

827 PE91

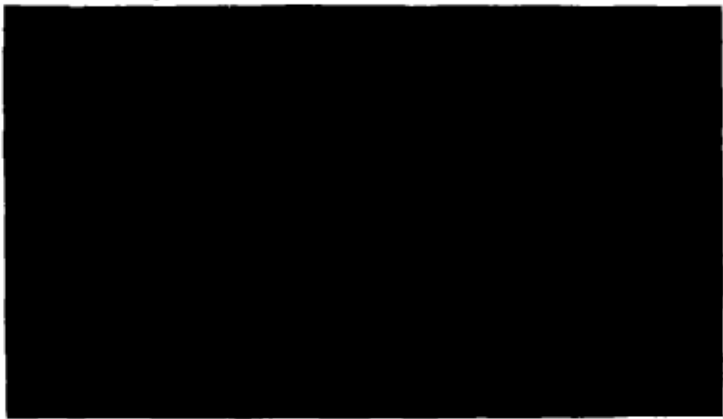
ENVIRONMENTAL HEALTH PROJECT

Prepared for:
ENVIRONMENTAL HEALTH DIVISION
OFFICE OF HEALTH AND NUTRITION

Center for Population, Health and Nutrition
Bureau for Global Programs, Field Support and Research
U.S. Agency for International Development



827-PE-13021





ENVIRONMENTAL HEALTH PROJECT

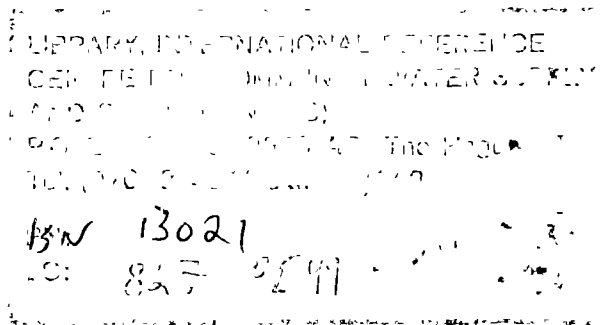
WASH Reprint: Field Report No. 331

Cholera in Peru:
A Rapid Assessment of the Country's Water and
Sanitation Infrastructure and Its Role in the Epidemic

Joseph Haratani
Donald J. Hernandez

May 1991

Prepared for the USAID Mission to Peru
under WASH Task No. 236



Environmental Health Project
Contract No. HRN-5994-C-00-3036-00, Project No. 936-5994
is sponsored by the Bureau for Global Programs, Field Support and Research
Office of Health and Nutrition
U.S. Agency for International Development
Washington, DC 20523

WASH and EHP

With the launching of the United Nations International Drinking Water Supply and Sanitation Decade in 1979, the United States Agency for International Development (USAID) decided to augment and streamline its technical assistance capability in water and sanitation and, in 1980, funded the Water and Sanitation for Health Project (WASH). The funding mechanism was a multiyear, multimillion-dollar contract, secured through competitive bidding. The first WASH contract was awarded to a consortium of organizations headed by Camp Dresser & McKee International Inc. (CDM), an international consulting firm specializing in environmental engineering services. Through two other bid proceedings, CDM continued as the prime contractor through 1994.

Working under the direction of USAID's Bureau for Global Programs, Field Support and Research, Office of Health and Nutrition, the WASH Project provided technical assistance to USAID missions and bureaus, other U.S. agencies (such as the Peace Corps), host governments, and nongovernmental organizations. WASH technical assistance was multidisciplinary, drawing on experts in environmental health, training, finance, epidemiology, anthropology, institutional development, engineering, community organization, environmental management, pollution control, and other specialties.

At the end of December 1994, the WASH Project closed its doors. Work formerly carried out by WASH is now subsumed within the broader Environmental Health Project (EHP), inaugurated in April 1994. The new project provides technical assistance to address a wide range of health problems brought about by environmental pollution and the negative effects of development. These are not restricted to the water-and-sanitation-related diseases of concern to WASH but include tropical diseases, respiratory diseases caused and aggravated by ambient and indoor air pollution, and a range of worsening health problems attributable to industrial and chemical wastes and pesticide residues.

WASH reports and publications continue to be available through the Environmental Health Project. Direct all requests to the Environmental Health Project, 1611 North Kent Street, Suite 300, Arlington, Virginia 22209-2111, U.S.A. Telephone (703) 247-8730. Facsimile (703) 243-9004. Internet EHP@ACCESS.DIGEX.COM.

WASH Field Report No. 331

CHOLERA IN PERU:
A RAPID ASSESSMENT OF THE COUNTRY'S
WATER AND SANITATION INFRASTRUCTURE
AND ITS ROLE IN THE EPIDEMIC

Prepared for the USAID Mission to Peru
under WASH Task No. 236

by

Joseph Haratani
and
Donald J. Hernandez

May 1991

Water and Sanitation for Health Project
Contract No. DPE-5973-Z-00-8081-00, Project No 836-1249
is sponsored by the Office of Health, Bureau for Science and Technology
U.S. Agency for International Development
Washington, DC 20523

Related WASH Reports

Field Report No. 302, *Planning for Water and Sanitation Programs in Bolivia, Ecuador, and Peru*, by David Ey. June 1990.

Field Report No. 201, *Final Evaluation of USAID/Catholic Relief Services Water and Sanitation Program in Ecuador, Peru, Guatemala, Honduras and the Dominican Republic*, by Oscar R. Larrea, Rose M. Schneider, Richard Duncan, and Homero Silva. January 1988.

Field Report No. 134-S, *A Summary of the Progress Evaluation of the Rural Water Systems and Environmental Sanitation Project in Peru*, by Jacques Faigenblum. March 1985.

Field Report No. 38, *Recommendations for the Rural Water and Environmental Sanitation Project in Peru*, by David Donaldson and Charles S. Pineo April 1982.

Field Report No. 30, *UNICEF/PAHO Joint Workshop on Drinking Water and Sanitation in Rural and Urban Slum Areas, Lima, Peru 17-22 November 1980*, by Emil T. Charlett. December 1981.

Field Report No. 1, *Socio-Cultural and Economic Characteristics of Conditions in Ancas and La Libertad, Peru, with Special Emphasis on the Callejones de Huaylas and Conchucos: In an Evaluation of CARE-sponsored Water, Sewage and Health Projects*, by Charlotte I. Miller. November 1980.

TABLE OF CONTENTS

ACRONYMS	v
ACKNOWLEDGMENTS	vii
EXECUTIVE SUMMARY	ix
1. INTRODUCTION	1
1.1 Background to the Cholera Epidemic	1
1.2 Purpose and Scope of the Study	1
1.3 Methodology	2
2. WATER AND SANITATION SECTOR ORGANIZATIONS	3
2.1 General Overview	3
2.2 Ministry of Health	4
2.3 Ministry of Housing and Construction	6
2.4 Pan American Health Organization (PAHO)	7
3. FIELD VISITS	9
3.1 Chimbote Water System Evaluation	9
3.1.1 Introduction	9
3.1.2 Water Systems	9
3.1.3 Other Observations	10
3.1.4 Recommendations	10
3.2 Committee for Vigilance over the River Santa Waters	11
3.2.1 Introduction	11
3.2.2 Water System	12
3.2.3 Cambio Puente	14
3.2.4 Discussion and Recommendations	14
3.3 Lima Water System	15
3.3.1 Introduction	15
3.3.2 Water Supply System	16
3.3.3 Sewage Disposal	18
3.3.4 Other Observations and Recommendations	19
3.4 Piura and Environs	21
3.4.1 Introduction	21
3.4.2 Piura Water System	22

3.4.3	Sewage System	22
3.4.4	Other Observations	23
3.4.5	Other Area Visits	24
3.4.6	Discussion and Requirements	25
4.	EPIDEMIC CONTROL ACTIONS	27
4.1	Overview	27
4.2	Short-term Emergency Measures Taken	27
4.2.1	Organizational Efforts	28
4.2.2	Summary of Short-term Measures Taken	29
4.3	Short-term Emergency Actions Needed	29
4.4	Medium- and Long-term Water Supply and Sanitation Programs Needed	30
5.	CONCLUSIONS	35
5.1	Resources	35
5.2	Constraints	36
5.3	Outlook for the Future	36
6.	RECOMMENDATIONS	39
6.1	Recommendations to USAID/Peru	39
6.2	Recommendations to the Government of Peru	40
	PHOTOGRAPHS	43
APPENDICES		
A.	Key Personnel Contacted	59
B.	Reference Documents	63
C.	Anti-Cholera Posters and Fliers	65
D.	Excerpt from CEPIS Report	73
E.	Excerpt from Plan Maestro de Agua Potable y Desague para Lima Metropolitana	81

TABLES

1.	Population of Peru	31
2.	Actual Water Supply Coverage Versus 1995 and 2000 Targets	31
3.	Actual Sanitation Coverage Versus 1995 and 2000 Targets	32
4.	Water Supply and Sanitation Requirements	33

ACRONYMS

CDC	Centers for Disease Control (Atlanta, Georgia)
CEPIS	<i>Centro Panamericano de Ingenieria Sanitaria y Ciencias del Ambiente</i> , Pan American Center for Sanitary Engineering and Environmental Sciences (WHO/PAHO)
COVARS	<i>Comite de Vigilancia del Agua del Rio Santa</i> , Committee for Vigilance over the River Santa Waters
DIGESA	<i>Direccion General de Saneamiento Ambiental</i> , Directorate General of Environmental Sanitation (MOH)
DISABAR	<i>Direccion de Saneamiento Basico Rural</i> , Division of Basic Rural Environmental Sanitation (MOH)
EPA	U.S. Environmental Protection Agency
GOP	Government of Peru
INAPMAS	<i>Instituto Nacional para Proteccion del Medio Ambiente por la Salud</i> , National Institute for the Protection of the Environment for Health
MOE	Ministry of Education
MOH	Ministry of Health
MOHC	Ministry of Housing and Construction
MPN	Most probable number
NGO	Nongovernmental organization
PAHO	Pan American Health Organization
PANFAR	<i>Programa de Alimentation y Nutricion para la Familia en Alto Riesgo</i> , Food and Nutrition Program for Families at High Risk
PPM	Parts per million

<i>pueblos juvenes</i>	Young towns, peri-urban communities
PVO	Private voluntary organization
SEDA	<i>Servicio de Agua Potable</i> (municipal water agency)
SEDAPAL	<i>Servicio de Agua Potable y Alcantarillado de Lima</i> , Lima Water Supply and Sewerage Service
SENAPA	<i>Servicio Nacional de Abastecimiento de Agua Potable y Alcantarillado</i> , National Water Supply and Sewerage Service (MOHC)
UDES	<i>Unidad Departamental de Salud</i> , Departmental Health Unit
USAID/Peru	United States Agency for International Development Mission in Peru
URO	Oral rehydration unit
USG	United States Government
WASH	Water and Sanitation for Health Project (funded by A.I.D.)
WHO	World Health Organization

Currency Equivalent: 550,000 Inti = US \$1

ACKNOWLEDGMENTS

We thank Craig Buck, USAID/Peru Director and his staff for their support during our assignment in Peru. Our assessment work would not have been possible without the collaboration and assistance of Dr. Edgar Necochea and Mr. Gerardo Arabe who managed our daily schedule of meetings and interviews.

We also express our gratitude to Dr. Jose Bisbal and Dr. Jesus Toledo and to Engineer Eugenio Bellido, all of INAPMAS, who made the necessary arrangements to meet key governmental and non-governmental representatives involved in the cholera epidemic and for guiding us on our field visits. Thanks are also due to Engineers Julio Burbano of PAHO and Alberto Florez of CEPIS for their valuable assistance.

We are indebted to Mrs. Libertad Barraza for her kind attention in responding to our many requests for help and to Ms. Lissy Venancio for her excellent word processing service.

We would be remiss not to express our gratitude to the many regional and local officials who so willingly took the time and effort to accompany us on our field visits. Finally our deepest appreciation goes to the many 'common folks' who cheerfully allowed us to intrude into their homes and lives in spite of the difficult times they are experiencing. Muchisimas Gracias!

ABOUT THE AUTHORS

Joseph Haratani has a diverse background in project design, implementation, and evaluation; civil and sanitary engineering; and coordination of Peace Corps programs in South America. Since 1983, he has served as a public health advisor to A.I.D. in the area of water supply and sanitation, participating in project design as well as advising field missions in management and evaluation of development programs. He is fluent in Spanish.

Donald J. Hernandez has over 40 years experience as a civil and sanitary engineer. He has worked in public health and environmental quality overseas—in Egypt, China, Nicaragua, Iraq, and Saudi Arabia—as well as for the U.S. Environmental Protection Agency and the State of Oregon. He speaks Spanish, in addition to German and Arabic.

EXECUTIVE SUMMARY

Introduction

Peru's cholera epidemic, which began in late January 1991, elicited a rapid response from the Government of Peru (GOP) medical establishment for the treatment of patients in Lima/Callao and the north coastal cities of Chancay, Chimbote, Trujillo, and Piura. The timely domestic response to the epidemic was followed by a flow of medical supplies and equipment from international donors. In the several weeks following the outbreak, the epidemic had spread from the coastal area inland into the Amazon watershed and across the national border into the neighboring countries of Ecuador, Colombia, and Chile.

While the response for the treatment of cholera patients and the donations of medical supplies and equipment have been commendable, very limited activities have been conducted and a totally inadequate amount of water and sanitation supplies and equipment have been provided by donors to stem the transmission of the disease. The major environmental measures taken to date have been increased chlorination and surveillance of existing urban water systems and distribution of home water purification chemicals and residual chlorine monitoring kits.

For a variety of reasons, including the resignation of the Minister of Health in mid-March, what had begun to develop into a coordinated anti-cholera campaign had, by late March, dissolved into a series of uncoordinated field actions by various government agencies. While each of these field activities is important and necessary, at their present level of effort they are not producing the impact needed to stem the spread of the disease.

Rapid Assessment of Water Supply and Sanitation

In view of the severity of the cholera epidemic and its rapid spread, USAID/Peru requested the Water and Sanitation for Health Project (WASH) to field a two-person team to make a rapid assessment of the water supply and sanitation situation. The main focus of this assessment was to be in the areas hit hardest by the epidemic, namely, the cities along the north coast of Peru.

After a review of pertinent reports and related documents and briefings by staff from the major agencies involved in controlling the cholera epidemic, the WASH team of two sanitary engineers made field visits to Chimbote, Lima/Callao, and Piura and their environs to assess the water and sanitation situation. In essence, the field visits confirmed the information provided in the earlier briefings, namely, that:

- Prior to the epidemic, chlorination of water supplies was an exception to the general rule. Since the epidemic, more water supplies are being chlorinated.
- With the possible exception of limited areas in Lima, urban water supplies are operated on an intermittent basis and are thus subject to contamination from leaks, back-siphoning, and cross-connections.
- Even when safe water is delivered to the home, there is the ever present danger of contamination because of inadequate hygiene practices related to the storage and use of water in the majority of households.
- Most households in peri-urban neighborhoods (*pueblos juvenes*) are not connected to the piped water or sewerage systems. These families receive water from public standpipes or buy water from tanker trucks. About half of the residents do not have formal excreta disposal facilities and are forced to defecate in any open area available.
- Organized garbage and solid waste storage, collection, and disposal are nonexistent in *pueblos juvenes* and inadequate in many areas of the central city. The poor and homeless often defecate in the same areas where garbage and solid wastes are disposed of and thereby increase the danger of cholera transmission from direct contact by scavengers or indirectly through disease vectors such as rodents and flies.
- Among the poor, due to a low level of education and lack of material resources, fundamental health and sanitation practices are often either unknown or not applied.

Emergency Short-term Measures Being Taken

Three agencies of the GOP (INAPMAS and DIGESA of the Ministry of Health and SENAPA of the Ministry of Housing and Construction), with significant technical assistance from CEPIS, have taken the lead in field activities designed to blunt the spread of cholera. As noted earlier, the main efforts have been to increase the chlorination of existing water supplies and to instruct residents in the use of and distribution of hypochlorite packets or solution for purifying water in the home.

Additionally, technical assistance has been provided to regional and local government agencies in organizing local cholera committees, developing anti-cholera campaign strategies, and assisting in initiating the campaigns.

The MOH and other entities have developed, printed, and distributed anti-cholera posters and leaflets providing messages on boiling water, sanitary food preparation, and good personal hygiene practices. The MOH is also broadcasting public service messages on ways to avoid contracting cholera.

Emergency Short-term Measures Needed

In order to control the spread of cholera, the following actions must be taken:

- Chlorinate all existing water supplies.
- Expand the household water purifying programs to all *pueblos juvenes*.
- Execute a mass media campaign on safe water, sanitary excreta disposal, good food sanitation, and personal hygiene.
- Execute an anti-cholera and health and sanitation education program through all schools to reach all students and their families.
- Execute a food sanitation program to instruct and train all food handlers including street vendors.
- Execute a nationwide garbage and solid wastes collection and disposal program.

Medium and Long-term Programs

The major actions needed on a medium and long-term basis to control the spread of cholera and other transmissible diseases will require, at a minimum, a tenfold increase in investment in water supply and sanitation infrastructure. Annual capital investment in the order of \$100 to \$120 million is needed to provide 80 percent urban and 50 percent rural water supply coverage and 75 percent urban and 50 percent rural sanitation (excreta disposal) coverage by the year 2000.

In addition, further increased investments must be made in health, sanitation, and personal hygiene education programs, food sanitation training for food handlers, and expanded garbage and solid wastes collection and disposal.

Conclusions

Resources:

- Peru has sufficient human (professional and technical) and institutional resources and many of the material resources needed to plan and mount an effective, unified anti-cholera campaign.
- Peru has an existing health services delivery system in place that reaches down to the district and municipal levels.
- Peru has an existing public education structure which reaches almost all towns having populations of 2,000 or more.
- Peru has a well-developed mass media industry which can be mobilized to disseminate health and sanitation information to a majority of the population.

Constraints:

- At the time of this study, there was no recognized central authority in complete charge of an anti-cholera campaign nor was there a unified campaign organization or strategic campaign plan.
- The ongoing decentralization of government will make the planning and execution of a national anti-cholera campaign more complex.

Recommendations

To USAID/Peru:

- Hire a full-time Peruvian engineer to act as the key USAID contact and action person and to collaborate with pertinent GOP offices and international agencies.
- Actively support reorganizing the MOH inter-ministerial cholera committee.
- Form a USAID/Peru working group to assist the full-time engineer in collaborating with GOP officials and international representatives in developing a national emergency anti-cholera campaign plan.

- Obtain emergency assistance funding to provide technical assistance and support for the emergency campaign plan.
- Re-activate USAID/Peru's involvement in the rural water supply and sanitation programs.

To the GOP:

- Appoint a "cholera czar" to organize a cholera task force responsible for planning, funding, and executing a unified campaign. This is the single most important action that must be taken by the GOP.
- Establish an emergency task force to plan, fund, and execute an emergency anti-cholera campaign plan.
- Establish a technical advisory group to provide unified technical advice to the emergency task force.
- As quickly as possible, shift the emphasis from a reactive (curative) effort to a pro-active (preventive) anti-cholera program.

Chapter 1

INTRODUCTION

1.1 Background to the Cholera Epidemic

In late January 1991, medical authorities in Peru noted an increase in cases of diarrhea along the coast north of Lima. Since a rise in diarrhea during the summer season is normal along the coast, it was initially thought that this was not an unusual occurrence.

