

ENVIRONMENTAL HEALTH PROJECT

ACTIVITY REPORT

No. 21

A Plan for CDS to Establish
A Water and Sanitation District
In Cité Soleil, Haiti

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Prepared for
ENVIRONMENTAL HEALTH DIVISION
OFFICE OF HEALTH AND NUTRITION

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



GreenCOM

Environmental Education and Communication Project



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Fred Rosensweig, EHP
Chris McGahey, EHP Consultant
Richard Noth, EHP Consultant
Lonna Shafritz, GreenCOM
Peter Gottert, GreenCom

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GreenCOM

Environmental Education and Communication Project

The Environmental Education and Communication (GreenCOM) Project promotes public awareness and community support for new environmental policies and practices. GreenCOM also promotes changes in individual behaviors and institutional practices. It does this through collaboration with environmental education and communication (EE&C) components of USAID Mission and Regional projects. GreenCOM project staff work with host-country and partner institutions by providing short- and long-term technical assistance to support a broad range of EE&C activities.

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ABOUT THE AUTHORS

Fred Rosensweig is the Technical Director for Human Resources and Institutional Development on the Environmental Health Project and a Vice President of Training Resources Group. His expertise includes the organization of the water and sanitation sector, policy analysis and implementation, and the design of institutional strengthening programs. He has extensive experience in managing multidisciplinary activities and coordinating wide ranging inputs. He served as team leader for the technical assistance effort on the Haiti activity. He has lived in Senegal, Cameroon, and Tunisia and carried out short-term technical assistance in more than 30 countries in Europe, Latin America, and Africa. Mr. Rosensweig is fluent in French.

Christopher McGahey is an environmental engineer working with Associates in Rural Development, Burlington, Vermont. He has an M.Sc. and Ph.D. from the Johns Hopkins University. In addition to work in the United States with EPA in wastewater treatment, he has overseas experience in Africa (Peace Corps, Kenya, and environmental impact studies for the World Bank), Thailand (with the International Rescue Committee working in a refugee camp in various engineering aspects), and the Caribbean. Most recently, he has worked with EHP in assessment and design of a wastewater treatment plan for Montego Bay, Jamaica, and has undertaken multiple trips to Haiti to work with CDS in developing the plan for Cité Soleil.

Richard Noth is a water and wastewater utility finance specialist. He has over 20 years experience working in Latin America and the Caribbean. His expertise is in conducting tariff and credit analyses of utilities, developing privatization plans, and improving utility management. He has worked with water utilities in Peru, Bolivia, Uruguay, Panama, El Salvador, and Jamaica. Mr. Noth has an M.P.A. from the University of Pennsylvania; he speaks fluent Spanish.

Lonna B. Shafritz is a senior program officer for Health, Population and Nutrition Programs at the Academy for Educational Development (AED). Ms. Shafritz provides technical assistance to social marketing and communication activities. She has worked with the environment, health and population projects throughout the world. Her expertise includes designing and analyzing applied behavioral research and developing, implementing, and evaluating programs. Ms. Shafritz has consulted for a variety of international organizations, including UNFPA, Pathfinder International, the Johns Hopkins University (PCS), John Snow International, and Save the Children. Additionally, she has extensive private sector experience in the United States in both marketing and economic research. Ms. Shafritz holds a B.A. degree in economics and history from Brandeis University and is fluent in French and Spanish.

Peter Gottert is an AED senior program officer on the Nutrition Communication Project. In this capacity he provides technical assistance and training materials development for community-level interventions and assists in the strategy development for regional and country-level projects. Mr. Gottert has conducted numerous workshops to strengthen the communication management capabilities of francophone African governments and PVOs. Mr. Gottert combines his graphic arts and message, research, design, and pretesting skills to assist community organizations to produce health promotion materials. Prior to joining AED, he lived in Benin for ten years where he founded and managed Development Graphics, with a client roster that included USAID, the World Bank, and UNICEF. Mr. Gottert speaks French fluently and holds a B.A. in urban technology from Brown University.



ACRONYMS

CAMEP	La Centrale Autonome Métropolitaine d'Eau Potable (Urban Water Supply Agency of Port-au-Prince)
CAR	Central America and the Caribbean (USAID Region)
CDS	Les Centres pour le Développement et la Santé (Centers for Development and Health)
CHF	Cooperative Housing Foundation
DHP	Department d'Hygiene Publique
GRET	Groupe de Recherche et d'Echanges Technologiques
IDB	Interamerican Development Bank
NGO	nongovernmental organization
PADF	Pan American Development Foundation
RHUDO	Regional Housing and Urban Development Office (USAID)
TPTC	Ministry of Public Works, Transport, and Communications
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
Currency:	15.5 gourdes = US\$1



EXECUTIVE SUMMARY

From October 1995 to May 1996, the Environmental Health Project (EHP), with assistance from GreenCOM, worked with Centres pour le Développement et la Santé (CDS) in drawing up plans for an autonomous water and sanitation District in Cité Soleil, an informal settlement of 200,000 inhabitants in Port-au-Prince. CDS has historically been the largest Haitian NGO and has been particularly active in Cité Soleil. EHP's efforts were part of an 18-month project designed by USAID/Haiti and RHUDO/CAR with funds from the Environmental Initiative for the Americas Program. The USAID activity was designed to enhance an ongoing UNDP-funded project to construct an independent water supply system for Cité Soleil. UNDP provided \$2.5 million to CDS to construct the system, which is scheduled for completion July 1, 1996. The system consists of two wells 5 km. from Cité Soleil, a water tank with a capacity of 264,000 US gallons, a network of pipes, and 70 public fountains, 60 of which are equipped with four faucets. Eighteen of the fountains were financed by Plan International.

The USAID project was designed to support CDS in establishing an autonomous organization capable of managing the UNDP-financed water supply system and providing environmental sanitation services with revenues from the sale of water. EHP has overall responsibility for the technical assistance, while GreenCOM is responsible for the behavior change component.

The purpose of the technical assistance was to help CDS in the following areas:

- Develop a financial plan to operate and maintain the UNDP-funded water supply system
- Develop an infrastructure plan to address the additional water and environmental sanitation needs in Cité Soleil
- Develop a plan for the creation of an autonomous District to manage the water and sanitation services over the long term

The plan developed for operation of the system has five major components, as described below.

Institutional Design of an Independent Water Management District

The District will be an independent, community-based organization established by CDS. Currently, CDS has a 3-year contract with CAMEP, the water authority for Port-au-Prince, to manage the water supply system in Cité Soleil. The plan calls for CDS to establish a new, autonomous organization and to then modify the current contractual arrangement with CAMEP so that there is an adequate, long-term framework for the District. The new organization will have autonomy to operate the system, set rates, retain its own revenues, and make its own investment decisions. The plan outlines the staffing requirements for the District, provides an organizational structure, and describes the management and administrative systems which must be developed.

Community Participation and Behavior Change

The District is organized so that the community will play a prominent role in managing the system. Each of the 70 public fountains will be managed by a neighborhood fountain committee. These committees will be formed from existing neighborhood associations that lie within the area served. Each committee will be responsible for hiring a fountain operator and a laborer to manage the fountain. The committee will also be responsible for collecting money from water

sales, reading the water meter daily, paying the operator, and ensuring that the fountain is maintained. Representatives of the fountain committees will comprise a zonal oversight committee.

The District will also be responsible for solid waste collection with direct involvement. Each of the seven zones in Cité Soleil will form a zonal committee, which, in addition to its water-related responsibilities, will in turn hire a solid waste collection crew and oversee its operation. The fountain and zonal committees will be paid a modest sum.

The behavior change component began by identifying current practices regarding water and sanitation—buying water, its usage, safety, and treatment; wastewater disposal; human waste disposal; public showers and laundries; and community involvement. Information about these practices was then used to develop a communications strategy and messages aimed at changing key behaviors.

Infrastructure

The infrastructure component includes a site description, current environmental conditions, and immediate and future needs for the water supply system, solid waste management, and domestic wastewater disposal. Water is currently brought into Cité Soleil by truck and sold to local vendors, who in turn sell it to residents. The most important immediate investment in the water supply system is to permit full coverage of the population with an acceptable volume of water by expansion of the number of public fountains. Environmentally, solid waste currently presents the major problem in Cité Soleil because there are no services to collect and transport the solid waste out of the community. Left with no alternative, residents throw their refuse into the network of drainage canals. Garbage clogs the canals to the point where the storm drainage combined with industrial wastewater and fecal material overflow into people's homes. Consequently, establishing a solid

waste management system is of paramount importance.

No sewage collection or treatment systems exist in any part of Port-au-Prince. The problem is accentuated in Cité Soleil where only 30% to 40% of the population have access to latrines. The major need in wastewater management is to expand access to latrines, preferably communal facilities due to extremely dense population and soil conditions inhospitable to household pit latrines.

Finance and Rate Scheme

Analysis of the current market size and the costs required to operate and maintain the water supply and solid waste collection systems shows that the District has the potential to be financially self-sufficient. The current market size is sufficient to sell water at a price slightly lower than the current prices from vendors. The resulting revenue will be sufficient to pay for all operations and maintenance of the water supply system as well as solid waste collection and disposal services for all residents of Cité Soleil. Although the Consultative Board of the District will have to make the final decision, it is recommended that the price of water be set at 1 gourde per 7-gallon container. At this price, the District should sell enough water to cover its costs, most of which are fixed. As additional fountains are built, unit costs will fall and additional revenues will be generated. At that point, it might be possible to lower the price of water, further expand the system, or undertake wastewater management projects without jeopardizing the financial position of the District.

Demonstration Activities

As part of this project, CDS received \$90,000 to implement demonstration projects focusing on key technologies and management systems. These are intended to serve as pilot projects which can eventually be expanded by the District to improve excreta control, decrease

environmental damage from indiscriminate wastewater disposal, and establish the means to implement the larger goals of sanitation service and disease reduction. The demonstration projects will include community-managed communal latrines, public laundry facilities, a pilot solid waste collection team, and implementation of the first two phases of the communications strategy.

The effort to establish an autonomous organization for a very poor and very large informal community is extremely ambitious and optimistic. The social and political environment in Cité Soleil is volatile and could prove to be a major obstacle. If the community

does not actively support this effort, the District will not be successful. The challenges are daunting; environmental conditions within Cité Soleil are among the most severe in this hemisphere. Nevertheless, the amount of money people are currently paying for water is so large that the potential for financial sustainability is very real. The acceptance and active participation of the community and the ability of CDS to establish a viable institution are the keys to the long-range success of the project. If it is successful, it will provide a model that has great potential for replication elsewhere in Haiti and in other countries.

1

Introduction

1.1 Background

In recent years, lack of fertile land, political instability, repressions, and embargoes have resulted in rapid migration from rural to urban areas of Haiti. For example, the population of Port-au-Prince has increased from an estimated 1 million to 1.6 million since 1990. This rapid urbanization has increased environmental concerns, particularly in the coastal zones where most Haitian cities are located. Migrants to the cities have difficulty finding employment and often end up living in crowded urban slums in areas with appalling environmental conditions. The situation in the slums of Port-au-Prince is particularly bad. There is no safe piped water supply and no adequate disposal of solid and human waste. These conditions create serious health hazards. Diarrheal disease incidence is very high, and diarrhea remains, along with intestinal parasites, the main cause of morbidity and mortality among children under five. In Cité Soleil, the largest slum area in Port-au-Prince, every child under five has, on average, one episode of diarrhea per month, and hospital case mortality can be as high as 25%. As expressed by residents of Cité Soleil, the greatest community improvement needs are water and sanitation.

In response to the environmental situation in Cité Soleil, USAID/Haiti and the Regional Housing and Urban Development Office for the Caribbean (RHUDO/CAR) designed the Haiti Urban Pollution Project. Cité Soleil is an informal settlement located on a filled wetland peninsula which extends into the Bay of Port-au-Prince. Approximately 200,000 residents

live in Cité Soleil without piped water, sewer systems, or solid waste services. Most residents purchase water from vendors, defecate in the open, and dispose of garbage in drainage canals.

USAID's efforts were designed to support a UNDP-funded project to construct an independent water supply system for Cité Soleil. UNDP provided \$2.5 million and contracted with Centres pour le Developpement et la Santé (CDS) to construct the system. CDS awarded contracts with private firms for the actual construction. The water system is scheduled to be completed in July 1996. CDS also signed an agreement with CAMEP, the urban water supply agency for Port-au-Prince, to manage the system for three years. When funding became available under USAID's Environmental Initiative for the Americas Program, USAID/Haiti, with assistance from RHUDO/CAR, saw an opportunity to support CDS in establishing an autonomous District capable of managing the new water supply system and, in addition, providing badly needed environmental sanitation services financed through revenues from the sale of water. The USAID component is designed for an 18-month period, with technical assistance from two of USAID's centrally-funded projects, the Environmental Health Project and GreenCOM.

Founded in 1974, CDS was historically the largest Haitian NGO, with approximately 1,800 employees. CDS is involved in health care, economic development, agriculture, education, water supply, and nutritional supplement programs. CDS has been particularly active in Cité Soleil, operating, until recently, a hospital and clinics. Currently they continue to direct programs in education,

sanitation, and credit in Cité Soleil. The Haitian Urban Pollution Project was designed to assist CDS in establishing an autonomous water and sanitation District (hereafter referred to as the District). The plan, developed with EHP assistance, would detail the specific requirements for setting up an autonomous organization capable of managing the water supply system and providing environmental sanitation services. The resulting document includes an organizational and management component, a financial strategy, a community mobilization component, an infrastructure component for improvement of environmental sanitation conditions, and a solid waste management plan. EHP was assigned overall responsibility for development of the plan, while GreenCOM was given responsibility for the community mobilization component.

1.2 Description of Cité Soleil

Although Chapter 4 provides a detailed description of Cité Soleil, the following section provides a brief overview. The initial construction of housing for 52 families in Cité Soleil began in 1958. After a serious fire in 1966 in neighboring La Saline, Cité Soleil experienced a large increase in population. Another fire destroyed an area near the central market, and another major influx of population followed. Since 1973, the area has undergone continuous population growth. The present day population of 200,000 lives in an area of approximately two sq. km. of habitable land, the densest and poorest population in the hemisphere. Cité Soleil is under the administrative authority of the municipality of Delmas. A major drainage canal serving Delmas runs through Cité Soleil to the Bay of Port-au-Prince. The topography is flat, with most of the population living less than two meters above sea level. Most people live in single family dwellings, but the density is very high as most of the dwellings are only one or two rooms. Half of the houses are cement with metal roofs, while the others are built with

scavenged material. Only 30% to 40% of the households have access to a latrine. The population density is estimated at 940 per hectare (390 per acre). Slightly over half the families have monthly incomes of less than \$53.

The environmental problems in Cité Soleil are severe. Open areas are filled with solid waste. Drainage canals carry both industrial and household waste from outside the area. Groundwater is just 1 to 5 feet below the surface and is fed by the surrounding ocean and by infiltration of the drainage canals. Because there is virtually no collection of solid waste, residents throw their garbage into the drainage canals and thus block the flow of liquid waste. The drainage canals overflow regularly into streets and people's homes.

Household water is supplied primarily by private vendors; water is brought into Cité Soleil by truck. Other sources include the Salesian Fathers who provide free water brought in by trucks and a deteriorated distribution network, operated by CAMEP, which provides contaminated water.

1.3 Relevant Donor Efforts

In the course of developing this plan, EHP contacted a number of donors who were either active in Cité Soleil or who were carrying out activities which were directly relevant to the District. The Inter-American Development Bank (IDB) is currently planning a project to rehabilitate the major drainage canals in Port-au-Prince. One of these canals crosses Cité Soleil and drains into the Bay of Port-au-Prince. The Ministry of Public Works, Transport, and Communications (TPTC) has recently begun field work for this project, and its eventual impacts on Cité Soleil are unknown. Plan International is currently active in Cité Soleil and has committed funds for the construction of water fountains for the District. It has also expressed interest in contributing further to the effort to establish a water and sanitation District. The Cooperative

Housing Foundation (CHF) has been very active in solid waste management in Port-au-Prince and provided useful insights to the design of the District's solid waste management plan. CHF activities have been principally directed toward establishing a solid waste management system for greater Port-au-Prince as well as spearheading community-level efforts in marginal communities. UNICEF has been active in developing effective latrines for poor urban communities in Port-au-Prince (although not including Cité Soleil). UNICEF shared with District staff its latrine designs and information on costs. UNDP was also contacted since it is funding the new water supply system. UNDP is not currently planning any other new efforts in Cité Soleil or similar areas, but has agreed to make some additional funds available for fountain construction.

Other organizations active in water and sanitation in Cité Soleil, such as GRET and the Mevs Foundation, are well known to CDS and District staff and were therefore not contacted by the EHP team. In the future, the District may want to contact these organizations to determine their interest in providing support.

1.4 Scope of Work

The purpose of the technical assistance was to help CDS in the following areas:

- Develop a financial plan to operate and maintain the UNDP-funded water supply system
- Develop an infrastructure plan to address the additional water and environmental sanitation needs in Cité Soleil
- Develop a plan for the creation of an autonomous District to manage the water and sanitation services over the long term

The scope of work called for the plan to be developed by March 1996 and implemented by April 1997. The following components were specified:

- A comprehensive infrastructure plan for water, wastewater, and human waste at the household and community level
- An organizational and management plan for an autonomous water and environmental sanitation District
- A financial strategy to implement the plan
- A human behavior and community mobilization plan
- A solid waste management plan
- Recommendations for demonstration projects that utilize behavior change strategies and appropriate technologies to show how to carry out modest, effective means of controlling household waste and sanitation

Although the scope of work initially called for the development of a plan after four months of review and site survey (by March 1996), the consultant team and CDS suggested that implementation of the plan begin after the initial visit of the technical assistance team in October 1995. The team believed that the magnitude of the task to establish an organization to manage water and sanitation services for 200,000 people required getting started as soon as possible. The team therefore wrote a preliminary version of the plan at the end of its October 1995 visit which included a series of actions to be carried out by June 1996, the date when the water supply system was scheduled to be completed. Additional technical assistance visits were made from December 1995 to May 1996. These visits provided the chance to collect more accurate financial information, technical data about environmental conditions, and community and household-level data for development of a communications strategy. By March 1996 the team had completed the plan for setting up the District with the exception of the communications strategy, which was completed in April 1996.

Over the next 12 months, EHP will carry out two monitoring visits to assess progress and recommend any necessary mid-course

corrections. USAID/Haiti will maintain ultimate responsibility for carrying out regular monitoring and oversight to make sure the entire project remains on track.

1.5 Organization of the Report

This report is organized into seven chapters. Following this introduction, Chapter 2 describes the organizational requirements to create an autonomous water and sanitation District. Chapter 3 describes the role of the community in the management of the District and the behavior change component. Chapter 4 provides the infrastructure plan, including descriptions of the site, the UNDP-funded water supply system, solid waste management, and control of domestic wastewater. Chapter 5 provides the financial analysis and possible rate structure as well as a financial management

plan. Chapter 6 describes the recommended demonstration projects. Chapter 7 summarizes external support needs and suggests a monitoring plan for the project.

It is important that this plan not be viewed as a static or fixed document. Although the plan tries to anticipate major actions that need to take place, it is impossible to predict changing conditions that may require modifications in the plan. Cité Soleil is a highly charged community; the response of residents as well as numerous other variables may necessitate different strategies. In addition, the District's hands-on, day-to-day experience in operating the water system and providing sanitation services in Cité Soleil will surely call for modifications and adjustments in this plan. This document should be viewed as a starting point, based on best available information and experience, but not the final word.

2 Creation of an Autonomous Water and Sanitation District

Establishment of the water and sanitation District in Cité Soleil will be based on four key principles:

- The District will have autonomy in key aspects of its operation, including setting policies and objectives, making investment decisions, developing budgets, setting tariffs, hiring and firing of personnel, setting salaries, and making investment decisions. (Autonomy does not mean that the District will be free of regulation by any outside institutions.)
- The District will be run with substantial involvement by the community. The District will be structured so that the community will play a major role in key decisions such as setting tariffs, investment decisions, and selection of water vendors.
- The private and nongovernmental sector will be involved where possible. Local community organizations will be responsible for management of the fountains and solid waste services. The District will also use private sector contractors for certain maintenance tasks to keep permanent staff levels and associated costs low.
- The District will be entirely self-financing and thus will be able to control all factors important to its operations. It is expected that the fees for water will generate sufficient revenues to pay the operating costs of both the water system and the sanitation services.

2.1 Goals of the Water and Sanitation District

The administrative and environmental goals of the District are to:

- Efficiently manage the UNDP-financed independent water supply system for Cité Soleil
- Provide solid waste collection services to all residents of Cité Soleil, using revenues generated from selling water
- Improve excreta disposal services available to residents of Cité Soleil

2.2 Institutional Relationships

Responsibility for water and sanitation services in Port-au-Prince is technically shared among a number of organizations including the Ministry of Public Works, Transport, and Communications; the Ministry of Health; the water company for the metropolitan area of Port-au-Prince (CAMEP); and the municipalities. Of these organizations, the most important for the District in the first year of operation are CAMEP and the municipality of Delmas.

CAMEP

In the next several years, the relationship between the District and CAMEP will be of primary importance. CAMEP, a state-owned company responsible to the Ministry of Public Works, Transport, and Communications, is the sole organization charged with responsibility for potable water in the Port-au-Prince area. CAMEP does not manage

drainage, solid waste, or wastewater. CAMEP's long-range strategy is to retain overall responsibility for supervising water supply, while delegating the day-to-day management of individual systems to other entities. The creation of a water and sanitation District in Cité Soleil is consistent with CAMEP's strategy.

Municipality of Delmas

Cité Soleil is under the jurisdiction of the municipality of Delmas. The long-range plan of the Government of Haiti is to delegate responsibility for municipal services such as water and sanitation to the municipalities. Although formal government approval of the transfer of responsibilities for such services appears likely, it is doubtful that in practice the municipalities will be able to accept such responsibilities for some time due to institutional weakness. The decentralization of responsibility will require substantial strengthening of municipal capability before local governments are ready to take on new responsibilities. Efforts in this direction are just beginning and cannot be expected to increase municipal capability in the next three years to the point where municipalities can assume responsibility for services like water and sanitation.

Centres pour le Développement et la Santé (CDS)

CDS is the organization responsible for setting up the independent water and sanitation District. CDS has a long history of involvement in Cité Soleil, deep knowledge of the community, and highly qualified staff who can be called upon during this project. CDS's significant capabilities in health education, community promotion, and community research could have been of great benefit to the District in its first year of operation. However, as of March 31, 1996, CDS terminated all its health-related activities in Cité Soleil, including health education and community promotion. As a result, CDS will no longer have the staff capability that could have greatly assisted the

water and sanitation District. CDS will continue to oversee establishment of the water and sanitation District in addition to managing projects in credit and education in Cité Soleil.

