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WATER AND SANITATION FOR HEALTH PROJECT

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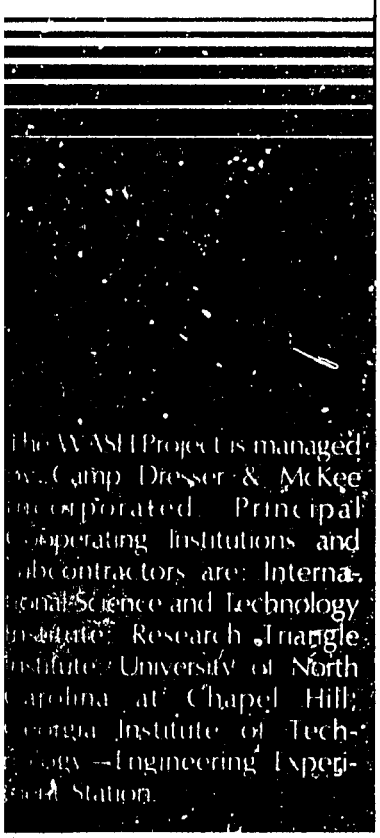

FEASIBILITY OF RURAL GROUNDWATER DEVELOPMENT IN HONDURAS

WASH FIELD REPORT NO. 65

DECEMBER 1982

Prepared for:
USAID Mission to the Republic of Honduras
Order of Technical Direction No. 115

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T115

December 15, 1982

Mr. John Oleson
Mission Director
USAID
Tegucigalpa

Attn: Mr. William Smith

Dear Mr. Oleson:

On behalf of the WASH Project I am pleased to provide you with ten copies of a report on rural groundwater development in Honduras.

This is the final report by William M. Turner, Ph.D. and is based on his trip to Honduras from October 19 to 27, 1982.

This assistance is the result of a request by the Mission on September 9, 1982. The work was undertaken by the WASH Project on September 15, 1982 by means of Order of Technical Direction No. 115, authorized by the USAID Office of Health in Washington.

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

Sincerely,

Dennis B. Warner

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

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

DBW:PFH:nmc

WASH FIELD REPORT NO. 65

HONDURAS

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Prepared by:

Dr. William M. Turner

December 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

TABLE OF CONTENTS

ACRONYMS

Acronym	Spanish Name	Translation
CEDEN	Comite Evangelico de Desarrollo y Emergencia Nacional	Evangelical Committee for National Development and Emergencies
CONSUPLANE	Consejo Superior de Planificacion	Senior Council for Economic Planning
JNBS	Junta Nacional de Bienstar Social	National Board of Social Welfare
MSP	Ministerio de Salud Publica	Ministry of Public Health
PRASAR	Projecto de Agua y Saneamiento Rural	Rural Water and Sanitation Project
SANAA	Servicio Autonomo Nacional de Acueductos y Alcantarillados	National Water Supply and Waste Water Disposal Service

SUMMARY

In order to help an AID-sponsored rural water supply and sanitation project which is being carried out by the Government of Honduras (GOH) and is reportedly behind the schedule foreseen in the project paper, WASH was asked to evaluate the feasibility of constructing wells as a means of rural water supply in the western part of Honduras. The evaluation was carried out by Dr. William M. Turner.

Based on the evaluation the following measures are recommended:

1. Springs should be used wherever possible in the mountains because of the difficulty of drilling wells in the complex geological formations.

2. Hand-dug wells should be used in the San Pedro Sula area.

3. AID should not buy well drilling equipment.

4. The program badly needs hydrogeological assistance. The best way to obtain this is to hire a Spanish-speaking hydrogeologist who is capable of getting the program moving and keeping up its momentum so that springs, drilled wells, and hand-dug wells are all being constructed simultaneously.

5. A private contractor should be hired to drill wells where they are appropriate.

The above recommendations are based on the results of the evaluation, which may be summarized as follows:

1. The rural people in the project area seem to prefer gravity systems fed by springs or surface streams. Usually these people are well aware of the location of these sources of water. Therefore in selecting springs or surface water sources, care must be taken to ensure consultation with them so that the source provides sufficient water in summer.

2. Drilled wells may not be cost effective in many areas. Drilled and cased wells in the volcanic terrane would probably have to be up to 200 feet deep and would cost about 30 lempiras (US$15) per foot for a 4-inch cased well. The difficulty of digging wells by hand in very hard volcanic rock may discourage the beneficiaries unless they are paid by their Patronato or the Rural Water and Sanitation Project (Projecto de Agua y

Saneamienta Rural, PRASAR). The exception to this may be mechanically drilled or augered wells in the sandy deposits of the Cortez District where water occurs at a shallow depth and drilling is easy and rapid.

3. There does not appear to be sufficient mechanical drilling equipment in Honduras to accomplish the present goals of the project (3,000 wells) within the allowed time frame (two years). Only 90 wells are reported to have been completed since the beginning of the project two years ago.

4. The use of wells should be considered only in areas where springs or surface water sources are not available. This is culturally acceptable to the beneficiaries of the project.

5. The project cannot move forward without in-country technical assistance to determine for each community or group of families which is the best source of water.

6. The mix of water supply systems that was presented in the project paper (wells in most communities and relatively few springs or surface sources) should be regarded only as a proposed mix. Site-specific evaluation of the communities should determine the appropriate water source to be used and will most likely change the existing plan.