The earliest cases of increased diarrhea were reported from the town of Chancay, a coastal town of 75,000 located some 60 km north of Lima. Fifty-three cases were reported on January 29. An epidemiology team from the Ministry of Health travelled that same afternoon to Chancay to study the outbreak. Similar outbreaks occurred almost simultaneously in Chimbote and Piura, coastal towns farther north.

On February 4, 1991, the presence of vibrio cholera was confirmed by laboratory analysis. This finding triggered an immediate response by pertinent offices of the Government of Peru to address what was now clearly identified as an outbreak of cholera, a disease which was virtually unknown in modern history on the South American continent.

The announcement of the epidemic in the international news media initiated a flow of emergency assistance from the international community. The bulk of donor aid was in the form of medical supplies and equipment needed to treat cholera patients. A limited amount of aid was provided for water purification consisting of chlorinating equipment and hypochlorite crystal packets for household water purification use.

1.2 Purpose and Scope of the Study

A preliminary report by a team from the Centers for Disease Control (CDC), which had been monitoring the epidemic since mid-February, indicated that while the treatment of cholera patients was adequate, there was an urgent need to assess water treatment facilities in coastal towns. USAID/Peru requested the Water and Sanitation for Health Project (WASH) to provide a two-person team to make a rapid assessment of the water supply and sanitation sector with respect to the ongoing cholera epidemic.

The WASH team was directed to identify water supply deficiencies, design short-term corrective measures, and identify long-term needs and possibilities for interventions in the field of water supply and sanitation. The study was to give highest priority to areas experiencing the greatest number of cholera cases.

1.3 Methodology

The study was implemented in two phases: preparatory and field work. The preparatory phase consisted of a review of the scope of work and documents pertaining to the cholera epidemic and a briefing by WASH staff prior to travelling to Peru.

The field phase of the study consisted of briefings by USAID/Peru staff, review of additional documents, and interviews with government officials and representatives of international and local institutions. First-hand observations were made during field visits to several affected areas. (See Appendix A for a list of personnel contacted in Peru and Appendix B for reference documents.)

Based on the information and data gathered, conclusions were drawn and recommendations developed. A draft report was prepared and a debriefing was provided to the USAID/Peru staff before the team departed from Peru.

Chapter 2

WATER AND SANITATION SECTOR ORGANIZATIONS

2.1 General Overview

Within the Government of Peru, responsibility for the water and sanitation sector is divided between the Ministry of Health (MOH) and the Ministry of Housing and Construction (MOHC). The MOHC is responsible for water supply and sewerage in towns and cities having a population of 2,000 or more. The MOH has the responsibility for providing water supply, excreta disposal, and environmental sanitation services in rural areas and towns having less than 2,000 population.

In the major cities, water supply and sewerage services are operated by semi-autonomous authorities. Environmental sanitation services such as garbage collection and street cleaning are provided by the municipal governments. In most towns under 2,000 population, there are no regular environmental sanitation services. About 25 percent of the rural population have rudimentary piped water systems. Almost none have sewerage systems. While some families have installed pit latrines, more than three-quarters of the rural population have no formal excreta disposal facilities.

In addition to the many government institutions operating in the water and sanitation sector, there are a large number of multilateral, bilateral agencies, PVOs, and NGOs also involved in the sector. Notable among these are the Pan American Health Organization (PAHO) and the Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS). USAID has made major contributions in the sector over the past several decades.

Interviews were held with seven government offices involved in the anti-cholera campaign. Five of these offices are within the MOH, and two in the MOHC. As described below, each of these offices has been active in varying degrees in combatting the cholera epidemic. Several had already undertaken field activities and/or had planned or were planning programs which involved providing direct assistance to local authorities and residents in the areas most severely affected.

Early on, an inter-ministerial emergency committee was formed consisting of representatives of the Ministries of Health, Housing and Construction, Agriculture, Fisheries, and Education to prepare a plan of action and to coordinate its implementation. It was reported that this committee held one initial meeting and had not met since. Another source reported that an inter-ministerial committee had been formed between the Ministry of Health and the Ministry of Housing and Construction. This committee was reported to have had representatives from SENAPA, SEDAPAL, INAPMAS, DIGESA, and DISABAR. This committee also was reported to have met once and had been inactive since. Neither of these reports were

confirmed and may be referring to the same group. Whatever the case may be, the end result is the same. Coordination of the cholera campaign activities from the top, especially since the resignation of the Minister of Health in mid-March, has been virtually nonexistent. Any coordination and cooperation now taking place is due to the valiant efforts of professional and technical staff in mid-management positions in these organizations.

The various efforts of the several offices, however, are not making the necessary impact on the spread of the cholera epidemic. At this time, there is no unified master plan to control the epidemic nor is there an officially designated director in charge of the campaign. Many actions are being taken and the public is being informed by the mass media on precautions to be taken. The MOH has run public service messages on television on washing hands, boiling water, and cooking food. It has also distributed and placed posters at hospitals and other public places instructing the public on these same topics. (See Appendix C for samples of posters and fliers.) All of these efforts are necessary and important but have not reached the level of intensity and consistency required to make a major impact on the spread of the disease.

2.2 Ministry of Health

Several different offices within the MOH are involved in the current effort.

Technical Directorate of Epidemiology. *Normal responsibilities:* This office is responsible for collecting data on 14 reportable transmissible diseases and standardizing reporting criteria, format, and periodicity. Additionally, the Directorate investigates outbreaks of specific transmissible diseases.

Cholera actions taken: The Directorate fielded an epidemiological team on January 29, 1991, to investigate the outbreak of diarrhea in Chancay. It has since sent teams to Chimbote, Trujillo, and Piura. In mid-February, staff from the Centers for Disease Control (CDC) in Atlanta, Georgia, arrived in Peru to assist the Directorate in investigating and monitoring the cholera outbreak.

Office of Statistics and Information. *Normal responsibilities:* This office is responsible for gathering, analyzing, and disseminating health statistics on a nationwide basis. It acts as the central collection point in the government for health-related information.

Cholera actions taken: During the present cholera epidemic, this office was maintaining a daily update of the status of the outbreak based on actual case reports from each departmental (state) health office. Unfortunately, due to the resignation of the Minister of Health and changes in the top officers, the flow of information was disrupted in mid-March. Since then, statistics on the status of the cholera epidemic have been based on estimates.

Division of Basic Rural Environmental Sanitation (DISABAR). *Normal responsibilities:* DISABAR is responsible for providing water supply and sanitation services to all rural communities having a population of less than 2,000. During the past decade, DISABAR decentralized its field operation by establishing 18 regional offices throughout the country. Due to the ongoing process of decentralizing the entire government structure, the new regional governments are in the process of taking over the operation of the regional DISABAR offices. Action is also pending on the possible transfer of the central DISABAR office from the Ministry of Health to the Ministry of Housing and Construction.

Cholera actions taken: DISABAR had planned a two-day seminar on basic sanitation, regionalization, and activities concerning the cholera epidemic, to be held on February 21 and 22. However, at the last hour the MOH decided not to authorize the seminar, so it was canceled.

On March 22, 1991, DISABAR presented a National Plan for the Prevention, Control and Monitoring the Cholera Epidemic to the National Planning Institute, requesting assistance in obtaining funding from an external source. This plan, estimated to cost US\$1,461,595, comprises four major activities:

- Chlorination and disinfection of potable water
- Installation of emergency latrines
- Control of water quality in rural areas
- Health education and monitoring of the epidemic

DISABAR also prepared a separate detailed plan to control cholera in the rural areas of Cajamarca, which would cost US\$104,007. The plan was to be used as a sample plan which other departments could use. This plan was prepared by DISABAR, unaware that the INAPMAS team had already travelled to Cajamarca in late February and had organized and initiated an anti-cholera campaign with the local authorities. Among the local people involved in the campaign was Engineer Hugo Tirado, Regional Director of the DISABAR office in Cajamarca. Apparently, there had been no communications between the two DISABAR offices.

Directorate General of Environmental Sanitation (DIGESA). *Normal responsibilities:* This Directorate provides professional staff resources to the MOH over a broad range of technical fields related to the environment. The staff plans and implements studies, training courses, and environmental sanitation projects.

Cholera actions taken: During the present epidemic, DIGESA in cooperation with the National Engineering University fielded a team of some 30 engineers and technicians who

travelled to the town of Chimbote to work in the *pueblos juvenes*. Team members met with community-level organizations such as health committees, mothers clubs, and community kitchens to inform the public on the characteristics of the cholera epidemic and to advise them on the basic measures they should take to avoid the disease. At these public meetings, which were held in many peripheral sectors of Chimbote, team members demonstrated the use of liquid bleach and packets of hypochlorite crystals to disinfect water stored in the home.

Team members also trained community leaders in the use of these materials so they could go from house to house to instruct individual home owners in their use. A simple residual chlorine test kit, designed by CEPIS and produced locally, was also provided to local health workers who were trained in its use to monitor chlorine residuals in individual homes.

National Institute for the Protection of the Environment for Health (INAPMAS). *Normal responsibilities:* The Institute acts as the clearing house and coordinating office for the MOH on all environmental activities related to health. It plans and implements environmental health programs which often require the participation of professional staff from other MOH offices such as DIGESA and DISABAR. It also establishes policies and technical guidelines for environmental health activities of the MOH.

Cholera actions taken: During the cholera epidemic, the Institute fielded a team to travel to Cajamarca to assist the local authorities in organizing a campaign covering the city and its environs. The team, consisting of six professionals from various technical disciplines, arrived in Cajamarca February 23, 1991, and spent one week organizing and implementing the campaign. It also prepared an emergency work plan describing the actions to be taken, the supplies and equipment needed, manpower requirements, and a cost estimate.

The Director of the Institute accompanied the EPA team on its field visits to Trujillo and Piura and to *pueblos juvenes* in Lima. The Institute also arranged meetings for the WASH team with the various government and nongovernmental organizations, and the INAPMAS Sanitary Engineer accompanied the team on many of its meetings and field visits.

2.3 Ministry of Housing and Construction

Two of the MOHC offices are involved in the current effort, as described below.

National Water Supply and Sewerage Service (SENAPA). *Normal responsibilities:* SENAPA is responsible for establishing policies and technical guidelines and assistance for all municipal water and sewerage authorities for towns and cities having a population over 2,000, except for the Federal District of Lima which operates as a separate autonomous authority.

Cholera actions taken: In response to the present cholera epidemic, SENAPA published an official Ministerial Resolution of February 15, 1991, describing emergency actions to be taken by MOHC, regional and local governments, and water supply and sewerage authorities. Specific instructions were developed for use in areas with and without piped water, areas with and without sewerage systems, and areas with and without latrines.

The President of the SENAPA Directorate was a key member of a team representing MOH, MOHC, and PAHO that travelled to the Departments of Tumbes and Piura to gather information on the cholera epidemic, and to meet with representatives of the Government of Ecuador to discuss ways and means to collaborate on the cholera epidemic.

SENAPA has also trained 23 of its engineers and technicians in the installation and operation of drip hypochlorinators which reportedly have been donated by the German government. These trained technicians have begun to travel to those towns and cities hardest hit by the epidemic where there is a need for chlorination, to install the equipment, and train the local staff in its operation. A key constraint to this activity is lack of adequate funds to cover travel costs of the large number of teams.

Lima Water Supply and Sewerage Service (SEDAPAL). *Normal responsibilities:* SEDAPAL is responsible for supplying water and sewerage service to the cities of Lima and Callao.

Cholera actions taken: SEDAPAL increased the application of chlorine at its La Atarjea surface water treatment plant. It also installed chlorinators on all operating wells. In conjunction with CEPIS, SEDAPAL instituted an extensive program for monitoring water quality throughout the treatment and distribution system.

2.4 Pan American Health Organization (PAHO)

Pan American (Regional) Sanitation Office Peru. *Normal responsibilities:* PAHO is the WHO Regional Office for the Americas, with headquarters in Washington, D.C. A sub-office located in Lima is charged with providing technical assistance in health activities to the Government of Peru, which may be in the form of general technical assistance or in special projects identified as critical needs.

Cholera actions taken: This office has been active at the highest level of government since the outbreak of the cholera epidemic. They participated in the first organizational meeting set up to coordinate anti-cholera activities, and were part of the governmental team that visited Tumbes and Piura to assess the status of cholera in those areas. They also provide technical assistance in the form of discussions and some excellent technical publications related to efforts required to combat the outbreak.

Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS). *Normal responsibilities:* This is a WHO Center operating under the aegis of the PAHO. Its primary responsibility is to provide technical assistance to countries in the area, with emphasis on problems peculiar to the area. This is done by carrying out research, laboratory studies, and field investigations. The center also maintains an extensive environmental health library and computer search capability.

Cholera actions taken: CEPIS participation during the current cholera outbreak has been quite extensive and valuable. It set up a 4-month agreement with SEDAPAL to provide technical assistance, training, and monitoring of the Lima water treatment plant and distribution system.

It carried out a rapid assessment of environmental problems in Chimbote very shortly after the cholera problem had been confirmed. The CEPIS laboratory did quality-control testing of various available chlorine chemicals used for water disinfections; and it also developed a simple inexpensive chlorine residual comparator which could be produced locally. CEPIS developed, in conjunction with UNICEF, a plastic sanitary home water storage and dispensing container which can be produced locally. In addition an engineer was provided to accompany the EPA consultants on a number of their field visits.

Chapter 3

FIELD VISITS

In addition to the many meetings held with the key governmental officials and agencies, the team made a number of field visits. These were not as extensive as desired, but time was not available for more. Major field visits were made to Chimbote, the COVARIS (Committee for Vigilance over the River Santa Waters) system, Lima City areas, and Piura and surrounding areas. These visits included water systems, sewage disposal systems, hospitals, health centers, health posts, and a number of cholera prevention meetings and education sessions. All of these greatly assisted the WASH team in becoming knowledgeable about current activities.

3.1 Chimbote Water System Evaluation

3.1.1 Introduction

When the first confirmation was made that cholera had appeared in Peru, a survey of sanitary conditions was undertaken in the city of Chimbote in the Ancash Region, one of the locations where cholera first appeared. This survey was carried out by CEPIS in conjunction with the MOH—a rapid assessment during the period 4-6 February 1991.

That study included visits to the water system, the sewage disposal system, quick evaluation of the markets, and garbage and hospital waste disposal. Since this visit appeared quite acceptable it was not felt that a revisit was necessary. The following is a summary of the water system as described in the CEPIS report.

3.1.2 Water Systems

There are two main types of water sources: 15 operational wells and a surface supply.

Well System. One set of wells feeds one surface (I) and three above-ground (II, IV, V) reservoirs which then serve the San Pedro zone and zones 1, 2, 3, and part of 4 (refer to Figure 1, Appendix D). These are in the older, more dense part of Chimbote. Only one of the wells is chlorinated. The second set of wells feeds a single above-ground reservoir (III) which serves zones 5, 6, and part of 4. Only one of these wells is chlorinated. Only reservoir I was considered in poor shape. The top is only slightly above ground; it is deteriorating and is in a location subject to garbage and excreta contamination.

The well system is not metered, there are unauthorized connections, water service is normally not available throughout the day, and back siphonage occurs. Also, many water and sewer lines are laid in the same trench.

Surface Water System. Water is drawn from the Rio Santa and delivered by the Stuart Canal. It is very muddy and contaminated, so is in need of a high degree of treatment. There is a complete treatment plant with flocculation, sedimentation, filtration, and chlorination. Reportedly this plant does not function properly due to design and construction deficiencies, improper operation, and lack of quality control and records. There are two above-ground reservoirs serving the South Zone of Chimbote. Deficiencies in distribution are the same as noted for the well systems.

3.1.3 Other Observations

Sewage is not treated except in a portion of the south zone where it goes to a lagoon. However, much of this is diverted to irrigate crops prior to reaching the lagoon. Any excess sewage from the lagoon goes to the sea. The north area has a large interceptor with a series of pumps and normally discharges to the drainage Bahia Coishco north of town, which also goes to the sea. However, pump failures occur frequently and the raw sewage bypasses to the bay in town at four different out-falls. (See Figure 2, Appendix D.)

Observations were made regarding the marine canneries, the markets, the hospitals, and general sanitation in and around the city. All of these showed areas and practices conducive to the spread of cholera and other transmissible diseases. Of special note are the hospitals where cholera patients are hospitalized and waste is inadequately treated. Another notable factor is the practice of defecating in open lots, fields, and other areas in the city and especially in the peripheral areas.

3.1.4 Recommendations

Major recommendations from the CEPIS report are the following:

- Water System, High Priority Needs
 - The water treatment plant operator(s) should be properly trained, in order to obtain proper plant operation.
 - Chlorination should be provided for all well waters. This will require new chlorinators.
 - Reservoir I should be repaired and properly protected from contamination sources. It should be fenced.
 - Chlorination should be increased to carry an adequate chlorine residual throughout the distribution system.

- The DIGESA team training should continue until all areas are covered, with follow-up visits at appropriate intervals.
- **Water System, Longer Range Needs**
 - Water source quality should be monitored to assist in determining treatment requirements.
 - Treatment plant construction defects should be corrected.
 - A laboratory should be equipped and operators trained so that proper plant and system monitoring can be carried out and records maintained.
 - Source and overall system modifications should be made in order to provide continuous water service, with separation of water and sewer lines.
 - House reservoir connections should be modified to avoid back siphonage and network contamination.
 - Unauthorized connections should be discontinued, as these cause water waste and can lead to back siphonage.

Sewage Disposal. Recommendations are contained in the attached extract from the CEPIS report and are quite essential to the control of cholera and other such infections. (See Appendix D.)

Other. Recommendations were also made regarding general sanitation, food marketing and preparation, garbage disposal, and the hospitals. These are essential and are in the extract (Appendix D).

3.2 Committee for Vigilance over the River Santa Waters

3.2.1 Introduction

On 24 March 1991 the WASH team visited the COVARS water system in order to assess a typical small independent water system. The following personnel were contacted, and accompanied them on the visit:

- Luis Gardia Dominguez, Vice President, COVARS

- Fernando Panta Morales, Secretary, COVARS
- Inocencio Lara, General Secretary/Primavera
- Ceferino Agurto, Distribution System Inspector

COVARS is a small independent water system which serves five *pueblos juvenes* areas to the northeast of Chimbote. No support is received from SEDA Chimbote. The areas served are Pensacola, Primavera, El Porvenir, La Union, and Cesar Vallejo. Each area has two representatives on the governing committee which is charged with the total operation and maintenance of the system. There are approximately 2,500 household connections which serve approximately 10,000 people. An estimated 900 households pay 0.4 million Inti (US\$0.73) per month, while the remainder pay occasionally. The non-paying people often contribute labor as a method of payment. An unknown number of non-serviced people also live in the surrounding area and must carry their water in buckets and other containers.

3.2.2 Water System

Source. There is only one source for the system, the Santa River. Water is brought from the river a reported 25 km via an irrigation ditch which also serves the COVARS system. At the point of intake the water is extremely muddy and would normally require a highly sophisticated treatment system in order to render it acceptable. There is no equipment to measure the water received, so quantity received or consumed is unknown.

