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# WATER QUALITY ASSESSMENT IN ECUADOR

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WASH Field Report No. 390  
February 1993

## WATER AND SANITATION for HEALTH PROJECT

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WASH Field Report No. 390

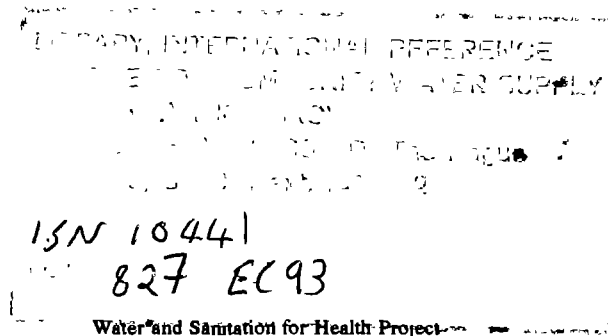
# WATER QUALITY ASSESSMENT IN ECUADOR

Prepared for USAID Mission to Ecuador  
under WASH Task No. 430

by

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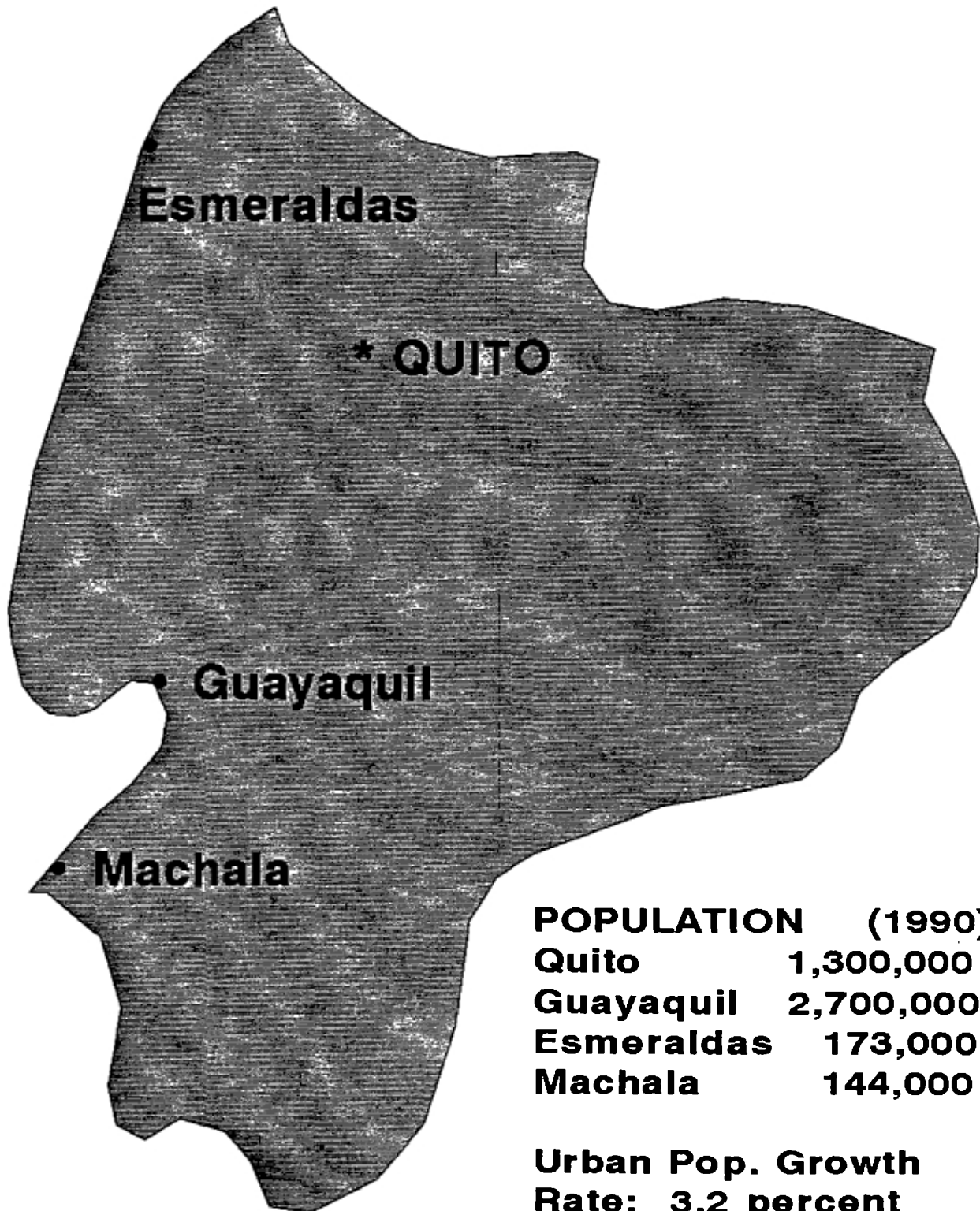
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# Ecuador



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# CONTENTS

ABOUT THE AUTHORS .....	v
ACKNOWLEDGMENTS .....	vii
ACRONYMS .....	ix
EXECUTIVE SUMMARY .....	xi
1. INTRODUCTION .....	1
1.1 Background .....	1
1.2 Scope of Work .....	2
1.3 Methodology .....	3
2. CHOLERA IN COASTAL ECUADOR .....	5
2.1 Introduction .....	5
2.2 Guayaquil .....	5
2.3 Machala .....	10
2.4 Esmeraldas .....	12
2.5 Organizations Involved in Cholera Activities .....	13
2.5.1 Water and Sewage Utilities .....	14
2.5.2 Ministry of Health .....	14
2.5.3 Ecuadorian Institute for Sanitary Works .....	14
3. WATER AND SANITATION SYSTEM .....	17
3.1 Introduction .....	17
3.2 Assessment of Guayaquil .....	17
3.2.1 Water Supply, Treatment, Storage, and Distribution System .....	17
3.2.2 Sewage Collection, Treatment, and Disposal .....	19
3.2.3 Solid Waste Collection and Disposal .....	19
3.2.4 Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation .....	20
3.3 Assessment of Machala .....	24
3.3.1 Water Supply, Treatment, Storage, and Distribution .....	24
3.3.2 Sewage Collection, Treatment, and Disposal .....	26
3.3.3 Solid Waste Collection and Disposal .....	26
3.3.4 Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation .....	26

3.4	Assessment of Esmeraldas	30
3.4.1	Water Supply, Treatment, Storage, and Distribution	30
3.4.2	Sewage Collection, Treatment, and Disposal	31
3.4.3	Solid Waste Collection and Disposal	31
3.4.4	Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation	32
4.	HYGIENE EDUCATION AND COMMUNITY PARTICIPATION	37
4.1	Introduction	37
4.2	Hygiene Education	37
4.3	Hygiene Practices at the Personal and Family Levels	39
4.3.1	Personal and Family Hygiene Practices	39
4.3.2	Hygiene Practices at the Community Level	42
4.4	Community Participation	43
4.5	Data Analysis	44
5.	INSTITUTIONAL ISSUES	47
5.1	Introduction	47
5.2	Institutional Capabilities	48
5.3	Interagency Cooperation	51
5.4	Legal and Regulatory Environment	52
5.5	Economics and Finance	53
6.	RECOMMENDATIONS	59
6.1	Water and Sanitation Recommendations	59
6.1.1	General Short-Term Water and Sanitation Recommendations Applicable to the Coastal Areas of Ecuador	59
6.1.2	General Long-Term Water and Sanitation Recommendations Applicable to the Coastal Area of Ecuador	59
6.1.3	Site-Specific Recommendation for Guayaquil	60
6.1.4	Site-Specific Recommendations for Machala	60
6.1.5	Site-Specific Recommendation for Esmeraldas	60
6.2	Hygiene Education Recommendations	61
6.2.1	Short-Term Recommendations	61
6.2.2	Long-Term Recommendations	61
6.3	Institutional Recommendations	61
6.3.1	Short-Term Recommendations	61



6.3.2	Long-Term Recommendations . . . . .	61
6.3.3	Recommendations for USAID . . . . .	62

APPENDIXES

A.	Sampling Programs for Guayaquil, Machala, and Esmeraldas . . . . .	63
B.	Persons Contacted . . . . .	67
C.	Sites Visited . . . . .	71

FIGURES

1.	Cases of Cholera by Province . . . . .	7
2.	Incidence of Cholera by Urban and Rural Area . . . . .	8
3.	Cases of Cholera in Population Centers of El Oro Province . . . . .	11
4.	Schematic Diagram of the Guayaquil Water System . . . . .	18
5.	Population Receiving Potable Water in Guayaquil . . . . .	21
6.	Sampling Results for Guayaquil . . . . .	22
7.	Schematic Diagram of the Machala Water System . . . . .	25
8.	Distribution of Municipal Water in Machala . . . . .	27
9.	Chlorine and Fecal Coliform Tests in Machala . . . . .	28
10.	Distribution of Municipal Water in Esmeraldas . . . . .	33
11.	Chlorine and Fecal Coliform Tests in Esmeraldas . . . . .	34

TABLES

1.	Water Delivery and Comparative Cost in Three Coastal Cities . . . . .	54
2.	Potential Monthly Revenues at Average Tanker Rate . . . . .	55



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Mr. Sonny Low, Sub-Director, RHUDO/SA



## ACRONYMS

A.I.D.	U.S. Agency for International Development (Washington)
AIDS	Acquired Immune Deficiency Syndrome
CARE	CARE International
CDC	Centers for Disease Control
CDD	Control of Diarrheal Diseases
EMA-G	<i>Empresa Municipal de Alcantarillado de Guayaquil</i>
EPAP-G	<i>Empresa Provincial de Agua Potable del Guayas</i>
EMAPYA	<i>Empresa Municipal de Agua Potable y Alcantarillado de Esmeraldas</i>
FAO	U.N. Food and Agriculture Organization
IEOS	<i>Instituto Ecuatoriano de Obras Sanitarias</i> (Ecuadorian Institute of Sanitary Works)
LAC	Bureau for Latin America and Caribbean, A.I.D.
mgd	millions of gallons per day
MOH	Ministry of Health
MPN	Most Probable Number
ORT	Oral Rehydration Therapy
ORS	Oral Rehydration Solution
ORU	Oral Rehydration Unit
PAHO	Pan American Health Organization
SNEM	<i>Servicio Nacional para la Eradicacion de Malaria</i> (National Service for the Eradication of Malaria)

USAID	U.S. Agency for International Development (overseas mission)
WASH	Water and Sanitation for Health Project
WHO	World Health Organization
WS&S	Water Supply and Sanitation
WTP	Water Treatment Plant



# EXECUTIVE SUMMARY

## 1. Introduction

The El Tor cholera pandemic arrived in Ecuador in March 1991, and through the course of the year caused 46,320 cases, of which 692 resulted in death. Most of the cases were confined to cities along Ecuador's coast. As part of its efforts to combat the spread of the disease, the Government of Ecuador, through its Ministry of Health, requested assistance from the United States Agency for International Development (USAID)/Ecuador in the form of chlorine to be used by water utilities in affected coastal cities.

The Water and Sanitation for Health Project (WASH), which was asked to participate in the review of this request, suggested that a more comprehensive approach should be taken to cholera control and prevention. Chlorine alone may not be an adequate solution to water quality problems if there are breaks in the distribution system, intermittent supply problems, and poor handling of water in households, all of which can lead to recontamination. Based on its experience in carrying out a cholera assessment in Peru, WASH suggested a multidisciplinary approach that looks at direct factors that affect cholera transmission (water quality and quantity, excreta disposal, solid waste disposal, and health practices), as well as the indirect influencing factors (community participation, institutional development, human resources development, financial planning, and the legal and regulatory environment). The approach recommends preventive actions that are ranked according to their impact on cholera and feasibility, i.e., their cost and the institutional capacity to carry them out.

The approach was accepted, and a multidisciplinary team consisting of a sanitary engineer, a hygiene education specialist, and an institutional specialist was scheduled to carry out the assessment in late 1992 following the national elections.

## 2. Methodology

During a three-week visit to Ecuador in December 1992, the team reviewed relevant background materials and conducted briefings with officials of USAID, the MOH, IEOS, and other agencies involved in cholera activities at the national level. The team also made site visits to three coastal cities, Guayaquil, Machala, and Esmeraldas. Team members met with officials within their respective disciplines, interviewed technicians engaged in cholera control activities, and collected data directly from cholera-affected areas.

Water quality data collection from site visits included water sampling from water sources. Tests, using portable laboratory equipment brought with the team, were made for chlorine residual and for bacteriological quality. Health and hygiene education data were collected through interviews with provincial and municipal health officials, and through direct interviews with people living in communities considered at risk. Institutional data were collected through

interviews with officers of provincial and municipal institutions involved in the delivery of water and sanitation services, and the review of studies, reports, and other documents.

### **3. Observations**

#### **3.1 Water Quality**

The water supply and sanitation (WS&S) characteristics of Guayaquil, Machala, and Esmeraldas were evaluated based on gathered information. The main conclusions from this evaluation included the following:

- Interruption of water supply or loss of pressure leads to the contamination of the water supply.
- Overnight storage of water in 55-gallon tanks or cisterns results in loss of the chlorine residual.
- Containers used to get water out of 55-gallon tanks or cisterns may contaminate the water remaining in the storage facility.
- The population at risk of contacting the *cholera vibrio* by ingestion of contaminated water is estimated at more than 50 percent for the study area.
- Poor hygiene practices in the manipulation of fecal matter can result in a case of incidental ingestion.
- Uses of contaminated water from the waterways for bathing and washing clothing can result in incidental ingestion of fecal matter contaminated with the *cholera vibrio*.

#### **3.2 Hygiene Education**

The review of documents and the interviews held with institutional and community personnel were useful in reaching the following conclusions with regard to the status of cholera in the coastal region, hygiene education activities, and community participation in water and environmental sanitation:

- The status of cholera in the coastal region is perceived to be stable. However, this perception is based on very general information; no analyses for decisionmaking have been made.
- Control measures, which have had success, are aimed at the treatment of sick patients. However, preventive programs have yet to be developed.
- Educational activities are based on the use of mass media to transmit messages. Messages, however, are not developed and evaluated on the basis of the knowledge, attitudes, and practices of the populations at risk.

- Community members have received information via mass media but have interpreted these messages in accordance with their own beliefs and knowledge and continue to follow dangerous hygiene practices.
- Community participation is understood to be any collaboration or cooperation from anyone in the community. There have been limited attempts to incorporate the community at large into program planning, implementation, and evaluation.
- Coverage provided by systems for the disposal of excreta is deficient, and systems built by the community do not meet the minimum requirements for safety and hygiene and do not take technical alternatives into account.

#### **4. Institutional Issues**

The rapid assessment identified problems with institutional capabilities, interagency cooperation, legal and regulatory issues, and economics and finance. The main conclusions of this assessment were the following:

- A national cholera committee exists, but it operates without a plan. There is no national or regional cholera strategy.
- Inter-agency cooperation is weak. Institutions involved in cholera activities generally work independently of other institutions. This phenomenon also occurs within institutions.
- Water and sanitation utilities provide poor service to their customers. The Ecuadorian Institute of Sanitary Works (IEOS), the normative agency established to regulate the sector, does not monitor the sector.
- The water and sanitation utilities are poorly managed. None are recovering costs. Most revenues come from central government transfers. Paternalism and politics, and not public administration, characterize services. Management of public enterprises is not understood. There appears to be no formal education available in public administration.

#### **5. Short-Term Recommendations**

The principal short-term recommendations resulting from this assessment include the following:

- Develop a contingency plan at each water supply system to ensure that electric power and chlorine are available all the time.
- Implement a household water disinfection program.
- Develop a permitting/certification system for *tanqueros*, privately owned tank trucks.
- Provide regional water quality laboratories with basic equipment, reagents, and trained personnel for monitoring and controlling water quality throughout the region.

- Convene an inter-agency workshop for the development of a cholera strategy for Ecuador. The strategy should have a regional focus.
- Strengthen the epidemiological surveillance system in order to allow cholera planning and decision-making to be based on risk of vulnerable populations, geographic area, and time of year. This should include the development of a communications plan for hygiene education.
- Train coastal region health educators and health inspectors in aspects of community studies, data analysis, use of epidemiological information, community participation, and education methodologies.
- Prepare and present an inter-agency workshop to review technical alternatives for excreta disposal systems.

## **6. Long-Term Recommendations**

Based on the site visits to Guayaquil, Machala, and Esmeraldas, the following long-term recommendations are applicable:

- Develop a master plan and preliminary design for water supply, treatment, storage, and distribution that will set the goal of supplying potable water to the design population 24 hours a day with less than 25 percent unaccounted-for water. The planning documents should comply with the requirements of international lending institutions, including cost recovery and environmental and public health assessments.
- Develop a master plan and preliminary design for the long-term management of sewage and excreta. The master plan should include the development of water quality goals that are compatible with the water master plan.
- Incorporate true community participation into cholera control and prevention activities.
- Monitor and evaluate the communications plan in order to provide feedback to the hygiene education process.
- Present a water supply and sanitation seminar to explore new approaches to financing and managing public utilities.
- Reform the public administration system at the national, regional, and provincial levels with a focus on creating an enabling environment for decentralization and privatization.
- Implement a latrinization program for urban areas.
- Strengthen the national cholera committee leadership by designating a private citizen to the position of chair.

## Chapter 1

### INTRODUCTION

#### 1.1 Background

The El Tor cholera pandemic, which started in Asia in the 1960s and spread throughout Africa in the 1970s, reached South America in January 1991. Cholera had been absent from South America for over a hundred years. Ecuador became the second country to report cholera in March 1991, when cases appeared in the coastal town of Bajo Alto, a shrimp-farming community near the city of Machala. By the end of 1991, Ecuador had reported 46,320 cases of cholera and 692 deaths, with most occurring in cities and rural areas along the country's Pacific coast. Through the first ten months of 1992, Ecuador reported 30,661 cases with 199 resulting in death. As in 1991, most cases in 1992 continued to occur in the coastal areas of the country.

In early 1992, as part of its efforts to combat the spread of cholera, the Government of Ecuador, through its Ministry of Health, requested material and technical assistance from USAID/Ecuador. A specific request received in February 1992 included assistance for the procurement of chlorine to be used by water utilities in coastal cities facing cholera problems. USAID/Ecuador, in forwarding the request to A.I.D.'s Bureau for Latin America and the Caribbean (LAC) for consideration for funding under regional cholera response funds, also asked that A.I.D. review the technical feasibility of the chlorine request. A.I.D. requested the Water and Sanitation for Health Project (WASH) to participate in this review.

The result of the review was that procurement of chlorine may not be an effective solution to the need for water of adequate bacteriological quality in the cities in the affected coastal area of the country if the integrity of the distribution system is not sound. Breaks in the distribution system lead to infiltration of contaminated water. Moreover, the delivery of disinfected water to the household is no guarantee of safety if the handling of the water in the home leads to contamination as a result of unhygienic practices. Therefore, A.I.D. proposed that, as a preliminary step, a team of water and sanitation specialists should assess the status of the water system in some of the largest cities with cholera problems.

The Ministry of Health and USAID/Ecuador agreed with this approach and requested that a team of two or three persons, funded under the LAC Bureau's regional cholera response funds, carry out the assessment in the fall of 1992 following Ecuador's national elections. A.I.D. requested WASH to carry out the assessment.

## 1.2 Scope of Work

In consultation with the Ministry of Health (MOH) and the Ecuadorian Institute of Sanitary Works (IEOS), USAID/Ecuador informed WASH that four coastal cities were identified for the assessment: Guayaquil, Machala, Manta, and Esmeraldas.

WASH's prior experience in carrying out a cholera assessment in Peru in 1991 was used to develop a detailed scope of work for the Ecuador Water Quality Assessment. The Peru assignment, conducted by two engineers, demonstrated that cholera prevention requires the attention of a number of distinct areas and factors. Their findings led to the development of a set of guidelines for conducting cholera-related field assessments. Entitled *Cholera Prevention and Control: Guidelines for Assessing the Options in Water Supply, Sanitation, and Hygiene Education*, the guidelines present a four-step process that leads to an action plan based on options available to a country. The process takes a multidisciplinary approach which looks at the direct factors that affect cholera—water quality and quantity, excreta disposal, solid waste disposal, and health practices—as well as the indirect influencing factors—community participation, institutional development, human resources development, financial planning, and the legal and regulatory environment.

Basing the scope of work on the cholera guidelines, WASH proposed that a multidisciplinary team consisting of a sanitary engineer, a hygiene education specialist, and an institutional specialist carry out the assignment. The team's work would include the following elements:

- Core descriptive data on cholera in the coastal region of the country
- Water and sanitation coverage in the identified communities
- Agencies and institutions in the water supply, sanitation, and hygiene education sectors
- Assessment of direct cholera transmission factors
  - Water quality
  - Water quantity
  - Excreta and solid waste collection and disposal
  - Hygiene practices: personal, family, and community
- Assessment of indirect influencing factors
  - Hygiene education
  - Community participation
  - Institutional capabilities
  - Inter-agency coordination and collaboration
  - Economic and finance issues

- Legal and regulatory framework
- Data analysis and recommendations
- An action plan based on prioritized recommendations
  - That can have an immediate impact on cholera especially with respect to quality of water consumed
  - That will have a long-term impact on cholera especially with respect to the quality of water consumed

### **1.3 Methodology**

During its three-week visit to Ecuador, the team reviewed relevant background materials and conducted briefings with officials of USAID, the MOH, IEOS, and other agencies involved in cholera activities at the national level. The team also made site visits to three of the identified coastal cities, Guayaquil, Machala, and Esmeraldas. Site visits were carried out by following the scope of work. Each member of the team met with officials in his respective area of emphasis, interviewed technicians engaged in cholera control activities, and made field visits to areas to collect data directly from cholera-affected areas.

