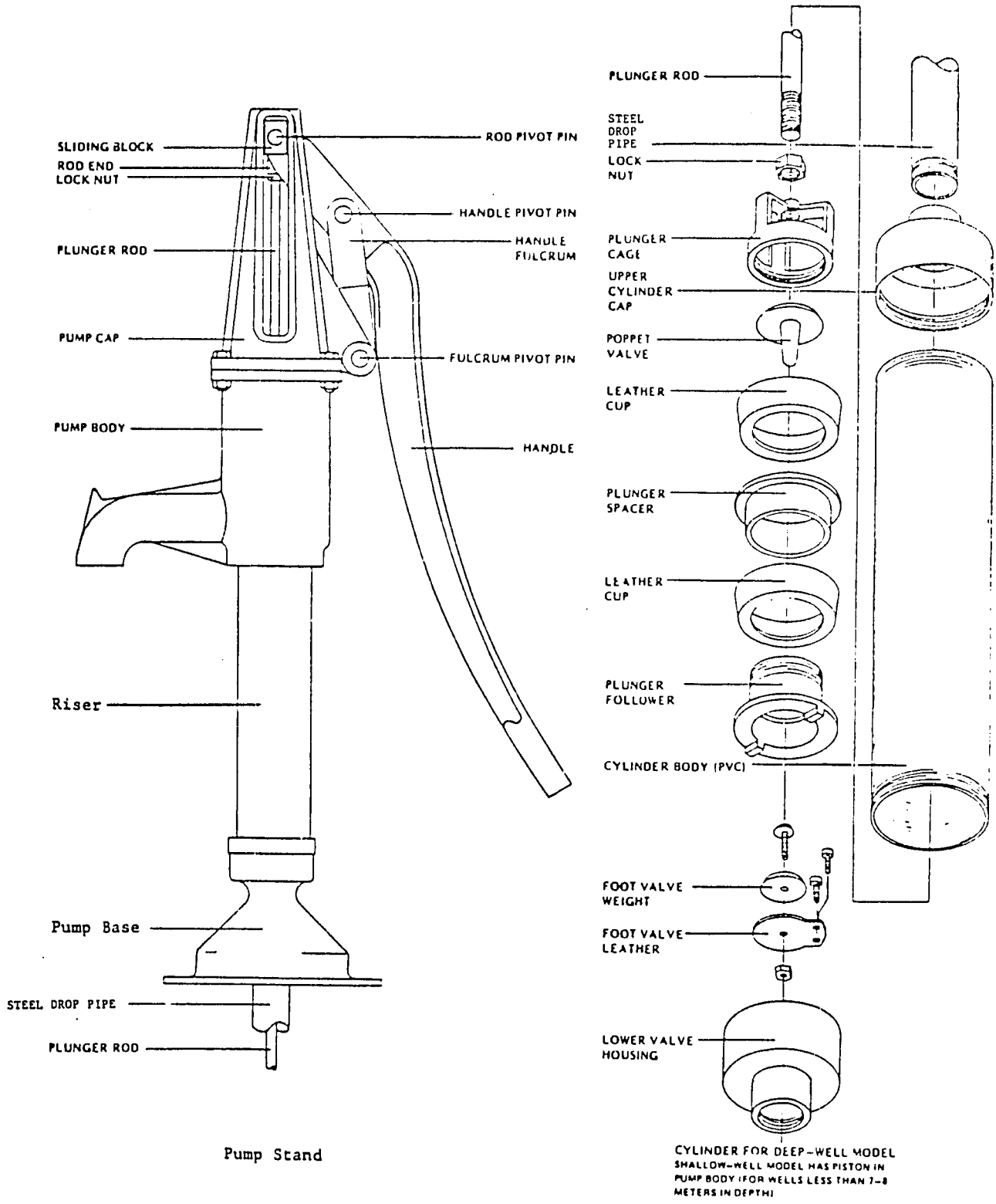


Figure 3

Typical
AID Deep-Well Handpump

Chapter 2

ACTIVITIES PRIOR TO OTD-48

2.1 Need for Village-Level Maintenance

After visiting the field for his OTD-1 activities, the consultant found that one of the critical elements for the success of the HSL II Project would be the involvement of the villagers themselves in planning, construction, operation, maintenance and repair of the water and sanitation systems to be installed. It was felt that the major purpose of the health education and training components of the project would be to prepare the villagers for this role through both motivation and improving their knowledge and practical skills.

Thus, it was felt that it was important to minimize as much as possible any difficulties which might be encountered with village-level operation, maintenance, and repair of the systems after installation. Experience in other programs had shown that one such potential difficulty was the down-the-well components of the conventional AID-design handpump. It was noticed that the pump design made it necessary to remove the pump from its base in order to maintain and repair any of the below ground parts. Such was the case, for example, if the leather cup pump seals had to be replaced (something which could happen as often as every six months). As removal of the pump and the heavy galvanized steel drop pipe and pump cylinder from the well was a very laborious task, it was felt that unless there was a large enough group of strongly motivated people in the village to do this job the chances of such maintenace being done on a regular basis were slight.

2.2 "Pull-Through-The-Base Pump"

In discussing the issue of long-term pump maintenance and repair with the Mission Health Officer (Dr. Oscar Rivera) and the Loan Coordinator (Dr. Jose Herrera Cabral) the problems of village-level maintenance and repair due to the difficulty of removing the drop pipe and cylinder were discussed.

In seeking to reduce maintenance problems, the WASH consultant explained about a PVC (Polyvinyl chloride) drop pipe that was being used in Tunisia. The advantage of using the PVC drop pipe was that: 1) a larger diameter drop pipe could be used; 2) that the pipe itself could be used as the pump cylinder; and 3) the piston assembly could be pulled up through the base of the pump without having to remove the drop pipe. It also meant that there was no need for a separate pump cylinder at the bottom of the drop pipe. It was pointed out that the only reason for having to remove the drop pipe would then be to repair the foot valve, pump strainer (screen), or drop pipe itself. But, this task would be easier with PVC drop pipe than with the conventional pump because the PVC drop pipe would be much lighter than the galvanized steel one.

Based on the advice of Mr. Knight, it was decided that the second 1,000 pumps from ETINCA should be built to accommodate the PVC drop pipe. As this would require some modifications in the pump design, Dr. Rivera requested the WASH consultant to note the appropriate changes on the drawings. At the same

time, the Mission requested the WASH consultant to modify the pump spout so that narrow-mouthed water containers could be filled more easily and with less wastage of water than occurred with the conventional spout.

2.3 Field Testing

Mr. Knight noted the modifications on the drawings (see Appendix A), and indicated that the concept was so new that a foot valve had not yet been designed and built for the PVC drop pipe/cylinder. He asked if it would be possible to field test a limited number of ETINCA manufactured pumps (before proceeding on a larger scale). SESPAS agreed to arrange for ten test sites near San Cristobal and permitted Mr. Knight to have the foundry (ETINCA) build ten "modified" pumps right away. Mr. Knight arranged with the foundry to make the changes he had indicated on the drawings and build ten pumps as soon as possible at no extra cost.

2.4 Foot Valve and Strainer Assembly

The foot valve strainer assembly that SESPAS was using was a U.S. imported (Clayton Mark) and cost $40.00. Mr. Knight recommended that a PVC foot valve for the PVC drop pipe be used rather than the one commercially available. He also recommended the use of the helically-slotted PVC roboscreen, which is a plastic pump strainer that fits on the the drop pipe below the foot valve to prevent sand and stones from entering the pump cylinder and destroying the pump seals.

While the ten pumps were being made at ETINCA, Mr. Knight fabricated ten PVC foot valves at the University of Maryland, and prepared a die from which a mold could be made in Santo Domingo for local manfuacture of the foot valve by injection molding.

Mr. Knight also shipped to Santo Domingo a device he had developed for broaching PVC pipe in order to produce an internally-ribbed pipe which could be helically-slotted to produce roboscreen.

Although extrusion of the pipe would be a more economical method of producing large quantities of the internally-ribbed pipe, Mr. Knight had developed the broaching device with the idea that it could be used to promote small-scale industries for the production of this device.

2.5 Laboratory Testing

Mr. Knight had identified one of the problems in using the PVC drop pipe to be that of the tensile strength of the solvent-welded joints that would have to be made on the twenty foot lengths of pipe that would be used as the drop pipe. He also felt that there could be some problems with connecting the PVC drop pipe to the pump hase.

Before returning to the Dominican Republic, Mr. Knight conducted some laboratory tests on the strength of solvent-welded PVC pipes and adaptors. The results are shown on Figure 2 of WASH Field Report No. 20, (June 1981). The principal finding of these tests was that it was critical that the pipe be

carefully cleaned before the solvent weld compound was applied and sufficient time should be allowed for the pipe joint to "set" prior to its being placed in service.

2.6 Field Installation and Testing

On April 21, 1981, Mr. Knight helped to install the first two modified pumps at Boqueron in Ocoa Province. This site was about an hour and a half's drive from Santo Domingo and was to be the closest test site to Santo Domingo. When it was pointed out that the other sites were to be spread far and wide, making monitoring and data collection very difficult if not impossible, SESPAS explained that it had not been possible to set up any sites nearer San Cristobal. Before Mr. Knight left the Dominican Republic on May 2 one more test pump was installed at Los Tramojos.

As experience had shown that most pump failures manifest themselves in the first month of testing, it was expected that the experience of the field testing of the PVC drop pipe pumps would quickly be available to SESPAS for training their field installation crews.

As it turned out, SESPAS did not complete the installation of the ten test pumps until April 1982 and, due to a serious illness, Mr. Knight was not able to return to the Dominican Republic to review the status of the test pumps until the Fall of 1981. In his absence, SESPAS pump installation crews were assigned responsibility for monitoring the test pumps. Although detailed data were not sent back to WASH and S&T/H/WS, the Mission did cable AID/Washington on May 19, 1981 saying that the pull-through-the-base pump had resulted in lower project cost, easier installation and maintenance, and a more efficient pump.

2.7 Local Manufacture of Foot Valve and Strainer Assembly

While Mr. Knight was in the Dominican Republic in April 1981, he investigated the possibility of having the PVC foot valve and the roboscreen manufactured there. At Dr. Rivera's request he also investigated the possibility of having plastic faucets made for the plastic household water containers that were to be distributed as part of the HSL II Project. Diseno Mecanico y Construccion (DIMECO), a tool and die shop, provided a quote for the foot valve. Tuberias y Materiales Plasticos (TMP), a plastics manufacturer, indicated that it was interested and had the capability of making the foot valve, roboscreen, and plastic faucets.

Chapter 3

ACTIVITIES CARRIED ON UNDER OTD-48

3.1 Request for Technical Assistance

Prior to ordering the remaining 1,050 handpumps needed for the HSL II Project in May 1981, the Mission requested AID/Washington to provide technical assistance for the implementation of the handpump repair and maintenance portion of the Health Sector Loan II. In June, 1981 this was expanded to include assistance in: 1) development of a maintenance manual; 2) organization of a village based maintenance program; 3) planning the logistics of a spare parts system; and 4) establishing a preventive maintenance program.

AID/Washington responded to the Mission's request by issuing Order of Technical Direction (OTD) No. 48 to the WASH Project on July 24, 1981. The order for the remaining handpumps was modified so that they could use the PVC drop pipe. This order was placed by the Mission in late June of 1981.

The Mission had requested that Mr. Knight carry out the work because of his familiarity with and interest in the project and his qualifications for the work. As he was not available until November 1981, it was agreed to wait until he could travel rather than send another consultant.

3.2 Report Organization

The remainder of this report describes the work done and lessons learned under OTD 48. Many of the details of the work were described in reports that have been sent to the Mission and are on file in WASH office. This report presents an overview of what was done.

The next chapter presents the scope of work for the WASH assignment under OTD No. 48 which is followed by a chapter that discusses the specific work that was done and another chapter that discusses some of the events since field work under OTD 48 was completed in October 1982. Conclusions and recommendations are presented in the final chapter. The appendices contain back-up data which, for the sake of brevity, were not included in the text of the report.

Chapter 4

SCOPE OF WORK FOR OTD-48

4.1 Services Requested

As indicated previously, in May of 1981 USAID/DR requested technical assistance in the implementation of the pump repair and maintenance portion of HSL II. On June 23, 1981, the Mission sent a more expanded scope of work for assistance with the handpump program. This, together with further clarification and modifications which the Mission and AID/Washington added as the work progressed, became the scope of work for OTD 48 as follows:

1. Assist with photography, compilation, and editing in the development of service manuals;

2. Assist with planning and organizing a handpump maintenance training program for selected villagers with mechanical aptitude so that there will be a sufficient number of handpump mechanics to handle minor breakdowns and routine maintenance at regional and community levels;

3. Assist in planning the logistics of supplying spare parts for the handpumps, including the quantity of each part to be stored and the expected incidence and nature of breakdowns which would govern the selection of parts and the place to store them (i.e., at the regional or the community level);

4. Prepare a schedule for preventive maintenance and develop guidelines for implementation of and continued adherence to the schedule.

4.2 Additional Requests

Between the time the OTD was issued and Mr. Knight's visit to the Dominican Republic in November 1981, a shipment of 20 pumps had been sent from the Dominican Republic to Haiti for an AID pilot handpump project. The pumps were found to be defective and there was considerable concern that the quality of the ETINCA pump had deteriorated to the point that it could not provide adequate service in the field. On investigating the matter, Mr. Knight found that the pumps sent to Haiti had been selected from a group of rejected pumps by mistake. Twenty other pumps were sent to substitute for the defective ones. At the same time, it was reported to the USAID/DR that SESPAS was having problems with some of the pumps they had installed which seemed to be related to manufacturing problems. Under OTD-1, Mr. Knight had found some problems with the ETINCA pump, especially in the quality of the leathers, iron casting, and thread cutting. Mr. Knight was able to help the foundry improve its quality somewhat, but field results were showing that the problems continued, although to a somewhat less degree. These problems were especially evident in the pumps sent to Haiti, and even the replacement pumps were not without defects in these areas. Therefore, AID/Washington decided to add the following two items to the scope of work:

6. Inspect the quality of handpumps already fabricated in an effort to determine the causes of the alleged defects in the pumps sent to AID/Haiti and

7. Help the local pump manufacturer (ETINCA) establish a quality control program for testing each pump before it is shipped from the foundry.

As work on OTD 48 progressed, it became increasingly clear that many of the problems that were showing themselves as "hardware" or technical difficulties were reflections of the institutional difficulties (i.e., administration, management, and organization) that were being encountered in attempting to carry out the HSL II Project successfully. In February 1982, two engineering advisors went to the Dominican Republic under WASH OTD No. 48 and found that the project was seriously behind schedule and would probably not be completed on time unless extensive changes were made in project implementation (see WASH Interim Report No. 1 for OTD 48). In May 1978 a hydrogeologist went to the Dominican Republic under WASH OTD No. 97 to assess the project's well drilling programs and recommended measures to help get the program back on schedule (see WASH Field Report No. 50).

Both of these technical assistance efforts identified extensive governmental administrative difficulties. To help the Mission resolve them, AID/Washington further modified the OTD 48 scope of work to include evaluation of administrative problems as they related to the installation of handpumps and recommendations to resolve them.

Chapter 5

FIELD ACTIVITIES OF OTD-48

5.1 General

The scope of work under OTD 48 was carried out during four trips to the Dominican Republic between November 1981 and October 1982. The first two trips in November 1981 and April 1982 dealt principally with quality control and preparation for the handpump maintenance program (see Interim Reports 48-1 and 48-2). The third trip, in June 1982, was to conduct a detailed overall evaluation of the handpump component of the HSL II Project including the administrative difficulties which were interfering with the installation and operation of the handpumps (see Interim Report 48-3). The last trip, in November 1982, was to assess the extent to which the recommendations made in Interim Report No. 48-3 had been implemented and the degree to which they helped improve the project. The findings from the last trip are presented in Appendix H. This document presents the conclusions and recommendations from Interim Report No. 48-3 and the progress made as of November 1982.

5.2 Field Trip of November 1981

5.2.1 Pump Quality

The WASH consultant first visited the Dominican Republic under OTD No. 48 between the 6th and the 16th of November 1981. He was joined by Mr. Howard Geller, a mechanical engineer, who assisted in inspecting handpumps at the foundry and at the UAPONDAN storage yard.

On November 5th, before going to the Dominican Republic, Mr. Knight visited the AID Mission in Haiti to inspect the first shipment of 20 pumps that had been sent there from the Dominican Republic. In spite of the fact that this shipment had been inspected by Knight in the Dominican Republic as part of OTD 1, it was obvious that the pumps were of poor quality. The principal problems were (1) poor thread cutting, particularly with female threads that were cut in a lathe with a single-point tool; (2) poor-quality leather cups and foot valves; and (3) porosity in cast iron components. Mr. Knight was charged with finding out what had happened between his inspection in the Dominican Republic and their arrival in Haiti.

Upon arrival in Santo Domingo, Mr. Knight discussed the SESPAS pump-manufacturing situation and the proposed O&M program with Dr. Rivera. It was agreed that a pump-inspection and acceptance procedure involving both ETINCA and SESPAS was badly needed. After discussion with S&T/H/WS it was agreed that WASH would assist in developing and implementing such procedures (see Appendix B and C).

Next, Mr. Knight and Engineer Caba of AID inspected the pumps at the SESPAS storage yard and found problems similar to those found with the pumps that had been sent to Haiti, particularly with the female threads. They also reviewed

a list of pumps and pump components that SESPAS had rejected. The list helped Mr. Knight to further develop his ideas for a quality control and improvement program at the foundry.

When they visited ETINCA, Messrs. Knight and Caba found the quality of workmanship had declined. Upon investigating the circumstances surrounding the Haiti shipment, they were told that the pumps had been mistakenly taken from a pile of pumps that SESPAS had rejected. The foundry agreed to send 20 new replacement pumps at no charge and to let AID/Haiti keep the other 20 pumps for spare parts. The foundry management also agreed with several suggestions made by Mr. Knight to improve quality control (see Interim Report 48-1 and Appendices B and C) and agreed to wet-test all of the pumps before delivering them to UAPODAN. Mr. Geller helped the foundry start up the wet-testing procedure. During most of this stay in the Dominican Republic, Mr. Knight wet-tested pumps at the SESPAS storage yard and found about 25 percent of them defective. At the conclusion of the trip, it was agreed that SESPAS would wet-test only a sample of the pumps it received and would rely on ETINCA's wet-testing all of the pumps.