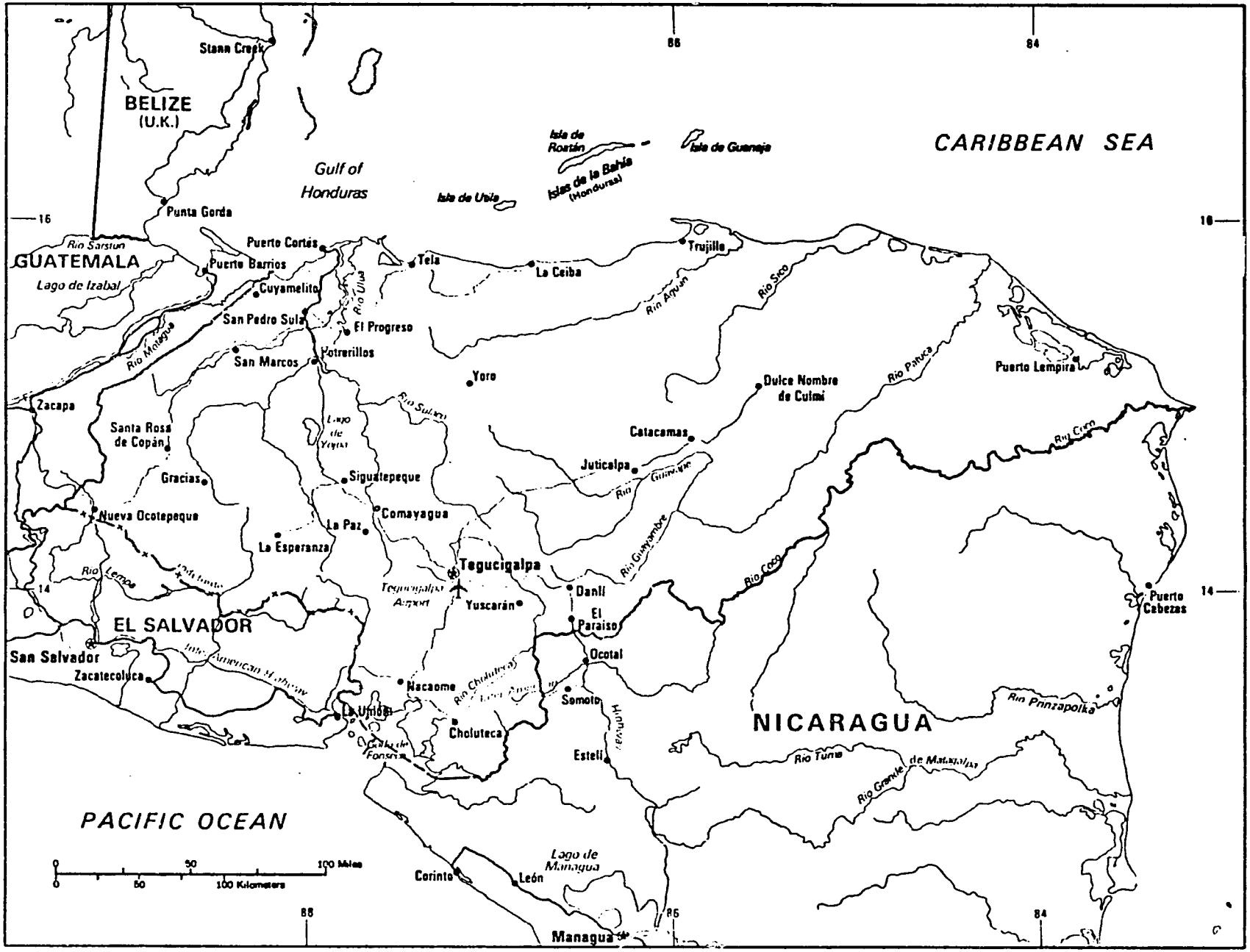
7. It appears that the most realistic way to accomplish the water-supply goals of the project is to engage a private contractor. If the PRASAR committee, which is interministerial, has the legal authority to hire a contractor, it should do so. If not, PRASAR should decide which of the two water-supply ministries, the National Water Supply and Wastewater Disposal Service, Servicio Autonomo Nacional de Acueductos y Alcantarillados (SANAA) or the Ministry of Public Health, Ministerio de Salud Publica (MSP), should engage the contractor. The PRASAR committee should have control over the individuals in the ministry who manage and supervise the contractor and should also require that a clerk of the works be engaged, probably by the non-contracting ministry, to provide resident supervision of the contractor, to certify what work has been done and be responsible for approval of payments to the contractor. A company such as Merriam and Merriam of Tegucigalpa could perform the clerk of the works function. Payments would be effected by debiting a guaranteeed irrevocable letter of credit opened with a first class bank.

8. If the recommendations of this report are accepted, a request for a proposal should be prepared and distributed and a private contractor retained.

ACKNOWLEDGEMENTS

The author expresses his gratitude to Richard Dudley, William Smith, Ray Baum, and Ing. Edmundo Madrid of the USAID Mission to Honduras, to Ing. Oscar Diaz and Jorge Tivino of SANAA, and to Ing. Efrain Giron of the MSP for their guidance and for discussions with the author which have led to a clearer understanding of the scope of the project. Mr. John Svanholm, a private consultant in Honduras, was also helpful in understanding the general geologic setting of Honduras and the occurrence of groundwater in the country. Mr. Hirschberger, the owner of PERHSA, a local drilling contractor, provided practical insight into groundwater availability and drilling conditions and costs.

Honduras



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Lambert Conformal Projection
Standard parallels 9°20' and 14°40'
Scale 1:3,400,000
Boundary representation is not necessarily authoritative

Railroad
Road
Airport

Chapter 1

INTRODUCTION

On March 31, 1980, the United States concluded a loan agreement with the Government of Honduras (GOH) for $10 million together with a grant of $500,000 to fund, among other things, the construction of multifamily water supply systems in the districts of Santa Barbara, Ocotapeque, Lempira, Cortez and Copan. As presented in the project paper these systems would be either gravity flow systems from a spring or a surface water source or wells with handpumps. The project is called the Rural Water and Sanitation Project (Projecto de Agua y Saneamienta Rural, PRASAR) and the National Water Supply and Waste Water Disposal Service (Servicio Autonomo Nacional de Acueductos y Alcantarillados, SANAA) and the Ministry of Public Health (MSP) are the executing GOH agencies.

SANAA has primary responsibility for all communities of more than 200 inhabitants and MSP for the predominantly rural communities of less than 200 inhabitants. Either system (gravity or wells) could be used to provide water to either of the targeted groups of communities. MSP has identified 3,000 communities as possibly requiring wells. SANAA has identified about 500 communities as its target. Based upon population estimates of these 500 comunities, if surface water is unavailable, as many as 2,000 additional wells may be needed. MSP would have the primary responsibility for installing all of these wells.

Appendix D is a summary of the PRASAR project and the responsibilities of SANAA and MSP.

The project is located in the rural areas of the western part of Honduras and particularly in the Districts of Lempira, Copan, Ocotepeque, Santa Barbara, and Cortez. Many communities have already been identified for assistance.

This project has been under way for more than two years and was originally scheduled to terminate on September 30, 1983 but has been extended to 1984. In implementing this program, the executing agencies have been unable to construct wells as rapidly as necessary to meet the original timetable. Given the presently planned mix of gravity systems (using surface water or springs) and wells and given the inadequate supply of equipment and technical personnel and the difficult hydrogeologic character of the terrane, it does not appear that the timetable can be met.

Recognizing the problem, the USAID Mission to Honduras requested that a WASH consultant evaluate the feasibility of constructing wells in the rural areas as a means of providing

a rural water supply. The Mission also requested recommendations concerning well siting and appropriate well-drilling equipment. The Mission did not expect the WASH consultant to site the 3,000 to 5,000 wells.

Chapter 2

GENERAL HYDROGEOLOGY OF THE PROJECT AREA

Given the size of the project area and the magnitude of the project, it was practical to examine the hydrogeology of the area only in its broadest terms. To gain an understanding of the hydrogeological setting, the WASH consultant traveled from Tegucigalpa and proceeded directly through the middle of the project area to Santa Rosa de Copan. From Santa Rosa de Copan, he proceeded to La Entrada and thence to Copan. From Copan, the trip terminated in San Pedro Sula. Details of the trip are given in Appendix B.