Data collection from site visits included water sampling for chlorine residual and bacteriological quality. The sample collection methodology consisted of (1) obtaining samples from water supply sources, streams used as a direct source of water supply by residents who don't have regular water service, finished water from treatment facilities, and, at the receiving end of the network, storage tanks or cisterns; (2) onsite analysis of total and free residual chlorine and pH; (3) collection of a 250-ml sample at each location for fecal coliform analysis. The samples were stored in an ice cooler and were analyzed within 24 hours after collection.

The field equipment used included the following items:

- a portable pH meter,
- a portable Hach colorimeter with digital readout,
- a Millipore portable incubator with power supply for 115v outlet and car cigarette lighter adapter,
- millipore's Melliflex vacuum pump,
- special petri dishes for use with the Melliflex pump,
- nutrient broth ampoules to be injected into the media,
- individually sealed sterilized dilution water bottles, and
- latex gloves.

All the bacteriological equipment and supplies are especially designed by Millipore for field work and use without the need for sterilization.

The methodology for data analysis for water and sanitation issues consisted of drawing conclusions regarding the risk of the population contacting cholera based on two principal pathways: direct ingestion and incidental ingestion. Direct ingestion can be defined as the mechanism by which a person can ingest the *cholera vibrio* by directly drinking and/or eating water and/or food that contain the *vibrio*. Incidental ingestion is the mechanism by which a person can indirectly ingest the *vibrio* by bringing their fingers to the mouth (by smoking, eating, or drinking noncontaminated food or water) with hands contaminated with fecal material that has the *cholera vibrio*. The incidental ingestion scenario is also applicable for children who suck their fingers after being in contact with human feces. In the evaluation of risks from a water and sanitation perspective, it is assumed that if fecal coliform bacteria are present, then the *cholera vibrio* can also be present.

Health and hygiene education data were collected through interviews with provincial and municipal health officials, through direct interviews with people living in communities considered at risk, as well as through unobtrusive observation of their behavior. Institutional data were collected mainly through interviews with officers of the various provincial and municipal institutions involved in the delivery of water and sanitation services, and the review of studies, reports, and other documents.

The approach adopted by the team was to map out each municipal area visited in terms of (1) the quality of water delivered to city residents by its existing treatment facility and distribution system; (2) the incidence of cholera throughout the water distribution system and whether it varied by area within the system; (3) the hygiene education activities relative to the incidence of cholera throughout the distribution system; and (4) the amount of institutional collaboration among agencies involved in cholera prevention and control activities and whether or not they were addressing/targeting areas of greater risk. The idea was to develop an overview of the water system and the quality of water being delivered, and of the incidence of cholera throughout the distribution system and what was being done about it.

Visits to the three cities were for three to four days. At the end of each visit, a debriefing was held during which the team presented its preliminary observations and recommendations to provincial health officials, municipal water and sewage utility officials, and provincial representatives of IEOS. Before departing Ecuador, the team debriefed the Ministry of Health, the National Cholera Committee, IEOS, and USAID/Ecuador.



## Chapter 2

### CHOLERA IN COASTAL ECUADOR

#### 2.1 Introduction

The assessment team visited three cities on Ecuador's coast. A general description of the cholera situation in each city is presented in the following sections. Also provided is some introductory information on the institutions visited during the assessment.

#### 2.2 Guayaquil

The onset of cholera in Guayaquil occurred in March 1991. As the number of cases rapidly increased, government institutions, private organizations, and the mass media mobilized efforts to combat the impact of the disease. A provincial cholera committee was a product of these efforts.

During March 1991, 268 cholera cases were reported in Guayas province, of which 193 cases were reported by the city of Guayaquil (the largest city in the province). The year 1991 ended with 14,951 cases in all of Guayas province (32 percent of the country total), with an incidence rate of 509 per 100,000 population. The city of Guayaquil alone reported 7,545 cases (50 percent of the total for the province) with an incidence rate of 411.1 per 100,000 population.

The remaining areas of the province, which are rural, reported 6,823 cases (46 percent of the total for the province), with an incidence rate of 653.3 per 100,000 population.

In Guayaquil City, the areas most affected were the south and center, which are characterized by squatter settlements with inadequate coverage of basic services such as water, excreta disposal, and sewage and solid waste disposal. The population of the central area is heterogeneous in nature as it contains both a commercial zone as well as residential dwellings. Although sewage and piped water systems are in place, the supply of water is irregular. Some days water service is unavailable during the entire 24-hour period. Provision of water by tank trucks constitutes the usual method of water supply where piped service is irregular or nonexistent.

The groups most frequently affected by cholera are those above the age of 15 years (74 percent of total cases for the province and for the city of Guayaquil) and males (61 percent of the total for the province, with no figures available for the city of Guayaquil). Data provided by the Provincial Statistics Department are not disaggregated by age, occupation, or work activities.

Overall mortality for the province is 4 per 100,000 population, with a death rate of 1 percent. For the city of Guayaquil, overall mortality is 3 per 100,000 of population with a death rate of 1 percent. These rates are acceptable in accordance with PAHO/WHO parameters. Some

rural cantons (a political jurisdiction analogous to a county) are reflecting cholera mortality rates of 27 per 100,000 population.

The current status for 1992 reflects a level of approximately 2,000 fewer cases than in 1991. As of week 44 of the year, the entire province had 11,558 cases, which represents 38 percent of the cases for the entire country (see Figures 1 and 2). For the entire Guayas province, the incidence rate was 393.5 per 100,000 of population while the city of Guayaquil reported 6,107 cases (53 percent of the provincial total), with an incidence rate of 332.7 per 100,000. The cantons outside Guayaquil reported 5,451 cases (47 percent of the provincial total), with an incidence rate of 495 per 100,000.

In 1992 in those geographic areas most affected by cholera, the composition of the affected population groups by sex and age is very similar to that reported in 1991. However, compared to 1991, the overall mortality rate from cholera appears to have decreased considerably at the canton level, with El Triunfo, Salinas, and Samborondon the only cantons that continue to reflect high rates as compared to the rest.

The incidence of cholera follows a seasonal pattern. Levels were the highest during the December to March rainy season and lowest during the dry season.

Risk factors identified by health authorities are contaminated water and food sold by street vendors. A major additional factor currently identified is the onset of the rainy season. However, since each of the above-mentioned elements is characterized by different phases, which could be affecting the transmission of cholera, there is a need to pinpoint causality and to define it in more specific terms.

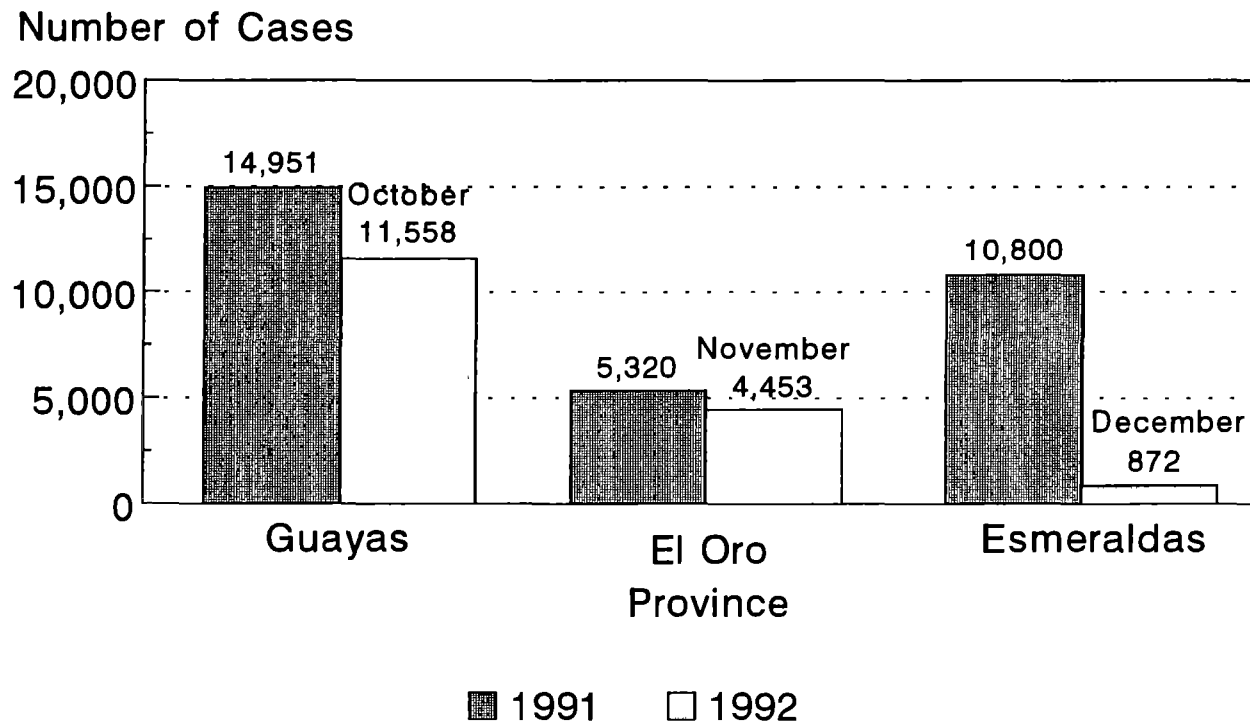
In response to the outbreak of cholera in 1991, many organizations, both public and private, mobilized resources to combat the disease although no evaluation was made of the degree of impact that each may have generated. The Ministry of Health intensified its activities related to the supply of inputs for oral or intravenous rehydration, training of personnel in case management, and preparation of health center facilities to handle the demand created by the increased number of cholera cases. All these measures have been effective, as reflected by the low mortality rates. In addition, a great deal of information was disseminated through the Ministry of Health's education department using mass media, including radio, television, and some printed materials.

In 1992, the cholera problem did not constitute the only priority for Ministry of Health authorities. In addition to cholera, the Ministry of Health focused on dengue, malaria, AIDS, and rabies. Currently, the possibility that the cholera problem is now under control is gaining credence.

The 1992 Ministry of Health work plan for the Guayas Province for cholera activities was oriented toward the training of institutional resources, procurement of the necessary supplies for treatment of cases, establishment of oral rehydration units at the community level. In addition, the development of an Educational Plan is anticipated, which will include numerous

**Figure 1**

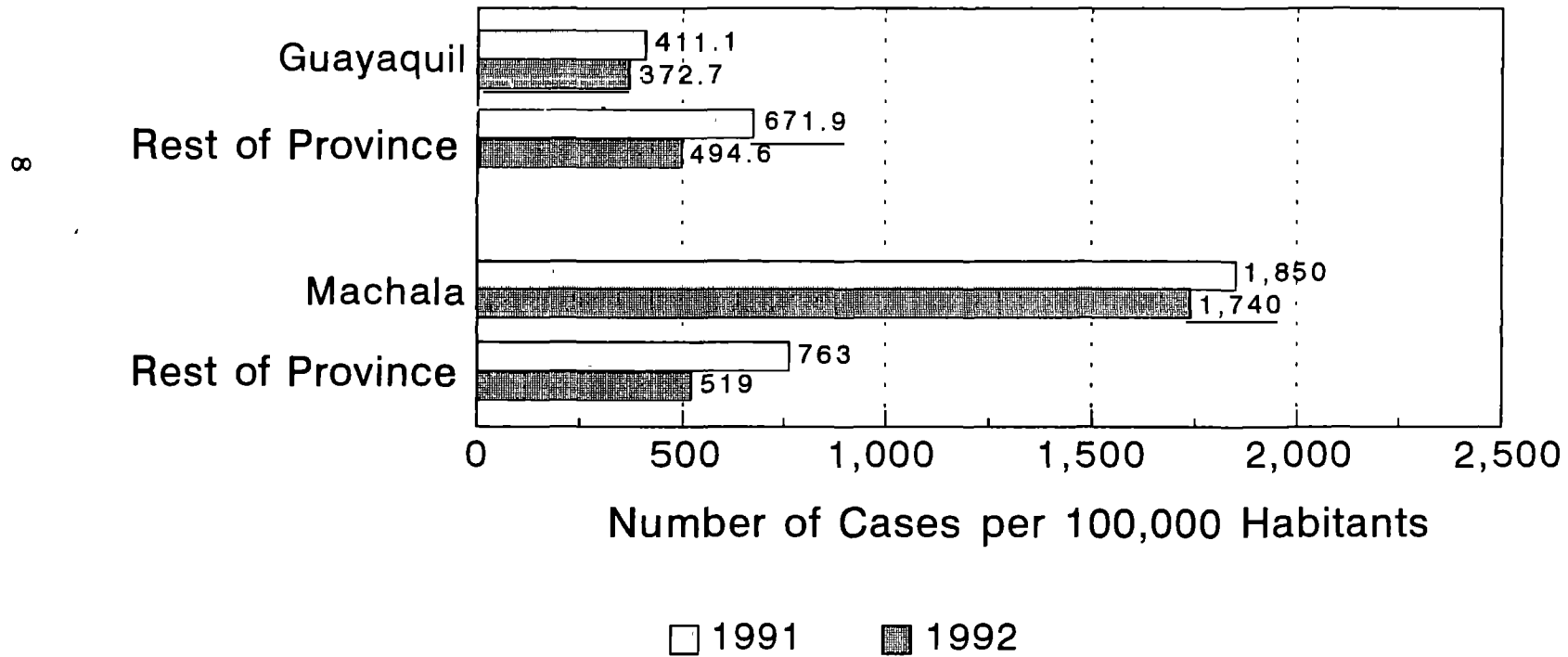
**Cases of Cholera by Province  
1991-1992**



Source: Provincial Department of Statistics  
Provincial Department of Epidemiology

## Figure 2

### Incidence of Cholera by Urban and Rural Area 1991-1992



Source: Department of Statistics, Provincial  
Department of Epidemiology, Provincial

government institutions, although it will lack a complementary community participation element.

Several organizations are constructing excreta disposal systems and water systems, but solely in rural areas. Among these organizations is IEOS, which, however, has little capability for coverage, concentrating mainly on providing designs for single pit and hydraulic seal latrines. Currently, IEOS has suspended all activities in the province due to lack of budgetary support. IEOS has contracted with private firms to build latrines in urban areas. However, to date none have been built, and IEOS has asked the firms to return the unspent advanced money, a request that remains unsettled.

There are no programs aimed at providing wide-scale technical solutions for excreta disposal in urban areas. The exceptions are international agencies such as Children International, which operates a few child day care centers, and health and dental clinics in some of the poorer neighborhoods of the city and has built latrines for the families of the children enrolled in the day care program.

CARE International has been collaborating in the construction of excreta disposal systems in one of the major cantons although the coverage they provide is low compared to demand. For instance, 600 latrines are to be built in a canton with 36,877 people and no previous latrine program.

Preventing death from dehydration and developing a hygiene education component are the primary approaches for dealing with the cholera problem. No obvious actions are being directed toward the prevention of risk factors that facilitate the transmission of this disease.

Some research activities have been carried out on cholera in the city of Guayaquil to look into epidemic outbreaks in certain rural areas, the resistance of *Vibrio cholerae* to various antibiotics, intra-hospital management of cholera cases, and the information system for epidemiological surveillance. This research has been performed largely by Ecuadorian personnel and, in some cases, with collaboration provided by the Centers for Disease Control (CDC) in Atlanta.

The principal findings of these studies show that:

- The problem of cholera in Guayaquil is concentrated in marginal urban areas lacking sanitary infrastructure and an adequate water supply in terms of both quality and quantity.
- The cause of outbreaks in rural areas was the contamination of wells by latrine seepage and rain runoff.
- Hospital-based management of cases had improved toward the end of 1991 although an exaggerated use of both intravenous rehydration solution and antibiotics had been observed.
- *Vibrio cholerae* is resistant to different antibiotics due to the indiscriminate use of self-medication as well as to the massive application of chemical prophylaxis.

- Motivating health personnel to remain active with surveillance activities may become a problem. Notification forms are not being consolidated, and the time stipulated for notification is too long. No analysis of information is being carried out at the local level, nor is there an adequate feedback system.

### **2.3 Machala**

Cholera first entered Ecuador through the community of Bajo Alto, a shrimp farming community in the canton of El Guabo. The first cases appeared in March 1991, specifically during week nine.

Cholera then spread rapidly among other cantons in El Oro. After August, the epidemic diminished considerably and leveled off at a steady rate of transmission. By the end of 1991, a total of 5,328 cases and an incidence rate of 1,110 per 100,000 of population were reported, affecting primarily the cantons of Machala (which contains the province's capital city, Machala), which had 63 percent of the total cases in the province and an incidence rate of 1,850 per 100,000 of population; Guabo, with 11 percent of the province total and an incidence rate of 2,220 per 100,000 of population; Santa Rosa, with 10 percent of the province total and an incidence rate of 850 per 100,000 population; and Pasaje, with 14 percent of the province total and an incidence rate of 130 per 100,000 of population. The latter three are classified as rural areas and reflect an incidence rate of 763 per 100,000 of population for the entire rural area (see Figure 3).

Seventy-seven percent of the cases occurred in the population above the age of 15 although no data is available on the sex or occupation of those individuals most frequently affected. The disease is seasonal in nature, with an increase in the number of cases occurring between the months of January and June, which also is the season of greatest rainfall. The rate of transmission decreases in the dry season.

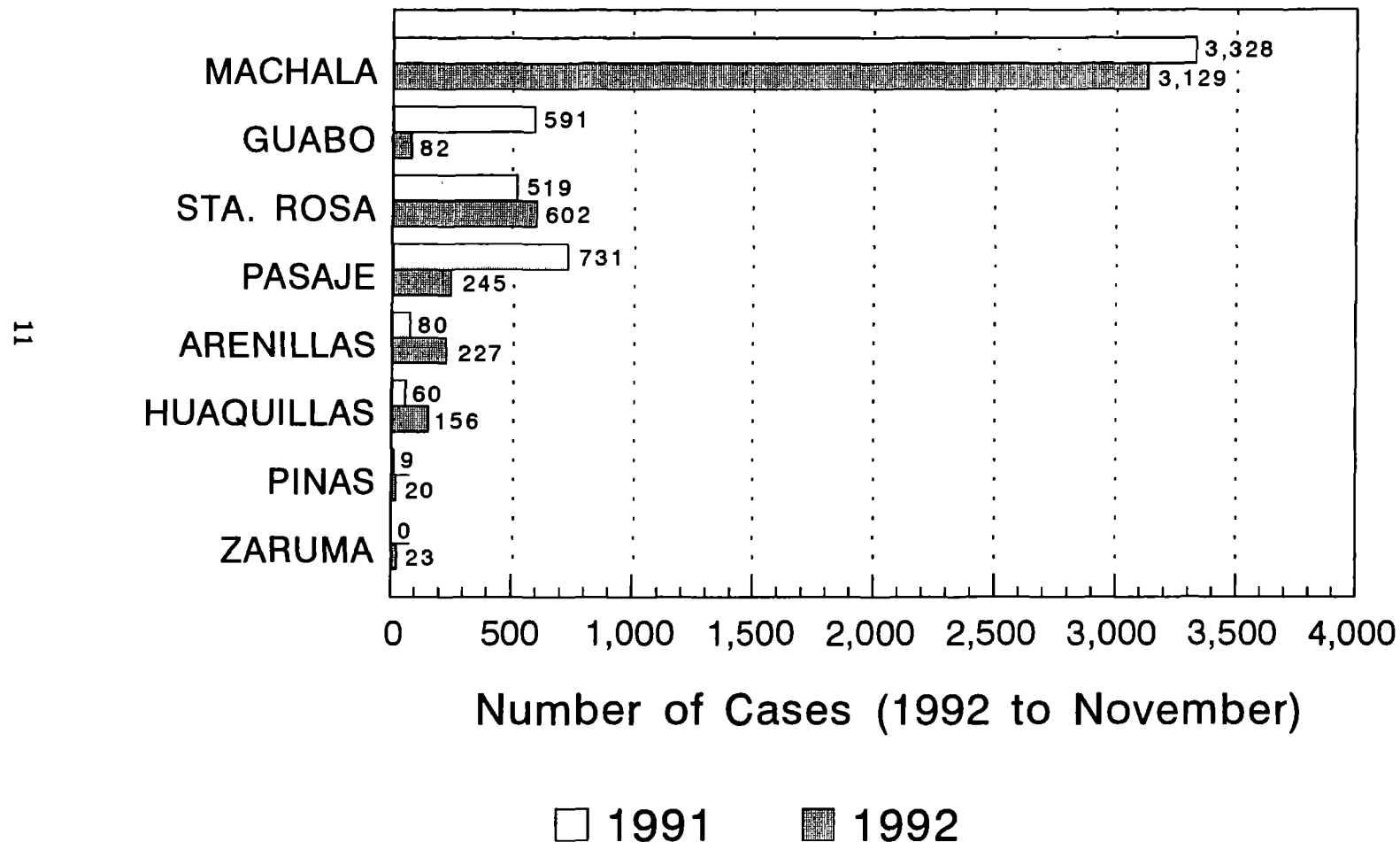
The incidence rate in 1992 was very similar to that in 1991, with a difference of approximately 100 fewer cases in 1992 as compared with the same week (46) of 1991. In 1992, among cantons, only El Guabo experienced a considerable decrease in incidence rate; whereas, by contrast, the rate doubled in other cantons. Moreover, some cantons that did not report any cases in 1991 are now reporting, which means that the number of cases remains stable for the province as a whole but that the problem is spreading over a much larger geographical area (see Figures 1 and 3).