5.2.2 Field Status

Messrs. Knight and Geller also inspected several field sites to ascertain the status of the installed pumps. Here the principal problems appeared to be lack of lubrication and consequent wearing out of pins and bushings at the pump's fulcrum linkages. Several other problems were also encountered (see Interim Report No. 48-1), and, upon returning to the foundry, they worked with the foundry management to correct them. Some standard pipe fittings were purchased for use as thread gauges to help correct this continuing problem.

5.2.3 Pull-Through-the-Base Pump

As of November 1980 not all of the ten test pumps had been installed for field testing of the PVC drop pipe. However, in a significant number of cases SESPAS was receiving reports that the PVC drop pipe was separating from the threaded/bell coupling at the pump base.

During the field trip Messrs. Knight and Geller helped the SESPAS crew install one of the pull-through-the-base pumps at a site selected by them near San Juan de la Maguana. In order to try to correct the separation problem, Mr. Knight had the crew add a six-inch length of two-inch diameter steel nipple at the pump base connection. This permitted the use of a PVC female adaptor which is much stronger (because of wall thickness) than the male adaptors previously used. Mr. Knight also had a stabilizer put on each 20-foot length of PVC pipe to keep the pipe from "whipping" in the well and creating stress-reversal-type weakening of the joint at the base. The ten pumps already installed were to be retrofitted with these modifications (see Appendix D) as there was a reason to pull them.

In preparation for the eventual large-scale installations of the pull-through-the-base pump Mr. Knight obtained from the plastics manufacturer samples of Schedule 40 PVC pipe and female adaptors to be used on the remainder of the ten test pumps. On behalf of SESPAS he also completed final arrangements for the tool and die made to make the mold for the plastic foot valve.

5.2.4 Maintenance Program

Mr. Knight discussed the maintenance program and job aid manual with Dr. Rivera and Mr. Casanova of SESPAS. Based on the results of these discussions, Messrs. Knight and Geller prepared a maintenance program procedure which, with some minor modifications, SESPAS and AID found acceptable (see Appendix E). SESPAS had the procedure translated and distributed to those responsible for maintaining the pumps.

5.2.5 Plastic Containers and Faucets

To assist the Mission, Mr. Knight assessed the progress of local manufacturers in developing the plastic faucets and check valves (see Items 2 of Cable S.D. 4238). To do this, several plastics manufacturers were visited to obtain information about plastic water containers for carrying water to the home and for storing it there. No information was obtainable, however, within the time Mr. Knight had been available.

5.3 Trip of April 1982

5.3.1 General

The second trip under OTD 48 was made by Mr. Knight between April 26th and May 1st, 1982 and was occasioned by continued reports of pumps malfunctioning in the field. The reports came both from the AID Mission and from two engineering advisors to the Dominican Republic in February and March 1982 under OTD No. 48. The purpose of Mr. Knight's trip was to continue to carry out the overall scope of work of OTD 48 and to give special attention to the following:

1. Assuring that the pins and bushings complied with the pump specifications and assist SESPAS in establishing an acceptance/rejection procedure for the pins and bushings;

2. Arranging to start production of foot valves and roboscreen;

3. Reviewing the procedure for constructing concrete aprons for pump installations so that the aprons will comply with the specifications;

4. Repairing and/or verifying that they have been repaired any broken PVC drop pipes for the modified pumps installed in the Spring of 1982;

5. General troubleshooting and making appropriate recommendations for pump manufacture, quality control, product acceptance or rejection criteria, and pump installation, operation and maintenance.

5.3.2 Pins and Bushings

As a result of this visit, it was found that the pins and bushings, which form the wearing hinge points for the three fulcrum linkages, continued to be the source of a major problem with the ETINCA pump. Revision of the contract

drawings found that the dimensional tolerances allowed for would permit bushings to comply with specifications and still be too large or too small in diameter to be press-fitted into the holes specified for the cast iron components (pumpcap, fulcrum, sliding blocks, rod end, and handle). To further complicate matters, it was found that the pins and bushings were not being manufactured by ETINCA. They were supplied to SESPAS by MITOVECA for supplying to ETINCA. A later investigation found that MITOVECA had not used correct procedures in purchasing these materials. In addition, when ETINCA tried to install the bushings supplied they found that many could not be press-fitted into the size holes which ETINCA was supposed to drill and that the bushings were concentric. On further investigation, it was also found that the pins and bushings did not comply with hardness specifications. (The pins were supposed to be Rockwell "C" 40 and the bushings Rockwell "C" 60. The pin, which is more easily replaced, was supposed to be softer than the bushing, so it would wear out before the bushing.) It was found that the pins and bushings being supplied by MITOVECA did not even approach the hardness requirements. In fact, the mild steel used to make them was so soft that its hardness could be measured only on the Rockwell "B" scale.

Rather than hold up production, ETINCA had decided to accept the defective pins and bushings from SESPAS. This has resulted in pins and bushings wearing out rapidly in the field and bushings falling out of the pumps.

During this trip SESPAS also authorized Mr. Knight to have TORNICA suspend production of pins and bushings until they could meet hardness specifications. Mr. Knight was also authorized to change the dimensional tolerance on the drawings so that the bushings could be pressfit into the pump.

In the meantime ETINCA itself had been contracted by SESPAS to manufacture pins and bushings to replace some lost or worn in the field and to provide a stock of spares. ETINCA used high-carbon steel for its product, which was expensive and difficult to machine, but they were much closer to the hardness specifications.

5.3.3 PVC Foot Valves and Roboscreen

Even though production of the PVC drop pipe pumps had been ordered in July 1981, manufacture of the PVC foot valves and roboscreens had not begun until April 1982. During Mr. Knight's visit, the order for making the injection model for the foot valves was placed, it was made, and fabrication of this item was started.

5.3.4 Well Aprons

While under OTD-1 Mr. Knight had found some problems with the quality of the concrete aprons being installed and their conformance to specifications, he did not see any defective aprons on this trip. When he discussed with SESPAS engineers the problems that had been observed in February and March, they indicated some modifications in the standard apron. They indicated the measures they were taking to correct the problems. Mr. Knight helped them to plan future activities.

5.3.5 Pull-Through-The-Base Pump

All seven of the test pumps that had been installed up to that time had steel nipples and stabilizers on the drop pipes and were reported to be working well. One of them was pumping from a depth of 95 feet and was said to be very easy to operate. The first pump that was installed with the steel nipple and stabilizer in November 1981, was working well and had had no problems. Several people said that the users and installers liked the pull-through-the-base pump.

5.3.6 General Troubleshooting

There were several indications during this visit that the handpump component of the project was being managed more carefully. SESPAS was continuing to wet-test pumps in its storage yard, and ETINCA was using better quality leather for cups and standard plumbing fittings for thread gauges. The result was an improvement in the quality of the pump being produced and a reduction in the number of defective pumps reaching the field.

Most of the pumps seen in the field during this trip were working well, but there was ample evidence that the pumps were not being lubricated. This pointed to the need for better community promotion, training of village maintenace people, and supplying them with grease in order to prevent the eventual breakdown of the pumps. In some cases, missing or broken parts had not been replaced or repaired pointing to the need for SESPAS crew to back up routine maintenance and repair efforts.

As problems with pump manufacture, installation, or operation often ocrurred between the scheduled trip of the WASH consultant, he often found himself spending a lot of time helping to resolve crises rather than being able to be involved in helping to set up the long-term maintenance systems that were needed.

5.3.7 Maintenance Manual

It was arranged for Dr. Herrera, Director of SESPAS, to give Mr. Knight a copy of the operation and maintenance manual for his review before he returned to the United States, but he was not able to deliver it before Mr. Knight left the Dominican Republic. This was delivered later to WASH by Dr. Rivera.

5.4 Trip of June 1982

5.4.1 General

In May 1982, a WASH consultant provided technical assistance to the Mission and SESPAS in the areas of hydrogeology and well-drilling, to accelerate the well-drilling operations and to reduce the number of dry holes being drilled. The findings presented in the consultant's report (WASH Field Report No. 50) along with continued reports of problems with the pumps in the field occasioned the third trip under OTD 48, which took place between June 6th and 12th, 1982. The purpose of the trip was to evaluate the administrative, management, and organization aspects of the HSL II Project as they affected the handpump component and make appropriate recommendations for improvement.

Four persons comprised the team which was led by Mr. Geller, a WASH sanitary engineer, and which consisted of Mr. Knight, Mr. Edwards (a WASH training, management, and institutional development consultant), and Mr. Donaldson, Associate Director of WASH. The team reviewed the goals, identified problem areas, and developed and recommendations for the following ten areas of the project:

1. Production of wells
2. Production of pumps
3. Acceptance of wells
4. Acceptance of pumps
5. Distribution of materials for well installations
6. Distribution of materials for pump installations
7. Community promotion related to pump installation, operation, use and maintenance
8. Installation of pumps
9. Maintenance of pumps
10. Administrative structure as it related to all of the above.

The activities of this team are described in considerable detail in WASH Interim Report No. 48-3 and will not be repeated here. Appendix F presents the executive summary of the report as well as key figures and tables. Appendix H presents the report's recommendations along with the status of their implementation as of October 1982.

The principal findings of this trip were twofold: (1) the process of obtaining a finished pump involved the management of at least five different contractors under at least seven different contracts (see Table 1, Appendix F) and (2) the lack of clearly defined roles led to people trying to do too much themselves rather than planning, defining, analyzing, and assigning roles and tasks and then collaborating to carry them out. Recommendations were made to help SESPAS and the Mission deal with these problems.

5.4.2 Pins and Bushings

During his trip Mr. Knight found that the hardness of the pins and bushings was greatly improved, although it still did not comply with specifications. After visits to both, TORNICA and ETINCA, recommendations were given to the Mission for action to be taken regarding this problem (see Interim Report No. 48-3).

5.5 Trip of October 1982

5.5.1 General

The fourth and last trip under OTD 48 was made by Mr. Knight between October 17th and 26th, 1982 and was occasioned by the need to update information on the status of the pump component of the HSL II Project so that AID/Washington could review the project as part of their plan for a new project, HSL III. Specifically, Mr. Knight was asked to give special attention to the following three items:

ERRATUM

p. 15, first sentence: Four persons comprised the team which was coordinated by Mr. P. Howard.

1. Review manufacturing process of foot valve and strainer;
2. Follow-up on quality control procedures recommended by the WASH team in June 1982;
3. Review manufacturing and acceptance process for pins and bushings.

Mr. Knight's trip report is presented in Appendix G, the highlights of which are discussed in the following paragraphs.

5.5.2 Foot Valve and Strainer Assembly

Mr. Knight found that the foot valve mold, which had been made by one manufacturer and was to be used by another, had to be modified in order for the valve seat to fit more easily in a standard two-inch PVC coupling. He also established a foot-valve rejection criterion (i.e., if a valve leaked more than 15 milliliters per minute it was not acceptable).

Mr. Knight set up the broaching and slotting equipment for the pump strainer at the same factory that was making the foot valves (i.e. TMP). Although the broaching device was originally designed to be operated manually, Mr. Knight arranged for it to be powered mechanically because of the large quantity of strainers that had to be made.

5.5.3 Pins and Bushings

While the hardness of the pins and bushings continued to improve, the pins averaged only C-26 and the bushings C-42. Another problem had developed, however, with the spacing of the cotter-pin holes in some of the pins, but ETINCA resolved the problem easily and provided SESPAS with test gauges for use in accepting or rejecting the pins.

5.5.4 PVC Drop Pipe Pump

By the time of this mission SESPAS had received about 200 PVC drop pipe type pumps from ETINCA and had installed about 40 in the field. Several of these modified pumps were found to be not operational. On investigating one of the pumps that had been installed at Haina, about 15 miles west of Santo Domingo, it was found that it had failed three days after it was installed. The drop pipe was 180 feet deep and the water level was 160 feet below the ground. It was found that failure was due to separation of the drop pipe at a joint where the pipe had been only partially inserted into the bell of the next length of pipe. As a result of this experience, the installation crew began marking each pipe length into inches from the plain end and inserting the end into the bell far enough so the mark could not be seen.

Mr. Knight helped the installation crew repair the pump at this site. In January 1983, however, it was found that the pump had broken down again five days after it was repaired, but the cause was not known.

5.5.5 Field Installations

Conditions in the field seemed to have improved substantially since the WASH team had visited in June, although some pumps still showed inadequate lubrication. All pumps inspected were working. Apron construction was greatly improved and now appeared to be complying with the specifications. One of the problems encountered in several communities, however, was the fact that children were throwing sand and pebbles down the well through several openings in the pump (pump-rod hole, spout, etc.). It was found in April 1983 that this was contributing to several pumps being reported as out of service.

5.5.6 Implementation of Recommendations of Interim Report No. 48-3

Appendix H presents the responses of the AID Mission to the recommendations made in WASH Interim Report No. 48-3. Most of the recommendations were being implemented or plans were being made to implement them. It was said that the remaining changes would be made in August 1982 after a new government administration took over and facilitated the implementation of the recommendations.

Chapter 6

SEQUEL

In January 1983, a four-person team visited the Dominican Republic as part of a world-wide technical/managerial review by AID of its handpump program. The conclusions of one of the team members are presented in Appendix I.

As a result of this visit, and because so many of the PVC drop pipe pumps were reported as being "not operational," a two-person team from the Georgia Institute of Technology visited the Dominican Republic in April and May 1983, to conduct a detailed inspection of the pull-through-the-base pumps that had been installed in the field. The purpose was to find out why the pumps were not operating and recommend measures to correct the problems. The team's findings and recommendations are presented in WASH Field Report No. 98, the text of which is presented in Appendix J.

The team found that 53 percent of random sample of 60 pumps of this type of pumps were non-operational (versus only 37 percent of the non PVC drop pipe pumps) at the time of a visit. Pages 8 and 10 of Field Report No. 98 (Appendix K) show the types of problems that were found to have caused the pumps to fail. Although some of the problems reflected inadequate quality control in the manufacture of the pump, the major problem appeared to be due to improper installation and/or design problems which allowed users to insert foreign objects into the drop pipe thus jamming the foot valve. These findings demonstrate the need to: 1) review the present pump design, 2) examine the desirability of replacing the PVC drop pipe and foot valves with metallic materials, 3) provide better training for the installation crews, and 4) implement a rigid inspection and acceptance procedure for pump manufacture and/or installation.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 General Comments

This chapter summarizes the major lessons learned from the efforts of this OTD. For details of conclusions and/or recommendations, the reader should refer to the three Interim Reports (T-48-1; T-48-2; and T-48-3), as well as the Final Reports for OTD-1, OTD-84, OTD-97, OTD-113 and OTD-143.

Additional information concerning this handpump program can be found in WASH Field Report No. 76 and 98.

In general, it can be said that the handpump element of the Health Sector Loan II Project was well conceived and, when compared with many comprehensive rural development projects in developing countries, is being reasonably well executed. Project personnel have been quick to recognize when external assistance was needed and have made an effort to change their program to improve its chances for success.

Although the project has encountered problems, it has shown steady improvement in dealing with them but improvements are still needed if the benefits of the project are to be long lasting.

7.2 Quality Control for Handpump Manufacture

The implementation of quality control, testing, and acceptance procedures seems to have resulted in improvements in many areas of the HSL II handpump project and have lessened field problems. These procedures should be continued, and project management should be attentive to other areas in which such procedures may help avoid or at least lessen problems.

7.3 Recommendations of Interim Reports

The Interim Reports issued under OTD 48 contain many recommendations most of which have been and/or are being implemented. Project personnel should continue to implement these recommendations as well as those made by other WASH teams that have assisted the HSL II Project.

7.4 Training Pump Installation Crews

Many of the problems being encountered with the pumps in the field are due to improper installation. Therefore, it is recommended that a unit in SESPAS should be established for the continuous training of the pump installation crews and village workers.

Among the wide variety of subjects that this training should cover are:

- How to train community maintenance persons;
- The procedures for handling and joining galvanized iron pipe;

- The procedures for installing handpumps using SESPAS equipment;
- The program elements for providing back-up to community handpump workers.

7.5 Inspection and Acceptance of Pump Installation

As was recommended in Interim Report 48-3 (See Appendix H) SESPAS should establish procedures requiring supervising engineers to inspect and formally accept pump installations until it is found that the installation crews are working satisfactorily. At that time, SESPAS staff should continue to conduct spot checks as a quality control measure.

7.6 Community Involvement

The length of time that the handpumps will continue to benefit rural communities is most influenced by the extent to which the people in these communities take an interest in keeping the pumps maintained and operating. The present work of the UTOC team will help to increase community awareness and involvement in the project, but, to help ensure the desire continuity of service, the local maintenance person should receive periodic training in SESPAS procedures. This continuous effort will also help to ensure that the local person knows where to go for assistance when problems exceed their limited capacity.

7.7 SESPAS Backup of Community Efforts

The primary focus of HSL II and SESPAS efforts is to try to involve the communities in the various aspects of the handpump program (i.e. site selection installation, maintenance, and repairs). To do this, it is necessary that SESPAS develop and maintain a spare parts logistics system that will deliver such diverse items as grease and replacement bushings to the community workers on a regular basis.

This system should also serve as a "feedback" channel to alert SESPAS staff on the types and frequency of back-up that should be provided to the communities to help them solve the problems that are beyond their usual resources.

7.8 Technical Assistance by WASH

The various types of problems identified and the length of time that is often required to design and implement corrective procedures highlighted the need for constant communications between all concernd (i.e., SESPAS, USAID/DR, S&T/H/WS and WASH) in order to identify problems and possible solutions at the earliest possible time.

7.9 Need for Trained Staff

Executing a project such as HSL II is often difficult enough in an urban setting where resources and skilled personnel are usually more readily available. It seems to be common, though, that such projects are attempted in the much larger rural areas with less money and less skilled personnel than would be

allocated for similar urban projects. Experience shows, however, that rural projects are quite complicated and troublesome to execute because of difficulty of access, lack of data and experience in working in rural areas, and a natural communication and cultural barrier due to the differences in experience, attitudes, beliefs, and expectations between rural and urban people. The experience of HSL II indicates that whether such projects are to be executed directly by the government (as in the case of HSL II) or by a contractor on behalf of the government, human, financial and material resources have to be identified and staff trained to carry out the multitude of tasks in this type of program. Ensuring the timely training and positioning of the needed human resources is probably one of the most critical and difficult elements of the HSL II effort. Figure 4 should help to visualize the types of resources needed and their timing.