Throughout the first part of the trip, terminating in Santa Rosa de Copan, an extensive sequence of effusive volcanic rocks was encountered. These included lava flows, pyroclastic breccias, and extensive amounts of ash and welded tuff. The ash and welded tuff are most easily observed as smooth surfaces on the great number of road cuts.

The permeability of the volcanic rocks varies widely from virtually impermeable volcanic ash to the more permeable breccias. However, even the breccias may have low permeabilities because of the angularity of the breccia fragments and their poor sorting.

The low permeability of these rocks is evidenced by the occurence of numerous seeps emanating from the contact between the thin soil horizon and the underlying volcanic rock. These rocks do have some permeability, however, because the volcanic terrane is commonly covered by pine forest in the higher elevations indicating that tree roots have found a solid footing and water. In some of the higher elevations, where the volcanics appear to have been deeply weathered to a thick sequence of brightly-colored red, orange, and yellow clay, the pine forests are lacking. Also, there are noticeably fewer inhabitants in this area.

Within the project area, there are many wide and basin-like valleys which have been carved into the volcanic terrane. Observations in these basins suggest a very thin soil cover on the basin floor as well as on the mountains. This supports the conclusion that the rivers in the area are actively downcutting and that alluvial material, which is usual in valleys elsewhere and which commonly forms good aquifers, is absent at least as far as Santa Rosa de Copan.

Although the terrane south of the road from Siguatepeque to Santa Rosa de Copan towards the border with El Salvador was not visited, the WASH consultant had conducted previous field investigations on the El Salvador side of the Honduran border where volcanoes are more or less active, as evidenced by

numerous hot springs emanating from recent basaltic lava flows. Where these lavas were present there was a paucity of ash, and the City of San Salvador had plans underway to exploit groundwater resources within the lavas. The results of these plans are unknown. The consultant's observations of the area, however, suggested that abundant groundwater in the area could only be obtained from lava tubes. The presence of volcanics immediately across the border in El Salvador does suggest that the volcanic terrane does extend at least to Honduras in the south.

Hirschberger indicates that wells he has drilled to depths of about 200 feet in the volcanic terrane have produced up to 50 gallons per minute. This compares well with the consultant's experience in similar terrane in New Mexico.

In proceeding north from Santa Rosa de Copan towards San Pedro Sula, the high relief which characterizes the mountainous volcanic area of southern Honduras gives way to topography of progressively lower relief, lower hills, and broader valleys. These changes in topography are closely associated with a belt of limestone which geological maps of Honduras indicate as trending generally east to west and is first encountered about 30 km north of Santa Rosa de Copan. This is a rather narrow belt and by the time La Entrada is reached, the limestone has given way to a massive thickness of what appear to be mudstone, graywacke, and conglomerate with olistoliths of limestone and limestone pebble conglomerate of various sizes. The topography associated with these rock units is much less rugged than the limestone terrane.

In general, limestone is considered a good aquifer which yields water when wells encounter saturated solution features or fractures. Certainly, the limestone in the project area is highly fractured, and good wells may be possible in the area. The highly indurated character of the mudstones, graywacke and conglomerate almost precludes the occurence of groundwater in large quantities, but wells of small yield may be possible.

The groundwater which is most commonly utilized by the people of this area is shallow and rises as small springs or seeps associated with the contact between the soil horizon or small fractures.

There can be no doubt that within the project area there is abundant rainfall and some of the rain percolates into the ground to become groundwater. In some places, however, as in the valley occupied by the community of Jesus de Otoro, almost desert-like conditions exist despite abundant rainfall. These conditions may be attributed to the paucity of groundwater available to the root systems of plants because the available rainfall runs off almost completely due to the lack of a thick soil horizon capable of retaining some of the rainfall as soil moisture and the impermeable bedrock below.

In the areas north of Santa Rosa de Copan towards San Pedro Sula active erosion has prevented the accumulation of a thick soil horizon on the hills. Svanholm (oral communication, 10/26/82) indicates that the wide valleys leading north towards San Pedro Sula do contain accumulations of alluvial material which may be more than 100 metres thick. These alluvial materials are said to contain abundant groundwater.

In the District of Cortez, which is within the project area, the terrane consists of an extensive sequence of recent clastic deposits overlaying the bedrock basement complex. Shallow groundwater is known to occur within these clastic deposits. The municipaliy of San Pedro Sula, for example, is reported to rely upon groundwater from 15 to 20 wells. Within this area, drilled or hand-dug wells will probably provide water easily. Furthermore, in this region there are large areas in which surface water and springs are not a likely sources.

Also within the project area are the offshore Bay Islands of Utila, Roatan and Guanaja. Utila is a rather flat and low-lying island west of Roatan. Water in Utila occurs as a lens of fresh water floating on top of saline water beneath the island. This water is best tapped by shallow, low-yield wells. Roatan, the largest of the Bay Islands, consists almost entirely of a core of metamorphic rock which is poorly weathered and highly fractured. Groundwater certainly occurs within the metamorphic rocks as a lens of fresh water floating above saline water. Wells on the island have been drilled close to the coast in the metamorphic terrane to a depth of as much as 60 feet by a cable-tool rig located at French Harbor. Water from these wells is fresh and apparently of good quality.

Chapter 3

CURRENT RURAL WATER SUPPLY PRACTICE

Throughout the region visited the predominant source of potable water for communities of fewer than about 25 families is spring or surface water. The water is conveyed to the homes by either polyethylene tubing or by pails and other containers. Where polyethylene is used, the projects, which are commonly not funded by the GOH, are organized by the Patronato or by individuals themselves. The only direct cost is for materials. The sources of water may vary in distance from several hundred metres to five or six kilometres from the consumer.

It is evident that the local people know the location of springs or surface supplies which are currently used or could be used as a source of drinking water. Only perennial springs and surface water sources should be used. Many springs and streams are reported to dry up in the summer.

In the larger communities water is already provided by community systems which generally use either a spring or a stream which has been impounded. One such system is located in San Juan de Opoa, a community west of Gracias. One problem with these sources is the possibility of contamination. Another problem is that, before installing the system, SANAA must study the area, which commonly costs 5,000 lempiras (US$ 2,500) and reportedly takes five months to complete. Inasmuch as SANAA has identified about 500 small communities which meet its criteria, it would appear that to provide spring or surface water supplies to villages having more than 200 persons is an undertaking requiring more resources than SANAA currently has available for such work.

