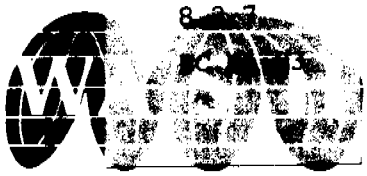
WATER FOR



COORDINATION AND INFORMATION CENTER

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EMERGENCY WATER SUPPLY ASSISTANCE DURING FLOODS IN ECUADOR

December 1982 – January 1983

WASH FIELD REPORT NO. 74

MARCH 1983

Prepared For:

USAID Mission to the Republic of Ecuador
Order of Technical Direction No. 42

WATER AND SANITATION FOR HEALTH PROJECT

WASH

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March 17, 1983

Mr. Paul Fritz
Acting Mission Director
USAID Mission
Quito, Ecuador

Attention: Mr. Kenneth Farr

Dear Mr. Fritz:

On behalf of the WASH Project I am pleased to provide you with 5 (five) copies of a report on Emergency Water Supply Assistance During Floods in Ecuador, December 1982-January 1983.

This is the final report by Fred Reiff and is based on his trip to Ecuador from January 14 to 28, 1983.

This assistance is the result of a request by the Mission on December 31, 1982. The work was undertaken by the WASH Project on December 31, 1982 by means of Order of Technical Direction No. 42, 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

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

DBW:cdej

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WASH FIELD REPORT NO. 74

EMERGENCY WATER SUPPLY ASSISTANCE DURING FLOODS IN ECUADOR

DECEMBER 1982 - JANUARY 1983

Prepared for the USAID Mission to the Republic of Ecuador
under Order of Technical Direction No. 42

Prepared by:

Fred M. Reiff

March 1983

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

Chapter 1

INTRODUCTION

By late December of 1982 it became evident that the "winter rains" in Ecuador were arriving earlier and with more intensity than usual. This early and heavy rainfall is thought to be a result of two natural cycles intermittently coinciding. The rainfall in Ecuador in December 1982 and January 1983 was heavy, extensive, and persistent. It affected the entire area west of the Andes up to the coast which is about one fifth of the country, and almost encompasses all of the best agricultural land and more than half of the population. Fortunately, very few lives were lost because of the non-violent nature of the flooding in populated areas, but the health impact will be felt for some time.

The agricultural sector was probably most adversely affected because of crop damage, the impossibility of planting during the normal planting season, and the breakdown in transportation of harvested crops to processing plants and markets. The transportation was severely affected because of extensive damage to highways, bridges, and railroads. Large numbers of homes and businesses were damaged especially in the rural areas and in poor urban areas.

Discussions with health authorities and with the directors of two hospitals revealed an increase in gastro-enteritic diseases especially among young children and infants. There was also concern because it appeared that a hepatitis epidemic was imminent and there had been several outbreaks of typhoid.

Chapter 2

WATER SUPPLIES

In general most of the community water distribution systems were constructed so that critical units were located above flooded areas. Babahoyo (about 75,000 people) was the largest community system with inundated water sources (wells). Numerous small rural communities including Baba, Caracol, Isla Bejucal and Jujan which lacked a distribution system had their water supplies inundated and contaminated by the flood waters. (Sewage and excreta disposal and sanitation were serious problems throughout the flooded areas.) They could have used the mobile water units also but the USAID disaster coordinator Robert Gersony had decided not to deploy these units in areas which lacked a community water system. The author pointed out to Mr. Gersony that although the drinking water was contaminated prior to flooding in many rural communities, flooding usually drastically increases contamination both by bringing in new pathogens and also very likely by increasing the dose of pathogens to which residents have a tolerence. Also it was pointed out that infants and children less than one year of age probably would be quite susceptible to waterborne diseases.

A thorough survey of these small rural communities by a knowledgeable health professional was recommended but it was apparently not felt important enough to carry out.