Community

The community must play a significant role in management of the District. The community did not have significant involvement in the planning and design of the UNDP-funded water supply system. In a survey conducted by CDS, the community had a positive response to the water supply system. Focus groups conducted in development of this plan confirmed this finding. The plan for setting up the District includes an approach which calls for significant community participation in decisions and daily operations.

2.3 Legal Issues

In January 1995, CDS, CAMEP, and the Ministry of Public Works, Transport, and Communications signed a contract which formally delegated management responsibility for the water and sanitation District to CDS for three years. This contract, included as Appendix A, defines the roles and responsibilities of CAMEP and CDS for implementation and management of the UNDP-funded water supply system. This document provides a workable framework for the District to be established and to operate over the next three years; it does not, however, provide for a permanent, autonomous organization to manage water and sanitation services in Cité Soleil over the long term.

The current agreement is written as a management contract between CAMEP and CDS. Since the ultimate objective is to create an autonomous organization independent of CDS, the current contract will not provide the legal status to achieve that objective. The specific issues which will eventually need to be addressed by the District to provide the legal framework for a permanent organization are the following:

- Authority to operate the water system in Cité Soleil on a permanent basis, subject to appropriate norms and standards
- Authority to set water and other rates, subject to the approval of its own consultative board
- The right to retain all revenues and use them to fund other services
- The authority to establish its own internal operating procedures
- Ability to make investment decisions which rely on revenues generated within its own service area, receive capital donations, and contract debt.

2.4 Roles and Responsibilities

Table 1 lists the various responsibilities that must be carried out to provide water and sanitation services to Cité Soleil.

2.5 Key Factors in Establishing a Successful Water and Sanitation Service Agency

The critical areas of performance for a successful water and sanitation company are listed below. These elements provide a picture of what the water and sanitation District in Cité Soleil should be aiming for.

Autonomy. Organizational autonomy is the institution's degree of independence from local or national governmental bodies. Autonomy means the power to make decisions about important matters such as budget, tariffs, hiring and firing personnel, planning, and policies. The District must be able to conduct its affairs with minimum interference and controls by other entities.

Leadership. Leadership is the ability to inspire others to understand the institution's mission and to work towards its achievement. Leadership also means providing positive role models and motivating staff to work hard.

Leadership occurs at all levels, not only at the general manager level.

Management and administration. Management is organizing people and resources to get the job done. Effective management is demonstrated by the capacity to get the most out of the resources available. Good managers are aware of operational details; they monitor and follow up on issues consistently. Good managers also seek to establish a climate of teamwork and cooperation among staff. Along with good management goes the establishment of effective administrative systems in personnel, budget, financial management, and information.

Commercial orientation. An effective water and sanitation District is committed to operating as a business. Decisions and actions of the District should be driven by a concern for cost effectiveness and efficiency. Financial equilibrium should be achieved annually. Cost factors should be a constant concern.

Consumer orientation. Consumer orientation means organizing and directing the efforts of the utility to serve consumers. All the actions of the District will be directed toward greater efficiency and equity in serving its customers. Staff at every level should have this orientation. Mechanisms should be in place for consumers to bring problems to the attention of the agency.

Technical capability. The District must be able to provide safe water, regular solid waste collection, and improved wastewater management. This work should be done not only by the organization's staff but also by private contractors and local community organizations.

Developing and maintaining staff. Quality staff are the backbone of any organization. The District must provide an environment which allows adequate job satisfaction, fair wages,

Table 1
Responsibilities for Water and Sanitation Services

Function	Organization Responsible
Setting policies and goals (planning)	District
Management and administration budgeting accounting personnel procurement contracting asset management	District
Commercial operations setting tariffs collections meter reading	District community organizations District/community organizations
Operation and maintenance of water system pumps pipeline to water tower water tower distribution network water fountains and fixtures	District District District District District/community organizations
Solid waste services collection cleaning drainage canals hauling solid waste to the landfill	District/community organizations District/community organizations District
Investments investment decisions design construction supervision	District District/CAMEP District/CAMEP
Monitoring water quality auditing finances technical operations	District/CAMEP District/CAMEP District

and benefits to retain staff. A minimum of unwanted turnover is an indicator of a good working environment.

Organizational culture. This term represents the set of values which guide everyday actions. The District must develop and convey a positive organizational culture that communicates to staff and customers that it is a good place to work. The District also needs to be able to respond to changing circumstances and be willing to grow and evolve. Staff should take pride in working for the District.

Interactions with external institutions. A water and sanitation utility must be able to influence positively and strategically those institutions which affect its ability to perform, including national and local government institutions, donors, and nongovernmental organizations. The District must be able to influence these external institutions to greatly improve the organization's chances of reaching its goals.

2.6 Organizational Structure of the Water and Sanitation District

The water and sanitation District in Cité Soleil will be organized into four departments: operations and maintenance of the water supply system, water sales, solid waste, and administration. Table 2 is an organization chart of the District.

Technical Services includes operations and maintenance of the water system, solid waste collection, and monitoring of the public fountains. Solid waste collection will be managed by entering into contracts with local community organizations. Water will be sold by entering into concession agreements with these community organizations.

The Consultative Board will have broad-based representation from all the concerned organizations. As of the writing of this plan, the Consultative Board will consist of one representative each from CAMEP, CDS, the municipality of Delmas, GRET, and Plan

International; two representatives from the community; and the general manager of the District. The role of the Consultative Board will include agenda-setting, advising, and monitoring. Although it will not be involved in day-to-day operational decisions, the Board will have the following financial and planning responsibilities:

- approve tariffs
- commission and review the findings of an annual financial audit
- approve the investment priorities
- approve projects funded by other donors
- approve the by-laws of the District
- set overall direction for the District
- approve the annual operating budget
- solicit external financing for new capital projects

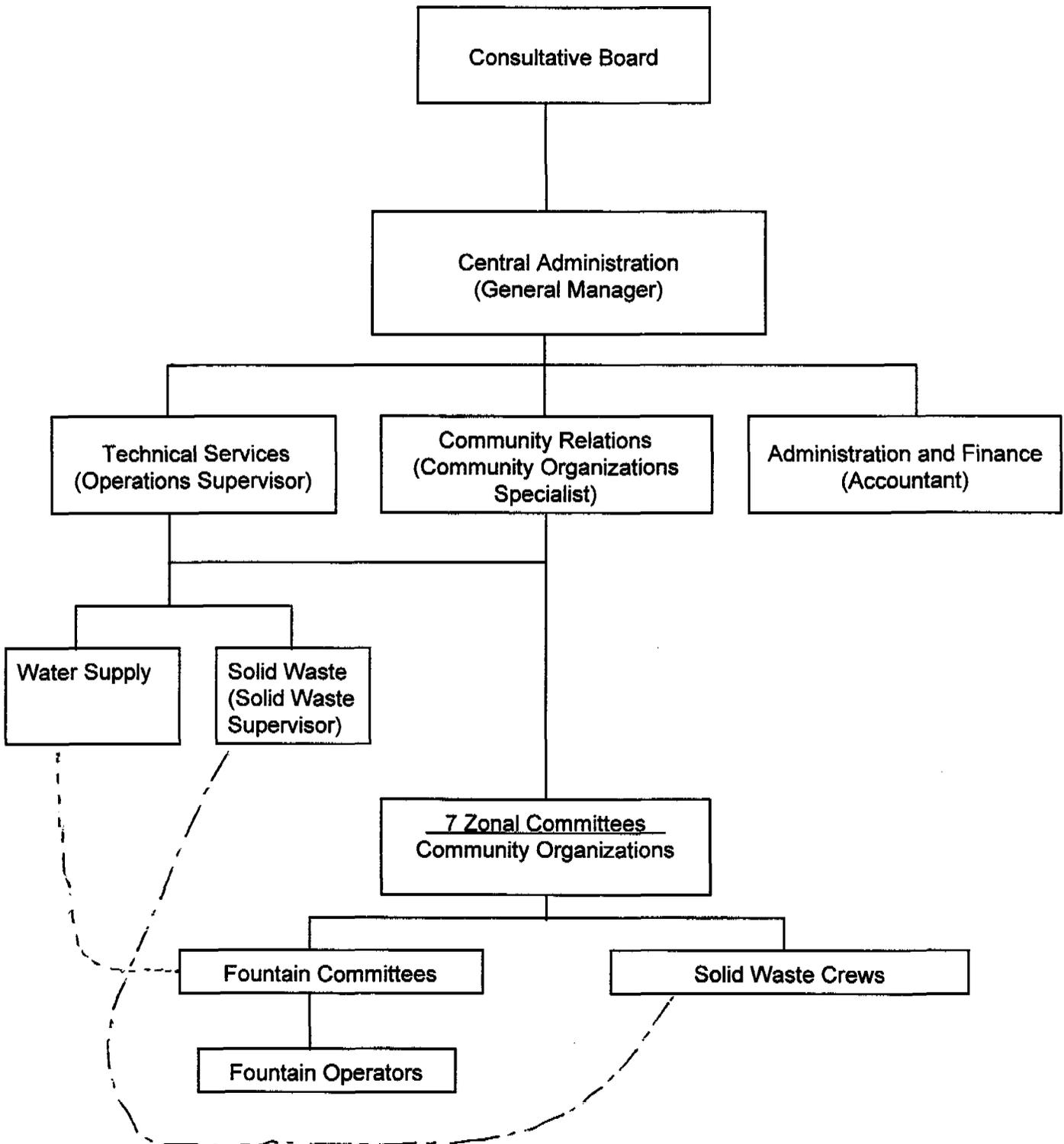
2.7 Staffing

The size of the District's staff will be as small as possible to minimize operating costs.

The central administration will consist of the following staff positions:

- general manager
- operations supervisor, responsible for both the water system and solid waste collection
- solid waste supervisor, responsible for direct oversight of the solid waste collection
- community organization specialist, responsible for liaison with local community organizations
- accountant, with overall responsibility for the finances of the District
- two cashiers
- two secretaries
- driver
- messenger
- guard
- seven zonal committee coordinators
- seven zonal committee clerks

Table 2
Organizational Structure



USAID is supporting three positions through April 1997: general manager, operations supervisor, and community organization specialist.

Additional staff required to operate and maintain the water system will include the following:

- two operators of the water tower
- technician and laborer to provide maintenance services
- three watchmen for the water tower and source wells

The fountain operators will not be employees of the District. Instead they will be chosen by the fountain committees and paid by them. The solid waste collection crews will not be employees of the District either. They will also be hired through zonal communities. The staff to operate and maintain the pumps at the two wells will be provided by CDS per Article 11 of the contract between CDS and CAMEP. (See Appendix A.)

2.8 Management and Administrative Systems

The District will need to set up all the internal systems necessary to run a small utility. These systems should be designed as simply as possible to avoid unnecessary expenses, but they must include the following categories:

- financial (budgeting, accounting, cash management)
- personnel (compensation, hiring and firing policies, fringe benefits, etc.)
- contracting (for outside services)
- procurement (supplies and equipment)
- inventory (maintaining stores and supplies)

2.9 Training Needs

Below is the list of the priority training needs for District staff. Not all of this training has to

be carried out through formal workshops; some of it can be provided on the job. In certain cases, the staff hired will already have the needed technical skills and will require only minimal training.

Fountain Operators

Fountain operators will need to be trained in a formal one- or two-day workshop. Because of the number of operators to be trained and the hands-on nature of the skills, workshops should be limited in size—10 to 15 people maximum. Fountain operators will need training in the following areas:

- basic operation and maintenance of the fountain
- meter reading
- overview of the water supply management system
- crowd control
- reporting responsibilities
- financial management
- keeping the fountain area clean and free of standing water

Fountain Committees

The fountain committees will require a basic orientation in how the water supply management system works, basic bookkeeping, reporting requirements, and monitoring of the fountain operator's job performance.

Zonal Committees

The zonal committees will require an orientation in the solid waste management system, basic bookkeeping, reporting requirements, and monitoring of the solid waste crews' job performance.

District Financial Staff

The accountant and two cashiers will have to be trained in the use of the financial system. This training will include cash management, accounting, and budgeting.

District Technical Staff

Three specific District staff from the central administration—the water tower operator, maintenance technician, and the solid waste supervisor—will have to be trained in customer service, technical requirements of the system, and operations and maintenance procedures. This training will be individualized, i.e., carried out by the operations supervisor with the three staff members separately.

All central office staff should be trained in management skills, community relations, and customer service. This training should be carried out by an external consultant in a formal workshop after all staff are hired and have had several months of experience working together.

2.10 Strategy for Creating an Independent District

The strategy for creating the District has several key elements:

- Implementation of the plan actually began after the preliminary plan was developed in October 1995. Key staff were hired, community input solicited, community organizations identified, and a Consultative Board formed. Starting implementation before the plan was finalized allowed more time to lay the groundwork for the District to be operational in July 1996, when the water system is scheduled to be finished.
- The District should become independent from CDS as soon as possible. CDS's role will be to get the District's organization started and provide administrative assistance for the first nine months of operation, making it easier for the District to be autonomous and to avoid CDS's being in a service delivery role. All staff hired by CDS (through the subcontract with EHP) should be considered employees of the District, even though

they will receive their pay from CDS during the transition period. The intent is to give the District a separate identity from CDS from the start. So, for example, the coordinator position in the subcontract should become the general manager of the District.

- The process for setting up the District should involve the community in decision-making from the beginning. Virtually all parties who were consulted during the development of this plan stated that the success of the District depends on the degree of support from the community. Chapter 3 describes the steps to involve the community.
- The current legal framework established in the contract between CAMEP and CDS does not provide an adequate long-term framework for an independent District. Nevertheless, discussions with CAMEP indicate support for the concept. When the details of the plan are developed and by-laws written, these should be approved by CAMEP, and if necessary the Ministry of Public Works, Transport, and Communication, to provide a sound legal basis for the future.
- CDS has experience that will be valuable in setting up the District. CDS has implemented a solid waste collection project in Cité Soleil. It is implementing a water supply project in La Saline. It has experience in community development and in carrying out community research. Experience gained through these activities should be brought to bear on this project to help realize its full potential.
- The District will need to coordinate its efforts with other organizations active in Port-au-Prince, especially those with ongoing activities in Cité Soleil. Plan International, which currently sponsors 9,000 children in Cité Soleil, has expressed direct interest in this project. Other organizations have carried out studies of many of the issues which the District will

address. A UNICEF activity built latrines in La Saline. UNDP recently funded a study on solid waste in Cité Soleil. GREC has developed community-managed water systems in Projet Drouillard. CHF has worked in the area of solid waste

management in Port-au-Prince. Linkages with these organizations should be established early to take advantage of their experience, both in setting up the District and making it operational.

3

Community Participation and Behavior Change

This chapter describes the social component of the plan to create a water and sanitation District in Cité Soleil. The social component is divided into two distinct but related areas. The first is involvement of the community in management of the District. Chapter 2 described the overall institutional framework for creating the water and sanitation District, and touched on the ways in which the community will be involved. This chapter describes in greater detail how that will occur.

The second area of the social component is behavior change. Achieving health benefits from improved water supply and sanitation services will require changes in the way residents store and use water and how they dispose of human, solid, and liquid waste. Another behavioral aspect relates to how the community perceives the District and residents' willingness to purchase water from the District instead of from private sellers.

To develop this part of the plan, GreenCOM, in conjunction with CDS staff, conducted qualitative research to determine current practices around the handling of water and disposal of greywater, human waste, and solid waste. Based on the results of this research, GreenCOM and CDS identified key messages to be delivered and developed an educational program aimed at changing behaviors in these areas. This chapter presents the results of the research and the communications strategy.

3.1 Community Participation

The objectives of the community participation component are to:

- Create a sense of ownership of the water supply system by the community so residents have a real stake in its success
- Place significant responsibility for managing water and sanitation services on the community (and conversely, reduce the management burden on the central District office)
- Protect the system against illegal connections and other abuses

3.1.1 Organization of Cité Soleil

Cité Soleil is composed of seven zones. Each has numerous community organizations or associations which have been formed. These organizations are neighborhood-based, and within any zone, there may be 20 or 30 separate ones. These organizations represent a wide variety of interests including social development, sports, and women's groups. The District will work through these existing organizations to involve the community in management of the system.

3.1.2 Community Management of Water Supply Services

As of May 1996, plans call for construction of 70 public fountains, with the likelihood that more will be constructed in the future. The strategy is to involve Cité Soleil residents directly in the management of the water supply system in three ways:

- Each fountain will be operated under the supervision of a five-member neighborhood fountain committee.

- Seven zonal committees, composed of representatives from the fountain committees, will act as liaisons between the District and the fountain committees.
- Two community representatives will serve on the Consultative Board.

The specific responsibilities of the fountain and zonal committees (and their position in the District's organizational structure) are based on qualitative research results, extensive discussions with the CDS team, and feedback obtained from community leaders in Cité Soleil during a three-day workshop. The guiding principle behind the design of the organizational structure is that any chance of success for the project rests primarily on active involvement of the beneficiaries, the residents of Cité Soleil. Local residents will be asked to create management committees. The design is also premised on neighborhood committees being responsive to the needs of the beneficiaries.

Neighborhood fountain committee. Local residents will be asked to elect a five-member volunteer committee (at least two members must be women) to manage each fountain. Each committee will supervise the work of one fountain operator (or more, if the fountains are adjacent), insure order and cleanliness around the fountain, resolve problems as they arise, and promote participation in local education/mobilization meetings.

Residents will be asked to vote for members of the local fountain committee. Candidates must be willing to work as volunteers and have respect in the community, a reputation for honesty, and availability to meet once a week. A public meeting will be held to elect the committee; election criteria and role of the committee will be explained, and hopefully 8 to 10 candidates (half men and half women) will be nominated. Each adult present will then vote for one candidate. The five candidates with the highest total votes (provided that at least two are women) will be

elected. Secret ballots were deemed the best method of protecting residents from the coercion of those who might seek personal gain and as a means of insuring that committee members truly reflect the voice of the majority.

Each committee will then elect a president, secretary, and treasurer; select one fountain operator (or operators, if the committee decides to divide the job between two or more people), and name a delegate to the zonal committee. The fountain operator will be responsible to the fountain committee, not the District. If residents are unhappy with the performance of the fountain operator, it will be the responsibility of the committee to rectify the situation.

Zonal committees. These committees, each representing one of the system's seven zones, will serve as intermediaries between the neighborhood fountain committees and the District. Zonal committees will be composed of one delegate from each fountain committee in the zone (between seven and ten, depending on the number of fountains in a given zone) and approximately five advisors, chosen by the District and approved by the fountain committee delegates. At least half of the members of the zonal committee should be women. Selection of the advisors will be based on the same criteria used to elect members of zonal committees. The zonal committees will be responsible for solid waste collection, as described in Section 3.1.3, as well as operation of the fountains.

Women's involvement. Although efforts were made to encourage the participation of women at the workshop, in the end, only five women attended, making it difficult for their opinions to be fairly represented. At the same time, several male participants clearly expressed their interest in the water system as a potential source of employment and, on several occasions, voiced frustration that the system was not addressing the unemployment

problem in Cité Soleil more directly. Given these social dynamics, it will be important to ensure that one-third to one-half of each community-based management committee is made up of women, a crucial step in safeguarding the system against exploitation for personal ends. Research results, experience from other countries, and comments made by participants at the strategy workshop all confirmed that women are less likely to be motivated by self-interest and more likely to support the system because of the health benefits it brings to their families.

Roles and responsibilities. The responsibilities of each fountain committee are the following:

- select the fountain operator (or more than one, if the committee so desires)
- select a fountain laborer
- ensure that the fountain operator(s) keeps the fountain open 12 hours per day
- collect the money from water sales each day
- read the water meter each day
- turn over all collections and the meter reading to the District every day
- finance and perform minor maintenance procedures
- ensure that the operator maintains the fountain and immediately reports to the District office or the committee any major repairs needed
- open a checking account so that the District can pay the fountain committee by check rather than by cash
- pay the fountain operator(s)

In this plan, the fountain operator is responsible to the committee, not the District. If residents are unhappy with the performance of a fountain operator, it will be the responsibility of the committee to rectify the situation.

The responsibilities of the fountain operator are as follows:

- ensure that the fountain is open during specified hours
- collect payment for water sales
- record meter reading each day
- maintain order and cleanliness around the fountain
- inform the fountain committee of any difficulties
- turn in cash and meter reading to the District daily

Zonal coordinator. The seven zonal coordinators will be full-time, paid employees. The coordinators' prime responsibilities will be to insure efficient, helpful communications between the District and the zonal and fountain committees; provide sound financial and administrative management of the zone; help fountain committees resolve problems as needed; and actively promote community participation in educational activities. Each zonal committee will be asked to recommend candidates for the position. However, final selection of the coordinators will be made by the District based on proven administrative skills and an ability to create and maintain trust between the District and the community-based management structure.

Payment of the fountain operators. The District has budgeted a maximum amount to pay a fountain operator and laborer. This was necessary to determine overall costs of the system and to set an appropriate water price. However, it will be up to each committee to decide what the operator's salary will be. A committee could decide, for example, to divide the job among multiple people. A committee could also decide to pay a fountain operator less than the budgeted amount initially, and increase it later if his/her performance warranted. The importance of the committee's setting the salary and paying the operator is to make it clear that the operator is responsible to the committee.

At the start, residents will pay for water from the fountains in cash. The use of tokens

or tickets was considered, to avoid having the fountain operator responsible for cash. The use of tokens or tickets poses other problems, however: it would add several steps to the process and bring with it the likelihood of counterfeiting, especially if tickets are used. To limit the amount of cash on hand, operators will be required to turn in the cash receipts each day. The preliminary estimate of water sales per fountain is \$50 per day. If it turns out that problems arise due to the use of cash, a system of tokens or tickets can be tried.

Payment to the fountain committee. The District will pay each fountain committee once a month. The payment will consist of the operator's salary (a figure set by the District) plus 50%, for use by the committee. Payment to the committee is intended to provide an incentive to take its responsibility seriously. The District will not put any restrictions on how the committee uses its portion; each committee can decide.

An alternative incentive would be to give the committee a percentage of sales. The advantage of doing this would be that the committees would encourage the sale of water. For the time being, the District should begin with payment to the committee of a percentage of the operator's salary and consider switching to a percentage-of-sales system at a later point if required.

Monitoring and enforcement. One of the District's key responsibilities will be to make sure that the fountains are operated honestly and efficiently. Problems that the District may encounter include inaccurate meter readings, operators' failure to turn in cash receipts each day, tampering with water meters, a committee's inability to deal with a fountain operator who does not show up for work, and failure to report needed repairs. (One important check will be the District's reading of all meters twice a month to verify the accuracy of daily meter readings reported by the operators or committees.) If these or other

problems are found, the District will make every attempt to help the committee resolve the problem. However, if such assistance does not work, the District will temporarily take control of the fountain, select an operator, and directly manage the daily operation. However, this should be a short-term measure. The District will try to reconstitute the committee and, as quickly as possible, return the responsibility for fountain management to the community. The reason for the District's taking over responsibility for a fountain is to keep the water supply system in operation for households in the area and to avoid a water crisis caused by poor management or other problems of the operator or committee.