Mortality in 1991 reached a level of 0.4 percent for the province as a whole, although some of the rural cantons showed a rate of 11 percent. For 1992, the number of deaths was the same as for the preceding year.

Health authorities believe that the major risk factors affecting the transmission of cholera are water and itinerant (street) vendors. However, regarding both factors, no determination has been made as to when contamination occurs. It could occur during the distribution of water,

### Figure 3

## Cases of Cholera in Population Centers of El Oro Province 1991-1992



Source: Department of Epidemiology, Provincial

the storage of water, or the handling of water or food. The approach taken to address the problem is very general, which makes it difficult to develop well-directed strategies.

In 1991, a series of activities designed to disseminate information was carried out. The mass media met with street peddlers, restaurant owners, office clerks, merchants, and schools in order to deliver messages to these groups. Flyers were distributed and information was broadcast by loudspeaker. But during 1992 these activities have almost completely disappeared. The principal activity continues to be the Control of Diarrheal Diseases (CDD) program, which includes cholera. The CDD program consists mainly of supplying inputs (oral rehydration salts) to the various health care organizations, training them in the management of cholera cases, and installing Oral Rehydration Units (ORU) in neighborhoods and communities.

Among other activities carried out were follow-up talks provided to ORU staff, talks aimed at street vendors, loudspeaker messages broadcast in those communities most affected, and distribution of chlorine and aerosol for residential disinfection. During carnival, flyers were distributed, loudspeaker messages were broadcast, and music was directed to tourists at the beaches. An agreement was subsequently finalized between CARE and IEOS for the construction of 1,200 latrines in the canton of Santa Rosa where the population is 60,957.

There was also a training plan for institutional resources in topics related to community participation. However, this plan could not be implemented due to a lack of financing.

The idea of distributing chlorine for residential use is very good provided it is supported by community-based training and follow-up plans. Chlorine distributed in 1991 was used most often for whitening clothes or was sold; it was not used to purify drinking water.

It should be noted that the Ministry of Health's primary activity is aimed at the prevention of deaths from dehydration. Disease prevention activities, however, are seldom seen. Construction of sanitary facilities, mainly latrines, occurs primarily in rural areas. There are as yet no latrinization programs underway in urban areas.

## **2.4 Esmeraldas**

Esmeraldas, located on Ecuador's northwest coast, is the capital of the province of Esmeraldas. Although the province is coastal, it falls under the jurisdiction of the Under-Secretariat for Health in the Sierra headquartered in Quito and not that of the Under-Secretary for Health in the Coastal Region in Guayaquil.

Cholera cases first began to appear in April 1991, and in subsequent months their number increased rapidly. The urban area most affected was the canton of Esmeraldas. The most affected rural areas were the cantons of Quinindé, Muisne, Eloy Alfaro, and San Lorenzo.

A slight decrease in the number of cases was observed during August although there was a further increase by the end of 1991. The total number of cases recorded in the entire province was 10,500. Unfortunately, it was not possible to obtain 1991 data by neighborhood for the



city of Esmeraldas nor for the rural areas by canton because the necessary information had not been processed and analyzed.

Through December 11, 1992, the number of cases recorded for the entire province was only 872. Sixty-three percent of the cases occurred in the canton of Esmeraldas, with an incidence rate of 280 per 100,000 population, and 37 percent occurring in the rural area, with an incidence rate of 233 per 100,000 population.

During 1992, the disease remained stable in Esmeraldas, with a low rate of transmission and a slight increase recorded during March. Health authorities consider water and itinerant food vendors to be the primary risk factors.

The population group most affected consists of individuals over 15 years of age. Although this group is the most affected, its mortality rate is similar to the rate for individuals younger than 15. The mortality rate was 0.35 percent for the province as a whole in 1992.

During 1991, a Cholera Committee, made up of a number of public and private organizations, was established. The committee carried out a large number of activities designed to disseminate information. However, this committee was not active in 1992.

In 1992, the primary anti-cholera activities were based on a provincial plan entitled "Prevention and Clinical Management for Cholera Patients." The principal activities covered in this plan included strengthening of epidemiological surveillance; training of institutional staff in the management of cholera cases; educational visits to food vendors, both in street stalls as well as restaurants; meetings with health center staff to review the Manual of Cholera Standards and develop an educational program; the organization of ORUs; and broadcasting of messages by loudspeaker in the marginal neighborhoods of Esmeraldas.

This plan did not specify a methodology to be followed to implement the activities nor did it provide for the intervention of other organizations.

In all three of the provinces visited, an increase in cholera cases coincides with the onset of the rainy season although it also coincides with festive, religious, vacation, and labor activities.

## **2.5 Organizations Involved in Cholera Activities**

Several principal institutions involved in cholera activities either directly or indirectly were visited during the assessment. These included the municipal water and sewage utilities, the Ministry of Health at the national level as well as at the regional and provincial level, and the Ecuadorian Institute for Sanitary Works (IEOS) at the national and provincial levels.

### **2.5.1 Water and Sewage Utilities**

*Empresa Provincial de Agua Potable del Guayas (EPAP-Guayas):* EPAP-Guayas provides service to the Guayas Province, an area of 20,500 km<sup>2</sup>. It reaches 1,517,600 inhabitants in a total population of 2,515,500 in its service area, which represents 60 percent service coverage. The utility employs a full-time staff of 1,462 and produces an estimated 440,000 m<sup>3</sup> of water per day. EPAP-Guayas' principal service area is the city of Guayaquil.

*Municipalidad de Machala, Departamento de Agua Potable:* The water department of the municipality of Machala provides service to 25 percent of the city's 145,000 people through its piped distribution system. The balance of the population receives service through tanker deliveries. The department produces about 12,960 m<sup>3</sup> per day and employs 95 full-time workers. The municipality, through the same department, provides some sewage service. The Provincial Council and IEOS also provide some sewage service.

*The Empresa Municipal de Agua Potable y Alcantarillado (EMAPYA):* EMAPYA is located in the city of Esmeraldas. The utility provides water to about 60 percent of the city's population of 174,000. Sewer service is provided by EMAPYA to only 30 percent of the population. However, some sewer service is provided to part of the city by IEOS (see Chapter 3). EMAPYA employs 145 full-time workers.

*The Empresa Municipal de Alcantarillado de Guayaquil (EMA):* EMA-Guayaquil provides sewage service to the city of Guayaquil and some of the surrounding rural regions, an area of 235 km<sup>2</sup> and a population of 1.6 million. The service covers about 60 percent of the population, or just over 1 million people. EMA employs a full-time staff of 650 and collects an estimated 141,000 m<sup>3</sup> of wastewater per day.

### **2.5.2 Ministry of Health**

The Ministry of Health (MOH) is the leading institution in Ecuador regarding control and prevention of cholera. The MOH is a centralized institution with major decisionmaking authority residing at the national level in Quito. There are three regional subsecretariats, the Sierra, the Coast, and the Orient. Guayaquil and Machala pertain to the coastal subsecretariat, and Esmeraldas pertains to the Sierra subsecretariat. Finally, there are directorates for health in each of the country's 21 provinces. In terms of cholera control, the MOH's director general at the national level chairs the National Cholera Committee. The National Cholera Committee is replicated at the provincial level.

### **2.5.3 Ecuadorian Institute for Sanitary Works**

IEOS was created in 1965 as a normative agency to oversee the development of water supply and sanitation services in the country. IEOS was also charged with assisting provinces and municipalities in developing public utilities to operate water and sanitation services. The institution's central responsibility was to prescribe and enforce standards for water supply and

sanitation projects, both in construction and operations. IEOS was originally ascribed to the Ministry of Health and remained under the auspices of the MOH until 1992 when it was moved to the newly created Ministry for Urban Development and Housing.

The law controlling IEOS, which was first amended in 1975, added planning, constructing, equipping, and maintaining health establishments throughout the country to the institution's responsibilities. A 1979 presidential decree established the Subsecretariat for Environmental Sanitation of the MOH to provide technical and administrative direction to IEOS. In 1992, the Subsecretariat for Environmental Sanitation was transferred from the MOH to the new Ministry of Urban Development and Housing. Administrative arrangements remain unchanged with the subsecretariat at the national level and provincial headquarters in each of the 23 provinces.



## Chapter 3

# WATER AND SANITATION SYSTEM

### 3.1 Introduction

This section summarizes the water supply and sanitation (WS&S) characteristics of Guayaquil, Machala, and Esmeraldas based on information gathered during the visit to these three urban centers in coastal Ecuador. In general, data were gathered from sampling and analysis of water used in the water supply and distribution systems; information gathered regarding the areas of water, sewage, and solid waste management practices from local agencies involved in WS&S; and observations, field inspections, and surveys of the study area.

### 3.2 Assessment of Guayaquil

#### 3.2.1 Water Supply, Treatment, Storage, and Distribution System

The source of all water supplied by the municipality in Guayaquil comes from the River Daule, located about 30 kilometers north of the city. Raw water is taken from the river and pumped via three force mains 1,500, 1,250, and 1,050 mm (60, 52, and 42 inches) in diameter, respectively. Water is treated at one regional water treatment facility known as La Toma Water Treatment Plant (WTP). This facility uses conventional water treatment processes consisting of pH adjustment (lime), coagulation (aluminum sulfate), sedimentation, filtration, and disinfection (with chlorine gas applied at a dosage of 4.5 mg/l or 2,250 kilograms per day). This plant was originally built in 1950 with a capacity of 180,000 m<sup>3</sup>/day (47.6 mgd). Subsequent plant expansions in 1968 and 1988 increased the capacity to 520,000 m<sup>3</sup>/day (137.4 mgd). Currently, the WTP is undergoing an expansion that will elevate its capacity by the end of 1993 to 630,000 m<sup>3</sup>/day (166.4 mgd). In addition, a new WTP is being built at an adjacent site that will have a capacity of 864,000 m<sup>3</sup>/day (228.3 mgd). If the funding process for the new construction is not interrupted, this new WTP could be completed by the first quarter of 1994.

From the La Toma WTP, the treated and disinfected water is conveyed by gravity to three reservoirs in the north sector of town where water is distributed to three sectors or districts (the north, center, and south). Most of the north sector receives treated water by spur connections from the three main aqueducts. The existing reservoir capacity in the system is 110,000 m<sup>3</sup>. A schematic diagram of Guayaquil's water system is shown on Figure 4.

Currently, the water demand exceeds the capacity of the system and only about 80 percent or 2.2 million of the 2.7 million people in Guayaquil and its suburbs receive potable water. However, of the people receiving water, only about 70 percent are served by the distribution network. The remaining 30 percent of the population that receives municipal water is served

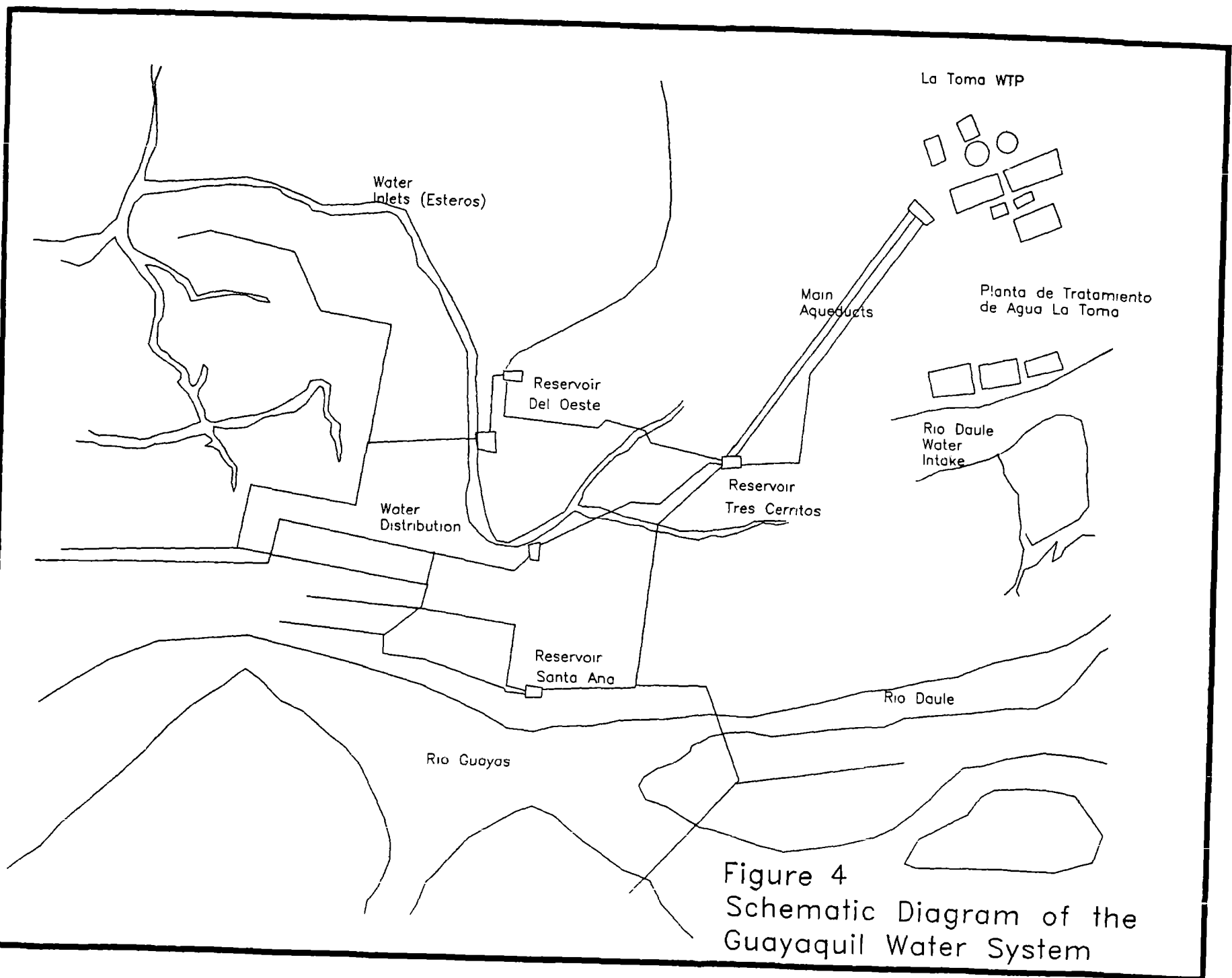


Figure 4  
Schematic Diagram of the  
Guayaquil Water System

by tanqueros that fill containers provided by the users (typically 55-gallon metal drums) or underground tanks or cisterns. There are about 400 tanqueros with capacities ranging from 7 to 10 m<sup>3</sup> of which 7 m<sup>3</sup> is the most common size. Each unit is allowed to make a maximum of seven trips per day.

The municipal water service is currently operating 24 hours a day in the north sector only. The center and south sectors of Guayaquil receive water an average of about 10 and 4 hours a day, respectively. Many users have pumps connected to the water services pipes of the network to pump water to their homes when the pressure is low or when service is cut off. Most of the distribution system is made up of old cast iron pipes installed more than 30 years ago.

### **3.2.2 Sewage Collection, Treatment, and Disposal**

In Guayaquil, less than 50 percent of the population is served by collection sewers. The wastewater collected is discharged untreated to the Guayas River, which flows into the Pacific Ocean. In areas not served by sewers, residents use substandard septic tanks and latrines that in most cases are in direct contact with the water table aquifer. In some areas near the water inlets, the residents built a hole in the elevated dwelling floor and discharged excreta directly to the water bodies. In addition, the visiting team was informed that some residents may defecate in newspapers and throw them in the garbage or in the backyards or adjacent lots.

### **3.2.3 Solid Waste Collection and Disposal**

Solid wastes collection is provided by the municipality by compactor trucks of about 20 cubic yards. In addition, due to lack of equipment, the city of Guayaquil subcontracts the services of private contractors that use open dump trucks. It was observed that sanitation workers operate without the necessary clothing protection and in most cases use bare hands to handle the waste containers or waste.

Solid waste is disposed of in an open/semi-covered landfill at which people are allowed to walk around and search through garbage piles. Hundreds of men, women, and children were observed during a site visit. Thousands of *gallinazos* (vultures) and other birds are also found feeding off the garbage piles. Parts of the landfill are covered with earth. There are several dwellings within a short distance (20 to 100 meters) of the waste disposal areas. Water is supplied by tanqueros in those dwellings.

### **3.2.4 Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation**

#### *Potential Water Quantity Pathways*

As previously mentioned, the water demand in Guayaquil exceeds the current supply capabilities in the area of treatment, storage, and distribution. Water service is available to about 80 percent of the population of Guayaquil of which about 70 percent is served by the water distribution system and the remaining 30 percent is served by tanqueros. Of those residents receiving water from the municipal distribution system, only those in the north sector have service 24 hours per day. In the central and southern sectors of town served by the water distribution system, water is available in the pipes only 10 and 4 hours per day, respectively.

Residents in areas served by the water distribution network have more water available for use than those residents in areas served by tanqueros. For instance, of an estimated 500,000 m<sup>3</sup>/day treated at the La Toma WTP, only about 22,400 m<sup>3</sup>/day are served to residents via tanqueros. As shown in Figure 5, this represents only 4.5 percent of the treated water supplied to 30 percent of the population served by the system.

The systems under construction at the time of this study will expand the treated water capacity by about 184 percent within three years. However, it will take longer to build the replacement networks and new distribution system needed to get the water to the users and reduce the unaccounted for water from 60 percent to less than 20 percent.

#### *Potential Water Quality Pathways*

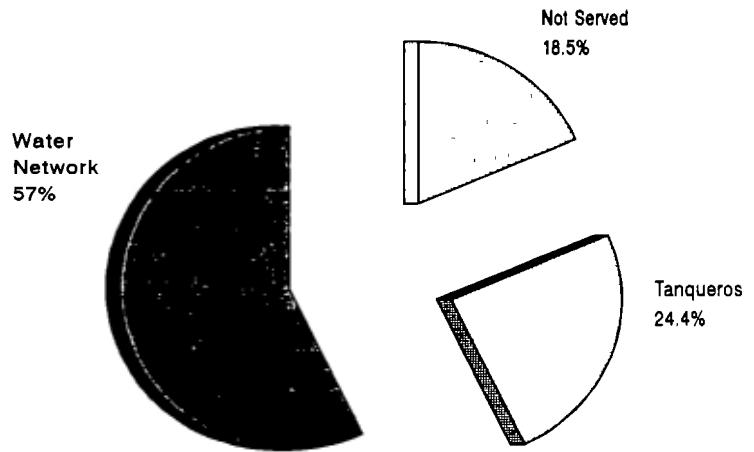
The site-specific parameters used to measure water quality in the study area included total and residual chlorine and fecal coliforms. The total and residual chlorine levels are used to measure the level of disinfection found in the water being analyzed. Typically, in the sanitary engineering practice, water supply systems should maintain at least one mg/l of free available chlorine residual in all areas of the water distribution network and at no time should it drop below 0.5 mg/l. The presence of fecal coliforms in the drinking water is an indicator that the water does not have the proper level of disinfection and that it has come in direct or indirect contact with human feces. The results of the site-specific sampling for these two parameters are shown on Figure 6. A description of the sampling points is presented in Appendix A. Coliform bacteria were detected in 55-gallon drums and cisterns used for water supply. The locations also correspond to those having low or no chlorine residual.

The water quality of the treated water from La Toma WTP is good and has adequate levels of chlorine residual. However, water quality deteriorates in the distribution system. The following factors contribute to the declining water quality:

- Interruption of water supply or loss of pressure. Contaminated water enters the water pipes when a negative pressure is created by suction pumps or loss of water in the pipe. Users ingest contaminated waste directly or by incidental ingestion.