Figure 4

Components of a Handpump Program

Well Construction Program

Phase	Planning and Design	Procurement	Manufacturing	Installation[1]	Maintenance[2]
Tasks	Marketing Study Assess Technical Feasibility Institutional Assessment Data Collection Evaluation of Alternatives Cost Analysis	Plans Specifications Bid Documents Contracts Qualification and Selection of Bidders	Management Training Managers, Technicians, Laborers Production Quality Control Quality Assurance Inspection Acceptance by Purchaser	Management Training Managers, Technicians, Laborers, Promoters Community Participation Organize Crews Logistics Warehousing Transport and Distribution of Materials	Management Training Managers, Technicians, Laborers, Promoters User Education and Motivation Spare Parts & Supplies Community Lubrication Community Maintenance Troubleshooting and Feedback
	TEAM		LEADER		
Skills	Marketing Industrial/Mechanical Engineering Sanitary Engineering Planning	Contracting Project Engineering Sanitary Engineering (rural water supply) Mechanical Engineering	Management HRD[3] Foundry Operation Machine Shop Operation Quality Assurance/ Control	Management Community Participation Promotion HRD[3] Sanitary Engineering	Management Community Participation HRD[3] Operation and Maintenance
Distribution of Technical Assistance	8%	24%	20%	20%	28%

1. Installation starts before manufacturing process is complete.
2. Maintenance starts before installation process is complete.
3. HRD = Human Resource Development

Appendix A

Summary of Changes Recommended by Mr. R. Knight To Adapt the Conventional AID-Type Handpump to One Using PVC Drop pipe

A SUMMARY OF CHANGES IN THE AID HANDPUMP IN THE DOMINICAN REPUPLIC

In October 1980 it was recommended that the bolt holes in the pump base be increased to at least 9/16" diameter to facilitate mounting the base to the concrete pedestal.

The next change, or changes, followed a meeting in February 1981 at the USAID Mission in Santo Domingo with representatives of both SESPAS and AID (WASH Field Report No. 20, pp 15). The idea of changing to a 2" PVC drop pipe and eliminating the cylinder, part of the drop pipe would be the cylinder, was presented by Knight. The idea was to make down hole component repairs as replacement easier. It would be possible to remove the plunger by removing the pumpcap and withdrawing the pumprod and plunger up through the drop pipe and the pump body (see Figure 1).

The only changes required in the basic pump would be to increase the size of the thread for the drop pipe from 1 1/4" NPT to 2" NPT and increase the neck of the base from 2 11/16" to 3 9/16" to maintain the wall thickness. It was pointed out that if the idea of the plastic drop pipe failed, a 2" x 1 1/4" bushing in the pump base would bring us back to where we were.

The other change would not affect the pump if it were to be used in a conventional installation.

This change involved extending the outlet by 1 1/2" and including a 1 1/4" female pipe thread to accept a bushing and nipple to reduce the outlet diameter to 3/4" (see drawing 102). This was to facilitate the filling of small mouth water containers.

In March 1981 I fabricated 10 PVC check valves (see Figure 4). With 2" PVC couplings, and caps, and 10-6" lengths 2" Roboscreen I made up 10 check valve and strainers assemblies, to be used in the 10 pump test program. I also conducted tests on PVC solvent welded pipe joints. For results see Figure 2.

In the meantime, the people at ETINCA were preparing 10 of everything we needed for the 10 pump pilot testing program (pp 17 WASH Field Report No. 20).

As the effective cylinder diameter was to be reduced from 2 3/4" to 2", the plunger parts had to be reduced accordingly (see drawings 111, 112, 113, 115 and 118).

At this time it was decided to increase the pumprod diameter from 7/16" to 1/2" in order to bring it in line with updated drawings.

Installation of the 10 test pumps began in April 1981. There was a measure of success, but one problem had to be overcome.

The standard 2" male thread to 2" female socket adapter failed on several of the pumps.

In November 1981 Knight recommended discarding this adapter and used a steel nipple, then a female thread x female socket PVC coupling to connect the drop pipe to the pump base.

This change plus the addition of plastic stabilizers (see Figure 3) has been very successful. One pump with such changes has been in operation for more than a year to date.

The change recommended in June 1982 was to further increase the diameter of the bolt holes in the pump base to 5/8".

The change has been implemented successfully.

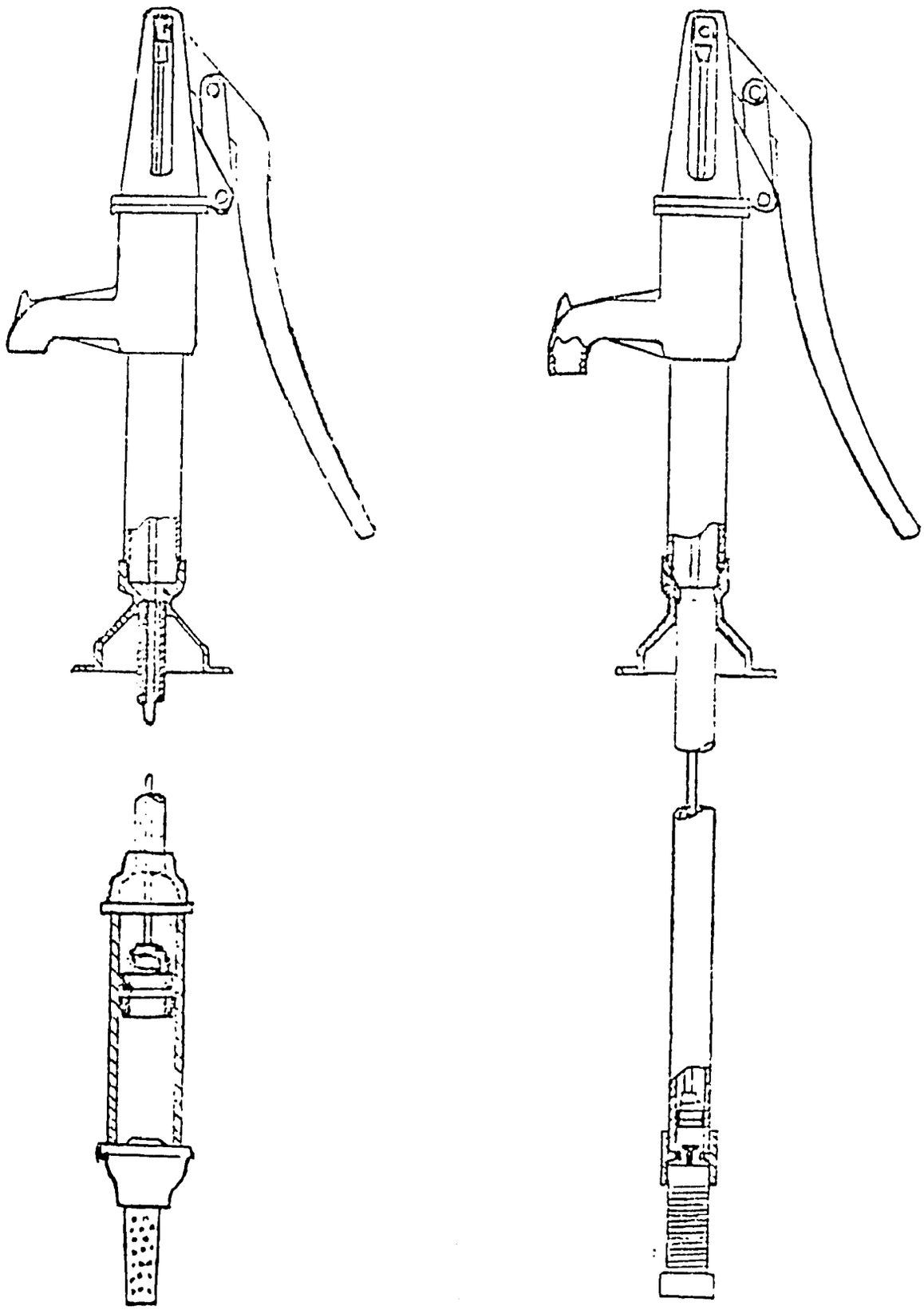
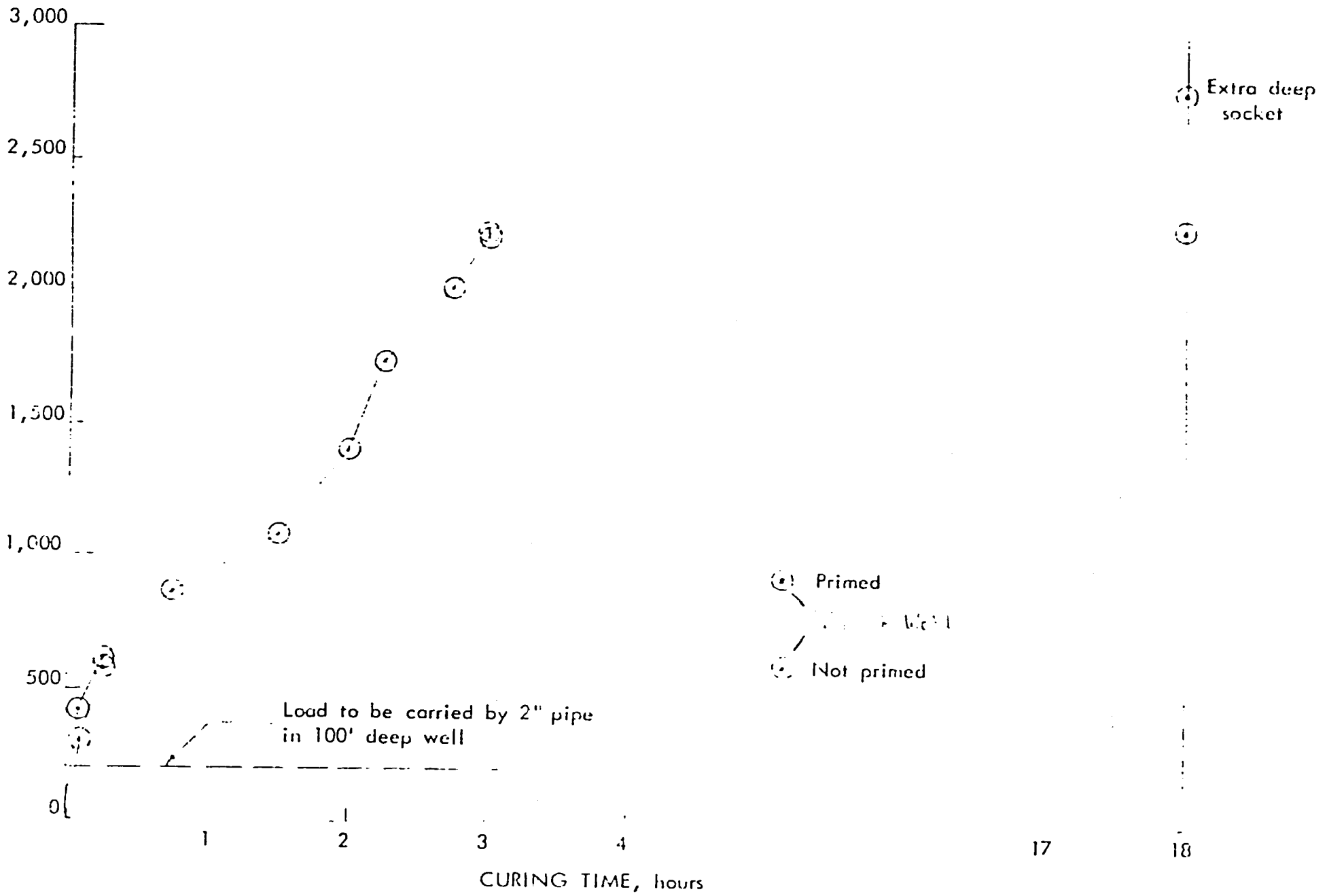
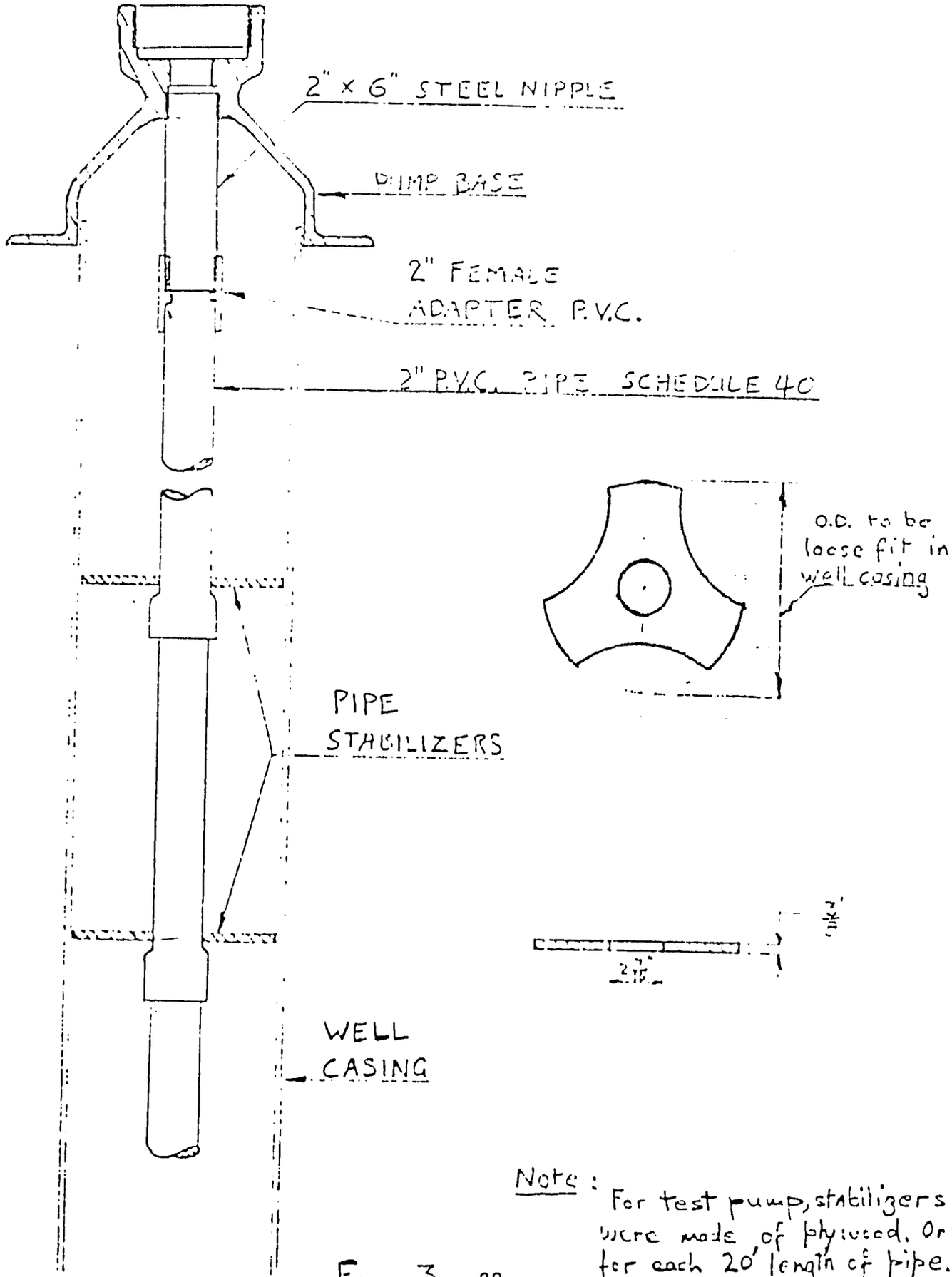


Figure 1

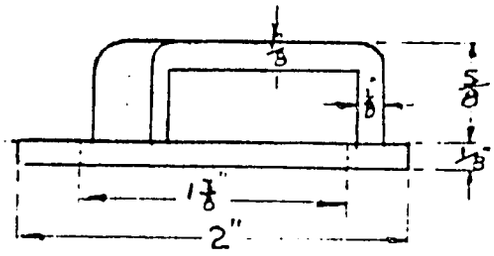
Proposed Changes in Current Pump Design

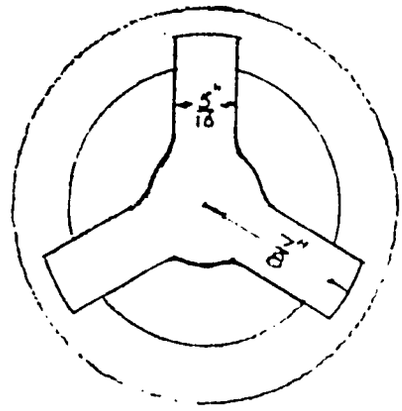

3,000
2,500
2,000
1,500
1,000
500
0
LOAD, pounds
Load to be carried by 2" pipe in 100' deep well
1
2
3
4
17
18
CURING TIME, hours
Extra deep socket
Primed
Not primed

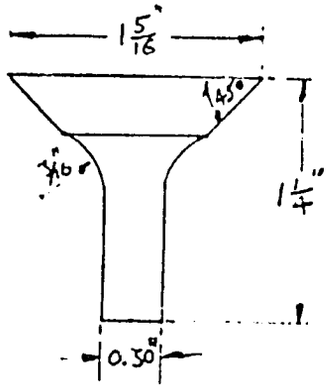


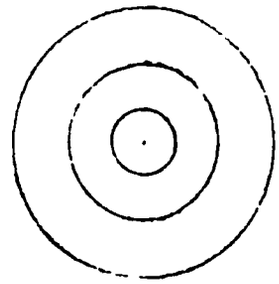
Note: For test pump, stabilizers were made of plywood. One for each 20' length of pipe.

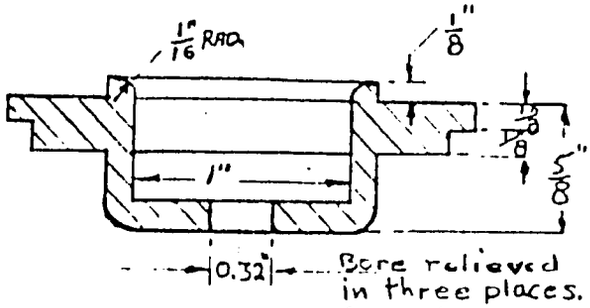
Fig. 3

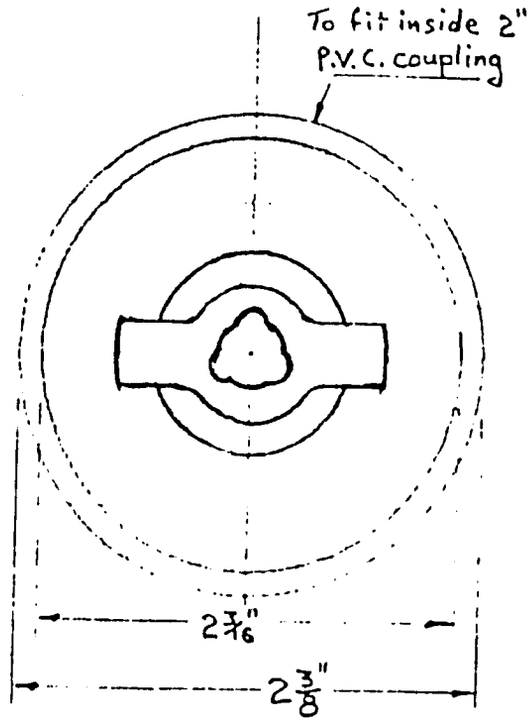












All unmarked radii should be 1/16".