Contract. The agreement between the District and each fountain committee will be formalized in a written contract. The contract will contain provisions concerning payment to the fountain committee, roles and responsibilities, and monitoring and enforcement provisions.

3.1.3 Community Management of Solid Waste Collection

The strategy for community involvement in solid waste management is similar to the one for water supply management. The system proposed for solid waste collection is to create at least one team in each of the seven zones in Cité Soleil. Each team will consist of 20 laborers and a crew chief and will be given basic equipment (shovels, wheelbarrows, rubber boots, rakes, etc.). This crew will be managed by the zonal committee with day-to-day management by the zonal coordinator. This zone committee will then select a zonal coordinator and a zonal clerk.

Roles and Responsibilities. The roles and responsibilities of the zonal committee with respect to solid waste are the following:

- select the solid waste crew

- ensure that the crew works a full workweek
- ensure that garbage is collected and brought to a collection point
- resolve complaints from residents
- open a checking account so the District can pay the committee by check
- pay the solid waste crews

Payment of Solid Waste Teams. The District has budgeted a set amount for the salaries of the crew members. The zonal committee will be responsible for paying the team on a regular basis, e.g., every week or two.

Payment for Solid Waste Collection. There will be no household or user fee for solid waste collection. Collection and disposal services will be paid for from water revenues.

Payment of the Zonal Committee. The District will pay the zonal committee at least once a month. Payment will consist of the salaries for the solid waste crew, the salary of both the zonal coordinator and the zonal clerk, plus an overhead of 10% of the salaries of the solid waste crew. As is the case with the fountain committees, the District will not place any restrictions on the committee's use of its overhead payment.

Monitoring and Enforcement. The District will monitor the performance of each zonal committee. Potential problems include too many crew members not showing up for work, and residents not having their garbage collected. District staff will try to assist the committee to deal with problems, but if those efforts are not successful, the District will be prepared to step in and temporarily take over the management of the zone. The District will then do whatever is necessary to reconstitute the committee and turn back the responsibility as quickly as possible.

Contract. The agreement between the District and zonal committee will be formalized in a

written contract. The contract should address roles and responsibilities, payment, and monitoring and enforcement provisions.

3.2 Behavior Change

This section presents the research findings and the communications strategy for changing key behaviors. The findings are based on 15 focus group meetings conducted by CDS in January 1996 with various residents of Cité Soleil. Overall, 540 residents participated. The results of this research have been used in designing key elements of the plan for the District.

3.2.1 Description of Current Practices

Water procurement

Residents of Cité Soleil generally purchase their water from mobile water vendors supplied by reservoir owners, who are in turn supplied by water trucks. (A number of residents who live near Catholic priest Père Lanoux's reservoirs receive water at no cost, except for Sundays when water is not distributed from those reservoirs.) Many residents use rainwater for various purposes (see the next section). Some households receive water from CAMEP, when water flows in the pipes. Due to unreliable service, many people no longer pay their CAMEP bills. In addition, a number of people get water through illegal tapping, mostly from the CAMEP system.

A 5- to 7-gallon bucket of water normally costs 1 gourde if purchased directly from reservoir proprietors and 1.5 to 2 gourdes per bucket from the mobile water vendors. On Sundays and when water is scarce, the price is higher, sometimes up to 3 gourdes.

According to the focus group comments, getting water is everyone's responsibility. If there is a servant, it is her job. If not, it is mostly children or women who fetch it. In a number of cases, it was said that "whoever needs it" gets it. While men claimed to search for water themselves, few women participants mentioned that men fetch water. It appears

that, for the most part, men will get water for their own needs, such as taking a shower, but are less likely to do so for domestic needs.

A trip to fill each water bucket can take less than 10 minutes if there is a reservoir nearby. If not, it can frequently take 20 to 30 minutes, when water is plentiful. It often takes children longer to bring water than adults. When water is scarce, it can take over an hour to get water and bring it home. Private reservoir owners indicated that when water is scarce, it can take up to five or six hours before a water truck arrives at their reservoir.

Focus group participants mentioned that sometimes when there is a line at the water source, there are tense problems that can become violent. Also, quite a number of participants indicated that they have to cross major roads (i.e., the National Route) which is very dangerous, especially with a full bucket on one's head.

Storage and usage of water

For the most part, participants indicated they use about four to seven buckets of water per day for drinking, cooking, and general household uses. Twice as much water is required on days when laundry is done. Water is generally stored in buckets, but a number also mentioned metal "drums", ceramic "canaris", plastic "gallons", and "cuvettes". Certain participants specified that they cover their water storage containers. The question of covering the storage containers was not asked directly, and many didn't specify. Water is reused several times. For example, water used to rinse laundry is used for bathing, cleaning the house, washing tennis shoes, or most importantly to minimize the dust by watering the street or around the house.

Many participants reported that rainwater is collected, especially for washing clothes. Many also use rainwater for showers, cooking, and cleaning dishes. Some people claimed to drink it, especially after treating it, but many others said they don't do that because they believe the water isn't safe. There were some

who don't use rainwater at all because they believe it to be contaminated.

Perceptions of Water Quality

The overall opinion was that water acquired directly from the reservoirs is not safe. Both men and women believed the reservoirs are not regularly cleaned and are badly constructed or situated (e.g., near latrines). They also indicated that the water is not usually clear (for the most part, it is yellow), has a bad smell and/or taste, and frequently contains particles (e.g., toad larvae, earthworms). The reservoir owners, however, maintain that the water is clean, since they claim to clean the reservoirs regularly and treat the water.

The water delivered by the mobile water vendors is perceived as even less pure because not only does it come from "dirty" reservoirs, but the buckets used to transport the water are themselves perceived as unclean, since it is assumed that the mobile vendors use their buckets for many things—to wash, eat, and drink from. The mobile vendors, like the reservoir owners, however, believe that the water they sell is safe because the reservoirs are washed often and because the water is treated. Water vendors point to another safeguard as well; the owners give them screens to pour the water through in order to filter out any foreign bodies, which were obvious indicators of unclean water.

The quality of piped water from the CAMEP system is also perceived as poor. Customers complained that water flowing in the pipes contains contaminants (i.e., algae, oil, tar, salt). Some CAMEP customers indicated that when the water runs, they can get clean water with a good taste from their spigots.

In contrast to these impressions, the reservoir water distributed by Père Lanoux was perceived as being much cleaner than that from other sources.

Treatment of Water

In order to make the water potable, most of the focus group participants reported adding

bleach (Clorox or Jif). Many also added lemon juice (presumably for taste rather than as a disinfectant), with a number adding both. Some said they boil the water, especially before giving it to their children. Other techniques were mentioned as ways to improve drinking water—use of a plant called “raquette”, a special tablet, or a screen (like that mentioned earlier by the mobile vendors) to remove solid particles.

Clean water was seen as necessary to good health, as a protection for the body, and of special importance for children. The diseases most often mentioned that are related to water include: diarrhea, malaria, typhoid, polio, cholera, and dysentery; skin problems including itching; vertigo; and colic and other stomach problems. Other diseases mentioned were cancer, female genital infections, tuberculosis, parasites, and malnutrition.

Disposal of Greywater

In general, greywater is thrown out in front of the house, in the nearby canals, or around the neighborhood. The focus groups mentioned several problems resulting from throwing out water into neighborhood areas, including stagnant pools where flies and mosquitos breed and the spread of diseases such as malaria, skin problems, and fever. Certain diseases were attributed to dishwater—vertigo, itching, and problems with the skin on the soles of the feet. Another problem cited is that the mud which forms from used water can cause accidents, especially for children. Disputes between neighbors often arise over outside disposal of greywater. They can even lead to legal proceedings.

The participants, especially those in flood zones, complained that the canal drainage system doesn't work very well; when water is thrown into the canals, it just stays there. Several said that it is extremely important that this situation be remedied and that there be somewhere safe to dispose of water, where it will drain properly.

Disposal of Human Waste

Of the 540 residents interviewed, 41% said that they have a latrine in the home. Such interviews, conducted without visual confirmation of the latrine, have typically been found to overestimate actual presence of latrines. Some participants indicated that they pay to use neighbors' latrines. Owners who rent their dwellings were concerned about human waste and thus prefer to rent to small families in order not to overload the latrine capacity.

Other responses indicated that many people defecate and urinate wherever they are—in the street, in public showers, etc. Another way that people dispose of human waste is to put feces on the roof.

Public showers and laundry facilities

Participants indicated that there are no public showers in Cité Soleil, but that there are certain places to bathe for a fee. At least one reservoir owner and one CAMEP client mentioned that they have or used to have a public washing place. It is unclear if these are real showers (i.e., with water falling from above) or just places where one can wash up. One person said that he had a shower but destroyed it, since it was abused by clients who used it to urinate and/or defecate.

In general, the participants believed that residents of Cité Soleil would appreciate construction of public showers and would be willing to pay a reasonable fee to use them. It was believed that if people used public showers, more water would be available at home for other purposes and there would be less mud in front of the houses. The participants suggested building several public showers in various locations, each with several shower heads in order to avoid long waits. (One participant who has a shower facility was concerned that the construction of public showers would reduce his income.) It was felt that public showers would be used primarily by men and children; women would feel uncomfortable if they lacked privacy. Also,

women were unlikely to use showers in the evening, even though that might be when they had available time, because of dangers to personal safety and potential domestic jealousy.

Household laundry is generally done at home or at la Plaine, a trip that can take all day. Some said they give their laundry to water vendors to wash for them. Some respondents mentioned a public laundry that used to be in Soleil 17 (at Père Lanoux's), but no one knew of any existing currently. The idea of finding somewhere to wash clothes nearby (i.e., public laundries) was very favorably received. Such a facility would eliminate the time and effort needed to bring lots of water into the house (and the related problem of having to dispose of it). Respondents seemed to picture a service for which they would pay a small sum and have access to unlimited water.

Organization of the Water Company

Overall, participants in the focus group were in favor of formation of a company to distribute water in Cité Soleil. The perceived benefits were that everyone would have access to safe water, at a moderate price, that would protect them (and their families) from disease. It was suggested that the company be private, since previous experience with the public sector in Cité Soleil, particularly with CAMEP, was negative.

Participants insisted that the fountains be managed by residents of Cité Soleil. They recommended that each fountain have a group of people from that "quartier", picked or elected by residents, to run and provide security for that particular fountain (and perhaps for other facilities such as showers or laundries). They recommended hiring one person per facility. Many respondents mentioned that having specific individuals assigned for this function would provide much-needed accountability and reduce illegal tapping, vandalism, and the like, which hurt all residents of the area.

Community participation and organizations

Generally, the focus group participants, especially those who belong to local organizations, indicated their intention to participate in this important project in several ways: by spreading the word and encouraging others to participate (primarily fellow group members), by helping in construction of the system, by maintaining and helping to provide security for the fountains to prevent illegal tapping or other disruptive actions. Overall, they saw the system as their own and felt it would most definitely improve their daily lives. Because of this sense of ownership, they said they would protect the system as they would their own personal property. Their main concern was vandalism—illegal tapping of pipes.

There were suggestions that the community and local organizations, including the "comités de quartier" be involved as soon as possible in making decisions about the water supply system. They noted fountains had been built already and wanted to be part of defining how the system will work.

Other Areas Where the District Should Focus

In addition to the public showers and laundry, the participants indicated that it was important to build more latrines, to remove the omnipresent garbage/debris from outside areas, and to find a way to improve drainage in the canals, especially in the frequently inundated zones.

Reactions from the Reservoir Owners and Mobile Water Sellers

While one or two reservoir owners mentioned that the new water system will reduce their income, overall it did not appear that they are worried about its disturbing their businesses. Some actually indicated that it would be good for the public. However, the great majority, many of whom have water faucets at home, seemed to believe that water from the new system will be delivered into the home.

In contrast, mobile water vendors, many of whom live outside of Cité Soleil, were very concerned that the new water system will affect their jobs, and some indicated that when the fountain system is in operation, they will have to stay in their villages and find other sources of income. They also reported that the residents of the Cité did not treat them well in general.

To summarize, the following main points emerged from the numerous comments and opinions expressed by residents in the discussions. They provide some clear ideas for planning the District's course of action.

- Management of each fountain should be somewhat autonomous, run by people from that specific neighborhood who are chosen by local vote or by local organizations. Each fountain manager will then be responsible to the local community and the water District, and will know whom to address to resolve water supply issues.
- Given the limited amount of water that can pass through the fountain along with the belief among participants that they will have access to unlimited amounts of water at a very low price, it is important to develop some system of "rationing" water. One way to do this is by pricing the water at about the same level or even slightly higher than the current water price at reservoirs. If the price is lower than current prices, demand for the new, "healthier" drinking water could be overwhelming, with long lines and consequent problems. A pricing system such as this would also help avoid potential resentment of reservoir owners and mobile vendors since they could still sell their water at the current price. It is important that the District water price stay stable for a considerable period of time to build confidence and maintain credibility with clients. Thus the initial price must be chosen carefully. If in the long term, the

demand for water is not met, the District should look for ways to increase capacity and/or adjust the price at the fountains.

- It is important that the District have at least one office in Cité Soleil. In addition to overseeing the water system, this office would be responsible for using the revenue to implement other activities beneficial to the Cité, such as garbage collection and removal, as planned by the project. The District should also develop measures to improve the non-functioning drainage canal system, which floods during significant rainfall. The problem of drainage was perceived as a serious annoyance and health risk to many residents of the Cité.
- In developing pilot projects, it appears from focus group discussions that there is more urgent desire for public laundries than for public showers. Having access to public laundries would decrease the amount of water that must be fetched (and discarded) by households and would significantly decrease the amount of time spent by those who currently travel out of Cité Soleil to do their laundry in a stream. Any site chosen for building a laundry should have good drainage (and not be in a frequently inundated area).

3.2.2 Communication Strategy

The primary objective of the communication strategy is to mobilize popular support behind the community-managed water and sanitation District. The strategy seeks to create an awareness in each family of its stake in the success of the program; its responsibilities to protect the water system against misuse or illegal activities; and the importance of cooperation in the solid waste program. The strategy will be carried out by first building commitment among community leaders and then organizing a community education/mobilization campaign which will include an extensive series of community meetings and

use of megaphones to continually reinforce priority messages.

The strategy is designed to cover the critical six month start-up period immediately before and after the opening of the system. The budget for activities in the initial start-up period appears at the end of this chapter (Table 3). Afterwards, ongoing education and mobilization activities will remain vital to its continued success. As of this writing, it would be premature to discuss the actual focus of any communication program beyond the start-up period.

Target audiences

The communication strategy's primary audience is the residents in Cité Soleil. A subset of that audience includes members of grassroots committees and community leaders who will be encouraged to organize neighborhood meetings. Current water vendors were considered but not retained as a target audience because the demand for their services is not expected to diminish, and most will continue to sell water at the same profit margin they now enjoy.

Communication channels

The communication strategy will reach the population through three basic communication channels: interpersonal contacts, print materials, and mass media.

- *Education/mobilization meetings.* These meetings will be carried out by community volunteers (leaders of community organizations, clergy, teachers, and members of the neighborhood fountain committees). To develop a sense of ownership among the residents, leaders of each organization will be asked to make a firm commitment to hold a minimum of four educational meetings before the water system begins operating. The goals of these meetings are threefold: a) to create an understanding of the benefits of clean water and a cleaner environment, b) to provide essential information to residents

about how the water and solid waste system operates, and c) to motivate families to be actively engaged in the local management of the system. The volunteers will be encouraged to hold as many meetings as necessary to reach all the members of their community.

- *Fact sheets.* A series of eight one-page fact sheets will contain all the information residents need to know about how the water and sanitation program operates. The purpose of the fact sheets is to ensure that accurate information is disseminated at each management level (and any misconceptions about the program are dispelled). The fact sheets will include illustrations and specific information on eight topics: the overall operation of the District, how the new system will function, activities/responsibilities of the fountain committees, activities/responsibilities of the zonal committees, how each family can support the system, the benefits of clean water, household hygiene and correct use of clean water, and the community benefits of clean water and a cleaner environment. The fact sheets will provide the agenda for each education/mobilization meeting. Starting six weeks before the opening of the system, two fact sheets will be distributed to the community volunteers every 10 days.
- *Megaphones.* Megaphones will serve as the mass media component of the communication strategy. Each zone will receive one megaphone and a sufficient supply of batteries to provide continual coverage of the zone. The "*Animateurs de Zone*" will ensure that the megaphones are used on a rotating basis in each neighborhood to communicate priority messages. At first the messages will emphasize the need to elect service-oriented members to the fountain committees. Once the committees are formed, the messages will reinforce essential information contained in the fact sheets.

- *Animateurs de zone.* Given the lack of community cohesiveness and mistrust many residents of Cité Soleil have for any institution (as observed during the strategy development workshop), community mobilization will play an even more critical role in the success of the water and solid waste system than originally thought. To address this need, 14 full-time *animateurs* (2 per zone) will be hired under the demonstration project budget for a 4 to 5 month period. The primary responsibilities of these *animateurs* will be:

- to assist with the creation and training of the neighborhood fountain committees
- to recruit, train, supervise, and insure regular follow-up meetings with all community volunteers
- to insure efficient use of the megaphones

Other mobilization and information materials. The communication strategy also calls for the purchase of 1200 T-shirts and hats to permit quick identification of residents actively contributing to the success of the system. Approximately 150 T-shirts and hats will be given to each zone for distribution to all members of local committees, fountain operators and community volunteers. The remainder will be used during the opening few weeks of system operation. Signs will also be designed and printed for the zonal office. Finally, seven banners, one for each zone, will be painted for the system's opening.

Logo and slogan. The logo concept and slogan for the water system were selected by community leaders during the strategy development workshop. The logo, which will be finalized in early May, incorporates a profile of a woman filling up a bucket at a fountain with the slogan on top and CADEPA, the acronym for the District, underneath. The

slogan is "Dlo Pwop se la Sante" (Clean water means good health).

Priority messages. It is proposed that diffusion of priority messages start before the creation of the fountain committees and continue through the opening of the system. The messages listed below are in the approximate order that they will be communicated.

Creation of Neighborhood Fountain and Zonal Committees (May and June)

1. Clean water means good health! Clean water means good health!
Parents, residents of Cité Soleil! Soon we will have clean water for our families. Members from our own neighborhood will be responsible for managing our fountain. We need your support.

2. Clean water means good health! Clean water means good health!
Attention all residents! This _____ (Saturday) _____ at _____ (4:00), at the _____, there will be an important meeting to elect the members of our neighborhood fountain committee. This committee will manage the water fountain in our community.

The committee will have five members. Two of the members must be women.

Any adult in our neighborhood can be a member if they are:

- 1) ready to serve our community as a volunteer
- 2) well respected in our neighborhood,
- 3) honest, and
- 4) available to attend at least one meeting a week.

With the support of each community member we will elect capable, service-oriented members to our fountain committee.

3. Clean water means good health! Clean water means good health!
Attention all residents! This _____ (Saturday) _____ at ____ (4:00), at the _____, there will be an important meeting to elect the members of our neighborhood fountain committee. This committee will be responsible for the water fountain in our community.

Listen to how this committee will serve the community.

- A) The committee will insure everyone knows the hours our fountain will be open and the price of a bucket of water.
- B) The fountain committee will organize meetings in our neighborhood so we all understand how clean water can help our families.
- C) The committee will insure order and cleanliness around the fountain.

With the support of each community member we will elect honest, well respected residents to our fountain committee.

When recruiting Community volunteers (early July)

4. Clean water means good health! Clean water means good health!

Attention all members of the clergy, school teachers, and all leaders of community organizations. We need your help to teach the families in our neighborhood all about the new water system.

Come to an important meeting this _____ (Sunday) _____ at ____ (6:00) _____, at the _____. Together, with the support of each community leader we will succeed.

To announce community education/ mobilization meetings (July - August)

5. Clean water means good health! Clean water means good health!
Attention all residents of quartier

_____ Come to an important meeting this _____ (Tuesday) _____ a

____ (5:00) _____ at the _____. Learn how the clean drinking water will protect your family against illness. With the support of each family we can successfully fight illness.

During the community education campaign

6. Clean water means good health! Clean water means good health!

Parents, listen carefully! Improve your children's health! Fight disease! Be sure your family drinks only clean water. Save time, save money, and insure your family's health.

Each 7-gallon bucket at the new community water fountain will cost only 1 gourde. The members of your fountain committee are _____, _____, _____, _____, and _____. See them for advice.

7. Clean water means good health! Clean water means good health!

Attention mothers and fathers! At last our children will have clean water to drink. They will have much less diarrhea, fewer intestinal problems, less sickness. You will spend less money on medicines. Be sure that your children drink only clean water. With the help of each family, we will succeed.

8. Clean water means good health! Clean water means good health!

Attention all community members. Very soon we will have clean water in our own neighborhood. If you have any

questions about how the water system will work, ask the members of our neighborhood fountain committee. The members are _____,

_____, _____ etc.

The fountain committee has been created to serve you.

With your support we will succeed.

9. Clean water means good health! Clean water means good health!
Attention all residents. Our fountain operator is _____. His job is to insure that each member of the neighborhood is correctly served in an orderly manner. He will provide you with reliable and safe water. With your support, we will be successful.

10. Clean water means good health! Clean water means good health!
Very soon (next week etc.) We will have clean water in our neighborhood. The success of our water system depends on everyone's help. Here are three actions each resident needs to take.

- A) Identify the fountain near you, and learn its hours of operation.
- B) Let those who come first to the fountain be served first.
- C) Maintain a clean fountain area by not throwing garbage on the ground.
- D) Report any problems to a member of the fountain committee.

With your help, we will succeed.

Training. Training will be the primary vehicle for launching communication activities. One- to two-day workshops are planned for all committees members and community volunteers both before and after the water system begins operating. Workshops held before the start-up are described below. Workshops scheduled after the start-up will

focus on management issues requiring additional emphasis and problems arising during the start-up period.

- *Neighborhood fountain and zonal committees.* A one-day orientation workshop will be organized for each zone to review how the water system functions, how the solid waste collection program operates, responsibilities of local committees, the fountain operator, the *animateurs de zone*, and the zonal coordinator, and to explain the organizational relationship of each committee to the others.
- *Animateurs de zone.* A two-day skill building workshop will prepare the *animateurs de zone* to effectively recruit, supervise, train, and engage community volunteers in carrying out grassroots education and mobilization meetings.
- *Community volunteers.* A one-day workshop and follow-up meetings will prepare community volunteers to launch a series of educational/mobilization meetings for the members of their association.

3.2.3 Implementation

The communication strategy will be implemented in four phases from May to October 1996.