Treatment. An 8-inch line transports the water approximately 50 m to the treatment facility, which is a small storage building with a concrete alum-mixing basin (approx. 0.6 × 1.3 × 1.3 m). Alum and water are mixed here and then dripped into a small chamber in the intake line. If the water appears to be muddier than usual, the drip rate is arbitrarily increased. There is a plant operation and maintenance employee living on site who is available at all times for mixing the alum, unplugging the intake, and performing general maintenance of the intake and treatment facility. This facility normally uses 50 kilo of alum every 4 to 6 days.

From the treatment facility the water flows approximately 70 m to the sedimentation basins which theoretically are in series. Each basin reportedly contains 100 m³. Water enters at one end of the first basin and exits from an opposite end into a corner of the second basin. However, it leaves the second basin from the same corner and thereby defeats the purpose for sedimentation. There was no evidence of any significant flocculation, there was little settling, and the departing water was still highly turbid. Each basin has a bottom drain for cleaning.

Water consumption is unknown because there is no measuring device of any kind at the plant. Without knowing the flow rate it is extremely difficult to adjust the alum dosage in such a manner to produce a proper floc for settling. Also since the operator really does not understand flocculation and settling, he is not aware of the value of increasing the settling

time by adjusting the flow rate, nor of the need for drawing off settled material from the basin bottoms. Little value is being received from these basins.

Reservoirs. An 8-inch line carries the water by gravity approximately 5 km to two reservoirs. The line is reportedly partially cast iron and other material (either ceramic or asbestos cement). The reservoirs are reportedly 750 m³ and 250 m³ and are plumbed to operate singly, in parallel, or in series. Water also can be drawn from the bottom or supernated. The water in these reservoirs is quite turbid, further indicating poor coagulation and sedimentation treatment. Both reservoirs have screened vents and the large reservoir does have a non-curbed concrete manhole entry point which could allow extraneous material to enter the reservoir, since it is flush with the reservoir top surface.

Chlorination. In 1985 COVARS was given a gas chlorinator and two cylinders for chlorination of the water (Capitol Controls Co. Colmar PA USA, Model 61CI/PR0064, serial 420-8). Due to a shortage of funds, no chlorine gas was purchased, so although installed, the chlorinator has not been operational. It appears to be in excellent condition, complete with scales. With the amount of turbidity present, however, extremely high chlorine dosages would be required, and effective chlorination would be questionable. Chlorine costs would be high.

System Feeder Main. From the reservoirs there is reportedly a 6-inch feeder main which transports water by gravity approximately 2 km to the five areas. It apparently is of various material including asbestos cement, cast iron, and possibly cement or ceramic. This is an old line which has been subject to much repair and may still have leaks. An abundance of source water reaches the sedimentation basins and reservoirs, but the 6-inch line from the reservoirs is too small to satisfy the demand. As a result the reservoirs are usually full, with a water shortage in the serviced areas. This is undoubtedly due to the small pipe size and possibly to incrustation.

Distribution System. This is an extremely old distribution system with evidence of deterioration. There are some fireplugs, but they are rusted almost beyond recognition. None appeared functional.

There were also a large number of holes dug in front of houses, to effect repairs to service connections or in which to deposit wastewater. In some, the pipe appeared to be intact, while in others one could see the two ends of a broken service line. Many of the holes contained water which seemed to come from breaks or deposited wastewater, as there had been no rain and the water table was not high.

As previously stated, water shortages in the system are quite frequent and back siphonage is sure to take place. A large population lives in very rudimentary huts which are not served by the system; water is transported in almost any and every type of container with little or no protection against waterborne infections.

3.2.3 Cambio Puente

Cambio Puente is another community near the COVARS which is not serviced. The town is high above the servicing reservoirs and cannot be gravity fed. In the absence of a pump and a distribution system, it is not possible to get water to the town from the COVARS system, although there would be an adequate supply of water if additional treatment facilities were built.

People in this pueblo obtain their water either directly from the irrigation ditch or from a single open dug well. This well was sampled using Hach Lauryl Tryptose MPN tubes and EC Medium MPN tubes and both tests were positive. No attempt was made to determine MPN.

3.2.4 Discussion and Recommendations

This visit was not intended to be a complete study of the COVARS water system. It was a rapid assessment of the system as a whole, since it represents an example of the small independent water systems which exist throughout Peru. In spite of the serious concerns of the COVARS staff, they do not have the resources to make improvements in the system. The COVARS managers are desperately seeking help from all available sources for technical assistance and funding to make urgently needed improvements in their water system. Unfortunately, as of the date of the visit, no assistance was forthcoming. The majority of the systems are likely to have many of the same problems as found here. Resolution of these problems will be particularly difficult in view of the costs involved. With an understanding of this situation the following recommendations are made:

- **COVARS Immediate Needs**
 - Provide operator training in flocculation, sedimentation, and chlorination.
 - Provide chlorine gas on a continuing basis and actuate the chlorinator.
 - Provide a simple water intake measuring device.
 - Have a DIGESA-type training team visit the nonserviced areas to train the people in water protection and chlorination.
- **COVARS Longer Range Needs**
 - Provide filtration unit(s) to follow sedimentation.

- Provide a larger parallel feeder main from the reservoirs to the serviced areas.
- Evaluate the distribution system to determine whether repair or replacement is most appropriate and carry out the findings
- Modify the reservoir vents and manhole to reduce the entry of extraneous material.
- Cambio Puente Immediate Needs
 - Have a DIGESA-type training team visit this area to train the people in water protection and chlorination.
- Cambio Puente Longer Range Needs
 - Consider including Cambio Puente within the organization of COVARS.
 - Provide potable water from the COVARS system to Cambio Puente, either with standpipes or house services. This would require pumping from the reservoirs or possibly from the flocculation and sedimentation treatment area.

3.3 Lima Water System

3.3.1 Introduction

The Lima water system, operated by SEDAPAL, is very large, necessarily quite complex, and exact statistics related to the system are not as accurate as one might desire. One excellent source of past information is the Plan Maestro de Agua Potable y Desague Para Lima Metropolitana written in November 1981 (printed 1982) by Engineering—Science of Arcadia, California. This plan has not been carried out, primarily due to a lack of funds. Several extracts of that report are attached. (See Appendix E.)

In 1980 the population of Lima was estimated at 5,020,000 people, with 3,778,000 receiving water from the piped system and 1,242,000 receiving water from vendors. There were an estimated 500,000 authorized connections, averaging 7.5 persons per connection. It was estimated that there were an additional 10-15 percent (50-75,000) unauthorized connections.

In 1991 the population of Lima is estimated at over 6,000,000 people, with approximately 4,700,000 receiving water from the piped system and 1,500,000 receiving water from vendors. There are an estimated 665,000 authorized connections, and an additional 65,100 unauthorized connections.

Total water produced averages 15 to 16 m³/sec. which amounts to a daily average of 1,229,000 m³/day. Approximately 40 percent of this is provided by deep wells, and 60 percent from surface water. Although this is the water produced, there are no valid figures for water consumption. It is estimated that system losses are at least 20 percent and may be as high as 40 percent of the water produced.

3.3.2 Water Supply System

Surface Water Supply (La Atarjea Treatment Plant). The sole surface source is the Rio Rimac which originates high in the Andes and flows 125 km to the sea in Lima, with a 5,000 m drop. Although it originates as a good source, mining operations, extensive slides and erosion, and direct discharge of raw sewage and industrial waste at many points rapidly turns it into a highly contaminated, difficult-to-treat source. Water is withdrawn at the La Atarjea plant within the city limits of Lima. One proposal in the Master Plan is to move the intake point up river, in an attempt to get better water. (See attached Figure A and Figure B in Appendix E.)

La Atarjea is a complete treatment plant designed to treat 15m³/second (1,296,000 m³/day). Due to the nature of the water source treatment difficulties, this plant is limited to 8.5-9 m³/sec. This plant provides 60 percent of the water for Lima. Pretreatment consists of a screened intake, primary settling, and prechlorination before the water goes to a large 500,000 m³ storage reservoir. This reservoir is normally used to provide uniform influent to the treatment plant. However, a critical use is when river turbidity is extremely high. At such times, the reservoir permits blending water to normalize turbidity going to the plant.

Flow from the reservoir goes to primary and secondary settling where flocculation and settling take place in both basins. The water is then sand filtered, chlorinated, and goes to storage reservoirs prior to entering the distribution system. Operation of this treatment facility is extremely difficult. Therefore, as soon as the cholera outbreak was confirmed, CEPIS assigned two personnel to the plant to provide technical assistance in plant operational control and monitoring and laboratory training.

Well Water Supply. There are a total of 300 deep wells located at various points, primarily in the peripheral areas and outside of the city. These are generally at higher levels and have not reached depths where salinity would be drawn from the sea. At any given time 270 to 280 wells are active. Loss of wells is primarily due to lowering of the water tables. These wells provide approximately 40 percent of Lima water production, or 6.5-7.0 m³/sec.

Reportedly all well supplies are chlorinated using gas chlorinators for larger outputs and hypochlorinators for the lower quantity sources.

Distribution System. As previously stated it is estimated that the Lima water system serves in excess of 6 million people. Approximately 4.7 million are served directly by service connections, and 1.5 million are served indirectly by stand pipes, tank trucks, and carrying from any source available. The central system has large feeder mains going to the various zones, which then branch out into separate independent areas. Overall losses are estimated at 20 to 40 percent. Most of this loss, based on the Master Plan study, appears to be due to leaky and broken faucets and valves and mains in the old part of the city (40-60 years old). As one drives through the city, it is common to see flooded areas which appear to be line breaks; and little action seems to be taking place to repair them.

As previously stated there are approximately 730,000 to 765,000 total service connections, both authorized and unauthorized. Of these, only an estimated 400,000 actually receive regular daily service. The others are all subject to frequent shortages and shut-offs. There is little attempt or incentive to conserve water, and there are no direct efforts or inspections to assure the absence of cross-connections at domestic, commercial, nor industrial facilities.

Because of frequent water shortages almost every water service has some type of storage facility. These range from simple, poorly constructed facilities to large well constructed reservoirs. These often are open unprotected facilities subject to local contamination, and with no back flow prevention, which is conducive to allowing contamination of the network. These storage facilities can be a hazard to both the owners and the community.

Tanker service is extensive and has great potential for creating problems. Private and publicly-owned tankers fill up at designated system water points and then haul out to the dependent areas. They normally serve these areas on a house-to-house basis, where each individual must buy the water. The water is put into every conceivable type of container, from bucket to reservoir. Charges vary, but the average in Lima is approximately US\$1 for a barrel (180-230 liters). Water from a tanker service can be a hazard to all of the people being serviced, due to potential contamination of the tank contents or the home owner's container.

Standpipes are normally centrally located outlets for use by all people living in that area. These often are poorly maintained and wasteful facilities. People in the area are expected to carry water to their homes in buckets from the standpipe. This is usually done, but people who can afford it often connect a hose and run it to their home. This is extremely wasteful and creates additional back siphonage potentials. Storage of water at home is normally poorly protected, if at all, and is subject to contamination.

Other sources of water are varied and depend on the ingenuity and need of the people. In Lima South (and probably in areas not visited), there is extensive use of raw sewage and

lagoon effluent for various types of irrigation including gardens. Hopefully it is not used for domestic purposes. This will be discussed later in the report. Also, where line breaks or valve leaks occur there may be an instant crowd to utilize the water. One stop made was at what appeared to be a permanent valve leak. The valve was located in a valve chamber which had then flooded and created a veritable oasis. Approximately 200 people were dipping out water to drink, doing their laundry on the spot, and bathing. The life of any employee attempting to repair that leak would certainly have been in jeopardy.

Prior to the cholera outbreak there was no routine system monitoring for either chlorine residual nor bacteriological purposes, and apparently no organization had this responsibility. In order to assist SEDAPAL, CEPIS started a monitoring program and assigned eight personnel to this program. The agreement between CEPIS and SEDAPAL was that CEPIS would provide these eight people and two at the treatment plant for four months, of which one month is already past. As of late March, no decision was made as to who would continue this effort at the end of the agreement. For the first test period, the city distribution system was divided into 35 sampling areas; 102 chlorine residual tests were made, and 30 showed no residual. Bacteriological tests of these 30 points resulted in 4 showing the presence of fecal coliform. These were all in areas where service interruptions occur. Twelve house cisterns were tested and eight showed the presence of fecal coliform. Chlorination dosages were increased, and free chlorine residuals can now be found in downtown areas as high as 0.5 and 0.6 mg/l. Heavy chlorine residuals were also detectable in the far south Lima feeder main, 17 to 20 km from the treatment facility. This was undoubtedly due to booster chlorination being introduced from the well sources.

3.3.3 Sewage Disposal

Of the homes, commercial establishments, hospitals, and industries which have direct water service only 50 percent are reportedly serviced by sanitary sewers, and these sewers are estimated to be functioning at less than 35 percent of the design flow. Three major outfalls discharge raw sewage directly into the sea within the city limits of Lima. There are also a large number of other raw sewage outfalls of various sizes that discharge to Rio Chillón and the sea in north Lima, and to Rio Rimac in central Lima. Some of the outfalls discharge to the ground surface, dry arroyos, and stream beds where they evaporate, soak into the sandy soil, or are totally used up for irrigation purposes before actually reaching a water course. The irrigation is for mixed purposes including gardens. Some of the major outfalls are shown in Figure C, Appendix E.

There are only two treatment facilities; both of these are in south Lima. The San Juan facultative lagoon system was designed as a 20-day retention facility. It is reportedly serving a population of 60,000 people and receiving 250 liter/sec. Utilizing those figures, however, the lagoons should be receiving 360 liters/capita/day. This appears to indicate an excessively high rate of water use. A number of the lagoons were septic and had large sludge deposits. Reportedly each lagoon is drained, dried out, and the dry sludge removed for use as fertilizer

every five years. Part of the effluent goes to a large group of experimental fish rearing basins which are part of a CEPIS study, and then helps irrigate a tree farm. The rest of the effluent discharges to a drainage channel where it evaporates or seeps into the ground and does not reach a flowing water course.

The second lagoon system is hardly used at all because much of the raw sewage is used for irrigation prior to reaching the lagoons. This facility has two parallel systems each with two lagoons in series. One had a small flow in and even a lower flow out due to seepage and evaporation. The small outflow evaporated and soaked into the ground prior to reaching a flowing water course. The second system was dry.

As previously noted, only 50 percent of the Lima establishments with direct water service are served by sanitary sewers, and not all of these have toilets. Those lacking sewers drain their water into holes or directly onto the ground. In the absence of latrines it is common practice to defecate in open lots, fields, and any other open areas in the city and especially in the peripheral areas. In the San Juan area it is reported that approximately 45 percent of the people use latrines and the remaining 55 percent defecate wherever they can.

3.3.4 Other Observations and Recommendations

Although not part of the WASH team assignment, observations were made of other activities which could affect cholera transmission. Food handling techniques are poor in homes and other food preparation and serving areas. The general education level of many people is low, with a minimal knowledge of sanitary precautions such as protecting food and water, washing of hands, proper depositing of fecal matter, and care in tending the sick. Also of special note are clinics and hospitals where cholera patients are treated. Proper waste disposal and equipment sterilization facilities and personnel are in short supply. Disposal of patient waste is also a serious problem especially under the sewage handling procedures previously discussed.

Due to time limitations, review of the Lima water system was not intended to be a complete study. It was designed as a rapid assessment of the system as a whole. Resolution of many of the problems noted will be very difficult in view of the costs involved. With an understanding of this situation, the following recommendations are made:

- **Water System, High Priority Needs**
 - Continue training of water treatment plant operators and technical assistance by CEPIS or other appropriate organization(s).
 - Continue chlorination dosages at current levels and assign permanent monitoring responsibility to a government

organization which can carry out this responsibility when the CEPIS—SEDAPAL agreement ends.

- Take immediate action whenever a main break is detected to avoid greater water loss and to prevent back siphonage.
 - At all tanker points, rechlorinate tanker water to bring the tanker water to a minimum of 1.0 mg/l chlorine residual. Dosage level required to reach this residual can be initially developed. Then a standard quantity of bleach/hypochlorite/other can be routinely added to each tanker while filling, based upon tanker size.
 - Set up an expanded training program similar to what was done in Chimbote by DIGESA and in Puente Piedra by INAPMAS to teach chlorination and other cholera prevention training to those who do not have direct water and sewage facilities. This should also include the information on hazards related to sewage irrigation and to indiscriminate defecation.
- Water System, Longer Range Needs
 - Institute an expanded system maintenance program which will concentrate on immediate repair of main breaks, greater leak detection and repair, improvement of service connections, monitoring of service connections and owner reservoirs and cisterns to reduce cross-connection, and detection and registration (or prevention) of all unauthorized connections.
 - Repair all deteriorating or improper standpipe facilities and set up a routine inspection program.
 - Institute a systemwide educational program to stress the need for water conservation and repair of all leaky and faulty home, commercial, and industrial valves, toilets, cooling water facilities, etc.
 - Review, update, and set up a phased program for carrying out appropriate activities set forth in the Master Plan.

- Sewage Disposal, High Priority Needs
 - Set up a training program similar to what was done in Chimbote by DIGESA and in Puente Piedra by INAPMAS for those without sewage facilities. This should include information on hazards related to sewage irrigation and indiscriminate defecation.
- Sewage Disposal, Longer Range Needs
 - Improve lagoon operation and management.
 - Review, update, and set up a phased program for carrying out appropriate activities set forth in the Master Plan.
 - Establish a latrine education and construction program.
- Other High Priority Needs
 - Take action in clinics and hospitals to prevent the spread of cholera from patients being treated. Disinfection materials are in short supply; at some locations sewers are not available; and where sewers are available there is no sewage treatment. Proper medical waste management programs must be stressed.

3.4 Piura and Environs

3.4.1 Introduction

On 1-3 April a visit was made by the WASH team to Piura and some of the surrounding towns and villages. They were accompanied by an engineer from INAPMAS; meetings were held with many government officials.

The cholera outbreak was first confirmed in Chancay and almost simultaneously occurred in Chimbote and Piura, cities further to the north. Because of the early onset in Piura this city was visited early in the outbreak by a special investigative team composed of representatives of MOH, SENAPA, and PAHO.

Among other problems noted was that of the 16 water source wells, only one was being chlorinated, and even that was not being carried out properly. Three wells were also found to be contaminated.

3.4.2 Piura Water System

A total of 16 deep wells supply this system, and reportedly all feed directly into the distribution system rather than into reservoirs which feed the system. There is no surface water supply.

As reported by the first government team visit, none of the wells was being properly chlorinated. However, since then a number of actions have been taken to overcome this, including the installation of chlorine gas injection systems at nine of these wells. These all feed into the well pump discharge line prior to entering the distribution system. There are plans to install similar chlorinators at the other six wells. Several wells were visited, and chlorine was being fed at a rate of 0.5 mg per liter. Although this is a major improvement there is no contact time prior to entering the system, and the dosage is not high enough to keep a residual throughout the system. (If a well is not contaminated, chlorine contact time may not be critical.) It should be noted, however, that at almost every well visited in Peru the pump lubrication water drained directly back into the well and had the potential problem of picking up contamination from the "always dirty" pump base area.

Pressure in the system is maintained by elevated tanks. Water sampling showed no chlorine residuals. This system, which serves the city and area in the same manner as almost all other systems seen in Peru, is leaky, and water service throughout the city is intermittent, with some areas only receiving water for less than an hour a day.