# Population Receiving Potable Water in Guayaquil



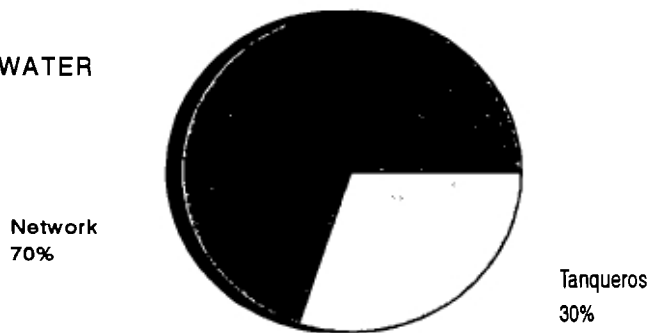
## DISTRIBUTION OF MUNICIPAL WATER IN GUAYAQUIL



500,000 m<sup>3</sup>/day

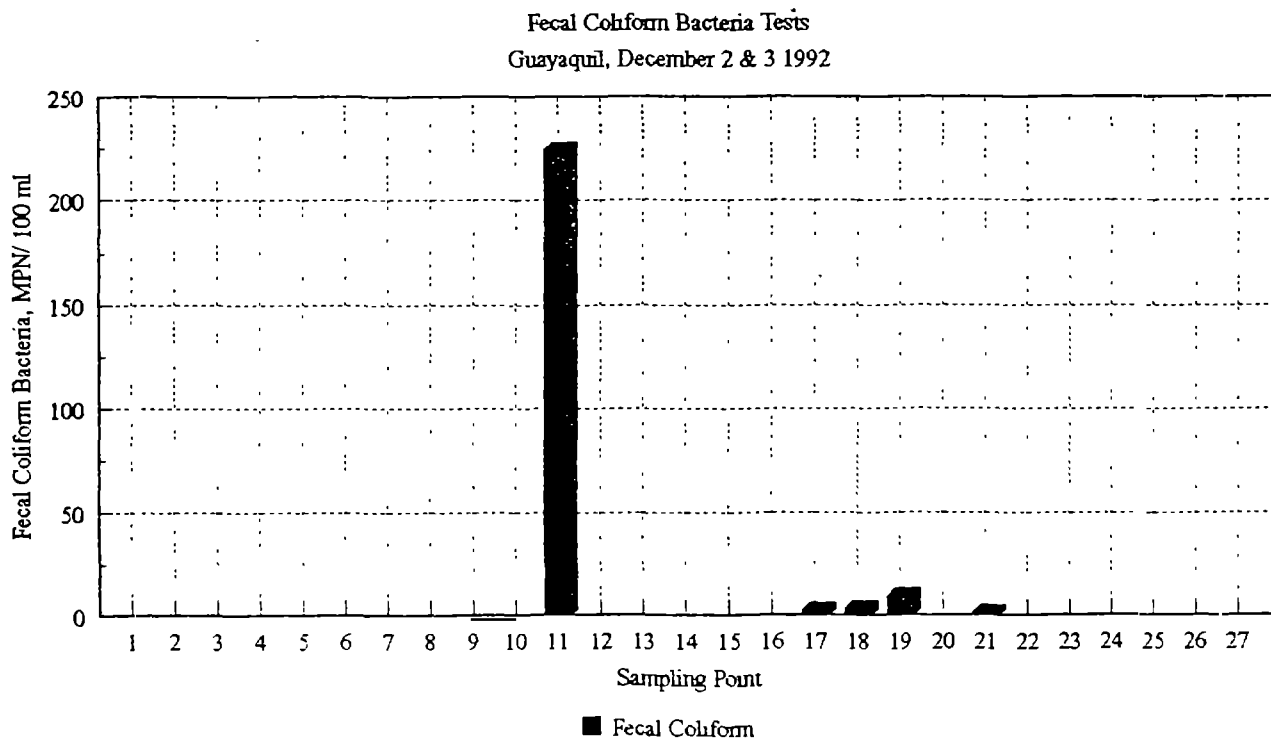
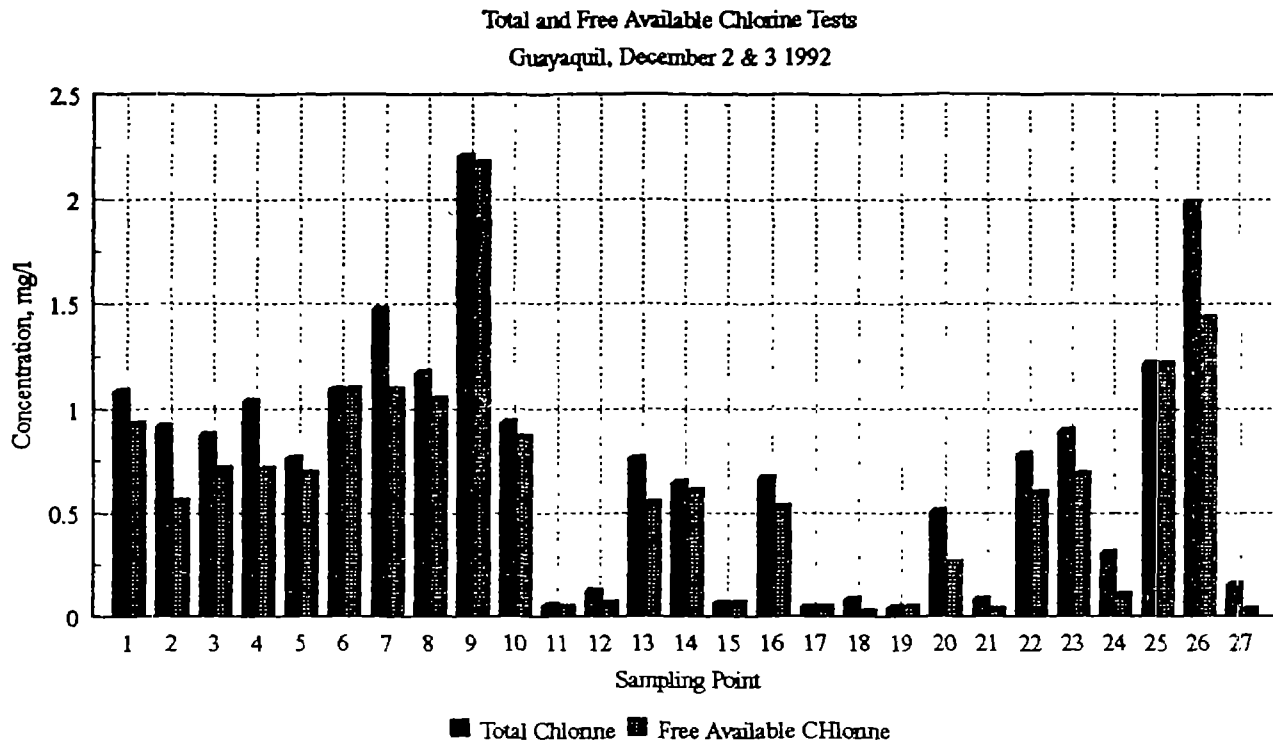
The amount of water distributed by tanqueros is based on 400 tanqueros at 8 m<sup>3</sup>/tank, 7 trips/day

## POPULATION SERVED BY PUBLIC WATER IN GUAYAQUIL



2.2 million people receive potable water from a total population of 2.7 million

Figure 5



**Figure 6 Sampling Results for Guayaquil**

- Overnight storage of water in 55-gallon tanks or cisterns results in loss of the chlorine residual. Coliform bacteria were detected in these types of storage systems. Therefore, a complete pathway of contamination via ingestion of water contaminated with fecal matter is possible.
- Containers used to get water out of 55-gallon tanks or cisterns may contaminate the water remaining in the storage facility. Because of poor hygiene practices, hands or containers contaminated with fecal matter are introduced in the storage tank.
- The population at risk of contracting the *vibrio cholerae* by ingestion of contaminated water is estimated at more than 50 percent. Higher risk areas include zones served by tanqueros, the south sector of town, the center sector, particularly areas of low pressure where people use suction pumps, and areas where residents use nonpotable water.

#### *Potential Wastewater Pathways of Contamination*

Wastewater discharged untreated from the city sewer into the Guayas River and other esteros (salt water inlets) releases fecal matter into all waterways around the city. In addition to the point sources that are discharged directly into the waterways, there are wastewater nonpoint sources of fecal matter derived from groundwater and storm runoff derived from improperly designed onsite systems such as latrines and septic tanks. The main factors attributed to a potential completion of the ingestion of food and water contaminated with fecal matter are as follows:

- Poor hygiene practices in the manipulation of fecal matter can result in a case of incidental ingestion.
- Uses of contaminated water from the waterways for bathing and washing clothing can result in incidental ingestion of fecal matter contaminated with the *vibrio cholerae*.

#### *Potential Solid Waste Pathways of Contamination*

The solid waste disposal site is partially an open air dump and a landfill. The waste material is not covered fast enough. In addition, several hundred people scavenge materials inside the uncovered waste. This population is at risk of coming in contact with cholera infected excreta that can be found in the waste and contracting the bacteria via incidental ingestion. Incidental ingestion can occur by eating, smoking, or taking the fingers into the mouth after the fingers are infected with the *vibrio cholerae*.

### **3.3 Assessment of Machala**

#### **3.3.1 Water Supply, Treatment, Storage, and Distribution**

Currently, the water supplied to the inhabitants of the city of Machala comes from three sources:

- Canal El Macho, which supplies 12,400 to 13,000 m<sup>3</sup>/day of surface water for treatment at the La Lucha Water Treatment Plant (WTP).
- Rio Casacay, which supplies the Regional WTP, which in turn currently supplies Machala about 6,900 m<sup>3</sup>/day.
- Corralitos and Diez de Agosto wells, each with a capacity of 4,320 m<sup>3</sup>/day.

Three additional water supply wells were out of service at the time of the visits. These are the Pubenza, Union, and Naranjos wells with capacities of 13,000; 8,640; and 5,200 m<sup>3</sup>/day, respectively. The Pubenza and Union wells need to have the pumps repaired. The Naranjo well seems to have installation or development problems, produces sediment extraction, and is perhaps not repairable.

The only water treatment facility that provides a marginal treatment is the La Lucha WTP. Other wells and the Regional plant supply only raw water that is not treated or disinfected. The La Lucha WTP uses lime addition for pH adjustment, flocculation with aluminum sulfate, sedimentation in a shallow bed sedimentation basin, and chlorine gas disinfection. The sand filters have been out of operation for more than two years. The plant does not have a laboratory for testing water quality for determining chemical dosages. All chemicals are fed by operator's estimates. The average chemical additions at this plant include the following:

- Lime = 0.65 mg/l,
- Aluminum sulfate = 15 mg/l, and
- Chlorine gas = 2.3 mg/l.

The Regional WTP is part of a water supply project that has been under construction for more than 12 years. Phase 1 of this WTP has a capacity of 86,400 m<sup>3</sup>/day. The plant is built but is not operational. It is estimated that 3,500 to 4,000 million sucres (1.9 to 2.15 million US\$) are needed to make this plant work properly. The construction activities are expected to take one year after the financing is secured.

The only water storage facilities in the system are at the Regional Plant and at the Puerto Bolivar Pumping Station. The water distribution system is very old. A schematic diagram of the Machala water supply system is presented on Figure 7.

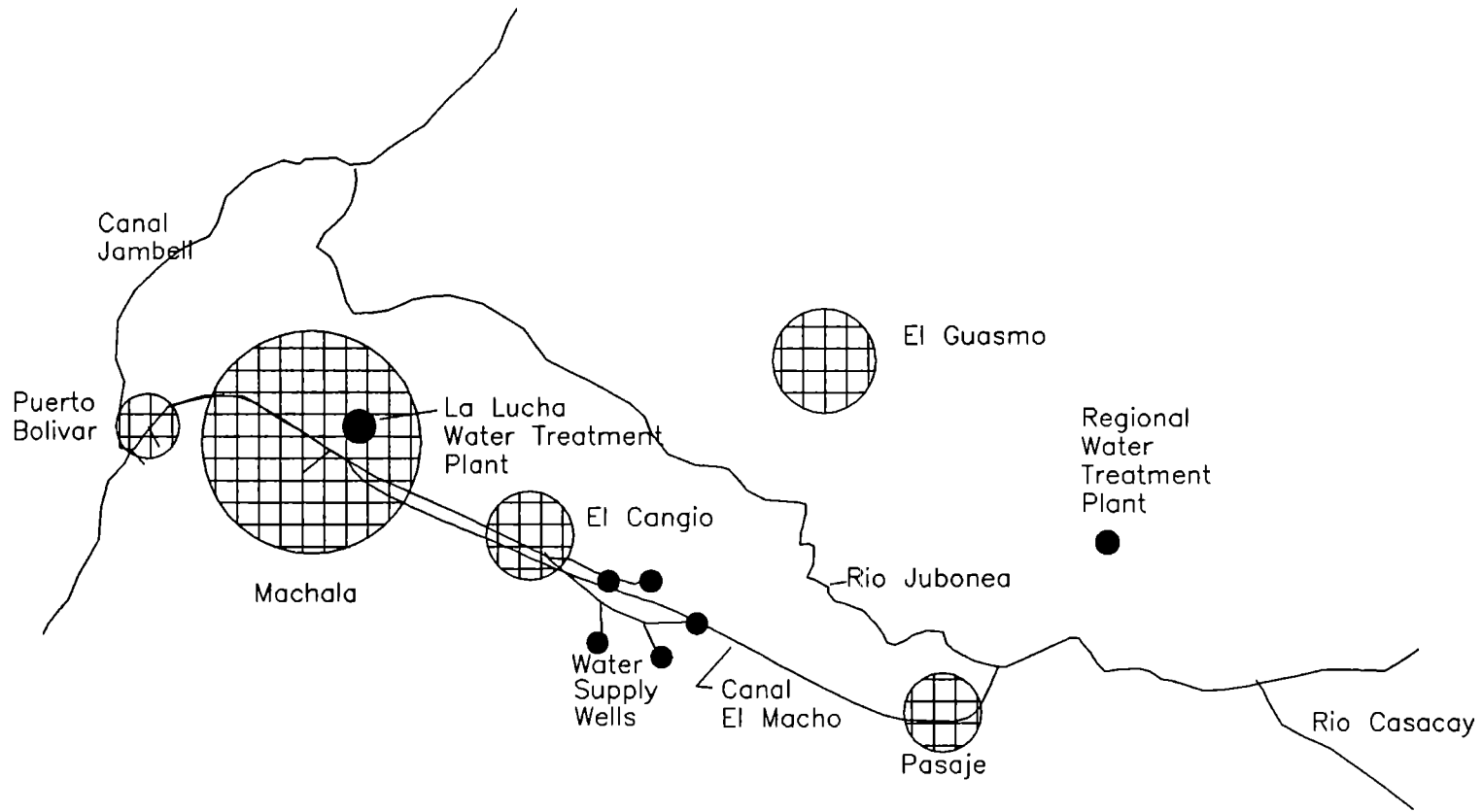


Figure 7 Schematic Diagram of the Machala Water System

### **3.3.2 Sewage Collection, Treatment, and Disposal**

The city of Machala does not have accurate drawings of the sewer collection system. According to sources interviewed in the municipality, less than 50 percent of the population is served by collection sewers. The wastewaters from the central and north sectors of the city are collected and discharged untreated to the El Macho channel, which flows into the Pacific Ocean. The sewerage areas in the southern sector of town discharge into the Estero Gualian, and the Puerto Bolivar area discharges into the esteros or directly into the bay. In areas not served by sewers, residents use substandard septic tanks and latrines that in most cases are in direct contact with the water table aquifer. In some areas near the water inlets, the residents build a hole in the elevated dwelling floor and discharge human excreta directly into the water bodies.

### **3.3.3 Solid Waste Collection and Disposal**

Solid waste collection in Machala is provided by the municipality's two compactor trucks (20 cubic yard capacity) and four open dump trucks. It was observed that sanitation workers operate without the necessary clothing protection and in most cases use bare hands to handle the waste containers or waste. Solid waste is disposed off at an open burning dump at which people are allowed to walk around and search through the garbage piles. Runoff from the waste dump flows to El Macho Channel.

### **3.3.4 Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation**

#### *Potential Water Quantity Pathways*

As previously mentioned, the water demand in Machala exceeds the current supply capabilities in the areas of treatment, storage, and distribution. Water service is available to about 90 percent of the population of Machala, of which about 60 percent is served by the water distribution system and the remaining 40 percent is served by tanqueros. Of those residents receiving water from the municipal distribution system, only about 75 percent have service 24 hours per day. Service is interrupted in areas such as Puerto Bolivar and in zones of the town where pressure is low. The Puerto Bolivar area, which is supplied from the Machala system and has a population of about 40,000, has water service from 6:00 to 10:00 a.m. and from 4:00 to 6:00 p.m. In Machala, some residents use pumps and pressure tanks to extract water from the network in areas where the water pressure is low.

It was found that those residents in areas served by the water distribution network have more water available for use than those residents in areas served by tanqueros. For instance, of an estimated 28,500 m<sup>3</sup>/day supplied from the different sources described above, only about 2,560 m<sup>3</sup>/day are served to residents via tanqueros. As shown in Figure 8, this represents only about 9 percent of the water supplied. This estimate is based on the fact that there are 40 private tanqueros making an average of eight trips per day with an average tank capacity

# Population Receiving Water in Machala

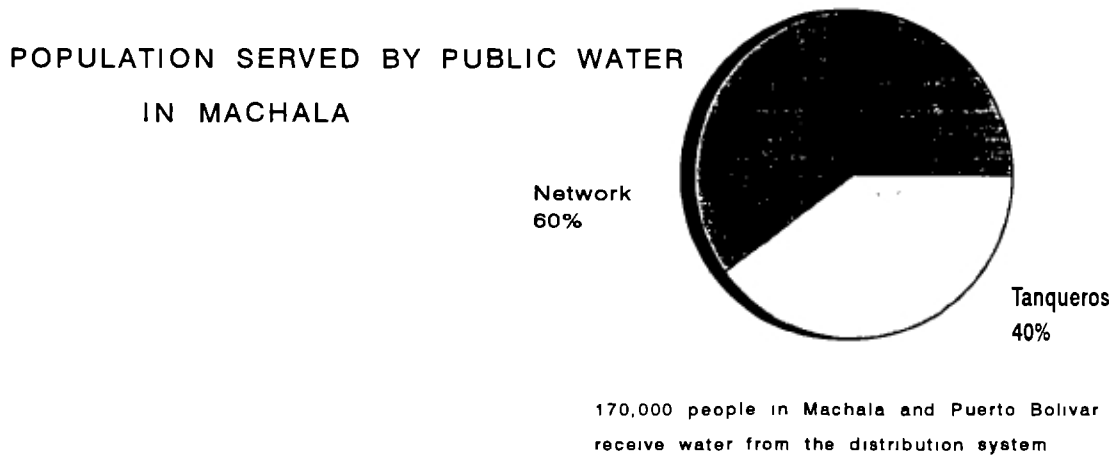
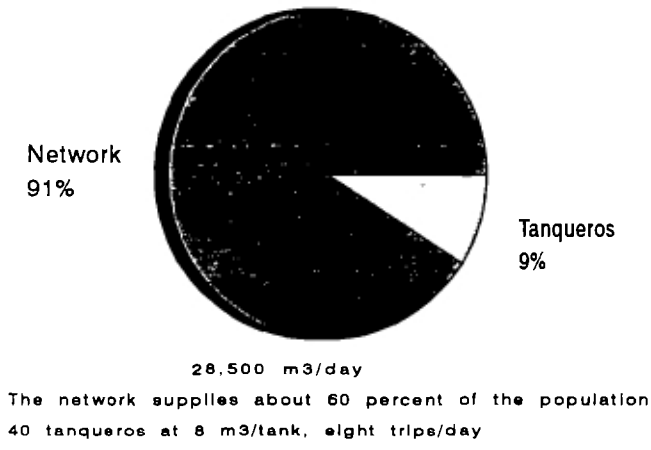
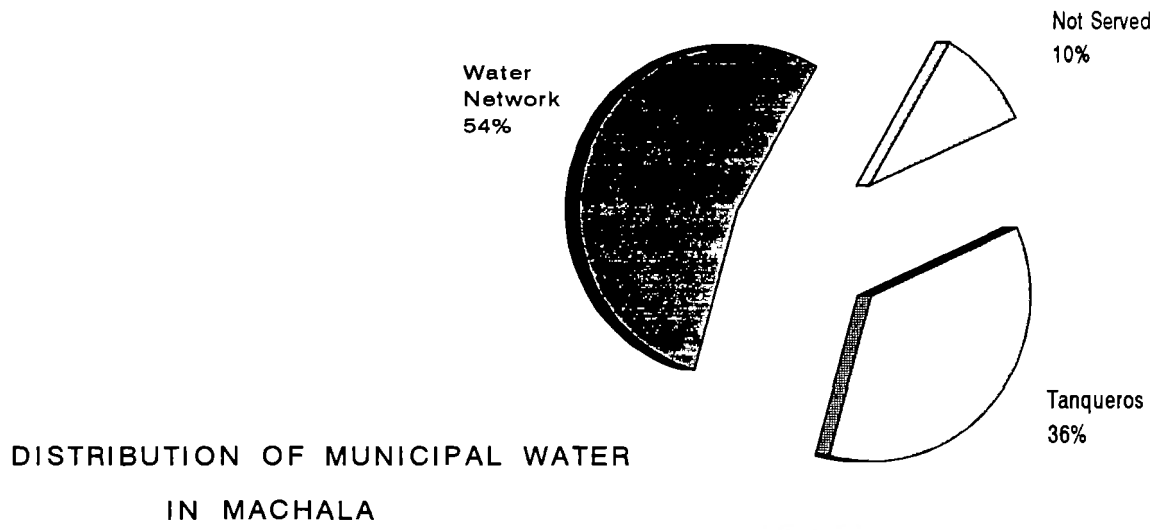
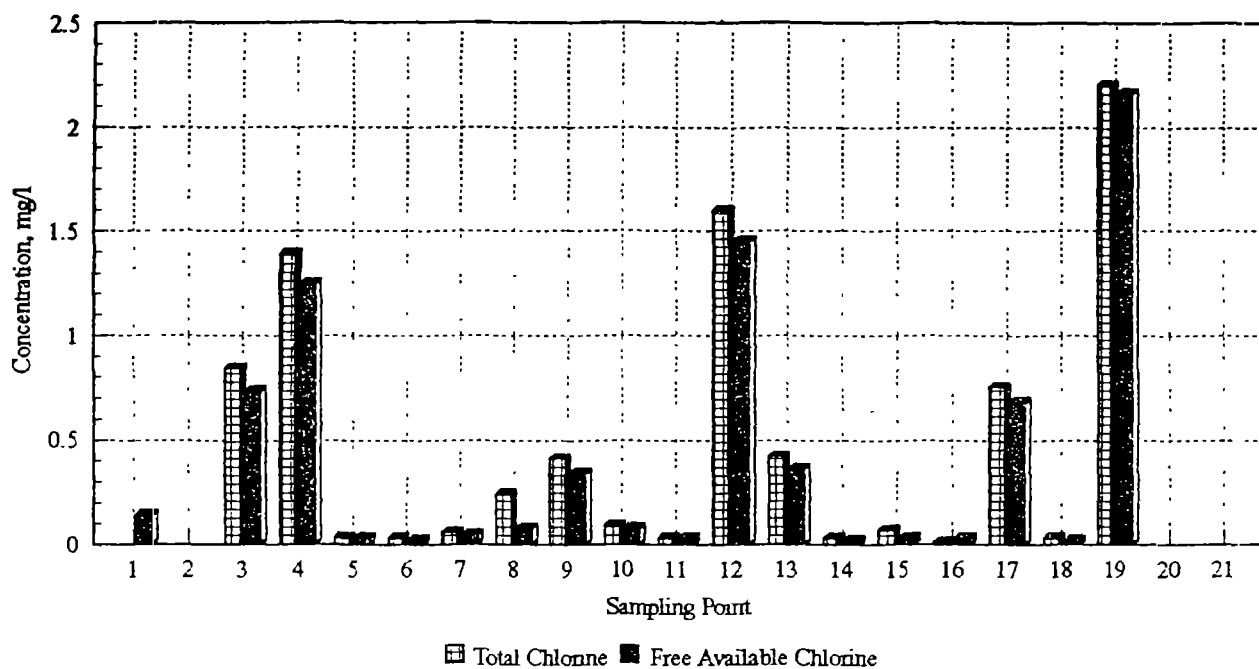


