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SELECTION OF ALTERNATIVES TO GRAVITY FLOW SYSTEMS FOR RURAL COMMUNITIES:
A Workshop To Train Guatemalan Engineers In Pumping Technologies

WASH FIELD REPORT NO. 56

SEPTEMBER 1982

Prepared for:
USAID Mission to the Republic of Guatemala
Order of Technical Direction No. 76

WATER AND SANITATION FOR HEALTH PROJECT

COORDINATION AND INFORMATION CENTER

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Sponsored by the U. S. Agency for International Development

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September 28, 1982

Mr. Peter Kolar
Mission Director (Acting)
USAID
Guatemala

Attn: Mr. Paul Cohn, Health Officer

Dear Mr. Kolar:

On behalf of the WASH Project I am pleased to provide you with three copies of a report on the Workshop to Train Guatemala Engineers in Pumping Technologies.

This is the final report by Daniel B. Edwards and is based on his trips to Guatemala from January to August 1982.

This assistance is the result of a request by the Mission on November 11, 1981. The work was undertaken by the WASH Project on December 29, 1981 by means of Order of Technical Direction No. 76, authorized by the USAID Office of Health in Washington, D.C.

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

Sincerely,

James E. Beverly
Acting Director
WASH Project

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

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A WORKSHOP TO TRAIN GUATEMALAN ENGINEERS IN PUMPING TECHNOLOGIES

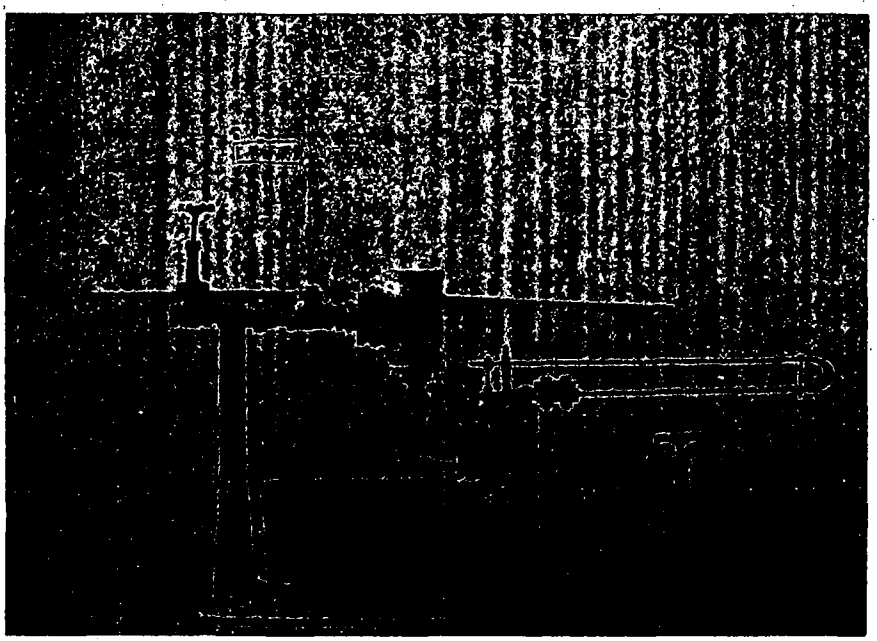
Prepared for the USAID Mission
to the Republic of Guatemala
under Order of Technical Direction No. 76

Prepared by:

Daniel B. Edwards

September 1982

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



Hydro-ram in Classroom: In background are student-generated decision factors for systems design and selection.

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EXECUTIVE SUMMARY

A four-week training workshop in pumping technology for small community water supply systems was provided for ten Guatemalan engineers in July 1982. The training project was provided at the request of the USAID Mission in Guatemala to fill an immediate need of agencies providing water to small communities. The primary local impetus for the project was Agua del Pueblo, a Guatemalan private voluntary organization (PVO) which forsaw the need to train their engineers as they received increasingly more frequent requests from lowland communities where gravity flow systems are not feasible. Locally participating agencies included CARITAS, the Guatemalan Office of Community Development, and the Guatemalan Department of Environmental Sanitation in the Ministry of Public Health. Technical assistance in the form of training expertise and professional engineering expertise in pumping technology was provided under OTD No. 76 by the WASH project.

This project has significance for the international water development training field for the following reasons.

- Need: Traditionally little practical training in pumping technologies is provided to the public sector/PVO engineer. He must often gain knowledge through trial and error. Most highly experienced pump system design specialists are employed in private firms. They, in turn, have often learned by interning under a specialist. This opportunity seldom exists for the predominately young engineers who work in the public sector in developing countries in village level water supply.

- Model Development: This project establishes a training model which demonstrates that it is possible, in a relatively short time, to train engineers to apply pumping technology to the most common local needs. The model uses a four-week, carefully planned workshop training process with field application and practical training methods. The model is adaptable to agency needs throughout the developing world.

- A Paradigm for Technology Transfer: This project uniquely combines the expertise of training technology specialization and engineering specialization to transfer knowledge and skills. Normally a practically experienced engineer is not a trainer. In this project training technologies such as case study, task teams, problem solving, field visits, demonstration, and simulation were conducted by engineers serving as trainers, with the backstopping of a training specialist who was not an engineer. By using this training approach, the experienced engineer was able to distill years of knowledge and skills and transfer them to other engineers with no previous experience with pumping systems.

The following products were the outcome of this project:

- Instructor's Manual: A complete manual in Spanish was produced to guide future instructors or to serve as the basis for adaptation to other situations. The manual consists of weekly benchmarks for the course, day-by-day training designs laid out in the sequence of instruction, field visit protocols and checklists, case study guides (with the cases calculated and solved), weekly evaluation forms, daily journal forms, guidelines for experiential learning, and lecture notes and/or lecture reference guides.

- Student/Instructor Reference Manual in Pumping: A complete reference manual was developed (mostly in Spanish) which will serve future instructors and trainees and which is now being used by course graduates. The manual contains all the theory necessary to work with the four types of pumping systems covered in the course; case studies, catalogue samples, examples of previously solved problems, formulas for calculating system curves, and diagrams and graphics. The reference manual was designed to be an integral part of the workshop method and to be of future use for the graduates.

- Training Outcome: Four local agencies in Guatemala now have engineers with the demonstrated capability of using examples of pumping technology for small community systems covered in the workshop: centrifugal pumps with horizontal and vertical axial mounting driven by either electric or internal combustion motors, hydro-rams, and windmills. The engineers are able to select the right pump for the system, design the system, and select the correct pipe and motor for the system.

Summary of Recommendations

The following recommendations are presented as possible future projects which build upon the experience of this work:

- As the need arises the course should be given in other Spanish speaking countries. Adaptation to local conditions should be minimal.

- A core of engineers from developing countries who are potential training instructors should be identified and prepared to conduct similar workshops based on this model. This will build more capability for technology transfer within developing countries.

- When opportunities to achieve economies of scale occur by combining Spanish speaking countries with similar training needs, they could be organized under WASH sponsorship to provide more training in pumping technologies.

- Similar efforts in other parts of the developing world should be pursued to develop practical training in pumping technology or other needed areas using the Guatemalan workshop approach as a model. A great deal of prior planning and design is required if the effort is to be successful.

- The demonstrated success of combining professional expertise in training with professional expertise in technical specialities to produce technology transfer should be repeated when other similar problem areas or needs arise.

ACKNOWLEDGEMENTS

The following individuals and institutions have contributed a great deal to the success of this project and deserve appreciation and thanks:

Paul Cohn, Health Officer USAID, Guatemala
Carlos Gomez, Director, Agua del Pueblo of Guatemala
Mathew Perl, Technical Assessment Officer, Agua del Pueblo
Emelio Falla, Engineer, Agua del Pueblo
Octavio Cordon, Consultant Engineer, Cordon y Merida, Guatemala
Alfredo R. Szarata, Consultant Engineer, Cordon y Merida, Guatemala
The support staff of Agua del Pueblo and Cordon y Merida
La Division de Saniamiento Ambiental del Ministerio del Salud Public de la Republica de Guatemala
Desarrolo de la Comunidad de la Secretaria de la Presidencia de Guatemala
Caritas de Guatemala
El Cuerpo de Paz de Guatemala (US Peace Corps)

Engineer Octavio Cordon (left center), Carlos Gomez,
Director of Agua del Pueblo (center right)

Chapter 1

BACKGROUND

1.1 Request from Agua del Pueblo

In August 1981 Agua del Pueblo (ADP), a Private Voluntary Organization (PVO) formed in 1972 to work in Guatemala on rural water supply and latrine programs, requested technical assistance through the USAID Mission for a training workshop which would provide their engineers with the capability of working with water systems which are alternatives to gravity flow. The original request, clarified by subsequent dialogue with the Water and Sanitation for Health Project (WASH) and USAID, led to two primary objectives for technical assistance: provide training for Agua del Pueblo engineers and other private and governmental agencies and develop a training model which could later be converted by ADP into training for para-professional technicians.

Chronology of Key Events

Needs assessment	February 1-5
Design and preparation meeting	May 3-4
Design of course and preparation of materials	June 21-July 2
Delivery of workshop	July 5-30

1.2 Justification for Request

ADP had been assisting small villages in the highlands of Guatemala to develop gravity-feed systems for drinking water. With the decrease in the number of suitable gravity fed sites and the increasingly difficult political situation in the highlands, ADP was experiencing a need to plan, design, and construct systems with alternative technologies for pumping and treating drinking water for villages. Specifically they were interested in learning more about pumping systems which use small pumps (powered by both electricity and internal combustion engines), hydro-pumps, and wind-powered pumps.

Agua del Pueblo was not alone in the need for technical assistance in pumping technologies. In Guatemala there was little experience with pumping technologies which served the small community. Most engineers working within the Ministry of Public Health Division of Environmental Sanitation, the National Office of Community Development, and Caritas, had received numerous requests for pumping systems from villages.

The engineers working for these agencies were young and inexperienced with alternative technologies. Opportunities for receiving practical training did not exist. The higher education institutions (such as the Central American Regional School of Sanitary Engineering in Guatemala) provided theoretical preparation but little applied training.

1.3 Scope of Work

By December 1981 a scope of work was developed and approved which would provide for development and implementation of a training course to meet the above need (see Appendix A). The scope of work called for six project phases: 1) collect background data; 2) conduct a detailed needs assessment with ADP and cooperating agencies; 3) design and develop a workshop with all attendant planning and materials; 4) conduct the workshop; 5) assist ADP in adapting the workshop for training paraprofessionals; and 6) conduct a paraprofessional workshop.

1.4 Synopsis of Needs Assessment Activities

An initial needs assessment visit was made to Guatemala by an engineer and a training specialist during the first week of February, 1982. This visit had the following objectives:

- Identify the course participants and determine their background and experience.
- Determine Agua del Pueblo's and the other participating agencies' expectations of the course content and methodology.
- Determine the training methods used by ADP to train paraprofessionals and structure the course within this replicable methodology.
- Determine the need for and availability of local resources for course delivery.
- Determine the need for inter-agency coordination in course content and develop information about participating agencies.
- Reach a working agreement with ADP on the overall scope of work, course content, methodology, time frame, and subsequent steps.

The above objectives were reached during the one-week visit. All agencies identified as course participants were interviewed, background data was gathered on likely participants to

determine course level, local resources were identified, and a set of agreements on subsequent steps were agreeded upon with ADP. At the same time an outline of course content was developed.

1.4.1 Course Content

The primary focus of the content was determined to be electrical and internal combustion powered pumping systems, with an emphasis on how to select the proper pump for typical Guatemalan villages. In addition, a review of wells, subterranean water, handpumps, hydro-rams, and windmills was agreed upon. It was thought that the request for treatment and storage systems would be difficult to cover within a four week course, but this question was left open until the planning and design phase of the project.

1.4.2 Course Methodology

It was agreed upon with ADP and recommended that the course methodology stress practical, experiential, problem centered training within a workshop format (rather than a traditional course). The primary vehicle for learning and integration of knowledge was determined to be the case study method, using cases of the most likely situations which an engineer working at the small village level (1000 inhabitants and fewer) would encounter. Field visits were determined to be feasible and were made an integral part of the methodology.

1.4.3 Course Materials and Resources

It was decided to develop a course reference manual in Spanish, given that most of the literature on pumps exists in English, and that a set of materials supporting course goals would need to be assembled regardless. Examples of projects which had been developed by Guatemalan agencies (in larger systems) were gathered, and visits were made to local shops and pump supply houses to verify availability of resources.