Piura currently has 10 of 16 wells chlorinated, but even when all are chlorinated this cannot be considered a safe supply. Routine chlorine residual and bacteriological testing is not being carried out. There is always a chance of well contamination, not enough chlorine contact time, system leaks, hazardous cistem connections, broken or damaged standpipes, and problematic tanker and bucket transfer and storage systems. These same problems are discussed in Section 3.3.2.

3.4.3 Sewage System

Less than 50 percent of the homes, hospitals, industry, and commercial establishments have service from sanitary sewers. Almost all system outfalls go directly to the river or to dry areas where they evaporate, soak into the ground, or are used for irrigation purposes. Reportedly there is one area which drains to a lagoon. The team was told that most of the sewage was used for irrigation prior to reaching or after leaving the lagoon.

Those homes and establishments not served by the sewer collection normally drain liquid waste into holes in the ground or directly onto the ground. Some homes have latrines, but not many. In the absence of toilet or latrine facilities, the common practice is to defecate in the fields, open lots, and any other available area, especially in the outer areas of the city and in the *pueblos juvenes*.

3.4.4 Other Observations

Primavera Visit. One evening was spent at the *pueblo joven* Primavera where a training program was being carried out in an impressive manner. It started with a socio-drama showing what happened in two families, one carrying out good anti-cholera practices, the other not, with the expected disastrous results. A discussion was held of anti-cholera practices including home water disinfection, defecation practices, food handling, and personal hygiene. Lastly, stock solutions of chlorine were passed out for home use. This was an excellent program and part of an overall plan for the entire Piura area. Organization in the Piura area for carrying out the anti-cholera campaign was the best observed during the team's stay in Peru.

Hospital. The local hospital in Piura has a large ground-level water cistern from which water is pumped to an overhead storage tank. Attempts were being made to rechlorinate at the cistern, but there was no chlorine residual in the system. It was believed that the rudimentary chlorination system contained no chlorine. Patient handling procedures were also observed. Temporary wards were set up in hallways, and it was evident that this is a probable source for more infection, in spite of attempts by staff to handle waste and equipment in a proper manner. Disposal of patient waste is of particular concern, especially under the sewage conditions cited above.

Regional Cholera Organization in Piura (Region Grau). An intersectoral cholera committee has been established under the office of the Regional President. The Director of the Departmental Health Unit (UDES) oversees the committee. It is divided into four sub-committees:

1. **Medical Services to the Public**—charged with organizing medical services in hospitals and other health facilities to treat patients. It also is responsible for the provision of laboratory services and epidemiological surveillance. The key agencies involved are the MOH, Social Security, and military and police sanitation.
2. **Environmental Control**—responsible for monitoring water supply systems, chlorination of water, excreta disposal, garbage and solid wastes collection and disposal and food sanitation. The key agency involved is the Directorate of Environmental Sanitation.
3. **Logistics and Finance**—responsible for the supply of medications, materials and equipment and for receiving and distributing donated supplies. The key agencies involved are the church parishes, CARITAS, CARE and the UDES.

4. Education and Media—responsible for developing and disseminating educational messages and materials concerning the cholera epidemic. The key agency involved is the Ministry of Education.

Below the regional level, the various responsibilities noted above are handled by local governmental offices (i.e., municipal governments, mayors, etc.) and nongovernmental organizations (i.e., community kitchens, mothers clubs, UNICEF, etc.).

Other. Observations noted in Piura were similar to those of other areas in Peru. Adequate garbage and solid waste disposal is lacking. Food handling techniques are poor in commercial establishments, and especially poor with respect to the street vendors. Records indicate that the vendors are prime suspects of cholera transmission in Piura. Educational level is low and there is minimal knowledge of sanitary precautions such as protecting food and water, personal hygiene, and proper deposition of fecal matter. All of these matters are being discussed in the UDES training program mentioned above, and countrywide discussion and training programs are sorely needed.

3.4.5 Other Area Visits

In addition to spending time in Piura, visits were made to a number of smaller towns and villages in the area. Generally the same problem conditions were found in these smaller towns that were found in Lima, Chimbote, and Piura. Among the towns visited were Catacaos and LaUnion.

Catacaos. The water system has two nonchlorinated wells as sources, one of which was inoperative at the time of the visit due to pump problems. The other well was operative but inadequate to provide a constant supply. The system has elevated tanks and provides water on an intermittent basis, never more than several hours a day. The system also leaks, has the same delivery problems as Lima, Chimbote, and Piura, and is not a dependably potable system.

For sewage disposal, the town has two parallel lagoon systems, each with two in-series lagoons. One system was totally dry, and the other was flowing minimally. As with other cities, raw sewage and effluent are drawn off for irrigation. The collection system has the same problems as Piura, and defecation problems and disposal are also similar.

The medical post was receiving no pumped water at the time of our visit and had no storage facilities, therefore no water at all. Two cholera patients were present and being handled in an even more rudimentary manner than in Piura. The food handling, hygiene, and sanitation practices were also poor.

La Union. The team visited the medical clinic area in La Union where the situation was similar to Catacaos, except this facility did not have a water connection. However, a trench

was being dug and a small plastic line was being laid to bring in water. The adjacent housing area was served by inadequate standpipes. One of these standpipes observed actually discharged below ground level into a muddy hole in the ground. Some homes did have what were probably unauthorized hose connections. One was sampled and, as would be expected, showed the presence of fecal coliform.

Villages (Arena, Tablazo Norte, Tablazo Sud, Yapato). Several small villages were also visited. Arena had a medical post which almost duplicated the situation of Catacaos. There was one unchlorinated well, elevated tank and standpipes, and water delivery approximately one hour a day.

A second village group (Tablazo Norte, Tablazo Sud, Yapato) had no water system at all, but water was to be piped into an elevated tank currently under construction. This tank would provide water to all of this village group.

3.4.6 Discussion and Requirements

It should be noted that this was a very quick visit and was not a complete study. However, based upon this visit, a number of recommendations can be made, recognizing that cost of corrections is a serious problem.

- **Water System, High Priority Needs**
 - Provide chlorinators for all well sources.
 - Dose all wells so as to provide a minimum chlorine residual of at least 0.5 mg/liter throughout the systems, or 1.0 at standpipes and tanker filling points. If this is not feasible, rechlorinate at tanker fill points to a residual level of at least 1.0 mg/liter.
 - Establish routine chlorine residual and bacteriological monitoring.
 - Expand the Piura program for health education and chlorine distribution to all areas.
- **Water System, Longer Range Needs**
 - Repair all line breaks or leaks as rapidly as possible, and set up a monitoring program of homes and other establishments to prevent cross-connections, improve cistern protection and use, and detect unauthorized connections.

- Repair all deteriorating or improper standpipe facilities and set up routine inspection programs.
- Set up a master plan for upgrading and providing water treatment systems countrywide, on a prioritized basis.
- Sewage Disposal Systems, High Priority Needs
 - Expand the Piura program for health education and chlorine distribution to all areas.
- Sewage Disposal Systems, Longer Range Needs
 - Improve collection systems and lagoon operation and management.
 - Establish a latrine education and construction program.
 - Set up a master plan for upgrading and providing sewage collection and treatment systems countrywide, on a priority basis.
- Other High Priority Needs
 - Action is required in hospitals, clinics, and medical posts to prevent the spread of cholera from patients. Disinfection material is in short supply, sewers are often not available, and where they are there is little or no treatment. Prior medical waste management programs must be implemented.

Chapter 4

EPIDEMIC CONTROL ACTIONS

4.1 Overview

The water supply and sanitation conditions in Peru have been characterized as a disaster waiting to happen. The cholera epidemic that Peru and its neighbors are now suffering has merely put a name on that disaster. In a sense, nature, in its own deliberate manner, is collecting its due on a debt that the world has failed to pay—a debt in the form of inadequate investments in water and sanitation infrastructures and the health education that accompany them.

At the time of this study, the focus of short-term preventive actions was being directed to urban and peri-urban centers along the north coast where the early impact of the epidemic was the most severe. However, it was reported from two sources (Piura and Cajamarca) that the epidemic was not only moving inland from the coast but also spreading out from the cities into the rural countryside. Furthermore, these reports suggest that the fatality rate among patients from rural areas is higher than that for urban patients and could possibly increase to the next level of magnitude, i.e., ten times the present level.

These trends point to the urgent need to improve and expand not only urban water and sanitation systems but to reactivate and expand the virtually moribund rural water supply and sanitation program. Failure to do so could invite a further, more devastating disaster to befall the rural population of Peru. Stepped-up investments in the long-term solutions for controlling the present, as well as future, epidemics must be initiated now on an emergency basis and not delayed for future consideration.

4.2 Short-term Emergency Measures Taken

As previously stated, each of the institutions contacted had taken some action toward combating the cholera epidemic. Seven of the nine contacted had undertaken direct action in the most seriously affected areas. Of the two remaining offices, the Office of Statistics and Information does not have a mandate to conduct field actions, and DISABAR has requested funding for its national cholera program but has not taken direct field action to date.

4.2.1 Organizational Efforts

Following is a listing of direct actions taken by specific institutions:

The Technical Directorate of Epidemiology has fielded epidemiology teams to Chancay, Chimbote, Trujillo, and Piura to monitor the cholera epidemic. It was being assisted by CDC staff.

The Directorate General of Environmental Sanitation (DIGESA) has fielded teams of engineers and technicians to work in the *pueblos juvenes* in Chimbote providing instructions, supplies, and training on home purification of water.

National Institute for the Protection of the Environment for Health (INAPMAS) sent a multi-discipline team to Cajamarca to organize and initiate a cholera campaign. It arranged meetings and accompanied the EPA team during its recent visits, as well as arranging meetings and itinerary and accompanying the WASH team during its visits. INAPMAS also conducted training in some Lima *pueblos juvenes* on home purification of water.

The National Water Supply and Sewerage Service (SENAPA) sent staff to the Departments of Tumbes and Piura to assess the cholera situation and to provide guidelines and specific instructions to the regional and local water authorities. SENAPA also trained 23 of its own engineers and technicians in the installation and operation of drip hypo-chlorinators (reportedly donated by the German government). These engineers and technicians will be sent out to install and train operators in those cities and towns most severely affected by the cholera epidemic.

Lima Water Supply and Sewerage Service (SEDAPAL) has increased the chlorine dosage of the Lima water supply. In conjunction with CEPIS, SEDAPAL has initiated an extensive water quality monitoring program throughout its distribution system. Staff have accompanied the EPA and WASH teams on field visits in the greater Lima area.

Pan American Health Organization (PAHO) staff members have accompanied government officials to the Departments of Tumbes and Piura to assess the status of the cholera epidemic. It is providing technical assistance to the government.

Pan American Sanitary Engineering Center (CEPIS) sent a team to assess the water supply and sanitation status in Chimbote and prepared recommendations for emergency actions to be taken by local authorities. It also sent an engineer to accompany the EPA team on visits to Piura and Trujillo. CEPIS staff and material support were provided to SEDAPAL for its expanded water quality monitoring program, while CEPIS designed and produced a simple chlorine residual test kit to be used at the local level to monitor water quality in homes.

4.2.2 Summary of Short-term Measures Taken

As noted above, a limited number of important field actions are being conducted in specific peri-urban areas of Lima, Chimbote, Piura and, reportedly, in Huaraz. The main focus of these activities is chlorinating urban water supplies, distributing hypochlorite packets, and instructing residents on how to purify their water in their homes.

With regard to sewage disposal, the main action taken has been the disinfection of feces and vomitus in hospitals using hypochlorite solution or muriatic (hydrochloric) acid.

Essentially, no concerted actions have been taken regarding improvements in food sanitation or garbage and solid waste disposal.

The MOH is broadcasting public service messages on ways to avoid contracting cholera. These messages provide information on home water treatment, food preparation, and personal hygiene. The MOH is also distributing posters showing how to avoid cholera.

All of the field actions being taken are important and necessary. The chlorination of urban water supplies needs to be rapidly expanded and monitored. The same is true for purification of water in the home. The handling and disinfection of feces in hospitals must be improved and clearly monitored by qualified technicians and the mass media campaign largely expanded and intensified.

4.3 Short-term Emergency Actions Needed

In order to make a significant impact on the transmission of cholera, a comprehensive anti-cholera campaign which includes the following elements must be planned and initiated immediately:

- Chlorination of all existing water supply systems
- Rapid expansion of household-level water purification activity
- A mass media campaign (TV, radio, newspapers) presenting a unified message on handwashing, boiling or purifying water in the household, handling and cooking food, safe excreta disposal, and sanitary garbage storage and disposal
- Provision of basic health and environmental sanitation messages and instructions to clients of all public and private health facilities

- Provision of basic health and environmental sanitation messages and instructions to students at all public and private schools and colleges and through the students to their families
- Demonstration activities and direct assistance in digging and using emergency pit latrines
- Instruction to street vendors, restaurant workers, and food handlers on sanitary food handling, purifying rinse water, and disinfecting utensils
- A massive, organized garbage and solid waste collection and disposal program

4.4 Medium- and Long-term Water Supply and Sanitation Programs Needed

The medium- and long-term water supply and sanitation program requirements discussed in this section are based on data provided in "Planning for Water and Sanitation Programs in Bolivia, Ecuador, and Peru," WASH Field Report No. 302 published in June 1990, and from an article, "Subregion andina: propuesta para continuar el decenio internacional de abastecimiento de agua," which appeared in *Ingenieria Sanitaria*, Vol. XLIII, Julio-Diciembre 1989.

Population figures are given in Table 1 for the years 1980 to 2000. The table illustrates the far greater anticipated growth in urban population, as compared to rural. These figures are then used to make an estimate of the number of people served (as well as the percent of population covered) by increased water and sanitation services. The target figures used in the 1990 WASH study are shown in Tables 2 and 3, with a breakdown into urban and rural populations.

Using 1989 as the baseline year and a per capita cost of US\$72 for urban water supply installation, the investment required to meet the 1995 coverage target of 84 percent would be US\$245 million; using a per capita cost of US\$32 for rural supplies, an investment of US\$41.6 million would be needed to meet the 1995 target of 40 percent coverage.

In order to meet the year 2000 water supply target of 80 percent coverage in urban areas, using the same per capita cost of US\$72, a total investment of US\$425 million will be required; and to meet year 2000 rural water supply target of 50 percent coverage, an investment of US\$70.4 million is needed, using the per capita cost of US\$32.

Thus a national (urban and rural) medium-term water supply program for 1995 would require a total investment of US\$286.6 million. The long-term target for year 2000 would cost a total of US\$495.4 million.

Table 1

Population of Peru
(millions)

Area	1980	1985	1989	1995	2000
Urban	10.2	12.6	14.4	17.4	19.0
Rural	6.6	7.2	7.4	7.7	8.0
Total	16.8	19.7	21.8	25.1	27.0

Table 2

Actual Water Supply Coverage
Versus 1995 and 2000 Targets
(population in millions)

Year	Total Pop.	Urban Areas			Rural Areas		
		Pop.	Served	%	Pop.	Served	%
1980	16.8	10.2	6.9	68	6.6	1.2	18
1985	19.7	12.6	9.1	73	7.2	1.2	17
1989	21.8	14.4	11.2	78	7.4	1.8	24
1995	25.1	17.4	14.6	84	7.7	3.1	40
2000	27.0	19.0	17.1	80	8.0	4.0	50

Table 3

Actual Sanitation Coverage
Versus 1995 and 2000 Targets
(population in millions)

Year	Total Pop.	Urban Areas			Rural Areas		
		Pop.	Served	%	Pop.	Served	%
1980	16.8	10.2	5.8	57	6.6	.02	0
1985	19.7	12.6	8.4	67	7.2	0.9	12
1989	21.8	14.4	8.5	59	7.4	1.3	18
1995	25.1	17.4	12.0	69	7.7	2.8	36
2000	27.0	19.0	13.1	75	8.0	3.0	50

Using 1989 as the baseline, the investment needed to meet the 1995 urban sanitation target of 69 percent at a per capita cost of US\$74 would be US\$259 million. To meet the rural sanitation target of 36 percent at a per capita cost of US\$35, an investment of US\$52.5 million would be needed.

For year 2000 targets, the urban coverage of 75 percent would cost a total of US\$422 million using the same per capita cost of US\$74. To meet the rural sanitation target of 50 percent coverage using the per capita cost of US\$35, a total investment of US\$94.5 is needed.

The national (urban and rural) medium-term sanitation program would cost US\$311.5; and for year 2000 the total cost would be US\$516.5 million.

The national medium-term (1995) water supply and sanitation program would require a total investment of US\$598.1 million over five years. A national long-term (2000) water supply and sanitation program would cost US\$1,011.9 million over ten years.

Table 4 below summarizes the short-term and long-term national water supply and sanitation needs.

Table 4

**Water Supply and Sanitation Requirements
(Weights in Metric Tons)**

Duration	Urban	Rural
Short-term (8 months) Disinfection only	Present Pop. Coverage Water 78% Sewers 59% Water Systems 200 Hospitals 100 Health Centers 1,000 Chlorinators 500 units Chlorine Gas 2,400 tons HTH crystals (70%) 2,000 tons Est. Cost \$4-6 million	Present Pop. Coverage Water 24% Latrines 18% Water Systems 3,000 Latrines 50,000 New Latrines 100,000 Total Latrines 150,000 Hypochlorinators 3,000 units HTH crystals (70%) 4,000 tons Lime 40,000 tons Est. Cost \$4-6 million
Long-term (1991-2000) Construction	Target Pop. Coverage Water 80% Sewers 75% Water \$425 million Sewers 422 million Est. Cost \$847 million	Target Pop. Coverage Water 50% Latrines 50% Water \$70.4 million Latrines 94.5 million Est. Cost \$164.9 million

In addition to the enormous infrastructure requirements for water supply and sewerage systems, further investments must be made in the areas of food sanitation and garbage collection and disposal. To begin with, existing laws regulating the production, handling, processing, and dispensing of food need to be rigorously applied. Similarly, laws and regulations pertaining to garbage and solid wastes need to be fully applied.

Health and sanitation topics need to be highlighted in school curricula giving special attention to the subject of personal hygiene. Specialized education and training programs need to be planned and conducted for food producers, handlers, and vendors.

Chapter 5

CONCLUSIONS

The overall conclusion is that the nation has practically all of the human, institutional, and material resources it needs to mount an effective anti-cholera campaign. The main constraint is that the nation has not been able to organize a unified effective command structure to plan, implement, and coordinate such a campaign. Some external funding will be needed to cover travel and transport costs to allow technical staff to get out into the field where they are needed most. External support will be needed for equipment and supplies.

5.1 Resources

Based on the information gathered from interviews, documents, and field visits, the following conclusions have been reached:

- There appears to be sufficient professional and technical human resources in the nation to be able to mount an adequate anti-cholera campaign. In addition to government and nongovernment staff, university students should be utilized.
- An adequate institutional framework exists at the national level to provide the necessary technical assistance and institutional support to the responsible regional and local authorities.
- Several hundred piped water systems are operating which can be rapidly upgraded to produce safe water.
- The government has sufficient rolling stock (vehicles) to meet most, if not all, of the transportation needs of a well-organized cholera campaign.
- A health services delivery system exists and operates down to at least the district and *municipio* levels which can be utilized to provide health services. Within this system there is an active national network of UROs (oral rehydration units) which is a major resource for the treatment of cholera patients.
- An educational structure exists that reaches almost all towns with populations of 2,000 or more (and to many towns below that size)

which can be utilized to provide educational material and information to all students and their families.