Phase I: Creation of service-oriented local management committees (May - June 96)

- Step 1. Progressive recruitment of *animateurs de zone* to assist with the creation and training of the local committees
- Step 2. Creation of the neighborhood fountain and zonal committees in a pilot zone (Boston)

Step 3. One-day orientation workshop for the fountain and zonal committees

Step 4. Extension of Step 2 and 3 to two additional zones (Cité Lumiere and Belecou)

Step 5. Extension of Step 2 and 3 to the four remaining zones

Phase II: Grassroots education/mobilization campaign (July - August)

Step 1: Two-day *animateurs de zone* training workshop

Step 2: Recruitment and one-day orientation for all community volunteers

Step 3: Six-week campaign of community education/mobilization meetings, supported by the fact sheets and megaphones

Phase III: Pilot operations and start-up of the system (August)

Step 1: Begin operating two to four pilot fountains to test all administrative and financial systems (approximately three weeks before the official start-up)

Step 2: Begin operating a pilot zone to test and refine all management systems. (approximately two weeks before the start-up)

Step 3: Prepare for the official start-up

Step 4: Start-up of the system

Phase IV: Strengthen Community Trust (August- October)

During the first two months of operation, weekly management meetings at all levels will be essential to insure efficient communication of important information, a speedy response to problem situations, and ongoing community education.

Further considerations related to the success of the communication strategy

Phased start-up: The present strategy calls for two to four pilot fountains to be tested for one week in early August and for an entire pilot zone to be operational two weeks before the official start-up. This schedule is designed to allow the District staff sufficient time to work out critical management problems before the entire system becomes operational. Undoubtedly there will be great pressure to put the remaining six zones into operation immediately after the pilot zone begins to function. However, it would be very beneficial to phase the start-up of the remaining six zones so that the District can gradually expand administrative and financial systems.

Avoid starting the system prematurely: Despite pressure to provide clean water to the population as quickly as possible, a premature start-up could be disastrous. Because community mobilization is difficult to quantify, project managers might be tempted to skip critical steps in an effort to hasten the opening. It can not be overemphasized that well organized service delivery during the initial days of operation will be crucial to maintaining the trust and support of residents for the community-based management system.

Table 3
Budget for Communications Program
(Start-up Period)

Description	Cost	Quantity	Total
T-shirts	\$4	1200	\$4800
Megaphones	\$150	10	\$1500
Batteries	\$.50	2000	\$1000
Banners	\$50	7	\$350
Fact sheets	\$1 per set of 8	1500 sets	\$1500
Educational Materials*			\$1090
Salary/ <i>Animateurs de Zone</i>	\$65	14 x 4.5 months	\$4100
Training/ <i>Zone + Fountain</i>	\$100	7 wkp x 2	\$1400
Training/ <i>Animateurs</i>	\$150	2	\$300
Orientation/ <i>Volunteers</i>	\$75	7 orientations x 2	\$1050
Posters	\$4	75	\$300
Signs/ <i>zone</i>	\$30	7	\$210
Hats	\$2	1200	\$2400
TOTAL			\$20,000

* To be determined after the opening of the system.

Funding for the communications program will come from the \$90,000 set aside for demonstration projects.

4

Infrastructure Plan

This chapter presents descriptions of the site, the current social and physical conditions, and the immediate and future needs of Cité Soleil. The text then describes the plan for the water supply system, solid waste management, and domestic wastewater control given the setting and needs.

4.1 Site Description

The residents of Cité Soleil live on roughly 2 sq. km. of filled wetland which extends into the Bay of Port-au-Prince. The site is virtually flat and sits at the outlets of major drainage canals from the metropolitan areas of Port-au-Prince and Delmas. Approximately 200,000 poor, urban dwellers live in this area. They exist without access to treated, convenient water supply, wastewater collection, solid waste removal, or other municipal services.

Cité Soleil is situated to the northwest of central Port-au-Prince within the municipality of Delmas. The area is bounded on the north by Rue Vulcain, and a housing scheme, and the Projet Drouillard, to the south by the former HASCO sugar processing facility, to the east by National Route No. 1, and to the west by the Bay of Port-au-Prince. Cité Soleil is traversed east to west in the northern section by drainage canal St. George, a principal drainage canal for metropolitan Delmas. In its southern section, it is traversed east to west by drainage canal E.H. also known as Canal Graise, a principal wastewater conduit for Cité Soleil and the industrial area to its east. The community is sliced north to south by an abandoned rail line which formerly served the HASCO facility.

Generally, the topography of the city is flat. The elevation of the vast majority of Cité Soleil is less than two meters above sea level. Roughly half of the area is less than one meter above sea level. The eastern-most section near National Route No. 1 rises rapidly from 2.5 to over 11 meters in elevation at the intersection of the principal road through the city, Avenue Soleil, and National Route No. 1. This intersection is the site of the elevated water tank which will service the community.

The city is composed of seven large zones, listed in Table 4. (The smaller communities which constitute each of these larger zones are also presented in the table.) Interviews conducted during field work in Cité Soleil indicate that most individuals have a strong sense of identification with their respective areas of residence and can easily indicate the boundaries between communities.

The area's growth was rather slow after the initial construction of lodgings for 52 families in 1958. The major influx of people to the center part of Cité Soleil occurred between July and September of 1966 after a fire in the adjacent La Saline community. At that time, 1,197 houses were built and designated "Cité Simone". Around 1972, Boston began to be settled after a fire ravaged an area near the central market of Port-au-Prince. Since 1973, the region has undergone a consistent and progressive influx of new residents. The area known as Warf developed rapidly in 1978 when filling and the construction of the pier were carried out.

Table 4
Zones and Communities in Cité Soleil

Zone	Constituent Communities
Partie Centrale	1ère Cité, 2ème Cité, Trois Bebe, Croix-Bleue
Boston	Haute Boston, Bas Boston
Brooklyn	Soleil 9-13, 15, 17, 19, 21, 23; Cité Norée; Warf, Cité Carton; Cité Ecclesiaste; Belekou
Linthau 1	Linthau 1, Ti Haiti
Linthau 2	Projet Linthau 2, Soleil 6 - 10
Cité Gerard	Cité Gerard, Soleil 4 (Père Lanoux)
Partie Drouillard	Cité Lumiere 1, 2, 3

In 1979, roughly 1000 families were relocated to the area which is today called Brooklyn—a marshy zone located across a narrow body of water to the north of the tank farm on the HASCO property. Today, the zones have essentially grown together and it is difficult to specifically delineate their boundaries. Their approximate perimeters are pictured in Appendix B.

The total population of Cité Soleil has been estimated by a number of sources in recent years. In 1988, a study in this area by l'Institut Haitien de Statistique et d'Informatique identified 13,800 residences and a total of 80,900 persons. This study estimated the population growth rate at 7% per year. Using these numbers, the current population of Cité Soleil would be estimated at 136,400, as shown in Table 5.

If assumptions are made that the 1988 census data are accurate and that the current population of Cité Soleil is approximately 200,000 people, then it can be seen from the above table that the growth rate (including

births, deaths, and immigration) of the community over the past eight years has averaged between 11 and 12%.

A second estimate of the present population of Cité Soleil can be made using data collected by CDS community animators and agents in December 1995. They tallied the number of mothers and children (from throughout the city) who benefit from health care provided by community clinics located in two zones, Boston and Brooklyn. The data which were collected are shown in Table 6. If one assumes that CDS provides services to 90% of the families in Cité Soleil, then the total number of families in the community could be estimated using the above data as 36,211. If another assumption is made that 5.5 persons/family is a reasonable estimation of average family size (a figure which includes men and older children in addition to women and children and which falls somewhere in the middle of estimates of other studies), then the present day population of Cité Soleil would be 199,161. This extrapolated figure reinforces the

Table 5
Estimated Population Growth Rate

Growth Rate	1988 Census	1995 Population	1996 Population
7%	80,900	127,500	136,400
8%	80,900	138,600	149,700
9%	80,900	147,900	161,200
10%	80,900	157,700	173,400
11%	80,900	168,000	186,400
12%	80,900	178,800	200,300

Table 6
Population Data from Clinic Visits, 1995

Zone	Families Served	No. of Mothers + Children	Mothers + Children/Family
Partie Centrale	2,372	9,612	4.05
Boston	5,004	22,277	4.45
Brooklyn	12,266	45,507	3.71
Linthau I	2,778	9,475	3.41
Linthau II	2,599	12,581	4.84
Cité Gerard	1,782	10,424	5.85
Partie Drouillard	5,789	21,579	3.73
TOTALS	32,590	131,455	4.03*

*A 1981 survey (FHC International, 1981) of 162 families in Cité Soleil concluded that the average family size was 4.09 people. The 1988 census described above determined that the average was 5.9 people/family.

operative value of 200,000 people taken in this document as the area's population.

Most of the dwellings in Cité Soleil contain single families, but the density of occupation is high because most of the houses consist of only one or two rooms. The population density in 1981 was estimated at approximately 1,200 persons per hectare. In 1996, it was roughly estimated to be 940 persons per hectare, assuming a population of 200,000. The data used in 1996 to determine population density are shown in Table 7. In the work performed as part of this consultancy, areas of zones were estimated from 1:5000 topographic maps and site visits to verify estimates and data on residential occupation within the overall area of Cité Soleil. A possible reason for the apparent decrease in population density between 1981 and 1996 could be that newer residents have moved into unstructured areas and have spaced their dwellings more widely than the older structured areas, populated by influxes of 20 years ago.

The range of family incomes in Cité Soleil appears to be relatively narrow. In 1994, 53% of families were found to have a total monthly income of less than 800 gourdes (US\$53, annual US\$636). The top 23% of the population had income greater than 1000 gourdes (US\$67, annual US\$800) per month (F&C, 1994).

Roughly half of the residences are constructed of cement with a metal roof, while most of the others are built of scavenged material. Most householders aim to obtain at least a cement floor, a condition made indispensable by the regular and frequent flooding which occurs in the city. Nearly all of the houses have a floor area of less than 40 sq. m. (432 sq. ft.). Between 60 and 70% of the houses do not have access to a latrine. Historically, this percentage has been even higher in certain areas, notably Brooklyn.

Cité Soleil is covered by nearly 30 km. of roads. Slightly over half of these roads are between 5 and 7 m. wide. Roughly one-fourth

of the roads are wider than 7 m., and those less than 5 m. wide comprise the other fourth. Eight percent of the road network is paved with asphalt, 22% in tiles, and 70% in compacted earth (F&C, 1994). Only 25% of the roads are in proper condition. The other 75% are practically impassable, particularly during times of rain. The central part of Cité Soleil can be reached easily by motorized vehicle. Portions of Linthau I, Linthau II, Partie Drouillard, and Boston can also be reached by central, permanent roadways. Much of the remaining area can be reached by vehicle only with significant difficulty.

Cité Soleil suffers from large doses of nearly every environmental threat imaginable. (See Table 8.) It is located at the western end of the principal runway of the National Airport and consequently suffers regular noise pollution. Its open areas are barren of vegetation and combine with tremendous accumulations of solid waste to generate significant dust on a daily basis. The drainage canals are largely fed from outside the city and can be assumed to carry pollutants from the manufacturing zones, principal roadways, petroleum storage facilities, and electrical generation plants which abut the eastern and southern borders of Cité Soleil. Groundwater can be found from 1 to 5 feet below ground and is fed by the surrounding ocean and by infiltration of the community's waste and polluted drains. The general lack of sanitary facilities combines with ever-present mounds of solid waste to generate a large and health-threatening population of flies and other pests. The entire area is then placed under enormous environmental pressure because the residents of Cité Soleil are directly exposed in their homes on a regular basis to the overflowing and flooding of the intensely polluted and regularly obstructed drainage canals.

Given the variety of environmental sanitation challenges that face Cité Soleil, it is imperative that the newly formed District focus on priority issues which can be managed

Table 7
Population Density by Zone

Zone	Acres	Hectare	% of Total Area	Population Estimated from Previous Table	% of Total Pop.	Persons/Hectare	Persons/Acre
Partie Centrale	96	39	20.2	15,000	7.5	390	160
Boston	31	13	6.6	31,000	15.5	2460	990
Brooklyn	105	46	23.7	75,000	37.5	1650	710
Linthau I	42	17	8.8	17,000	8.5	1010	410
Linthau II	104	42	22.0	16,000	8.0	380	150
Cité Gerard	54	22	11.5	11,000	5.5	500	200
Partie Drouillard	34	14	7.2	35,000	17.5	2540	1030
TOTALS	466	193	100.0	200,000	100.0	940	390

Table 8
Environmental Pressures on Cité Soleil

Environmental Hazard	Status in Cité Soleil
Population Growth Rate	12%
Population Density	150 - 1,030 people per acre
Noise Pollution	Near end of National Airport runway
Air Pollution	Airborne dust from barren ground, rotting solid waste, and
Surface Water Pollution	Open drains contain industrial waste, feces, animal waste
Flooding	Septic and toxic material in drains overflows during typical
Groundwater Pollution	Shallow groundwater contaminated by excreta disposal,
Latrine Access	30%; 140,000 people without latrine access
Solid Waste	120-150 m ³ per day with no regular collection

with its own human and financial resources and not attempt to undertake the technical and educational effort to address each of the environmental threats which are present. Priority issues for the District are (1) provision of a high quality, reliable drinking water supply to generate financial resources, (2) removal of solid waste from Cité Soleil to improve surface drainage, reduce vector borne disease threats, and alleviate traffic congestion, and (3) introduction to Cité Soleil of sustainable demonstration projects to manage domestic wastewater. After establishing the viability of these interventions with the substantial involvement and input from the residents of Cité Soleil, then educational interventions and more specific sanitation efforts can be implemented.

4.2 Water Distribution System

4.2.1 Current Water Supply

Water is presently brought into Cité Soleil by three principal means. First, a large amount of the water supply is brought into the area by truck, sold to local vendors who are typically equipped with permanent 3,000-gallon holding tanks, and then retailed by 5- to 7-gallon buckets to residents. Secondly, Père Lanoux and the Salesian Fathers also bring truckloads of water into Cité Soleil. This water is distributed free of charge to residents who bring buckets to either their location on Soleil 4 in Partie Central or to their other location on Soleil 17 in Brooklyn. According to representatives of these programs, between 90,000 and 120,000 gallons of water are brought into Cité Soleil each day except Sunday. The third means is somewhat problematic: in the southern portion of Cité Soleil, a water distribution network exists which occasionally provides water from CAMEP. The precise location of the CAMEP distribution network is not known, but the contractor installing the new distribution

system has excavated what are apparently CAMEP pipes in both the Boston and Partie Centrale areas. Anecdotal evidence gathered in field interviews shows that the CAMEP water is available only irregularly and is typically of brackish quality indicating leaking pipes and system contamination. These comments were verified in focus group sessions conducted as part of this work and described in Section 3.2.1.

A count of water trucks entering Cité Soleil at four locations (Avenue Soleil, Rue Boston, Rue Sanon, and Rue Vulcain) was conducted by CDS representatives from 10 to 14 February 1996. The results indicate that slightly over 200,000 gallons of water are brought into Cité Soleil by truck on a typical day (Table 9). These results indicate that only one gallon of water per day per capita is being brought into Cité Soleil by truck. It should be noted that this study was conducted at a time of rainfall in the area, and residents of Cité Soleil may have been meeting a portion of their water needs by collecting rainwater. It is also possible that the recorded amount of water brought in to serve Père Lanoux' facilities did not accurately record the true size of his trucks. He owns two 29,000-liter trucks which were not independently identified in this study. At the time of this writing, there is no definitive explanation for this relatively low volume of water being brought in to supply Cité Soleil's residents. It is assumed that the remainder of the residents' needs are met through the third water source in the area (piped water via CAMEP).

4.2.2 UNDP Water Supply Project

The original project paper for the UNDP water supply project, written in 1986, aimed to provide 120,000 residents of Cité Soleil with 20 to 25 liters (5.5 to 6.9 gallons) of water per person per day through 105 communal water fountains. Ten years later, the District is taking on this challenge and will begin by providing a

Table 9
Volume of Water Transported into Cité Soleil by Truck

Day	General Water (gallons)	Père Lanoux (gallons)	Total (gallons)
Saturday	212,000	36,300	248,300
Sunday	138,600	0	138,600
Monday	133,100	62,700	195,800
Tuesday	163,900	42,900	206,800
Average per Delivery Day	161,900	47,300	

regular supply of high-quality water for a reasonable price through a network of communal water fountains equitably distributed throughout the population. The District will not, however, be able to meet the water provision goals of the original project design. In the 10 years since that design, the beneficiary population has grown significantly and construction costs have risen. These two factors dictate the more limited scope of the current project: 70 communal water fountains are being built to provide water to 200,000 residents. In this configuration and operating for 12 hours per day, it is estimated (in Chapter 5 of this document) that the system can provide 437,000 gallons of water daily or 8.0 liters (2.2 gallons) of water per day for each of Cité Soleil's 200,000 residents. The supply and storage components of the system can provide sufficient water to service the entire population with 20 to 25 liters per person per day. System capacity is limited by the number of communal fountains. With an increased number of fountains, the District would be able to reach the goal of 20 liters (5.5 gallons) per person per day for all of Cité Soleil. To reach this goal the District would need 170 fountains (with all four faucets functioning) open for business 12

hours per day, with faucets actually running 9 of those hours.

The sources of water for the District are located approximately 5 km. to the north, slightly to the west of the line delineated by the abandoned railway which bisects Cité Soleil. The site is situated in the Cul de Sac plain which is a broad valley limited to the north and south by high mountains. It consists principally of alluvial deposits of gravel and limestone. The terrain is practically flat and its aquifers serve as the principal drinking water sources for a large portion of the population of Port-au-Prince.

The system will be supplied by two electric pumps serving groundwater wells. At the time of this writing (March 1996), one of the wells has been drilled to a depth of 100 meters and the decision had not yet been made by the contractor regarding the depth at which the pump will be installed, although it has been recommended in a CAMEP study (Direction Technique, Service de Production, Execution a Duvivier d'un Forage pour l'Alimentation en Eau Potable de Cité Soleil, 1995) that the well be located 54 meters below ground level. Pump selection is proceeding on this basis. According to the CAMEP report:

“In order to avoid the risks of pump inundation and over exploitation of the groundwater, it is advisable to place the pump at 54 meters and to exploit the well at a discharge rate of 50 liters per second or about 180 m³ per hour.”

The scheduling of the installation of the second supply well is currently unknown, as UNDP and FENU have yet to enter into contractual arrangements with anyone to install, test, and connect the well. The pumps are scheduled to be delivered in May to A&R Construction.

The design capacity and storage of the UNDP-financed water supply system are as follows:

- 2 wells each equipped with a pump.

- J Line submersible pump
 - Franklin motor
 - Total design head: 480 feet
 - Estimated pump sizing: 125 horsepower, 460 volt, triple phase, 60 cycles, 3450 rpm
 - Emergency power: One 160 kV generator

- water system production

- 1 well

- 39 liters/sec flowrate
 - = 2,366 liters/minute
 - = 141,960 liters/hour
 - = 39,000 US gallons/hour
 - = 650 US gallons/minute

- 2 wells

- 78 liters/sec flowrate
 - = 4,732 liters/minute
 - = 283,920 liters/hour
 - = 78,000 US gallons/hour
 - = 1,300 US gallons/minute

The water tank reservoir is sited on the highest point in Cité Soleil at the intersection of Avenue Soleil and National Route No. 1. It is being installed by Precosa, a local construction contracting firm. Upon completion, it will be 27 meters (89 feet) in height. At the time of this writing, construction of the reinforced concrete reservoir is nearly complete.

- water tank capacity
 - 1,000 cubic meters
 - = 264,000 US gallons

The project will provide water to the population of Cité Soleil through concrete block water fountains equipped with four faucets per fountain, a water meter, a secure steel door, and iron bars for grating across an observation/transaction window. The installation of the fountains and the distribution network is being carried out by A&R Construction, a local design/build contracting firm.

The UNDP system, as it is currently being constructed, will have 70 fountains and 270 faucets. The total number of fountains includes 33 fountains constructed under the UNDP budgeted funds, 18 fountains to be constructed using funds provided by Plan International, and an additional 20 fountains financed through additional UNDP funds. At the time of this writing, 33 fountain structures were in place but were not yet equipped with piping, doors, or grating. Additional funding is being pursued by the Haitian Project Coordinator, Henri Suplice, to expand the system through the construction of additional fountains.

The system is designed to deliver 3 US gallons/minute (11 liters/minute) from each faucet in the system. A water meter will be installed at each fountain in such a way that it will be highly resistant to tampering. The construction overseer from A&R Construction has suggested that the inlet pipe to the meter be encased in an iron sleeve sunk into the floor of each fountain and enclosing the inlet pipe

completely until it enters the meter. General agreement has been given by the project engineer, Pierre-Michel Genois, to this approach to resolving the issue of water meter security.

Seventeen fire hydrants are connected to the distribution system. Thus, it is of crucial importance to (1) maintain pressure in the distribution system at all times, (2) ensure the immediate disconnection of any illegal connections made by residents to the system, and (3) establish and carry out a regular, rigorous maintenance program for the valves, hydrants, and other hardware components of the system.

4.2.3 Evaluation of Hazards

Three potential sources of contamination of the drinking water source exist. First, the wells are located in the Cul de Sac plains, the former principal agricultural site of the HASCO sugar company. Second, although assurances have been given by the Director of CAMEP that the groundwater resources required to supply the bulk of the trucked water in the environs of Port-au-Prince is significantly less than what was formerly extracted by the sugar company, it is possible that with continued extensive pumping, the wells will be subject to salt water intrusion from the sea. Third, the wellsites are located roughly 1,400 meters (0.88 miles, 1,540 yards) from the site of the current municipal landfill for Port-au-Prince at Truttier.

The first potential threat would appear in source water as increasing nitrate concentration in the water supply. Precautionary surveillance would be to test the water for nitrates at least once every six months.

The second hazard, salt water intrusion, would be indicated by increasing specific conductivity of source water and can be avoided by maintaining water drawdown in each well below the maximum rate of 50 liters per second, 180 cu.m./hour, stipulated by CAMEP in their "Direction Technique,

Service de Production: Execution a Duvivier d'un Forage pour l'Alimentation en Eau Potable de Cité Soleil" issued in November 1995. This threat should also be monitored by testing the conductivity and chloride concentration of the water once every six months.

The threat to the wells posed by their proximity to Truttier is minimized by (1) the wells being upgradient from the landfill (i.e. groundwater flows from the well sites to the landfill) and (2) locating the intakes to the wells between 28 and 52 meters below ground level. This area is below an 11-meter thick layer of sandy, gray-green clay (argile sableuse, gris-verdatre), as identified in the Direction Technique mentioned above. An indication of contamination of the water by the landfill would be detected by an increase in the pH value of the water. This should be monitored on a daily basis by the District staff.

Two principal risks to the provision of safe water are posed through the piping network in Cité Soleil. The first risk is that caused by illegal connections to the water supply pipes. Every effort has been made during system construction to increase the difficulty anyone would have in trying to tap into the water system illegally. All of the pipes are galvanized iron and have been laid under paved roadways, at the greatest depth possible. The second risk comes if the system is not constantly pressurized with water. Apparently, it is standard practice in Haiti to pressurize water distribution systems only when demand is expected. This can lead to back-syphoning and can easily contaminate the entire water distribution network. A significant portion of the pipeline has been laid below the level of the brackish groundwater, and any negative pressure in the lines would lead to the intrusion of this polluted, saline water into the water distribution network.