1.4.4 Clarification of Scope of Work

It was determined that ADP was sufficiently experienced at training paraprofessionals to complete phases V and VI (develop and deliver a workshop for paraprofessionals in the course content after learning from WASH consultants) without additional support from WASH.

Chapter 2

PLANNING AND DESIGNING THE WORKSHOP

2.1 Planning Activities: The Need and Importance of Planning

The planning activities undertaken to develop this four-week workshop included a series of steps and more than 30 person-days of effort. Subsequent to the needs assessment, a Spanish speaking engineer in the U.S. immediately began to develop an introductory manual in pumping technology. A qualified Guatemalan engineer was identified to serve as the workshop technical trainer during this phase. A short planning conference was held in Guatemala to lay out course objectives and a working sequence of training activities and to define planning and development tasks. This was followed by training design and materials development conducted separately in Guatemala and the U.S. by the technical specialist and the training specialist. During the two weeks prior to the workshop, a training design was put together along with a draft instructor's manual and a student resource manual. This final preparation period took place in Guatemala.

The importance of all of this planning activity cannot be underestimated in achieving a well structured workshop which is conducted using experiential methodology. A case study cannot be thrown together at the last minute, particularly when it includes 12 problem steps and a reference manual. This workshop used four such case studies. Field sites must be researched and visited to ensure that they provide examples of engineering which parallel course content. Workshops and distributors need to be contacted to provide pump and pipe samples, etc.

2.2 Initial Design Meeting

An initial workshop design meeting was conducted in Guatemala City, which included the director of Agua del Pueblo (Carlos Gomez) and the two-person WASH consultant team (an engineer identified as the workshop technical instructor and a training specialist identified to provide training and workshop design expertise). The objectives of the meeting, held on May 3rd and 4th, 1982, were as follows:

- To reach final agreement on the specific workhsop content.
- To establish written goals for each component of the workshop.

- o To determine a tentative sequence and flow of the training activities and display them in block calendar form.

- o To discuss workshop methodology between the two WASH consultants and define what written materials, equipment, field sites, and resources would be needed.

- o To develop a workplan to address workshop materials development, design, and support needs prior to the workshop.

- o To determine roles and team assignments of WASH consultants and Agua del Pueblo.

- o To establish the exact dates of the workshop.

The results of this conference met the above objectives and are detailed below.

2.2.1 Workshop Goals

The following goals were developed on the basis of discussion and review of the initial goals, taking into consideration the available time of the workshop and the feasibility of delivery. These goals represent agreements between the course instructors and Agua del Pueblo.

At the end of the workshop, the participants would be able to:

a) Discriminate among technological options which are alternative to gravity flow systems for provision of water within the constraints of acceptable levels of potability.

b) Identify types of pumps in general and their uses (centrifugal, well pumps, hydro-ram); discuss sources of energy and their applications; demonstrate knowledge of the application of selection of pipe.

c) Design a system for the selected option in each case, taking into account the optimization of concurrent factors such as economics, technology, and socio-cultural concerns. Within the design, be able to work with (at least) the following three major pumping technologies:

   - Centrifugal pumps (horizontal and vertical)
   - Hydro rams
   - Positive action pumps (hand- and wind-propelled)

d) Within the above three options, demonstrate knowledge of the following factors:

   - Pumping curve

- Economical velocity of pumping
- Purchasing specifications
- Delivery inspection and testing
- Mounting
- Site-testing of pump with source.

e) Apply the skills and knowledge acquired in the workshop in a real field situation; and be able to transfer knowledge and skills to the technician level appropriate to the program needs of the sponsoring institution.

f) Discuss opportunities for coordination among the institutions represented in the workshop at the level of the engineer.

2.2.2 Component Objectives

The following represents an outline of the subject-matter for the development of specific learning objectives and lesson plans for each general goal.

Introductory Material

a) Course Goals and Objectives, Goal Agreement, Expectations and Norms, Ice-Breaker

b) Types of Pump: An Introduction

- Positive displacement
- Kinetic: centrifugal, piston: axial and mixed, regenerative
- Special types: jet, ejector, air, ram

c) Sources of Energy (motor-driven):

- Electric motor
- Internal combustion: gasoline and diesel
- Windmill

d) Pipe

- Materials: PVC, Galvanized iron, cast iron
- Criteria for selection: life span, use factors
- Fittings
- Accessories
- Specifications.

Specific Case Study Examples

Case A: Project with a centrifugal pump, horizontal axle (surface source)

- Selection criteria

- Pumping curve
- Economical velocity
- Selection of the appropriate pump
- Selection of the appropriate motor
- Suction
- Data for installation and planning
- Controls
- Additional equipment
- Specifications for acquisition
- Mounting
- Reception testing
- Operation manuals
- Maintenance manuals
- Economic and socio-cultural factors for target population of this selected alternative.

Case B: Project with a centrifugal pump with vertical axel (well source)

- Selection criteria
- Aquifer pumping test
- Pumping curve
- Economical velocity
- Selection of appropriate pump
- Selection of appropriate motor
- Selection of the transmission
- Installation data and plans
- Controls
- Additional equipment
- Location of wells: general introduction to aquifers
- Economic and socio-cultural characteristics of the target population with relevance for this selected alternative
- Specifications for acquisition
- Mounting
- Operation manuals
- Maintenance manuals

Case C: Project with hydro-ram

- Selection criteria
- Basic information
- Types of rams: imported, local manufacture
- Details of installation, plans
- Additional equipment
- Specifications for acquisition
- Mounting
- Operation and maintenance

Case D: Project with reciprocal pump powered by windmill

- Selection criteria
- Basic information
- Types of pumps

- Types of windmills
- Additional equipment
- Specifications for acquisition
- Mounting
- Operation and maintenance

2.2.3 Draft Sequence of Workshop

The following chart represents a first draft of how the workshop content would be sequenced and an approximation of hours intended per component. During the final design phase, which was to take place during the two weeks prior to workshop delivery, this schedule was to be adjusted.

2.3 Development of Training Materials

A student reference manual was developed (a copy is in the WASH library) to contain all of the necessary training materials and handouts for the workshop. The manual contains the four case studies used as the basis for the workshop. They were designed to provide maximum learning for typical situations in Guatemala. A wealth of reference material is compiled in the manual so that the student may use it as a guide to future problem-solving in pumping systems. The manual was designed also to serve the student with all of the information necessary to solve the case study problems presented. The manual is bound into two volumes and contains approximately 1,000 pages. Manual content includes:

- Introduction: Course content, schedule, case study method, benchmarks, and goals for each week.

- General Information: Sector analysis of water in Guatemala, introductory manual on pumps (Carlos Borge), procedures for designing pipe systems, pump selection guide, bibliography.

- Lecture Readings: Types of pumps, sources of energy and catalogue selections on motors, slide rule for electrical wiring selection, notes and catalogues on pipe, couplings and fittings, slide rule for selection of pipe.

- Case Studies and Supporting Materials: (Sections 4-7) Four case studies, (centrifugal pumps with a horizontal axle, and with a vertical axel, hydro-rams, and windmills). Supporting materials include calculation of curves, NPSH, water hammer, catalogues, electric motors, diesel motors, installation, mounting, reception, testing, operation, maintenance and controls.

- Pipe Hydraulics: Notes on the hydraulics of pipe.

SELECTION OF ALTERNATIVE TECHNOLOGIES
FOR POTABLE WATER SUPPLY TO RURAL COMMUNITIES

Schedule of Activities

	Monday	Tuesday	Wednesday	Thursday	Friday
Week I	Orientation & Goals Pumps	Pumps Motors	Pipes Motors	Motors	Case A
	Case A	Case A	Case A	Case A	Case A
Week II	Case B	Case B	Field Visit	Case B	Case C
Week III	Case C	Case C	Field Visits	Field Visits	Case D
Week IV	Case D	Case D	Institutional Coordination	Conclusions &	Transfer to Work Planning
				Applications	Conclusions & Closure

AM		PM	
	8-9		2-3
	9-9:50		3-3:50
	10:10-11:00		4:10-5:00
	11:00-12:00		5:00-6:00

- Resolved Problems: Examples of problems which have been solved; laws of affinity, system curves, economical velocity, economic comparisons of pumps, NPSH, pump selection, cost benefit study, calculating annual operation cost, hydro-ram selection.

2.4 Development of Instructors' Manual

An instructors' manual (copies available through WASH) in draft form was developed during the two weeks prior to workshop implementation. This last planning effort, along with the development of the student reference manual, brought the content and methodology into sharp focus and resulted in the final schedule which appears in the next section of this report.

The instructors' manual was drafted both to use for workshop delivery and to serve as a guide for future instructors. During the workshop delivery, this manual was sharpened and refined after each session. The content of the manual includes:

- Introduction: Workshop description, general goals and objectives, use of the manual, workshop methodology, schedule, the use of the journal in the workshop, and evaluation forms.

- Day-by-Day Designs: A training design is provided for each session, complete with session objectives, activities, and content guides. This part of the manual is divided into weekly sections with goals and benchmarks for the week.

- Annexes: The annexes include the solutions to the four case studies (for instructor use only), a Spanish-English vocabulary of pumping terms, and graphics and illustrations.

Chapter 3

IMPLEMENTATION

3.1 Introduction: Dates, Location, Participants

The workshop was held in Agua del Pueblo's Guatemala City offices and training room from July 5 through July 30, 1982. The workshop was entitled "The Selection of Technology Alternatives to Gravity for Water Supply to Rural Communities", although the instructors and participants commonly called it "The Pump Workshop", as this was the focus of the activity.

There were ten participants from four agencies in attendance. All the participants were younger than 30 years of age and none had been working in his field more than five years; many had worked a good deal less. Eight of the ten participants held engineering degrees and two were finishing up their last preparation for final exams or thesis. None of the participants had worked with pumping system design or pumps before. Most had worked with gravity flow systems, some extensively. Although the participants had received some general theoretical introduction to hydraulics in engineering school, the concepts and formulas were rusty and needed to be dealt with in the course as review. A list of participants and agencies follows:

- Ministry of Public Health, Division of Environmental Sanitation

  Pedro Saravia
  Betsy Thompson (Peace Corps Volunteer)
  (third name is missing on list submitted)

- Office of the Presidency, Community Development Office

  Juan Nitsch
  Emilio Aragon
  Ruben Dario Calderon

- Caritas, a dependency of the Catholic Church

  Adalberto Quinones
  Porter Rivers (PCV)

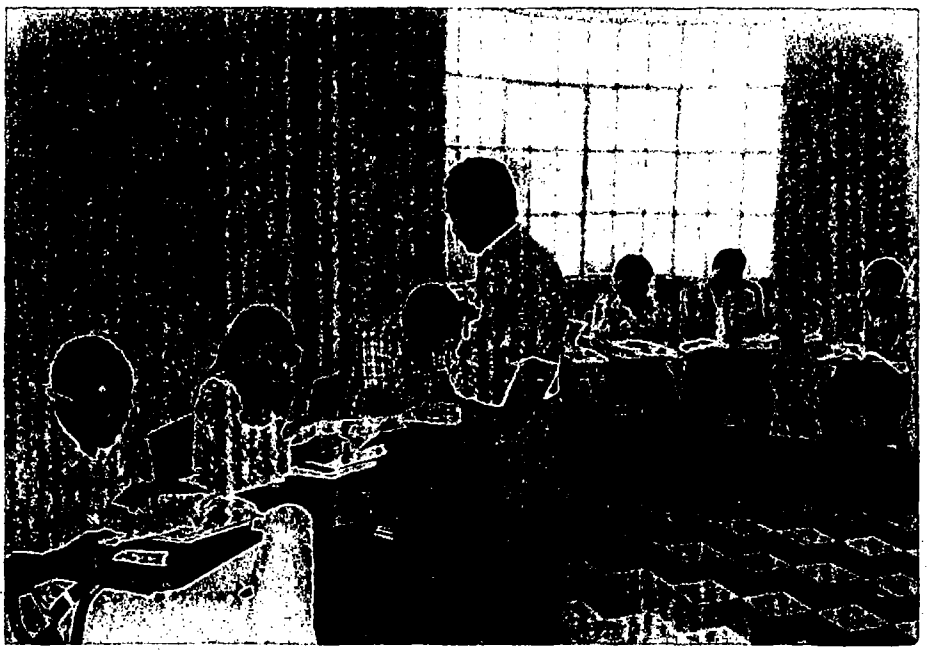
- Agua del Pueblo

  Emelio Falla
  Carlos Cordon (Guest)

The training site was a large room with desks, chairs, and a blackboard. Newsprint and colored magic markers were used extensively for drawings. Although most activity took place

The Participants

The Classroom



Using the Reference Manual

within the training room, short trips were made to pump distributors, repair shops, a commercial engineering firm with a catalogue library, and six different field sites where installation examples could be studied and critiqued. Each participant brought a hand calculator and they were provided with a student reference manual and two slide rules; one for calculating electrical wire, the other for calculating pipe.