- The level of development of the mass media in the nation represents a major resource which could be mobilized to disseminate information to the public.

5.2 Constraints

- There is no unified authority with overall responsibility for anti-cholera activities.
- There is no single command structure to plan, implement, and coordinate an anti-cholera campaign.
- There is no anti-cholera master plan.
- Without a master campaign plan, there is no rational and organized method for determining material and financial needs on a national basis.
- The decentralization of some national governmental functions to newly-created regional governments is necessarily causing temporary disruptions of ongoing national programs. Regional governments are in the process of taking over the control of field offices such as DISABAR's regional office complexes. During this period of transition, it will be more difficult to organize and implement a national anti-cholera campaign. However, in certain regions, an intersectoral cholera organization has been established. (See Section 3.4.4 for the Regional Cholera Organization in Piura which could be used as a model for other regions.)

5.3 Outlook for the Future

There is every reason to believe that cholera will become endemic in Peru after the present epidemic runs its course. The preventive measures that need to be taken to control future outbreaks must focus on providing safe water supplies, sanitary excreta disposal, and education on health-related topics and especially on personal hygiene practices.

Educational information and training will be needed in food sanitation at the home-preparation level and at the production, handling, processing, and retail levels. This activity

should include monitoring food establishments such as restaurants, bars, markets, and sidewalk vendors. A program of scheduled periodic inspections on a permanent basis is needed. Existing (or new) food handling and retailing license requirements should be strictly enforced.

Since the major focus of the present study was to assess urban water supply systems, no attempt was made to collect specific information or data on the government food control program. However, it would be fairly safe to assume that contaminated food is playing a significant role in the present cholera epidemic. Based on this assumption, there is a definite need to assess the health and sanitation aspects of food production, handling, and retailing as part of a comprehensive health and sanitation program planning exercise. Similarly, an assessment of the garbage and solid waste collection and disposal systems would also be in order.

In contrast to the relatively small investment required for emergency upgrading of the quality of existing water supplies (mostly chlorination equipment and chemicals), the cost of medium-term and long-term water supply and sanitation construction requires an investment of a geometrically higher magnitude than the average investments made in the past decade. Depending on the data source, annual investments in water supply and sanitation works in Peru averaged between US\$6 and \$30 million during the 1980s. The projected annual investment requirements for water and sanitation to the year 2000 range from US\$100 to \$120 million.

During the 1980s, USAID/Peru invested roughly US\$1 million annually in the rural water supply and sanitation program. It is unlikely that funding at even the next level of magnitude (i.e., US\$10 million per annum) would be forthcoming, let alone the second level of magnitude at US\$100 million per annum.

Because of the realities of A.I.D.'s funding process and limitations, USAID/Peru could continue to make a significant impact by re-establishing its involvement in the rural water supply and sanitation program at about the same investment level as during the 1980s.



Chapter 6

RECOMMENDATIONS

6.1 Recommendations to USAID/Peru

Since USAID/Peru and the U.S. Government are already involved in the cholera campaign (i.e., CDC, EPA, and WASH teams and plane-loads of commodities), USAID/Peru must now decide on the level and the duration of assistance it will provide for both the short-term (8 months to the end of 1991) and the long-term (to year 2000).

All of the following recommendations require USAID/Peru to initiate immediate actions. Some, such as the hiring of staff and formation of committees and working groups, can be completed quickly, however, their tasks will require involvement in both short-term and long-term activities.

- Provide the full-time services of a USAID/Peru engineer who is knowledgeable about the water supply and sanitation sector in Peru. This engineer should preferably be a Peruvian. His/her scope of work would be to act as the key contact and action person in USAID/Peru and to collaborate closely with key staff in the several pertinent offices of the MOH, MOHC, and MOE to carry out a quick sample survey of urban water and sewerage systems, schools, and hospitals; and rural water systems, latrines, health centers and posts, and rural schools to collect and update emergency water supply and sanitation improvement requirements on a nationwide basis. (The SENAPA inventory of major water systems should be utilized as a basis for this update.) The country should be divided into zones of priorities with the northern coastal zone having top priority.
- Actively support the MOH in reorganizing the inter-ministerial cholera campaign committee.
- Propose the formation of a technical advisory working group to provide unified technical advice and guidance to the inter-ministerial committee. Membership on the working group would be composed of senior technical staff from pertinent ministries and ex-officio representatives of multilateral and bilateral development agencies.
- Or, alternatively, form a USAID/Peru working group to collaborate with the MOH, MOHC, and MOE in their campaign planning and to identify specific areas where USAID/Peru can provide assistance.

This working group would consist of resident representatives of multilateral and bilateral donors (e.g., PAHO, CEPIS), and NGOs (e.g., CARE, CARITAS, UNICEF, Univ. of Engineering, etc.). Its initial task would be to develop a national emergency (short-term) anti-cholera campaign plan, to be presented to the GOP. USAID/Peru would organize and sponsor a one-week workshop for the working group to prepare the plan.

- Obtain emergency assistance, in funds or in kind, at the \$2 to \$5 million level to provide major support for short-term water supply and sanitation needs including the purchase of locally produced equipment and chemicals and the printing and distribution of hygiene and sanitation education materials.
- Reactivate USAID/Peru involvement in the rural water supply and sanitation program on an immediate emergency-funded basis.
- Earmark any USAID/Peru emergency funds for specific campaign costs such as professional and technical staff travel and vehicle expenses (fuel, oil, and preventive maintenance). None of the funds should be used to pay for staff salaries or benefits nor for administrative overhead costs such as rent, communications, and office maintenance and cleaning. Some funds could be set aside for the purchase of locally-produced water treatment chemicals and supplies. (Imported equipment and supplies should be donated by foreign governments and PVOs.)

6.2 Recommendations to the Government of Peru

The first recommendation to the GOP is intended for the office of the President. Once the initial action of naming a cholera czar is taken, the rest of the recommendations will follow at the level of government decided by the President. The team makes the following recommendations, based on observations and findings:

- Name a top-level national cholera campaign czar.
- Establish an emergency task force to be chaired by the cholera czar.
- Assign a top-level staff (i.e., Vice Ministers) on a full-time basis to the task force from the Ministries of Health, Housing and Construction, Education, Agriculture, Fisheries, and Finance.

- Establish a technical advisory group consisting of senior professional and technical staff from the above-named ministries with ad hoc members from international and national organizations to provide technical advice to the task force.
- Through the task force (in collaboration with the USAID/Peru-sponsored working group) prepare, obtain financing for, and execute a nationwide cholera control campaign utilizing existing staff and material resources at the national, regional and local levels of government. As part of the campaign plan, the task force should prepare an updated list in detail of equipment and supplies needed from donors.
- Again, through the task force, direct the technical advisory group to conduct an assessment of a representative cross-section of urban water systems to develop a master list of chlorination equipment and chemical supplies needed to provide safe water in existing systems.
- Via the cholera campaign, shift the emphasis from a reactive (curative) effort to a pro-active (preventive) program, i.e., make a shift in focus from the hospital to the living environment with flexibility for close collaboration with a variety of regional government structures and campaign organizations.



COVARS Staff—Chimbote

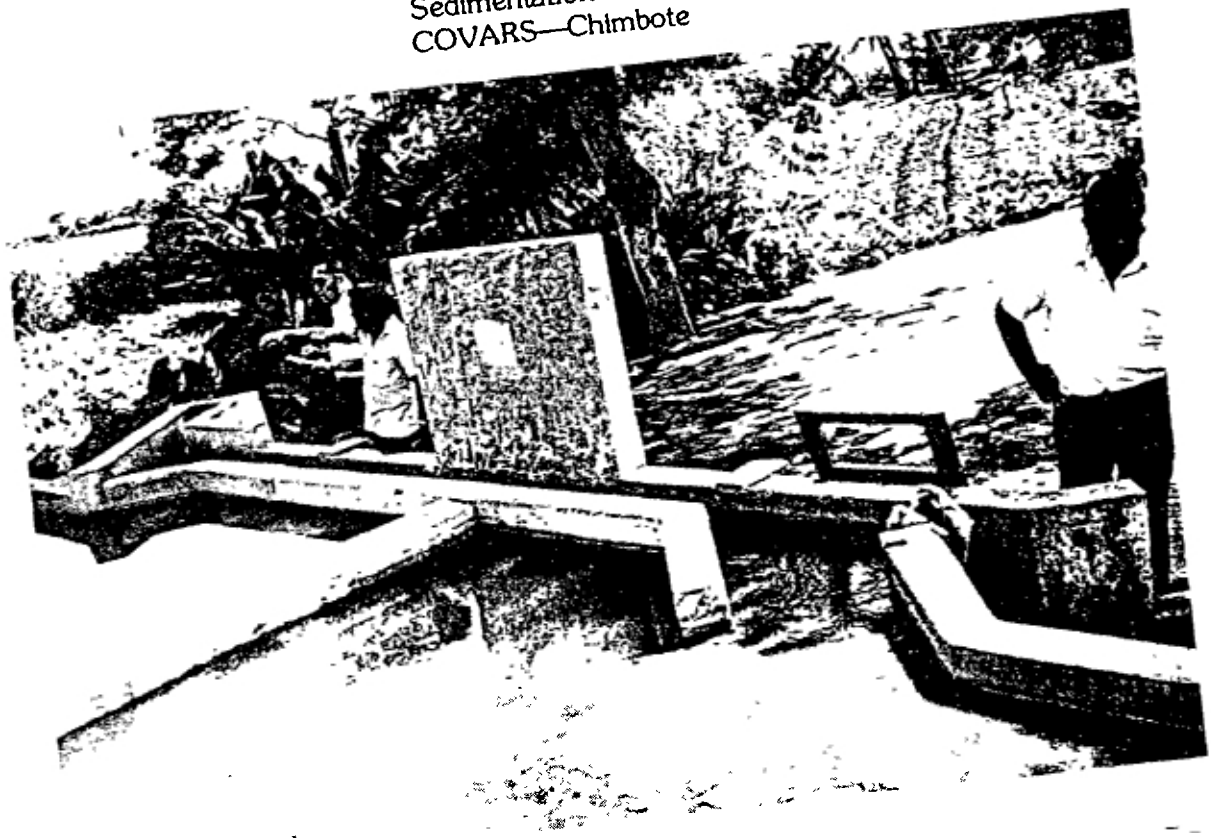


Plant operator with aluminum sulfate coagulant

Coagulant Mixing Chamber
COVARs—Chimbote



Sedimentation Basins
COVARs—Chimbote



DIGESA Brigade Meeting with Public
Pueblo Joven—Villa Maria—Chimbote



Villa Maria Residents at DIGESA Meeting



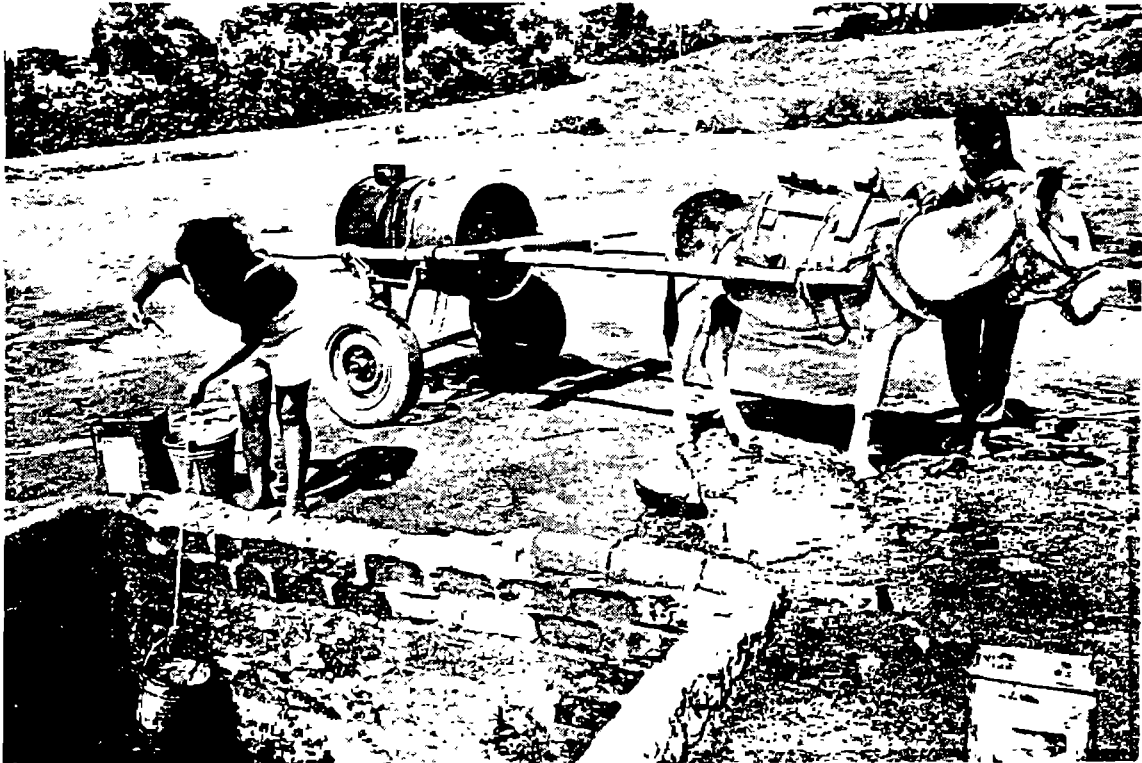
Hypochlorite Packets and Chlorine Test Kit
DIGESA Brigade—Chimbote



DIGESA Brigade Distributing Packets
Villa Maria—Chimbote



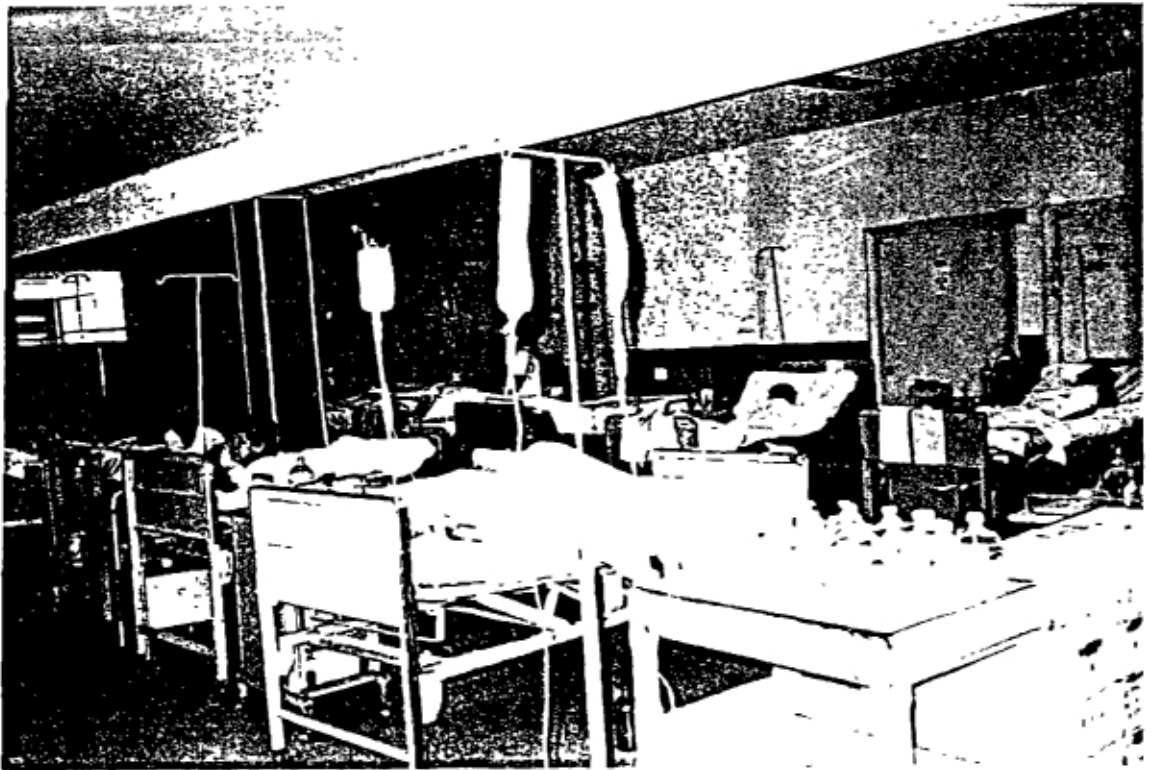
Obtaining Water from an Open Well
Cambio Puente—Chimbote



Street Vendor Selling Home-made Drinks
Piura



Cholera Ward in Hallway
Regional Hospital—Piura



Bed Pan Disinfection Station
Regional Hospital—Piura





Hypochlorite Dosing Device
Regional Hospital—Piura

Community Kitchen
La Primavera—Piura





Engineer Luis Quispe demonstrates using hypochlorite solution to purify water in the home
La Primavera—Piura