The maintenance of positive pressure in the pipelines at all times will require the diligent observation of the entire pipe network by utility staff at least two times per week and

an effective community-driven means by which illegal connections will be identified, punished, and rectified.

4.2.4 Water Quality Monitoring

Satisfactory water quality in a distribution system can be assured only through continuous monitoring of the quality of the water entering the system and at various points in the system. An effective sampling program is essential. Based on the recommendations of the 1962 U.S. Public Health Service Drinking Water Standards, the minimum number of samples to be collected from a distribution system and examined each month to ensure bacteriological water quality ranges from two for systems serving less than 2,000 persons, to twelve for 10,000, to sixty per 50,000. (The points to the need for 240 samples per month for the Cité Soleil utility.) Under normal circumstances, analyses for most chemical substances need be made only semi-annually.

In order to monitor water quality at a high frequency, it will be most convenient for the utility to obtain and operate its own (1) simple chlorine concentration determination kit and (2) pH value determination kit. The presence of free available chlorine (rather than chlorine which is combined with ammonia or chlorine absorbed to organic matter) in water at least 10 minutes after chlorine has been introduced and thoroughly mixed insures destruction of all harmful bacteria. However, the disinfecting power of chlorine depends upon the form of residual chlorine present, the contact time, the temperature, and the pH value of the water. For example, if the pH value is less than 8.0, then 0.2 mg/l (0.2 parts per million) of free residual chlorine will destroy bacteria in a 10-minute contact period at all temperatures. The pH value of the source water measured in pumping tests ranges from 6.96 to 7.35. The District should therefore ensure that a minimum of 0.2 mg/l of free chlorine and a near neutral pH value are maintained

throughout the distribution system by analyzing eight samples per day from various locations where water is distributed to residents of Cité Soleil.

4.2.5 Operation and Maintenance

It has been conclusively demonstrated that it is far more effective and less expensive over time to invest effort and funds on regular maintenance activities throughout the life of a program rather than waiting for the inevitable breakdown and deterioration of equipment due to lack of proper maintenance. In the business of drinking water provision, the high-quality product is only as beneficial and reliable as the equipment and pipes which bring the water to the user. Many excuses have been given for ineffective maintenance, particularly in developing countries, but there are few good reasons for system failure due to lack of diligent maintenance. The District will provide its own staff and efforts to properly maintain all components of the project which may come under its control. This will include large portions of the water storage and distribution system and the fire hydrants which are part of the distribution network.

A generic, sample maintenance schedule for the components of the District's system adapted from a more comprehensive schedule produced by the World Health Organization (WHO, 1984) is shown in Appendix C and will be used as a guide by the District staff in developing their own maintenance plan.

4.2.6 System Expansion

It is vital to the long-term provision of water to the residents of Cité Soleil and to the financial sustainability of the District that both the distribution network and the number of fountains be increased over time. Expansion of the system is principally a matter of constructing additional water fountains to

connect to the existing distribution network. It is also possible to extend the piping network into some presently unserved areas of the community. Two areas, Boston and Ti Haiti, have been identified at this point as underserved by the distribution system. Boston is very densely populated, and it has been difficult to find locations to site fountains. Ti Haiti does not presently have a water pipeline entering the community. The physical portion of site improvements can be completed in a relatively short amount of time. For example, the first 25 fountains took approximately one month to construct.

Plan International has already agreed to finance the construction of 18 fountains, and it may consider assisting in expanding the system further. The Project Coordinator will pursue this effort through direct contact with the organization. The cost of each fountain, including all piping, labor, transportation, and appurtenances, is estimated by the contractor to be US\$2,212 (33,195 gourdes). The cost of the materials required for each fountain is shown in Appendix D.

It is recommended that before the District attempt to expand its services, it focus on operating and maintaining its present network. After the District is confident that it is recovering its costs and operating in a sustainable manner, then it should reassess the distribution and use of its existing fountains and determine underserved areas of Cité Soleil and its ability to expand service into those areas by extending the distribution network, building new fountains, or attaching existing water vendors to the network (described in Chapter 6).

4.3 Solid Waste Management

The 200,000 residents of Cité Soleil receive no services to collect and transport solid waste out of the community. The municipality, the responsible governmental authority, is unable to provide this service, and private contractors

are reluctant to enter the area and collect the trash due to the hostile reputation of the residents of Cité Soleil and the fact that there is plenty of solid waste for them to pick up in other, more congenial, and better paying communities of Port-au-Prince.

4.3.1 Estimated Daily Solid Waste Production

One source (OPS/OMS, 1993) estimated that Cité Soleil generates on the order of 200 tons (460 m³) of domestic solid waste per day. No supporting evidence was provided for this figure, and fortunately two other studies have been carried out which yield relatively consistent solid waste production values which are substantially less than this figure. The average daily production of solid waste per household in Cité Soleil was estimated by a household survey in 1994 (F&C, 1994) to be 1.2 kg. This study calculated an average of 5.2 persons per household and 0.23 kg of waste generated per person per day (0.58 liters/person/day, 116 m³ per day for Cité Soleil). For over 90% of the homes surveyed, the average daily production was between 0.1 and 3 kilograms. CDS solid waste management staff who have extensive experience mobilizing emergency solid waste removal in Cité Soleil state that between 120 and 150 m³ of solid waste are generated in Cité Soleil per day.

Not included in these figures is any solid waste which enters Cité Soleil from outside its borders. It would be expected that this would occur as part of the daily flow of waste into the community and during rainfalls through the drainage canals which enter Cité Soleil. On a daily basis, no observations were made of solid waste in any of the drainage canals entering Cité Soleil. It would be expected, however, that some solid waste would enter the community during rainfall. This volume would be expected to be highly variable, largely uncontrolled, and uncontrollable with the exception of its capture at culverts which

precede the entry of major drainage canals into Cité Soleil.

4.3.2 Current Solid Waste Collection and Disposal

Currently there is no solid waste collection or removal occurring in Cité Soleil. The most recent efforts ended in early 1996 at the conclusion of a USAID-funded work program. Through this and other projects, CDS has gained extensive experience mobilizing residents and transportation to remove solid waste from Cité Soleil. Typically, whenever solid waste accumulated to the point at which canals overflowed and seaside areas were completely overrun, CDS procured external funding and organized community-wide efforts to collect and remove the waste. Typically, the waste was disposed of in La Saline in the proximity of the Croix des Bossales market where there had been public works equipment which spread the waste. Serious reservations were expressed about the potential environmental consequences of using this site due to its proximity to the Bay of Port-au-Prince, and it has recently been officially closed.

The principal current solid waste disposal site is located at Truittier, approximately 9 km (5.4 miles) from the center of Port-au-Prince. It is an area of 205 hectares (506 acres) which has been in use since April 1983, and serves as the principal discharge area for all of metropolitan Port-au-Prince. An environmental assessment of this site conducted in 1993 (Murray, 1993) concluded that the Truittier site is an acceptable location for the immediate disposal of solid wastes. It is relatively isolated, the groundwater there is saline and thus unfit for drinking or agriculture, and regional data collected in that study indicated that the movement of groundwater is away from potable water wells and toward the Bay of Port-au-Prince.

Chemical analyses of samples collected at the site were performed by Etude et Traitement en Chimie Appliquée of Port-au-Prince (phone 46-43-04) as part of the 1993 environmental assessment. Significant findings included high turbidity, color, elevated salinity, presence of ammonium ions, negligible oxygen content, and a disagreeable odor attributed to degradation of organic material. Additional detailed chemical analyses were conducted by Savannah Laboratories and Environmental Services, Deerfield Beach, Florida (phone 305-421-7400) which concluded that the sole priority pollutant detected was toluene in acceptable levels.

It should be noted that the contaminated samples examined in the environmental assessment were collected from a depth of 20 meters. The pumps for the District water supply system are proposed to be sited at a minimum depth of 50 meters. The existence of an 11-meter-thick band of clay between the two collection depths significantly increases the likelihood that the contaminated aquifer observed under the Truittier site is different from that which will be accessed by the District's system. Drilling logs completed by CAMEP during the drilling of the first well to serve the District indicate two aquifers under the area. Truittier would directly impact the upper of the two while the water supply for Cité Soleil would access the lower of the two.

A visit to the Truittier landfill site during January 1996 noted that the landfill is in full operation with regular delivery and burning of solid waste. Although two bulldozers were available for leveling and covering the waste, neither was operating due to the unavailability of fuel.

It is understood that municipal landfilling is not always the optimal disposal technique for municipal waste. While composting of organic waste material is a theoretical disposal method for the waste collected in Cité Soleil, great care should be taken to ascertain the market for composted material, the cost of such a system, and the availability of skilled

operators to manage, operate, and maintain this technically difficult method of waste management before considering it a viable waste treatment method.

4.3.3 District Management of Solid Waste

The residents of Cité Soleil are confronted with a variety of problems resulting from the generation of large amounts of domestic solid waste on a daily basis. The District will oversee solid waste collection services by working with the community to mobilize salaried collection teams and ensuring private contractors' rapid, efficient payment for the removal of solid waste from Cité Soleil.

A 1990 study of all of metropolitan Port-au-Prince (Roark, Bessalel, Dalmat, Murray, 1991) concluded that even within the poorest neighborhoods in which their survey was conducted (e.g., La Saline, Cité Soleil), 42% of households indicated that they would be willing to pay an average of \$1.85 per week per house for solid waste collection service. More importantly to the District, 81% of those interviewed in the poorest communities would be willing to participate in a community organization to dispose of solid waste.

The system being proposed by the District to collect and remove solid waste from Cité Soleil is based on a model which was field-tested in 1995 in a number of communities in Port-au-Prince by the Cooperative Housing Foundation (CHF). The District proposes to oversee one team in each of the seven zones of Cité Soleil. As described in Chapter 3, each team of 20 laborers will be provided to the District through a zonal committee made up of representatives of fountain committees. The District will provide each zonal committee with basic collection equipment, salaries for each crew member, and a 10 percent overhead for discretionary use by the committee. Table 10 gives CHF's actual costs to mobilize and equip a collection team.

Slight alterations to this model are being proposed by the District and are shown in detail in Section 5.2.3. District revenues are being designed to cover not only the cost of the zonal solid waste collection teams but also the collection and transport of the solid waste out of Cité Soleil to the municipally operated landfill. It is this final step, the regular and effective removal of solid waste from the area, which has repeatedly been shown to be the weak link in previous solid waste collection efforts in Cité Soleil and other locations in Port-au-Prince and which is being included as an integral responsibility of the District. The District will recruit, hire, and pay private contractors to load solid waste in Cité Soleil and transport it to the municipal landfill at Truittier. Based on CHF's experience, this cost is estimated at US\$5/m³ of waste removed. Such an employment and payment structure would provide significant opportunities for the development and expansion of this part of the private sector. If the District is reliable in managing and paying for this service, it could rapidly become a major partner in encouraging the growth of private sector contractors to perform this type of work in the most efficient and sound operational manner.

Two complex steps must be taken by the District staff before beginning the operation of its solid waste management component. First, the District must establish zonal committees. Second, agreement must be reached among the committees, the District, and a transportation contractor regarding the most efficient means of collecting refuse, loading refuse into containers or vehicles for transportation, and payment of the contractor by the District. According to CHF, which has a long history of community-operated waste collection and disposal programs, entrepreneurs frequently have reservations about working directly with community groups as they fear that payment of fees may not keep up with the quantity of solid waste moved. They typically prefer contracting with individual households or with companies or official agencies since they can

Table 10
CHF Costs for Solid Waste Collection (1995)

Item	Quantity	Unit Cost (gourdes)	Total Cost* (gourdes)	Total Cost (US\$)
Tools (shovels, rakes, boots, masks, gloves)	Per Team	4,030	4,030	269
Team Supervisor	1 Per Team	90 per day	1,980 per month	132 per month
Workers	19 Per Team	40 per day	16,720 per month	1,115 per month
Total Cost Per Month			18,700	1,247

15.5 Gourds = US\$1

*Assumes 22 work days per month

then provide services according to reliable payment schedules. Putting this preference into the current context, to maintain reliable service, the District should pay the contractors directly for collection and removal services. These are crucial links, as the solid waste collection component of this activity is meaningless if the waste is not regularly and efficiently removed from Cité Soleil for landfill disposal.

To meet a portion of the immediate needs of the residents of Cité Soleil and to permit field development of the structure (interconnected responsibilities and relationships) to implement the solid waste component, the District will mobilize one zonal solid waste team as a demonstration project as water sales begin. The steps required by the District to establish this team are presented in Chapter 6. After three months of operation of this demonstration team, the District should be prepared to expand solid waste collection and disposal services into the other six zones of Cité Soleil funded with water revenues.

After the fundamental operations of the District's solid waste program are in operation, i.e., the regular collection of community solid

waste and its removal from the area—the District's goal in solid waste management should be to support the community-based solid waste crews and zonal coordinators in taking on the planning, promotion, implementation, administration, suasion, and enforcement roles necessary to the management of a solid waste management system. These groups should be encouraged to be responsive to their constituents by providing and even improving services to meet their needs. Within each community, the District should work with the responsible organization to develop long-range implementation plans for improving solid waste management within its jurisdiction. The components of such an implementation plan could include:

- encouraging waste sorting and waste reduction in households
- prohibiting the use of unauthorized dump sites
- promoting household delivery of garbage to selected sites
- organizing community collection networks
- supporting public campaigns to promote improved solid waste management

4.3.4 Expansion of Solid Waste Management

The day-to-day operation of the basic solid waste collection component described above will be a complex undertaking, but it is not beyond the capacity of the District. Expansion and improvement of the system should not be considered until the system of zonal committees, private transporters, and District staff is working effectively to reduce the severe solid waste crisis which currently exists in Cité Soleil. After the District has established its ability to manage and direct basic solid waste collection and disposal, it will be able to undertake expansion of services, refinement of their efforts, and leveraging of external funding for programmatic improvements.

Once the seven zonal committees are operational, if the District learns that a single labor team of 20 is insufficient to handle the solid waste generated in a zone, it (the District) could mobilize more teams if finances permit. No revenue is generated to the District by solid waste collection, so any decision to commit District funds to mobilizing more teams must be carefully weighed against the income to the District through water sales. External funding could be used by the District to offset the costs of additional teams, but this should be done only after the District is able to clearly demonstrate the effectiveness of the approach.

To make the collection of solid waste in Cité Soleil more efficient and to maximize the use of local labor, funding could be mobilized either from within the District or external assistance to enable either the District or a zonal committee to buy solid waste collection hand-carts to facilitate the collection of solid waste at households for cartage to selected transfer stations for disposal outside Cité Soleil. Such carts can be adapted from the hand-carts currently in use for all types of material transportation in Cité Soleil or can be simply and reliably constructed from welded metal and lightweight tires, both of which are readily

available in Cité Soleil. If desired by the community and waste haulers, external funding could also be mobilized for leasing or purchasing rubbish "skips" in which solid waste could be dumped and hauled away in large volume. Any of these possibilities would facilitate the removal of solid waste from Cité Soleil and, in so doing, have a major, positive impact on the lives of residents.

4.4 Wastewater Management

No sewage collection or treatment systems exist in any part of metropolitan Port-au-Prince. Domestic and industrial wastewater is typically disposed into on-site pits or roadside drains. The problem is accentuated in Cité Soleil where between 60 and 70% of the residents, some 130,000 people, do not have access to latrines. In these cases, human excreta is disposed of on the ground, in drainage canals, or on the roofs of households. The problem is particularly severe in the areas of Cité Soleil where the crowded, poor-quality housing is located on very small plots with inadequate drainage. In these areas, stagnant water mixes with enormous amounts of human and solid waste to create favorable conditions for vector proliferation and increases in diarrheal diseases.

It is generally acknowledged that the majority of wastewater in Cité Soleil is not generated by the residents of Cité Soleil. The bulk of this liquid enters the area through a network of drainage canals which begin far away in the hills of Delmas municipality. Cité Soleil presents a flat relief and is traversed by a number of these significant drainage canals; notably the Canal St-Georges on the north and the Canal Graisse (Grease Canal) or E.H. on the south. The entire area is subject to regular flooding, caused principally by the all-too-frequent obstruction of these canals by accumulated solid wastes of all types.

4.4.1 Immediate Environmental Risk

Currently, the most acute wastewater-related environmental impact on the residents of Cité Soleil is not the indiscriminate disposal of human waste in the community, but rather the regular inundation of wastewater into the community from drainage canals by flooding during typical rainstorms. It should be the first goal of the wastewater management component of the District to assist in preventing overflowing drainage canals from carrying their raw, septic contents up to and inside the houses of the residents of Cité Soleil. This problem should be significantly reduced by the solid waste collection and disposal program described in Section 4.3.

The District's efforts in solid waste removal and improved wastewater management are inextricably linked: to facilitate keeping the highly polluting waste inside the drainage canals, every effort must be made by the solid waste collection teams to not only collect solid waste on the ground and roadways of Cité Soleil, but also to clear and maximize the flow and volume of the existing drainage network. This effort must be carried out in the large canals and in the smaller drainageways which run throughout Cité Soleil. After reducing this unacceptable environmental contamination, it will then be possible to address additional issues surrounding the disposal of household wastes, including excreta and other wastewaters.

In looking ahead to future efforts of the District in facing these issues, demonstration projects will be undertaken to explore the means by which excreta disposal can be controlled and greywater can be managed for beneficial reuse in Cité Soleil. The District's contribution to this effort will not be in technology application, as simple, well-built latrines exist in Cité Soleil, but rather in working with community organizations to develop management systems for the operation, maintenance, and emptying of

communal latrines. An approach for a demonstration project to accomplish this is described in Chapter 6.

4.4.2 Potential Impact of Untreated Waste Stream

It is the team's understanding, principally through anecdotal information and informal interviews with the residents of Cité Soleil, that the amount of water supplied to the city by the new water distribution system will only slightly increase the total amount of water entering the waste stream in the area. In other words, the water supplied by the new project will replace water which residents currently purchase from vendors or obtain from other sources. Residents are limited in their potential water intake by household finances and the physical effort required to carry water.

As the District begins to bring an increased supply of water into Cité Soleil, it will become increasingly important to direct efforts toward the control and management of domestic wastewater. Supplemental income from the operation of the District will be used to continue the introduction of wastewater collection and disposal facilities developed as demonstration projects in Cité Soleil.

4.4.3 Expansion of Wastewater Management

The wastewater management projects which can be undertaken by the District, either with its own or external funding, are limited by two environmental conditions in Cité Soleil: the high water table and the highly organic nature of much of the soil in the community. The high water table will force excreta management systems to be constructed entirely or predominantly above ground. The organic nature of the soil will limit the locations where, for example, water shops with controlled greywater disposal can be located.

Both such concepts are possible in Cité Soleil and are desired by the community, as indicated in focus group sessions.

Funding is available within the USAID-funded portion of this program to identify and implement focused demonstration projects in the area of wastewater management. (Detailed descriptions are contained in Chapter 6.) If such demonstration projects are successful, the District should be in a position to utilize its own funds and leverage funds from other donor agencies to duplicate and/or improve on the demonstration efforts.

4.5 Summary of Future Infrastructure Investments

The basic functioning of the District will enable it to meet the basic needs of a portion of the population of Cité Soleil. To increase its coverage and maximize the effects of its efforts for the entire population, the District will need to identify its successful efforts and demonstrate their viability to various members of the donor community. As described in Sections 4.2.6, 4.3.4, and 4.4.3, each of the three components of the District's infrastructure improvement efforts could be

augmented by careful application of District revenues and infusions of external funding. Initially, the primary responsibility of the District will be to establish the viability of its operation and control systems and to demonstrate through efficient management, cost recovery, and customer satisfaction that its efforts are effective, desirable, and bring improvements in the environmental status and health conditions of Cité Soleil. Such demonstrations will enable the District to leverage additional funding for (1) more water fountains to serve the residents of Cité Soleil with high-quality drinking water, (2) more efficient and cost-effective collection and disposal of household solid waste, and (3) greater access to clean, well-managed, and affordable excreta management systems.

The implementation of all or most of the possible infrastructure expansions available to the District is not likely to be possible by the District alone. The ideas presented above as well as the results of implemented demonstration projects should be made known to funding agencies in the country and the region so that the District can attract and effectively put to use funds from donor agencies.

5

FINANCE AND RATES

This chapter describes how the private sector has organized delivery of water in Cité Soleil, the market size and cost structure. Financial aspects of solid waste collection are also described. The text then analyzes what it will cost to operate and maintain the potable water system that is under construction, and why having too few fountains will limit potential revenues and distribution. Then cost projections are made using the best data available. The analysis shows that the new community-based District has an excellent chance of being financially self-sufficient. Despite the bottleneck in water sales presented by the limited number of fountains currently in the system, the District can provide less-expensive potable water and also finance solid waste collection to improve the severely degraded urban environmental conditions.

5.1 Market Size and Structure for Water and Sanitation Services

5.1.1 Present Structure of Water Supply in Cité Soleil

Most of the 200,000 people who live in Cité Soleil obtain water from local vendors (estimated at 133) who stock water trucked from nearby private wells. Total daily purchases are at least 200,000 gallons, based on turnover times of water vendors' supplies. One organization supplies 100,000 gallons of water per day free of charge.

A family of 6 pays about US\$3.79 monthly, assuming it uses a daily minimum of 1.5 gallons of water per person at the going

price of about \$0.097 per 7-gallon bucket (1.5 gourdes at the exchange rate of 15.5 gourdes per dollar). Residents in Port-au-Prince served by the municipal water utility pay about \$4.00 a month for an unmetered house connection. Some persons reported purchasing up to 5 gallons per person per day and paying up to 2 gourdes for a 7-gallon bucket.

The minimal 200,000 gallons sold yield 28,571 7-gallon buckets. At the lower price of 1.5 gourdes, this generates total water sales in Cité Soleil of US\$84,238 monthly, or US\$1 million a year. This very conservative estimate is quite remarkable for such an impoverished population. Table 10 summarizes these findings.

Water retailers in the area sell about 67% of total volume used. A typical vendor buys a truckload of water (3,000 gallons) for \$20 (300 gourdes). The trucker retains about 30% of this amount. In two days, the vendor sells the water for nearly \$60 (900 gourdes). The water costs the truckers \$1.61 at the well (25 gourdes) per truckload. Depending on traffic, a typical trucker makes about 5 trips daily. Thus 14 trucks could provide the 67 total round trips required to bring 200,000 gallons per day. During a rainy period, the District counted an average of 46 retail trucks entering Cité Soleil daily. The total marketing margin is about 35 times the price of water at the well, leaving ample pricing margin for the new District.