In several locations large diameter hand-dug wells were seen. These wells are usually quite shallow and encased in a cement caisson and have a manhole and a handpump on the concrete cover. Some problems with these sources are: 1) if the pump fails to operate, villagers remove the cover and use the water for washing, thereby contaminating the well, and 2) because many of the wells only penetrate the water table by a few feet, the wells dry up during the dry season. No small-diametre, drilled wells with handpumps were seen. There are reportedly numerous hand-dug wells in Honduras.

Chapter 4

WELL LOCATION

Wells must be located where the groundwater is. Hence, there must be a fundamental understanding of the location of groundwater in the area. Although not intended as a substitute for the detailed hydrogeological expertise which the project needs on a full-time basis, the guidance presented in this chapter gives some rudimentary principles based on the consultant's observations.

Within the project area recharge of the groundwater system occurs primarily on the mountains and hills. Water entering the subsurface flows downhill and discharges near the valley floors as springs or within the valley soils and alluvium as underground water courses. The slope of the water table more or less parallels the slope of the land surface. Where the moving groundwater encounters zones of very low permeability, the water may be forced to the surface as springs. In the coastal plain areas of Cortez, infiltration of rainfall recharges the groundwater system directly below the infiltration site. In this area and the Bay Islands groundwater discharges into the sea.

Successful wells will most likely be located in the groundwater-recharge zones (hills) or in groundwater-discharge areas (valleys or coastal plains). Due to the steep slope in many areas, recharge-zone wells may have to be located on hilltops because mechanized drilling equipment probably could not function on the hillsides at a reasonable cost.

Chapter 5

DRILLING CONDITIONS AND METHODS

Drilling conditions within the areas of volcanic terrane may be very difficult no matter what type of mecharical drilling equipment is used. Drilling rates as low as one foot per day have been reported in some areas of volcanic rock. Discussions with the owner of PERHSA, a Tegucigalpa-based drilling contractor, indicate that, although drilling conditions vary, many wells have been drilled in volcanic terrane. Cable-tool methods are preferred over rotary methods in this terrane. Rotary equipment requires a high level of drilling skill and equipment maintenance, whereas cable-tool or percussion methods require much less skill. Rotary methods require the use of a drilling fluid to remove drill cuttings from the bore hole. If proper drilling technique is not applied carefully, the fluid can also seal any available porosity and decrease well yield. Cable-tool methods do not require the circulation of drilling fluid while drilling. Finally, the drilling surface of cable-tool drill bits may be easily resurfaced whereas expensive rotary bits must be imported.

In limestone terrane both rotary and cable-tool methods may be used. The cable-tool method is probably the preferred one because of the rotary method's potential problem of losing drilling fluid in the fractured limestone above the water table. Cable-tool methods do not have this problem.

In areas underlain by mudstones and well-indurated graywacke and conglomerate, drilling may be very slow by rotary methods. Furthermore, the tilted beds of rock in the structural deformations of these units will probably deflect the rotary drill bits. Cable-tool methods will be less affected by this problem.

The alluvial material of valley floors and the coastal plain may be easily drilled by either rotary or cable-tool methods. Within these materials rotary methods have the advantage that water forced down the center of the drill string may be used to jet down wells. On the other hand, the bailer used by cable-tool rigs can be used to bail down wells just as easily, the difference being that a cable tool rig can bail down a larger diametre well than can be jetted by a rotary rig.

Drilling within the metamorphic terrane of the country can best be accomplished with cable-tool equipment for the same reasons discussed under volcanic terrane. Hirschberger has drilled in the vicinity of La Esperanca and reports that a well 180 feet deep produced about 50 gallons per minute.

The Evangelical Committee for National Development and Emergencies, Comite Evangelico de Desarrollo y Emergencia Nacional (CEDEN), currently has two cable-tool rigs in Honduras, but it is reported that they have had little success in drilling for water in the western part of Honduras. As a result it is said that they moved their rigs to other parts of the country. This seems to support the present observations regarding the difficulty of drilling for water in parts of western Honduras despite the fact that goundwater does occur in some measure.

Chapter 6

REMARKS CONCERNING TECHNICAL SOLUTIONS

At present the Project has little qualified technical direction in the field. All direction takes place at offices in Tegucigalpa, Santa Rosa de Copan and San Pedro Sula. Little or no work is being done at potential project sites that are more than one day's round trip journey from one of these cities. Another measure which also limits the project's access to some of the large communities is SANAA's project selection criterion that the community or the source of water must be within five or six kilometres of an all-weather road.

Neither SANAA nor MSP have sufficient in-house expertise to make site specific evaluations and select appropriate water sources (wells, springs, or surface water) themselves. Such expertise requires a knowledge of at least geology and hydrogeology. In some instances sanitary engineering expertise is also needed to evaluate the suitability of a water source as a drinking water supply. The WASH consultant met with one consulting geologist in Honduras who may be a valuable resource for this project, but it is unlikely that persons with both geological and hydrogeological expertise are available in Honduras.

To locate adequate well and spring sites properly it is evident that technical personnel will have to spend a great deal of time in the rural areas and will not be able to return to Tegucigalpa or one of the other major urban centers on a daily basis. It also seems evident that there are no individuals with the necessary qualifications in Honduras. Therefore, effective program implementation requires that technical expertise be brought in from abroad.

Drilling capacity in Honduras is as follows:

1. the MSP presently has one combination rotary-cable-tool rig manufactured by Netherlands Oil Tool Supply 8.V. which was financed by the European Economic Community and is reportedly working in other areas of Honduras;

2. SANAA currently has one rig which is not in operating condition;

3. PERHSA has seven rigs including 2 BE (Bucyrus Erie) 22, one BE 24, and one BE 20. They have one Hillman prospecting rig and two rotary rigs: one CME and one Wichita Falls; and

4. Hidro-Sistemas in San Pedro Sula has three Schramm top-drive rotary rigs.

It is the consultant's impression that SANAA does not have enough tool pushers, competent maintenance personnel, or warehouse personnel to implement the well-drilling aspects of this project without outside help.

Chapter 7

CONCLUSIONS

The following conclusions have been made as a result of the field mission:

1. Because only 90 wells are reported to have been constructed under the project (which originally called for 3,000 wells by the end of 1983), operational aspects of the project must be reevaluated, alternative sources of water supply sought, and more realistic goals established.

2. In communities with fewer than 25 families the greatest progress in the installation of small water supply systems is being made by the people themselves without government assistance. The provision of some basic materials and guidance to the people through their Patronato by the GOH should result in greater progress.

3. With the exception of the limestone and alluvial terrane, the bedrock in the area has low and highly variable permeability. In these areas hand-dug wells can be constructed, but because labor is donated it is reported that local people will stop digging if they do not find water near the surface. This poses an especially serious problem because the wells must be dug deep enough to have water in the dry season.