2.1. Installation and Operation of the Emergency Water Purification Units

The first plant was set up on January 1 and utilized river water. Because of the heavy load of colloidal material it was necessary to clean the Katadyne filter elements about every 15 minutes. This took about 10 minutes so the plants were producing water about half of the time. Double shifts were being run.

In the late afternoon of the January 2 the plant intake was connected to the city water system which had become operative but was highly contaminated. This allowed filter runs of about two hours but iron in the water necessitated by-passing the triocide units which began to release excessive iodine (up to 5 mg/l). Disinfection was then done by batch chlorination. On the third of January, a second plant was set up in the same location (on the river across from the hospital). On the January 4, the local volunteers became the primary operators and ran the plant's two shifts and by the fifth day of operations local operators became routine. It was not clear when the third unit went into operation at the well site but it seems to have been January 10 or 11.

A fourth plant was set up and disassembled as a training exercise to test the effectiveness of the operating manual and the training of the local personnel by the technicians, but it was never really operated to produce water. It was disassembled, re-packaged, and sent back to Guayaquil to be stored for potential lecture deployment when and if needed. It was determined by Mr. John Austin, USAID, that the city and IEOS crews who were trained had the capability of setting up and dismantling these plants.

The other three plants functioned reliably and continously but because the demand had diminished to where one plant could easily handle the demand and because the city water system was being improved with the addition of gas chlorination facilities it was decided to reduce the scale of operation at Babahoyo to one plant.

On the 20th of January the treatment unit at the well site was taken out of operation and moved to the river front site to be set up on the 21st. The two units (#2 and #8) at the river front were taken out of operation on the 21st and packaged up. By mid-morning of the 21st, unit #9 was in operation at the river front and it was capable of producing more than 27,000 gallons per day (2 shifts).

Experimentation with pre-chlorination on the 20th and 21st of January resulted in adoption of this method instead of the post-chlorination previously used. This was done to reduce the previous taste, odor, and color problems resulting from oxidation of ferrous iron and organics during batch chlorination of the stored treated water. It resulted in an essentially color, odor, and taste free water with a free chlorine residual of about 1.5 mg/l. This is explained in more detail below.

Pre-chlorination also gave the benefit of longer filter runs between washing and resulted in a filter cake which was much easier to remove than before, requiring only one fourth the number of strokes of the brush.

On the 21st of January, Ecuador's President Hurtado visited Babahoyo including the USAID water treatment units. He had the operation explained by the local operators who explained that they were USAID units and pointed out how well the units worked, how they were trained by USAID personnel and how they were ready, willing, and able to set up additional plants where necessary and that additional plants were available in Guayaquil.

On the author's last day at Babahoyo, he paid two operators hired by USAID, Regional de Santis and Jorge Rodrigez, 8,000 and 2,900 sucres respectively. Jay Anderson had provided 10,000 sucres cash to the author to do this.

2.2. Water Quality Produced

2.2.1. Users Viewpoint

From discussions with people hauling the water, they generally believed the water was safe to drink and that it was about as palatable as the city water supply before the flood. A few mentioned that during the first days of the operation, the water tasted bad from chemicals but that it had been improved. All of them expressed appreciation for this supply during a time of need.

2.2.2. Sample Testing

During the initial set up for treatment of river water few if any chemical or bacteriological samples were taken. After switching to the city system for raw water various tests were conducted including coliform and fecal coliform,

chlorine residual, iodine residual, and iron. The author of this report tested for chlorine residual and iron using both Hach and Loribond field test kits for each. The test results from both compared within 10 percent. The author also tested for total coliform with a field millipore filter kit. In addition, these same tests were run on intermittent samples by IEOS who also conducted an iodine test on the finished water in the second day of operation.