3.2 Methodology: Extended Case Study Method

A variety of experiential, adult learning methodologies were used throughout the workshop. The primary approach underlying all of the methods can be summed up with the statement, "Let them learn by doing it themselves; then let's all learn from what they did."

The key learning vehicle in the workshop was a series of extended case studies. This is a particular variation of case study methodology which is problem centered. The case study was structured in two parts; a general description of a community situation needing to transport and distribute water. Facts were built into the situation so that the student could focus on alternative solutions to solving the overall problem. The second part of the case study was a breakdown of the case into a series of step by step specific problems. This was called the "case study guide." After presentation of the overall case, the instructor would ask the group to work on sub-problem number one in task teams. After this was completed, the students would present their proposed solutions which would be critiqued.

In order to solve the sub-problems the students needed theory inputs. These were available in a variety of forms: they could get the information by reading the reference materials in their manuals, and/or short lecture-demonstrations would be given by the instructors. The students were even required to leave the classroom, go to distributors and select locally available or orderable equipment using current catalogues, calculate prices and do cost-benefit analysis on the useful life of the system. They were also required to do independent study and assist each other in task teams.

After a particular case was completed (or at some point near completion), a field visit would be made to inspect installations similar to those in the cases. A field visit protocol (an inspection form) was developed which required the student to collect data on the field visit. These data were then analysed back in the classroom and the students and instructors critiqued the installation. By the time the case study was complete (several days of work), every step in system design, calculation, selection of equipment, purchase, inspection, installation, maintenance and operation would be covered. This method is summarized in the following graphic. (See figure 1).

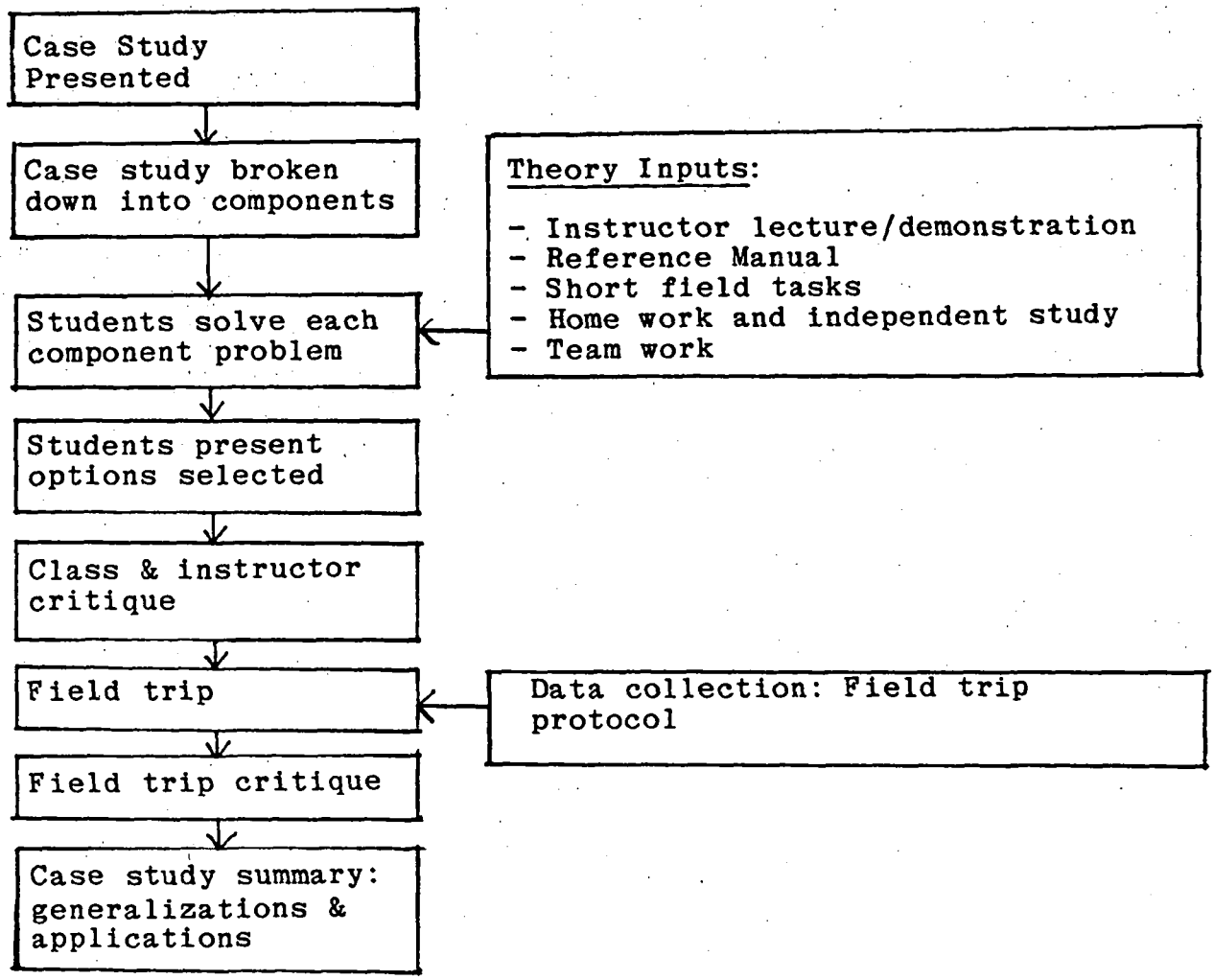
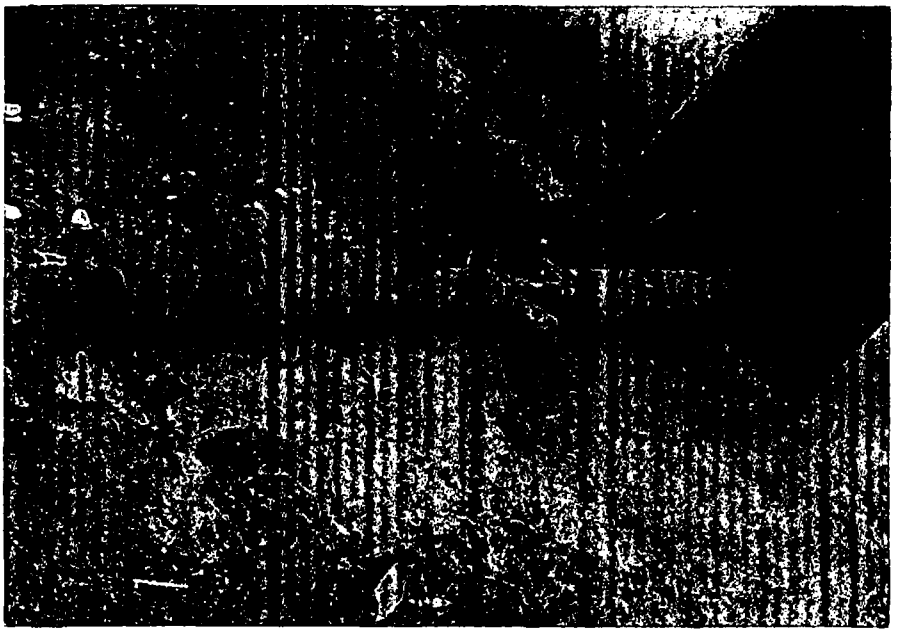


Figure 1: Extended Case Study Method

Field Trip to a Repair Shop

Field Trip to a Repair Shop

Field Trip to see an Installation



Centrifugal Pump: Submersible Electric Motor
(Field Trip)

Workshop Team Tasks

The entire focus of this case study method was toward practical application. The assumption was always "You are going to be doing this on your job next month; be sure you can do it."

3.3 Goals, Objectives and Sessions

The goals and objectives noted previously (2.2.1, 2.2.2) became the guiding goals for the workshop. These were sequenced and broken down into weekly benchmarks (at the level of expected outcomes for a given week). In turn, for each session, a guiding goal or objective became very specific for the session. The weekly benchmarks and sessions are listed below (the specific session objectives are in the Instructors' manual).

Benchmarks, Week one

By the end of Week One, the participants would have:

- Understood the methodology and norms of the workshop
- Understood and agreed to the workshop objectives
- Had a general introduction to the types of pumps which were appropriate to the four case studies in Guatemala
- Had a general introduction to the types of motors available for the case studies
- Had an introduction to pipe

Sessions, Week one:

Monday:

1) Introductions, Goals of the workshop, Methodology, Workshop norms (2 hrs)
2) Pumps which apply to water supply projects in Guatemala (3 hrs)
3) General introduction to pumps: Hydraulics (1 hr)

Tuesday:

4) Introduction to pumps: Hydraulics (continued) (2 hrs)
5) Introduction to motors (2 hrs)
6) Case Study A: theme, case presentation, source's rate of flow, schematic

Wednesday:

7) Introduction to pumps (Centrifugal), (2 hrs)

8) Hydraulics of pipe (2 hrs)

9) Case A continued: Theme, economical velocity (2hrs)

Thursday:

10) Pump assembly: Visit to repair shop (2 hrs)

11) Introduction to motors, electrical (2 hrs)

12) Case A continued: Theme, system curves

Friday:

13) Introduction to couplings (2 hrs)

14) Introduction to pipe: Specifications, connectors, selection (2 hrs)

15) Case A: Theme, continuation of system curves.

Benchmarks, Week Two

By the end of week two, the participants would have:

- Studied and applied Case A: Centrifugal pumps with a horizontal axel
- Studied and applied the techniques necessary to determine pumping economical velocity, and developed system curves for pumping, laws of affinity, and suction head
- Learned how to select a centrifugal pump mounted with a horizontal axel and powered by an electric motor
- Learned how to write specifications for pumping equipment
- Learned techniques for reception testing and mounting a pump
- Studied factors necessary for operation and maintenance and how to use the corresponding manuals
- Made field visits to installations similar to Case Studies A and B and critiqued Case A installation.

Sessions, Week Two:

Monday:

(Note the sequence of sessions were changed due to logistics so the session numbers are not sequential this week. They are presented in the order in which they were given.)

28) Case study B: Theme, presentation of the case, sources of water, rate of flow, schematic (1 hr)

29) Methodology of conducting a pumping test (2 hrs)

30) Selection of a turbine pump, vertical axel with a combustion motor (3 hrs)

Tuesday:

Field visits: Submersible electric pump, horizontal axial pump, couplings

Wednesday:

Field visits: Diesel motors, horizontal axial turbine pump, hydro-ram

Thursday:

16) Case Study A continued: Theme, laws of affinity (2 hrs)

17) Case A: theme, specific velocity (1 hr)

18) Case A: Theme, NPSH (1 hr)

19) Introduction to Water Hammer

Friday:

20) Case A: Theme, pump selection (4 hrs)

21) Case A: Installation scheme, controls and additional equipment (2 hrs)

Benchmarks, Week Three:

By the end of week three, the participants will have:

- Studied and applied Case Study B: centrifugal turbine pumps with a vertical axel
- Learned how to select a turbine pump with a vertical axel powered by an internal combustion engine

- o Learned to select a submersible pump powered by an electric motor
- o Studied and been introduced to subterranean water
- o Studied the methodology for doing a pumping test
- o Made two field visits to installations corresponding to the Case studies and applied their accumulated skills
- o Learned to appropriately locate a pumping station
- o Studied and applied Case Study C: Hydro-rams'
- o Learned to select the appropriate hydro-ram for a particular situation

Sessions, Week Three:

Monday:

23) Case Study A: Theme, electric motors (1 hr)

24) Case A: Specifications (1 hr)

25) Case A: Mounting and testing (1 hr)

26) Case A: Operation and maintenance (2 hrs)

20) Student presentation of solutions, case review (2 hrs)

Tuesday:

31) Case Study B: Theme: continuation of case guide, system curve (4 hrs)

32) Selection of turbine pumps with a diesel motor

Wednesday:

35) Field visit: Windmills, city of Guatemala pumping purification plant

Thurday:

33) Case B: Continuation of study guide, presentation of solutions (4 hrs)

34) Investigation of ground water (2 hrs)

Friday:

37) Case C: Theme, presentation of the case, water sources, rate of flow, schematic (1 hr)

38) Installation and selection of a hydro-ram, case presentation of solutions

Benchmarks, Week Four:

By the end of the fourth week, the participants will have:

- o Learned different ways to construct and design hydro-rams
- o Studied and applied Case D: Windmills
- o Studied sources of information on wind
- o Learned to select a pump powered by a windmill
- o Learned how to determine the specifications for a windmill and understand maintenance and operational requirements.
- o Reviewed all of the case studies, cleared up misconceptions and developed criteria for the selection of the right equipment available locally.
- o Discussed and developed criteria for interagency coordination at the engineer level
- o Considered ways to appropriately transfer their knowledge to all necessary project interfaces
- o Evaluated the process, goals and achievements of the workshop
- o Completed the graduation ceremony.