4. Within areas of alluvial terrane, wells can be dug by hand and at less cost than by drilling. Water should be found near the surface, but construction time will be much longer than for wells drilled by cable-tool methods.

5. The cost effectiveness of mechanically drilling wells is questionable, but if drilled wells are constructed, cable-tool methods would probably be the most appropriate. Also, well construction should be done by private companies selected by competitive bidding. The profit should be fixed, and the contract should insist on the GOH's right of audit and renegotiation of the profit. The WASH consultant's experience in many countries indicates that private contractors can construct wells less expensively than governments can using government-owned equipment. Only if private equipment is unavailable or if there are certain highly specialized drilling requirements is there a reason for government to enter the drilling business. Such is not the case in the present project.

6. Many residents of the area either are already using spring water or know of springs near their homes which could be developed for potable water supplies, provided the water is available in summer.

7. Where there are fewer than 25 families involved, some communities have prefered to install their own gravity system rather than pay the high costs required by SANAA.

8. There appear to be no technical individuals who themselves are capable of evaluating which type of water supply system should be used for each community or group of houses. SANAA would probably prefer to use an engineering solution involving impoundments, pipes, and tanks after a costly and time-consuming study. MSP, because of its charge, would probably prefer to use wells to the exclusion of springs or surface water if they are available.

9. Gravity flow systems are preferred because they require virtually no maintenance and can be much less costly than drilled or hand-dug wells from a materials and capitalized operation and maintenance point of view.

10. There are no technical personnel available to supervise well drilling or the hand digging of wells, to provide on-site guidance, and to perform well acceptance tests.

Chapter 8

RECOMMENDATIONS

For the project to move ahead with reasonable speed the following recommendations are made.

1. Competent technical direction should be provided in the form of full-time geological, hydrogeological and engineering expertise to aid in the selection of appropriate water sources, well-siting, sanitary protection, construction, training, maintenance, and identifying the need for the expertise as the need arises.

2. Technical personnel should determine the best source of water for each community on a site-specific basis.

3. Because of the potential of straining the cooperative relationship between SANAA and MSP, the technical personnel should come under a direct contract from the PRASAR committee, rather than SANAA or the MSP, if PRASAR has such legal authority.

4. Because of the depressed hiring market for geologists in the United States (particularly those with B.S. degrees in geology) the Peace Corps, PVOs in Honduras, or a private contractor could provide geologists for project initiation and technical assistance. This would be helpful only if the project deadline was extended by several years, because such personnel would need time to be brought on board, to be trained (e.g., in language), and to develop in-country experience.

5. It is recommended that if Peace Corps geologists are used they be under the general supervision of an in-country consultant who is thoroughly familiar with the geology of Honduras. This person would provide initial in-country training and would be a resource person to be called upon by the PVO or contractor geologists as the need arises. The in-country consultant would be a part-time, direct hire USAID consultant.

6. Surface or spring water is a culturally acceptable source and should be encouraged. Regardless of the water source, however, the project should proceed under the supervision of technical personnel with a geological background.

7. Greater emphasis should be given to project implementation by mobilizing the people themselves, and less emphasis should be given to water supply feasibility studies. If the people to be served are uninterested and cannot be mobilized, they should be passed over for the time being.

The example of neighboring communities that succeed in developing an improved and/or more convenient water supply may lead to an eventual interest and mobilization of the once-disinterested communities.

8. Unless USAID is willing to purchase 10 to 15 cable-tool rigs, spare parts, and ancillary equipment (including trucks and welding equipment) and provide operator training and maintenance personnel, it is not recommended that drilling equipment be purchased.

9. If the GOH and USAID are interested solely in developing rural water supplies for smaller groups of people and they wish to implement the program quickly and carry it out rapidly, a direct contract with a private water supply contractor should be made by the PRASAR committee. Any materials required would be obtained by the private contractor, and any well drilling would be subcontracted by the contractor.

10. If direct hire of a well contractor and/or a hydrogeologist is decided on, payment should be made under transferable irrevocable documentary letters of credit guaranteed by a first class bank upon presentation of commercial invoices and supporting documentation approved by a clerk of the works.

11. To engage a contractor, PRASAR, perhaps with the assistance of a consultant, would prepare a request for proposal which would be open to international response. Upon receipt of proposals, an evaluation team would select a prime contractor.

12. A separate contract should be let to an independent engineering firm to act as a clerk of the works whose duty it would be to verify project progress and approve invoices for payment.

13. To expedite the work, payment should be based on incurred cost plus an incentive fee or bonus based on performance.

APPENDIX A

Water and Sanitation for Health (WASH) Project
Order of Technical Direction (OTD) Number 115
September 15, 1982

TO: Dr. Dennis Warner, Ph.D., P.E.
WASH Contract Project Director

FROM: Mr. Victor W. R. Wehman Jr., P.E., R.S.
AID WASH Project Manager
S&T/H/WS

SUBJECT: Provision of Technical Assistance Under WASH Project Scope of Work for USAID/Honduras for the Rural Water and Sanitation Project (522-0166)

REFERENCES: A) Tegucigalpa 7718, dated 9 Sept 82

1. WASH contractor requested to provide technical assistance to USAID/Honduras as per Ref A, para 1-5 (modified in this OTD).

2. WASH ccntractor/subcontractor/consultants authorized to expend up to 95 person days of effort over a four (4) month period to accomplish this technical assistance effort.

3. Contractor authorized up to 90 person days of international/ domestic per diem to accomplish this effort.

4. Contractor to coordinate with USAID/Honduras (William Smith and Ray Baum), LAC/DR/HN (Linda Morse), LAC/DR/ENGR (Rod MacDonald), with the Honduras Desk Officer and should provide copies of this OTD along with periodic progress reports or ETA information as requested by S&T/H or LAC Bureau staff.

5. Contractor authorized to provide up to two (2) international round trips from consultants home-base through Washington D.C. (for briefing/preparation) to Tegucigalpa, Honduras and return to consultants home base through Washington D.C. for debriefing and report preparation.

6. Contractor authorized local travel expenses in Honduras NTE $1100 during the mission without the written approval of the AID WASH Project Manager. This travel can take placa as appropriate and necessary.

7. Contractor authorized to obtain secretarial, graphics or reproduction services in Honduras as necessary to accomplish tasks. These services are in addition to the level of effort specified in para 2 and 3 above NTE $ 880 without the written approval of the AID WASH Project Manager.

8. Contractor authorized to provide for car rental/vehicle rental if necessary to facilitate effort. Mission is encouraged to provide mission vehicles if available and appropriate.

9. WASH contractor will adhere to normal established administrative and financial controls as established for WASH mechanism in WASH contract.

10. WASH contractor should definitely be prepared to administratively or technically backstop field consultants and subcontractors.