The tests conducted by the author confirmed that the chlorine dose in the batch treatment had been reduced to obtain a 0.5 to 0.7 mg/l level of free residual chlorine. It also confirmed that the final water had an iron content of 1.3 to 1.5 mg/l. The primary reason that various personnel from IEOS and USAID had decided to reduce the chlorine level was because heavier chlorination resulted in yellow water with a bad taste and odor. Subsequent experimentation by the author confirmed that when the final residual chlorine level was raised above 1.0 mg/l color and taste problems did occur. When a level of 2 mg/l was reached, the color was similar to urine.

The author experimented with pre-chlorinating at various levels to oxidize iron and organics prior to filtration so these offensive substances could be removed by the filter. Various quantities of calcium hypochlorite were added to the raw water with various detention times. It was found that a dose of about 10 to 12 oz (by measuring cup) of calcium hypochlorite per 3,000 gallon of raw water and a detention of one hour was necessary to exceed the threshold for reaction.

With this procedure it was possible to obtain a micro flow in the raw water tanks and to filter it out on the filter elements. The filter cake then turned black and did not penetrate the filter element as far as it did without pre-chlorination. Longer filter runs were obtained (almost double) and the effort to remove the filter cake was reduced (from an average of 16 brush strokes to 4 brush strokes.

In addition, the finished water had a chlorine residual of 1.5 mg/l and iron level of less than 0.2 mg/l. The color was almost not noticeable. Neither the operators nor a number of users detected a bad taste or odor. All in all the quantity was much improved.

A sample of this finished water was brought back to the U.S. to test for iron, manganese, and silver (possibly leached from the Katadyne filter element). Iron was found to be 0.16 mg/l; manganese was not detected, and silver was found to be less than 0.01 mg/l.

2.3. Water Demand

Records were not available for dates before January 7 so it was difficult to estimate the demand from the time of set up until January 7, but by January 7, a total of about 63,000 had been produced by pump #1 and a total of about 42,000 gallons had been produced by pump #2, or about 100,000 gallons had been produced in the period from 2nd of January. This averages out to about 20,000 gallons per day.

Upon arrival in Babahoyo on January 14, 1983, there were three USAID mobile emergency water treatment and disinfection units in operation. Two were located at the river front across the street from the hospital and the other was located more or less in the center of town across the street from the main wells. At that time the two units on the beach were producing a total of about 21,000 gallons/day and the well site unit was producing about 5,000 gallon per day. The amount of water being utilized was gradually reduced until on January 21, 1982 only about 10,000 gallons per day were being utilized and one unit was easily able to keep up with the demand of an 8-hour operating day.

Throughout this period the bulk of the water utilized was hauled by tank trucks but up through January 21, there was a continuing but diminishing demand by individuals carrying water by hand, bicyle, car, truck, and wagon.

The well site was not a popular site from which to collect water. It was located at the intersection of two narrow unpaved roads whereas the river front site was easily accessible by a farily wide paved road and was on some of the highest ground in town.

The author discussed the amount of water being utilized and what it was being used for with the people collecting it. Generally, it was used for drinking, cooking, washing dishes, and washing hands and face. It was determined that the families who were hauling water themselves were using between 10 and 40 liters per capita day. The amount seemed to be controlled by the means and ease of transportation and availability of storage containers.

The total Babahoyo population was estimated by city officials to be about 75,000 people. City officials estimated that about 30,000 people had been served by these USAID mobile emergency units. This is possible if different populations were served on different days, but it is doubtful that more than 10,000 people were served on any one day.

Chapter 3

RECOMMENDATIONS FOR IMPROVING THE MEWTDU

1) Avoid sources which contain heavy colloidal clay, ferrous iron, or unoxidized manganese. Try to find clear, settled surface water or use wells or infiltration galleries. It is absolutely necessary to utilize such raw water and to provide chemicals for pre-treatment.

2) Provide the following field test kits with those units.

   a) Iodine
   b) Chlorine (free residual)
   c) Iron
   d) Total coliform, millipore filter.

3) Include "Feeder gauge" to utilize to determine when filter elements should be replaced.