Sessions, Week Four:

Monday:

39) Case C: Theme, different types of Hydro-rams (3 hrs)

40) Case D: theme presentation of the case, calculation of rate of flow, water sources (3 hrs)

Tuesday:

41) Case D: Theme, selection of a windmill pump (4 hrs)

42) Cases C & D: Specifications of operation and maintenance (2 hrs)

Wednesday:

43) Review: Criteria for equipment selection, local conditions (3 hrs)

44) Interagency coordination (3 hrs)

Thursday:

45) Applications and conclusions: How to transfer knowledge to necessary project interfaces (3 hrs)

46) Applications and conclusions: Review of principal skills and knowledge of the workshop (3 hrs)

Friday:

Final evaluation (4 hrs)
Closure and graduation

3.4 Staff

The staff for the workshop consisted of two Guatemalan engineers, one Guatemalan hydrogeologist, and a training specialist from the U.S. The principal workshop instructor was an engineer with an M.A. in hydraulic engineering from the University of Minnesota. The secondary instructor held an M.A. in sanitary engineering from UC/Berkeley, and two sessions were given by the hydro-geologist, who held a PhD from the University of Neuchatel, Switzerland. The training specialist was bilingual and held a BA from UC/Berkeley and an MA from Antioch University in Educational and Social Psychology (see resumes attached, Appendix D).

The staff was exceptionally well qualified for a course of this type. Both principal technical instructors had more than 20 years of practical experience working within Guatemala, both for public institutions and in private engineering firms. They were familiar with what was feasible locally and could arrange quick access to innumerable local resources, field sites, local repair shops, local distributors, pumping installations, and guest lecturers. Both were exceptionally supportive of the training methodology which the training specialist was bringing into the workshop. There was a healthy blend of practical experience and theoretical preparation among the staff.

3.4.1 Staff Roles

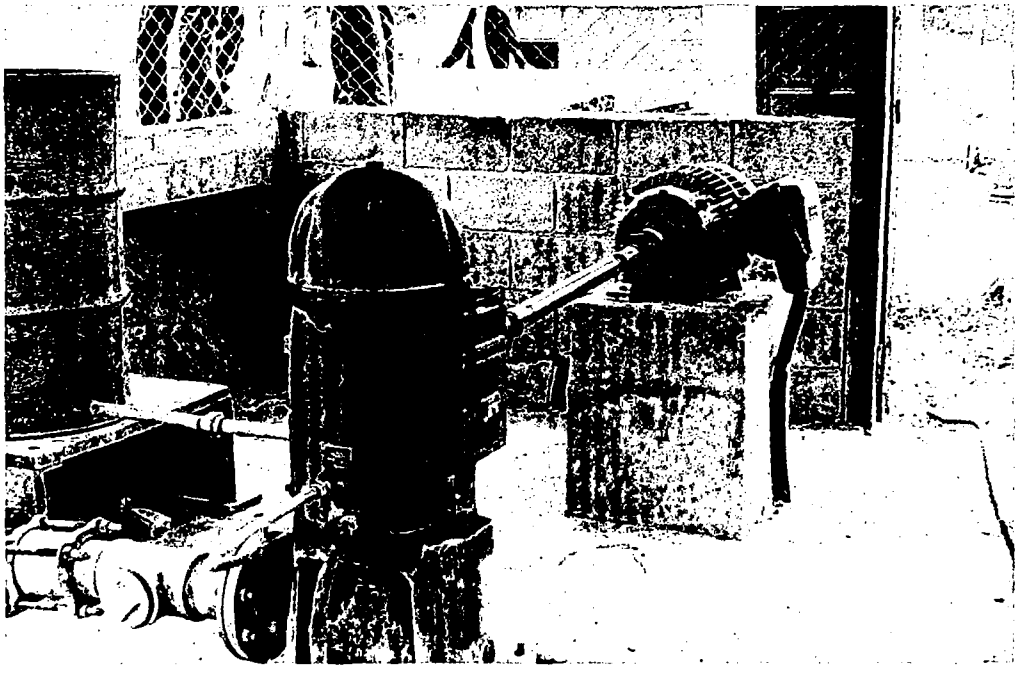
Because of the unique blend of specializations among the staff it was important that roles be defined clearly. The lead instructor was responsible for delivering the technical material on a daily basis and briefing the secondary instructor and any guests on the technical development of the workshop. The training specialist was responsible for designing the way the material would be presented, working with the instructors

ahead of time, watching the delivery, and debriefing the delivery after each day. In addition, the training specialist was rewriting the instructors' manual and documenting the design as it unfolded each day. Logistics were handled by both.

The training specialist was also responsible for communicating weekly benchmarks, doing group maintenance tasks (such as the weekly feedback session) and managing the evaluation sessions and any non-technical sessions.

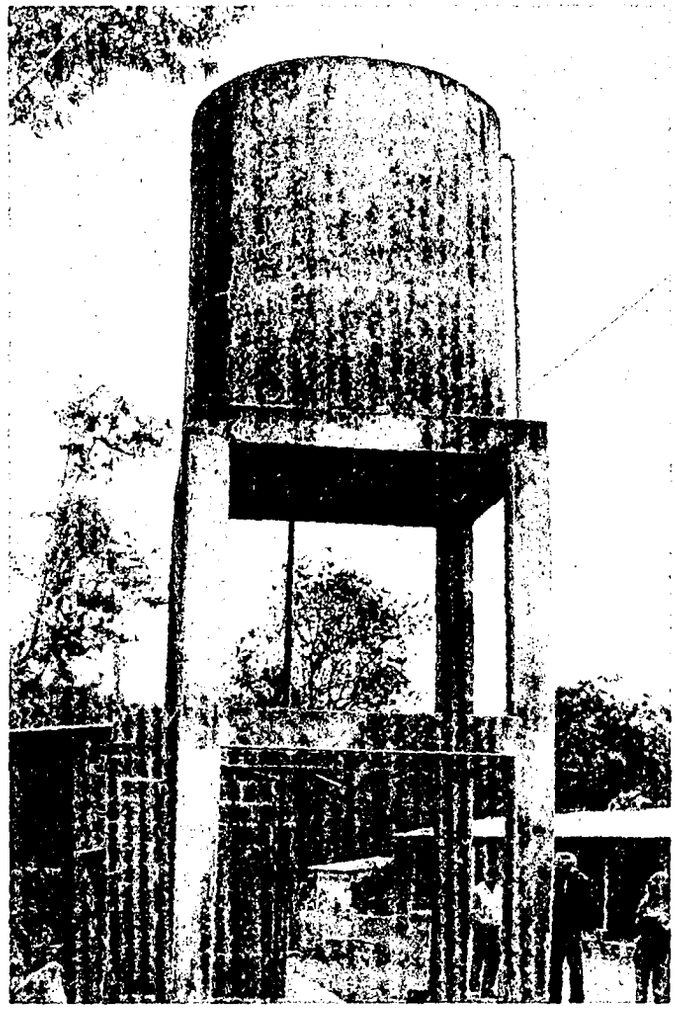
The combination of specialties served to produce an effective course delivery and was a key factor in the success of the program.

Field Trip: Demonstrating a Watson-Spicer Coupling



Field Trip: Vertical Axel Centrifugal Pump, Electric Motor Powered, Watson-Spicer Coupling.

Field Trip: Taking Altimeter Reading



Field Trip: Storage Tank for Hydro-ram System

Chapter 4

EVALUATION OF RESULTS

4.1 Overview

Various methods were used to evaluate the workshop. Formative evaluation was conducted each week by using a trainee reaction opinionaire and a verbal feedback session. Measurable (summative) evaluation was conducted daily and at the end of each case study presentation by examining the results of the calculations and problem solving steps which each participant carried out. By reflection and discussion on the two above methods, the instructors were able to adjust the pace, presentation, and level of instruction, and make some final decisions on how to improve the next workshop. An evaluation should be conducted by WASH within six months to determine the extent to which the participants are able to carry out successful field work on pumping systems. This would provide a measure of final course results which was not within the scope of this effort. This section summarizes a) instructor evaluations, b) weekly opinionaires and c) final evaluation forms.

4.2 Instructor Evaluations

The instructors' observations of all participants during the case work indicate that they successfully completed all of the cases, were able to make all the necessary calculations, met all of the training goals and objectives, and should be able to apply the workshop skills and knowledge in their work.

The participants were highly receptive to the practical methodology, demonstrated a lively curiosity, and worked diligently throughout the four weeks. The level of instruction was appropriate for most of the participants. Some worked more slowly than others, but the pace was altered to ensure that everyone understood all of the material before proceeding.

In retrospect there are some things that would be changed to make the material fit into a more effective learning scheme. The original design was logically sequenced (and the instructor's manual reflects this original thinking). However, due to a series of logistical constraints, the schedule was altered. As a result some of the case studies overlapped in treatment and some field visits were made before the participants had enough information to be able to knowledgeably critique what they were seeing. This required that they gather data, then reflect back on the field visit after the fact.

Another area which should be improved, given a future opportunity, is the instructor preparation for using experiential methodology. A workshop of this nature should allow a two or three day period of staff training for familiarization with experiential methods. This did not take place because of time constraints. Consequently, some of the instructors were more successful than others in working a case study and following a methodology which stresses student responsibility. The training specialist, therefore, was required to work daily with the instructors to improve their methods without having had the benefit of laying a basic methodological foundation. This proved awkard at times, especially with guest instructors who moved into an ongoing set of procedures and group norms. The worst feedback from the participants was in situations such as these.

4.3 Student Evaluations: Weekly Opinionaires

To interpret the following results, a Likert scale of 1=low, 5=high was used to measure goal achievement. Comments are summarized and translated from Spanish to English.

Week # 1

A. Achievement of Goals	Score
1. To understand the methodology and norms of the workshop; to understand the objectives.....	3.8
2. General introduction to the types of available pumps which apply to the case studies.....	4.3
3. General introduction to the types of motors available which apply to the case studies.....	3.8
4. Introduction to the types of pipe available.....	4.4
5. Case A: Economical velocity.....	4.5
6. System curves.....	4.8
7. Introduction to couplings.....	3.8

B. Level of instruction

The level of instruction to this point is:

Too simple	Appropriate	More complex than necessary, but understandable	Much more complex than desirable
1	8	1	

N = 10 respondents

C. What skills and knowledge stand out as significant for this week?

Types of pumps, types of motors, use of pumping and system curves, couplings, economical velocity, calculating pipe, learning how to use catalogues.

Week # 2

A. Achievement of Goals

1.	General introduction to goundwater and pumping tests.....	3.13
2.	Field visit. Know visit protocol, Cases A and B applied.....	4.33
3.	Learn laws of affinity.....	4.11
4.	Learn specific velocity.....	4.44
5.	Learn NPSH.....	4.33
6.	Learn Water Hammer, an introduction....	4.00
7.	Pump selection, Case A.....	4.22
8.	Installation schemes, Case A.....	3.50

Week # 3

A. Achievement of Goals

1.	Learn to select a vertically mounted axle) turbine pump powered by an internal combustion engine.....	3.8
2.	Learn to select an electric submersible pump.....	4.1
3.	Study the methodology to conduct a pumping test.....	3.4

4. A basic introduction to aquifers and subterranean water..... 3.6

5. Field visits: windmill and pumping station, water treatment plant..... 4.0

6. Case study C, Selection of a hydro-ram, theory of rams..... 3.8

B. Level of Instruction

The level of instruction to this point is:

Too simple	Appropriate	More complex than necessary, but understandable	Much more complex than necessary
	5	2	

N = 7

C. What skills and knowledge stand out as significant for the week?

The selection of a turbine pump with a vertical axel powered by a diesel engine.
How to conduct a pumping test
Introduction to hydro-rams
Submersible pumps

Week # 4

A. Achievement of Goals

1. Learn methods of hydro-ram construction.. 4.0

2. Case D: learn sources of information on wind and the selection of windmill driven pumps..... 3.5

3. Comparison of case studies: developing criteria for pump and system selection... 4.1

4. To explore ideas for interagency coordination..... 3.8

5. To consider methods for transfering knowledge to the necessary project interfaces and others at work..... 3.9

B. Level of Instruction

Appropriate	More complex than necessary, but understandable
5	1

N = 6

C. What skills and knowledge stand out as significant for this week?

Selection and design of hydro-rams
Selection of windmills

4.4 Student Evaluations, Final Course Evaluations

The following evaluation questionnaire was given the last day of the workshop. The results are tabulated and presented with the questionnaire. Comments are recorded as given and translated into English. All comments are recorded and if comments were repeated, they are only listed once.