Current prices provide hard evidence of residents' capacity to pay for water. The new company will have to manage its relations with the community carefully to convert this capacity into willingness on their part to contribute toward the services they require. It will also need to carefully structure relations

Table 11
Estimated Market Size of Water Sales Cité Soleil

Population	200,000		
Per capita usage (gal.)	1.5		
Daily usage (gal.)	300,000		
Free water (gal.)	100,000		
Water sold per day (gal.)	200,000		
RETAILING	G	US\$	US\$
No. Vendors: 133 estimated			
Retail price (\$/7-gal. bucket)	1.50	0.097	
Retail sales (\$/day)		2,771	
Retail sales (\$/month)		84,238	
Cost per 3,000 gal.	300	19.35	
Wholesale (\$/month)		39,216	
Retail gross margin			45,022
TRUCKING			
Trucks day: 67 estimated			
Cost per 3,000 gal	25	1.61	
Source water cost \$/month		3,279	
Trucking gross margin			35,937
SOURCE WATER			3,279
TOTAL			84,238

Exchange rate: 15.5 gourdes/US\$1

with the people currently involved in selling and transporting water.

Important assumptions include:

- Population of 200,000
- Per capita daily water purchases of 1.5 gallons in Cité Soleil
- Daily average sales of 1,500 gallons for a typical vendor

5.1.2 Present Structure of Waste Collection

Residents typically throw trash, domestic wastewater, and excrement into open canals adjacent to their dwellings. For many years, as external funding has been available CDS has periodically hired local day-laborers to clean the streets and canals. USAID recently completed financing of this activity through

the Pan American Development Foundation, with 1,000 laborers at work.

The private firms contracted by the national government to haul garbage away from Cité Soleil have provided irregular service. CDS has had better experience contracting directly with firms, for which it pays about US\$5.00/m³. When haulage has been punctual, residents have reliably taken trash to deposit sites.

5.1.3 Volume of Sales from the New Water System

The number and design of the public fountains that are now contracted will limit maximum sales to about 437,000 gallons per day. This is well under the pumping and distribution capacity of the new system (936,000 gallons per 12 hour day, using 2 wells), even considering the unaccounted-for water which is estimated at 30% of production. Limited sales will limit net revenues of the District. Since most of the District's costs are fixed, if more water could be sold, net revenues would increase accordingly. Table 12 summarizes the dimensions of sales volume and service coverage.

Table 12
Sales and Production Data
New Water and Sanitation District

SYSTEM TOTALS		
fountains		70
faucets/fountain	4	270
gal/min/faucet	3.00	
sales hours/day (with 25% down time)	9	
gal sold/day/faucet	1,620	
gal sold/day		437,400
gal sold/mo.		13,340,700
SERVICE COVERAGE		
gal/person/day	1.5	
population served		291,600
unaccounted for water	30%	
production gal/day		568,620
tower capacity gal	264,000	
tower turnover/day		2.2

Seventy fountains are being installed as part of the Cité Soleil water distribution network. The design of the fountains calls for an average of four ½-inch faucets, each with a rated flow of 3 gpm. Each fountain costs \$2,212. Adding more fountains would greatly improve service coverage and availability of water for increased per capita consumption. About 84 additional fountains (costing \$186,000) would allow all the population to consume 5 gallons of District water per day. This would use maximum system capacity during a 12-hour day.

5.2 Costs of Service of Water and Sanitation District

5.2.1 Administrative Overhead

The budget for overall management of the District follows the cost estimates determined by CDS (see Table 13). To this an additional small amount will be needed for support staff and zonal committee representatives.

5.2.2 Operation and Maintenance for Water

The team foresees that seven employees will operate and maintain the water pumping and distribution system as shown in Table 14. Fountain committees will select operators for each fountain and oversee their performance under a concession agreement with the District. Table 14 summarizes projected operations and maintenance costs for supplying water. Labor costs are projected for the work force that is needed, with salaries at prevailing rates, including overtime of an estimated 25% of base rates (50% for fountain keepers to accommodate 12 hour daily operation).

Pumping charges are in line with what it currently costs truckers to purchase an equivalent amount of water from private wells, less about 20% for labor that is calculated

separately. The estimates assume that all other costs will be slightly more than that of labor, a conservative ratio for a water company. District staff must establish their division of labor with CAMEP and must gain some practical operating experience to further refine these estimates.

5.2.3 Solid Waste Operations

CDS has ample experience with clean-up campaigns of streets and canals in Cité Soleil, but it has not established a permanent solid waste collection system. Estimates of the cost of this effort assume that seven crews will be needed, each of 21 persons. (See Table 15.) The cost includes a sizable fee for hauling the trash collected, as haulage controlled by government has not worked so far.

5.2.4 Capital Recovery for Investment

Efficient water and sanitation utilities should be able to contribute capital toward their own expansion and major repairs. A community-based organization is no exception. The community should use the important capital donation (UNDP grant) in their water system to raise capital for future works. A minimal amount would be to recover the cost of the system during its useful life (about 40 years) plus receive a modest return on the investment. Ideally the price of water should maintain the District's purchasing power vis-à-vis international inflation. About 2% per year in dollars would be a minimum, or \$7,600 per month (Table 16). According to Article 31 of the contract between CAMEP and CDS, the money is to be jointly controlled by CDS and CAMEP.

5.3 Water Rates

The preliminary cost estimates demonstrate that a well-managed local water and sanitation District clearly can provide Cité Soleil with

Table 13
Administrative Costs of the District
(per month)

	# Persons	\$/mo.
CENTRAL OFFICE SALARIES		
General Manager	1	2,500
Community Relations	2	1,500
Operations Supervisor	1	1,000
Solid Waste Supervisor	1	1,000
Accountant	1	1,000
Cashier	2	800
Secretary	2	1,000
Driver	1	160
Messenger	1	160
Guard	1	200
Cleaner	1	100
SUBTOTAL		9,420
ZONAL OFFICE SALARIES		
Zonal Coordinators	7	903
Zonal Clerks	7	339
SUBTOTAL		1,242
Utilities & supplies		1,000
Transport		250
TOTAL		11,912

Exchange rate: 15.5 gourdes/US\$1

Table 14
Water Supply O&M Costs
(per month)

	G/mo.	Over-time	No.	G/mo. Total	\$/mo. Total
Salaries					
Operators	2,250	563	2	5,625	363
Guards	1,100	275	3	4,125	266
Maintenance	2,250	563	1	2,813	181
Laborer	1,100	275	1	1,375	89
Fountain keepers & maint.	1,000	500	70	105,000	6,774
SUBTOTAL					7,673
Community overhead	50%				3,387
Distribution system repairs*					150
Pumping charges & chemicals*	20gds/			115,619	7,459
Transport					300
Private contractors					500
Other (global estimator at 100% salaries)					7,673
TOTAL					27,142

**Estimated based on global typical values. Precise data unavailable for Port-au-Prince and Haiti*

Table 15
Solid Waste O&M Costs
(per month)

	Day rate g	Persons/ crew	No./ 7 crews	G/mo. 26 days	\$/mo.
Salaries					
Cleaners	36	20	140	131,040	8,454
Leader	45	1	7	8,190	528
Animator/ supervisor	90		1	2,340	151
SUBTOTAL					9,133
Community overhead	10%				913
Handtools replacements	1 year life \$25/person				292
Hauling fees	120 m ³ day	\$/m ³ 5.00			15,600
TOTAL					25,938

Table 16
Estimated Capital Recovery
 (per month)

Administration	11,912
Water Supply O&M	27,142
Solid Waste O&M	25,938
O&M Contingencies @ 10%	5,308
Capital recovery for investment	7,600
TOTAL	77,900

Table 17
Alternative Pricing Scenarios

Price per 7 Gallons (gourdes/US\$)	Number of Fountains	Water Sales (gal/day)	Total Revenue (\$/month)	Total Cost (\$/month)	Surplus Revenue (\$/month)
1.50/0.10	70	100,000	43,571	77,900	(-)34,329
1.50/0.10	70	200,000*	87,142	77,900	9,242
1.50/0.10	70	437,400**	190,581	77,900	112,681
1.00/0.06	70	100,000	26,143	77,900	(-)51,757
1.00/0.06	70	200,000	52,286	77,900	(-)25,614
1.00/0.06	70	300,000	78,429	77,900	529
1.00/0.06	70	437,400	114,350	77,900	36,450
0.75/0.05	70	200,000	43,571	77,900	(-)34,329
0.75/0.05	70	437,400	95,291	77,900	17,391
0.50/0.03	70	437,400	57,174	77,900	(-)20,726

- Notes: 1. Does not include any payments made to CAMEP
 2. Assumes operation every day of the month
 3. Uses exchange rate of US\$1 = 15.5 gourdes
 * estimated current retail volume of water in Cité Soleil
 ** maximum retail volume of proposed system, using 70 fountains in operation 12 hours per day

better and less expensive water while also financing solid waste removal. This will help resolve environmental and health problems associated with blocked drainage and flooding and provide the country with a prototype of how to sustain solid waste collection.

The EHP team tested some alternative price schemes for 7 gallons of water, keeping as constants the cost of administration, water supply, solid waste removal, and a minimal amount of reinvestment. The results are shown in Table 17. This table indicates that the initial price of water should be 1 gourde per 7 gallon bucket. This will allow the District to do a little better than break even, assuming sales of 300,000 gallons daily.

The results displayed in Table 17 clearly illuminate a number of important issues, two of which are vital to operation of the District. First, the numbers demonstrate the importance of maximizing water sales. Regardless of the water price, the District is at risk of operating "in the red" if it does not sell enough water to cover its costs. A major portion of the District's costs are fixed; they will not vary with the amount of water sold. Maximizing water sales thus maximizes District revenue.

Second, the District should not lower the price of water too far, even if it determines that it is maximizing its sales. The last row of the table shows clearly that if water is priced too low, the District will lose money even operating at its current maximum capacity. To be able to lower the price of water, the District will have to expand its service either by adding fountains or by incorporating existing water vendors into its supply system, as described in a demonstration project in Chapter 6. Unit costs could fall further if additional fountains were built and per capita usage increased.

This analysis shows the tremendous advantage that the debt-free District brings to the community. The residents of Cité Soleil can use the greater efficiency of the piped system to leverage a lower price for water, maintain and expand the system, and obtain needed urban environmental services.

However, if opinion shifts and residents demand free water since the system was donated, or attempt to destroy it because it affects certain parties, or try to hook up house connections to it and destroy its integrity, then the system will likely fail.

An additional threat to the District's viability is any decision by CAMEP regarding fees and the portions of the water supply system that CAMEP will control. To date, CAMEP has agreed to abide by the conditions in the contract with CDS: CAMEP is to receive 40% of yet undefined "profits," and capital recovery funds are to be held jointly by CDS and CAMEP. Should any change occur in this relationship, the District's operations would be threatened. CAMEP has historically had significant difficulty maintaining its water distribution networks. From past experience, there is no reason to anticipate that CAMEP now has the capacity to monitor, maintain, or repair the system.

If CAMEP insists on operating part of the system, it should not receive an amount greater than the costs to the District to provide the same service. Under no circumstances should CAMEP be permitted to capture revenue generated by the District to subsidize CAMEP's costs in other regions of Port-au-Prince.

5.4 Financial Management Practices

The District will equip itself with the basic financial management functions of an autonomous and self-financing utility. This section describes the basic functions and what is needed to undertake them. They cover planning and budgeting, revenue estimation, rate setting and collections, procurement, accounting, cash management, debt management, and auditing and reporting.

5.4.1 Planning and Budgeting

The District needs a long-term vision as a permanent entity. It will work along with

consultants to identify long-term service objectives, projects, and their capital costs to meet these objectives and the budgeting requirements for the next two years.

A preliminary review shows that certain areas of Cité Soleil will not benefit from the new infrastructure unless action is taken to install more fountains than are currently under construction. With an insufficient number of fountains, the limited volume of sales will keep water prices high. The District staff should follow up on any interest by external organizations in financing additional fountains to maximize its revenues.

As for any utility financing its own operations, revenues and costs must be budgeted. The projections prepared in this document need refinement to account for detailed operational planning. Key figures within the District will undertake such planning with specialized external assistance. The budget will be ready for presentation when the District is officially formed. A system will be in place to monitor monthly expenditures against this budget. Simple software for personal computers is available to integrate budgets, billing, and accounting; such software will be utilized by the District.

5.4.2 Revenue Estimation, Rate Setting, and Collections

The team working to form the District will be prepared to project revenues and review the financial implications of alternative policies and programs. Preparation of a proposal for rates will be an early item on the District's administrative agenda.

A simple billing system needs to be developed or purchased that tracks meter readings, records payments, and details the fountains and communities involved. Consolidating this on a personal computer will help with reporting and controls.

Once the District sets its rate for water, it must select a mechanism to adjust it monthly or bi-monthly to keep up with inflation.

Changing water rates that have remained frozen in inflationary settings is difficult. The District will use a price index for this purpose, based on the cost of its electricity. The mechanism for doing this will be part of the initial rate package.

The community organizations or water vendors will pay the District every day. The District should not let cash accumulate with vendors, given the very precarious conditions in Cité Soleil, abject poverty, and unemployment.

Frequent reading of water meters will help avoid problems. Utilities normally do this monthly, but weekly readings are advisable in Cité Soleil to help establish sound business practices. Community organizations responsible for fountains can read and report their own meter counts each time they deposit funds with the District. The District will spot-check these readings at least twice a month with its own staff.

5.4.3 Procurement

Rules and regulations for purchasing need to be developed. Requirements for inventory need to be specified, an area equipped to store them must be secured, and a system installed to control their use.

5.4.4 Accounting

Before the District opens, an accountant will be in place to develop a basic accounting system that will be functional when the District begins operations.

5.4.5 Cash Management

Simple ways have been developed for people to manage cash flow while avoiding temptation and theft. These methods will be implemented to treat the public with efficiency and allow community organizations to oversee fountain-keepers. Details of the cash management procedures are described in Chapter 3.

5.4.6 Debt Management

Policies will be developed regarding management's authority to contract debt, particularly short-term debt for working capital.

5.4.7 Auditing and Reporting

An external audit once a year will help keep financial management transparent. The District's accountant must produce auditable reports and records.

6

Demonstration Projects

A portion of the project funds will be used for demonstration projects, augmenting the basic activities of the District. The demonstration projects will focus on technologies, management systems, and community mobilization. The goal is to educate residents of Cité Soleil while developing infrastructure that can begin to meet their long-term wastewater management (and particularly excreta) disposal needs. After extensive discussions with District staff, residents of Cité Soleil, Haitian professionals, and USAID officials, a list of recommended demonstration projects has been assembled, scheduled, and costed as steps toward sustainable environmental improvement in Cité Soleil.

These demonstrations will serve as pilot projects which can be expanded under the management of the District to improve excreta control, decrease environmental damage from indiscriminate wastewater disposal, and establish the means by which the District will implement its larger goals of sanitation service and disease reduction. If they are successful, the District can show these projects to external funding agencies to entice them to contribute to expanding the District's services to residents of Cité Soleil.

The selected technologies are not necessarily new to the community, but their form of implementation—with involvement of the recipients and management by the local community—is a first-of-its-kind effort in Cité Soleil. In most cases, it will be the management system rather than the technology itself which will be the innovative portion of the demonstration projects.

6.1 Recommended Demonstration Projects

The District has the capability and funding to undertake each of the demonstration projects presented below before the end of the Haiti Urban Pollution Project (April 1997). Each demonstration has been selected (1) to help the District achieve its overall goals of community management, education, wastewater control, and expansion of the water distribution system and (2) to demonstrate that community-managed efforts are effective and sustainable. Each demonstration project is described briefly below, described in more detail in following sections, and incorporated into a proposed implementation schedule in the final section of this chapter.

Community-managed, neighborhood sanitation facilities. Years of experience have shown that communal latrines should never be constructed without input from beneficiaries and their commitment to management and maintenance. This pilot project will emphasize the development and refinement of systems of community management of neighborhood communal latrines.

Community-managed water stations with laundry facilities and greywater distribution. Certain locations adjacent to water fountains have sufficient space for laundry facilities. A clear consensus was expressed in focus group sessions that such facilities would be highly desirable to the community and would greatly reduce a burden on the women of Cité Soleil.

Setting up a system for collection of waste and removal to the municipal landfill outside of Cité Soleil. As discussed in Chapter 4, the collection and removal of solid waste is key to improving environmental and health conditions in Cité Soleil. As a pilot project, the District will form and work with a zonal committee of residents to staff, supply, and mobilize one solid waste team in one defined geographic area of Cité Soleil and pay a private contractor to haul the collected solid waste for disposal.

Hooking up the water distribution system to an existing water vendor. The District's ability to supply high-quality water to the residents of Cité Soleil is limited by the number of fountains and faucets in the network. To provide more water to residents while avoiding the expense of constructing more water fountains, the District will establish a pilot project whereby water is fed directly from the distribution network into an existing water cistern currently operated by a water vendor.

Upgrade an existing communal latrine by adding ventilation pipes to minimize odor inside the latrine. One of the services the District can provide to the residents of Cité Soleil is technical assistance. During field investigations, an existing communal latrine was identified which was built without ventilation pipes, and the access cover to the extremely large and deep vaults only loosely held in place. Upgrading the facility would be quite simple and inexpensive and would serve as a convenient entry point for the District into the community and a specific illustration of the technical assistance it can provide.

Implementation of the communication strategy. The communication strategy to be developed by GreenCOM is a crucial contribution to educating the residents about the various aspects of the water supply system and District. It is also vitally important to mobilizing residents to become participants in and overseers of the system.

The USAID budget contains \$90,531 earmarked for use on demonstration projects. Table 18 contains a proposed implementation schedule including each of the demonstration projects discussed above. Some of the proposed demonstrations are one-time efforts; others are multiple efforts to maximize the number of residents served and utilize the earmarked money during the life of the project.

6.2 Community-Managed, Neighborhood Sanitation Facilities

Conventional sewerage is not a viable option for Cité Soleil in the foreseeable future due to extremely limited institutional capacity and the overall lack of wastewater collection and treatment in Port-au-Prince. Consequently, any efforts to install sanitation facilities in Cité Soleil must use on-site disposal systems which can be emptied manually or by mechanical means and reused over time.

Under favorable conditions, *individual* on-site sanitation is often successful at population densities as high as 150 persons per acre. Unfortunately, the estimated population densities in Cité Soleil calculated in Chapter 4 range from 150 to 1,030 persons per acre. Consequently, individual on-site sanitation facilities are not a viable option. Rather, emphasis must be on *communal* sanitation facilities. This approach is recommended, despite the frequent rate of failure of such systems worldwide due to lack of input from the beneficiaries in their siting, construction, and management. The District will face this challenge by beginning a latrine-building pilot project with examination of its social feasibility, clear identification of community responsibilities, mutual agreement between the District and the community regarding management and operation of the facilities, and educating the project beneficiaries regarding their role in overall community hygiene.

Table 18
Schedule and Cost of Demonstration Projects

Project	People Served	Schedule	Cost (US\$)	Cumulative Cost
Latrine Upgrade	500	May-June 96	\$631	\$631
Communication Strategy	200,000	May-Oct 96	\$20,000	\$20,631
Solid Waste Collection	30,000	May-Aug 96	\$13,400	\$34,031
Latrine Construction & Management	300	Sept-Oct 96	\$5,000	\$39,031
Latrine Construction & Management	300	Nov-Dec 96	\$5,000	\$44,031
Latrine Construction & Management	300	Nov-Dec 96	\$5,000	\$49,031
Hook-up Water Vendor	300	Jan 97	\$500	\$49,531
Latrine Construction & Management	300	Jan-Feb 97	\$5,000	\$54,531
Laundry Construction & Management	750	Jan-Feb 97	\$5,500	\$60,031
Latrine Construction & Management	300	Jan-Feb 97	\$5,000	\$65,031
Latrine Construction & Management	300	Feb-Mar 97	\$5,000	\$70,031
Latrine Construction & Management	300	Feb-Mar 97	\$5,000	\$75,031
Latrine Construction & Management (2 at 1 location)	600	Feb-Mar 97	\$10,000	\$85,031
Laundry Construction & Management	750	Feb-Mar 97	\$5,500	\$90,531

With the limited funds available through the demonstration portion of the overall project budget, the District will not be able to substantially, directly, and positively impact the health of the residents of Cité Soleil. It is generally accepted that 75% of a community's residents must have access to and use a sanitation facility before positive health impacts can be expected. Currently, only 30% to 40% of Cité Soleil's residents have access to a latrine. To reach 75% coverage, 90,000 people would have to gain access to latrines. Communal latrines in Cité Soleil are typically constructed with 20 to 24 individual stalls which are estimated to be able to serve 15 people each. One communal latrine would therefore be expected to serve a maximum of 360 people. Obtaining 75% coverage would therefore require the construction of 250 such latrines, a number outside the current project budget. The estimated cost presented below will cover construction of only 9 latrines.

As a pilot project, the District will establish a replicable mechanism with extensive community involvement to select viable latrines; establish the community's desire for and commitment to improved sanitation; locate the latrines; define roles and responsibilities for construction, operation, maintenance, and emptying; and finance construction of the latrines. The District will begin by defining to the community the technologies which are available to and sustainable by them. Within this framework, and with guidance from the District's community relations staff, the community will identify its preferred technologies, locations, and method by which the sanitary condition of the latrine will be maintained. Finally, and only after agreement is achieved on management and maintenance responsibilities, the District and community will agree on the separation of contributions between them to supply materials, labor, funding, and oversight for latrine construction.

ESTIMATED COST: \$45,000

6.2.1 Viable Sanitation Technologies

The physical setting of Cité Soleil presents a number of conditions that severely limit the type of sanitation facilities that can be installed. Groundwater is typically very shallow (0 to 5 feet below ground level) in most of Cité Soleil, although in certain locations, groundwater is over 6 feet below ground level. In areas of very shallow groundwater, the viable options will be limited to those that totally encase excreta underground or those that can be built above ground level and emptied, either by pump trucks or manually.

The soils in most of Cité Soleil are of a highly organic nature. Where this is the case, soil absorption systems will not be possible, and the limitations described in the previous paragraph will apply. Use of soil absorption systems, such as unlined or porous-lined pits, may be possible in the areas of Cité Soleil where soil will absorb wastewater and the groundwater is sufficiently deep to allow underground construction.

UNICEF has the most experience with the installation of communal latrines in marginal areas around Port-au-Prince, having recently constructed four communal latrines in the La Saline area of the city. These units consist of a single 12 m³ vault (4m x 1.5m x 2m) covered by five latrine cabins. The costs for four of these units was 323,580 gourdes (US\$21,572), or US\$5,393 each. The Haitian Department d'Hygiene Publique (DHP) is responsible for pumping out each vault and disposing of the waste material in the way it sees fit. According to UNICEF engineers, DHP disposes of the material "in the country." DHP has been responsive to the community's needs; it pumps the latrines which service 300 people approximately once every two months.

No applicable siting or construction standards exist in Haiti for sanitation facilities. Recommendations are therefore based on best possible engineering, environmental, and public health approaches to the specific difficulties which exist in Cité Soleil. It is

assumed that each residence in the program area will not have a water supply connection to the home but rather will continue to collect water at central distribution points and carry it to the household. This means that water-borne sanitation systems are not applicable in Cité Soleil. Viable options for excreta control are consequently limited to a variety of communal latrine designs that do not require a consistent water source. The following sanitation systems meet these criteria and may be considered for use in Cité Soleil:

Soil absorption systems
Ventilated Improved Pit (VIP) latrines

Systems where soil absorption is not possible
Sealed Ventilated Improved Double-vault Pit (VIDP) latrines
Vault latrines (cesspools) and suction tanker collection

Detailed descriptions and drawings of the technologies are contained in Appendix E. Two of the potential technologies are currently in use in the community (i.e., VIP and vault latrines) while another has not yet been introduced (VIDP latrines).