4) Redesign the release system for the pre-filter elements.

5) Consider utilization of a mobile plate settler system for pre-settling. This could be adapted to the inflatable tanks and could be used in pre-treatment if necessary.

6) Provide instructions on how to determine when pre-chlorination is indicated and how to do it.

7) Delete from instructions the use of the aluminum packaging boxes to hold water. They were sprung by this. Otherwise strengthen the box design.

8) Use a single size of hosing for both discharge and suction.

9) Do not use clear plastic hoses. They developed heavy algae growth.

10) Do not use the corrigated plaster suction hose. It continued to develop leaks, not only from wear in the box but after it was in use.

11) Provide better, more durable, more accurate pressure gauges. After use they were too far off to follow the manual instructions to use a differential pressure to determine when to backwash.

12) Provide more and stronger handles on the heavy crate. Moving these crates by hand was more difficult and required more men than anticipated.

APPENDIX A

6/16/81
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extra copy for file #2 of OTO 42

June 12, 1981

Water and Sanitation for Health (WASH) Project
Order of Technical Direction No. 42

TO: Mr. Dennis Warner, P.E.
WASH Contract Project Director (Acting)

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

SUBJECT: Provision of Technical Assistance Under WASH Project Scope of Work for OFDA Disaster Assistance Activity

REFS: A) Verbal request McClusky to Wehman in preparation for major disaster

B) Howell (OFDA)/Wehman memo of 11/12 June 1981

1. WASH contractor requested to provide technical assistance to OFDA as per REF A and REF B Scope of Work (augmented).

2. WASH contractor/sub-contractor/consultants authorized to expend up to four hundred (400) person days effort over a three (3) month period to accomplish this technical assistance effort.

3. Contractor to provide daily situation report briefings to Embassy country team and to OFDA daily or as required.

4. Contractor to coordinate directly with Office of Foreign Disaster Assistance (Mr. Martin Howell (Director), Ms. Carol Siegel (Fiscal Control), Mr. George McClusky (Acting Deputy Director), Mr. George Beauchamp (Operations Officer), Mr. Jack Slusser (Health Officer), Mr. Bill Kelly (Science and Technology Officer) as appropriate at 632-5916 in Main State Department Bldg.

5. Ensure Mr. Charles Mathews (LAC/DR/ENGR), Ms. Elena Brienman (LAC/DR/HN) and pertinent desk officer are aware of and given copies of this OTD.

6. Water Supply and Sanitation Assessment Team

Mr. Wehman, DS/HEA, will be traveling soon after the disaster activity for disaster assessment and coordination effort. OFDA and Mr. Wehman requests WASH contractor obtain the services and availability of at least eight (8) highly qualified personnel experienced in urban and rural water supply and waste disposal, public health and field operations to accompany Wehman to site (probably using military aircraft from Andrews AFB). Personnel should have one suitable suitcase or duffle bag, combat boots or equivalent, at least 10 days of rations, and suitable number of changes of clothes. If team members have jungle fatigue or fatigue type pants and fatigue blouse or equivilant or blue jeans and work shirts or equivalent, this would be

ideal. Members should wear field jacket or equivalent on flight. Members will be required to meet at a metropolitan Washington, D.C. or equivalent location within 12 hours of notice and preferably within 6 hours of notice by WASH Coordination and Information Center.

Team members should anticipate spending minimum of 15 days or 2 weeks upon arrival in the disaster area.

Team members will be under the administrative and technical direction of Mr. V. Wehman. WASH team members including Wehman (AID) will be administratively attached to the U.S. Ambassador or USAID Mission Director or other appropriately designated representative. Administrative, vehicle, telecommunications, helicopter, lodging and messing facilities will be arranged by the U.S. Government to the extent possible and if practical and convenient to WASH team members while carrying out their work. For all practical purposes, the WASH team members may be considered as part DAST resource. When DAST is removed from country, WASH team also will be removed unless mutally agreed upon by WASH contractor, DS/HEA, OFDA and V. Wehman.