Figure 8

# Chlorine and Fecal Coliform Tests in Machala



## Fecal Coliform Tests Machala, December 7 & 8 1992

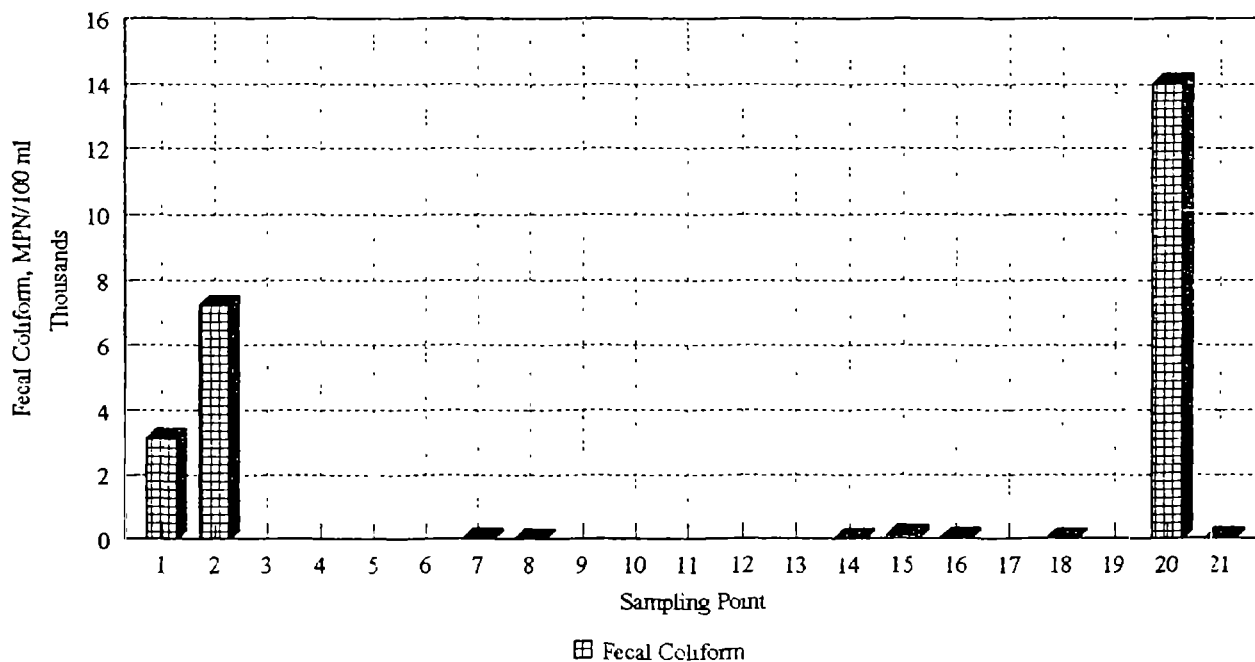


Figure 9



of about 8 m<sup>3</sup>/day. Tanqueros in Machala have no restriction on the number of trips they can do per day.

Phase I of the Regional WTP would expand the treated water capacity of the region by about 300 percent within one year from the time the financing is resolved. However, it will take longer to build the replacement networks and new distribution system needed to get the water to the users and reduce the unaccounted for water from 60 percent to less than 20 percent.

#### *Potential Water Quality Pathways*

The site-specific parameters used to measure water quality in the study area included total and residual chlorine, and fecal coliforms. The results of the site-specific sampling for these two parameters are shown on Figure 9. A description of the sampling points are presented in Appendix A. Chlorine residual concentrations tested in the system were below minimum desirable levels in more than 85 percent of the samples analyzed. Of the three water supply sources, only the La Lucha WTP chlorinates the water. The two wells and the Regional WTP are not chlorinating. According to local representatives, the La Lucha WTP shuts down water supply service when chlorine is not available. With the exception of the two water supply wells in use at Machala, coliform bacteria were detected in virtually the entire water system, particularly in 55-gallon drums, cisterns, and water from the distribution network. Fecal coliforms were detected in the surface water supplies of La Lucha WTP and the Regional WTP registering 7,000 and 18 MPN/100 ml, respectively. The raw water quality of the treated water from La Lucha WTP is considered of very poor quality and the treatment system is deficient, consisting of substandard coagulation (15 mg/l dose of aluminum sulfate), sedimentation, and disinfection with chlorine gas. Filters have been out of service for more than two years. In addition, this plant does not have the capabilities to perform any water quality testing since it does not have a laboratory or any equipment. The regional plant is completely bypassed and water is supplied without disinfection.

High levels of fecal coliforms were detected in the El Macho Channel downstream from the La Lucha WTP intake. These channel waters are used by people for bathing and washing clothes.

In addition to the factors described in Guayaquil, which are common to Machala, the following contribute to the declining water quality:

- Chlorine residual above 0.5 mg/l was present in less than 15 percent of the samples analyzed. The absence of free chlorine residual was worse at 55-gallon drums and cisterns served by tanqueros and at cisterns fed by the water distribution network in areas of low pressure.
- Some residents complained that water received from tanqueros was salty and had a foul smell. Discussions with officials from the municipality indicated that several tanqueros have been suspended for taking water from some private wells that are not considered to have suitable water quality.

- The coliform bacteria levels of the raw water used at the La Lucha WTP are very high; thus the water is not suitable for water supply. Significant capital improvements are needed to make the La Lucha WTP suitable for producing potable water. It is probably more cost-effective to repair the Pubeza and the Union wells and install new wells than upgrading the La Lucha WTP.
- The population at risk of contacting cholera from poor water quality is estimated to be higher than 60 percent. High risk areas include Puerto Bolivar, all areas served by tanqueros, and areas where water pressure in the network is low or negative.

The potential wastewater and solid waste pathways of contamination for Machala are similar to those previously described for Guayaquil.

### **3.4 Assessment of Esmeraldas**

#### **3.4.1 Water Supply, Treatment, Storage, and Distribution**

Water supply, treatment, storage, and distribution in Esmeraldas are handled by the *Empresa Municipal de Agua Potable y Alcantarillado* (EMAPYA). The water supplied by the municipality of Esmeraldas comes from a well field in an island in the Esmeraldas River. The well field had nine wells originally, but two are out of service and beyond repair. The seven operating wells have a combined capacity of 28,080 m<sup>3</sup>/day. There is a project under construction, managed by IEOS, that will add four new wells with a combined capacity of 17,710 m<sup>3</sup>/day. This project is stopped at the present time because of funding problems. The work remaining consists of adding the control panels and making the pipe connection to the force main. In addition, some residents who do not have a water supply and cannot afford to pay for water from tanqueros use water from the nearby contaminated rivers. This is particularly the case in the El Cabezón sector, which uses water from the Esmeraldas River, and the Codesa sector, which uses water from the Teune River.

The only existing water treatment facility in Esmeraldas is the Planta de Agua Potable or Potable Water Treatment Plant. The Potable WTP was originally built in 1964 with the same current capacity of 24,000 m<sup>3</sup>/day. The process includes cascade aeration for iron removal, two 12-meter diameter circular sedimentation tanks, eight sand rate filters with a 160-m<sup>2</sup> surface area, chlorine gas disinfection, 200-m<sup>3</sup> storage tank, and booster pumps. The plant used to have a stand-by generator, but it is no longer in service. The original chlorine cylinder storage and chlorination system is no longer used. Chlorine cylinders have to be moved by a front-end loader to the location where it is connected to the treated effluent. At the time of the visit, the plant was not chlorinating the treated water because the front-end loader used to move the cylinder belongs to the municipality. On the day of the visit, the labor force of the municipality was on strike. Based on the information provided by the chemical engineer who operates the plant, the plant uses about a ton (909 kg) cylinder every 60 to 90 days. At an average water production rate of 19,200 m<sup>3</sup>/day, this equates to a chlorine dosing ranging from 0.79 to 0.53 mg/l, which is very low dosing for proper disinfection. The plant operators

have not performed a single water quality test in more than two years due to lack of funds for equipment and reagents.

The new Regional WTP is under construction by IEOS with a Phase I design capacity of 86,400 m<sup>3</sup>/day. This plant will supply the city of Esmeraldas and nearby towns. This plant, which is expected to be in operation in less than two years, will treat surface waters from the Esmeraldas River. It is expected to feed Esmeraldas by bringing a treated water aqueduct to one of the existing storage tanks.

There is a privately owned and operated water treatment plant at the oil refinery. This plant supplies water for the refinery, the thermo-electric power plant, and the Petro Ecuador Subdivision. A sample from the treated water was tested and showed free and total chlorine residual concentrations of 2.2 and 2.64 mg/l, respectively.

From the existing water treatment plant, water is distributed to three 2,500-m<sup>3</sup> storage tanks and to one 500-m<sup>3</sup> storage tank. A new 1000-m<sup>3</sup> storage tank is currently under construction. The water distribution system is as old as the Potable WTP. A schematic diagram for the system was not available for inclusion in this report.

#### **3.4.2 Sewage Collection, Treatment, and Disposal**

The responsibility for sewage collection and disposal in Esmeraldas is split between EMAPYA and IEOS. EMAPYA operates and maintains the central and southern sectors of town. These sectors have several direct discharges to the Esmeraldas River, which flows into the Pacific Ocean. The sewage collected in the northern sector of town is conveyed to a pumping station and discharged into the ocean via a 1,600-meter outfall. There are no sewage treatment facilities in Esmeraldas or plans for future sewage treatment.

#### **3.4.3 Solid Waste Collection and Disposal**

Solid waste collection in Esmeraldas is provided by the municipality. The city has seven compactor trucks, each with 20 cubic yard capacity. Four are operating and three are under repair. Each truck makes two trips per day every day except Sunday. It was observed that garbage is piled up in the street, usually without containers. Animals, such as dogs and gallinazos, can be observed eating from the uncontained garbage.

Solid waste is disposed of at a new sanitary landfill, which covers the garbage daily. Prior to the operation of the new landfill, garbage used to be disposed of in the banks of the Esmeraldas River.

### **3.4.4 Data Analysis Regarding Potential Pathways of Contamination due to Poor Sanitation**

#### *Potential Water Quantity Pathways*

The water demand in Esmeraldas exceeds the current supply capabilities in the area of treatment, storage, and distribution. Water service is available to about 90 percent of the estimated 170,000 population of Esmeraldas of which about 80 percent is served by the water distribution system and the remaining 20 percent is served by tanqueros. Of those residents receiving water from the municipal distribution system, only about 70 percent have service 24 hours per day. Service is interrupted by sectors using valves located throughout the distribution system. Some areas in the elevated sectors of town have distribution network but water never reaches such areas due to lack of pressure.

Like in Guayaquil and Machala, it was found that those residents that are in areas served by the water distribution network have more water available for use than those residents that live in areas served by tanqueros. For instance, of an estimated 19,200 m<sup>3</sup>/day supplied from the Potable WTP, only about 670 m<sup>3</sup>/day are served to residents via tanqueros. As shown in Figure 10, this represents only about 3.5 percent of the water supplied. This estimate is based on the fact that there are 14 private tanqueros making an average of six trips per day with an average tank capacity of about 8 m<sup>3</sup>/day. Tanqueros in Esmeraldas have no restriction on the number of trips they can make per day and do not need a permit to operate.

Phase I of the Regional WTP would expand the treated water capacity of the region by about 360 percent within approximately two years, assuming work continues at the current pace. However, it will take longer to build the replacement networks and new distribution system needed to get the water to the users and reduce the unaccounted for water from 40 percent to less than 20 percent.

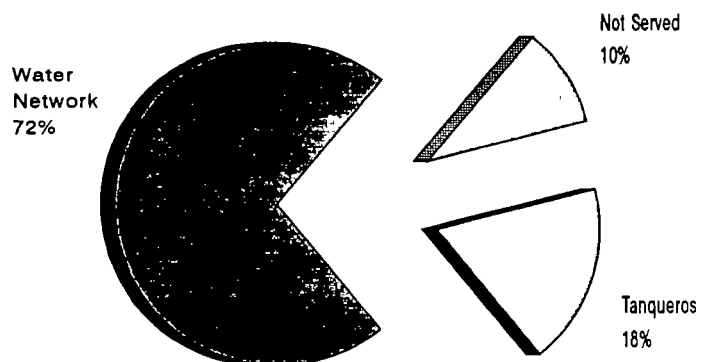
#### *Potential Water Quality Pathways*

The site-specific parameters used to measure water quality in the study area included total and residual chlorine, and fecal coliforms. The results of the site-specific sampling for these two parameters are shown on Figure 11. A description of the sampling points are presented in Appendix A. Chlorine residual concentrations detected in the system were below minimum desirable levels for all samples with the exception of the sample from the private plant from the refinery.

Fecal coliforms were not detected in the source of water supply to the Potable WTP. However, high levels of fecal coliforms ranging from 260,000 to 360,000 were detected in the Teune River, which is used for bathing and washing clothes. In some cases it is the only source of water for residents who cannot afford to pay the tanqueros. In addition, fecal coliforms were also detected in the network, in 55-gallon drums filled by tanqueros, and in cisterns fed from the network or by tanqueros.

In addition to the factors described in Guayaquil, which are common to Esmeraldas, the following factors contribute to the declining water quality:

# Population Receiving Water in Esmeraldas



DISTRIBUTION OF MUNICIPAL WATER  
IN ESMERALDAS



19,200 m<sup>3</sup>/day

The network supplies about 80 percent of the population  
14 tanqueros at 6 m<sup>3</sup>/tank, 6 trips/day

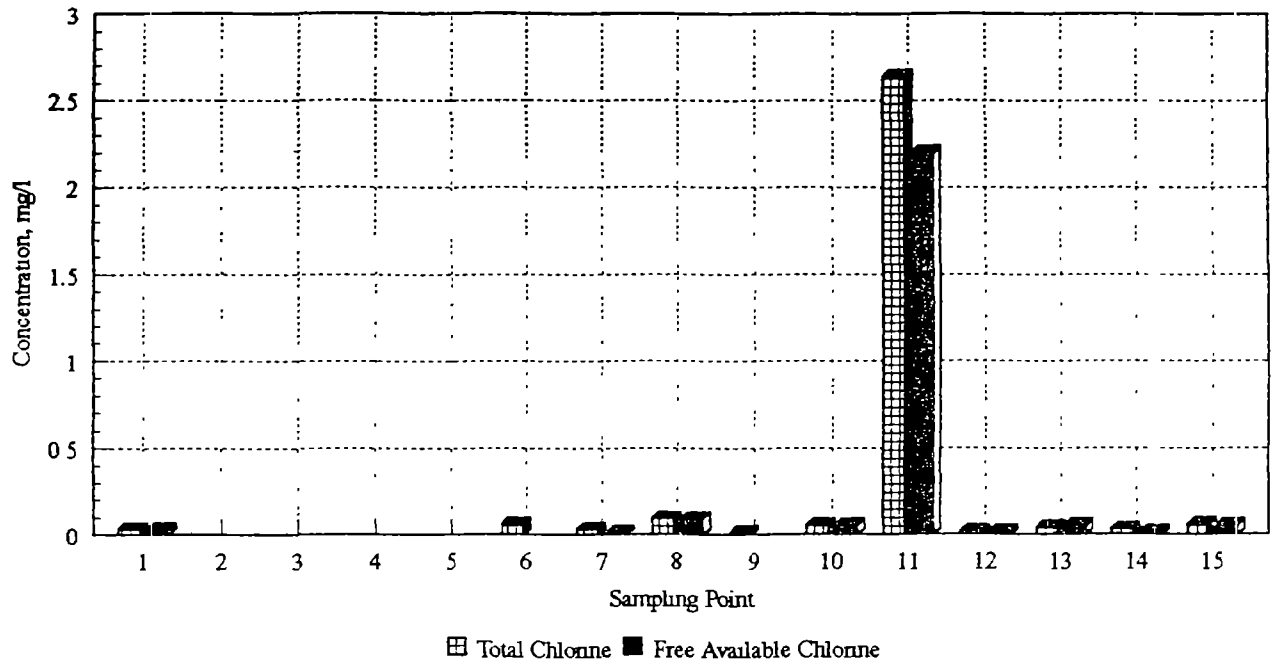
POPULATION SERVED BY PUBLIC WATER  
IN ESMERALDAS



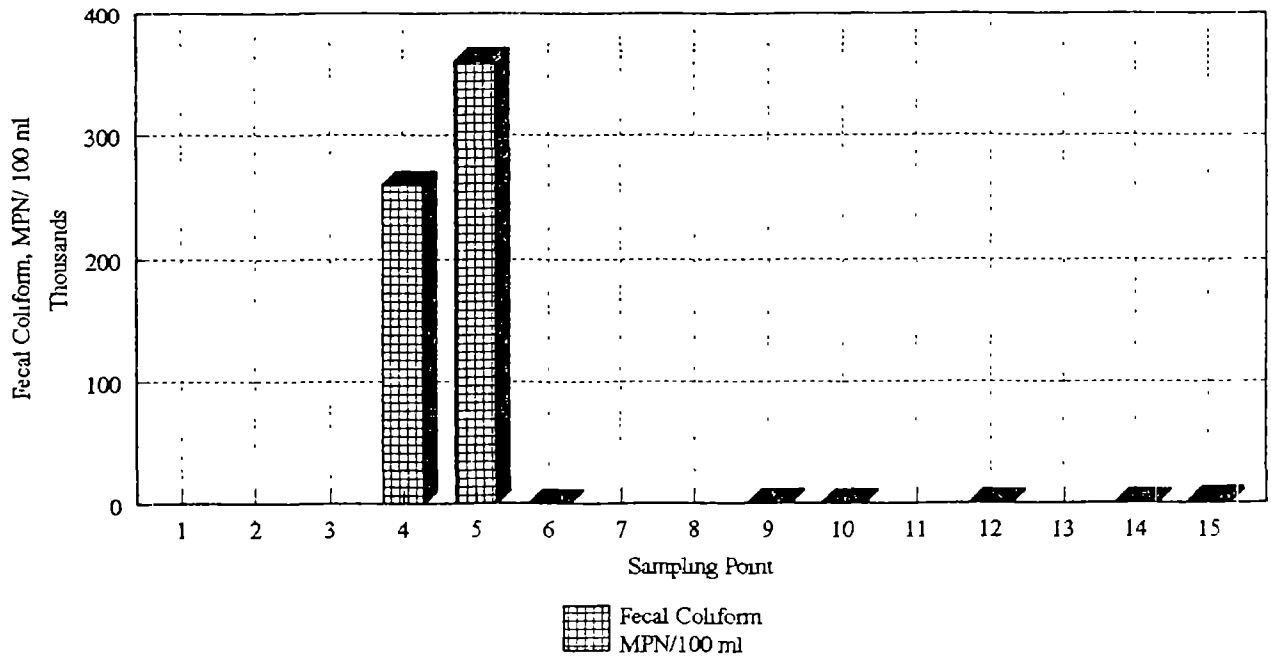
160,000 people receive water  
from the distribution system

Figure 10

## Chlorine and Fecal Coliform Tests in Esmeraldas



### Fecal Coliform Testes Esmeraldas, December 10 & 11 1992



**Figure 11**

- Chlorine residual measured in the Esmeraldas system was less than 0.1 mg/l for all samples analyzed. The refinery water has more than adequate chlorine residual.
- Some residents complained that water received from tanqueros was from the river and not from the Potable WTP. Discussions with representatives from the health department confirm this statement.
- Water service can be interrupted by power failure.
- Disinfection is not applied regularly, and probably when treated water is disinfected, the dose is inadequate (0.8 to 0.5 mg/l).
- The coliform bacteria levels of the river water used by residents of El Cabezón and Codesa are in high risk of incidental and direct ingestion of water highly contaminated with fecal matter.
- The population at risk of contacting cholera from poor water quality is estimated to be higher than 60 percent. High risk areas include the El Cabezón sector, Codesa, all areas served by tanqueros, and areas where water pressure in the network is low or negative. The potential wastewater and solid waste pathways of contamination for Esmeraldas are similar to those previously described for Guayaquil.