Fig. 4

Appendix B

Quality Improvement Program
Proposed by Mr. R. Knight

Etinca Equipo Tecnico Industrial, C. por A.
CONSTRUCCIONES DE EQUIPOS Y MAQUINARIAS
CALLE SAN JUAN DE LA MAGUANA 102
TEL. 566-8776 APTDO. No. 158-12
VILLAS AGRICOLAS, STO DGO. R.D.

Del escritorio de:

13 de noviembre de 1981

RECOMENDACIONES A TORNEROS Y DEMAS TECNICOS

1-HACER ROSCAS EN TORNOS

2-RECTIFICAR ROSCAS CON MACHOS

3-METER MACHOS UN 60%=1 1/16 APROXIMADO

4-LARGO DE LA ROSCA 1 1/4 APROXIMADO

5-NO MAQUINADO PIEZAS DEFECTUOSAS

6- NITIDEZ EN EL TERMINADO DE LAS PIEZAS

7-SELECCION ZUELA (PIEL) 1ra. CALIDAD

8-ESPESOR ZUELA PREFERIBLE 7/32" 6 1/4 PARA COPAS

9-ACERO PARA CASQUILLOS 50-54 R.C. APROXIMADO

10-ACERO PARA EJES 40 R.C.

11-OBSERVAR LAS BARRENAS QUEDEN EN SUS MEDIDAS Y DISTANCIAS

12-HACER ROSCA EN UN EXTREMO DE VARILLA 1" LARGO

13-LA ARANDELA DEBE SER DE BRONCE

DEPARTAMENTO TECNICO
AR. FREDDY FERNANDEZ

Appendix C

Pump Testing Procedure
Proposed by Mr. R. Knight

November 13, 1981

PUMP TESTING PROCEDURE

A. Deep Well Cylinders

The deep well cylinder can be tested if the leather cups fit loosely enough so that the pump rod can be moved by hand. If so, place the cylinder upright in a basin of water and test whether the cylinder pumps adequately. (Make sure that the leather cups are wet at the start of the test.)

Also, at the top of the pump stroke, pick up the cylinder to make sure that the foot valve is working. If the pump does not work immediately due to loose leather cups, set the wet pump aside for about 15 minutes (to let the leather expand). Then test the pump cylinder again.

During the test, make sure that:

1. The foot valve is working;
2. The plunger valve is working;
3. The leather cups are sealing adequately;
4. There are no leaks through the threads where the end caps screw on to the cylinder.

Also, visually check the threads on the ends of the cylinder and on the end caps. If they look suspect (too much thread exposed or poorly cut threads), test the threads with male and female gauges (standard pipe fittings).

B. Shallow Well Pumps

Test the shallow well pump by attaching a 4" threaded steel nipple in the pump base (wrap teflon tape around the threads on the nipple to get an air-tight seal). Then place the pump in a basin of water and test it. (Make sure that the leather cups are wet at the start of the test.)

During the test, make sure that:

1. There are no leaks through any of the threads which pass water and/or air;

2. The threads in the base are pesent and are adequate (based on attaching of steel nipple);

3. The pump discharges a reasonable quantity of water.

Also, while pumping water, stop the pump with the piston at the top of the stroke and leave it for a few minutes. Then resume pumping to see if water comes out immediately. If not, the foot valve is leaking.

Visually check the threads at the bottom and top of the cylinder. If a significant amount is exposed (1" or more at the bottom and 1/2" or more at the top), take the pump apart and test the threads using male and female gauges. Reject a component if the gauge does not fit properly.

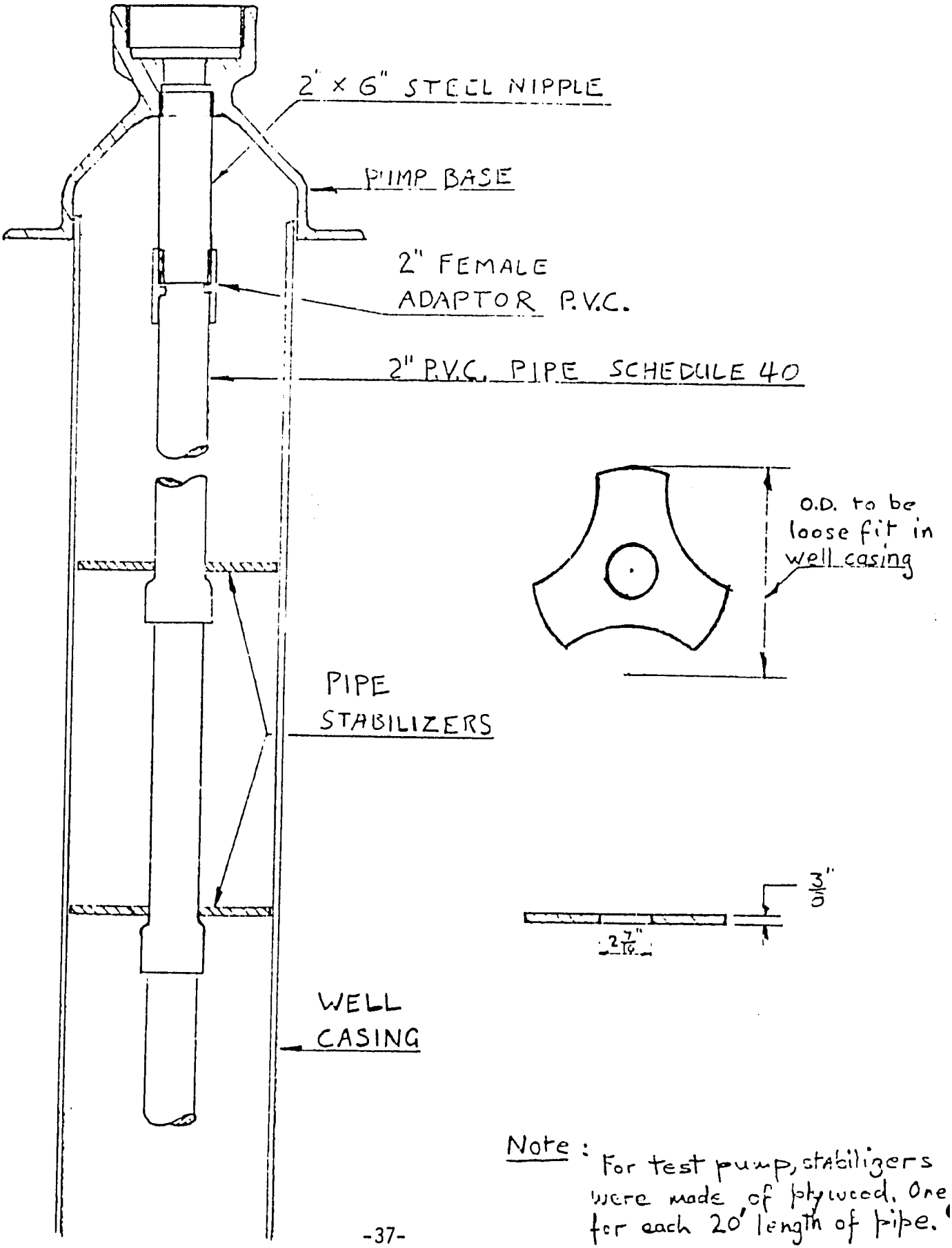
C. Modified Pumps

The piston assembly for the modified pump can be tested by placing the assembly complete with a short section of pump rod into a 2" PVC pipe. This pipe should have a foot valve attached at the bottom. The enclosed piston assembly is then placed in a basin of water to test its pumping capability.

Other components for the modified pump can be inspected and/or tested separately from the piston. The seal on the foot valve can be checked by filling with water. The threads on the pump body can be checked visually and/or using male and female gauges.

Appendix D

Modifications Proposed by Mr. R. Knight To Increase Strength Of Base Connection In Pull-Through-The Base Pump



Note: For test pump, stabilizers were made of plywood. One for each 20' length of pipe.

Appendix E

Outline of Handpump Maintenance Program

OUTLINE OF HANDPUMP MAINTENANCE PROGRAM

I. TRAINING

A. VISUAL AIDS

1. Technical repair manual for regional level technicians (under preparation).

   a) The format will be a ringed notebook so that pages can be added in the future as new designs are introduced.

2. Pictorial manual for local level maintenance persons.

3. Cutaway section of an actual pump (a rejected pump can be used).

4. Samples of worn out components (cups, pins, bushings, etc.).

B. PROGRAM

1. Regional level technicians.

   a) Trained by SESPAS.

   b) Training may require a few days.

   c) Training involves disassembling pumps and making major repairs.

   d) Regional level technicians may be drawn from experienced pump installers.

2. Community level maintenance people.

   a) Trained by SESPAS and regional technicians.

   b) Training can take plase for one day at a regional center with a group trained at the same time.

   c) Community level maintenance people can be selected within their communities and should be a person with some mechanical aptitude.

   d) It may be possible to pay this person a small amount of money from the handpump fees collected by the local health committee. Also, the local maintenance person can be given a tittle, badge, etc. for prestige and to help motivate this person to carry out his (or her) responsibilities.

II. RESPONSIBILITIES

A. COMMUNITY LEVEL PERSONS

1. Responsibile for 10-20 pumps within the village.

2. Duties.

   a) Weekly lubrication.

   b) Visual inspection to make sure pump is working properly and to look for wear in pins and bushings and leaks in pump body.

   c) Change pins and bushings when necessary.

   d) Change cups on the shallow well pump and the modified pump when necessary.

   e) Repair cracks in the concrete support slab and patch minor leaks in pump body.

   f) Report to regional level technician when major repairs are needed.

3. In more remote areas, the community level maintenance persons may have to make (and be trained to make) more significant repairs.

B. REGIONAL LEVEL TECHNICIAN

1. Responsible for 50-200 pumps in a region.

2. Duties.

   a) Replace broken or worn out components such as handle, fulcrum, cylinder liner, valves, etc.

   b) Change the cups on the original deep well model.

   c) Seal leaky threads and pin holes in the pump body if necessary.

   d) Oversees and support the local maintenance persons in their region.

III. EQUIPMENT

A. TOOLS FOR THE COMMUNITY LEVEL PERSONS

1. Wrenches

   a) Pipe (stilson)

   b) 2 adjustable type

2. Pliers.
3. Hammer.
4. Pin punch.

B. MATERIALS FOR THE COMMUNITY MAINTENANCE PERSONS

1. Grease and oil can.
2. Pins and bushings.
3. Cups for shallow well and modified pumps.
4. Paint, caulk, cement.

C. TOOLS FOR THE REGIONAL LEVEL TECHNICIANS

1. Tool kit as per manual.
2. Plastic pipe cutter for modified pumps.
3. Chain wrench.

D. MATERIALS FOR REGIONAL LEVEL TECHNICIANS

1. Handles.
2. Fulcrums.
3. Pump cups.
4. Body and cylinder.
5. Bases.
6. Linkage at the top of the pump rod (Cabeza de varilla).
7. Lengths of pump rod.
8. Rod couplings.
9. Complete piston assemblies as well as piston parts.
10. Leather checks valves.
11. Plastic pipe.
12. Plastic pipe cement and cleaner.

13. 2" plasitc adapters.

14. Plastic strainers and check valve assembly.

15. Paint, caulk, cement.

16. Telfon tape and/or gasket cement.

IV. PREVENTATIVE MAINTENANCE

A. STORAGE

1. Keep pumps lubricated.

2. Cover pumps stored outdoors with a canopy or canvas cover.

B. INSTALLATION

a) Lubricate moving components during installation.

V. INFORMATION TRANSFER AND LOGISTICS

A. REGULAR VISITS OF REGIONAL TECHNICIANS TO PUMP SITES

a) Make sure that the pumps are working and are being cared for at the local level.

b) Provide the local maintenance persons with equipment when necessary.

B. EMERGENCY PUMPS FAILURES

1. Local persons contact regional technicians when serious failure occurs.

a) "Promotores" and other health committee persons can be used to carry information between local and regional levels.

C. RECORDKEEPING

1. Pump identification.

a) Location (village name).

b) Pumps numbered by location.

c) Date of installation.

2. Records kept by regional technicians.

   a) One page per year per pump.

   b) Same service information obtained verbally during the regular monthly visit of the technician to the pump sites.

3. Information on record.

   a) Amount of pump usage (approximate person-hours per day of pumping and number of people served).

   b) Pump discharge performance (qualitative or quantitative in terms of output per stroke).

   c) Date and type of repairs.

   d) Frequency and manner of lubrication.

Appendix F

Executive Summary, Figures and Tables
From WASH Interim Report 48-3
for June 1982 Visit