7. Emergency Water Purification Plants Operating Team.

In addition to the above 8 man team for WS&S assessment purposes, WASH contractor requested to develop sub-contract or sub-sub-contract, as appropriate, with Cummins-Wagner Inc. of Maryland Route 32 in Annapolis Junction, Maryland to obtain the services under the WASH contract of up to six (6) Cummins-Wagner personnel for purposes of sending them to the country for up to 3 weeks each, operating the 6 or 7 OFDA Mobile Purification Plants and training local personnel in the set up, opration, maintenance, security and distribution of water from these potable water plants. Suggest you use overhead, overtime, fee and cost schedules as per their existing contract with OFDA (see Carol Siegel, 632-5916.

Contractor should arrange for appropriate team personnel reasonably available to go to Cummins-Wagner facility Saturday, 13 June 81 to get detailed operational instruction on equipment from Cummins-Wagner personnel. (see Ref. B para A.)

8. Contractor authorized up to 380 person days of international per diem or domestic per diem as appropriate.

9. Contractor personnel authorized to travel by domestic or international civilian airlines or by U.S. military aircraft or DAST aircraft as appropriate and timely. Contractor authorized up to 20 round trips for WASH personnel from their home base through Washington to P and return as appropriate. All personnel will return through Washington for debriefing at OFDA and WASH before returning to home base.

10. Contractor authorized to expend up to eight thousand dollars (8,000) for local supplies, materials, graphics, interpreter, secretaries.

11. Contractor authorized miscellaneous expenses in accordance with AID regulations.

12. Contractor authorized to rent or hire vehicles as necessary and appropriate.

13. Contractor should provide for the services of Mr. Donald Vandertulip as a sanitary/environmental engineering resource to the OFDA Coordination Center in Washington for a period of up to 15 days, including 15 days of Washington per diem, and up to 2 round trips from San Antonio, Texas to Washington, D.C. if necessary. Mr. Vandertulip will be the principle liaison between OFDA and WASH, CIC and field WASH team members.

14. Consultants, sub-contractors, sub-sub-contractors and OFDA personnel (Siegel) should be notified that WASH resources are ready and on alert. All contracting mechanisms must be set in place no later than noon 13 June 1981.

15. Contractor authorized to start drawing down time authorized in para 2 and 8 above as necessary and appropriate for alert status.

16. Suggest all consultants obtain hepatatis shots before going.

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

VWW:ja:6/12/81

June 11, 1981

MEMORANDUM

TO: DS/HEA, Mr. Vic Wehman

FROM: OFDA, Martin D. Howell, Director

SUBJECT: Work Order under WASH Contract

Please prepare a work order under the WASH Contract in support of OFDA's Water Purification Unit package. Following is the proposed Scope of Work:

A. Travel to Cummins-Wagner Plant in Annapolis Junction, Md. (storage cite of OFDA water purification units) and undergo a course of instruction in the operation and maintenance of the AID/OFDA water treatment plants.

B. Be prepared to depart upon six hours notice to any part of the world and to remain for a period determined by AID, which normally would be 30 days or less. Contractors should be prepared to live under the most difficult and austere conditions and to be prepared to operate and maintain the AID/OFDA Water Treatment Plants.

C. They will provide instruction in the proper operation and maintenance to such personnel as AID or the host government will designate to provide continuous operation and maintenance of the unit upon departure of the WASH technician.

D. Necessary tools and equipment including field equipment will be provided by AID. The decision as to what equipment is needed will be made by AID.

E. While transportation will normally be arranged by AID, there may be times when WASH personnel will be asked to arrange for their own transportation. WASH personnel will be required to provide their own clothing and comfort items as required. WASH personnel will be responsible for obtaining and maintaining valid passports prior to requests for their services. AID will be responsible for arranging for any necessary visas.