11. Contractor to have consultants leave coordinated field draft report with mission before return to the U.S. Final report due to S&T/H within 30 days of return of consultants to the U.S.

12. New procedures regarding subcontractor cost estimates and subcontractor/consultants justifications remain in effect.

13. Mission should be contacted immediately and technical assistance initiated as soon as convenient to USAID.

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

WASH
Proj.
DIR.

COPY

Department of State

TELEGRAM

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ACTION AID-00

ACTION OFFICE STHE-01
INFO LACE-03 LADP-03 L&DR-03 SAST-01 ENGR-02 RELO-01 MAST-01
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SWW LWehman

UNCLAS TEGUCIGALPA 7718

AIDAC

FOR V. WEHMAN, S/T

E.O. 12356: N/A
SUBJ: RURAL WATER AND SANITATION PROJECT 522-0165

1. REQUEST WASH ASSISTANCE IN DEVELOPING RECOMMENDED MECHANICAL WELL-DRILLING PROGRAM TO EXPEDITE INSTALLATION OF 3,000 HAND-PUMPS IN WESTERN HONDURAS.

2. PROJECT STATUS: MINISTRY OF HEALTH PURCHASED 1120 DEMPSTER PUMPS DURING FIRST INTERNATIONAL BID. TO DATE 55 MINISTRY PROMOTORS HAVE INSTALLED ONLY 100 HAND DUG WELLS. PROJECT BY WASH TO DEVELOP LOCALLY MADE HANDPUMP ON SCHEDULE AND FACTORY AVAILABLE FOR PRODUCTION OF HANDPUMPS. PROJECT COMPLETION DATE IS 9 83 EXTENSION OF ONE YEAR CONTEMPLATED. NUMBER OF PROMOTORS TO BE INCREASED TO 80. HOWEVER, PROMOTORS ALSO RESPONSIBLE FOR INSTALLATION OF 32,000 LATRINES AND IMPLEMENTATION OF HEALTH EDUCATION COMPONENT.

3. DESCRIPTION OF AREA: MOST NEEDY AREAS ARE S/W. MOUNTAINOUS REGIONS OF LEMPIRA AND OCOTEPEQUE DEPARTMENTS ALTHOUGH PROJECT AREA ALSO COVERS COPAN, SANTA BARBARA AND CORTES. GROUND WATER RESOURCES OF MOST NEEDY AREAS DESCRIBED AS "VERY SMALL TO SMALL QUANTITIES FROM VOLCANIC ROCKS; AT DEPTHS OF 50 TO 150 M; LOCALLY MODERATE QUANTITIES FROM VERY DEEP WELLS." RESOURCES OF CONTINGENT AREAS TO NORTH ARE DESCRIBED AS, "MEAGER TO VERY SMALL QUANTITIES FROM SANDSTONE; FROM LESS THAN 15 TO 200 M IN DEPTH." ROCK TYPE IN MOST NEEDY AREA DESCRIBED AS "RHYOLITE, IGNIMERITE, DACITE AND TUFF, MINOR BASALT." CONTIGUOUS ROCK AREA TO NORTH DESCRIBED AS, "SANDSTONE, SHALES, CONGLOMERATE, LIMESTONE, TUFF AND OTHER ROCK." RAINFALL SEASON OCCURS PRIMARILY IN JUNE THROUGH NOVEMBER.

4. SCOPE OF WORK: CONTRACTOR (S) TO INSPECT PROJECT AREA AND (1) RECOMMEND SUITABLE DRILLING PROGRAM AND EQUIPMENT TO BE UTILIZED FOR DRILLING OF 3,000 SHALLOW WELLS, IS MOSTLY LESS THAN 100 FEET BUT IN NO CASE MORE THAN 165 FEET WITH REASONABLE TIME FRAME REMAINING - NO MORE THAN TWO YEARS PRESENTLY EXPECTED. PRIMARY INTEREST IS IN PSSIBLE USE OF HAND-PORTABLE DRILLING EQUIPMENT, OR THAT WHICH COULD BE MOUNTED ON BACK OF JEEP OR PICK-UP. CONTRACTOR(S) TO ALSO RECOMMEND, (2) IN SUFFICIENT DETAIL TO BE OF PRACTICAL VALUE TO PROMOTORS OR WELL DRILLING RIG OPERATORS. THOSE LOCATIONS LIKELY TO BE MOST PRODUCTIVE.

5. SUGGEST BILL TURNER, PRESIDENT OF AMERICAN GROUND WATER INTERNATIONAL IN NEW MEXICO AS EXPERT CONSULTANT FOR WELL-DRILLING RECOMMENDATIONS. ALSO SUGGEST 60 DAYS TO COMPLETE SURVEY AND MAKE RECOMMENDATION. MINISTRY OF HEALTH ASSURES PROJECT VEHICLE AVAILABLE TO CONTRACTORS. LIMITED SECRETARIAL SERVICE ON AS AVAILABLE BASIS. ASSUME NO OTHER COSTS TO MISSION.
NEGROPONTE

Received ST/H (Wehman) 9-14-82
Passed to WASH 9-14-82

UNCLASSIFIED

APPENDIX B

Log of Field Trip

FIELD LOG

KM 53 on road to Siguatepeque from Tegucigalpa at Rancho Chiquito.

Rancho Chiquito is a small group of 16 families whose homes are located along the main road. There is a public school at this location which undoubtedly serves a larger area.

As long as two years ago, these 16 families, through their Patronato, decided they needed to improve their water supply. Sources of water higher up in the pine covered volcanic mountain southwest of the community were well known to the local people. A delegation from the community visited with the Ministry of Public Works in Tegucigalpa to seek their assistance.

It is reported by the Treasurer of the Patronato that the Ministry felt a study was needed and that the total project cost would be about 3,000 lempiras (US$1500). This was so far beyond their means that they decided to construct the system themselves by impounding water at the source and leading it to a water storage tank at the local school with six kilometres of 1/2" polyethylene. From this point, water is conveyed to each house by means of 1/2" polyethylene pipe. Each of the distribution pipes terminates in a standard garden hose faucet.

To raise money for the project, which eventually cost the 16 families 400 lempiras, the children of the community, under the supervision of the school master, collected money from passing tourists on the main road. The system was completed in about May of 1982 and is presently functioning very well at present. The water seems clean and potable.

The geologic setting at Rancho Chiquito is apparently a complex assemblage of volcanic rock and ash which appears to have a low permeability. Water is commonly seen to seep out of the face of road cuts where the volcanic rock is in contact with the overlying soil. Certainly fractures within these rocks also contain groundwater.

KM 5 at Rincon on road to La Esperanca.

At Rincon there is located an elevated tank. Residents in the area report that water is piped to it from a small dam on a surface stream some distance away.