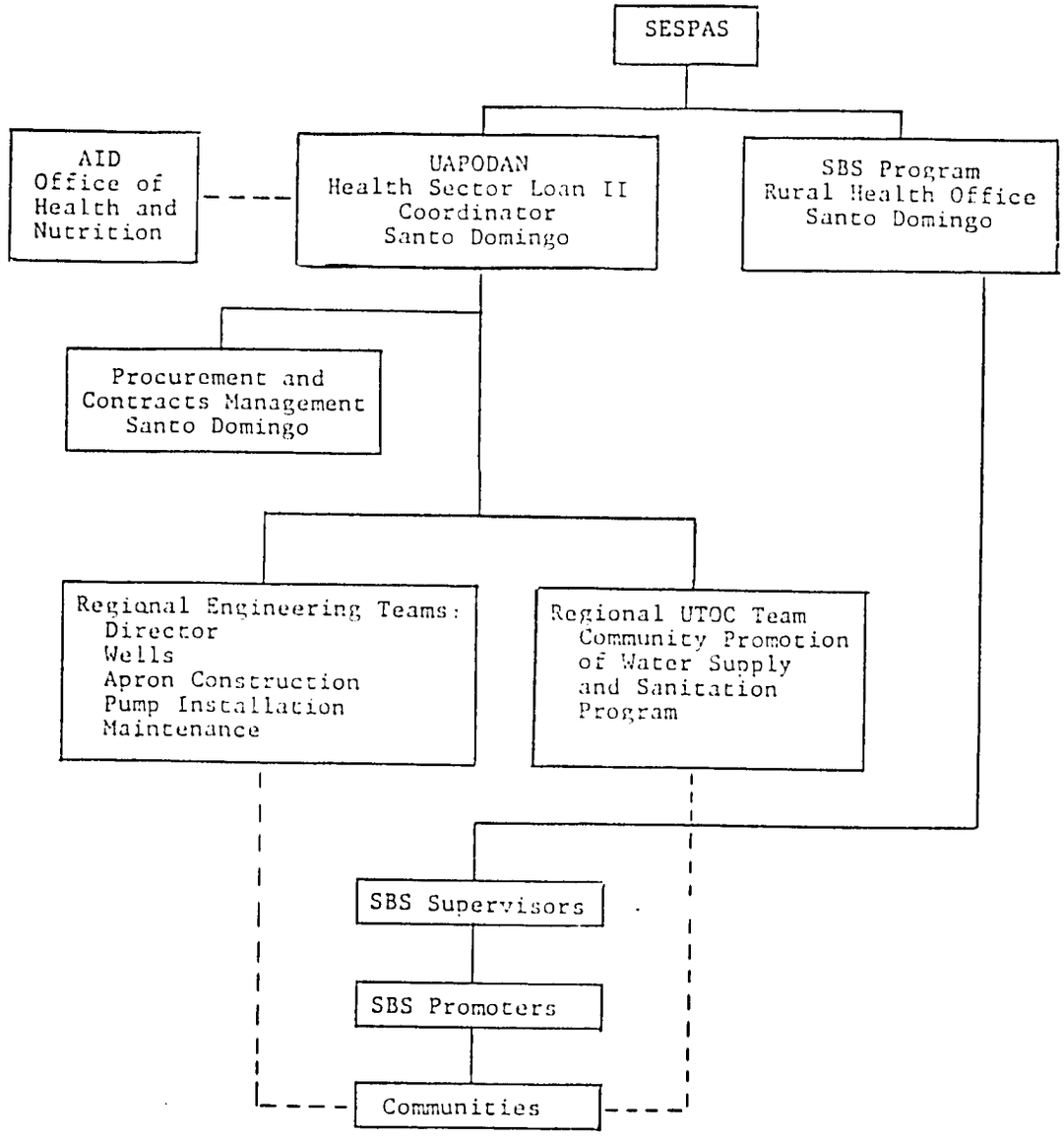


Figure 1

Existing Administrative
Structure

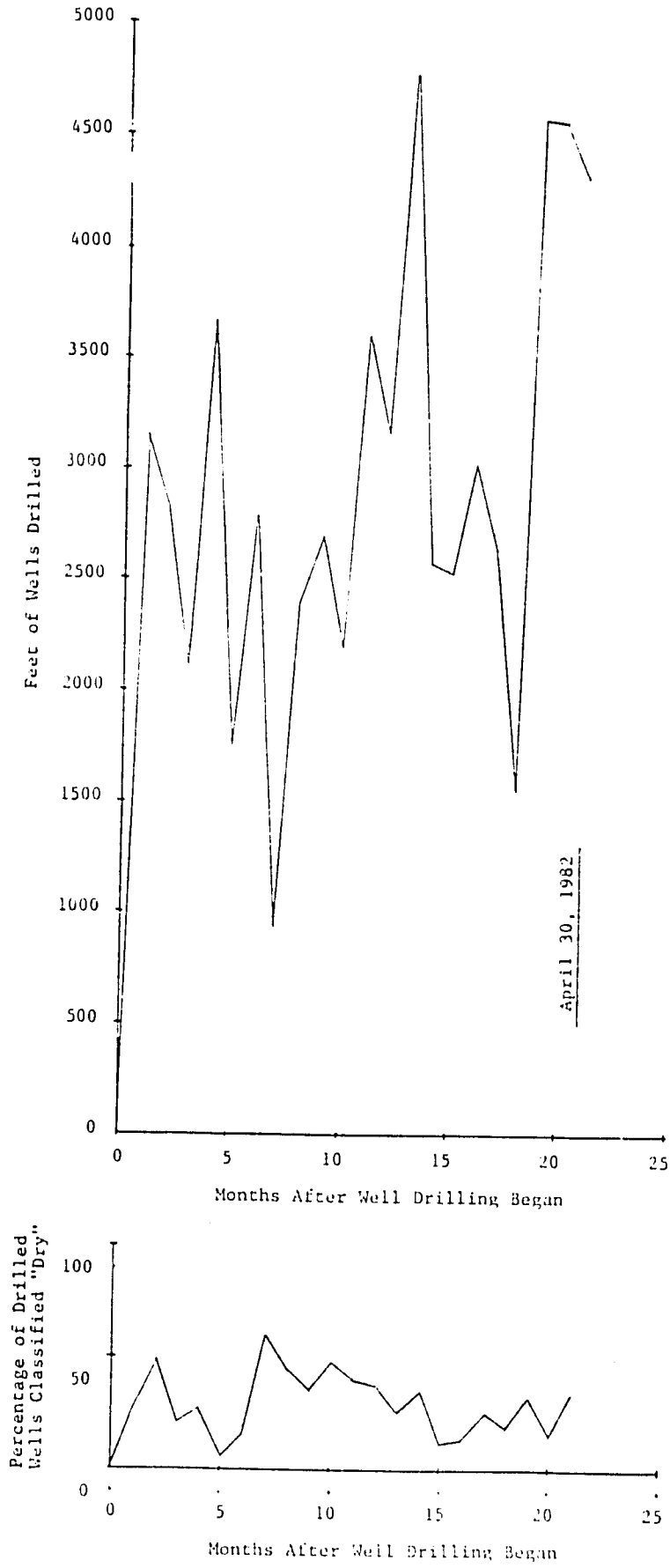


Figure 2

Monthly Progress of Well Drilling and Percentage of "Dry" Holes

Health Sector Loan II Project
Dominican Republic

Prepared by CDM-WASH Project
Based on Data from AID/Santo Domingo
June 1982

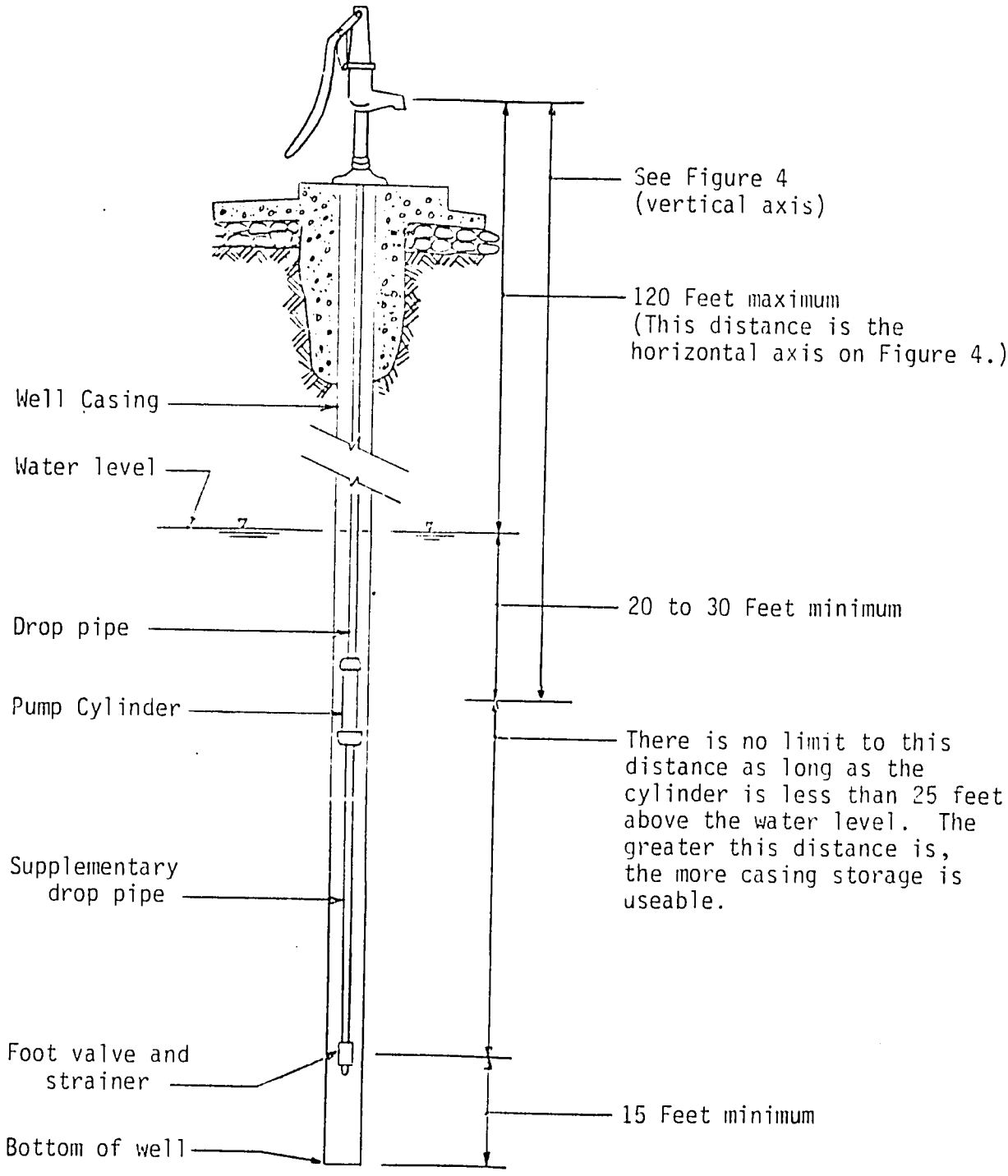
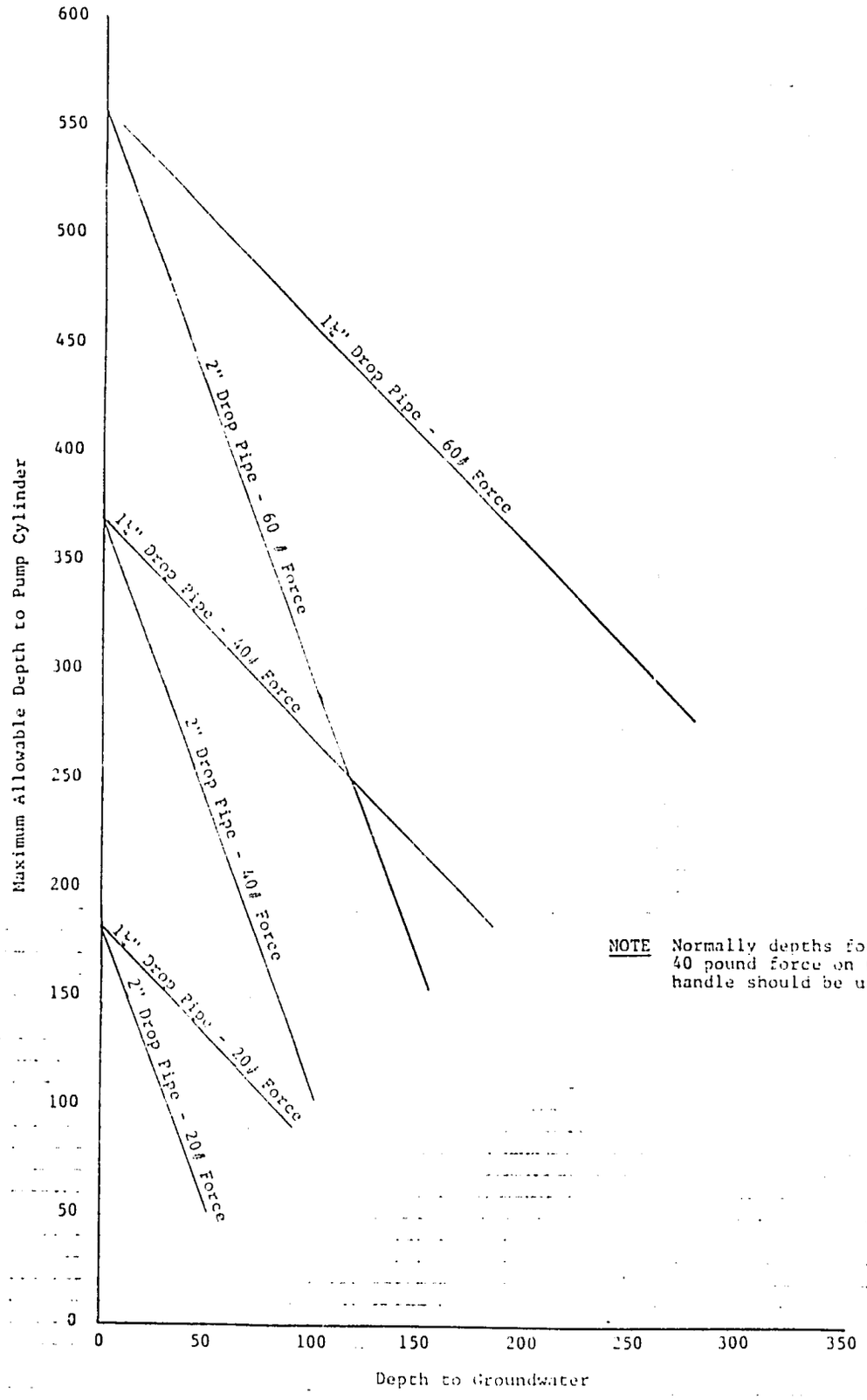


Figure 3

Depth Limitations for AID
Handpump Installations

CDM-WASH Project
June 1982



Figure

Depth Limitations for AID Handpump
Health Sector Loan II Project
Dominican Republic

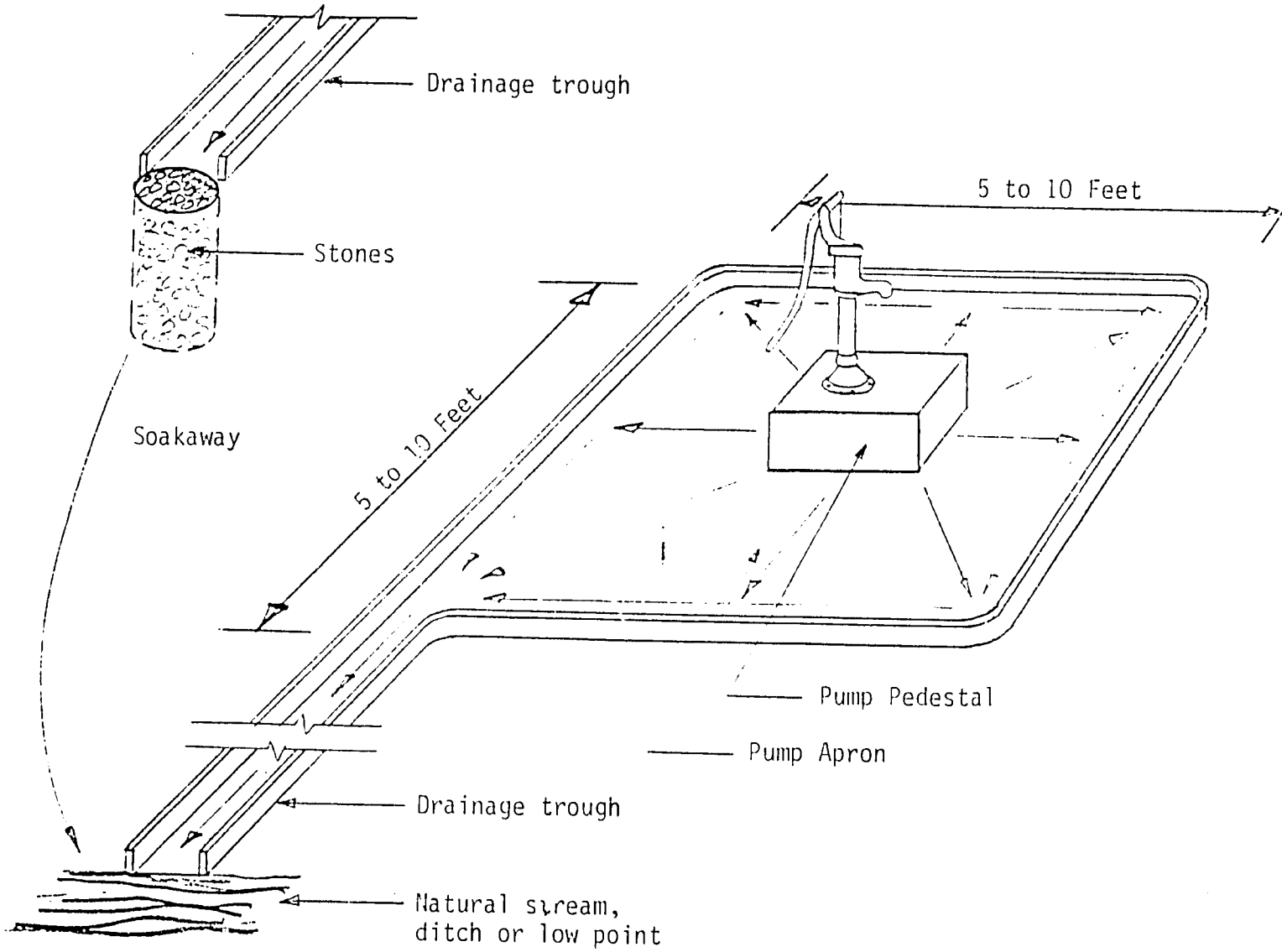
Prepared by CDM-WASH Project
June 1982

Pump Part	SESPAS Contract with:	Delivered to:	Delivered by UAPODAN, S.D. to:
Pump rod	United States or Dominican Republic Suppliers	UAPODAN, Santo Domingo	UAPODAN, Azua
Bolts	"	"	UAPODAN, Azua & ETINCA
Nuts	"	"	UAPODAN, Azua & ETINCA
Cotter pins	"	"	ETINCA
1.25"x0.75" GI reducers	"	"	UAPODAN, Azua
0.75"x2" GI nipples	"	"	UAPODAN, Azua
6"x2" nipple	"	"	UAPODAN, Azua
3" GI pipe (cylinder and pump body)	"	"	ETINCA
1.25" GI drop pipe*	"	"	UAPODAN, Azua
2.75" PVC cylinder liner*	"	"	ETINCA
Casting of cast iron parts	ETINCA, Santo Domingo	N/A	N/A
Leather cups	"	N/A	N/A
Plungers	"	N/A	N/A
Machining	"	N/A	N/A
Assemble pump stand	"	UAPODAN, Santo Domingo	UAPODAN, Azua
Pins and bushings	TORNICA, Santo Domingo	UAPODAN, Santo Domingo	ETINCA
GI couplings for pump rod	"	"	UAPODAN, Azua
2" PVC drop pipe	Associated Services of America, Inc., Coral Gables, FL	UAPODAN, Santo Domingo	UAPODAN, Azua
Mold for plastic foot valves	DIMECO, Santo Domingo	UAPODAN, Santo Domingo	Tuberias y Materiales Plasticos, Santo Domingo
PVC adaptors	Tuberias y Materiales Plasticos, Santo Domingo	UAPODAN, Santo Domingo	UAPODAN, Azua
Plastic foot valve and strainer assemblies	"	"	UAPODAN, Azua
Drop pipe stabilizers	"	"	UAPODAN, Azua

*These were supplied for the first pump order (for 1,000 pumps), which has been completed, but are not being supplied for the present order of 1,050 pumps.

Table I

Contracts for Handpump Production
Health Sector Loan II
Dominican Republic



Notes:
1. If it is not possible or convenient to drain the trough to a natural stream, ditch or low point, drain it to a soakaway, which is a hole filled with stones.
2. It is important that apron drainage not be allowed to create mud or pools of water.

Figure 7

Pump Apron and Drainage Trough
(not to scale)

CDM-WASH Project
June 1982

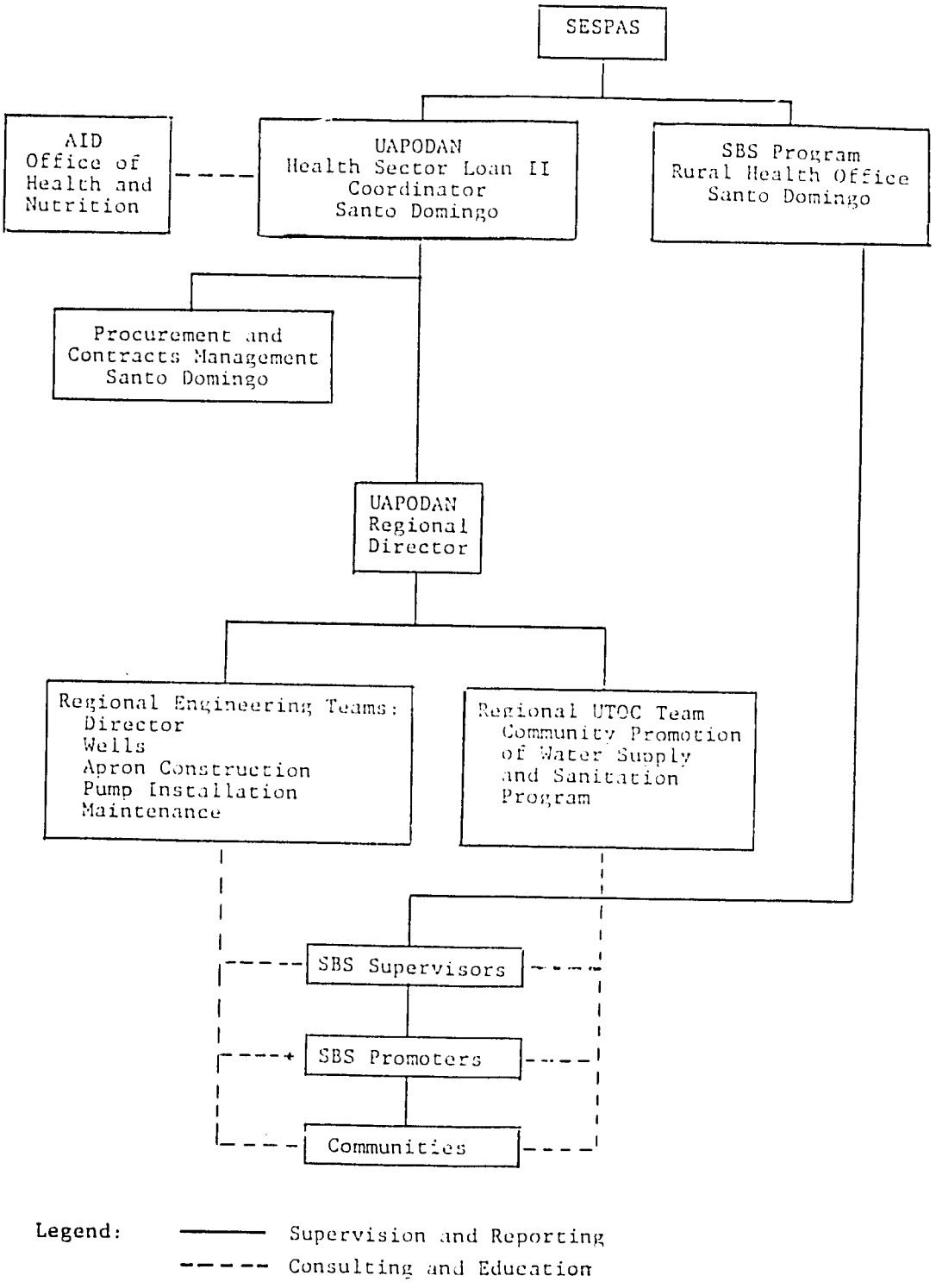


Figure 8

Recommended Administrative
Structure

Appendix G

Trip Report October 1982
By Mr. R. Knight

UNITED STATES GOVERNMENT

memorandum

DATE: October 26, 1982

FROM: Robert Knight, WASH Project

SUBJECT: Trip Report - Dominican Republic - October 17 - October 22, 1982

TO: Dr. Oscar Rivera Rivera, HAN

10/17 - Arrived at Santo Domingo Airport a little behind schedule. Had to take a taxi to hotel Santo Domingo Norte.