Final Evaluation Questionnaire

1. What do you consider to be the strengths and weaknesses of the workshop?

Strengths:

- The technical material covered especially the following areas: centrifugal pumps, submersible pumps, parameters of pipe design, hydro-rams, motors, couplings, systems curves, pumping test, cost analysis, norms and specification of system design and construction, pump selection.
- The course established a good foundation for continued learning.
- The field trips for application of knowledge.
- Learning how to use the catalogues.
- The applied nature of the workshop.

Weaknesses:

- The presentations on aquifers and ground water needed more time.
- The light treatment of windmills.

- o Switching and overlapping of case studies.
- o More work on using catalogues
- o More on how to do the calculations for electric wiring and motors.
- o More on installation.
- o Too much material, too intense.

2. As a result of the workshop, how comfortable do you feel designing a water supply system using the knowledge gained form the workshop?

Not very comfortable: 0 responses

Able to do it with considerable technical assistance: 0 responses

The first time will be difficult but, yes, I can do it: 6 responses

I feel well trained and able to do it: 3 responses

3. Application

During the next two years, how many pumping systems do you anticipate designing based on information of agency demand?

0-1: 0 responses
2-3: three responses
4-5: two responses
6 or more: four responses

4. Workshop Methodology

In the workshop a series of training methods and resources were used. Please indicate how successful the following techniques were for you. (Scale of 1 = low; 5 = high).

a)	Field visits	4.7
b)	Reference manual	4.3
c)	Classroom training	4.7
d)	Written handouts and readings	4.2
e)	Visits to repair shops	3.7
f)	Case studies	4.3
g)	Problem exercises	4.4
h)	Use of diary	3.6
i)	Small group work	3.6
j)	Step by step case guide with instructor	4.0

5. What changes would you suggest in the training methodology?

- o More reading and problem work at home, less in class
- o Don't do field visits until the case has been covered
- o Organize the reference manual so it is easier to find things
- o More practice, less theory, less end of session student recaps
- o Use more audio-visual aids
- o Do more field visits

6. Overall Goal Achievement

Mark the rate of goal achievement on the following workshop objectives:

a) Be able to discriminate between technological options which are alternatives to gravity flow systems..... 4.4

b) Be able to identify types of pumps in general.. 4.3

c) Discuss sources of energy for pumps and their applications..... 4.2

d) Be able to demonstrate applied knowledge of pipe selection..... 4.8

e) Be able to demonstrate applied knowledge of pump selection..... 4.5

f) Be able to demonstrate applied knowledge of motor selection..... 3.7

g) Be able to demonstrate applied knowledge of couplings..... 3.4

h) Be able to demonstrate applied knowledge of wiring..... 3.4

i) Be able to design an option similar to the case study mod..... 4.5

j) Be able to use and apply the following technologies:
centrifugal pumps..... 4.5
hydro-rams..... 4.5
windmills..... 3.6

7. To what extent do you know how to transfer technology to the appropriate person in a project?..... 3.6

8. What suggestions do you have for workshop follow-up?

   - o Establish a good technical library with catalogs
   - o WASH should circulate publications and articles on pumps to our agencies, and we should internally do the same between agencies
   - o WASH should set up a consultation process for a few days next year for Engineer Cordon so we can get help if we need it
   - o A workshop in water distribution methods
   - o Do a survey in a few months to see how we are applying the knowledge
   - o Do a workshop in aquifers and subterranean water
   - o Hold regular meetings of the group

Chapter 5

RECOMMENDATIONS

5.1 Replication of the Model

Discussion:

The training model which this project has developed has proved that it is indeed possible to train engineers in development agencies in pumping technologies appropriate to local needs using a short four week workshop process. The need in Guatemala was great. Discussions with members of the WASH staff with contact throughout the developing world indicate that the need also exists in many developing countries. This particular workshop has been put into a replicable format with the instructor's manual and the student reference manual. It can easily be adapted to other Spanish speaking countries as is. Similar projects could be developed in other parts of the world in other languages (or in English).

Recommendations:

The following recommendations derive from this discussion:

- As the need is documented, this course should be given in other Spanish speaking countries. Adaptation to local conditions would be minimal. The case studies, while typical of Guatemala, are generally applicable.

- A core of engineers from Spanish speaking countries could be trained in how to apply this model as one option. The course could then be given in each country separately and adapted locally.

- Opportunities to achieve economies of scale could also be considered, in addition to the above option, by combining engineers from many countries into a single workshop. Locally applicable "know how" in field experiences would be sacrificed, however.

- Similar efforts in other parts of the developing world should be actively pursued when needs exist.

5.2 Continued Use of the Paradigm

Discussion:

This project demonstrated that it is indeed possible to use experiential training methodology, combining an engineer with a great deal of practical experience and a training specialist, to produce a useful, practical model to transfer tech-

nology. By using training technology and training organization, it was possible to distill skills, knowledge and a great deal of practical experience into a workshop. This is an alternative to longer term solutions to training such as internships and traditional education followed by on-the-job training. However, it should not be assumed that this formula automatically produces the desired results. There are a number of conditions which need to be met for a successful effort in which the engineering and training specialties are blended to design and deliver a workshop.

In order to continue efforts such as these, care should be exercised to ensure that the recommendations below are followed:

- There needs to be a local institutional support structure for the training. The type of management and logistical support provided by Agua del Pueblo was essential.

- The proper staff must be selected. The technical trainer must be open to trying out experiential training and be able to communicate in front of groups. He/she must be open to feedback and suggestions from the training specialist and genuinely interested in helping people learn in non-directive ways. The training specialist must be curious about the technology and willing to learn how to deal with technical material.

- A great deal of planning time must be provided for design and development of the workshop as well as for prior staff training and arrangement of workshop events. This is true even when training materials have already been developed.

5.3 Summary

This project has demonstrated the viability and usefulness of a workshop approach to skill transfer in pumping technologies for engineers. It has demonstrated the importance of careful planning for needs assessment, workshop design, and materials development. It has also shown that information and skills can be distilled by experienced pratitioners and learned by inexperienced young engineers in a relatively short time using experiential learning and a case study/field application methodology. Ultimately this project contributes to model of technology transfer by combining training specialities and technical specialties in a productive collaboration process.

APPENDIX A

WATER AND SANITATION FOR HEALTH (WASH) PROJECT
ORDER OF TECHNICAL DIRECTION (OTD) NUMBER 76

December 29, 1981

TO: Dr. Dennis Warner
WASH Project Director

THRU: Victor W.R. Wehman, Jr., P.E., R.S.
AID WASH Project Manager
S&T/HEA/CWSS

FROM: John H. Austin
S&T/HEA

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

REF:
1. Letter Cox to Cohn, 27 July 81
2. Memo Cohn to Mantione (August 11, 1981)
3. WASH Cable 127 of 30 October 1981
4. USAID/Guatemala Cable No. 07672 of 11 November 1981
5. Scope of Work

1. WASH contractor is requested to provide the technical assistance to USAID/Guatemala as per Ref. 5.

2. WASH contractor is authorized to expend 130 person days over a 12 month period to accomplish this technical assistance effort.

3. Contractor to coordinate directly with USAID/Guatemala (Paul Cohn). Ensure that this OTD is provided to and discussed with (Charles Mantione) and the Guatemala desk officer. Keep these people advised of progress.

4. One hundred and five (105) days of international or domestic per diem is hereby authorized.

5. Local travel and transportation within Guatemala is authorized as necessary. WASH contractor to rent car, vehicles, and pay taxis as appropriate to to accomplish mission outside Guatemala City.

6. Seven day work week in Guatemala authorized if necessary and certified by WASH Project Director.

7. Miscellaneous expenses authorized NTE $2,500.

8. Contractor authorized to hire secretarial and/or drafting services up to NTE 30 person days in the U.S. and/or Guatemala.

9. Contractor should make weekly contact with WASH Project Director, with written reports at the end of each phase.

agua
del pueblo

7a. Avenida Norte No. 84 - Antigua, Guatemala, C. A.
Cable: ADPGUAT - Teléfono 0320558
Apdo. Postal 369

ADPGUAT 159
July 27, 1981

Mr. Paul Cohn
USAID/Guatemala
Embajada de los EE.UU.
Guatemala, Guatemala

Dear Paul:

Greetings from Antigua. This will be my last communication with you before I head for the U.S. to begin my new work with ADP in California. Let me start, then, by saying how much I've enjoyed working with you in the last few months, and how pleased I am that AID made the choice it did for Scott Edmonds' replacement. We have every hope that our relations with the AID/Guatemala Health Division will continue to be as happily symbiotic during your tenure there as they were during Scott's.

The specific motivation for this letter is to request your assistance in arranging technical assistance for ADP through AID's new WASH program. We understand that this program makes various types of technical assistance available to organizations such as ours, given local AID mission approval of the request. We are at a stage in our growth in which technical assistance in the development of our in-house capabilities in some alternative water and sanitation technologies would be very useful.

Getting down to specifics: as you know, ADP has for the last nine years been designing and building rural water supply systems, using, for the most part, gravity-flow technologies. We have had some experience with other technologies (for example, we just completed a hydraulic ram project in Santa Rosa), but we acknowledge that our expertise in these other technologies is quite limited.

What we would like, then, are the services of a WASH-sponsored, Spanish-speaking specialist who would be able to come to Guatemala for a period of a month or two to work with our two Guatemalan staff engineers and our paraprofessional rural water technicians. The purpose of the visit would be to give our technical staff some practical, applied instruction in the design, construction and maintenance of village water systems using pumps and wells, hydraulic rams, rain collection cisterns and other technological alternatives appropriate to this region. The instruction would, ideally, include lessons in evaluating and choosing between alternative approaches, as well as the design, construction and maintenance instruction mentioned earlier. If the same specialist were also able to offer guidance on the use of alternative latrine designs, that would be excellent.

Please let us know as soon as possible what you think of this request, and whatever you can tell us about how we should go about preparing a more detailed request for WASH. We look forward to your response.

I'll be back in Guatemala in early 1982 for a month or so to touch base with our Guatemalan crew. In the meantime, you may communicate with Matt Perl, our new Guatemala-based program advisor, whom you've met, or with me, at 1813 Meadowview, Petaluma, CA 94952, phone (707)778-6920. Take care of yourself. Let's keep in touch.

Regards

Stephen Cox
Associate Director

WASH Proj. File.

OPTIONAL FORM NO. 10
JULY 1973 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Charles Mantione, LA/HN **DATE:** August 11, 1981

FROM : Paul Cohn PHD/USAID/Guatemala PC

SUBJECT: Request by Agua del Pueblo thru USAID/Guatemala for WASH services

Agua del Pueblo (ADP) is a PVO formed in 1972 to work only in Guatemala on rural potable water supply and latrine programs. ADP assists small rural communities in developing, constructing, maintaining and financing the water/sanitation systems themselves. ADP supplies technical assistance in the various phases of organization and construction, assists in identifying loan sources for the community, and provides small "pump priming" grants when essential. ADP has worked with more than forty communities almost all of which have excellent records both in system maintenance and loan repayment without further ADP assistance. ADP is currently completing a contract with the Ministry of Health, under a USAID/Guatemala grant/loan, to train nine Rural Health Technicians to be Rural Water Technicians working directly for the Ministry.

The demand for ADP services based upon expertise and past performance is growing as is their funding and staff. The ADP expertise is primarily in small gravity feed systems and they are interested in expanding their expertise into other technologies. USAID/Guatemala has worked with and supported ADP for several years and supports this request for WASH Project general technical assistance. The ADP request to AID/GUAT is attached. We underline the necessity for supplying the T.A. in Spanish as their staff, with one exception, is Spanish speaking only.

We would appreciate hearing from you as soon as possible.

c.c. DS/HEA/EH WASH Project Officers

Encl.: as stated

Passed to WASH 8/18/81

Received ST/HEA (Wehmann) 8/18/81

Advance info.