VIP Latrines

VIP latrines are a viable excreta disposal system for selected locations in Cité Soleil. Locations will be chosen primarily on the ability of the underlying soils to absorb wastewater. In addition, VIP latrines will be located only in areas where pits can be excavated above the level of the groundwater. Because of the shallow groundwater in many sections of Cité Soleil, the substructure of latrines may need to be constructed partially above ground. Such VIPs have been built for private use on certain sites in Cité Soleil and appear acceptable to the community. Due to the high population density in Cité Soleil, latrines should not be constructed for individual families but rather

should only be built to serve as communal facilities. Sizing of facilities will be done as described in Appendix E.

Estimated cost for construction of VIP latrines is based on UNICEF's latrine construction program in marginal areas of Port-au-Prince—approximately US\$1,000 per individual unit (\$5,000 per block of five units) including sub- and super-structure.

VIDP latrines

VIDP latrines are a viable option for excreta disposal for sites where there is an understanding and commitment on the part of an organization to manage the latrine, i.e., to accept responsibility for the eventual manual emptying of latrine vaults and disposing of the decayed contents. Due to the population density in Cité Soleil, VIDPs should not be installed for individual houses. They are more suitable for centrally located communal facilities under the management of householders, an existing authority, or a community group, depending upon the wishes of the users.

Estimated cost of a VIDP latrine, based on UNICEF construction costs of similar units in marginal areas of Port-au-Prince, is approximately US\$2,500 per individual unit (US\$5,000 per 5 cabin, communal unit) including sub- and super-structure. Each vault would be sized as described in Appendix E for VIP latrines.

Vault latrines (cesspools)

This type of system is not suitable in all cases because of (1) the requirement of truck access to the facility, (2) difficulty of ensuring that the vault is regularly emptied, and (3) necessity of having funds available for the continuing cost of tanker emptying and disposal. This technology may, however, be a viable option in selected locations where these criteria can be met.

Significant organizational efforts must be carried out before installing this technology due to the stringent operational requirements and severe consequences if misused (i.e., leaking, concentrated, raw sewage in large volume). However, this technology was used successfully by UNICEF in La Saline. Estimated costs in Cité Soleil would be approximately the same as those paid by UNICEF, \$5,000 per block of 5 units.

6.2.2 Social Feasibility Analysis

It is generally accepted that in all sanitation interventions, planners must gather information on norms and attitudes of those impacted by the intervention before implementation is begun. After identifying the range of viable technologies and before locating and constructing a latrine, the District must ensure that the beneficiaries want the latrine, are prepared to take on responsibility for its operation and maintenance, are willing to participate in its installation, and will cooperate with the District to ensure that the latrine is maintained in a manner acceptable to District staff. The nine questions below, adapted from Perrett (1983), must be answered "yes" by beneficiaries before the District proceeds with locating and constructing a communal latrine. The answers to these questions may vary greatly by neighborhood. Honest and satisfactory responses by each neighborhood community will determine whether or not the District will focus its efforts there.

(1) Do the intended beneficiaries want improved sanitation? The ultimate beneficiaries of sanitation improvements are the residents of communities where systems are constructed. It has been demonstrated worldwide that merely constructing sanitary facilities is not a sufficient reason for people to use them. Before the District considers locating a facility, it will need to identify the prospective beneficiaries and ensure that sanitation is among their priorities. If it is not, then the District can

either invest time in educating those residents regarding why a sanitation facility is in their interest or transfer its efforts to another location where the residents are prepared for and desiring of improved sanitation.

(2) Are the beneficiaries able and willing to pay for sanitation improvements?

or

(3) Are the beneficiaries able and willing to contribute labor and/or materials toward the cost of sanitation improvements? The roles of the beneficiaries are to develop, own, and manage the facility. The role of the District is to ensure that the beneficiaries are actively involved in all phases of decision-making during project development. The District must determine in early discussions with potential beneficiaries how they are willing to contribute to sanitation improvements. Under no circumstances should the District shoulder all costs of siting and constructing a communal facility.

(4) Do people's likes and dislikes fit the technology options available? While it is acknowledged that the technical options available to the residents of Cité Soleil are limited, the selection of a technology, its design, and its siting should involve and account for the preferences of the beneficiaries. There is little likelihood of long-term success of a facility which the beneficiaries do not like or otherwise will not use.

(5) Are the technology options compatible with the project population's existing defecation practices and related habits?

and

(6) Are the planned sharing arrangements acceptable to beneficiaries? Discussions must be held between the District and the beneficiaries regarding their preferences of, for example,

family ownership versus communal ownership of their latrine; selection of individual cabins or stalls within a larger structure; methods of allocating and sharing latrine cabins; separation of men's, women's, and children's facilities; or any other concerns which the beneficiaries may have which can determine facility design.

(7) Are the planned sitings of facilities acceptable to beneficiaries? Residents should be involved in specifics of facility siting, such as proximity to houses, direction in which doors face, and availability of pump truck access.

(8) Do projections about the rate at which new facilities will be built or existing ones improved match beneficiaries' capacity to change their habits or to adopt new technologies? While the District would like to reach 75% coverage of the population by building latrines as soon as possible, the key to long-term health improvements is proper use of latrines, not simply their number. The pace of latrine construction must be balanced with educational efforts to improve individuals' sanitary habits. The provision of additional latrines should be carried out parallel with local desire or demand for improved sanitary excreta disposal systems.

(9) Do the beneficiaries have the willingness and capacity to maintain a hygienic sanitary facility over the long-term? The beneficiaries must commit themselves to the upkeep of their facility. Open discussions should clarify such issues as whether the District or the community will perform repairs to the facility, arrange and pay for emptying if necessary, and take corrective action if the latrine is not maintained hygienically. In the long term, each of these areas should be the responsibility of the community, but initially the District may need to take a limited role while educating community members about the necessity of their taking over the activities.

6.3 Communal Laundry Facilities

The women of Cité Soleil endure a regular and burdensome job in laundering their families' clothing. To do the family laundry, women must either bring 8 to 12 buckets of water to the house or they must travel outside of Cité Soleil to a more rural laundry site (a full day's job). Women in focus group sessions expressed strong feelings in favor of communal laundry sites. Despite this strong desire, both site selection and management of such facilities will need special care since the volume of water used in laundering presents complex issues.

For maximum benefit to the community, wastewater (or greywater) generated by a communal laundry facility should be disposed of underground. Details and design of this type of facility are contained in Appendix F. Controlled, subsurface greywater disposal would remove one environmental pollutant and a source of disputes throughout Cité Soleil, while providing an innovative method of wastewater disposal. Such a system would also provide the potential for creation of greenspaces in the community.

Site selection for laundry facilities will be limited in Cité Soleil by the generally poor condition of the lower elevation soils. Availability of adequate land area, community desires, and perhaps most importantly, soil permeability will be determining factors of site acceptability. One percolation test, carried out in Cité Soleil in February 1996 on the north side of Avenue Soleil across from Soleil 17, indicated the near impermeability of the soil in that particular low elevation location due to its highly organic nature. Successful conduct of a percolation test on the proposed site is a necessary prerequisite for the installation of any laundry facility with underground greywater disposal.

If a location is found which has adequate land area and soils as described in Appendix F, then the District will undertake a social feasibility study as described in Section 6.2.2 to ensure that (1) beneficiaries and a responsible

management body are identified, (2) the beneficiaries want the facility, (3) the beneficiaries are prepared to take responsibility for its operation and maintenance, (4) the beneficiaries are willing to participate in its installation, and (5) the beneficiaries will cooperate with the District to ensure that the facility is maintained in a manner acceptable to District staff. Satisfactory answers to the nine questions posed in Section 6.2.2 concerning latrines should be obtained by the District before proceeding with construction of a communal laundry facility.

Facility design will be completed through a joint effort among the District manager (an architect), the operations supervisor (an engineer), and the community. It is not possible to present a design as part of the plan as each design will be site specific. A built model of a communal latrine exists at Père Lanoux's distribution facility in Soleil 4, and greywater disposal design criteria are contained in Appendix F. Full engineering design of any facility will be prepared and approved by USAID to assure negligible environmental impact.

Because the design depends upon available areas' soil absorptive capacity and the volume of water to enter the greywater system, the cost of a system can only be roughly estimated before detailed site-specific designs are prepared.

ESTIMATED COST: \$5,500

6.4 Solid Waste Collection Project

No solid waste is currently being collected in Cité Soleil, and there are no municipal plans for collection in the foreseeable future. Consequently, it is imperative that the District begin mobilizing at least one solid waste collection team immediately. A demonstration project will allow the District to begin having a beneficial impact on the environment while implementing in a focused, defined area its community organization, program

management, and financial management systems. The systems developed in this pilot effort will serve as models for the financial, oversight, and management systems which will be used with community organizations to manage expanded solid waste efforts.

Implementation of this pilot project will require roughly one month of preparation time, equipment purchase, and two months of full coverage for the salaries of those employed as the solid waste collection team. During the first month of preparation (July 1996), priority activities for the District will include (1) establishing a zonal committee in one of the seven zones of Cité Soleil, (2) identifying with this committee their responsibilities and benefits regarding the proposed effort to remove solid waste from their zone, (3) selection of and equipping a zonal solid waste collection team, and (4) making arrangements for a private contractor or contractors to rendezvous with the zonal collection team on a daily basis, collect the waste, transport it out of Cité Soleil, and receive payment from the District.

Over the following two months of this pilot activity (August - September 1996), the District, the zonal committee, and the contractor will work together to refine communication, direction, and financial management of the solid waste program in one zone (while anticipating expansion into an additional zone or zones when District revenues allow).

ESTIMATED COST: Equipment purchase—\$500, monthly costs—\$4,300; total cost—\$13,400.

6.5 Connection with an Existing Water Vendor

Given the available funding, the principal constraint on the District's ability to maximize its service to Cité Soleil and revenue is the limited number of water fountains. To expand the District's revenue without incurring

additional construction costs, the District will conduct a pilot project in which one water vendor with an existing water storage cistern will be connected to the District's distribution network and permitted to retail water in the same manner as neighborhood fountain committees. The water provided by the District to the vendor will be metered, and the vendor will receive the same salary from the District as does a fountain keeper. (The vendor will not be entitled to the 10% overhead which is given to neighborhood water committees.)

Particular attention will be paid by the District to monitoring the quality of the water before and after storage in the vendor's cistern. The District will be providing high quality water to the vendor, and the District must ensure that storage of the water in the vendor's cistern does not in any way reduce the quality of the water provided to the final consumer. District staff will monitor the chlorine concentration and pH value at the cistern outlet once each day for the duration of the pilot project to ensure that quality is maintained. This testing regimen should continue for one month to ensure long-term compliance on the part of the vendor. In addition, the District will compare the performance of the individual vendor to community fountain committees in terms of (1) promptness of submission of cash receipts, (2) accuracy of meter readings, (3) cleanliness of water distribution point, (4) customer satisfaction with hours of operation and quality of water, and (5) maintenance of water pipes and meter. If the pilot vendor meets these criteria, the District will look to expand this arrangement to other water vendors.

ESTIMATED COST: \$500

6.6 Communal Latrine Upgrade

A community latrine has been constructed in the Belekou area by the Mevs Foundation. It was originally to be managed by an individual who would charge residents 0.25 gourdes per

use. The residents elected not to pay for this service, and the management structure fell apart. The latrine is currently open to the public at no cost, and to date it is being cleaned by those who use it. The facility consists of two dozen stalls elevated over four large-volume block vaults constructed above groundlevel.

Unfortunately, it was constructed without ventilation pipes for the vaults, and the interior of the structure smells badly even though the facility has barely been used. As a demonstration project and public awareness activity, the District will work with residents of the neighborhood surrounding the latrine to install four ventilation pipes on the structure, one in each vault. These pipes should remedy the odor problem since the latrine is very close to the seashore and is subject to a regular sea breeze.

At the outset of this activity, the District will discuss with community members how they and the District could each contribute to the upgrading. It is important that the District not undertake the repair by itself. The residents who use the latrine must be involved in discussions and decision-making so that the final upgrading plan has their input and consent. General recommendations for this site are (1) install one 4" diameter PVC vent pipe on each of the four vaults, (2) each ventilation pipe should extend above the highest point on the roof of the latrine, and each should be equipped with screening to prevent flies from escaping up the pipe, (3) relocate the metal access door to the vaults so that they are safe and can be emptied by pump trucks, and (4) seal and reinforce the original location of the access door. In discussions with beneficiaries, responsibilities will be separated and defined between the District and the residents. For example, the District might provide materials and technical assistance, while the community contributes advice and labor.

In addition to improving sanitation in the immediate community, upgrading of this facility will serve as an initial entrance into the

community by the District and a marketing device for the goals and services of the District. This relatively simple effort could be repeated in other locations throughout Cité Soleil on an as-needed basis.

ESTIMATED COST: \$631

6.7 Communications Strategy

The original draft plan for the District, developed in the fall of 1995, assumed that the District's communication strategy would be implemented in Cité Soleil by the network of then-existing community animators working in the area under the direction of CDS health programs. As CDS has ceased its involvement in health programs in Cité Soleil as of the end of March 1996, these resources will no longer be available to the District. Funds for implementing the communication strategy are not explicitly contained in the USAID budget under which the District is operating.

In order to effectively support the District in its communication strategy prior to the distribution of water through the Cité Soleil system, it is proposed that a portion of the

demonstration project funds be directed to this effort to prepare educational material, increase community education, and enhance the community's understanding of the District prior to water coming through the system. The details of the six month implementation plan and its estimated costs were established by a consultant from USAID's GreenCOM project with extensive input from community members and District staff.

The aims of this effort are (1) to sensitize the residents of Cité Soleil to the approach being taken by the District, (2) to communicate educational and informational messages to the residents, (3) to recruit, train, and mobilize community-based animators, and (4) to organize the residents into fountain and zonal committees which will be integral and necessary elements of the District's operation. Immediately upon acquisition of demonstration funding, the District will implement a focused, scheduled series of communication and organizational activities which are crucial to the opening of the District and its provision of water and services to the community.

ESTIMATED COST: \$20,000

7

Summary and Next Steps

The plan to set up an autonomous, financially self-sufficient District in Cité Soleil is very ambitious. There is no question that the District has the potential to be financially sustainable. People are currently paying for water an amount that can finance the operation of the water supply system and provide solid waste services as well. The technical recommendations in the plan are realistic. What will determine the success of the project are the institutional and community components. Will the community be willing to purchase water from the District, and will they feel enough ownership of the system to protect its well being? Will the District be strong enough institutionally to adequately manage both water and sanitation services for a densely populated community of 200,000 people? Will the political situation remain stable enough for the District to function? If the answers to these questions are positive, the District has the potential to make real improvements in the living conditions in Cité Soleil.

This chapter is intended to be a bridge to implementation of the plan. It summarizes the areas of the plan that are most critical to success and areas of potential interest to other donor organizations. It also provides a monitoring tool.

The chapter contains the following sections:

- Priority activities between March 1 and the target date for inaugurating the water system, August 1, 1996
- Summary of key infrastructure projects for external financing
- Technical assistance needs

- Indicators for monitoring the performance of the District

7.1 Priorities from March 1 - August 1, 1996

Although Appendix G contains the list of key actions in each area, there are four priorities for the period that are highlighted below. The District will not be able to begin operations until these priority areas are successfully addressed. These priority areas are intended to be the focus of the efforts of District staff until the opening of the water system.

Formation of fountain committees and zonal committees. The formation of these committees is the key to involving the community and providing services. To make the District a community-based organization, the committees will be the focal points for management of the fountains and collection of solid waste. Therefore, these committees must be formed in a participatory manner in time so they are ready to assume their responsibilities when water starts to flow. Because of the number of committees that must be formed, this task is the highest priority.

Development of financial and administrative procedures. If water sales are as expected, the District will handle \$1 million in revenue annually. Although the District cannot expect to sell 200,000 gallons per day the first several months of operation, it will begin handling significant amounts of money immediately. This will require that all financial systems be in place and that all parties be trained in their use.

The District must select a contractor, develop administrative and accounting systems, and train staff.

Development of an operations and maintenance system. The entire approach of this plan depends on the sale of water. Research findings indicate that people will buy water if the service is reliable and water is of good quality. Reliable service and good quality water depend on an effective operations and maintenance system. O&M procedures must be developed specifying what preventive maintenance must be done, when, and by whom. A generic scheme is presented in Appendix C which must be refined to meet the specific needs of the District. A contract must be awarded to provide back-up service for maintenance that is beyond the District's capability. O&M staff must be hired and trained. Fountain operators must be trained to operate the system and do simple repairs. Spare parts must be stocked. Although the water supply system is not complicated technically, it is by no means maintenance free. The O&M system must be in place by Day One of system operation.

Development of a solid waste management system. Although the development of a solid waste management system is less complicated technically than development of a water supply system, it still must be addressed. Since CDS has significant experience in solid waste collection, it will probably be easier to activate than the other three priorities. Also, the District will begin the program first in only one zone. CDS will need to select the zone, form a zonal committee, hire a solid waste coordinator, purchase equipment for the solid waste crew, and enter into a contract to haul the solid waste to the landfill outside the area.

7.2 Summary of Key Infrastructure Projects for External Financing

Several opportunities exist in this program for additional external assistance. Additional

support would allow the District to (1) improve its provision of services, (2) expand its provision of drinking water, (3) reduce the price of the water, and (4) accelerate the beneficial impacts on the health and environment of the residents of Cité Soleil. These have been discussed in detail in Chapters 4 and 6 but merit summarizing here. Chapter 4 gave descriptions of how external funding could augment revenues from the District to expand the coverage and service of the infrastructure which has been installed. Chapter 6 presented demonstration projects which will be fully developed using USAID project funds, but which could be expanded throughout Cité Soleil with additional long-range, external funding. The following daily District activities would benefit from external financial assistance:

- *Water System Expansion.* It is vital to the long-term provision of water and financial sustainability of the District that both the distribution network and the number of fountains be increased over time. Expanding the system is principally a matter of constructing additional water fountains to connect to the existing distribution network. The piping network must also be extended into some presently unserved areas of the community.

External financial assistance has already been leveraged by the District from Plan International (Foster Parents Plan) for construction of 18 fountains. This funding has greatly increased the financial viability of the District and has enabled it to begin providing water at a price which is very competitive with water now vended in the community. System expansion is tied to increased revenue, which in turn directly leads to increased community involvement, improved service, and greater impact on the environment and health in Cité Soleil. Over time, the District will channel its own funds into system expansion, but external funding in the near future would

permit the District to greatly expand its services through its existing managerial and community relations systems.

- *Increasing Efficiency of Solid Waste Management.* After establishing the logistical and managerial systems necessary to mobilize solid waste collection and disposal in one zone, the program should be quickly expanded to cover all of Cité Soleil as shown in the Technical Action Plan in Appendix G. It should be possible for the utility to cover the expenses of enlarging the program, but external funding sources could also play significant roles.

External funding could enable the District to enhance its solid waste collection scheme in a variety of ways. For example, funding could be made available to lend to residents or organizations to obtain and operate their own solid waste transportation vehicles to assist further in keeping the revenues of the District inside Cité Soleil. External funding could also enable residents to buy solid waste collection hand-carts to facilitate the collection of solid waste at households for cartage to selected transfer stations for disposal outside Cité Soleil. If desired by the community and waste haulers, external funding could also be mobilized for leasing or purchasing rubbish "skips" in which solid waste could be disposed and hauled away in large volume by locally-owned, government-owned, or otherwise privately owned trucks.

Any of these possibilities would facilitate the removal of solid waste from Cité Soleil and, in so doing, have a major positive impact on the lives of its residents. While each suggestion is outside the central mandate of the District and therefore of relatively low priority for commitment of District funds, each would serve to increase the efficiency of solid waste collection and thereby maximize the impact of the

District's resources on the environment of Cité Soleil.

The following demonstration projects would benefit from external financial assistance:

- *Community-managed, communal latrines* throughout Cité Soleil would provide significant positive environmental impacts on the residents of Cité Soleil. Health impacts, however, are not likely to be evident until over 75% of the population of Cité Soleil is using hygienic latrines. The demonstration projects will emphasize development of a replicable community-managed system by which latrines are constructed and maintained. External funding would allow the rapid expansion of the developed management system throughout Cité Soleil to achieve the goal of 75% usage and decrease excreta-related illness.
- *Community-managed water stations with laundry facilities and greywater distribution* were enthusiastically supported in focus group sessions. Doing household laundry is now an onerous burden on the women of Cité Soleil as they must either commit a day to travel and do laundry outside Cité Soleil or must carry to their household about 10 buckets of water on laundry day (with the concomitant problem of water disposal). Community laundry facilities would greatly alleviate the task. As a beneficial side effect, they would also serve as greenspaces and social centers for the users. In demonstration projects, the District will establish optimal design of these stations and will test and refine their management systems. External funding would allow these stations, possibly including showers and latrines, to be constructed at as many locations in Cité Soleil as are suitable for their installation.

- *Support for the communication strategy developed to educate and involve the residents of Cité Soleil in their District.* The communication strategy is a crucial step in educating the residents about the various aspects of the water supply system and the District. External funding, particularly in the early months of the District's operation, would optimize its efforts to reach and involve each local organization and individual in Cité Soleil to contribute to the durability and quality of service provided by the District.

7.3 Technical Assistance Needs

USAID funding has been limited mainly to assistance in developing a plan to create the District. By necessity, the plan is a framework and does not provide full details in each area. The plan delineates the District's major components and spells out major tasks to be accomplished. Funds remain to carry out three short monitoring visits by April 1997, but these visits will be limited to assessing progress and pointing out areas needing attention.

To give the District every chance of success, other organizations may be interested in providing technical assistance. Such assistance might be part of a project which includes investments in infrastructure. Assistance could also help to strengthen internal operations of the District or to fully document its implementation relative to this plan. At the time of this writing, it is not possible to pinpoint exactly where such assistance might be needed. It could be targeted at financial systems, at strengthening O&M systems, at designing facilities, or at developing a long-range plan. It could also be used to develop hygiene education programs to improve health benefits. As the District begins operation, future technical assistance needs will become apparent. What is certain is that the financial assistance provided to develop this plan will not be sufficient to ensure long-term program success.

7.4 Indicators for Monitoring the Performance of the District

Water and sanitation utilities use indicators to track their performance; they are useful in that they point out the strengths and weaknesses of the utility and can be compared over time. Table 19 provides a list of indicators that the District will use to assess its performance. They were selected because they reflect the key objectives of the utility and because the data they require will be readily available. They represent a mix of institutional, financial, and technical performance measures. These indicators will be used in assessing performance in 1997, the first full year of operation, i.e., measurement of performance will take place *after* the initial six-month start-up period, July-December 1996.