10/18 - After a brief meeting at AID office of HAN, Eng. Caba and I left for SESPAS. SESPAS has already taken delivery of approximately 200 pumps of the modified version.

It was interesting to note that a canopy had been erected for protection of pumps. I handed over to the person responsible for handpump acceptance, two desting devices. One for testing check valves, and one for testing plunger assemblies.

While there, I saw a sample of the plastic sabilizer for the 2" drop pipe.

Our next call was at ETINCA. Pins and bushings again was the topic of conversation. The distance between the holes in the pins on some of them was not within tolerance.

Unfortunately the error was mostly on the short side which made it difficult or impossible to install the cotter pins. Before leaving, Freddy Hernández offered to make gages to check the hole positions on both long and short pins, and give the gages to Manuel Cassanovas at SESPAS in order that the pins may be checked before acceptance.

At Tuberías y Materiales Plásticos, we talked with Sra. Pannochia, mother of Orlando Pannochia. Orlando was still in the US so we could not meet with him. She did however, set it up for us to work with the people in the machine shop next day.

We next visited DLMECO to discuss the possibility of modifying the check valve mold. The sample check valves were a little tight in a standard 2" coupling. This tightness could cause distortion which in turn could cause leaks.

The modification would not be a problem but Julio César wish to talk to the person in charge of the injection molding before making any changes.

We had with us samples of the pins and bushings and Mr. César tested the hardness of them for us. The pins averaged 26, and the bushings 42 on the Rockwell "C" scale. Still below the requirements of the specifications but a definite improvement.

10/19 - Eng. Caba and I went to Tubería y Mat. Plast. and took their truck over to ETINCA in order to pick up the broaching and slotting equipment and set it up in the machine shop of Tub.Mat. Plast.

Before setting up the broaching and slotting equipment I demonstrated the importance of resurfacing the check valve face and seat. First I leak tested a check valve that had not been machined. It leaked very badly. Then I set up the turning fixture, which I had brought with me, in a lathe. The ease with which the valves could be resurfaced was appreciated by the operator, and the difference in performance of the valve was obvious.

I recommend that any valve which leaks more than 15 ml. per min. should be rejected.

Some preliminary set up of the broaching and slotting was done. The slotting head was not compatable with the lathe and some modifications were required.

10/20 - A modified pump had been installed at Haina, a community about 15 miles west of Santo Domingo. This pump worked well for 3 days then failed. The failure was due to a poorly made solvent weld joint in the drop pipe.

We saw the drop pipe in the SESPAS yard. Where the joint had failed, the pipe had been inserted into the bell a mere inch or less. With the inside of the bell being slightly tapered, as is intended, this would provide a very weak connection.

A good lesson may have been learned here. When we next saw the installation crew in action, great care was taken to make a pencil mark on the pipe 2" from the end. The mark was not expected to be seen if the pipe had been inserted into the bell by the right amount.

After leaving SESPAS we picked up the check valve mold from Tub.Mat. Plas. secondary plant in Herrera and returned it to DIMECO for minor changes.

Thenwe returned to Tub.Mat.Plas. main plant in Santo Domingo to do further work on the broaching and slotting.

The broaching went well although the equipment was powered by hand. An unenviable task at best.

In the slotting operation, our second attempt was very successful.

Later at a meeting at SESPAS. I inquired about the status of the modified handpump to date. I was informed that approximately 40 pumps have been installed and 4 or 5 of them are down for various reasons.

SESPAS have now adopted the policy of installing the modified version of the handpump in wells that exceed 100 feet in depth.

10/21 - Today we planned a field trip. Sra. Altagracia Mesa, Eng. Caba, a WAPCDAN driver and I set off for San José de Ocoa, via Haina and Bani. Sra. Mesa was recently hired to head the UTOC team of health educators. Her interest in the potable water program prompted her to accompany us.

Our first stop was at Haina, the site of the pump which had suffered from a poor solvent weld joint. We told the villagers that we would likely return next day to re-install the handpump.

We continued on to Gualey and saw one of nine pumps in this community. It was working well but showed little sign of lubrication.

At Los Rochis we arrived in time to see a pump being installed. This pump was one with 7/16" diameter holes in the base which still presents an installation problem. Fortunately this problem will phase out as the bolt holes have been increased, first to 9/16" and now to 5/8".

I noticed a vast improvement in the concrete apron here. The pedestal was the correct height, and the apron sloped nicely down toward the drainage trough. This trough could have been longer, but when the pump was working, the villagers soon realized what was needed and set to work with shovels and hoes and extended the drainage ditch some distance from the well.

The practice of building a soakaway, as recommended by Mr. Howard, has not yet been adopted. I am told however, that this may begin next week.

At Las Tablas we visited a clinic which had a solar powered refrigerator. It worked very well. There was a drilling rig in action nearby. I noticed that the wells which had been cased were capped with steel plates welded to the casing.

At San José de Ocoa we visited a gravity flow system. It seems to be very successful. The users, of course, are very happy with it. We saw one pump here with a 180' drop pipe. The water table was 135'. It was performing well but like so many others, needed lubrication.

At Arrojo Palma we visited three pump sites. All three pumps were working but one of them was not being used because it was pumping muddy water.

Of all the pumps visited on this trip (15-20) every one was in working order.

10/22 - As promised, we planned to return to Haina today to re-install the hand-pump. First we had to go to Tub. Mat.Plast. A check valve/strainer assembly was fabricated in the machine shop and nine plastic stabilizers were made for us while we waited.

One stabilizer for each 20' length of drop pipe. The drop pipe was 180' long and the water table was 160' below ground level.

Equipped with all the parts we needed, we left for Haina where we met the installation crew. This was a two-man crew who relied on community participation, which was in abundance here.

Because of the length and weight of the drop pipe we increased the prime curing time for the solvent welded joints from 5 mins. to 20 mins. gradually as the weight of the pipe increased.

From this field trip I became aware of two requirements:

(1) I had several requests for some kind of gland or protector at the pump cap around the rod. It seems that there are problems with children stuffing sand and dirt down through the pump rod hole.

(2) A controlled method for bell ending PVC pipes in the field. A simple jig would suffice.

10/25 - Eng Caba and I visited INAPA on our way to AID to see what progress had been made with the office space being made available to SESPAS.

When we arrived at AID we went over the recommendations made in the WASH Field Report No. 50.

We also discussed with Dr. Herrera, the pin and bushing situation.

At Tub. Mat. Plast. I explained to the machine shop technician the set up for mechanically powering the broaching device rather than by hand. I could not demonstrate at this time as the thrust bearing had been damaged and I had to purchase another.

I was still unable to make contact with Mr. Orlando Pannochia although he is back in Santo Domingo.

We returned to the AID office and met with Dr. Rivera and John H. Thomas.

We had to return to DIMECO to transfer the check valve mold back to Tub. Mat. Plast. Further sample injection runs will be made.

10/26

To: Dr. Oscar Rivera Rivera, HAN

Ing. Ceba and I went to Tuberias y Materiales Plasticos at Herrera to see the samples of the plastic check valves which had been made in the morning. They were much better, but some were still a little tight in a standard 2" coupling. This was likely due to temperature control.

After lunch we returned to Haina to see the pump that we had reinstalled last Friday. It was working alright, but the well needed to be disinfected.

Next we returned to Materiales Plasticos plant in Sto. Dgo. to deliver the new thrust bearing for the broaching device to the machine shop.

Our last visit was to Etinca. We took back a broken pump plunger cage. Sr. Freddie Fernandez replaced it with a new one, and told his foundry man to strengthen the cage legs by increasing the inside radius.

Returned to A.I.D. Talked with Dr. Rivera and John Thomas.

Appendix H

Summary of Steps Taken to Implement the
Recommendations of Interim Report No. 48-3
As Reported by Mr. R. Knight to S&T/H/WS
In November 1983

DOMINICAN REPUBLIC

RESPONSES TO RECOMMENDATIONS

For

HANDPUMP OPERATION AND MAINTENANCE
(Interim Report No. 3)

JULY - NOVEMBER 1982

TABLE OF CONTENTS

RECOMMENDATIONS

RESPONSES

Production of Wells

1. Now that three additional drilling rigs are in operation, the production capacity for Region I is sufficient to maintain the schedule which UAPODAN has established for itself based on its operational experience. This schedule is at about one-half the pace foreseen in the project paper. UAPODAN should now make every effort to maintain that schedule. Given manpower and equipment, this is all that can be expected programmatically for that region. Overall acceleration of drilling will require starting in other regions and putting together new area teams. (See recommendations on administrative structure.)

1. With a total of ten drilling rigs now available, operations have now started in region 4. (Banica)

2. Design and implement immediately a training program for the technicians who work under the UAPODAN engineers in drilling wells and supervising well production.

2. Seventy-five villagers from three different regions have been trained.

3. Rotate the well technicians between contractors on a regular basis so that no one person is always inspecting the same contractor.

3. This practice has not yet been established.

4. Seek an agreement with INAPA for a practical training course for UAPODAN engineers in methods for locating wells and practical hydrogeology and well hydraulics.

4. Yes, an agreement has been sought and reached.

5. Drill deeper in order to increase well storage in "slow" aquifers, so as to provide sufficient water within the casing to keep pace with the pumping rate. Figures 3 and 4 show the depth limitations that apply. The height that the pump lifts water is equal to the distance between the spout of the pump and the water level in the casing, regardless of the depth at which the pump cylinder is set. The distance between the spout and the water level should not be more than 120 feet. The pump cylinder should be set 20 to 30 feet below the water level to allow for drawdown and at least fifteen feet above the bottom of the well to prevent soil, which might enter the casing, from intefering with the operation of the pump cylinder. Additional drop pipe can be used between the pump strainer and the cylinder to make more effective use of the casing's water storage capacity without adding to the weight of pump rod that has to be lifted during pumping. In no case, however, should the pump strainer be less than fifteen feet above the bottom of the well.

5. A positive yes to everything in this recommendation, with the exception of two well sites where the water table is approximately 160' below the ground surface.

RECOMMENDATIONS

RESPONSES

Production of Pumps

1. The contract with the foundry specifies on pages 44-45 that the foundry is responsible for assembling and turning over to UAPODAN a complete pump which meets all technical specifications (for all parts). Therefore, UAPODAN should designate a person charged with the responsibility of quality control relations with the foundry and enforce the contractual agreement. This person should be trained in quality control, perhaps in the U.S.

   1. Two people have been assigned this task. In Santo Domingo Manuel Casanova has this responsibility, and Dexter Giovanni is his counterpart at the Field Office in Azua.

2. The foundry should reject all parts it receives that do not meet specifications.

   2. The foundry is now doing this and in fact provided UAPODAN with gages to check hole dimensions and locations in the pivot pins, a number of which the foundry has already rejected.

3. Change the specifications for the dimensional tolerance of the bushings so that the foundry is required to press-fit them into the pump body. (See Appendix B.)

   3. The specifications have not yet been changed, but the foundry is now making the holes in the castings to accommodate the supplied bushings. (press fit).

4. Add to the specifications for the pins and bushings a tolerance for roundness and straightness (TIR, total indicator runout). (See Appendix B.)

   4. The recommended changes have been inserted in the contract to the suppliers (Tornica) of the pins and bushings.

5. Institute a random check procedure (two percent) of pins and bushings for hardness, dimensional tolerance and straightness.

   5. This is being done. The hardness testing is done at DIMECO.

6. Change the specifications so that the bolt holes in the pump base have enough tolerance to facilitate setting the base on the pedestal, as Mr. Knight has already advised SESPAS to instruct the foundry. (See Appendix B.)

   6. The guide bushings in the drilling jig used at the foundry, have been changed from 9/16" to 5/8" and the holes in the pump base are now being drilled 5/8". I witnessed a pump installation where the base had 5/8" dia. holes. It makes the operation much easier without sacrificing the strength of the base.

7. Do not change the bushings in the field. If they must be changed, remove the entire pump cap, replace it with a spare, and return the original pump cap to the foundry or other machine shop.

   7. This procedure is now being followed.

8. Implement recommendations made previosuly by Mr. Knight. (See WASH Field Report No. 20, OTD 48 interim reports 1 and 2, and Appendix B of this report.)

   8. All of the recommendations have been implemented. The question of press fitting the bushings into the castings is answered in response No. 3 above.

RECOMMENDATIONS	RESPONSES
9. AID/Santo Domingo should send a cable or telex to the WASH Project (Cable Address WASHAID, Telex No. WUI 64552) or send a State Department cable to Mr. Wehman's attention (AID/W, S&T/H/WS) on the first and third Friday of every month indicating the status and progress of pump production and well-drilling aspects of the Health Sector II project. This should include wells drilled and percent "dry," pumps produced and percent rejected, numbers and locations of those installed and the communities visited by maintenance crews and UTOC team. The report should identify problems encountered and how they have been or will be solved, commenting specifically on the quality control checks of all manufactured parts, forewarning of any bids to be advertised and/or contracts to be awarded, and requesting information that would be helpful.	9. Nothing has been done with respect to this yet. It may be necessary to contact Dr. Rivera as he is the person who authorizes long distance calls, cables, etc.
Acceptance of Wells	
1. Institute an administrative procedure at the field engineer level which requires him to "officially" receive and "sign off" on each well with a quality control check list which details: ° well log ° total depth of well ° depth to water table ° feet of casing (distinguish between perforated and solid) ° rate of pumping/bailing ° rate of recharge (see WASH Field Report No. 50) ° water quality (see WASH Field Report No. 23, pages 59-61) ° well temporarily capped and sealed with welded steel plate.	1. All items in this recommendation are checked, but not on a concise checklist or by any one person.
2. Continue the five gallon-per-minute criterion for accepting wells.	2. Yes.
3. Implement the recommendations of WASH Field Report No. 50.	3. Yes.
Acceptance of Pumps	
1. SESPAS should implement the quality control program described in Chapter 3 and institute a formal acceptance sign-off check list form for pump acceptance.	1. The pumps are being checked before acceptance, but there still is no formal sign-off checklist.

RECOMMENDATIONS

2. SESPAS should inspect and test the pump before it is painted.

3. SESPAS should find out the legal implications of making changes in, and additions to, the specifications.

4. SESPAS should have contract documents reviewed by a competent engineer before advertising for bids. Better yet, have an engineer prepare the documents and have a lawyer review them.

Distribution of Materials for Well and Pump Installations

1. SESPAS should document its procurement, supply and distribution procedure to be sure that it remains successful, to be able to expand it into other regins and to be able to find causes of problems that might develop in the future.

2. SESPAS should also take steps to store materials off the ground and under cover. (See Appendix B.)

Community Promotion Related to Pump Installation, Operation, Use and Maintenance

1. Define the roles of all the actors in the promotion phase SBS promoters, UTOC, UAPODAN). To assist in doing this an organization development consultation intervention workshop should be designed to produce the following outcomes:

   a) role agreement
   b) specific work plan for 1 month, 3 month, 6 month periods. The plan should assign tasks and responsibilities.

2. Put the original work plan of the UTOC unit into practice for materials, training of SBS supervisors and promoters, and maintenance training. Provide UTOC with vehicles, equipment and materials to do its job. Examine the possibility of increasing the size of the UTOC team to carry out its work plan.

RESPONSES

2. This is not being done. There are obstacles in the way. S.E.S.P.A.S. would need a man at the foundry at all times. Pump parts are painted before assembly, therefore testing would be impossible before painting.

3. This has not yet been done.

4. This situation has not yet arisen as there has been no bidding since this report was prepared.

1. Since Srs. Casanova and Giovanni have taken over their new roles, procurement, supply and distribution is carefully documented.

2. Where reasonably possible this is done. A canopy has been erected to cover the pumps stored at the UAPODAN yard in Santo Domingo and all other parts, bolts, pins, bushings, nipples and couplings etc., are stored off the ground and under cover.

1. Dr. Herrero advertised in the press for a person qualified t head the U.T.O.C. health educators. He held interview and selected a Sra. Altagracia Meso. Sra. Meso was h and given the task of selecting 5 supervisors and 25 field health educators.

2. This is coming. On a field trip I saw two or three SBS promoters doing the rounds on shiny new motor cycles.

RECOMMENDATIONS

3. Arrange a consultation with Carlos Gomez of Agua del Pueblo in Guatemala for technical assistance and program exchange in practical promotion techniques, visual aids and simple, useful educational materials. Enlist his aid for workshop design for promoters.

4. Re-institute the requirement that the pump-maintenance fund be collected by the local health committees before a pump is officially turned over to a community. Withold the handle, if necessary, until the community contributes the money.

5. Train the local SBS promoters in the program and use them as a primary link with the community to enlist community participation in apron construction.

6. Reduce installation team to one or two people so that community involvement will be necessary in order to install the pumps.

Installation of Pumps

1. Institute a quality control system for handpump installation for the supervising engineers that would include a check list and sign-off.

2. Do a training course for the crews that build aprons, using models which demonstrate the correct practice. The models could be constructed at the UAPODAN field office. (See Figure 7.)

3. Supply chlorine for disinfecting the wells, and add this to the sign-off checklists.

Maintenance of Pumps

1. For the moment, restrict the community role in maintenance to pump lubrication.

2. Institute a control procedure using a form for the local promoter to fill out weekly or monthly which specifies:

   - which pump (assign a number, preceded by a community letter code)
   - state of repair

RESPONSES

3. Nothing has been done about this yet.

4. In some communities this is working. In others it just doesn't. It seems to depend on the strength and coverage of the health committee.