Women obtaining hypochlorite solution in colored bottles
La Primavera—Piura





Red Cross workers anti-
cholera socio-drama
Pueblo Jovan—
La Primavera
Piura

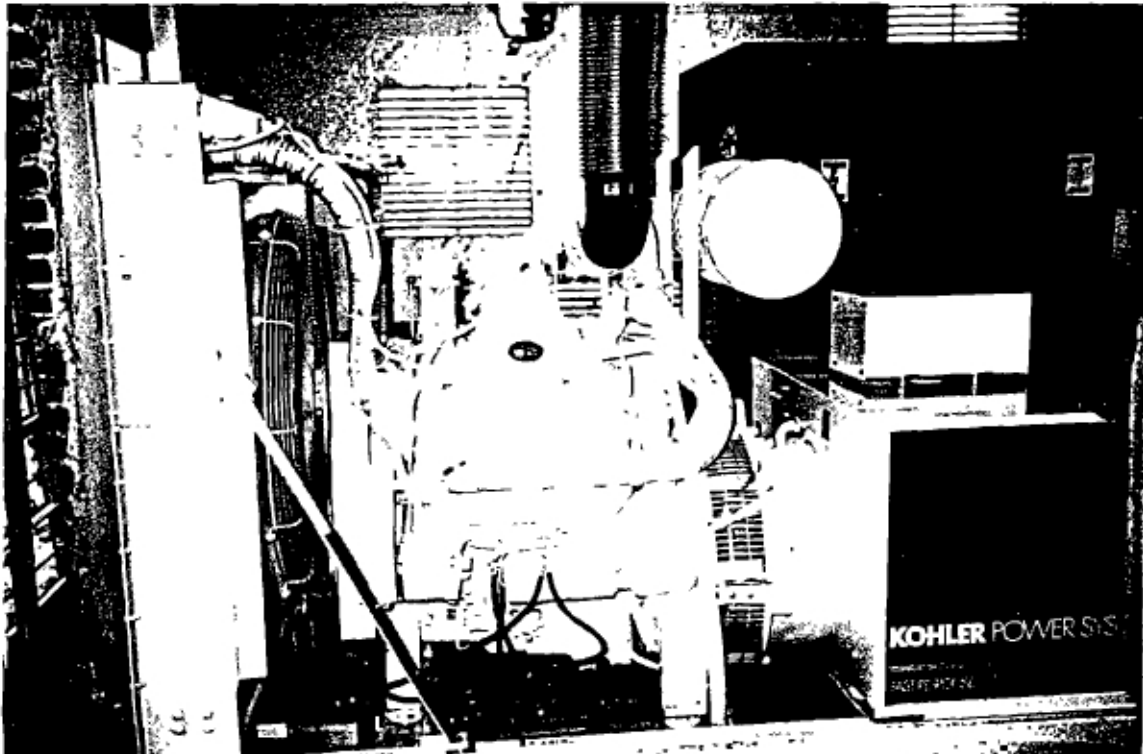


Daughter in family dies from
contracting cholera



Gas Chlorinator installed at well Piura

Back-up generator installed at well Piura



Public Standpipe
San Juan de Miraflores—Lima



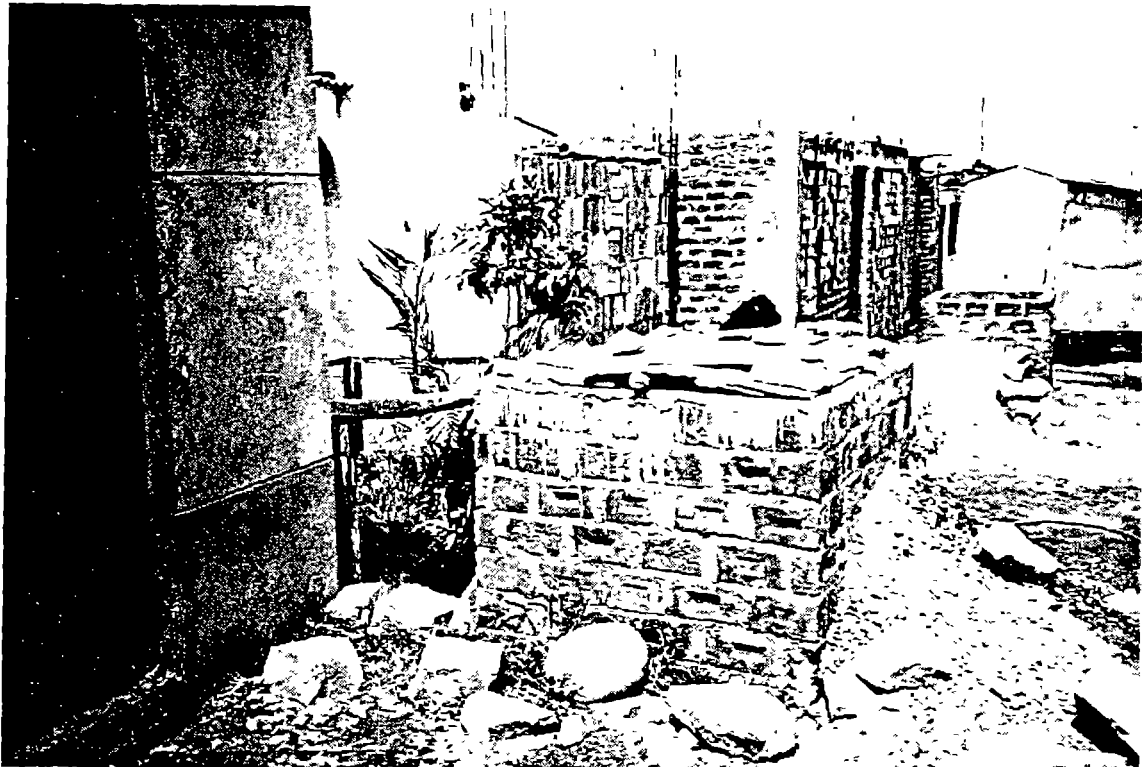
Getting water from public standpipe
San Juan de Miraflores—Lima



Filling Tanker Trucks
Near San Juan de Miraflores



Ground level storage tanks
San Juan de Miraflores



Gate on raw sewage canal to irrigate crops in background
San Juan de Miraflores—Lima



Anti-cholera community meeting
Pueblo Joven—Puente Piedra—Lima



Singing the National Anthem
Pueblo Joven—Puente Piedra—Lima



Fetching Water from a public standpipe
at pueblo joven "La Union," Piura



Close-up of young girl fetching water from the same
standpipe in pueblo joven "La Union," Piura



APPENDIX A

KEY PERSONNEL CONTACTED

A.I.D./Peru

Craig G. Buck, Director
Barbara Kennedy, Deputy Director
Charles Mantione, Chief of Human Resources
Dr. Edgar Necochea, Acting Chief of the Health, Population and Nutrition Division
Gerardo Arabe, Project Coordinator

Ministry of Health

DIGESA (Direccion General de Salud Ambiental)
Ing. Francisco Alvizuri Pomacaja, Director General
Ing. Javier Prado
Ing. Doris Alfaro
Ing. Miguel Tipacti

INAPMAS

(Instituto Nacional de Proteccion del Medio Ambiente para la Salud)
Dr. Jose Bisbal, Director
Dr. Jesus Toledo
Ing. Eugenio Bellido

DISABAR

(Direccion de Saneamiento Basico en el Ambiente Rural)
Dr. Jose Guillermo Oporto Calderon, Director General
Dr. Guillermo Marguina, Director Programa Evaluacion

Oficina General de Epidemiologia

Luis Seminario, Director General
Dr. Juan Manuel Ureta
Augusto Lopez

Oficina de Estadistica e Informatica

Dr. Julio Acosta, Director General
Dr. Elias Lozano, Deputy Director General

SENAPA

(Servicio Nacional de Agua y Alcantarillado)

Ing. Manuel Barron Ramos, Presidente del Directorio

Ing. Jorge Izaguirre

Ing. Alicia Chang

SEDAPAL

(Servicio de Agua Potable y Alcantarillado de Lima)

Ing. Placido Aguirre Alata

Ing. Luis Salinas Hurtado

Hilda Abuid Nazal, Public Relations Officer

Ing. Eduardo Bauer

SEDA Piura

Ing. Eugenio Ortiz, Gerente General

World Health Organization

PAHO (Pan American Health Organizations)

Julio Burbano, Sanitary Engineer

World Health Organization

CEPIS (Pan American Center for Sanitary Engineering and Environmental Sciences)

Ing. Alberto Florez Munoz, Director

Henry J. Salas, Sanitary Engineer

Ing. Guillermo Leon

USEPA (U.S. Environmental Protection Agency)

Edwin E. Geldreich, Science Advisor Microbiology

Kim R. Fox, P.E. Environmental Engineer

PRISMA

(Proyectos en Informatica, Salud, Medicina y Agricultura)

Josephine Gilman, Director

COVARS (Comite de Vigilancia de Aguas del Rio Santa)

Luis Garidia Dominguez, Vice Presidente COVARS

Fernando Panta Morales, Secretaria COVARS

Inocencio Lara, Secretario General/Primavera

Ceferino Agurto, Inspector de Renes

Puente de Piedras Hospital

Dr. Justo Meza, Director

Dr. Felicia, Bravo, Director School Health

- Piura

Dr. Miguel Leon, Sub Director, UDES

Ing. Luis Qulspe, Director de Saneamiento

APPENDIX B

REFERENCE DOCUMENTS

- Tauxe, Robert V., Chief Epidemiology Section, CDC; Epidemic Cholera in Peru: Preliminary Report, February 22, 1991.
- Pardon, Mauricio, PhD, et al; Evaluacion Sanitaria del Sistema de Abastecimiento de Agua y Saneamiento de la ciudad de Chimbote en el Marco de la Epidemia del Colera de 1991; 4 - 6 de febrero de 1991; CEPIS/OPS; Lima, Feb. 1991
- Feachem, Richard G., et al, Sanitation and Disease Health Aspects of Excreta and Waste water Management, World Bank Studies in Water Supply and Sanitation 3.
- Anonymous, Pautas para el Control del Colera, Organizacion Panamericana de la Salud, Washington, DC; Document WHO/CDD/SER/80.4 Revision 2 (1991)
- Anonymous, Medidas Preventivas en el Sector Ambiental para Enfrentar la Amenaza del Colera, Organizacion Panamericana de la Salud, Washington, DC.
- Anonymous, evaluation de las medidas adoptadas en la Region Grau para evitar la propagacion del colera por falta o insuficiencia de servicios adecuados de agua potable, desagues y disposicion de excretas; Ministerio de Salud, Ministerio de Vivienda y Construccion (SENAPA), Organizacion Panamerican de la Salud, Marzo de 1991.
- Rojas, Guillermo del Solar, Ministro de Vivienda y Construccion, Resolucion Ministerial No. 039-91-VC-8200 aprueban directiva referente a medidas para evitar la propagacion de colera por falta o insuficiencia de servicios adecuados de agua potable, desagues y disposiciones de excretas (Directiva No. 01-01-VC-1101)
- * Anonymous, propuestas de acciones inmediatas para el control de la epidemia del colera - saneamiento basico, Ministerio de Salud, Ministerio de Vivienda y Construccion, Organizacion Panamericana de la Salud, 8 de febrero de 1991.
- Mamani, Eugenio Bellido, Ing. INAPMAS, Informe el saneamiento ambiental en el Departamento de Cajamarca frente a la emergencia de la epidemia "del Colera" (del 23 de feb. al 2 de marzo de 1991), marzo de 1991.
- Marquina, Guillermo; Proyecto-Control del Colera en al Zona Rural de Cajamarca; Ministerio de Salud, Direccion de Saneamiento Basico Rural; Lima, 1991.

Anonymous; Medidor de Cloro Residual de Bajo Costo para Programas de Vigilancia de Calidad del Agua para Consumo Humano; Hojas de Divulgacion Tecnica; CEPIS/OPS, Octubre 1986.

Anonymous; Propuestas de Acciones Inmediatas para el Control de la Epidemia del Colera - Saneamiento Basico, CEPIS/OPS, Lima, 8 febrero de 1991.

Anonymous; Contaminacion de Aguas en la Costa de Lima Metropolitana; Ministerio de Salud, DIGESA; Lima, 1984.

Navarro Palma, Augusto; Subregion andina: Propuesta para continuar el decenio internacional de abastecimiento de agua; Ingenieria Sanitaria, Vol XLIII, Julio - Diciembre 1989.

Eg. David; Planning for Water and Sanitation Programs in Bolivia, Ecuador, and Peru, Field Report No. 302, WASH, June 1990

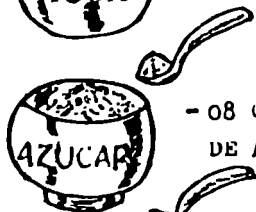
APPENDIX C

Anti-Cholera Posters and Fliers

COMO PREPARAR SUERO CASERO :



- EN UN LITRO DE AGUA HERVIDA FRIA, AÑADIR..



- 08 CUCHARADITAS DE AZUCAR, Y



- 01 CUCHARADITA DE SAL AL RAS.

RECUERDA! DESPUES DE CADA DEPOSICION DEBES TOMAR EL SUERO CASERO, Y ASI EVITARAS DESHIDRATATE.

Sales de Rehidratación oral.

VACIAR EL CONTENIDO DE UN SOBRE DE SALES DE REHIDRATACION ORAL EN 1 LITRO DE AGUA HERVIDA FRIA, MOVER BIEN Y DAR DE BEBER.

DESPUES DE 24 HORAS DE PREPARADO, NO CONSUMIRLO.



RECUERDA :

- NO HAY VACUNA EFICAZ CONTRA EL MAL DEL COLERA.



- SOLO CON TU AYUDA Y COLABORACION PODREMOS VENCERLA.



- POR ELLO DEBES ADOPTAR LOS CORRECTOS HABITOS DE ALIMENTACION Y LIMPIEZA.



- AYUDANOS A DIFUNDIR ESTOS MENSAJES ENTRE FAMILIARES Y AMIGOS.



- ANTE EL PRIMER SINTOMA ACUDE AL CENTRO DE SALUD MAS CERCANO A TU HOGAR.



PAREMOS "EL COLERA"



REGION GUAYAS

Comité Multisectorial.

SALUD - EDUCACION

COMO EVITAR EL COLERA



EL COLERA.

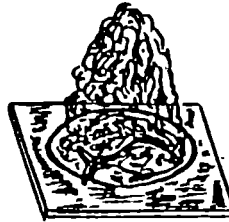
- ES UNA ENFERMEDAD MUY GRAVE PRODUCIDA POR LA BACTERIA "VIBRIO COLERA", LA CUAL SE INSTALA EN EL INTESTINO PRODUCIENDO DIARREAS LIQUIDAS ABUNDANTES PARECIDAS AL AGUA "LAVADO DE ARROZ".
- PRODUCE TAMBIEN VOMITOS Y CALAMBRES CON DESHIDRATACION LLEGANDO A PROVOCAR LA MUERTE DE LA PERSONA AFECTADA.
- SI EL PACIENTE NO ES ATENDIDO A TIEMPO, PUEDE LLEGAR AL ESTADO DE COMA EN 24 HORAS; POR ELLO Y DE FORMA INMEDIATA DEBE HIDRATARSE.

QUE HACER?

- APENAS SE INICIA LA ENFERMEDAD TOMAR ABUNDANTES LIQUIDOS, DE PREFERENCIA SALES DE REHIDRATACION ORAL, QUE REEMPLACEN LOS LIQUIDOS PERDIDOS POR LAS DIARREAS Y VOMITOS. ESTAS SE CONSIGUEN EN UROS COMUNALES, COMEDORES.
- SI LA ENFERMEDAD AVANZA ACERCARSE AL SERVICIO DE SALUD MAS CERCA DE SU DOMICILIO, Y DE PERSEGUIR LOS SINTOMAS ACERCARSE AL HOSPITAL.

Respecto a tu Alimentación:

HIERVE EL AGUA ANTES DE BEBERLA.



CONSUME SOLO ALIMENTOS COCINADOS, FRITOS O SANCOS CHAFOS.

LAVA BIEN LAS FRUTAS Y VERDURAS ANTES DE COMERLAS.



NO CONSUMAS ALIMENTOS Y BEBIDAS DE DUDOSA PROCEDENCIA, TAL COMO LAS QUE EXISTEN EN LOS ARBULANES.

Respecto a tu Higiene Personal:

INTENSIFICA EL HABITO DE LAVAR LAS MANOS ANTES Y DESPUES DE COMER Y LUEGO DE IR AL BAÑO.

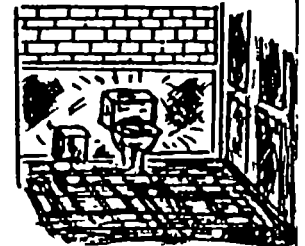


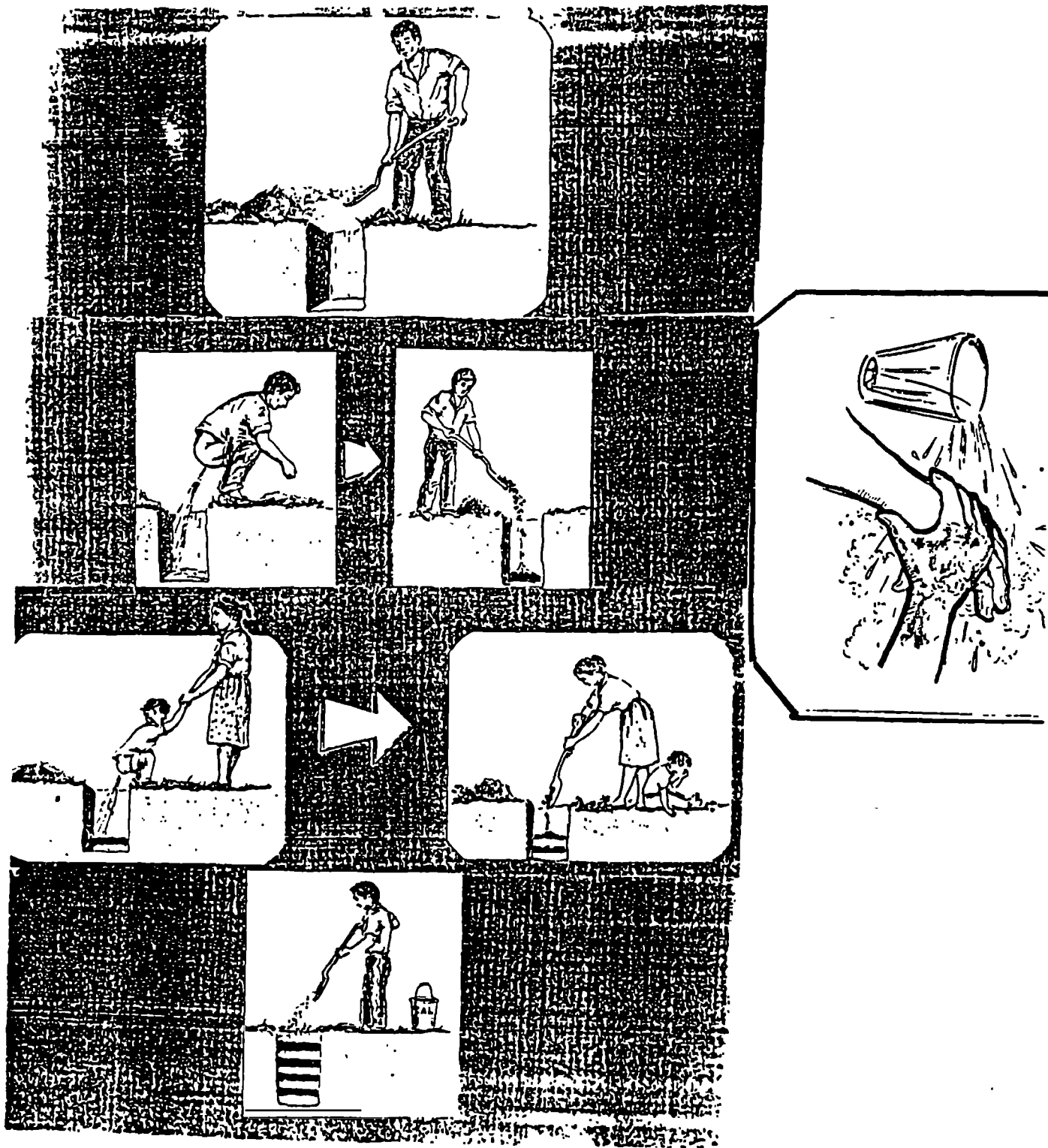
LAVA LOS UTENSILIOS DE COCINA.