The hydrogeologic setting here is also a complex assemblage of volcanic rock and ash.

KM 18 on road to Santa Rosa de Copan.

At km 18 on the road to Santa Rosa de Copan is a path leading to the community of Santa Fe about 5 km distant. On the main road, a sign reads: "Proyecto Lactario Acueducto" JNBS 1980. Local people indicate that Santa Fe has a school and a community center which both have water. The water comes from a small spring and flows by gravity through one-inch PVC pipe to a tank above the village. Five homes are reportedly connected to this tank by means of 1/2" white PVC pipe. The system was reportedly paid for by the government and perhaps by JNBS.

This area is also comprised of volcanic terrane.

KM 43 at Guatateca on the road to Santa Rosa de Copan.

At Guatateca, JNBS constructed two large diameter wells. The wells were hand dug, reportedly by local labor, and the JNBS paid the material costs. The well which was visited was completed on June 2, 1982 and was inoperative. The manhole cover from the cement enclosed well had been removed and the water was being used for laundry and bathing. Local people reported that the second well was still operating. This was the last JNBS project that was seen until the village of Gracias about 130 km farther along the road.

In this area, the geologic terrane is also volcanic in character with a thin soil cover. As one leaves the western end of the valley in which the main village of Jesus de Otoro is situated, one is struck by the very thin cover of soil above what appears to be a bedrock of volcanic ash deposits. In this area, the climate appears to be distrinctly arid. However, the arid character may be largely attributed to the rapidity of runoff and the resulting paucity of water for the sustenance of vegetation. The volcanic terrane itself probably possesses a low permeability thereby facilitating runoff of precipitation and the retention of almost no soil moisture.

A further examination of this valley and others that were visited suggests that the rivers which are draining these areas are still actively downcutting and removing the thin soils almost as soon as they are formed. Consequently, in the valleys along the road to Santa Rosa de Copan there is little alluvial material which in many areas acts as a good aquifer.

KM 61 at La Corradas on the road to Santa Rosa de Copan.

At this location, there are four homes which have water piped in. The people of this community, like the people of Rancho Chiquito, installed their own water system for a total reported cost of 250 lempiras. This cost was paid for by the beneficiaries with no help from the government.

The system utilizes a water source, long known to the people, located about 200 yards from the houses. Water is piped to the homes with 1/2" polyethylene. The system was finished at the end of April 1982.

KM 98 on road to Santa Rosa de Copan.

At this locality, a cement caisson was observed from the road with a small Heller-Aller Company hand pump. The pump was manufactured in Napoleon, Ohio. Written in the cement were the markings MSP y Comunidad and the date February 23, 1981. Evidently, this well was constructed in cooperation with the Ministry of Public Health (MSP) and the community. Only one residence was observed nearby though others no doubt exist in this area.

The well was hand dug into a weathered rock soil comprised of volcanic rock in a very pleasant setting surrounded by pine trees.

KM 61 to 89 on road to Santa Rosa de Copan.

In this area, not many dwellings were observed. Furthermore, pine forests were almost completely absent. The soils are very deeply weathered (three metres or more) and are primarily clayey saprolites of rich and varied shades of red, orange, and yellow. The area is also higher in elevation than areas previously visited.

KM 125 at Aguacaliente.

Local residents take water by pail from a nearby quebrada (surface stream) which drains the mountains to the north and passes through pine covered hills. There is a small seep near the house which rises at the shallow excavated contact between the thin soil and the underlying rocky volcanic bedrock. This water is used for washing, bathing, and the irrigation of a small plot of vegetables and bananas. There is an adequate flow of water, however, to be used for drinking as well if the quality could be protected.

KM 167 on road to Santa Rosa de Copan.

At this location, the first occurrence of metamorphic rock was observed. The rock appears to be sequence of highly fractured phyllite or slate covered by volcanic rock.

KM 169 at Mehocote on road to Santa Rosa de Copan.

At Mehocote, two houses are served by a gravity system. The two famiies contributed to the purchase of 2 rolls of 1/2" polyethylene pipe for 77 lempiras each and constructed the system themselves with no government assistance. The water flows by gravity from a nearby spring or impoundment and it is led into steel barrels at the homes.

KM 178 leaving Gracias on road to Santa Rosa de Copan.

On leaving Gracias one observes a sign of PRASAR. The water supply system constructed by PRASAR in the area consists of a distribution system using 1/2" galvanized steel pipe. Water for the system reportedly comes from the nearby river.

It is evident that this system served many more than the one to 16 homes which were visited and which were constructed without government help. Gracias is one of the major communities along the road to Santa Rosa de Copan.

KM 205 at Lindero on the road to Santa Rosa de Copan.

At km 205, there is a sign which reads: "Construye for la Communidad de Lindero 12 Mayo 1970". The civil works at this location consisted of a spring box along the roadside in which a seep having a flow rate of about one gallon per hour occurs from volcanic breccia. The water from this seep is used almost entirely for washing.

KM 211 at San Juan de Opoa.

At San Juan de Opoa, PRASAR has constructed the water system. PVC pipe leads the water from a small impoundment in the mountainside behind the village to a central tank from whence it is distributed. The distribution, however, does not reach all homes in the community.

KM 214 at Montana de San Juan de Opoa.

At this location occur several homes which are not on the community water system. They feel the cost is too much for them and they walk down to the village to fetch water in pails or tins. The homeowners acknowledge that there are many springs located above their home on the mountainside which they could tap for their home use if they had the 1/2" polyethylene tubing. They indicate the best source to be one and one-half kilometres away.

Again, in this area the terrane is comprised of volcanic rock and a thin soil horizon.

Although local people want water and many systems both publicly and privately constructed make use of impoundments, there is the recognition that the impoundments are not always desireable. Many small children in these areas have drowned in the surface water impoundments. If such impoundments are used in the future, fencing might be provided to improve safety.

KM 7 on road to San Pedro Sula.

As in the outskirts of Tegucigalpa and along the road from Siguatepeque to Santa Rosa de Copan, at km 7 small pits were observed by the side of the road. Water in these pits is used for washing. Water in these pits comes from seeps emerging at the contact between the thin soil horizons and what appears to be impermeable red clastic volcanic flows and tuff.

KM 11 on road to San Pedro Sula.

At km 11, one encounters another well constructed spring box. This spring box provides for sanitary protection of the water and water from this spring box is used both for washing and drinking. Its presence is well known for passing cars stopped to collect drinking water. The springs box is said to be more than 10 years old. There is no indication of which government agency constructed this spring box.

KM 33 on road to San Pedro Sula.

For the first time, limestone is seen to comprise the terrane. Volcanic rock is no longer present.

KM 39 on road to San Pedro Sula near Los Janitos.