5. Yes, this is being done.

6. Yes. I saw a two-man installation crew at two different well sites. At each site community participation was in abundance and totally voluntary.

1. No. This is not being done.

2. Yes. This is happening and a model apron has been constructed at the UAPODAN field office in Azua.

3. This had not yet been done when I was there in October, but Dr. Herrera had a supply of chlorine in his office for distribution.

1. Yes. This is the case.

2. The promoters have notes on condition of pumps in their monthly reports.

RECOMMENDATIONS	RESPONSES
3. Implement the training program for two people per community that is planned and has been tried out in Azua. The maintenance team not the engineer should be trained to do the training. A work plan should be developed for this.	3. This program is underway. Although, present duties are restricted to lubrication, the trainers did cover minor repairs to down-hole components.
4. Crews from several neighboring communities should work together when doing down-hole repairs.	4. This has not yet arisen.
5. An inventory and distribution procedure should be prepared for spare parts (handles, pump caps, fulcra, pins and bushings).	5. This has been done.
6. All of the pumps installed in the first six months should be systematically checked and lubricated, and worn or broken parts should be replaced.	6. This has been done in San Jose de Ocoa and Azua.
7. Investigate the use of locally-available lubricants, such as peanut oil, for lubricating the pumps.	7. Investigation has been carried out. It seems that almost anywhere something is available. Whether it be peanut oil, lard or commercially available lubricants.
Administrative Structure	
1. A qualified management consultant should be brought in to assist in clarifying roles, analyzing tasks, preparing work plans, and establishing administrative control, evaluation and correcting procedures.	1. No response.
2. The consultant should assess what training is needed to fulfill roles, carry out the work plans and recommend action.	2. No.
3. Some administrative changes would be helpful to improve project implementation. The present administrative structure is that diagramed in Figure 1. It is recommended that the existing structure be changed to that diagramed in Figure 8. The principal change would be the addition of a UAPODAN regional director who would be located at the regional field office in order to manage the regional activities and facilitate coordination of activities within the region and between the region and the UAPODAN office in Santo Domingo. Another change would be the establishment of direct educational, promotional and consultative relationships between UAPODAN regional units and the SBS supervisors and promoters.	3. At the moment there is no change.

Appendix I

Conclusions of a Technical/Managerial Review of the
AID Handpump Program in the Dominican Republic By WASH
As Part of a Global Review of USAID's Handpump Program
January 1983

6.4 Conclusions from the Visit

6.4.1 What Are the Residual Effects at the National Level?

The main residual effect of this effort is that SESPAS has been successfully assisted to establish a potentially viable program for delivering safe water to those living in the dispersed areas of the Dominican Republic (i.e. population concentrations of fewer than 800 people) that is incorporated with other primary health care programs such as sanitation.

Another residual effect is the development of a national awareness of the limitations of technological "fixes". It has become very clear that if these types of programs are to be successful, technical solutions must be mated with managerial, maintenance, and user education schemes that realistically reflect the skills and technology currently available in the Dominican Republic.

This project has also opened the door for other efforts to produce low-cost locally manufactured water and sanitation devices.

6.4.2 What Are the Residual Effects at the Official Level?

The fact that SESPAS has been able to work with INAPA on the well drilling problem shows that the two agencies have realized the need for mutual cooperation and support. Additional cooperative efforts can now be started using this one as a model.

6.4.3 Should the AID Type Handpump Program Be Considered Further by GODR or USAID/DR?

The answer to this is two-fold. First, it is clear that the following technical modifications must be resolved before the AID type handpumps should be recommended for use in the Dominican Republic:

- Either a mechanism must be established for producing large numbers of pins and bushings that meet hardness specifications or a substitute must be found for the bearing support problem (sealed ball bearings for example).

- A way must be found to replace the foot valve on a deep well pump without removing the base bolts (for example, pull it through the base).

- A better scheme for ensuring the lubricating of above-ground moving parts must be developed so that field lubrication is less critical.

- Better methods of drilling and testing wells must be developed.

In addition, the following software elements must be implemented before this, or any, handpump program should be considered further:

- A logistics system that will result in having the most common spare parts available in the local store.

- A multi-tiered maintenance system that will call for the user to do such basic maintenance such as lubrication, while regional teams provide preventive maintenance and back-up for heavier maintenance such as pulling the pump to repair a foot valve.

- A user education system which addresses the use of such techniques as radio, audiovisual, etc.

The recommendation to obtain additional handpumps over those currently on order is highly dependent on the degree to which the current program can resolve the above mentioned questions.

6.4.4 Was the Exercise Cost Effective?

In view of the low unit cost of the developmental effort (approximately $50 per pump) and the fact that it resulted in an operational program, it can be said that this is the most cost effective of all the programs examined to date.

6.4.5 What Efforts Are Needed for Future Implementation?

The Mission and SESPAS need to do more work on institutionalizing and staffing the following schemes into a long-term program elements:

- Quality control
- Acceptance procedures
- Well drilling
- User education
- Preventive and maintenance repair
- Training of staff and users

6.4.6 What Should the Next Steps Be for USAID/DR?

The Mission should: 1) call for an in-depth up-date of the July 1982 WASH Interim Report No. 3 under OTD No. 48 (Ref. 6.3), 2) assist SESPAS to collect hard data on frequency of repair and life-cycle costing of various pumps and schemes, and 3) turn their attention to implementing the software schemes mentioned in Item 6.4.5.

Appendix J

Text of WASH Field Report No. 98 Covering
Status of AID-Type Handpump in the Dominican Republic
As Reported by Georgia Institute of Technoloy
April - May 1983

Chapter 1

INTRODUCTION

The U.S. Agency for International Development (USAID), through its Office of Health, Bureau for Science and Technology in Washington, and its Mission in Santo Domingo, initiated a rural water supply project as part of a wider public health effort in the Dominican Republic (Health Sector Loan II). One component of the project is the local manufacture, installation, and maintenance of 2,300 handpumps in rural communities. One thousand of these pumps are of the conventional AID design. The others are of the modified version (Figure 1). At present, 1,000 conventional handpumps and 200 modified handpumps have been installed.

1.1 Events Leading to the OTD

In January 1983 a technical/management review team visited the Dominican Republic to look at its AID handpump program and found evidence that the program was experiencing problems with a modified version of the AID handpump that featured a 2-inch PVC drop pipe and a PVC foot valve. The modified pump differs from the conventional AID-design handpump in that the conventional one uses a 1.25-inch galvanized steel drop pipe and a 3-inch cylinder (see Figure 1). A substantial percentage of the pumps were failing to operate properly just a few weeks after installation. The review team suggested a field investigation be conducted to determine the cause of failure of the modified pump. Based on this investigation a corrective course of action could be recommended.

Based on the above findings, Admendment Two of Order of Technical Direction (OTD) No. 143 was issued by the AID office of Health in Washington in March 1983, requesting the Water and Sanitation for Health (WASH) Project to survey, inspect, and analyze the current status of the locally manufactured, "pull-through-the-base-type" modified AID-design handpumps that had been installed in rural communities under the Health Sector Loan II Project.

1.2 Scope of Work

The scope of work Admendment Two of OTD 143 (see Appendix A) was the following:

A. Perform an initial survey of the "pull-through-the-base" handpumps already installed to determine field performance.

B. Document with instant black and white photographs all installed handpumps and handpump facilities surveyed.

C. Document persistent problem areas resulting in handpump system failure.

D. Bring back to Washington, D.C. appropriate samples of defective handpump system elements.

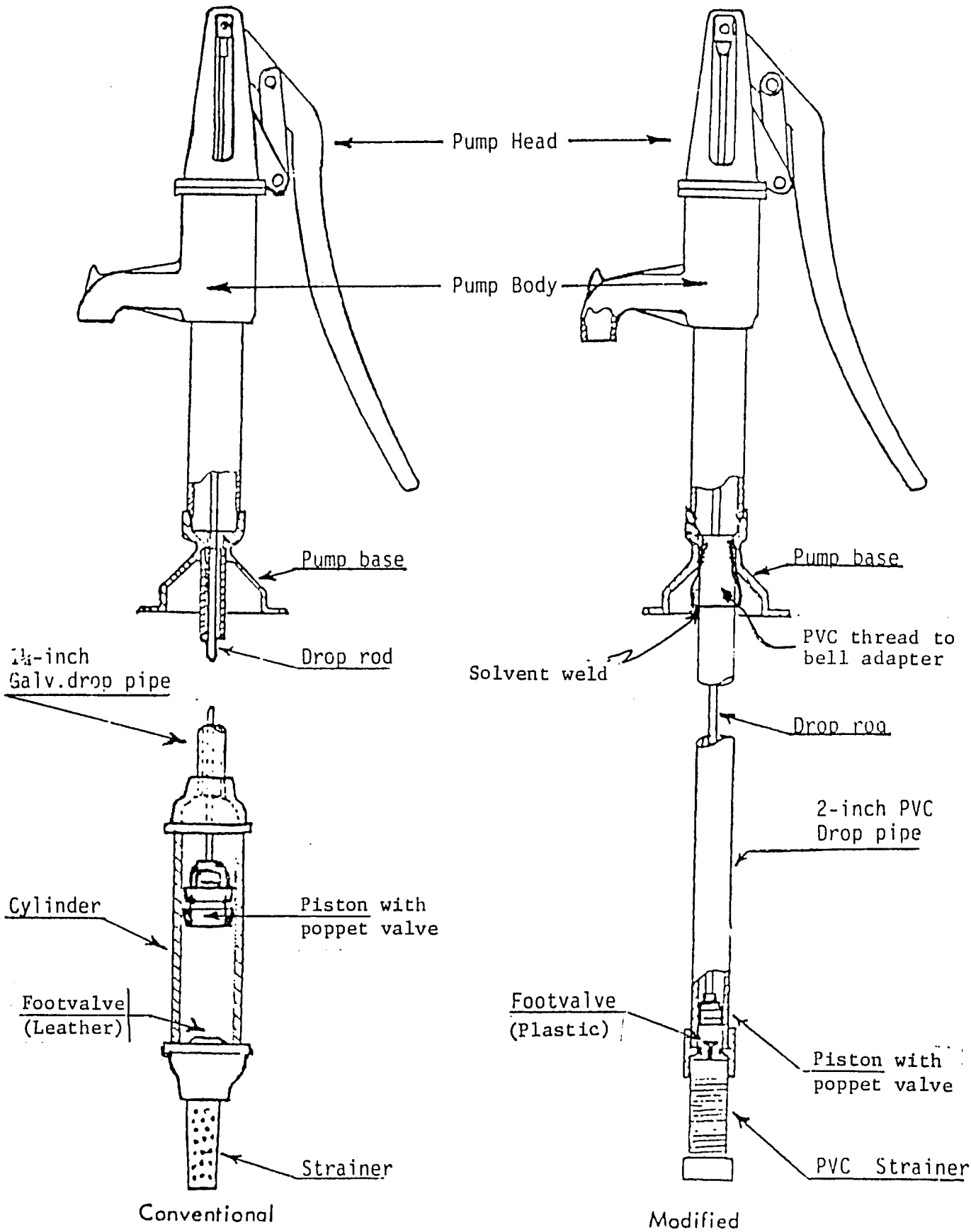


Figure 1

Source:WASH Field Report No.20
June,1981

AID HANDPUMP

E. For each site surveyed obtain the following information:

- o length of service
- o maintenance performed to date
- o depth of well
- o length of drop pipe
- o apparent quality of PVC joints and strainers
- o any foreign objects found in pipe components
- o condition of foot valve(s)
- o condition of connections of PVC drop pipe at pump stand base
- o current water level of well
- o description of problems with any part of handpump system
- o date of survey
- o date of notification of SESPAS maintenance crews for them to repair the broken handpump
- o average number of users of handpump system per day
- o estimate of average daily quantity of water taken per user per day if available.
- o any other pertinent information on particular sites.

Chapter 2

METHODS AND PROCEDURES

The field activities were conducted in two parts: the surveillance mode and the detailed inspection mode. For the surveillance mode, site visits were made to existing installations, and the working status of 60 randomly-selected modified AID handpumps was observed and noted. Additional information recorded was the exterior condition of the pump, the condition of the bushings, and the degree of lubrication. For the detailed inspection mode, 30 handpumps, which were found to be inoperable during the surveillance mode or previously reported by the Government of the Dominican Republic as inoperable, were disassembled and the causes of the malfunctions identified. The condition of the pump components was noted along with other information such as the date of pump installation, the approximate number of users, the exterior condition of the pump, the depth of the well, and the level of water in the well.

Appendix D contains the handpump field inspection procedures used while conducting the work required by OTD 143. Appendices E and F present the site data sheets filled out during the surveillance and detailed inspection modes, respectively.

Chapter 3

FINDINGS AND CONCLUSIONS

3.1 Summary of Data

The most frequent types of problems were : (1) A combination of design faults, manufacturing modifications, and/or installation which permitted the introduction of foreign matter into the drop pipe that interfered with the normal operation of the piston (plunger) poppet valve and/or the foot valve popper, (2) plunger popper valve failure, (3) separation of the PVC pipe assembly, and (4) the separation of the plunger rod.

3.2 General Findings

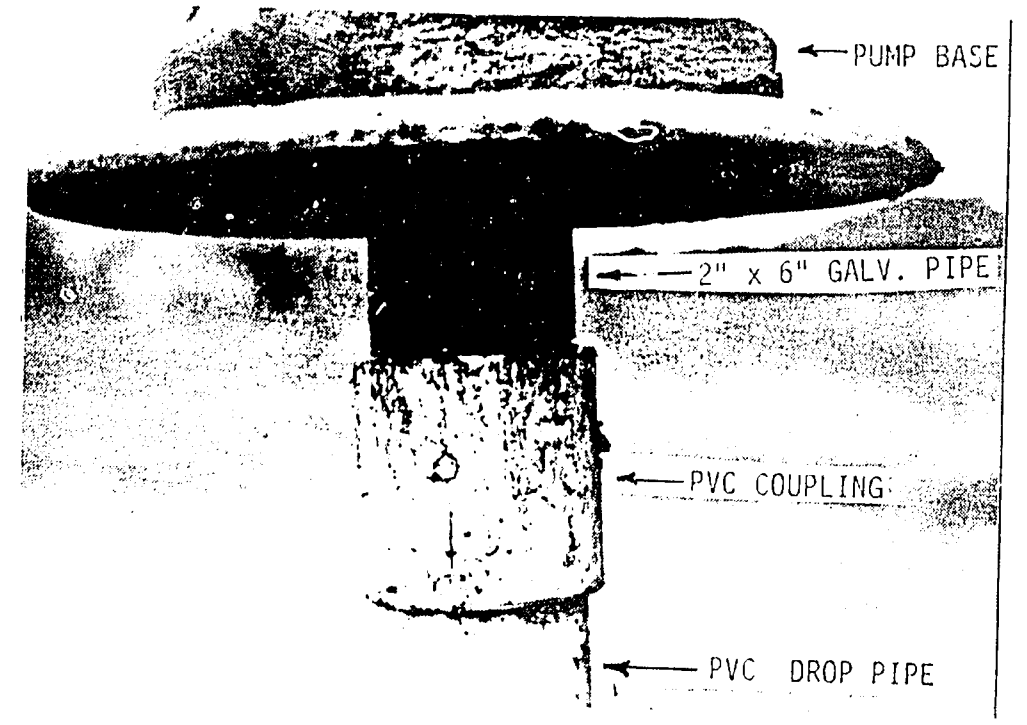
The above problems were due to the following:

- Problem Area 1 (42.5 percent) - Foreign materials such as pebbles, stones, sticks and even a "C" battery were found in the drop pipes as a result of an oversized drop rod opening on the pump head, improper installation techniques and/or deliberately inserting them through the spout (see Appendix G). The foreign matter became lodged between the plunger poppet valve or the foot valve poppet and seat, preventing the poppet from properly closing. Since no similar field investigation has conducted on the "conventional" pumps that are currently in the field it cannot be said that this is a problem unique to the "modified" pump. However, the frequency of failures and short length of time between installation and failure are unusual deviations from other experiences with handpump installations in the Dominican Republic and elsewhere.

- Problem Area 2 (15 percent) - Due to a defective plunger poppet valve, failures occurred when the valve got stuck between two legs of the cage or did not completely cover the valve seat. This is an apparent design problem.

- Problem Area 3 (15 percent) - Separation of the PVC occurred at the joint between the drop pipe and the PVC male-threaded adaptor in six cases. When inspected, little, if any, PVC solvent was found sticking to the internal surface of the PVC adaptor (Figure 2). In five cases the drop pipe had to be lifted out of the well by bonding another length of PVC pipe to it. The pipe ends became covered with new solvent in this process, so their surfaces could not be inspected. In one case it was possible to lift the PVC pipe out of the well with a rope. This allowed a better inspection since the pipe surface was not covered by new solvent.

- Problem Area 4 (15 percent) - Plunger rod separation was found in six cases. In two cases, the plunger rod had separated from the rod end. In three cases, the separation was at a coupling between rods. In one case, the separation was at the plunger assembly.



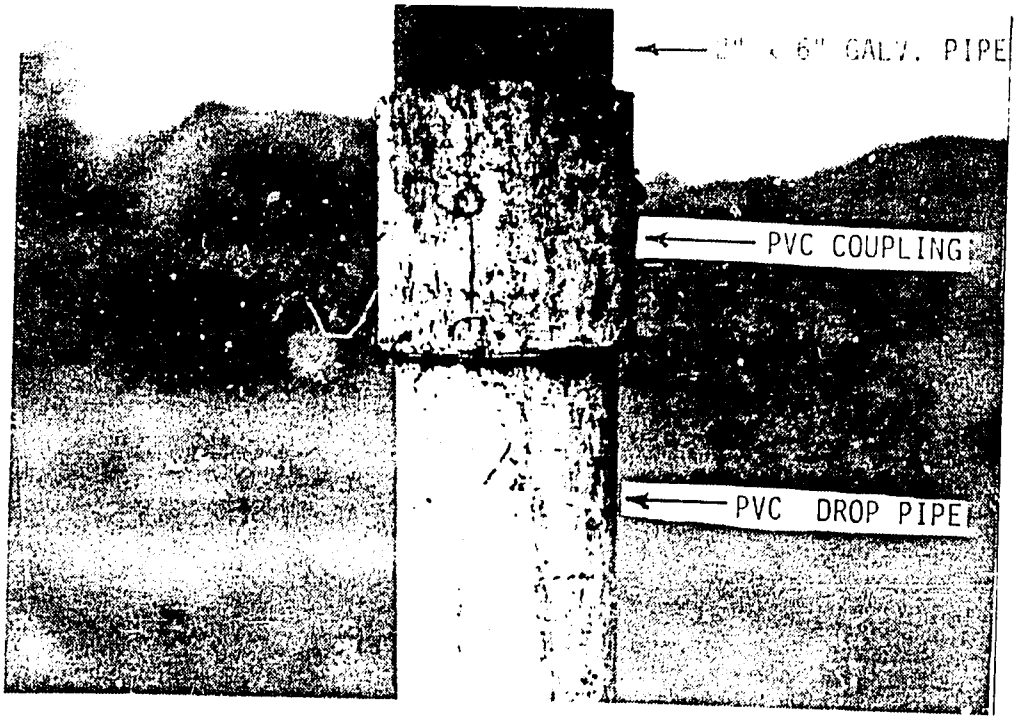


Figure 2

HAND PUMP BASE AND DROP PIPE
CONNECTION ASSEMBLY

- Problem Area 5 (12.5 percent) · See Table 1 for nine problems.