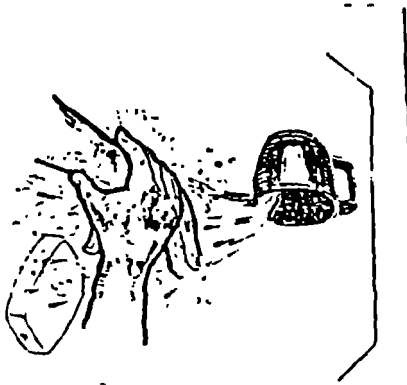
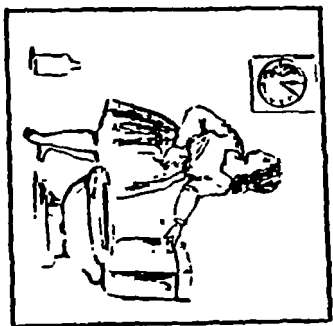
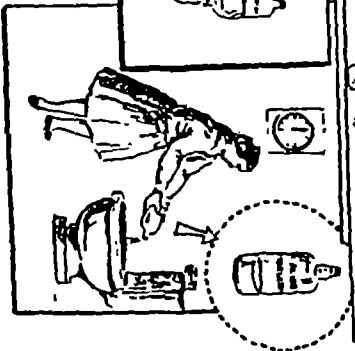
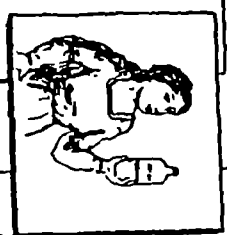
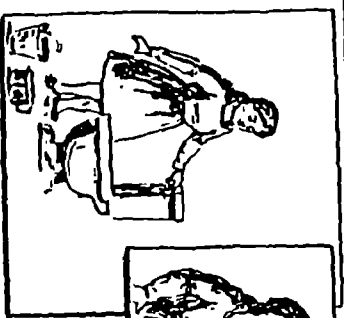
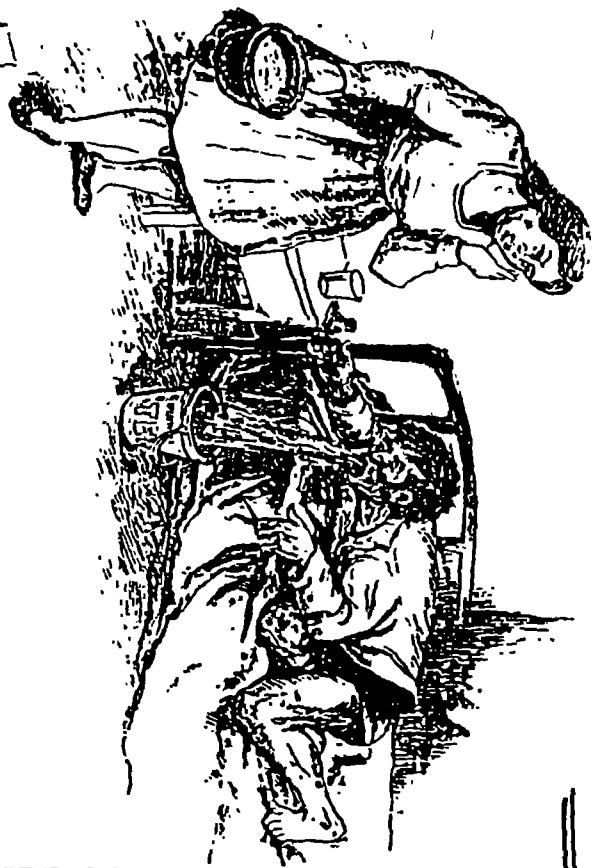


SI NO CUENTAS CON SERVICIOS HIGIENICOS CONSTANTE Y CONSERVALO TAPADO.

MANTEN LIMPIOS LOS SERVICIOS HIGIENICOS DE TU HOGAR.







Miraflores Cesar's Hotel

LIMA-PERU

☆☆☆☆☆

Año de 1991

COLERA VIRUS

Como por de conocimiento público en el país se han presentado casos con virus del cólera, sus primeros síntomas producen diarrea y deshidratación.

El Hotel, a través de su departamento Médico, ha tomado todas las precauciones necesarias para darle a usted completa seguridad, un excelente servicio y todas las medidas que se deben tomar.

Nos permitimos darle algunos consejos adicionales:

1. No debe comer pescado ni mariscos crudos.
2. Tome solamente agua pasteurizada en botella o gaseosas.
3. No beba agua del caño.
4. Para sus comidas seleccione nuestros restaurantes o lugares donde sepa que los productos son absolutamente frescos, nunca en lugares de expendio ambulatorio.

ESTAMOS CONCIENTES DE SU SEGURIDAD Y LA NUESTRA !!!

Cordialmente,

El Gerente

CHOLERA VIRUS

It is our regret to know that in the country we are located there are cholera cases. The new cholera virus produces symptoms such as diarrhea and dehydration.

- The Hotel, through its Medical Department, has taken every precaution necessary to give you complete security and a top quality about what they should do.

We are permitted to give you some additional advice:

1. Do not eat raw fish or sea food.
2. Drink only pasteurized water or soft drinks.
3. Do not drink tap water.
4. Use our restaurants or select places in which you know they have absolutely fresh food. Never eat food sold in the street.

WE ARE CONSCIOUS OF YOURS AND OUR SECURITY !!!

Cordially,

Un hotel diferente...

El Gerente

APPENDIX D

Excerpt from CEPIS Report

Informe de la Mision

de

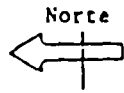
Evaluacion Sanitaria del Sistema de Abastecimiento
de Agua y Sanemiento de la Ciudad de Chimbote
en el Marco de la epidemia del Colera de 1991

preparado por

Ing. Lidia Canepa de Vargas
Oficial del Programa del Mejoramiento de la Calidad del Agua
para Consume Humano, CEPIS

Lgdg. Margarita Aurazo de Zumaeta
Microbiologa, CEPIS

Ing. Mauricio Pardon, PhD



- P = Pozo
- R = Reservorio
- * = Equipo de desinfección

Río Lacramarca

Canal Stuart

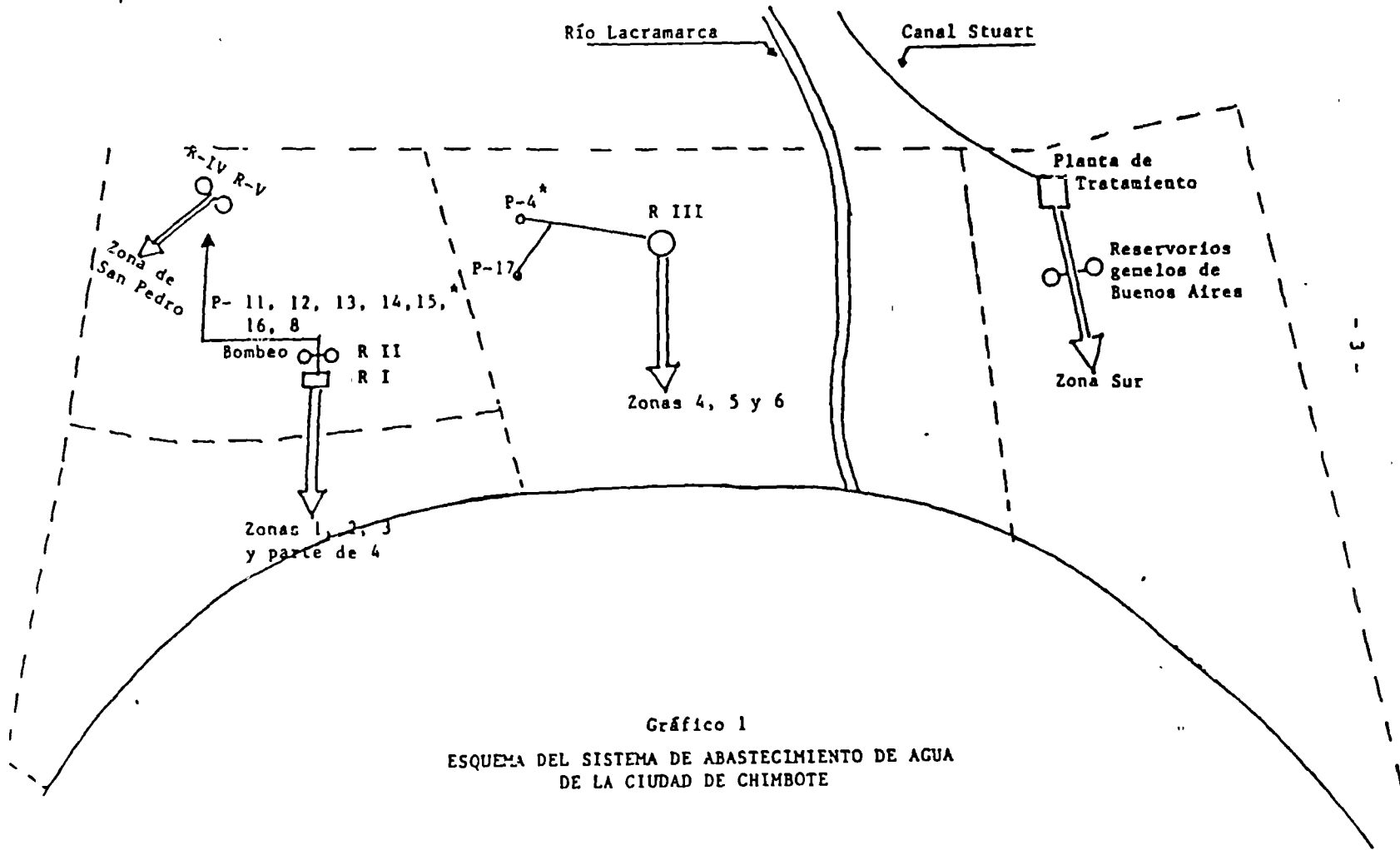
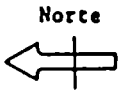


Gráfico 1

ESQUEMA DEL SISTEMA DE ABASTECIMIENTO DE AGUA
DE LA CIUDAD DE CHIMBOTE



CB = Cámara de bombeo

Emisor = Emisor

SISTEMA DE DISPOSICION
DE AGUAS RESIDUALES DE
LA CIUDAD DE CHIMBOTE

76

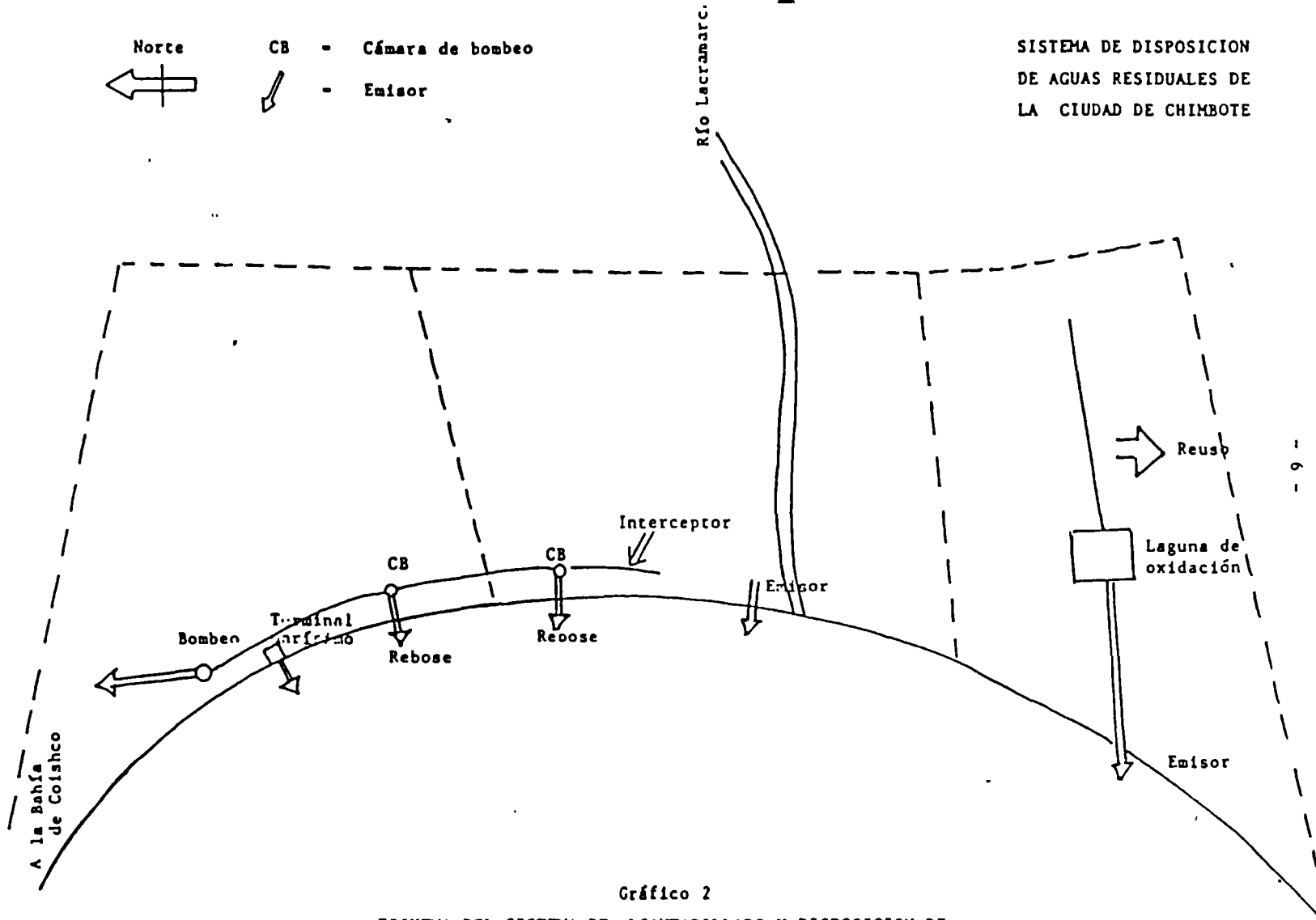


Gráfico 2

ESQUEMA DEL SISTEMA DE ALCANTARILLADO Y DISPOSICION DE
EXCRETAS DE LA CIUDAD DE CHIMBOTE

ANALISIS DE RIESGOS EN LOS SERVICIOS DE AGUA Y SANEAMIENTO ORIENTADO HACIA UNA PRIORIZACION DE ACCIONES CORRECTIVAS PARA EL CONTROL DE LA PROPAGACION DE LA EPIDEMIA DE COLERA EN CHIMBOTE

COMPONENTE	ITEM	RIESGO	FACTORES DE PRIORIZACION		INTERVENCION RECOMENDADA
			Riesgo	Capacidad de respuesta	
1.0 AGUA					
<u>Producción</u>					
A. Superficial/Planta de tratamiento	1.1	Fuente expuesta	M	M	. Monitoreo y control
	1.2	Diseño defectuoso de la planta	M	L	. Rehabilitación
	1.3	Operación deficiente	M	I	. Curso de capacitación
	1.4	No existe control de calidad, laboratorio ni registros	M	M	. Capacitación y equipamiento
B. Aguas subterráneas/ Pozos	1.5	Sólo 2 de 15 pozos cuentan con equipo de desinfección	A	I	. Equipamiento e instalación
<u>Almacenamiento</u>					
A. Reservorio RI	1.6	Ausencia de protección, instalación rodeada de asentamientos precarios que no cuentan con servicio de agua	A	I	. Construir/instalar cerco, Provisión de punto de agua controlado.
	1.7	Punto de agua extraído de la línea de aducción	M	I	. Clausurar punto de agua
	1.8	Techo de fibrocemento deteriorado permite ingreso de materiales, personas y animales	A	I	. Reparación/instalación de techo adecuado
<u>Sist. Distribución</u>					
	1.9	Servicio intermitente; 4 horas/ día (6-10 a.m.)	A	L	. Aumento de oferta de agua (aumento de producción/control de pérdidas)
	1.10	Acopio clandestino de agua	A	M	. Control
	1.11	Cajas de conexión domiciliaria son punto de contaminación de la red	A	M	. Conexión de personas a la red
				I	. Adecuación de puntos insano
	1.12	Ausencia de cloro en la red de distribución	A	M	. CSA

Riesgo: Alto (A), Medio (M), Bajo (B)

Captación de Respuesta: Inmediata (I), mediano plazo (M), largo plazo (L)

COMPONENTE	ITEM	RIESGO	FACTORES DE PRIORIZACION		INTERVENCION RECOMENDADA	
			Riesgo	Capacidad de respuesta		
2.0 ALCANTARILLADO						
A.	Recolección	2.1	Cajas contiguas a cajas de agua	A	M	. Optimizar manejo de redes para evitar represamientos y atoros
B.	Disposición					
	Interceptor	2.2	Funcionamiento represado por operación de cámaras de bombeo	A	I	. Reparación/optimización de uso de equipos . Control operativo
	Cámaras Bombeo	2.3	Reboses van al mar (caleta de pesca)	A	M	. Control operativo
	Emisores	2.4	Al mar, caleta de pesca; doméstico e industrial (pesca)	A	L	. Tratamiento/Emisarios submarinos
C.	Reuso	2.5	Reuso sin tratamiento en agricultura, Zona Sur/Santa Rosa	A	I	. Control

Riesgo: Alto (A), Medio (M), Bajo (B)

Capacidad de Respuesta: Inmediata (I), mediano plazo (M), largo plazo (L)

COMPONENTE	ITEM	RIESGO	FACTORES DE PRIORIZACION		INTERVENCION RECOMENDADA
			Riesgo	Capacidad de respuesta	
3.0 SANEAMIENTO					
A.	Excretas	3.1 Práctica extendida de defecación al aire libre	A	I M	. Enterramiento, CSA . Letrinización
B.	Alimentos	3.2 Práctica extendida de preparación y consumo de alimentos al aire libre en condiciones insanitarias	A	I	. Control . CSA
		3.3 Falta de agua en mercados y paraditas	A	M	. Provisión de agua e infraestructura
		3.4 Lavado insanitario de pescado y mariscos	A	M	. Provisión de agua e infraestructura
		3.5 Consumo de verduras irrigadas con desagües crudos	A	I I	. Control . CSA
		3.6 Pescados y mariscos provenientes de las caletas contaminadas por descargas de desagües crudos	A	M I	. Control . CSA
C.	Basura	3.7 Recojo insuficiente	A	L	. Mejoramiento del recojo
		3.8 Proliferación de moscas	M	L	. Disminución de basura y desechos en el ambiente
D.	Hospitales	3.9 Excretas de pacientes de Cólera son arrojados al colector público	A	I	. Tratamiento de excretas
		3.10 No existe tratamiento de desagües	A	L	. Implantar sist. de tratamiento
		3.11 No se desinfecta materiales e instrumentos	M	I	. Esterilización por hervido
		3.12 Insuficiente capacidad de atención a pacientes	A	I I	. Logística de uso de centros asistenciales . Uso de centros asist. portátiles de emergencia (IPSS, Ejército, Defensa Civil)

(CSA: Campaña Sanitaria Agresiva)

Riesgo: Alto (A), Medio (M), Bajo (B)

Captación de Respuesta: Inmediata (I), mediano plazo (M), largo plazo (L)