F. Upon completion of duties, WASH personnel will submit a written report on the performance of equipment, difficulties encountered, lessons learned and recommendations, if any, for additions or changes of equipment.

APPENDIX B

ITINERARY

Washington, D.C. - Miami	January 13, 1983
Miami - Quito	January 14, 1983
Quito - Guayaquil	January 15, 1983
Guayaquil - Quito	January 27, 1983
Quito - Washington, D.C.	January 28, 1983

APPENDIX C

OFFICIALS CONTACTED

USAID

Quito

Paul Fritz, Acting Director
Jack Thrower
Dr. Kenneth Farr
Engineer Greg J. Goewery
Gonzalo A. Calderon
Engineer Herbert Caudill - (By telephone only)

Quayaguil

Harry Wilkenson
Roderick MacDonald P.E.
Nich Bela, Engineer
John Austin, Engineer (AID/Washington)
Charles Grover

PAHO

Dr. Chalos Pettigiani
Carlos Arevalo
Engineer Rainando Hederra

Ecuadorians

Fidel Endara - Sub Secretary Heates
Andres Altamirando - Civil Defence Quauyaquil
Vicente Coello Barata
Rodrigo Alvarado - Civil Defence/E.S.P.L.
Ing. Pablo Baquerizo, President C.I.C.G.
Javier Sanchez)
Gesse Safadi) Translators of Manual
Ing. Quiroz IEOS
_____ Director Babahoyo Hospital

Technicians

Ray Rieves (Cummins & Wagner)
Marty Gullivan " "
Bruce Donaldson, (WASH)

Ecuadorian Plant Operators

See attached list

ECUADORIAN TECHNICIANS QUALIFIED TO OPERATE WATER PURIFICATION UNITS

Name Identification No.	Date of Birth Place of Birth	Organizational Affiliation/ Profession	Education
Julio Cesar Hinojosa Rabasco 120048140-4	7/8/53 Babahoyo, Los Rios	IEOS	Universidad Técnica de Babahoyo
Galo Luis Quintano Rivera 120066878-6	2/17/52 Quevedo, Los Rios	IEOS Pipe Inspector	Quevedo High School
Roboan Antonio Alava de Lucca 120168587-0	1/3/63 Babahoyo, Los Rios	IEOS Pipe Inspector	Eugenio Espejo (Segundario)
Cesar Anibal Cartacho Valencia 020004187-9	5/22/47 Bolivar - Charanda	IEOS Pump Mechanic	4° Curso Comercio, Colegio 13 de abril
Jesus Cristobal Indio Zambrano 120082039-5	12/2/57	IEOS Pipe Inspector	
Freddy Hernan Marin Aguilera 120173330-8	7/25/64 Babahoyo, Los Rios	Civil Defense (Local?)	Eugenio Espejo (Segundario)
Reynaldo Jhonny Valencia Zumba 120058415-7	10/25/53 Babahoyo, Los Rios	Civil Defense Dredging Mechanic	Estrada Coello (Segundario)
Luis Enrique More Ira Cabezas 0906854476	10/11/58 Babahoyo, Los Rios	Civil Defense Dredging Mechanic	5 de noviembre (Segundario)
Agusto Antonio Padilla Rodriguez 0905904595	4/16/55	Civil Defense	

Jorge Telmo Rodrigues Sanchez 1200897807	10/8/56 Babahoyo, Los Rios	Civil Defense Driver (and Law Student)	University of Guayaquil
Victor de Santis Carvajai 120106500-8	11/17/56 Quevedo, Los Rios	Student	Colegio Nacional Eugenio Espejo Sexto Curso, Sociales (Coming to U. S. to study at Brigham Young University)

OTHER CONTACTS

Municipal Contact Person

Vicente Coello B.
Treasurer
Municipalidad
Phone: 730088/7

Source: Data collected by Marty Gullivan
January 1983