C-1

WUI GA
111Z*
WASHAID 64552

TELUS 014 1545 10/30
FR

TO: USAID MISSION
AMEMBASSY
GUATEMALA CITY (GUATEMALA)

ATTN: PAUL COHN

FROM: DAVID DONALDSON
WASH PROJECT

OUR CABLE 127

1. FOLLOWING OUR CONVERSATION REGARDING YOUR LETTER OF 11 AUGUST TO CHARLES MANTIONE, LAC/DR/HN, WASH HAS SPOKEN TO STEVE COX AND BRUCE CLEMENS OF AGUA DEL PUEBLO, ADP AND WE SUGGEST THE FOLLOWING PROGRAM OF WORK THAT WILL COVER ABOUT SIX WEEKS (THIRTY PERSON DAYS) USING THE SERVICES OF A SPANISH SPEAKING PROFESSIONAL WITH EXPERIENCE IN: A) DESIGNING, CONSTRUCTING, OPERATING AND MAINTAINING WELLS, SMALL PUMP STATIONS, VILLAGE WATER DISTRIBUTION AND SANITATION SYSTEMS, B) MAKING NEEDS ASSESSMENT AND TASK ANALYSIS, AND C) CONDUCTING SHORT COURSES. DEPENDING ON THE INITIAL ANALYSIS, THE PROPOSED PERIOD MAY HAVE TO BE LENGTHENED.

2. THE MISSION WILL BE CONDUCTED IN TWO PARTS. THE FIRST WILL BE TWO WEEKS IN GUATEMALA TO DEVELOP NEEDS ASSESSMENT, TASK ANALYSIS AND DETERMINING SKILL LEVEL OF ADP STAFF AND THEN DEVELOP AND DISCUSS WITH ADP THE PROPOSED TRAINING PACKAGE FOR TARS AND ENGINEERS. THE CONSULTANT WOULD THEN RETURN TO NORMAL PLACE OF RESIDENCE DURING WHICH THE CONSULTANT WOULD DEVELOP SUCH MATERIALS WHICH WOULD TAKE PLACE DURING THE SECOND PHASE OF THE MISSION.

3. THE SECOND PHASE OF THE MISSION WOULD BE THREE OR MORE WEEKS IN GUATEMALA FOR TRAINING TO PRESENT TECHNICAL CONCEPTS AND DISCUSS THESE WITH ADP STAFF. FORMAL PRESENTATION WOULD BE INTEGRATED WITH WORKING WITH AGUA DEL PUEBLO STAFF IN PRACTICAL FIELD APPLICATION OF MATERIALS PRESENTED IN THE COURSE TO ACTUAL SITUATIONS. DURATION OF LECTURE AND FIELD WORK WILL BE BASED ON RESULTS OF FIRST PHASE MISSION.

4. THE OBJECTIVES OF THIS EFFORT WOULD BE FIRST TO WORK WITH TEN TARS, AND TWO CIVIL ENGINEERS FROM AGUA DEL PUEBLO PROJECT TO IMPROVE THEIR TECHNICAL KNOWLEDGE OF, AND SKILLS IN, EVALUATION, DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF THE SMALL DI-

2. THE MISSION WILL BE CONDUCTED IN TWO PHASES. THE FIRST WILL BE TWO WEEKS IN GUATEMALA TO DEVELOP NEEDS ASSESSMENT, TASK ANALYSIS AND DETERMINING SKILL LEVEL OF ADP STAFF AND THEN DEVELOP AND DISCUSS WITH ADP THE PROPOSED TRAINING PACKAGE FOR TARS AND ENGINEERS. THE CONSULTANT WOULD THEN RETURN TO NORMAL PLACE OF RESIDENCE DURING WHICH THE CONSULTANT WOULD DEVELOP SUCH MATERIALS WHICH WOULD TAKE PLACE DURING THE SECOND PHASE OF THE MISSION.

3. THE SECOND PHASE OF THE MISSION WOULD BE THREE OR MORE WEEKS IN GUATEMALA FOR TRAINING TO PRESENT TECHNICAL CONCEPTS AND DISCUSS THESE WITH ADP STAFF. FORMAL PRESENTATION WOULD BE INTEGRATED WITH WORKING WITH AGUA DEL PUEBLO STAFF IN PRACTICAL FIELD APPLICATION OF MATERIALS PRESENTED IN THE COURSE TO ACTUAL SITUATIONS. DURATION OF LECTURE AND FIELD WORK WILL BE BASED ON RESULTS OF FIRST PHASE MISSION.

4. THE OBJECTIVES OF THIS EFFORT WOULD BE FIRST TO WORK WITH TEN TARS, AND TWO CIVIL ENGINEERS FROM AGUA DEL PUEBLO PROJECT TO IMPROVE THEIR TECHNICAL KNOWLEDGE OF, AND SKILLS IN, EVALUATION, DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF THE SUCH DEVICES FOR SMALL COMMUNITIES (100 TO 500 INHABITANTS) AS:

-WATER PUMPING DEVICES USING LOW-COST DEVICES SUCH AS HYDRAULIC REAMS, SUBMERSIBLE ELECTRIC PUMPS, WINDMILLS: WATER STORAGE AND DISTRIBUTION SYSTEM DESIGN AND CONSTRUCTION: OPERATION AND MAINTENANCE FOR SMALL WATER SYSTEMS: INFILTRATION GALLERIES: RAIN COLLECTION SYSTEMSAND CISTERNS: LOW COST SANITATION MEASURES THAT COULD BE COUPLED WITH PROPOSED DRINKING WATER MEASURES, AND WATER WELL SITING AND DEVELOPMENT.

THE SECOND OBJECTIVE WOULD BE TO MAKE ADP AWARE OF STAFFING AND TRAINING REQUIREMENTS THAT WILL BE NEEDED BY THE VILLAGE AND ADP WHERE SUCH DEVICES ARE DESIGNED BY ADP AND THEN CONSTRUCTED, OPERATED AND MAINTAINED BY THE VILLAGES. THE THIRD OBJECTIVE WOULD BE TO DEVELOP ADP CAPABILITY TO TRAIN TRAINERS AND PROMOTERS IN THIS MATERIAL SO THAT ADP COULD SERVE AS A RESOURCE BASE FOR OTHER SIMILAR PROGRAMS IN COUNTRY AND/OR NEARBY COUNTRIES.

5. IT IS PROPOSED THAT THE LANGUAGE OF THE MISSION SHOULD BE SPANISH AND ALL LECTURES AND DOCUMENTS SHOULD BE VERY PRACTICALLY ORIENTED AND SHOULD BE WRITTEN IN SPANISH.

6. WE REQUEST YOU DISCUSS THIS PROPOSAL WITH AGUA DEL PUEBLO GUATEMALA. WE HAVE DONE SO WITH ADP/US AND AID'S OFFICE OF HEALTH IN WASHINGTON, DC.

7. REQUEST YOU INDICATE IF ANY CONSIDERATION HAS BEEN GIVEN TO INCLUDING SIMILAR TYPE PROFESSIONALS FROM OTHER PROGRAMS IN GUATEMALA AND/OR OTHER CENTRAL AMERICAN COUNTRIES.

8. RESPECTFULLY REQUEST A REPLY TO THIS CABLE BY 23 NOVEMBER WITH YOUR INDICATION OF DATE WHEN CONSULTANT SHOULD BE IN GUATEMALA FOR FIRST PHASE. THE EARLIEST WE COULD HAVE SOMEONE IN THE FIELD WOULD BE AFTER 15 JANUARY 1982.

WASHAID 64553
NNNN=
ACCEPTED TMU463 BEING PROCESSED

ACTION COPY

UNCLASSIFIED

Department of State

INCOMING TELEGRAM

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UNCLAS GUATEMALA 7672

AIDAC

PASS TO: VICTOR WEHMAN, DS/HEA; C/O DAVID DONALDSON

E.O. 12065: N/A

SUBJECT: WASH PROJECT TECHNICAL ASSISTANCE TO AGUA DEL PUEBLO, GUATEMALA

REF: (A) TELCOM DONALDSON-COHN, (B) COMMERCIAL CABLE 10/30/81

1. REF CABLE DISCUSSED WITH AGUA DEL PUEBLO (ADP). THEY ARE MOST INTERESTED IN TECHNICAL ASSISTANCE AND HAVE THE FOLLOWINGHFOMMENTS.

2. ADP SAYS THE TAR'S DO NOT HAVE THE NECESSARY TECHNICAL BACKGROUND TO ACTIVELY PARTICIPATE IN AND BENEFIT FROM AN INTENSIVE SHORT COURSE OF THIS NATURE. THE TECHNICAL LEVEL OF THE TRAINING WOULD HAVE TO BE LOWERED IF THE TAR'S WERE INCLUDED AND THE ADP ENGINEERS WOULD BENEFIT LESS. THE TAR'S WILL BENEFIT MORE IN THE LONG RUN THRU WORKING WITH THE ADP ENGINEERS AFTER THE WASH TECHNICAL ASSISTANCE.

Clarify

3. ADP WOULD LIKE TO INVITE SIMILAR TYPE PROFESSIONALS FROM OTHER PROGRAMS IN GUATEMALA TO PARTICIPATE IN THE SECOND PHASE OF THE WASH PROGRAM. ADP PREFERS TO WORK ALONE WITH THE WASH SPECIALIST IN THE FIRST PHASE OF DEVELOPING NEEDS ASSESSMENT, TASK ANALYSIS, AND DETERMINING SKILL LEVEL OF STAFF.

4. ADP REQUESTS THE SPECIALIST FOR TWO WEEKS BEGINNING JANUARY 18, 1982. THE CURRENT TAR COURSE ~~CLASSES HAVE~~ BEEN RESCHEDULED DURING THAT TIME TO ENABLE THE ADP ENGINEER TO BE AVAILABLE. ADP REQUESTS A FIRM COMMITMENT FOR THAT PERIOD.

5. THE DATES FOR THE SECOND PHASE OF WASH TECHNICAL ASSISTANCE CAN BE SCHEDULED DURING THE JANUARY VISIT.

CHAPIN

Received ST/Hea (Wehman) 11/17/81
Passed to WASH 11/17/81
LOG

UNCLASSIFIED

Scope of Work
For
Mission To Assist USAID/Guatemala
(Aqua del Pueblo)

PROJECT OBJECTIVES

The Objectives of this project are:

1. To develop a training course, including instructional materials to teach developing country engineers to select various technologies for planning, designing, constructing, operating and maintaining small scale drinking water systems.

2. To train course participants to identify, plan, design and construct a small community drinking water system that the community will operate and maintain throughout its useful life.

3. To develop with participating organizations a capacity for adapting and transferring the technical knowledge identified from the engineer level to the paraprofessional level.

PROJECT OUTPUTS

The outputs of this project will be:

1. A course manual for training engineers on how to identify, plan, design, construct, operate and maintain drinking water systems that include a range of those technologies appropriate to Guatemala.

2. Four to ten engineers who will be able to plan, identify, design, construct, operate and maintain a drinking water system that uses technologies that are appropriate to Guatemala.

3. A demonstrated capability by engineers to adapt the material of item 1 to a paraprofessional level training course.

PURPOSE OF THE PROJECT

Since its inception Agua del Pueblo (ADP) has been assisting small villages in the highlands of Guatemala to develop gravity-feed systems for drinking water that require a minimum of treatment. With the decrease in the number of suitable gravity fed sites, ADP is experiencing an increasing need to plan, design, construct and place in operation systems which will require alternative technologies for pumping and treating drinking water for the villages.

Given the need for additional experience in this area, they have requested USAID/Guatemala to provide assistance for training from 4 to 10 engineers (two from ADP, two from Ministry of Health and the others from various organizations) in the techniques and procedures for the selection, planning, design, construction, operation and maintenance of the various alternative technologies for the provision of drinking water to small communities.

The knowledge imparted above will be used by the trainees to improve their own work and to train other groups of paraprofessionals and technicians such as the Tecnicos en Acueductos Rurales (TAR's), so that they will be able to assist in the planning, designing, construction, operation and maintenance of participatory type village water projects that will utilize these alternative technologies.

PROPOSED PROJECT

To train the above engineers in the desired practices, it is proposed to have WASH consultant(s) work with USAID/Guatemala and ADP to carry out the following six phased mission:

Phase I: Collection of Background Data:

During this phase, Agua del Pueblo will: (1) identify the other institutions whose engineers or other employees will receive the training planned under this activity, obtaining candidate's resumes where possible; (2) explain the nature and objectives of the training activity to all potential participating institutions and evaluate the institution's interest in the activity; (3) prepare an initial survey of technologies either currently in use or possibly feasible, to assist in the contractor(s) initial work planning; (4) for each technology discussed in the survey, identify potential problems such as import restrictions, the availability of spare parts, the existence of qualified maintenance assistance, etc; (5) supply the WASH contractor(s) detailed materials current describing ADP training program, its contents and methodology, as well as other materials descriptive of ADP's project implementation methodology; and (6) where possible, obtain similar information on the programs and activities of other institutions involved in the training activity.