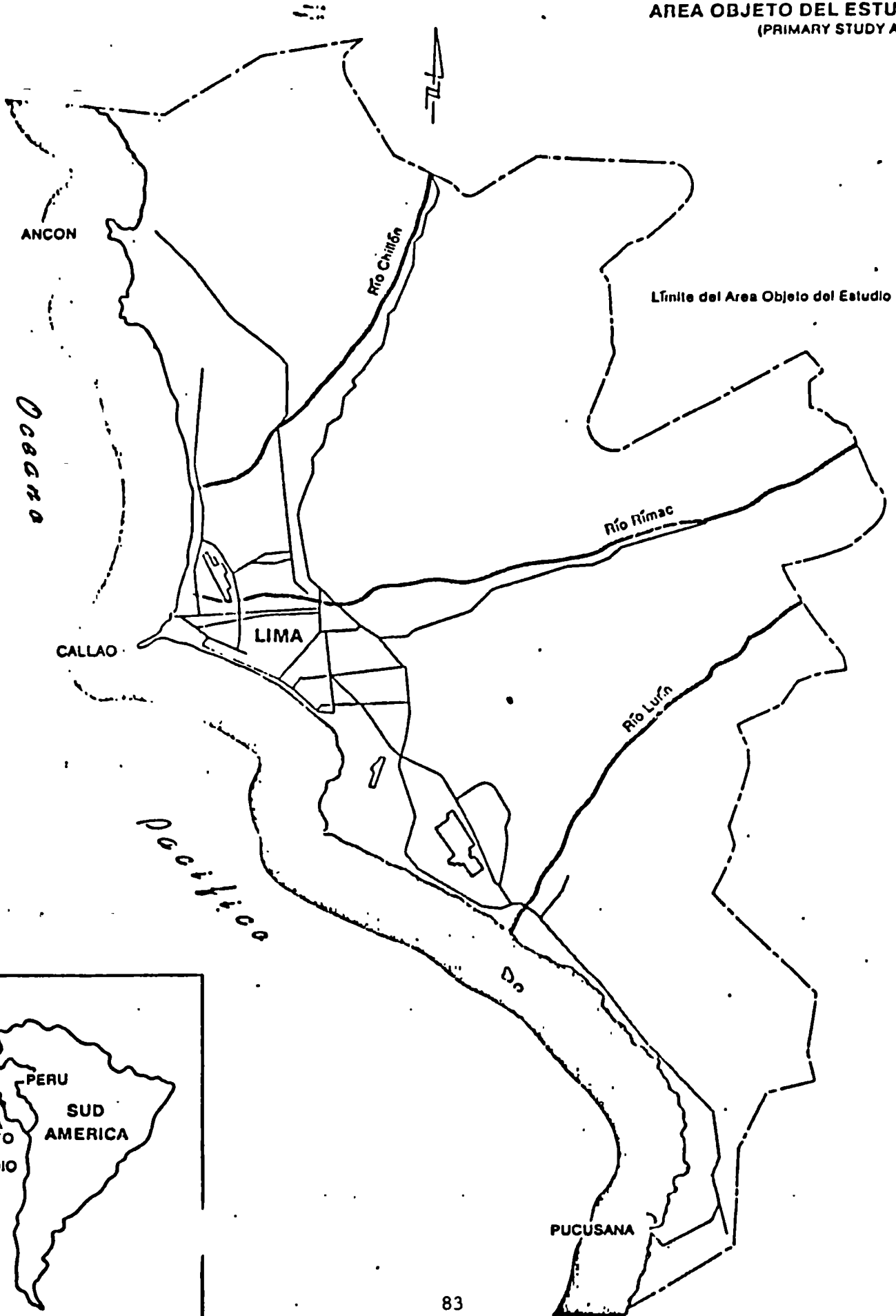
APPENDIX E

**Excerpt from
Plan Maestro de Agua Potable y Desague
para Lima Metropolitana**

by Engineering-Science
Arcadia, California



FIGURA A.
AREA OBJETO DEL ESTUDIO
(PRIMARY STUDY AREA)



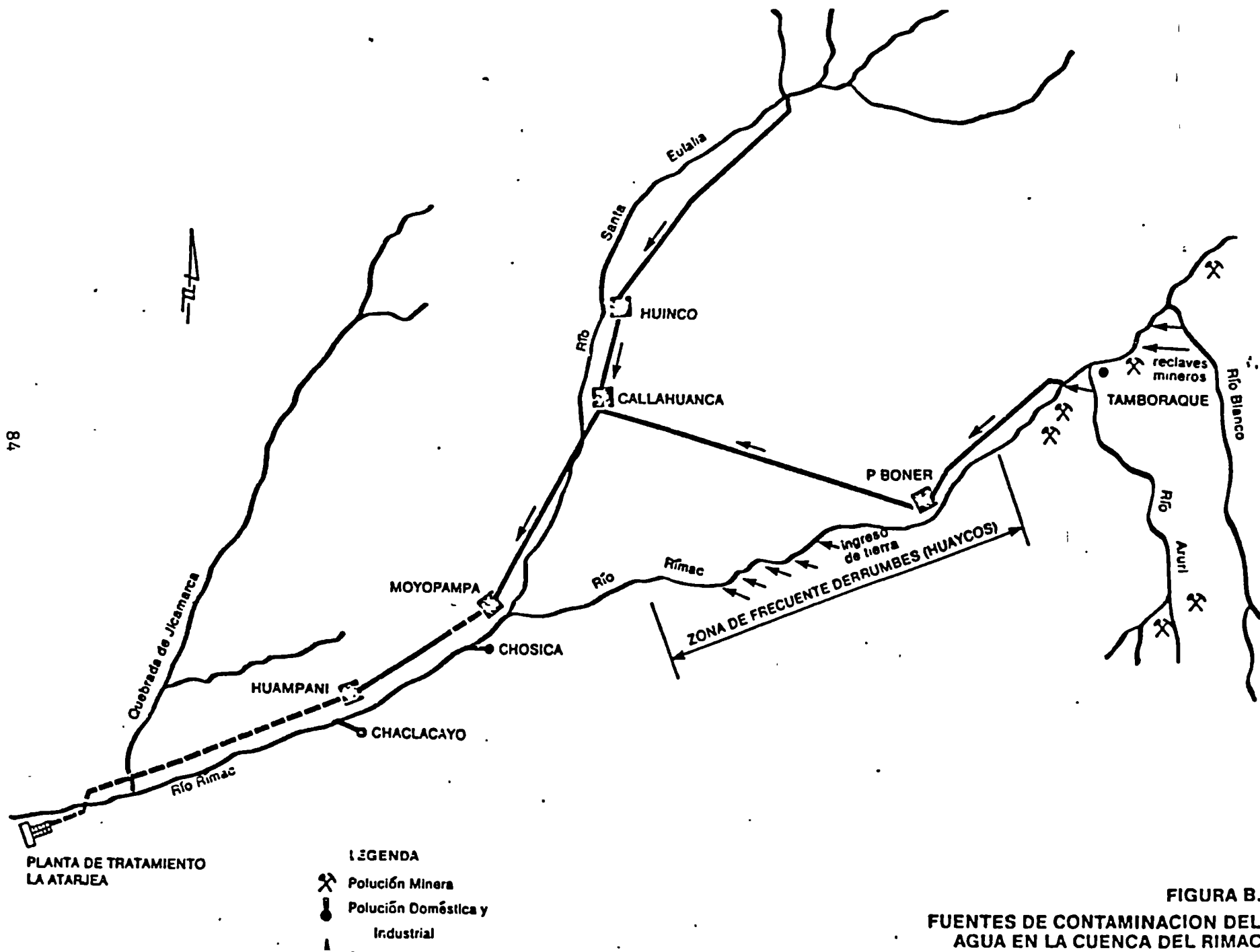
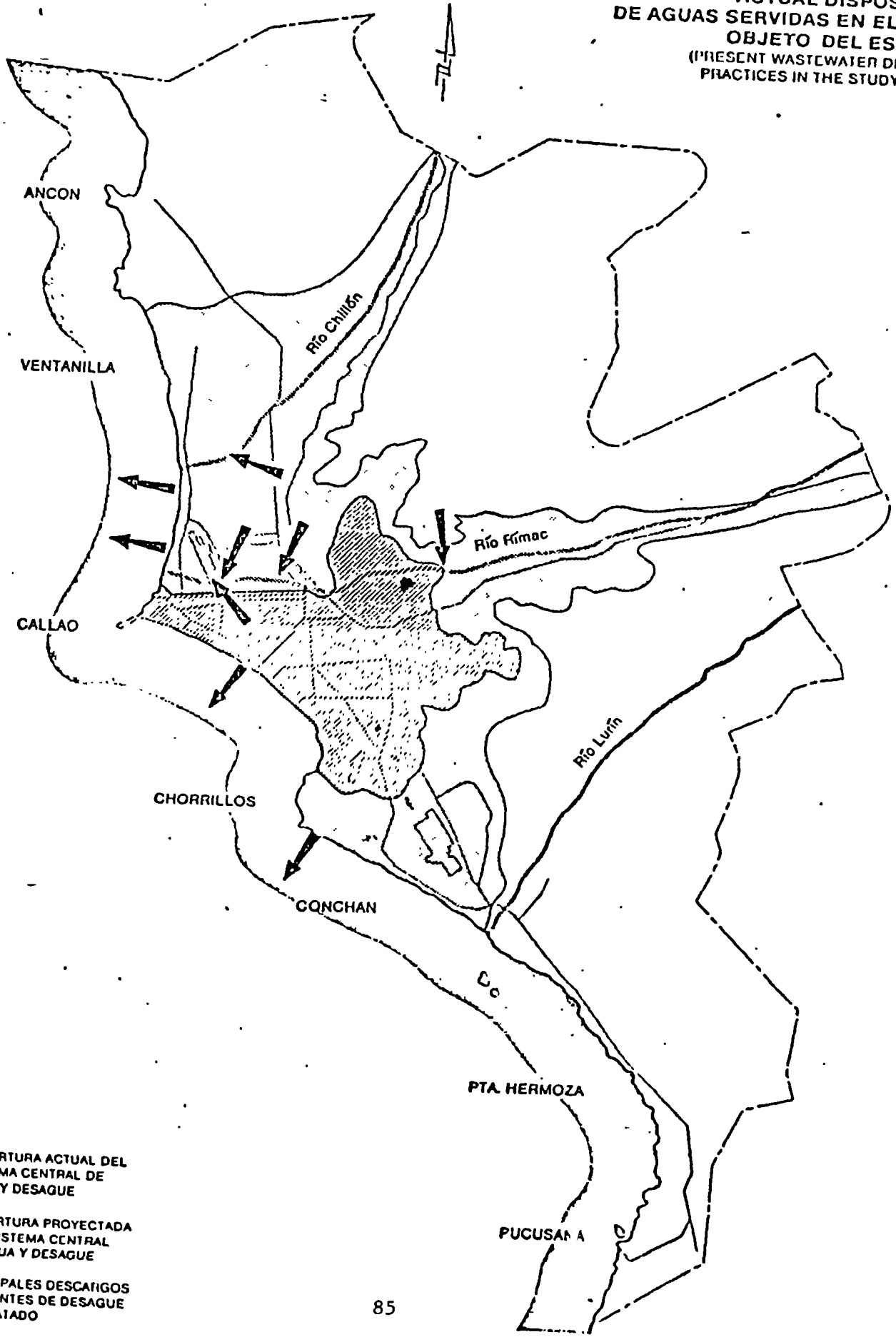



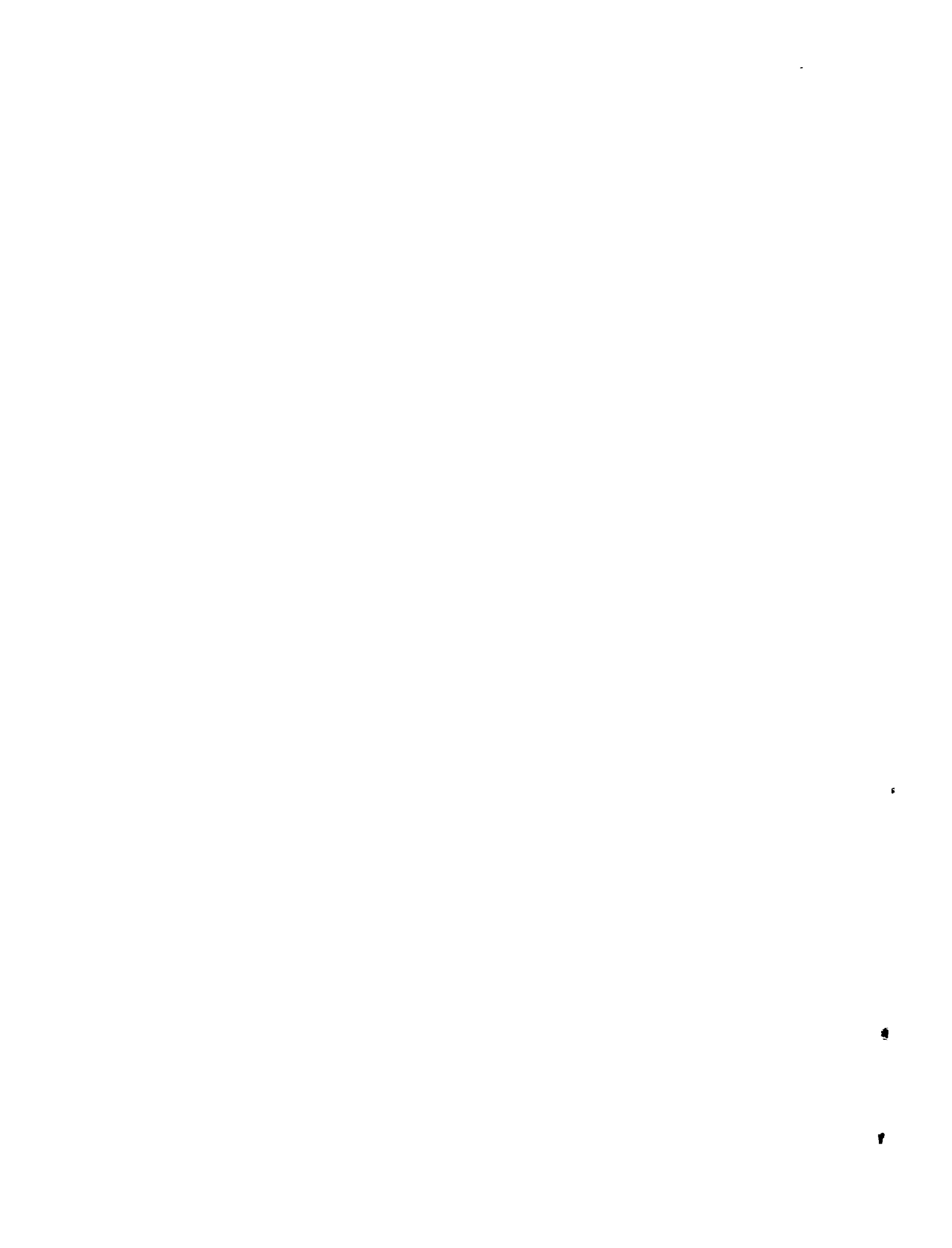
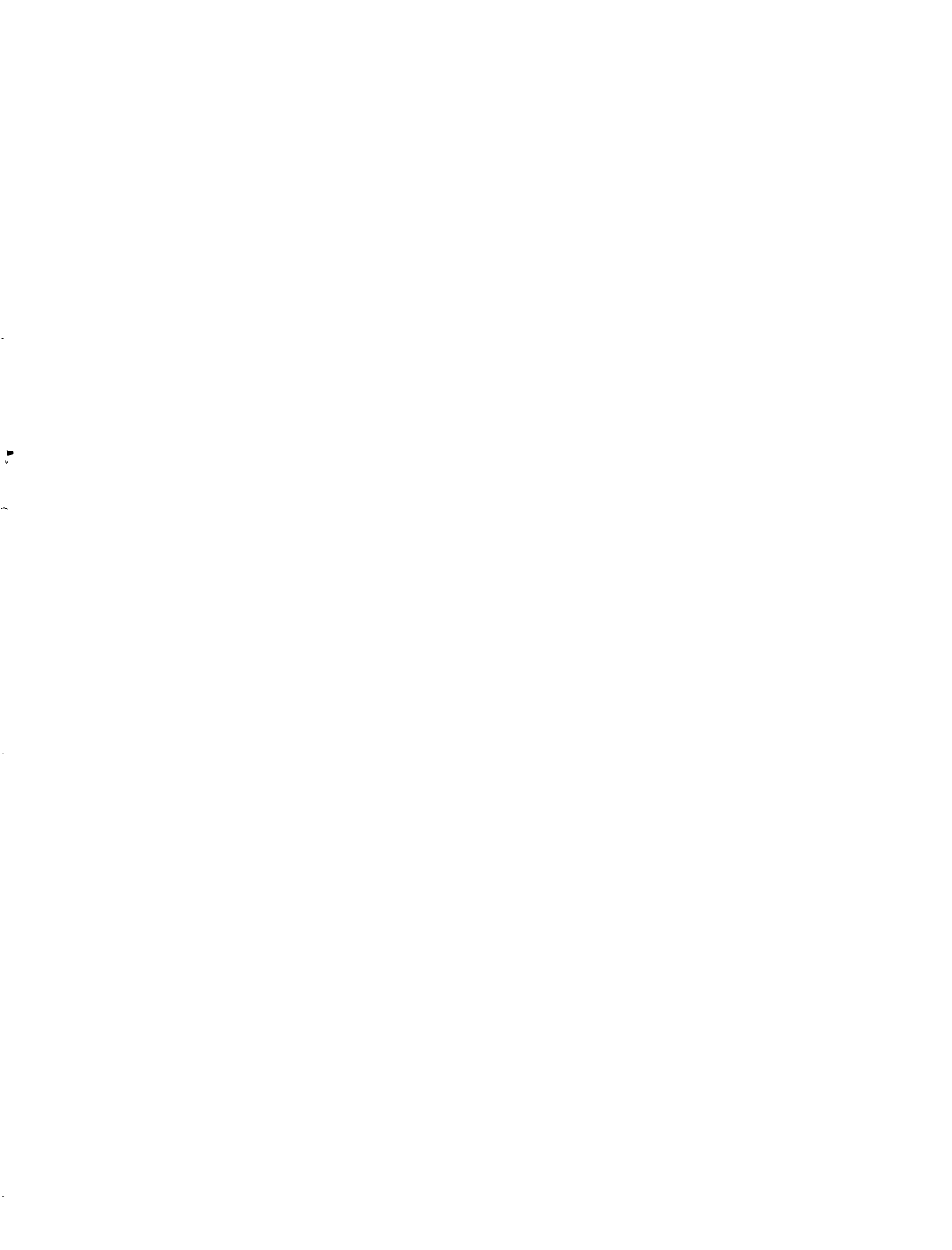


FIGURA C.
ACTUAL DISPOSICION
DE AGUAS SERVIDAS EN EL AREA
OBJETO DEL ESTUDIO
(PRESENT WASTEWATER DISPOSAL
PRACTICES IN THE STUDY AREAS)



-  COBERTURA ACTUAL DEL SISTEMA CENTRAL DE AGUA Y DESAGUE
-  CUBERTURA PROYECTADA DEL SISTEMA CENTRAL DE AGUA Y DESAGUE
-  PRINCIPALES DESCARGOS EXISTENTES DE DESAGUE NO TRATADO





The Environmental Health Project (EHP) provides technical assistance to USAID missions and bureaus and other development organizations in nine areas: tropical diseases, water and sanitation, wastewater, solid waste, air pollution, hazardous waste, food hygiene, occupational health, and injury. It is part of the Office of Health and Nutrition's response to requests from USAID missions and bureaus for an integrated approach to addressing environment-related health problems. In addition to EHP, this effort includes an Environmental Health Requirements Contract and a PASA (Participating Agency Support Agreement) with the U.S. Centers for Disease Control and Prevention. A wide range of expertise is made available by EHP through a consortium of specialized organizations (see list below). In addition to reports on its technical assistance, EHP publishes guidelines, concept papers, lessons learned documents, and capsule reports on topics of vital interest to the environmental health sector. For information on the reports available, contact EHP headquarters.

ENVIRONMENTAL HEALTH PROJECT