In addition to the above reported problems that resulted in pump failure, it was observed that most pumps had extremely loose bushings. However, this problem had not caused any pump malfunctions as of the time of inspection. In addition, it was observed that in general the handpumps were poorly lubricated and many did not have any lubrication at all.

Table 2 summarizes the surveillance mode inspection activities and Table 2 the detailed inspection mode. Table 3 is a matrix of each site where a detailed inspection was carried out and each site's associated problems. Appendix G shows representive pictures of the problems presented above.

3.3 Conclusions

Based on the findings, the following conclusions are drawn:

- The manufacturing quality of the handpumps is generally poor. Deficient quality controls in the factory were apparent and the methods and procedures used by SESPAS for pump acceptance from the manufacturer were not adequate in providing assurance of suitable pump quality or conformance to specifications. Appropriate handpump acceptance tests were not conducted, thus permitting defective handpumps to reach the field.

- Handpump installation techniques need to be improved. This is especially true with respect to PVC solvent application.

- There is a considerable lack of maintenance. Poor lubrication or none at all was the rule. It takes a long time for the limited number of maintenance crews to respond to a village's request for help in repairing a broken pump. During the inspection visits it was noted that villagers lack even the simplest information concerning the proper maintenance of a handpump. This makes it difficult, if not impossible, for the user to do simple maintenance locally.

Table 1

Summary of Detailed Inspection Mode
(Sample size was 30 pumps)*

Problems Identified During Detailed Inspection	Frequency of Problem	Problem Area	Percentage Problem
Foreign matter	17	1	42.5 %
Poppet valve stuck/worn out	6	2	15 %
Separation of PVC drop pipe	6	3	15 %
Separation of plunger rod	6	4	15 %
Separation of foot valve cage on non-reinforced foot valve**	2	5	5 %
Steel nipple unscrewed from pump base	1	5	2.5 %
Bottom 15 feet of drop pipe filled with mud	1	5	2.5 %
Water level in well below piston level	1	5	2.5 %
	40***		100 %

*Not all of these pumps were among those inspected in the surveillance mode. Some had previously been identified as inoperable by SESPAS.

** The first group of foot valves used in the project were not reinforced. At present, the foot valve used has been reinforced.

***The 30 pumps in the sample had 40 total problems, since some pumps had multiple problems.

Table 2

Summary of Surveillance Mode

Surveillance Mode

- size of random sample:	60 pumps
- pumps not working:	32 pumps (53 percent)
- pumps working:	28 pumps (47 percent)

Table 3

MATRIX OF INOPERABLE PUMPS BY SITE AND CAUSE OF FAILURE

	Plunger (Piston)			Separation of Pipe or Rod		Foot Valve and Bushings		
	Foreign Matter	Poppet Stuck Open	Poppet Disk Worn Out	PVC Drop Pipe	Plunger Rod	Footvalve Stuck Open with Trash	Bushings Loose or Missing	Other* Problems
1. Bogueron (T)	X	X					1	
2. Ranchito (T)					X		3	
3. Refugiados	X						3	
4. Tablas (Clinica)		X		X			2	
5. Arabelli Soto			X				4	
6. Martina Espequero				-See Note-			1	
7. La Cabria					X		6	
8. M. de Regla							5	X
9. M. Vargas		X					4	
10. V. Jimenez				X			2	
11. G. Estepan						X		
12. D. Solis						X	3	
13. J. Reyes			X	X				
14. R. Bello (T)	X						7	
15. V. Santo (T)	X							
16. O. Valdez							2	X
17. M. Contreras							4	X
18. A. Puello	X				X		3	X
19. M. Tapia (T)	X		X		X		5	
20. J. Diaz						X	5	
21. Sebana Larga Escuela	X				X	X	1	
22. J. Alta Gracia	X				X	X	0	
23. F. Pujols				X			0	
24. B. Franco				X			0	
25. M. Matos							1	X
26. A. Arias	X						0	
27. Vengan a ver Escuala	X						0	X
28. La Urea				X			4	
29. El Corbano	X						2	
30. Barranca (La Gallera)	X						1	X

T = Test Site: Installed by a consultant or by SESPAS between April and December 1981.

Notes: Tablas (martina Espeguero): Pump was working at time of inspection. However, community had previously reported it as inoperable and that it worked and failed alternatively. Failure condition was not present at inspection time.

*Other Problems:

- The 2" diameter by 6" long galvanized nipple became unscrewed from pump base. Drop pipe fell into the well.

- Water level below plunger.

- Silt on foot valve poppet and seat.

- Drop pipe filled with mud to a height of 15 feet.

- Separation on foot valve cage.

Chapter 4

RECOMMENDATIONS

In developing the recommendations of this report the writers take notice of the fact that over half (53 percent) of the pumps were not operational at the time of inspection and that the major problem was that of foreign matter in the drop pipe (42 percent of the cases.) In 15 percent of the pumps visited were there problems directly related to the plastic drop pipe and its solvent welds. In an additional 15 percent of the cases it was clear that the poppet valve of the plunger cylinder needed to be redesigned so that it was larger and heavier and had a longer tail. These redesigns would prevent the poppet from sticking in the cylinder cage while at the same time fully covering its seat. The recommendations that follow address these basic problems.

This chapter contains a set of recommendations and a set of alternative considerations. The former is based on OTD requirements and presents the most reliable way for the current project to be carried to a successful completion. The latter reflects various economic and political concerns of SESPAS and the Mission. However, due to the fact that the second set of recommendations would involve a technology that has not yet been proven through extensive field tests, it cannot be assured that they will be successful in resolving the problem with the modified pump.

SESPAS stopped production of the handpump due to a (a) problems being reported with the modified AID handpumps installed in the field, (b) general poor manufacturing quality of the modified handpumps, and (c) the present manufacturer requesting an increase in the handpump price. Based on the above, SESPAS has considered the selection of a new manufacturer. While the field problems are substantial they can probably be solved satisfactorily if the recommendations are implemented.

4.1 Recommendations Based on OTD Requirements

The following recommendations are based on the problems found during the field inspection and analysis of the handpump system component samples taken:

Recommendation No. 1

It is recommended that for approximately 640 pumps remaining to be manufactured for the Health Sector II Project, the price of the pumps not be the only deciding factor for procurement. The selection of a manufacturer should also be based on a technical evaluation of each bidder's managerial capabilities, foundry and machine shop facilities, plant capacity, and level of product quality as evidenced by observation of products being manufactured at the time of the technical evaluation. The manufacturers quality control procedures should be carefully evaluated.

Recommendation No. 2

It is recommended that the selected manufacturer be responsible for the overall quality of the complete pump, not just certain components. SESPAS should avoid a repetition of the past whereby items such as pins, bushings, and foot valves were purchased separately by SESPAS and then delivered to the manufacturer for assembly.

Recommendation No. 3

It is recommended that the modified "pull-through-the-base" type AID handpump design be replaced by the conventional design that uses a 3.0-inch cylinder and a 1.25-inch drop pipe (galvanized iron). The foot valve for the pump should be either a locally made metal poppet valve or a Clayton Mark (or equivalent) model which is available in Dominican Republic hardware stores for approximately $8.00.

Recommendation No. 4

For those pumps installed in the field with 2" PVC drop pipe and the locally made plastic foot valves it is recommended that additional 3-inch-diameter pump cylinders be manufactured and installed as needed.

Recommendation No. 5

Additional cap assemblies should be manufactured to replace those in the field with loose bushings. The leather flapper foot valves should be replaced with metal popper/rubber seat foot valves in the AID handpumps of conventional design that were installed before the modified pump.

Recommendation No. 6

It is recommended that the plunger poppet valve failure be corrected by increasing the diameter of the top of the poppet as well as increasing the diameter and length of its shaft, to provide a better seal and to prevent it from getting stuck between two legs of the plunger cage. Additional poppet valves should be manufactured to replace those in the field.

Recommendation No. 7

It is recommended that SESPAS, the USAID Mission, and the handpump manufacturer be provided with in-depth and extended technical assistance for each of the above recommendations. This should include assistance to the selected manufacturer in production and quality control and to SESPAS on acceptance testing. Also, such assistance should extend to the following areas:

- For assisting SESPAS to develop a long-term, locally based maintenance system for training community organizers (health educators) in techniques for increasing awareness of the need for proper maintenance and repair of

handpumps. This can be achieved by establishing a training system with field based workshops. After these workshops, community organizers would be capable of training villagers in maintaining and repairing their handpumps.

- o Preparation of bid documents, gauge kits and specifications before a new manufacturer is selected. This would insure proper inclusion of pertinent technical manufacturing requirements (for instance, one requirement should be the use of properly designed and fabricated jigs and fixtures).

- o Assistance to the manufacturer in quality assurance procedures and to SESPAS in acceptance procedures.

- o Determination of the reasons behind large amounts of foreign matter found in the plunger and foot valve assemblies. It is believed that the causes range from vandalism to improper installation procedures (for instance, laying the drop pipe on the ground and causing dirt, rocks, twigs, etc., to enter into the drop pipe without cleaning it out before installing it).

- o Capability of anticipating handpump operational problems.

4.2 Alternative Considerations

At the request of SESPAS and the USAID Mission, WASH consultants examined some economic and financial aspects of the handpump component of the Health Sector Loan II Project (i.e. SESPAS has purchased all the materials necessary for the installation of the remaining 640 modified AID design handpumps, which represents an investment of over $80,000).

SESPAS stated that it would be difficult to use the purchased materials in other projects or even transfer them to another government agency. Also, because various problems associated with the handpump program have cast a negative image, SESPAS would prefer to avoid the further adverse publicity which would result from wasting materials or transferring them to another project.

In light of this situation, the following alternatives though not necessarily recommend are suggested:

- o The remaining 640 handpumps yet to be manufactured could be of the modified AID design. However, the PVC foot valve should be replaced with a locally available 1.25-inch brass foot valve (a Clayton Mark or equal model which is available in Dominican Republic hardware stores for approximately $8.00). Implementation of this change would require purchasing the brass foot valve and a 2 by 1.25-inch reducer.

- o To prevent separation of the PVC drop pipe assembly at the handpump base, the SESPAS installation and maintenance crews have used a 2-inch diameter by 12-inch long bell-ended section of PVC pipe between the 2-inch PVC adaptor and the PVC drop pipe assembly (Figure 3). The 2-inch PVC adaptor and the 12-inch section of PVC pipe are glued 24 hours prior to handpump

installation. So far this has apparently eliminated separation of the PVC drop pipe assembly at the location where this problem most frequently occurred. This practice should be continued wherever the PVC drop pipe assembly is used. However, there is not sufficient field-test data to guarantee the success of this approach, and it should not be expected to totally correct the PVC drop pipe separation problem.

- For existing installations that used the modified pump, the foot valve and the connection of the drop pipe at the pump base could be replaced with the brass foot valve and the 12-inch section of pipe, as described above, at a time when regular maintenance or repair is conducted.

The above alternative considerations should be implemented if the following steps are followed. Otherwise, the likelihood of success will be extremely low.

- SESPAS should carefully inspect the handpumps before accepting them from the manufacturer, thus drastically upgrading quality control.

- SESPAS should radically improve handpump field installation procedures.

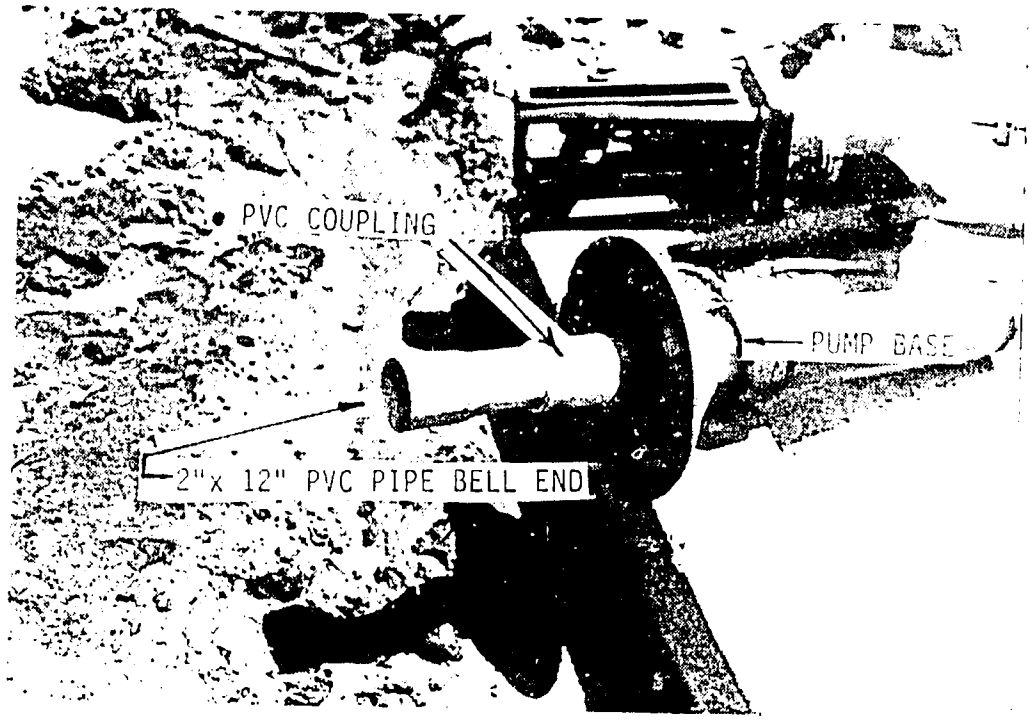
- SESPAS should carefully train handpump installation and maintenance crews and provide awareness of the consequences of an improperly installed handpump.

- To correct the problem of loose bushings in the cap assembly of existing pumps, any of the components (cap, fulcrum, rod end, and handle) that need better fitting bushings can be taken to a general machine shop by maintenance crews to have the hole(s) reamed to a diameter of approximately 0.874 inches, which would provide a press fit with a bushing with an outside diameter of 0.875 inches. While this is being done on a specific handpump, a new component can be replaced to avoid leaving the community without a working pump.

  SESPAS should carefully prepare for the logistical burden which will result from having handpump heads with two different size bushings until all pumps have the same size bushings. There should be extremely careful planning before making the decision to go ahead with the implementation of this alternative. Record keeping and a system for the clear identification of the pump installation sites are of utmost importance.

- Earlier installed AID handpumps (conventional design) should have their leather flapper foot valves replaced with metal poppet/rubber seal foot valves (brass type) when the former ones become worn out or fail to operate properly.

Before implementing the alternative considerations stated above, SESPAS should consider the high maintenance cost if the above considerations do not correct the problems completely and compare that cost with the $80,000 already invested in PVC pipe and other materials.



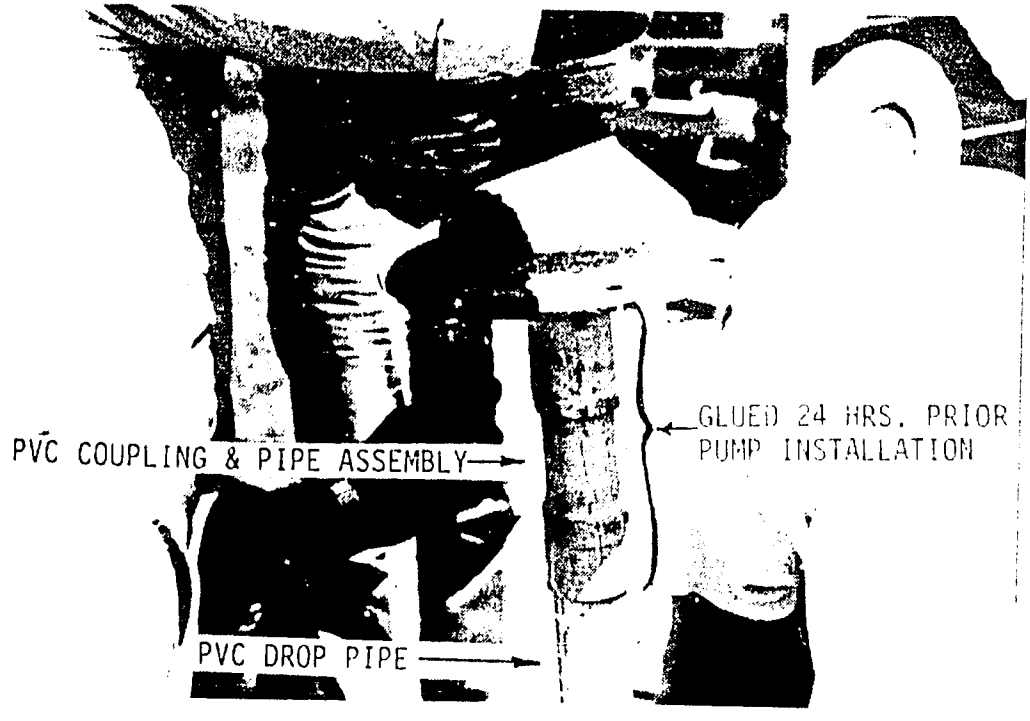


Figure 3

PVC DROP PIPE CONNECTION GLUED 24 HRS. PRIOR PUMP INSTALLATION TO PREVENT PVC DROP PIPE SEPARATION

SESPAS should contact private voluntary organizations in the country to investigate the possibility of selling the PVC pipe purchased to them in order to minimize a loss to the project if the decision is made to use the conventional AID design handpump.

The conventional AID design handpump is recommended for future handpump programs in the Dominican Republic. This is the best technical solution and in addition it would reduce the number and types of spare parts and logistic problems.