The above mentioned data will be provided to WASH before the project proceeds to Phase II.

Phase II: Needs Assessment:

During this Phase the WASH consultants will: 1) identify the types and number of situations that will require alternative technologies (for example: submersible pumps in drilled wells, windmills to drive handpumps, diesel motors to drive centrifugal pumps from streams, etc.); 2) identify potential solutions by visiting a number of appropriate sites, 3) work with ADP and other participating organizations to select solutions that realistically could be built, operated and maintained in the local communities; 4) assess the level of knowledge and skills of the engineers who will participate in the training from both a technical and training perspective; and, 5) discuss with the participating organizations' specific plans for using the engineers in the future, including both training programs and project development.

To carry out this Phase, WASH will provide consultants, one qualified in the various technologies being considered and a second qualified to assess the engineers' training capability.

Phase III: Workshop Development:

During this Phase the WASH consultants will develop the course to be presented in Guatemala. During Phase II, the appropriate length of this Phase and the best location to develop the training course will be determined. Both consultants involved in Phase II will work on developing the training course in collaboration with the participating organizations. The first element will be to design sessions for imparting technical and managerial knowledge on the selected technical solutions. (For example, what technical and logistical systems are needed for a diesel operated pump). The second would be to design relevant training sessions to provide the trainees with performance based skills in the technologies selected for use in Guatemala. Training should be hands-on and experience based. The two major elements should not be treated as two distinct areas, but in an integrated manner.

This Phase will be carried on with close collaboration between WASH/Washington staff, the consultants, and participating organizations to discuss approaches and review materials.

Phase IV: Workshop Implementation:

During this Phase, the WASH consultants in collaboration with the collaborating organizations will: 1) conduct the workshop developed in Phase III; and 2) begin development of a plan with ADP and other participating organizations to adapt the knowledge and skills learned for use in the training of other program personnel in these organizations.

Phase V: Adaption of Workshop For Other Program Personnel:

During this Phase, the WASH consultants will prepare a comprehensive plan to adapt the knowledge and skills developed in Phases III and IV for a paraprofesional training course.

Phase VI: Implementation of Paraprofessional Workshop:

During this Phase, WASH may be called upon to provide assistance in the implementation of the paraprofessional training activity.

S&T/HEA/WS:JAustin:ja;sms:12/29/81

APPENDIX B

Daniel Edwards

Itinerary

Travel to Guatemala City: January 31, 1982

Return from Guatemala City: February 6, 1982

Travel to Guatemala City: May 2, 1982

Return from Guatemala City: May 5, 1982

Travel to Guatemala City: June 19, 1982

Return from Guatemala City: August 30, 1982

APPENDIX C

Officials and Other Personnel Interviewed

Carlos Gomez, ADP Director
Emilio Falla, ADP TARs Training Engineer
Hernan Ruiz, ADP Field Engineer
Mathew Perl, ADP Advisor
Julio Guillermo Garcia Ovalle, DSA Director
Cesar Leonel Soto Arango, DSA Regional Engineer
Pedro Augusto Tax I, DSA Area Engineer
Gerardo Rodriguez, UNEPAR, Programming and Engineering Director
Ramiro Villatoro, UNEPAR Community Water Systems Chief
Mario Guillermo Abularach, UNEPAR Community Water Systems Deputy Chief
Roberto Galindo, UNEPAR Community Water Systems Engineer
Carlos Garcia, UNEPAR Community Water Systems Engineer
Guillermo Guzman Chincilla, Sanitary Engineering Regional School Deputy Director
A. Maselli, Talleres Maselli Manager
Luis Francisco Egurrola G., Fairbanks Morse Sales Manager

APPENDIX D

Resumes of Workshop Staff

RAFAEL OCTAVIO CORDON MORALES

EDUCACION

Universidad de San Carlos de Guatemala	Ingeniero Civil (1960)
Universidad de Minnesota	Master of Science in Civil Eng. (1961)
Universidad de Minnesota	Desarrollo de Aguas Subterráneas (1961)
Robert A. Taft Center, Cincinnati	Tratamiento Aguas Negras (1962)
Universidad de Carolina del Norte, Chapel Hill	Cursos de Análisis de Sistemas, Probabilidades, Química del Agua y Calidad del Agua (1970)

IDIOMAS

Español e Inglés; lee Portugués

ASOCIACIONES PROFESIONALES

Colegio de Ingenieros de Guatemala, Colegiado No. 417.

American Society of Civil Engineers (Member)

Asociación Interamericana de Ingeniería Sanitaria

American Water Works Association

Water Pollution Control Federation

EXPERIENCIA PROFESIONAL

El Ingeniero Cordón trabajó de Noviembre de 1958 a Enero de 1964 para la Municipalidad de Guatemala, en la Dirección de Aguas, en donde desempeñó diversos cargos, entre los cuales cabe resaltar: Jefe de Plantas de Purificación, Ingeniero de Diseño, Jefe de la Sección de Planeamiento y Director Interino. De los trabajos desarrollados por el Ingeniero Cordón, deben mencionarse espe-

cialmente, la operación del Sistema de Abastecimiento de Agua de la Ciudad de Guatemala, el Estudio de Tarifas, la Ampliación de la Planta de Purificación del Cambray, la supervisión de construcción de redes de distribución, así como el diseño de algunas de las fuentes ornamentales construidas por el Municipio. Participó en el Proyecto Piscayá Municipal, en el diseño de las captaciones, planta de purificación y en los estudios de financiamiento y tarifas.

Posteriormente de Febrero a Diciembre de 1964 trabajó en el Departamento de Acueductos y Alcantarillado de la Dirección General de Obras Públicas como Ingeniero Diseñador de la Sección de Acueductos, en donde tuvo a su cargo la investigación, diseño y cálculo de acueductos tanto rurales como de cabeceras departamentales, tales como Cuilapa y Jutiapa.

Más adelante, de Enero de 1965 a Marzo de 1967, en el Proyecto Xayá-Pixcayá del Ministerio de la Defensa, trabajó como Ingeniero Especialista, teniendo a su cargo los estudios y diseños de varias fases del Proyecto, tales como: estudios de población, captación, estudios económicos y financieros, y planta de purificación. Así mismo participó en los estudios de conducción y red de distribución.

De 1965 a 1972, desempeñó el cargo de profesor de medio tiempo en la Escuela Regional de Ingeniería Sanitaria de la Facultad de Ingeniería de la Universidad de San Carlos de Guatemala, teniendo a su cargo programas de investigación aplicada e impartiendo los cursos de Hidráulica Aplicada y Laboratorio de Procesos Unitarios.

Durante el otoño de 1970 fué Profesor Asistente Visitante, en el Departamento de Ciencias Ambientales e Ingeniería de la Escuela de Salud Pública, de la Universidad de Carolina del Norte en Chapel Hill, Estados Unidos.

Desde 1966 a la fecha el Ingeniero Cordón se ha dedicado a la actividad profesional de consultoría en la Firma Cordón y Mérida, Ings. de la cual es Socio. Por razones de su especialidad, ha participado directamente en todos los trabajos de Ingeniería Sanitaria e Hidráulica que la firma ha ejecutado; un listado de éstos con su descripción se encuentra en el Curriculum de la Firma, resaltando entre ellos:

El diseño efectuado durante 1973 de la planta de purificación de agua Lo de Coy para tratar el agua de los ríos Xayá y Pixcayá con un caudal de 1.3 m^3/seg y con un costo de Q.7.5 Millones. El proceso empleado es el convencional de floculación, sedimentación y filtración, tiene facilidades para agregar sulfato de aluminio, cal hidratada, silicofluoruro de sodio, cloro y polielectrolitos.

Durante 1974 tuvo bajo su responsabilidad la conducción del "Estudio y Reestructuración de los sistemas de Abastecimiento de Agua Potable y Alcantarillado del Pais", ambicioso esquema para organizar la atención estatal de estos servicios a nivel nacional. El estudio contiene un modelo de ley y el diseño de una agencia estatal.

Desde 1975 a 1980 fungió como Jefe de Proyecto para los servicios de supervisión de la construcción del Acueducto Nacional Xayá-Pixcayá que Cordón y Mérida, Ings. prestó. Este trabajo con una inversión de Q.17 Millones comprende la construcción de: una presa de derivación en el río Xayá, una línea

de conducción con canales, túneles y sifones de 1.40m, 1.80m y 1.14m de diámetro respectivamente, caminos de acceso, la Planta Lo de Coy, un tanque de distribución de 25,000 m^3 y parte de la red de distribución de la Ciudad de Guatemala.

En 1976 tuvo a su cargo, como Director de Proyecto, la coordinación del desarrollo de los proyectos Aeropuerto Santa Elena y Obras dentro del Parque Tikal con un costo estimado de Q.40. Millones.

Durante 1978 desarrolló un Manual de Operación y Mantenimiento para la Planta Lo de Coy y entrenó al grupo de operadores que efectuaron la puesta en marcha de la Planta.

El Ing. Cordón coordinó, de 1977 a 1980, los trabajos de supervisión que la firma prestó al Programa de Fortalecimiento en Salud al Area Rural. Este programa financiado con fondos de AID y del Gobierno de Guatemala contempla la remodelación de varios hospitales departamentales, así como la elaboración de Planes Maestro para dos hospitales departamentales.

En el año 1980 tuvo a su cargo la elaboración del Estudio de Tarifas para el Sistema de Alcantarillado y Drenaje de toda la Ciudad de Guatemala encargado por el Departamento de Drenajes de la Municipalidad a Cordón y Mérida, Ings. y financiado con fondos del BID.

Durante 1979 a la fecha ha colaborado con la firma ESCO, de Chapel Hill, N. C. en la recolección, selección y preparación de información para la publicación en preparación "Diseños Típicos para Acueductos Rurales" que la WHO esta por sacar a luz.

PUBLICACIONES

- Manual para Operadores de Plantas de Purificación de Agua Potable con Aplicación a las Condiciones de Guatemala. (Septiembre 1960)

- Análisis Estadístico de los Datos de Diseño y Operación de Tanques de Mezcla y Sedimentadores Usados en Estados Unidos y Canadá. Boletín de Ingeniería. (Enero 1962)

- Dimensionamiento de Sedimentadores. Boletín de Ingeniería. (Enero 1967)

- Cloradores versus Hipocloradores. Boletín de Ingeniería. (Enero 1967)

- Progreso de la Investigación de Canales de Mezcla. Boletín de Ingeniería. (Marzo 1968), con el Ingeniero Otoniel Samayoa.

- Optimización de Líneas de Conducción. Seminario de Computación Electrónica. (Guatemala 1971)

- Progreso de la Investigación de Demandas de Agua. Programas de Investigación, Escuela Regional de Ingeniería Sanitaria. (1972), con el Ingeniero Otoniel Samayoa.

- Selección, Fabricación y Calificación de Venturis en Guatemala. Programas de Investigación, Escuela Regional de Ingeniería Sanitaria. (1972), con el Ing. Manuel Prado.

- El Uso de las Computadoras en Ingeniería Sanitaria. VIII Seminario Centroamericano de Ingeniería Sanitaria. (Guatemala 1972), con el Ing. Luis Felipe Mérida I.

- Lo de Coy, a New Water Treatment Plant for Guatemala City. 94a. Conferencia Anual de la AWWA. (Junio 1974) Boston, Mass.

- Participación en Publicaciones de OPS/OMS Revisor de Textos:
  - Water Quality Surveillance Manual. WHO, (Ginebra 1976)
  - Plumbing Guide. WHO, (Ginebra, en proceso)
  - Teoría, Diseño y Control de los procesos de Clarificación de Aguas. Serie Técnica No. 13, CEPIS/OPS (1973).

- Colaboración en el Manual de Diseños Típicos para Acueductos Rurales; a ser publicado por el "International Reference Center for Community Water Supply" de la WHO en La Haya, a ser publicado.

- Planta Lo de Coy. Diseño de los Filtros. XIII Congreso Centroamericano de AIDIS. (Marzo 1981)

ALFREDO R. SZARATA SAGASTUME

EDUCACION

Universidad de San Carlos de Guatemala	Ingeniero Civil (1952)
University of California Berkeley, California	Master of Engineering (1954)
Secretaria de Salubridad, México, División de Malariología Venezuela, Oficina Sanitaria Panamericana.	Curso de Postgrado en Saneamiento Ambiental (1958)
Universidad Central del Ecuador Banco Interamericano de Desarrollo. Organización Panamericana de Salud. Quito, Ecuador	Curso de Sistemas Tarifarios para Abastecimientos de Agua Potable (1967)

IDIOMAS

Español e Inglés

ASOCIACIONES PROFESIONALES

Colegio de Ingenieros de Guatemala, Colegiado No. 224

Asociación Interamericana de Ingeniería Sanitaria, Capítulo de Guatemala.