## Chapter 4

# HYGIENE EDUCATION AND COMMUNITY PARTICIPATION

### 4.1 Introduction

Hygiene education is considered the vehicle necessary for influencing behavior that is likely to lead to contamination of water and food and transmission of cholera. This chapter reviews the level of effort carried out by the Ministry of Health, as well as by other organizations, to design and implement hygiene education activities. The complementary details with regard to knowledge, attitudes, and practices of hygiene behaviors by individuals, families, and communities observed during site visits are also included. In addition, a review of those activities being implemented with community participation and a definition of what is meant by community participation and how it is being implemented will be provided.

The discussion that follows presents general observations applicable to the management of cholera activities at the central level, and in the coastal region. Observations are not disaggregated by urban areas visited because many of the findings are shared in common.

### 4.2 Hygiene Education

Efforts at hygiene education so far have helped create a very generalized concept that the source of the cholera problems lies in water, with itinerant vendors, and in seafood. It is a concept that is relatively simplistic because it fails to capture and convey the more complex aspects of disease transmission. For example, when considering the role of water, the particular problem may lie with contamination at the source, or contamination may be occurring in the distribution system, or in storage, or during handling in the home. Other pathways may be implicated in particular situations and should be investigated before education messages are designed and disseminated.

The Ministry of Health at all three levels visited (central, regional, and provincial/local) has a Department of Epidemiological Surveillance, directed by a physician with the assistance of professional nurses. Commonly referred to as Epidemiology, the department is in charge of the cholera information notification system. There is also a Department of Development and Protection that is in charge of the planning of cholera-related activities and, in some cases, implements the Control of Diarrheal Disease (CDD) program, which is directed by a physician.

The Department of Education, which is under the direction of an educator, is responsible to either Epidemiology or Development and Protection. The Education Department has a group of inspectors who carry out promotional activities and give talks to promote health programs. These inspectors are concentrated in the provincial health headquarters. These inspectors are generalists, however, and have not been trained in subjects relating to community studies and education methodologies.

When the cholera epidemic broke out in 1991, the Education Department received support from the central level in the form of videotaped and printed materials, which were developed at the central level by the Ministry of Health or by private organizations collaborating with the campaign. However, even at the central level, the Education Department of the Ministry of Health did not play a role in planning and coordinating this campaign at the regional or provincial levels. The regional and provincial levels did not receive clearly defined guidelines as to how to conduct an educational activity and thus were restricted to carrying out informational activities independently.

Several different communications channels, including printed media, radio, and television, were used to carry the educational messages. The use of institutional personnel, such as educators, inspectors, nurses, and physicians, were used in implementing a series of activities such as informative talks aimed at several different social groups, offices, itinerant vendors, markets, restaurants and, in some cases, home visits. Frequently, broadcasting by mobile loudspeaker was used in individual neighborhoods to transmit various types of messages with wide-scale coverage. The participation of other organizations, such as the Ministry of Education, played an important role in the transmission of information among children and community residents, although not as part of the school curriculum but rather by incorporating the information into school activities and only so long as the peak of the outbreak lasted.

In some cases, the messages and the education component appeared to be contradictory. For instance, at the community level, people were told not to eat food sold by itinerant vendors and itinerant food stands were closed down and prohibited. At the same time, hygiene messages were targeted at these same itinerant vendors.

The educational messages developed by the technical staff were generally directed at what people should know about cholera. However, they did not take into account the knowledge, attitudes, and practices of the population as a whole so that they could be targeted at specific behaviors. Also, they did not take into account the technical feasibility of having the population implement the recommendations proposed by the technicians.

Sometimes, messages were aimed at getting people to alter multiple activities in their daily lives, but frequently the recommendations given did not correspond to the risk factors actually involved in the transmission of cholera. As a result, messages were confusing in some instances. For example, a hygiene education plan recently started in Guayagul is aimed at preventing five different diseases. In addition to cholera, dengue, malaria, AIDS, and rabies are targeted under one program. Without targeting a specific behavior or hygiene practice to a specific disease, the potential for implicating the wrong pathway is great. At worst, people may believe that if they modify a behavior to prevent malaria they have also prevented cholera.

Many other messages were not technically feasible for the community to implement but rather were based on a series of recommendations aimed at covering all possible sources of contamination. No exact definition had been made of the target population that was to be reached, nor was any effort made to determine whether the channel to be used and the

message to be transmitted were accessible to those individuals at greatest risk of contracting the disease.

No evaluation currently exists of the large number of activities carried out that would provide criteria for the adoption of a particular strategy and for the implementation of that strategy.

There was considerable interest in developing a hygiene education component in 1992. A number of different plans were developed in various provinces although, in the final analysis, none could be considered to be a truly sustainable and effective communications plan. Rather, the messages were the same ones used during the outbreak of the epidemic two years ago.

Several of the provinces have begun to develop a plan to redistribute personnel, particularly the inspectors, by assigning them to various health sub-centers where they would be incorporated into health teams at the local level. This could be the first step toward constituting a future education component based on information originating in the community.

Overall, the Ministry of Health's efforts appear to be aimed primarily at identifying outbreaks; less attention is given to cholera during periods when levels of transmission are low. Even though epidemiological studies show how cholera has been transmitted in Ecuador, they have not been used as a basis for designing communication plans for hygiene education or for making related program decisions. They have also failed to address the technical capability existing at the community level to carry out recommendations made by technical staff. It appears that the idea of learning to coexist with cholera has become institutionalized.

Knowledge of people's hygiene practices provide a basis for hygiene education activities. Some data were gathered about these practices at the personal, family, and community levels. General observations are presented in the next section.

### **4.3 Hygiene Practices at the Personal and Family Levels**

When a cross-section of community residents are interviewed, it is possible to see that they have been exposed to a variety of different sources of information and that they are able to repeat with ease the recommendations they have received. For example, people say they have heard that cholera is transmitted by water and that this is why they boil it, or that cholera is transmitted by eating food from street vendors, or by eating seafood, or as a result of a general lack of hygiene. However, deeper probing shows that people have their own concepts, which are different from what they have been told through the communications media.

#### **4.3.1 Personal and Family Hygiene Practices**

Information about hygiene practices at the personal and familial levels were obtained by speaking with informants, and observing their living environments. The opinions held by various individuals include the following:

- The cholera problem is over because nobody talks about it anymore.

- Cholera can be avoided by boiling water. No mention was made of using chlorine as an alternative and they are most distrustful of the water provided by truck tanks. They consider the problem solved once they boil the water. They see no connection between their hands and cholera because the message that has been disseminated is that the water harbors cholera, and that cholera has been destroyed once water is boiled. When their storage facilities and handling procedures were examined, it was found that they use wide-mouth containers to store water and cups to ladle out the water, and that they dip their hands into the water.
- Mosquito larvae cause cholera. This idea stems from the belief that the Ministry of Health is disinfecting water for cholera when the SNEM (National Service for the Eradication of Malaria) inspectors visit homes to apply the larvicide ABATE to water containers in an effort to prevent the proliferation of the mosquito that transmits malaria.
- The main problem with human excreta is the foul odor, which is what cause diseases. For these people, the solution to this problem lies in the application of creosol or lime in the latrine. They do not associate excreta with cholera because the messages have primarily encouraged the use of latrines or the burial of excreta (as cats do), but do not explain why this should be done.

When people who have had cholera were interviewed, they stated that they became ill because they ate seafood, because insects came into contact with their food, or because they do not practice hygiene at home. They also mentioned that chlorine can also produce cholera. In one instance of a hospitalized cholera case, the individual stated that he boiled water at home; that he did not eat anything from street vendors; that he had a sanitary toilet in the house; and that he did not understand why he had contracted cholera although he suspected that he had caught the disease from a neighbor because there had been a case of cholera in that person's home.

Improper excreta disposal was observed everywhere. Some people were aware that the problem was caused by water, garbage, and excreta but, since they lacked these services in their homes or in the community, they were not concerned. In addition to the lack of knowledge about excreta disposal, technical problems were also observed. For example, in the coastal areas visited, especially in Machala, shallow water tables present problems for latrine construction. For residents who get their water from ground sources, contamination from latrines is a real problem. Also, in the rainy season, the latrine contents literally float to the surface. Presently, simple pit latrines and water seal (pour-flush) latrines are the only two alternatives being constructed, neither of which constitutes an appropriate technology. An exploration of technical alternatives in latrine design, perhaps under a workshop format, is necessary.

People believe that food provided by itinerant vendors can cause problems only if it is re-heated food. They never associate the problem with food handling. People state that they do not always wash their hands because of the shortage of water and that, since water is too expensive to buy, they try to use as little as possible. The use of soap for hand washing is not

customary because the people do not perceive the importance of doing so with respect to the problem of disease. They feel it is sufficient to wash their hands with water only.

Interviews held with itinerant food vendors uncovered a series of beliefs that are quite different from the messages contained in the educational materials. These beliefs included the following:

- One fruit vendor stated that his products did not have cholera because he had washed them at home. However, he handled the fruit with the same hands with which he handled money. When asked if money could contaminate his hands and the fruit, he said no because he wiped his hands with a dirty rag, which he produced from under the table. He added that mangoes were not a problem with regard to cholera because they had skin, which is where the disease lies and, since he peels them and puts them in bags, there is no problem. He was observed to have dirty hands while peeling the mangoes.
- An orange juice vendor stated that he has no problem with cholera because he uses only fruit and ice. Asked if the ice could be contaminated by cholera, he said no because the ice is factory-made and that the cold temperature kills cholera.

Most communities exercise no control over the activities of street vendors to ensure the quality and cleanliness of the food. Perhaps this will come about once the communities receive sanitary training and participate actively in control activities.

One exception is the municipality of Guayaquil, which has recently established a Public Health Department headed by a physician and staffed by a work team of 25 supervisors who are also physicians. This team establishes and maintains contact with itinerant food vendors, provides them with some basic training and carries out follow-up activities using video tapes and other types of information. The vendors are also given physical examinations to ensure that they are in good health. These activities are being supported by the United Nations Food and Agriculture Organization (FAO), which provides financing for the educational component. The program also promotes and sells, at a subsidized price, a cart that is hygiene friendly, e.g., it has compartments for holding clean water. The municipality requires that two people staff the carts so that the food handler does not handle money, that they keep their hair cut short, wear aprons and caps, and exhibit a health certificate extended by the municipality's Public Health Department.

Neighborhoods and marginal urban communities were visited in each of the three cities included in the assessment. In addition to individual and family practices, observations at the community level were made of hygiene practices. Some of these observations are discussed in the next section.

### **4.3.2 Hygiene Practices at the Community Level**

It was possible to observe a number of structural differences among the marginal communities and neighborhoods visited. However, they also shared certain characteristics, such as their location on a river bank or canal, their location in swampy areas with or without landfill, their lack of water supplied through a piped network or, in those cases where there is a piped system, the intermittent supply of water, and excreta disposal systems that are deficient or simply nonexistent.

A common feature in all locations was the presence of water storage containers, usually 55-gallon drums or larger cisterns on the streets in front of homes for storing water purchased from tank trucks. In Machala, some houses were built over swamp water, on stilts, and a shed which was used as a latrine discharged directly into the water. From this water, shrimp larvae are obtained to be sold to shrimp farmers and, in some cases, the water is used to wash cooking utensils and for other domestic uses and even, it is suspected, for drinking. Other dwellings had already been provided with earth or hydraulic fills under their floorboards and in their yards although the water table rises up to the surface during the rainy season.

In those locations near a fresh water river or canal, many people were observed washing clothes; children were bathing; and people were collecting water for domestic use. This water receives untreated effluent discharged directly from sewage systems and public garbage dumps.

No systems for properly disposing of excreta were observed in the homes visited, and in those cases where such a system exists, it consists solely of a hole with poor quality walls. In cases where there is a flush toilet with a valve, it remains closed to save water. Thus a considerable amount of fecal matter accumulates. A few dwellings were observed to follow sound hygienic practices. In others, used toilet paper was disposed of in containers without lids, and as a result large quantities of paper accumulated. Observations disproved the claim that this paper was burned every day. Fecal matter was observed in residential yards as well as in the streets.

Many complaints were heard about latrines that have been built which become flooded during the rainy season and about the fact that there is little space left to allow new holes to be dug in the yard.

In Guayaquil, the team visited a day-care center that provides shelter, food, and care for as many as 800 children. Bathrooms were observed to be clean although a large quantity of used toilet paper was seen in the yard close to where children were playing. In the kitchen, the utensils were protected from insects; soap was in the wash basin; and two large, wide-mouthed containers held boiled water for consumption. During the visit, a child came in from the yard where he was playing to get a drink of water from one of the containers. The team observed the child using a cup and dipping part of his hand into the water as he filled the cup.

The problems observed can be summarized as follows: inadequate water quantity and quality, storage of water in wide-mouthed containers which permit water contamination through the introduction of dirty hands and dippers, and above all, the almost universal lack of adequate

excreta disposal which makes the contamination or recontamination of water easy, especially when water is poorly stored and handled unhygienically.

An important determinant of successful WS&S interventions, including hygiene education activities, is effective community participation. Community participation is the process by which communities benefitting from an intervention became competent and independent managers of these technologies and programs. A look at the role of community participation as observed by the team is discussed next.

#### **4.4 Community Participation**

The concept of community participation varies from one organization to another. The Ministry of Health includes in its definition of community participation an activity that receives collaboration from the community where an outbreak of cholera occurred and where the community organized itself. In one example, a community under guidance received from health personnel successfully carried out the sanitation, monitoring, and maintenance of contaminated wells. The community received supplies of chlorine for this purpose along with instructions for its use. However, no follow-up was conducted to determine which activities continued to be carried out by community members.

In another example, health officials said they had successfully engaged community participation through the appointment of a community leader to establish a distribution center for oral rehydration salts to treat cases of diarrhea. This individual was selected with no consideration for whether he resided permanently in his home. Consequently, he was always away from home at work, and could never respond to the demands of the community.

Activities at the provincial and local levels often are constrained by the absence of a community development department within the Ministry of Health that could ensure compliance with guidelines for community participation. There are, however, health inspectors whose activities consist largely of trying to motivate and give talks in the communities although they do not employ a systematic methodology for community participation and follow-up.

Other organizations, such as IEOS and some international agencies such as CARE, have been working in rural areas in the construction of water systems and latrines. Their approach more closely reflects what is meant by community participation in that it includes contacting community leaders, members of existing governmental and religious organizations in the community, and the community at large through public meetings to give educational talks, to discuss local problems regarding sanitation, and to define the extent to which the community would participate in the project. As a rule, IEOS or CARE provides a portion of the materials, and the community provides the labor and locally available materials. Throughout the construction period, there are promoters and inspectors who supervise the building of the works and provide support in the form of educational talks.

While these efforts are excellent during the planning and construction phase of work, there is no plan for following up on community participation activities after the project is completed.

Moreover, there is no mechanism in place to determine whether, over a number of years, the people continue to practice sound hygiene habits and whether they make good use of and adequately maintain infrastructure built during the project.

During the community work process, a coordinating group is organized. In some cases, this group is headed by a woman. During project implementation, the organizations are kept informed as to the work performed by this organized group. Once the project is finished, all contact between the benefactor group and the community organization is lost.

#### **4.5 Data Analysis**

In late 1992, the cholera problem was relegated to a position of secondary importance, both by Ministry of Health authorities as well as by other organizations that have been involved since the epidemic broke out in 1991. This applies also to the community level. The threat of hemorrhagic dengue fever is being given a higher priority than cholera in the coastal areas. Conceivably, an epidemic of hemorrhagic dengue fever could cause more deaths than cholera. The number of cholera cases in 1992 in the coastal areas was not very different from the number reported in 1991, and epidemiological surveillance activities—from the collection of information to analysis for decisionmaking—have also decreased. Nonetheless, deaths are occurring from cholera while none have yet to occur from dengue fever.

The dissemination of information activated during the first year of the cholera epidemic, including communications media and the mobilization of institutional resources, is presently nonexistent. It is still possible to find sporadic announcements in newspapers, although such messages are not relevant to actual cholera transmission. Moreover, many send a message no longer believed by the people, e.g., that cholera is fatal, yet most people survive.

There are no national or regional plans for the prevention and control of cholera. What is observed at national, regional, and provincial/local levels is a CDD program aimed principally at preventing death from dehydration. From a technological standpoint, it was good that oral rehydration therapy was in place when the epidemic started. It helped contain the death rate over the short-term. However, a long-term strategy that deals with preventing the transmission of the disease is absent.

Specific risk factors connected with outbreaks should be identified. There is also a need to identify those factors that keep transmission at low levels during some periods of the year which, as part of a vicious circle, are contributing to the spread of the disease. It will also be necessary to address the issue of food and the confluence of the various factors affecting the occurrence of outbreaks.

The mass media are useful in getting information to people. However, in order for information dissemination to influence behavior, it should be complemented with follow-up actions at the community level where person-to-person contacts can help to ensure more lasting changes in the behavior as well as to monitor and provide feedback to the program.



There are several steps that can help develop an information base for a hygiene education program. These include the particular risk factor causing transmission, whether from the epidemiological standpoint (including geographic area and exposed population) as well as from the standpoint of the knowledge, attitudes and practices of the general public; the behavior to be adopted in order to minimize exposure to disease; the feasibility of instituting a new behavior from the standpoint of the community and its available resources; and the population group responsible for incorporating a new behavior into their daily lives. In order to develop a matrix to help us organize ideas and maximize resources, a communications plan must include, at a minimum, the following components:

- the target group to be reached, which should already be identified;
- the message to be transmitted, which depends on the knowledge to be imparted or the behavior to be changed;
- the channel to be used to reach the target group, which must be determined on the basis of both penetration and accessibility;
- the most appropriate times to reach the target group, which depends both on their habits and their activities; and
- the evaluation methodology to be used to measure the use, incorporation and impact, not only of the medium or channel used but also of the message transmitted and the desired behavioral change.

The communications process is dynamic, as is the level of knowledge acquired by the population; therefore, monitoring the plan will allow for modification of the messages when necessary. For instance, the Ecuadorian population was heavily exposed in 1991 to a series of messages that are now outdated and will no longer capture the attention of the public. As part of a new strategy for developing new and interesting messages, planners could incorporate messages alluding to festive occasions or important public events, e.g., the Christmas season, festivals, or vacation times.

Children, especially those of school age, are currently in a formative stage and will be responsible for ensuring the permanence of long-term changes. Consequently, information about cholera should form a part of the school curriculum and not be limited to an activity carried out sporadically in times of epidemics.

Community participation must be considered not only in connection with activities during project implementation, but also in connection with the community education process. It should embody the notion that the community may indeed participate in the planning, implementation, and evaluation of any construction, maintenance, or educational activity. A methodology must be devised that will ensure the sustainability and follow-up of community activities.

Also important in the water and sanitation sector is the role played by women, as it is generally women who remain at home, who retrieve and handle water, who are charged with

caring and guiding the children, and who are responsible for the use and cleaning of the family latrine. Therefore, the participation of women in WS&S interventions must be taken into account from the time of planning and selection of alternatives up to the implementation of educational activities both in the family unit as well as in their own communities.

Community participation has become a very important factor in the planning, implementation, and evaluation of communications programs. It has contributed considerably to expanding the coverage that health promoters are able to provide. It enables communities to take charge of interventions on their behalf, to move from passive recipient to active participant. In terms of hygiene education campaigns, it is a way of leveraging limited resources, of getting more with less when approached properly. Ultimately, such participation is critical to the success of long-term solutions to cholera vulnerability.

## Chapter 5

### INSTITUTIONAL ISSUES

#### 5.1 Introduction

The Water Quality Assessment looked at institutional factors that are seen as requirements for developing a strategy for a permanent solution to cholera vulnerability. Successful water supply and sanitation institutions share characteristics that include sound cost recovery, the ability to respond to client needs, trained staffs, management and administrative systems that motivate people and enable them to get things done, and the ability to plan technically and managerially for growing demands on their services. Institutions in the water supply and sanitation sector are also influenced by normative institutions that establish policy and set standards for service performance and that regulate and enforce service performance. Successful institutions feel responsible about providing good service to their customers; they are also held accountable to do so by larger normative agencies that have the public interest in mind and the sanction of national law.

Of the institutions visited during the assessment, the Ministry of Health, EMAP-G, EMA-G, the Department of Water in Machala, EMAPYA, and IEOS, as well as other municipal and provincial entities, the characteristics of success were absent. All the institutions had well-trained staffs, many with excellent technical credentials, yet frequently their institutions were in crisis. Problems observed included inadequate financing and poor cost recovery as well as management and administration problems leading to a failure to adapt to changing demand for services.

A profound deterioration among public utilities has taken place during the 1980s. The "politicization" of the institutions charged with providing water supply and sanitation is partly to blame. While Ecuador can be proud of its democratic stability over the 1980s, the appointment of political operatives to the directorates of public utilities left many of them depleted at the end of the decade. Political appointees were all too often technically unqualified for running the utility. But the lack of a national focus on the future, a failure to use normative tools to oversee the performance of utilities, dependence on the national government for financing both for investment and recurrent costs, weak preparation in public administration, and a lack of coordination between as well as within institutions carry a large burden of responsibility for institutional weakness.