In travelling from Santa Rosa de Copan towards San Pedro Sula, the terrane becomes less mountainous and broad valleys occur. Los Janitos is a small community in one of the broad valleys. SANAA constructed the water system here and water is drawn from a small dam in the mountains to the west. The water, however, is reportedly not good for drinking. Consequently, homeowners in the area have constructed their own systems using 1/2" polyethylene to convey water to the homes. In one system which was observed, the water simply discharged continuously from the polyethylene, their being no faucet on the polyethylene. The water, though cloudy in appearance, was reported to be sweet and potable.

KM 46 at La Entrada.

For the first time on this trip, a windmill was observed. La Entrada is situated in a broad flat valley. The windmill was not operating even though the tail vane was open.

KM 17 on road to Copan.

The rock types have changed to tilted and relatively undeformed tertiary marl and shale deposits and turbiditic graywacke deposits from the crushed and deformed limestone olistoliths along the road from Santa rosa de Copan to La Entrada. From these rocks roadside springs are not uncommon.

KM 24 on road to Copan.

The relatively undeformed marl has changed to a highly deformed reddish mudstone which is enclosing olistoliths of limestone and limestone pebble conglomerate.

Houses in this area appear to each have their own water supply which is piped with polyethylene from springs in the nearby hills.

KM 17 to Copan.

This entire stretch of road passes through terrane of what appears to be deformed tertiary marls, shale, turbiditic graywacke, conglomerate and red mudstone. In some areas, the inclusion of limestone olistoliths and limestone pebble conglomerate olistoliths is common. These rock types and their structure are not unlike the seca shale of the Santa Elena Peninsula of Ecuador in which are found petroleum bearing olistoliths of Azucar Sandstone. Also, along this stretch of road, road side springs do occur.

KM 78 from La Entrada on road to San Pedro Sula.

Here are found hard brecciated white limestone at the surface. The area is more or less level.

KM 87 from La Entrada at Naco Cortez.

At Naco Cortez there is a SANAA-CARE project. About three kilometres from the village in the mountains to the northeast a small dam was constructed across a stream. The water is brought to the village by plastic pipe and then distributed by PVC pipe to about 200 homes. The system has reportedly been in operation about three years.

APPENDIX C

List of Officials Contacted

USAID Mission

Richard Dudley
William Smith
Raymond Baum
Ing. Edmundo Madrid

SANAA

Ing. Oscar Diaz
Ing. Jorge Tivino

MSP

Ing. Efrain Giron

Others

John Svanholm, Private Consultant
Mr. Hirschberger, Owner of PERHSA

APPENDIX D

PRASAR Project

Coordinador Proyecto

PROYECTO DE AGUA Y SANEAMIENTO RURAL

(PRASAR)

PROYECTO: AID No.522-0166

PRESTAMO: AID No.522-U-036

A.- INFORMACION GENERAL

a)	Préstamo:	US$	10,000,000.00	58%
b)	Donación:	US$	500,000.00	
c)	Fondos Contraparte Nacional (G.H.):	US$	3,778,158.00	20%
d)	Aportación Comunitaria:	US$	3,916,613.00	22%
e)	Monto Total Proyecto:	US$	18,194,771.00	
f)	Fondos AID Subproyecto SANAA	US$	5,813,772.00	
g)	Fondos Nacionales SANAA (G.H.)	US$	1,550.966.00	
h)	Fondos AID Subproyecto MSP.	US$	4,686,228.00	
i)	Fondos Nacionales MSP(G.H.)	US$	2,227,192.00	
j)	Firma del Convenio de préstamo	31 de marzo de 1981		
k)	Fecha de Terminación:	30 de septiembre de 1983		
l)	Organismos Ejecutores:	m.1) Ministerio de Salud Pública y Asistencia Social.		
		m.2) Servicio Autónomo Nacional de Acueductos y Alcantarillados. (SANAA)		
m)	Ubicación Física del Proyecto:	Departamentos: Lempira, Copán Ocotepeque, Santa Bárbara y Cortés.		

Coordinador Proyecto

Proyecto

n) *Comité Proyecto:* *Ing. Efraín Girón - PRASAR-MSP*
Lic. Luis A. Canales -PRASAR-MSP
Ing. Oscar Díaz - PRASAR-SANAA
Ing. Edmundo Madrid - PRASAR-AID

B.- INTRODUCCION

El Gobierno de los Estados Unidos de América, a través de la Agencia para el Desarrollo Internacional (AID), suscribió con la República de Honduras, el 31 de marzo de 1980, un Convenio de préstamo bajo el número 522-U-036, por la cantidad de US$ 10,000,000.00 (DIEZ MILLONES DE DOLARES) y un Convenio de Donación por US$ 500,000.00 QUINIENTOS MIL DOLARES), los que serán utilizados para financiar un Programa en las zonas rurales a través de la construcción, a base de autoayuda, de pozos multifamiliares, acueductos con flujo por gravedad, sistemas de disposición de excretas (pequeñas redes o fosas sépticas) y letrinas, así como también un Programa de Educación para la Salud, diseñado con el fin de reforzar el impacto del Proyecto.

c.- PROPOSITO Y COBERTURA DEL PROYECTO

Con la ejecución y desarrollo de este Proyecto, se espera beneficiar aproximadamente 200,000 familias, las cuales tendrán acceso a facilidades de agua y de disposición de desechos humanos y estarán utilizando ambos, con el funcionamiento adecuado de sistemas de mantenimiento.

...../

Proyecto de Agua y Saneamiento Rural

AID No. 522-0166 MSP y SANAA
Tegucigalpa, D. C., Honduras, C. A.

Coordinador Proyecto

El Proyecto comprende los siguientes componentes:

C.1 Servicio Autónomo Nacional de Acueductos y Alcantarillados (SANAA)

There are

90 wells INSTALLED

C.1.1 Construcción de 180 nuevos acueductos. Have Now 40 Have 200 Plus

C.1.2 Construcción de 50 mejoramientos de acueductos. ←

C.1.3 Construcción de 21 alcantarillados.

C.1.4 Censo de Acueductos Existentes.

C.1.5 Plan de Adiestramiento Sub-Sector Agua Potable y Alcantarillado.

C.2. Ministerio de Salud Pública y Asistencia Social (MSP)

C.2.1 Componente de Saneamiento.

C.2.1.1 Construcción de 3,000 pozos excavados a mano equipados con bombas manuales. 5-10 Holes Less than 200

C.2.1.2 Reparación de 800 pozos existentes.

C.2.1.3 Instalación de 25 Molinos de Viento.

C.2.1.4 Construcción de 18,000 letrinas sanitarias de fosa simple.

C.2.1.5 Instalación de 14,000 tazas sanitarias selladas con agua (Tazas Campesinas).

C.2.2 Componente de Educación para la Salud.