EXPERIENCIA PROFESIONAL

Trabajó inicialmente en la Municipalidad de Guatemala, donde desempeñó diversos cargos: Auxiliar de Ingeniero, Departamento de Ingeniería (1947-1951); Ingeniero Jefe de Sección, Departamento de Ingeniería (1952 y 1956-1957); participando en planificación, diseño y construcción de sistemas de desagues y de pavimentos de concreto; Jefe del Departamento de Limpieza (1954-1955) en el que organizó el sistema de recolección gratuito en esquina y en el establecimiento y funcionamiento de rellenos sanitarios.

Como Ingeniero Sanitario, Consultor de la Oficina Sanitaria Panamericana, Organización Mundial de la Salud, trabajó en Bolivia y Nicaragua (1958-1965)

en el asesoramiento de actividades de ingeniería en programas de erradicación de malaria. Proporcionó asesoría al personal profesional de los servicios nacionales en recopilación cartográfica, sistemas de localización e identificación de comunidades; organización, planeamiento y control de actividades de rociado intradomiciliar incluyendo estudios de rendimientos de personal, uso y mantenimiento de equipos y vehículos, y sistemas de abastecimiento. También participó en el adiestramiento de personal auxiliar, asesorando en los sistemas de formación y como instructor.

Como diseñador en la rama de agua potable trabajó en el Proyecto Xayá-Pixcayá del Ministerio de la Defensa, (1965-1966), teniendo a su cargo directamente varias fases del Proyecto, tales como: Línea de conducción compuesta de canales, túneles y sifones, supervisión de los estudios geológicos, estudios económicos y presupuesto.

Posteriormente trabajó en el INFOM en la ejecución de sistemas de agua potable, (1967-1970) como Supervisor en el Programa 100 TF, donde su responsabilidad principal fué la revisión de los diseños de proyectos de agua, la elaboración de las tarifas adecuadas y coordinación de la Supervisión de construcción de las obras, habiendo participado en sistemas para cabeceras departamentales y municipales.

Como Catedrático Universitario durante los años 1968-1972, desempeñó los cargos de Profesor de Ingeniería Sanitaria I y II y en 1971 de Saneamiento Ambiental, en el Departamento de Ingeniería Civil, de la Facultad de Ingeniería de la Universidad de San Carlos de Guatemala.

Ing. Szarata - 3

En 1968, como Consultor Temporal de la Oficina Sanitaria Panamericana, Organización Mundial de Salud, efectuó un estudio de tarifas para el Departamento de Obras Sanitarias de la República del Perú, para la recuperación de las inversiones en proyectos de agua potable en ese país con adecuado financiamiento de la operación y mantenimiento.

De Agosto de 1970 a Mayo de 1972, fungió como Sub-Director del Acueducto Nacional Xayá-Pixcayá, en los que actuó coordinando la elaboración de especificaciones técnicas, contractuales asi como bases de licitación, en adición a las funciones administrativas.

De Mayo de 1972, a Octubre de 1975, desempeñó el cargo de Sub-Gerente del Instituto de Fomento de Hipotecas Aseguradas (FHA) en donde su ocupación principal fué el control de financiamiento de programas de vivienda y sistemas de control de calidad de construcción, habiendo además coordinado la elaboración de nuevas especificaciones técnicas y elaborado las bases para financiamiento desde el período de construcción.

Desde 1972 colabora con Cordón y Mérida, Ings., habiendo tenido a su cargo la preparación de Especificaciones y Documentos de Licitación de diferentes proyectos diseñados por la firma que incluyen Planta de Purificación, Escuelas de Capacitación, Aeropuerto, Reparación de Facilidades Portuarias y otras.

A partir de Noviembre de 1975 formó parte del personal permanente de Cordón y Mérida, Ings. como Ingeniero Residente, teniendo a su cargo la consultoría de la Construcción del Proyecto Xayá-Pixcayá, el cual comprendió la construcción de la captación de un río, túneles, canales, sifones, caminos de acceso, presa, planta de purificación de agua y red de distribución y cuyo costo se

ha estimado en Q.17 Millones; asesoró a la Unidad Ejecutora a nivel de la Dirección y de las Supervisoras de obra sobre aspectos de supervisión y de diseño del acueducto, y coordinó las actividades del personal de soporte, especialistas de la firma Cordón y Mérida, Ings., para el asesoramiento a la Unidad Ejecutora.

También con esta firma tuvo a su cargo la supervisión de la construcción de una Escuela para Auxiliares de Enfermería en Jutiapa durante 1979 y 1980.

En el año 1980 participó activamente en la elaboración del Estudio de Tarifas para el Sistema de Alcantarillado y Drenaje para el área del valle de la ciudad de Guatemala, encargado por la Municipalidad de Guatemala, que fué financiado con fondos del BID.

Desde Enero de 1981 tiene a su cargo el desarrollo de los servicios de Cordón y Mérida, Ings. para el Programa 029 del CEEP, en su Primera Fase, que incluye la realización de diseños de adaptación para la reposición de 60 escuelas dañadas por el terremoto así como la preparación de planos y documentos contractuales para contratar las construcciones, coordinando las labores del personal de diseño, efectuando diseños, cálculos y preparación de documentos contractuales, además de las visitas de campo previas al diseño.

6a. AVENIDA 6-94, ZONA 9
TELEFONO 316494
GUATEMALA C. A.

CARLOS ENRIQUE MUÑOZ PALACIOS

EDUCACION

Universidad de San Carlos de Guatemala	Ingeniero Civil (1965)
Laboratoire d'hydraulique de L'école Polytechnique de Lausanne, Suisse	Hidraúlica (1966/67)
Faculté de Sciences de L'Université de Lausanne, Suisse	Geología y Geofísica (1967/70)
Le Centre d'hydrogéologie de L'Université de Neuchatel Suisse	Doctorado en Hidrogeología (1970)

IDIOMAS

Español, Francés; Lee Inglés

ASOCIACIONES PROFESIONALES

Colegio de Ingenieros de Guatemala, Colegiado No. 540

EXPERIENCIA PROFESIONAL

El Doctor Muñoz trabajó en el Departamento de Acueductos y Alcantarillado de la Dirección General de Obras Públicas (1965-1966) como Ingeniero Proyectista, siendo responsable del diseño de varios proyectos de introducción de agua potable para varias comunidades urbanas de la República de Guatemala. Así mismo efectuó diseños y cálculos para diferentes estructuras hidraúlicas.

En (1970) al retornar de Suiza, tuvo a su cargo el diseño del anteproyecto de captación de las quebradas Guaraquiche y Los Encuentros para el abastecimiento de agua potable a la Ciudad de Chiquimula.

DANIEL B. EDWARDS

Hartnell College	AA. Filosofía (1960)
University de California, Berkeley	BA Ciencias Sociales (1971) Estudios de Urbanización
Antioch University	M.A Psicología de enseñanza experiencia de Programas (1975)
Asociación Profesional de Laboratorios de Entrenamiento de Adultos	Estudio Post-graduado, aprendizaje en diseño de taller y facilitación de grupos (2 años)

IDIOMAS

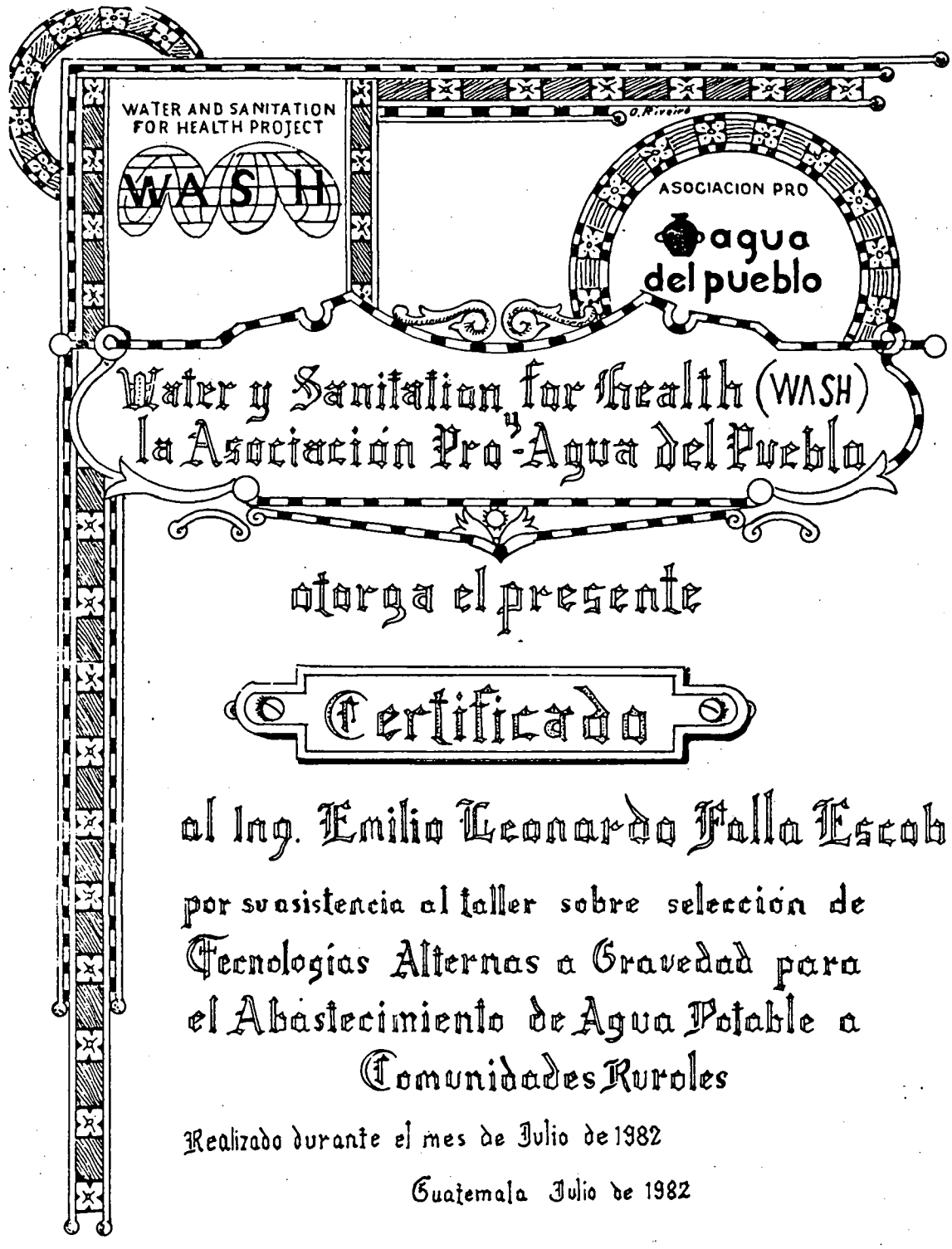
Inglés
Español
Francés

ASOCIACIONES

La sociedad Americana de Desarrollo y Entrenamiento
La sociedad de Entrenamiento, Educación e Investigación Intercultural.

EXPERIENCIA PROFESIONAL

El Señor Edwards reune 15 años de experiencia en el campo de desarrollo. Ha trabajado los últimos 4 años como Director de entrenamiento del Cuerpo de Paz en Washington; por 5 años como Profesor - de Psicología en las Universidades de Antioch y Western Washigton State en Seattle, Washington, donde enseñaba la materia de Educación no formal y Sistemas de Cambio Humano. Ha dirigido varios talleres de Educación no formal, Gerencia para Directores de Programas de Desarrollo, y entrenamiento Intercultural. Actualmente el Señor Edwards trabaja como consultor independiente bajo su propia agencia que se llama TRAINING RESOURCES GROUP.



Water y Sanitation for Health (WASH)
la Asociación Pro-Agua del Pueblo

otorga el presente

Certificado

al Ing. Emilio Leonardo Falla Escoba

por su asistencia al taller sobre selección de Tecnologías Alternas a Gravedad para el Abastecimiento de Agua Potable a Comunidades Rurales

Realizado durante el mes de Julio de 1982

Guatemala Julio de 1982

O. Cordón
Ing. Octavio Cordon

Daniel B. Eduards
Daniel Eduards

Carlos Gómez