Mass migrations and population growth have caused an explosion of demand in all three cities visited. These "invasions," as they are generally referred to, have taken place in all cities along Ecuador's coast. When the problem began in the early 1980s, the institutions charged with delivery of water supply and sanitation services took little notice. At the same time, national institutions also took no notice of the potential threat such migrations could have to public health and failed to impose actions that might have stemmed some of the migration. At best, the migrations worked to the advantage of political candidates seeking themes and votes for

their campaigns. Once elected, officials worked to secure delivery of service to their new constituents. Securing the rights of squatters went unbalanced by any commensurate effort to impose obligations on these new city residents such as property taxes, however meager they might be. Today, the problem of squatter settlements has become a crisis because of the lack of water, inappropriate or nonexistent excreta disposal, and the threat of cholera.

Ecuador's new national government has initiated a climate of change to decentralize public services. Privatization is being put forward as an important part of this change. Modeled after decentralization and privatization efforts elsewhere in the region such as in Chile, Argentina, and Mexico, Ecuador's new directions offer hope that the administration of public services can be made efficient, self-sustaining, and responsive to public demand and need. The long years of dependence on central government transfers to municipal-level utilities, however, will make change difficult to achieve. In addition to having to bring the public along politically, i.e., forming coalitions among interest groups affected by change to support new policies, which the national government is not doing, a reform of the country's approach to public administration will also have to be instituted.

Under an ideally reformed public administration system, the national level would set policy, establish norms, and regulate their implementation. Regional and provincial entities would be responsible for program design and implementation within the norms established at the central level. They would in turn be regulated by the central entities, but not controlled by them in terms of decisionmaking.

Public administration reform would also have to include a focus on public finance. Provincial and municipal entities are presently uninformed of how to finance their operations other than by subsidies from the central government, for both capital investment and recurrent costs. Service charges to customers are below cost recovery even when collected. Efforts to decentralize and privatize operations of public utilities will have to be complemented by the development of capital markets where municipalities can raise money to invest in their infrastructure. Moreover, because people who manage public utilities will require skills in the management of public finances, reform must also include the development of a cadre of public administrators prepared to manage public financing explicit to decentralized and privatized operations.

The following sections will present a few examples of the institutional issues observed during the Water Quality Assessment. Most of the issues observed were common among the institutions visited, especially among the utilities.

## **5.2 Institutional Capabilities**

### *The Ministry of Health (MOH)*

Beginning at the national level, MOH is the institution best suited for providing leadership in protecting public health. With respect to cholera control and prevention, however, the MOH's performance has failed to set national health policy in a way that takes the issue beyond one

that is just an MOH concern. Cholera is transmitted by routes associated with the lack of safe water and the lack of excreta disposal. It is therefore appropriate that the MOH be actively involved in seeing to it that the utilities providing water and sanitation are in fact doing so; and where the utilities are not able to do so, that the MOH be actively engaged with other institutions and the communities themselves to see to it that sources of water used and methods of excreta disposal are adequate to protect the greater public health. Where polices do not exist for the MOH to act this way, they should be taking the lead in shaping such policies.

Protecting public health, not just curing cases of illness, should be the MOH mandate. Presently, the MOH is more directly engaged in curative activities with respect to cholera. Maintaining stocks of oral rehydration salts (ORS) and intravenous fluids is seen as a higher priority than overseeing the larger public health in a preventive way.

An additional impediment to MOH institutional effectiveness is its high degree of centralization. Regional subsecretariats feel disengaged from the central MOH operation, both in national resources and in technical assistance extended by international donors. With the incidence of cholera highest in coastal cities, and with the water supply, sanitation, and hygiene problems present in those areas, assistance directed to the regional subsecretary should be a priority for national MOH officials.

In the coastal cities, the provincial directorate for health is engaged in trying to cope with the cholera problem. In Guayaquil, for example, the provincial directorate reports spending a great deal of time teaching "survival skills" to squatter populations so that they can contend with the high risk of diarrheal disease they face as a result of living in an environment with scarce safe water resources, and inadequate excreta disposal, rather than improving the overall health of the population. The provincial directorate also expressed some frustration with having to set up and staff health centers in these areas just because these goals were part of a larger national plan. Meanwhile, there is a surplus of trained doctors in the country, many of them trying to develop private practices in these marginal urban areas. If some resources could be directed to support these doctors, scarce resources might be extended further than they are now to staff a government health center.

#### *Empresa de Agua Potable-Guayas (EMAP-G)*

In late 1992, EMAP-G was in a crisis situation. Due to a very large influx of people squatting in the peri-urban areas in Guayaquil not served by the existing water supply network, EMAP-G has been forced to provide water to these sections by tanker truck (see Chapter 3). Nonetheless, the delivery service of the utility has been poor. Its current coverage is about 60 percent of the population of Guayas Province, most of whom live in Guayaquil. Unaccounted for water represents 61 percent of the utility's daily production (WASH Field Report No. 376). The utility suffered from a succession of regressive political appointments at the directorate level during the 1980s. Service deteriorated; no attention was paid to the increasing problem of urban squatters; billing of customers became sporadic; and planning for the future virtually halted.

The newly appointed directorate, however, is trying to cope with the situation. Billing of customers was restarted in December 1992, after a hiatus of eleven months. Also, a new law now before Congress may reduce political influence by limiting the appointment of directors to people who are "technically" qualified. Whether they will be managerially qualified remains to be answered.

#### *Empresa Municipal de Alcantarillado de Guayaquil*

EMA-G is a reflection of its sister organization, EMAP-G. The performance data for the utility have been poor (see Chapter 3). The political exertions that affected EMAP over the 1980s also took their toll on EMA-G. The major impediment facing EMA-G is billing, since it is based on water consumption.

Another new piece of legislation is expected to improve the performance of EMA-G. The proposed legislation, now before the national congress, will create a new utility that will combine both water supply and sewage service. If passed, the new law would take effect January 1, 1994. Meanwhile, other actions during 1993 are expected to further improve service. Part of a new World Bank loan will be used to study how various efficiencies can be gained, including training of existing staff, for increased economic self-sufficiency and for possibly privatizing some actions, such as billing.

#### *Empresa de Agua Potable y Alcantarillado-Esmeraldas*

EMAPYA manages a water and sewer system built in 1965 for a population of 30,000 people. Today, the city has a population in excess of 170,000, but has never extended or improved the delivery system. Water service is rotated by sub-circuits in the system. Service, therefore, is always sporadic. Customers demonstrate their displeasure with the abnormal service by exiting from their obligation, i.e., most do not pay their water and sewage bill. Billing recovery is about 40 percent.

EMAPYA claims that it is able to provide water to about 60 percent of the population through the network. The other 40 percent are served by tanker truck or take water from the Teune or Esmeraldas rivers. Sewer service is provided to 29 percent of the population. The lack of sewage further complicates the larger problem of excreta disposal and is one of the major points of concern in terms of cholera control (see Chapters 3 and 4). A few days of rain in early December ushered in an outbreak of cholera with 25 cases being reported by mid-month with three deaths. Though no epidemiological search was carried out, the assumption is that the rains washed fecal matter into streams used by some people not served by the city, which led to disease.

### **5.3 Interagency Cooperation**

Interagency cooperation is generally weak between agencies as well as within institutions in some cases. Overall, the lack of national, regional, and local strategies to deal with cholera underscored the poor cooperation between institutions. Some examples are presented in the following paragraphs.

Ministry of Health (MOH) departments presented the unique characteristic of being staffed with technically capable people who, unfortunately, work in isolation from the other departments. The prime example of this was observed at the municipal health directorate level between the epidemiological department and the health education department. While the epidemiologists were working to isolate the origins of cholera cases, their findings were not being used by the health education people to design health messages targeted at groups at risk identified by the epidemiologists. The flip side of the coin looked the same. Health education people were designing information for mass diffusion, rather than developing education messages targeted at the high risk groups being identified by the epidemiologists. The same pattern was observed at the regional and the national levels. Coordination between agencies at all levels—the national, regional/provincial, and municipal—was characterized by the same kind of independence observed within the MOH. Where the MOH might take the lead to bring different institutions together to combat cholera, their approach is to treat it as a problem exclusively within their mandate. This is to be expected, as traditionally the control of diarrheal diseases has fallen entirely under the MOH. However, prevention and control of cholera really require the coordination of a number of institutions including the MOH. The water and sanitation utilities should be actively engaged. IEOS, as the normative agency, should be engaged, as should provincial councils, municipalities, and NGOs and PVOs.

Among the PVO community, the work of CARE International has been outstanding with regard to latrization programs and the way they are implemented with active community participation. The excellent work notwithstanding, the lessons learned are not being incorporated into a larger national strategy for water supply and sanitation. Rather, what is more typical of the PVO experience is that they work independently of governmental agencies, and all too often the government is content with this arrangement. The lack of a national strategy or of guidelines for water and sanitation interventions, therefore, leaves the door open for a multitude of programs in the sector.

The absence of interagency cooperation leaves the country unprepared to adequately control the spread of cholera (see chapter 4). A well—defined strategy needs to be developed if existing resources are to be used efficiently. Also, the coordination and implementation of a strategy would benefit from a strong cholera committee both at the national level and the regional level. Presently, the chairmanship of the National Cholera Committee is but one of many duties of the Subsecretary for the Ministry of Health. The Subsecretary's myriad of duties leave little time for developing and encouraging an active agenda for the Cholera Committee. Leadership of the National Cholera Committee would be greatly strengthened if the chairman were a private citizen interested in public health issues.

## 5.4 Legal and Regulatory Environment

The poor performance of utilities also arises from a lax regulatory environment. IEOS and the MOH are two entities that have regulatory and enforcement functions with regard to water supply and sanitation services, and protecting public health. However, both fall short of fulfilling these mandates.

IEOS has the sanction of law to set norms and to oversee the performance of public water and sanitation utilities. However, IEOS has never actually performed this role. The reason may be that it simply lacks credibility at the provincial and municipal levels. It may also be due to the fact that IEOS acts almost exclusively as a construction agency rather than the normative and regulatory agency it was created to be. A strong IEOS performing its normative mandate would monitor utilities in production of an adequate quality and quantity of water and in the proper disposal of wastes. The absence of regulatory oversight ensures poor service performance and leaves the utilities free to ignore the future in terms of adequately addressing increasing demand and the need to plan for investment in infrastructure.

An example of this was observed in Esmeraldas. EMAPYA allows tankers unlimited trips from the treatment plant. Tankers (with a capacity of 7 m<sup>3</sup>) pay an average of S2,800 per trip to EMAPYA. The general manager informed the team that some tankers, to increase their margins, alternate fill-ups at the treatment plant with fill-ups from the Teune River (a highly polluted source -- see Chapter 3), and sell both loads at the average rate of S4 per liter, (S28,000 per trip). If indeed this kind of alternate service is occurring, it represents criminal activity. But in the absence of a working regulatory agency, such activity is allowed to continue.

A similar problem was observed at the Esmeraldas treatment plant. On the day of the team's visit, a gas chlorine cylinder ran out. Replacing the one-ton cylinder depends on the availability of a front-end loader from the municipality. Municipal workers were on strike so the loader was not available. Meanwhile, EMAPYA continued to distribute water without telling the public that it was untreated. A functioning monitoring agency would have treated the situation as an emergency and insisted that the municipality, in the interest of protecting public health, replace the cylinder. They would also have insisted that the utility advise customers to disinfect the water in their homes until further notice.

Notwithstanding IEOS' mandate, however, its credibility to have leverage with EMAPYA may be unlikely in the best of circumstances. The team was told that an S850 million grant IEOS obtained from Ecuadorian Development Bank (BEDE) in 1990—to increase water production through the development of four new wells and the expansion of the distribution network—has been frozen since mid-1992. EMAPYA suspects that IEOS diverted some of the funds to other activities.

The transfer of IEOS out of the MOH to the Ministry of Urban Development and Housing has created some uncertainty about its overall future as well as its relationship with the MOH. Given the climate of national budgetary pressures, there is concern among personnel about force reductions. Despite the fact that the transfer decree retains virtually all the responsibilities



given to the institution while under the auspices of the MOH, there is still concern about what IEOS's program goals will be.

The MOH, on the other hand, is the first voice of concern that should be heard regarding public health. Currently the MOH's approach to cholera is to respond to outbreaks rather than sound the alarm to municipal officials and the public at large about impending threats to public health. Suggested here is something quite different than educating the public about hand washing and excreta disposal to avoid cholera—things the MOH is indeed doing. What is suggested is that the MOH possesses the tools to be more vigilant in detecting emerging threats to public health. For example, had the MOH notified municipal, provincial, and national officials that the hundreds of thousands of people squatting in marginal urban areas without water and without excreta disposal present a serious threat to public health, policies to discourage some of the migration might have emerged.

Also absent from the legal and regulatory arena are private interest groups (*juntas civicas*). A strong coalition of public health-minded citizens lobbying the national legislature or applying pressure to existing laws and institutions could function as a tool to create an enabling environment and to strengthen existing interest groups or to create new ones.

## **5.5 Economics and Finance**

The economic and financial operations of the water supply and sanitation utilities are not encouraging. The three utilities visited are recovering only a small part of their costs from the billing of customers. There are two types customers: those with household connections, and those receiving water from tankers. The performance of the first group is uniformly poor. Collections from households with connections to the network range from only 25 to 40 percent. In some cases, billing has been an occasional exercise with as many as eleven months between billings. Even when billings were made, the tariffs were very low and below true cost—in fact, often as much as four times below what the second group pays when it receives water by tanker.

The second group not only receives poorer quality and a smaller quantity of water, they also pay upon delivery and pay more per unit of water received than those with household connections (see Chapter 3). Table 1 presents some comparative data between cities visited and between customers with household connections and those receiving water by tanker.

In Table 1, there was some dispute over the correct rate charged per household in Guayaquil as to whether the rate was 0.50 sucres or 1.0 sucres. The argument is irrelevant because the water utility has not billed customers since January 1992. Household connections provide

**Table 1**

**Water Delivery and Comparative Cost  
in Three Coastal Cities**

	<i>Household Connections</i>			
	<i>Guayaquil</i>	<i>Machala</i>	<i>Esmeraldas</i>	<i>Tanker**</i>
Liters per month* per household	30,000	30,000	30,000	6,250
Cost per liter (in sucres)	0.50	0.024	0.16	4
Total/Month cost per month (in sucres)	15,000	720	4,680	25,000

\*Based on WHO requirements of 155 liters per capita per day for a household of six.

\*\*Tanker rates average four sucres per liter in all three cities visited.

water to 1.5 million of Guayaquil's 2.7 million inhabitants. The average tanker rate was calculated by averaging the rates encountered in the three cities. Tanker rates varied according to location of the delivery point, e.g., difficult access hillside settlements, by day of week, or by distance. Actual rates varied from 600 to 1,000 sucres for 55 gallons (208 liters). At an average rate of 800 sucres for 208 liters, the per liter rate is roughly four.

Table 2 demonstrates the potential revenues the utilities could be collecting if all their customers paid as regularly and as much as do those now receiving water by tanker. Table 2 assumes that every household would receive normal service and meet at least the minimum WHO standard of 155 liters per day per person.

Tables 1 and 2 provide some information basic to understanding the economic and financial problems facing the water and sanitation utilities in the three cities visited.

*Empresa de Agua Potable-Guayas*, as noted above, has a serious cost recovery problem. The team did not review current accounting statements. At the time of the team's visit, billing was just being restarted after an 11-month hiatus. But the utility's past reporting shows that only 33 percent of daily production is billed in the best of times. EPAP's overall deficit was \$5,940 million or 54 percent of revenues, and the operating deficit was \$3,808 million or 37 percent of operating revenues in 1991 (WASH Field Report No.376).

**Table 2**

**Potential Monthly Revenues  
at Average Tanker Rate**

	<i>Guayaquil</i>	<i>Machala</i>	<i>Esmeraldas</i>
Liters per month per household	30,000	30,000	30,000
Cost per liter (in sucres)	4	4	4
Total per month (in sucres)	120,000	120,000	120,000
Total US\$	\$67	\$67	\$67
No. Households*	450,000	24,000	28,000
Revenues US\$	\$30,000,000	\$1,608,000	\$1,929,600

\*Based on total population with six persons per household.

*Empresa Municipal de Alcantarillado*, the primary sewer authority in Guayaquil, had a deficit of S1,630 million on total operation costs of S2,626 million in 1991. Since sewage is billed along with water, and water has not been billed since January, the deficit probably increased in 1992. The team did not conduct an analysis of the utility's accounting, as it was difficult to get access to data other than general information.

*Departamento de Agua Potable de Machala*

This network attempts to provide water service to all of its 145,000 inhabitants. The system was built in the 1960s to serve a population of 40,000 and has never been expanded. It has also suffered from poor maintenance (see Chapter 3). The department claims to reach about 40 percent of the current population through its distribution system, but service interruptions, breaks, and illegal connections all suggest that only about 25 percent of the population is served by the network. The rest are served by tankers.

The department is presently in a serious economic crisis. It is currently spending 91 percent of its budget on recurrent costs. Its accounting statement for 1991 has not been completed because of insufficient data. The most recent year, 1990, shows an operating deficit of S50 million, which was 12 percent of the S413 million budget. The fact that the 1991 accounting statement is not available, and that the data on 1992 were not readily available to the team

during its visit suggests that problems are serious. IEOS is providing \$400 million for renovation of the system. As with all of the other utilities, an important source of revenues is from the municipality, which in turn depends on the transfers from the national government.

The composition of the municipality of Machala's expenses in 1980 compared with those in 1989 underscores the problems facing the municipality and water department. In 1980, 53 percent of its budget was for investment in infrastructure, while recurrent costs accounted for 31 percent. In 1989, investment in infrastructure accounted for only 9 percent of the budget while recurrent costs accounted for 82 percent. The team was told that recurrent costs in 1991 were 92 percent of the budget, although an accounting statement was not available for the team's review to verify this figure. Transfers from the central government accounted for 57 percent of the municipality's revenues in 1981 and 51 percent in 1989. Taxes accounted for only 22 percent of revenues in 1981 and 19 percent in 1989 (Jarrin, et al., 1991,). Yet, unemployment in 1988 was only 4.4 percent of the adult population, suggesting good potential for some cost recovery.

Machala's population has been growing at the rate of 3.6 percent over the last 10 years, and at the rate of 5.3 percent over the previous 20-year period. This is a rate higher than that of any other urban area in the country. The high level of economic activity makes the area attractive. The high population growth rate suggests that the population will double in another 10 years or so. It is hard to imagine how the department will deal with trying to provide service to 350,000 people when it is unable to do so for 145,000. What is evident from the population growth and the high level of economic activity, however, is that there are resources available that may be as yet untapped.

#### *Empresa de Agua Potable y Alcantarillado*

EMAPYA, the water and sanitation utility in Esmeraldas, has had seven general managers in the last two years. The current general manager has been in office for five months. The general manager is recruited and selected by the city council. The high rate of turnover at the executive level reflects the utility's problems, and the inability of any one person to solve them. A decline in revenues over the years has left the utility in a crisis. The situation has become so bad that EMAPYA no longer carries accounts payable in its accounting statements. Accounts payable are about \$525 million. About half of the accounts payable are underpaid salaries and unpaid benefits to the utility's 145 employees. (Since June 1992 all employees have been receiving only partial salary payments.) Some benefits, such as social security payments, have been unpaid for as long as two years.

Mainly because of the underpaid salaries and unpaid benefits, EMAPYA workers are expected to begin an indefinite walkout January 10, 1993. If sustained for any length of time, the walkout will mean a complete halt of service. That it will begin in the rainy season when the transmission of cholera is intensified only aggravates the threat to the public health of Esmeraldas.

With the accounts payable removed, the utility's operating statement shows an operations deficit of only \$23 million as of the first semester of 1992. With accounts payable in the

statement, the operations deficit reaches S550 million, or almost 82 percent of EMAPYA's overall 1992 budget of S673.4 million.

Presently, EMAPYA is collecting revenues on about 40 percent of the water supply service it delivers. (Sewage charges are a percentage over the amount of water consumed.) Both water and sewage have rates on a graduated scale for residential, commercial, and industrial consumers. A campaign to encourage payment by defaulters was started by EMAPYA in December 1992. The idea is to publish (by newspaper and radio) the names of any customer with arrears of two years or more. Failure to pay after this notice will result first in service being discontinued. The next step will be a court order (*juicio coactivo*). It is expected that those in arrears will pay the defaulted amount plus interest. Prosecution may be an option for those who fail to follow through, but since no case has yet been tried, it is difficult to judge whether or not such a campaign would work. EMAPYA's history of poor service gives the utility weak leverage in trying to get customers to pay.

Privatization also holds some promise for improving the utility's technical operations, and therefore its service. A plan to privatize some operations is under consideration. Employees currently know about the existence of a privatization plan, but because its details are unknown, a climate of suspicion and worry has been created.



## Chapter 6

### RECOMMENDATIONS

#### 6.1 Water and Sanitation Recommendations

##### 6.1.1 General Short-Term Water and Sanitation Recommendations Applicable to the Coastal Areas of Ecuador

Based on the site visits to Guayaquil, Machala and Esmeraldas, the following short-term water and sanitation recommendations are applicable:

- Develop a contingency plan at each water supply system to ensure that power supply and chlorine are available at all times.
- Develop a household water disinfection program for all areas that receive water from tanqueros, for areas where cisterns are used, and in zones where water pressure in the distribution network is low. This program should promote the use of closed containers with a water valve for in-house drinking and food preparation water. In addition, this program should include the supply of chemicals for disinfection and an educational training program. Prepare a workshop to teach local authorities how to execute this program.
- Develop a permitting/certification system for tanqueros. Establish new laws based on which criminal charges can be brought against tanqueros or any person who sells contaminated water to the public.
- Provide regional water quality laboratories with equipment, reagents, and trained staff to monitor and control water quality throughout the region. Minimum testing capabilities should include turbidity, color, pH, hardness, chlorides, total and free available chlorine residual, total and fecal coliform, nitrate, nitrite, iron, calcium, and magnesium.

##### 6.1.2 General Long-Term Water and Sanitation Recommendations Applicable to the Coastal Area of Ecuador

Based on the site visits to Guayaquil, Machala, and Esmeraldas, the following long-term water and sanitation recommendations are applicable:

- Develop a master plan and preliminary design for water supply, treatment, storage, and distribution that will set the goal of supplying potable water to the design population 24 hours per day with less than 25 percent unaccounted for water. The planning documents should comply with the requirements of international lending institutions, including cost recovery and environmental and public health assessments.

- Develop a master plan and preliminary design for the long-term management of sewage and excreta. The master plan should include the development of water quality goals that are compatible with the water master plan.

### **6.1.3 Site-Specific Recommendation for Guayaquil**

In addition to the general recommendations, the site-specific recommendation for Guayaquil is as follows:

- Study the feasibility of providing an exclusive and direct aqueduct to the south sector of town that by-passes the storage reservoirs of the north. Include in this evaluation the cost-effectiveness of using the well field proposed by a group of British consultants to supply the south sector.

### **6.1.4 Site-Specific Recommendations for Machala**

In addition to the general recommendations, the following are site-specific recommendations for Machala:

- Expedite the restoration and repair of the Pubenza and Union wells and bring them online as soon as possible. Instead of upgrading the La Lucha Water Treatment Plant, the city should investigate the possibility of adding more wells and decommissioning the existing plant as soon as possible.
- Install chlorinators for all water supply wells or common force mains as soon as possible.
- Install a post-chlorination facility at the Puerto Bolivar storage tank and pumping facility.
- Expedite the installation of chlorine facilities at the Regional WTP.

### **6.1.5 Site-Specific Recommendation for Esmeraldas**

In addition to the general recommendations, the following is a site-specific recommendation for Esmeraldas:

- Expedite the completion of the new water supply wells to increase the quantity of water supply.



## **6.2 Hygiene Education Recommendations**

### **6.2.1 Short-Term Recommendations**

- Strengthen the epidemiological surveillance system so that cholera planning and decision-making is based on risk of vulnerable populations, geographic area, and time of year. This should be linked to the development of a communications plan for hygiene education.
- Develop and present a workshop in the coastal region to train health educators and health inspectors in information gathering techniques at the community level. Topics should include data collection and analysis; approaches for community participation; use of epidemiological information; and the preparation, implementation, and evaluation of hygiene educational strategies and campaigns.
- Develop and present an inter-agency workshop to review a full range of technical alternatives available for on-site excreta disposal.

### **6.2.2 Long-Term Recommendations**

- Incorporate community participation into cholera prevention and control activities but follow clearly defined guidelines that ensure the sustainability of the strategy.
- Monitor and evaluate hygiene education campaigns to ensure feedback to the process.

## **6.3 Institutional Recommendations**

### **6.3.1 Short-Term Recommendations**

- Convene an inter-agency workshop for the development of a regional cholera strategy for coastal Ecuador.

### **6.3.2 Long-Term Recommendations**

- Develop and present a water supply and sanitation seminar that explores new approaches to financing and managing municipal utilities.
- Explore the possibility of reforming the public administration system at the national, regional, and provincial/municipal levels focused on creating an enabling environment for decentralization and privatization.
- Strengthen the national cholera committee leadership by designating a private citizen to the position of chair.

### **6.3.3 Recommendations for USAID**

- Increase development assistance in latrinization, directed at urban areas.

## **Appendix A**

### Sampling Programs for Guayaquil, Machala, and Esmeraldas

### Sampling Program - WASH Water Quality Study, Ecuador

#### Guayaquil Sampling Program

Sample ID	Date	Time	Description	Location	pH	Chlorine, mg/l		Total bacteria*	Fecal coliform*	Comments
						Total	Free			
1	02-Dec-92	7:38a	Network pipe, hose	Guayaquil Centro, Villa Cabilca	7.1	1.08	0.92		negative	Residents filling buckets with hose
2	02-Dec-92	8:00a	Network pipe, hose	Guayaquil Centro, Calle los Rios	7.2	0.91	0.55		negative	Residents filling buckets with hose
3	02-Dec-92	8:20a	Network pipe, hose	Guayaquil Centro, Garcia Moreno y Francisco Segura	7.2	0.87	0.71		negative	Residents filling buckets with hose
4	02-Dec-92	8:41a	Network pipe, hose	Guayaquil Centro, Portete y Lorenzo de Quesada	6.7	1.03	0.71		negative	Residents filling buckets with hose
5	02-Dec-92	8:57a	Network pipe, manometer/sampling	Guayaquil Centro, Jose Mascote y Iro de Mayo	7.1	0.76	0.69		negative	Manometer reading = 6 psi
6	02-Dec-92	9:13a	Estacion rechlorinadora	Guayaquil Centro, Luis Verneze y Tugurahua	7.3	1.09	1.09		negative	Former re-chlorination station, now truck fill up
7	02-Dec-92	10:22a	Camara de despacho	Guayaquil Norte, Guayaquil Norte, Olmos y Gran Via		1.47	1.09		negative	Flow splitting station Flow controlled
8	02-Dec-92	10:49a	Toma de Bella Vista	Guayaquil Norte, Toma de Bella Vista		1.17	1.04		negative	Truck tank fill up
9	02-Dec-92	1:15p	La Toma Water Treatment Plant	KM 26	7.5	2.2	2.17		negative	Finished water after chlorination
10	02-Dec-92	1:45p	Toma de tanqueros norte	Km 8.5		0.93	0.86		negative	Truck tank fill up
11	03-Dec-92	8:04	55 gal tank	Quasmo central,		0.05	0.04	Positive	224	55 gal drum Filled previous day
12	03-Dec-92	8:25	55 gal tank	Quasmo sur, Bloque 2	7.7	0.12	0.06	Positive	negative	Filled yesterday
13	03-Dec-92	8:49	55 gal tank	Quasmo sur, Proletariado Sin Tierras	7.3	0.76	0.54	Positive	negative	Filled today
14	03-Dec-92	9:07	55 gal tank	Quasmo sur, La Playita	7.6	0.64	0.60	Positive	negative	Filled today
15	03-Dec-92	9:30	55 gal tank	Quasmo central, Coop Miramar	7.5	0.06	0.06	Positive	negative	Filled yesterday
16	03-Dec-92	9:40	55 gal tank	Quasmo central, Nuevo Horizonte	7.5	0.66	0.52	Positive	negative	Filled today
17	03-Dec-92	10:00	55 gal tank	Quasmo norte, coop los Verjeles	7.3	0.04	0.04	Positive	2	Community cistem filled last week by tanqueros
18	03-Dec-92	10:20	55 gal tank	Quasmo central, coop 10 de Agosto	7.3	0.08	0.02	Positive	3	Private cistem filled two days before by tanqueros
19	03-Dec-92	10:40	Cistem, fed by network	Sur - Comision de transito	7.0	0.04	0.04	Positive	9	Water taken from a hose that fills cistem
20	03-Dec-92	11:05	Network with suction pump	Coop, Fartusa	7.0	0.50	0.25	Positive	negative	
21	03-Dec-92	11:21	55 gal tank	Cooperativa Santiago Roldos	7.0	0.08	0.03	Positive	1	Filled yesterday
22	03-Dec-92	11:35	55 gal tank	Cooperativa Santiago Roldos	7.3	0.78	0.59	Positive	negative	Filled today
23	03-Dec-92	11:49	55 gal tank	Sur Oeste, La Trinitaria	7.3	0.89	0.68	negative	negative	Filled today
24	03-Dec-92	12:08	55 gal tank	Sur Oeste, Parroquia Febras Cordero	7.3	0.30	0.10	Positive	negative	Filler earlier in the day (about 7 am)
25	03-Dec-92	12:25	55 gal tank	Calle F & 27	7.3	1.21	1.21	negative	negative	City sewer
26	03-Dec-92	12:40	Network with suction pump	29 y Sidalena	7.3	1.98	1.43	negative	negative	Water is dirty and stinks when it comes in
27	03-Dec-92	1:00	Network used to fill tank	11 y Francisco de Marco	7.3	0.15	0.03	Positive	negative	Used for car wash

\* MPN/100 ml = most probable number per 100 ml

# Sampling Program - WASH Water Quality Study, Ecuador

## Machala Sampling Program

Sample ID	Date	Time	Description	Location	pH	Chlorine, mg/l		Fecal coliform*	Comments
						Total	Free		
1	07-Dec-92	11 15	Raw water from channel	La Lucha WTP			0.14	3,100	Water from El Canal El Macho
2	07 Dec-92	11 45	Raw water from channel	La Lucha WTP				7,200	Water from El Canal El Macho
3	07-Dec-92	11 50	Chlorinated Water before pumping	La Lucha WTP	6.7	0.84	0.73	0	First chlorine application
4	07-Dec-92	12 00	La Lucha finished water	Tanquero filling up at La Lucha		1.25	1.39	0	After second chlorination
5	07-Dec-92	12 25	Water supply well - Corralitos		7.3	0.03	0.03	0	
6	07 Dec-92	12 45	Water supply well 10 de Agosto		7.5	0.03	0.02	0	
7	07-Dec-92	3 20	Pumping station - Puerto Bolivar	Puerto Bolivar	7.6	0.06	0.05	15	Many people come to wash cloth and get buckets of water
8	07-Dec-92	3 40	55 gal drum	Calle Municipalidad y Cordoba, Restaurant, Puerto Bolivar	7.5	0.24	0.08	2	Restaurant
9	07-Dec-92	4 00	Water from network	Ciudadela El Seguro, Machala	7.5	0.41	0.34	0	Pump and pressure tank system. Takes water from the network
10	07-Dec-92	4 20	Water from network	Ciudadela El Pilo, Machala	7	0.09	0.08	0	This section of town has sufficient water pressure
11	07 Dec-92	4 40	55 gal drum	Barrio El Porvenir, Machala	7.5	0.03	0.03	0	Served by tanquero yestrdy. The source is probably a private
12	07-Dec-92	5 00	Cistern	Calle Santa Rosa y Gasyacan, Centro	7.0	1.60	1.45	0	Tanquero. The area has city water but very low pressure
13	07-Dec-92	5 15	Hose from network	Calle Juan Montalvo y Pichincha	7.0	0.42	0.36	0	Hose from network. Tee of the 2" PVC pipe. Potential contam
14	07-Dec-92	5 30	Water from network	Ciudadela Unioro	7.5	0.03	0.02	6	Pump and pressure tank system. Takes water from the network
15	08-Dec-92	9 05	Community cistern	Barrio Voluntad de Dios	7.4	0.07	0.03	116	Common water for several dwellings
16	08-Dec-92	9 20	Cistern fed by network	Ciudadela Las Brisas	7.5	0.01	0.03	30	Cistern fed by network. Pump and pressure tank
17	08 Dec-92	9 35	Water from network	Calle Boyacan y 10 de Agosto	7.0	0.75	0.68	0	Direct from network
18	08-Dec-92	10 05	55 gal drum	Los Verjeles	8.0	0.03	0.02	1	Looks like is from a different source
19	08-Dec-92	10 15	55 gal drum	Los Verjeles	7.3	2.20	2.16	0	At the time it was supplied by the tanquero
20	08-Dec-92	10 30	Canal El Macho	Los Verjeles				14,000	Water used for washing cloth and swimming
21	08-Dec-92	12 15	Raw water from the Rio Jubones					18	Source of water to the regional plant

\* MPN/100 ml = most probable number per 100 ml

## Sampling Program - WASH Water Quality Study, Ecuador

### Esmeraldas Sampling Program

Sample ID	Date	Time	Description	Location	Chlorine, mg/l		Fecal coliform*	Comments
					Total	Free		
1	10-Dec-92	1:30	Tanquero fill up	El Cabezón area, north	0.03	0.03	0	Just below the WTP.
2	10-Dec-92	2:00	Water Treatment Plant Influent	North	0	0	0	Water from well field after aeration
3	10-Dec-92	2:10	Water Treatment Plant Effluent	North	0	0	0	Chlorination not working because they can't change tank
4	10-Dec-92	5:45	Río Teuna	North	0	0	260,000	People bathing and washing cloth
5	10-Dec-92	6:15	Río Teuna - Downstream	North	0	0	360,000	People bathing and washing cloth
6	10-Dec-92	9:20	Community cistern	Codessa Area	0.06	0	3	Owner sell water to nearby residents. Cholera case nearby
7	11-Dec-92	9:35	Network water	Aire Libre Sector	0.03	0.01	0	Service all the time
8	11-Dec-92	9:50	Network water	Calle Eloy Alfaro, Centro	0.09	0.09	0	Commercial Building
9	11-Dec-92	10:05	Cistern fed by network	Hospital Delfina Torres Concha	0.01	0	3	Largest city hospital with one active cholera case
10	11-Dec-92	10:10	Cistern fed by network	Las Palmas, Norte	0.05	0.05	2	Military facility
11	11-Dec-92	10:30	Water from the refinery WTP	Las Palmas, Norte	2.64	2.2	0	Tanquero. Water used by the refinery and the Petro Ecuador Subdivision
12	11-Dec-92	10:45	55 gal. drum fed by tanquero	Tercer Piso Sector, North	0.02	0.02	22	Tank filled earlier that morning. Paid 800 sucres.
13	11-Dec-92	11:00	Cistern fed by tanquero	Tercer Piso Sector, North	0.04	0.05	0	The cistern is 7 m <sup>3</sup> . Was filled about 20 days ago. Paid 28000 sucres
14	11-Dec-92	11:20	Network water	Santa Marta	0.03	0.02	54	Place near the river. Area was sanitary fill.
15	11-Dec-92	11:40	Cistern fed by tanquero	Barrio Los Almendros	0.06	0.05	2,000	Cistern filled yesterday. Coliform uncountable >2000 MPN/100 ml

\* MPN/100 ml = most probable number per 100 ml

96

## Appendix B

### Persons Contacted

#### USAID/Ecuador

Mr. Michael Jordan, Acting Deputy Mission Director  
Dr. S. Ken Yamashita, Health Officer  
Mr. Sonny Low, Regional Housing and Urban Development Office  
Dr. Mario Vergara, General Development Office  
Dr. Patricio Murgueytio, General Development Office  
Ing. Adalid Arratia, Project Coordinator

#### IEOS, Quito

Ing. Vladimir Roura, Sub-secretario of IEOS  
Ing. Aurelio Ochoa, Director of Basic Sanitation  
Ing. Diego Gonzalez, Chief of Projects, IEOS/USAID

#### MOH, Quito

Dr. Efrain Pacheco, Director General of Health  
Dr. Alberto Narvaez, National Director of Epidemiology  
Dr. Diana Zavala, Chief, Gastrointestinal Diseases Program and Cholera  
Dr. Franklin Idrovo, Control of Diarrheal Diseases Program  
Mr. Eduardo Sainzar, Health Educator, Maternal and Infants Program  
Lic. Segundo Neira, Chief, Department of Education  
Lica. Rosita Andrade, Department of Education

#### National Cholera Committee, Quito

Dr. Efrain Pacheco, Director General of Health and Chairman of the Committee  
Lic. Mario de Torre, General Coordinator for the Director General of Health  
Dr. Carlos Romero, Delegate, Ministry of Education  
Dr. Mario Valcarcel Novo, Delegate, PAHO  
Lic. Carlos Rosero, Delegate, Ministry of Education  
Dr. Guadalupe Perez, National Institute for Hygiene, Quito  
Dr. Alfredo Davila, National Institute for Hygiene, Guayaquil  
Dr. Hernan Moscoso, Director, Improvement and Promotion, Ministry of Health  
Dr. Diana Zavala, Delegate, Directorate for Epidemiology  
Dr. Francisco Carrasco, Director of Health Services, Ministry of Health

#### IEOS El Oro Province, Machala

Ing. Fransisco Vera Dominguez, Provincial Director  
Ing. Richard Añasco Dávila, Director, Water Department, Municipality of Machala

Dr. Jose Vicente Cedeno, Director of Planning, Ministry of Health  
Dr. Arik Benhamour, Coordinator, French-Ecuadorian Project for the Control of Diarrheal Diseases and Cholera

CARE International

Mr. Chris Roesel, Project Manager  
Dr. Raul Cadena Gonzalez, Sub-Director

IEOS, Guayas Province (Guayaquil)

Ing. Felton Florencia Santana, Provincial Director  
Lica. Maria Pia Cabrera, Public Relations  
Ing. Augusto Dao Ochoa, Technical Director  
Ing. Milton Guaman, Construction Inspector  
Ing. Leopoldo Guerrero, Chief, Environmental Control Laboratory  
Ms. Luz Cisneros, Laboratory Technician  
Ing. Fildel Camchong, Program Engineer

Municipality of Guayaquil

Ing. Mario Chavez Baird, Executive Director, EPAP  
Ing. Gustavo Castillo, Technical Division, EPAP  
Ing. Ismael Lopez, Director of Operations, EPAP  
Ing. Eduardo Barreras, Interim Director, EMA  
Ing. Castillo, Technical Division, EMA

MOH, Guayaquil

Dr. Ernesto Gutierrez, Sub-secretary, Health Region II  
Dr. Enrique Vera, Coordinator for Sub-secretary, Region II  
Dr. Ricardo Canizales, Chief of Epidemiology, Sub-secretary, Region II  
Dr. Liria de Vaca, Director, National Health Services, Guayaquil  
Lic. Rosa Riofrio, Epidemiologist, Sub-secretary Region II  
Dr. Alfredo Davila, Chief of Bacteriology and National Diagnostic Coordinator for Cholera, Guayas Province  
Dr. Silvio Torres, Director for Provincial Health, Guayaquil  
Dr. Bolivar Cardenas, Chief, Department of Epidemiology Guayaquil  
Dr. Fausto Caicedo G., Department of Epidemiology, Guayaquil  
Dr. Cesar Pastor, Department of Epidemiology, Guayaquil  
Sr. Jose Recalde S., Chief, Provincial Department of Statistics, Guayaquil  
Dr. Antonio Martinez, Director of Public Health, Municipality of Guayaquil



## **Appendix C**

### **Sites Visited**

Ximena Parish, sector Guasmo Sur Guayaquil  
Letamendi Parish, sector La Chala Guayaquil  
Tarqui Parish, sector Mapasingue, Marta Roldos, Guayaquil  
Avenida 9th of October, Guayaquil  
Central Plaza, Guayaquil

Barrio Rayito de Luz, Machala  
Barrio Venezuela, Machala  
Comunidad Bajo Alto, Canton Guabo, Machala  
Comunidad Caliburo, Canton Santa Rosa, Machala

Barrio Codesa, Esmeraldas  
Barrio Propicia 4, Esmeraldas

Debriefing of National Cholera Committee, December 17, 1992  
Debriefing of IEOS, Quito, December 17, 1992  
Debriefing of USAID/Ecuador, December 17, 1992

**Camp Dresser & McKee International Inc.**  
Associates in Rural Development, Inc.  
International Science and Technology Institute  
Research Triangle Institute  
University Research Corporation  
Training Resources Group  
University of North Carolina at Chapel Hill

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## THE WASH PROJECT

With the launching of the United Nations International Drinking Water Supply and Sanitation Decade in 1979, the United States Agency for International Development (A.I.D.) 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 multi-year, multi-million 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 since then, CDM has continued as the prime contractor.

Working under the close direction of A.I.D.'s Bureau for Science and Technology, Office of Health, the WASH Project provides technical assistance to A.I.D. missions or bureaus, other U.S. agencies (such as the Peace Corps), host governments, and non-governmental organizations to provide a wide range of technical assistance that includes the design, implementation, and evaluation of water and sanitation projects, to troubleshoot on-going projects, and to assist in disaster relief operations. WASH technical assistance is multi-disciplinary, drawing on experts in public health, training, financing, epidemiology, anthropology, management, engineering, community organization, environmental protection, and other specialties.

The WASH Information Center serves as a clearinghouse in water and sanitation, providing networking on guinea worm disease, rainwater harvesting, and peri-urban issues as well as technical information backstopping for most WASH assignments.

The WASH Project issues about thirty or forty reports a year. WASH *Field Reports* relate to specific assignments in specific countries, they articulate the findings of the consultancy. The more widely applicable *Technical Reports* consist of guidelines or "how-to" manuals on topics such as pump selection, detailed training workshop designs, and state-of-the-art information on finance, community organization, and many other topics of vital interest to the water and sanitation sector. In addition, WASH occasionally publishes special reports to synthesize the lessons it has learned from its wide field experience.

For more information about the WASH Project or to request a WASH report, contact the WASH Operations Center at the above address.