One of the primary constraints to developing indicators is the availability of data. Since there will be no house connections in Cité Soleil, the indicators will have to rely on system-wide data. Below are brief explanations of the indicators and the data used in their measurement.

Access to improved waste management services. CDS estimates that 120 m³ of solid waste are generated daily in Cité Soleil. Thus, if 60 m³ (15-20 truckloads, depending on truck size) are hauled away daily, it is assumed that 100,000 people (half the population of Cité Soleil) have access to solid waste services. The hauling contractor should be able to provide data on how much is being hauled since he will be paid based on the amount (truckloads) taken to the landfill.

Consumption of treated drinking water from the District. CDS turned over management of the health services system in Cité Soleil to the Ministry of Health at the end of March 1996, so gathering reliable health statistics is not assured, and funds are not available to collect them. As a result, it will not be possible to directly measure health impacts. As an

Table 19
Performance Indicators for the District

Indicator	Unit	Target		
		1996	1997	1998
Access to improved waste management services	number of people	2,500	100,000	150,000
Consumption of high- quality drinking water from the District	gallons per day	65,000	175,000	200,000
Operating costs recovered through user fees	percentage	80%	100%	110%
Amount of District revenue used to finance waste disposal services	\$ per year	\$17,000	\$200,000	\$220,000
Average amount of solid waste hauled to landfill daily	cubic meters	15 m ³	60 m ³	90 m ³
Meters working	percentage	90%	90 %	90%
Unaccounted-for water	percentage	30%	30%	30%
Water quality	percentage of samples with an acceptable chlorine concentration	95%	95%	95%
District staffing	Ratio of District employees to gallons of water sold per day	same	one employee/ 13,000 gallons sold	same

alternative, the indirect measure of health benefits will be the quantity sold and the quality of the water. This indicator is also important since revenues depend entirely on the ability of the District to sell the water it produces. The data to measure consumption will be easy to collect since the water tower and the fountains will be metered.

Percentage of operating costs recovered through user fees. The best measure of financial sustainability is the percentage of operating costs recovered through user fees. Although

the financial plan includes eventual system replacement, recovery of 100% of operating costs will in itself be a substantial achievement. The data for this indicator are simply total operating costs as compared to total revenues.

Amount of District revenues used to finance waste disposal services. Because of the environmental sanitation objectives of the District, an important indicator is how much money is being spent on waste disposal services. Initially, waste disposal services will cover only solid waste, but the hope is to

generate revenues which will eventually finance excreta disposal facilities as well. The amount spent per year on waste disposal services should be readily available in the District financial system.

Amount of solid waste hauled to the landfill daily.

This indicator will be a measure of the effectiveness of the solid waste management system. The data for this indicator will be collected as part of the hauling contractor's payment records and used to determine how many people have access to waste management services. CDS has a reliable baseline of how much solid waste is now being generated on a daily basis in Cité Soleil.

Meters working. This indicator will be essential in determining the effectiveness of the commercial system. The reliability of the meters is the basis for ensuring that the fountain committees are collecting revenue for all the water they sell. Local fountain committees will report meter readings daily, which will create a quick-alert system if meters are not functioning properly. Verification of meter readings and of meters' operating correctly will be done by an occasional spot check by District staff. *Unaccounted-for water.* The percentage of unaccounted-for water is an excellent measure of overall operational

efficiency. This indicator encompasses losses due to leaking faucets, leaks in the distribution system, nonfunctioning meters, and illegal connections. Water produced (and potentially sold) should be measured from the water tower, the initial point at which the District is responsible for the system. Unaccounted-for water is the number of gallons of water leaving the water tower minus the number of gallons actually metered at the fountains. If the meters work, the figure is available.

Water quality. Water quality is an indirect indicator for health benefits. It will be measured by periodic collection of samples and testing to determine whether the chlorine concentration is acceptable.

District staffing. This indicator will determine whether the District is overstaffed. The ratio is determined by dividing the expected gallons of water sold daily by the number of central office staff. ("Central office staff" does not include the fountain operators or solid waste crews, who work for the committees, nor does it include any contractor staff such as the hauling company or back-up maintenance company.) This indicator will be a good measure of the continued involvement of the private sector and the community. The data should be readily available.

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APPENDIX A

CONTRAT CAMEP - CDS

**CONTRAT
CAMEP - CDS**

EXECUTION DES TRAVAUX ET EXPLOITATION DU SYSTEME

D'ALIMENTATION EN EAU POTABLE DE LA PREMIERE

SECTION COMMUNALE DE VARREUX

(CITE SOLEIL)

DECEMBRE 1994

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C O N T R A T

ENTRE

La Centrale Autonome Métropolitaine d'Eau Potable (CAMEP), représentée par le Président de son Conseil d'Administration, l'Ingénieur Marc Henri Rousseau FRANÇOIS, Ministre des Travaux Publics Transports et Communications (T.P.T.C) identifié au No pour le présent exercice fiscal, demeurant et domicilié à Port-au-Prince, d'une part,

ET

Les Centres pour le Développement et la Santé (CDS) représentés par le Docteur Réginald BOULOS, Président du Conseil d'Administration de cette organisation, identifié au No 318-51-655 demeurant et domicilié à Port-au-Prince, d'autre part.

IL A ETE ARRETE ET CONVERU CE QUI SUIF

A- EXECUTION DES TRAVAUX

Article 1.- Les CDS travaillent conjointement avec la CAMEP à l'achèvement du programme de construction et de réparation du système d'alimentation en eau potable de la première section communale de Varreux (Cité Soleil)

Article 2.- Les CDS ont la responsabilité financière et administrative du programme des travaux. Ils s'engagent à entreprendre toutes les démarches nécessaires pour assurer le financement de l'exécution et de la supervision des travaux de construction et de réhabilitation du système d'eau potable. Ils assument sous le contrôle de la CAMEP la gestion et le suivi de toutes les activités prévues dans le programme.

Article 3.- Le programme des travaux doit être conforme avec le Plan Directeur de la CAMEP et répondre aux critères techniques définis dans le document d'ACCORD DE PROJET HA1/85/CO2 et dans le dossier qui a fait l'objet d'appel d'offres du 7 Janvier 1991.

Article 4.-

Le programme des travaux comprend:

- 1- La fourniture et l'installation de deux (2) pompes de refoulement.
- 2- La construction des chambres de pompage.
- 3- Le raccordement des pompes au réseau électrique de l'EDH.
- 4- La fourniture et la mise en place des tuyaux et de tous matériaux servant à compléter le réseau de distribution.
- 5- La fourniture et la mise en place des tuyaux et de tous matériaux servant à compléter le réseau de distribution.
- 6- La fourniture et l'installation des stations de traitement.
- 7- La fourniture et l'installation de compteurs à la sortie des pompes, à l'entrée de la ligne de refoulement dans la cité, à la sortie du château d'eau et à l'entrée de toutes les lignes de distribution directement branchées sur la ligne de refoulement.
- 8- La construction d'un château d'eau de 1000 m³.
- 9- La réalisation de certains branchements (écoles, hôpitaux, centres de santé, institutions publiques ou privées) et la construction de 105 bornes fontaines payantes.

Tous ces travaux doivent être réalisés conformément aux descriptions et prescriptions techniques décrites dans les documents cités en annexe.

Article 5-

Ces travaux ayant déjà fait l'objet d'une étude approuvée par la CAMEP, aucune modification ne peut y être apportée sans une autorisation écrite de la CAMEP.

Article 6-

Les CDS peuvent décider de l'adjudication des travaux. Toutefois une liste de firmes préqualifiées doit être préalablement soumise à la CAMEP pour approbation.

- Article 7- La CAMEP participe à la supervision des travaux et les CDS s'engagent à faire respecter les recommandations de la CAMEP par les Entrepreneurs.
- Article 8- La CAMEP met à la disposition du programme toutes les installations existantes du système de distribution d'eau potable dans la zone définie. Ces installations ainsi que celles du programme restent la propriété de la CAMEP.
- Article 9- Les travaux ne peuvent être réceptionnés de façon provisoire ni définitive en l'absence de la CAMEP ni sans son approbation.
- Article 10- A la fin des travaux, la CAMEP remet le système de distribution aux CDS pour exploitation. Toutefois, les CDS sont tenus de soumettre à la CAMEP au préalable sa structure de gestion pour approbation.

B- Exploitation du système

- Article 11- La CAMEP s'engage à confier aux CDS la gestion et l'entretien de son système hydraulique de la Cité Soleil pour une durée de trois (3) ans renouvelable qui commence à la date d'achèvement des travaux de construction du système.

Ce système hydraulique comprend les puits, les stations de pompage, les stations de traitement, la ligne de refoulement, les compteurs, les châteaux d'eau, le réseau de distribution, les bornes fontaines et les branchements.

L'une quelconque des deux parties doit signifier à l'autre 6 mois à l'avance de façon formelle sa décision de ne pas renouveler le contrat.

- Article 12- Les CDS, responsables du fonctionnement du service, le gèrent conformément au présent contrat. Ils sont autorisés à percevoir auprès des abonnés et des acheteurs aux bornes fontaines, un montant destiné à rémunérer les obligations mises à leur charge.

Le prix de l'eau est fixé conjointement avec la CAMEP et ne peut être sujet à des modifications sans une autorisation écrite de la CAMEP.

Article 13- Dès la prise en charge des installations, les CDS sont responsables du bon fonctionnement du service dans le cadre des dispositions du présent contrat.

Article 14- Pendant sa durée, le contrat confère aux CDS le droit exclusif d'assurer au profit des abonnés et acheteurs le service de la distribution publique d'eau potable à la Cité Soleil. Les CDS disposent également du droit exclusif d'entretenir, au-dessus ou au-dessous des voies publiques, tous les ouvrages et canalisations nécessaires au service.

Le service de la distribution, la gestion du système et l'entretien du réseau et des ouvrages se font par les CDS, sous le contrôle de la CAMEP.

Article 15- Les contrats de branchement seront établis conformément aux modèles et suivant les normes en vigueur à la CAMEP.

Article 16- Compte tenu de la nature des sols dans la zone des forages et vu la position de ces derniers par rapport au littoral, les CDS ont pour obligation d'assurer un suivi fidèle des opérations au niveau des forages.

Les CDS s'engagent à informer la CAMEP le plus rapidement que possible de toute anomalie constatée à ce niveau et à prendre toutes les dispositions nécessaires pour garantir le bon fonctionnement des puits et des limites de pompage.

Article 17- Sous aucun prétexte, le service d'eau n'est gratuit.

Tout consommateur, particulier ou personne morale, organisme privé ou public, y compris les CDS, paie sa consommation suivant le tarif fixé comme convenu à l'article 12.

Article 18- La CAMEP assurera le contrôle du service par un représentant délégué en permanence sur les lieux.

Les CDS lui réservent dans leurs locaux un espace où il dispose des moyens de travail.

Les CDS lui prêtent leur concours pour qu'il accomplisse sa mission de contrôle en lui fournissant tous les renseignements et documents nécessaires.

Article 19-

Pour permettre le contrôle des activités financières et techniques du contrat, les CDS produisent dans un délai de quinze (15) jours à la fin de chaque trimestre un compte rendu technique et un compte rendu financier. ✓

Compte rendu technique

Au titre du compte rendu technique, les CDS fournissent les informations suivantes:

- Nombre de bornes-fontaines en fonction.
- Nombre de bornes-fontaines réalisées pour la période.
- Nombre de branchements réalisés pour la période.
- Nombre de branchements en attente.
- Nombre d'heures de fonctionnement par jour de chaque pompe.
- Volume d'eau distribué (basé sur la lecture des compteurs).
- Volume d'eau produit.
- Nombre de branchements en fonction.
- Facturation et encaissement par classe et type d'abonnés.
- Encaissement par borne fontaine.
- Fiche des travaux d'entretien réalisés.
- Fiche des travaux d'extension réalisés.
- Plan actualisé du système avec localisation des bornes-fontaines et des abonnés.

Compte rendu financier

Le compte rendu financier doit préciser:

- Les dépenses par poste (entretien, personnel, etc)
- L'état des revenus.
- Les résultats d'exploitation.

Article 20- Tous les contrats de vente d'eau passés par les CDS avec des tiers et nécessaires à la continuité du service doivent comporter une clause réservant expressément à la CAMEP la faculté de se substituer aux CDS dans le cas où il serait mis fin au contrat.

Article 21- Les CDS ne peuvent en aucune façon concéder les privilèges ou même une partie des privilèges que lui confère ce contrat à un tiers.

Article 22- Les travaux d'entretien, d'extension et de branchements sont exécutés par les CDS et à leurs frais avec l'autorisation et sous le contrôle de la CAMEP.

Tous les ouvrages, équipements et matériels du système hydraulique qui permettent la marche de l'exploitation y compris les compteurs et les branchements sont entretenus en bon état de fonctionnement et réparés par les soins des CDS et à leurs frais sous le contrôle de la CAMEP.

Article 23- Faute par les CDS de pourvoir à l'entretien des ouvrages et installations du service, la CAMEP peut faire procéder, aux frais des CDS, à l'exécution d'office des travaux d'entretien nécessaires au bon fonctionnement du service, quarante huit (48) heures après une mise en demeure restée sans résultat.

La même procédure peut être utilisée en cas de malfaçon dans le rétablissement des chaussées et trottoirs à l'emplacement des tranches.

Article 24- La CAMEP se réserve le droit d'intervenir conjointement avec les CDS à n'importe quel moment sur le réseau pour contrôler le service et vérifier la qualité de l'eau distribuée.

Suivant les constatations, elle peut exiger des interventions urgentes de la part des CDS. En cas de non intervention de ces derniers, les dispositions prévues à l'article 23 du présent contrat seront appliquées.

Advenant le cas où les CDS se révèlent défectueux ou ne peuvent assumer le service durant plus de 24 heures, la CAMEP prend en charge le fonctionnement du système jusqu'à ce que les CDS prouvent qu'ils sont en mesure de reprendre en main le service.

Article 25- Les CDS s'engagent à fournir de l'eau aux habitants de la zone

L'eau distribuée doit présenter constamment les qualités imposées par la réglementation en vigueur à la CAMEP.

Si les installations deviennent insuffisantes pour satisfaire à la quantité, à la qualité ou à la pression, les CDS doivent présenter à la CAMEP le projet de travaux d'amélioration à exécuter pour rétablir la situation avec une marge de sécurité suffisante.

Les CDS doivent également signaler à la CAMEP tout indice d'anomalie trouvé sur le réseau.

Article 26- Les CDS se chargent de surveiller le réseau afin de prévenir contre tout branchement clandestin.

Article 27- Le tarif appliqué par les CDS pour la revente de l'eau est fixé par la CAMEP. ✓

Ce tarif est sujet à des ajustements périodiques en fonction du taux d'inflation.

Article 28- La vente d'eau aux bornes-fontaines, la facturation des branchements et l'encaissement des redevances se feront par les CDS suivant les procédures arrêtées avec la CAMEP. ✓

Article 29- Tout branchement particulier doit être garanti par le versement d'une caution équivalente au montant cumulé de trois mois d'abonnement aux CDS.

Article 30- Tous les impôts, taxes ou redevances de toute nature établis par l'Etat y compris les impôts relatifs aux immeubles du service sont à la charge des CDS.

Article 31- A la fin de chaque trimestre, les CDS font conjointement avec la CAMEP le décompte des rentrées et des dépenses effectuées pour obtenir le résultat d'exploitation. ✓

Le montant correspondant à la dépréciation du système sera alors prélevé et déposé dans un compte conjoint CAMEP -CDS.

La balance ou profit net (recettes moins dépenses moins dépréciation) sera partagée comme suit: ✓

- 60% sont gardés par les CDS pour l'amélioration, et l'extension et les frais de fonctionnement du système hydraulique de la Cité Soleil.

- 40% sont remis à la CAMEP pour l'extension de son réseau dans d'autres zones défavorisées de l'aire métropolitaine et l'aménagement de l'interconnexion entre les champs captant de la CAMEP et le château d'eau de la Cité Soleil.

A la cessation ou à l'expiration du contrat, les CDS perdent automatiquement son droit de signature sur le compte conjoint CAMEP -CDS et la CAMEP devient l'unique détenteur de ce compte.

Article 32- Les CDS s'engagent à affecter le personnel qualifié aux besoins du service à partir de la date d'entrée en vigueur du contrat.

Les membres de ce personnel doivent être porteurs d'un badge distinctif indiquant clairement leurs fonctions.

Article 33- La CAMEP n'a ni engagement, ni obligation envers les membres du personnel engagé les CDS.

A l'expiration du contrat ou en cas de résiliation, la CAMEP est libre de renvoyer ou de garder un ou des membres du personnel ou même le personnel tout entier.

Article 34- La CAMEP peut résilier le contrat à n'importe quel moment dans l'un des cas suivants:

- 1- Distribution continue d'une eau de mauvaise qualité
- 2- Distribution de l'eau dans des conditions d'insalubrité
- 3- Interruption générale ou partielle non justifiée de la distribution
- 4- Etat défailant du système
- 5- Non production dans les délais prévus des documents cités à l'article 19

- 6- Refus de faciliter au représentant de la CAMEP l'accès au contrôle
- 7- Non respect d'un article quelconque du contrat

Article 35- En cas de résiliation ou à l'expiration du contrat les CDS sont tenus de remettre à la CAMEP tous les documents et informations nécessaires à la poursuite de l'exploitation du système.

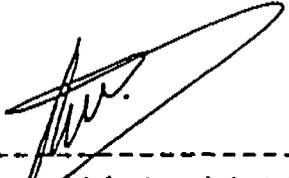
Article 36- En cas de litige entre les deux (2) parties, la Cour Supérieure des Comptes est la seule instance compétente capable de trancher le différend.

Fait à Port-au-Prince, le *4. janvier 1995.*



Gérald Jn BAPTISTE, Ing
Directeur Général
CAMEP

Marc Henri Rousseau FRANÇOIS, Ing
Ministre des T.P.T.C.
Président du Conseil
d'Administration



Docteur Réginald BOULOS,
Président du Conseil
d'Administration des CDS

APPENDIX B

ZONAL MAP OF CITÉ SOLEIL

Appendix C

Generic Water Supply Maintenance Schedule for District Refinement

Daily:

Pump House	Clean and sweep floor. Wipe and clean walls and piping. Clean and sweep exterior site. Tend lawn and garden. MATERIALS: Cleaning materials
Pump	Record readings of suction and delivery gauges. Check packing glands to leak slightly during operation. Check tightness of nuts and bolts. Check lubrication of bearings. MATERIALS: None
Electric Motors	Check motor bearings. MATERIALS: None
Switchgear	Record voltage, current, and kW-hour meters. MATERIALS: None
Chlorine	Prepare correct strength solutions. Clean outside of tanks and valves.
Preparation Tank	MATERIALS: None
Diesel Generator	Check oil level and top up, if necessary. Lubricate all lubrication points. Record oil pressure, temperature, speed, and battery charge. Record working hours and total since last oil change/last overhaul. Clean outside parts. Check nuts and bolts for tightness. Check alternator bearings. Check fuel level in fuel tank and refill. MATERIALS: Lubricating oil, fuel oil

Weekly:

Chemicals Store	Clean and sweep floor. Clean outside. Replenish stocks. MATERIALS: Chemicals
Diesel Generator	Wash and clean air filter. MATERIALS: None

Monthly:

- | | |
|------------------|--|
| Mains | Check for leaks and illegal connections and repair if necessary.
MATERIALS: None |
| Reservoir | Check float valve. Check leaks in piping and repair if necessary.
MATERIALS: None |
| Diesel Generator | Dismantle injectors and test spray. Replace defective nozzles if necessary.
MATERIALS: Injector nozzles |
-

Every 3 Months:

- | | |
|------------------|--|
| Switchgear | Check starter and clean contacts. Check setting of overload relays.
MATERIALS: None |
| Diesel Generator | Clean and inspect injectors. Check valve clearance. Check and clean oil filters. Fit new fuel filter elements. Check starting system. Change engine oil or in accordance with manufacturers manual. Check switchgear and setting of overload relays.
MATERIALS: Fuel filter element, engine oil |

Every 6 Months:

- | | |
|-----------------|--|
| Pump | Replace grease/oil in bearings without disassembly. Check alignment of coupling. Replace packing in glands.
MATERIALS: Grease/oil, packing material |
| Electric Motors | Check alignment of coupling. Change lubricating oil/grease without dismantling.
MATERIALS: Lubricating oil/grease |
| Chlorine Dosing | Dismantle gravity feed doser. Clean and reassemble.
MATERIALS: None |
| Hydrants | Flush hydrant. Apply grease to threads on cap of grease fitting. If leaking, replace. (Kennedy brand—apply grease; Mueller brand—place oil in the top of the hydrant)
MATERIALS: Lubricating oil/grease |

Yearly:

- | | |
|------------|--|
| Switchgear | Clean/replace contacts as necessary. Calibrate measuring instruments.
MATERIALS: Starter contacts, if necessary |
| Valves | Check valve gland and repack if necessary. Close fully and open.
MATERIALS: Packing materials |
| Chlorine | Inspect structure and protective paint/lining and repair as necessary. |

Preparation Tank Examine valves and pipe connections and repair as necessary.
MATERIALS: Paint, lining material

Chlorine Dosing Overhaul: Dismantle dosing pumps and replace defective parts. Examine electric motors and switchgear. Paint all metal surfaces.
MATERIALS: Spare parts as necessary; paint

Reservoir Inspect structure. Drain reservoir. Wash and clean inside and outside. Disinfect floor and walls with hypochlorite (HTH) solution. Check all valves, open and close, and repair if necessary. Check level gauge.
MATERIALS: Hypochlorite (HTH) solution, gland packing, paint

Diesel Generator Check alignment of coupling. Check and regrind valves and adjust valve clearances. Clean deposits from cylinder heads and pistons.
MATERIALS: None

Every 2 Years:

Pump House Check and repair any leaks in roof. Paint inside and outside walls and piping.
MATERIALS: Building materials, paint

Diesel Generator Overhaul: Complete dismantling, cleaning, and replacement of defective parts.
MATERIALS: Spare parts as necessary

Every 3 Years:

Pump Remove pump for complete overhaul in workshop. Replace defective parts as necessary.
MATERIALS: Spare parts as required

Measuring Instruments Dismantle, send to specialized contractor for calibration and/or repair.
MATERIALS: None

Water Master Meter Dismantle and send to workshop for checking and calibration.
MATERIALS: None

Mains Paint exposed pipes with anti-corrosive paint.
MATERIALS: Anti-corrosive paint

Every 5 Years:

Electric Motors Remove motor for complete overhaul at workshop. Replace with motor of similar type, if available.
MATERIALS: Ball/roller bearings, if necessary

Appendix D

Estimated Quantities and Costs to Build a Communal Water Fountain in Cité Soleil

Item	Units	Quantity	Unit Price (Haitian \$)	Cost (Haitian \$)	Cost (U.S. \$)
15x20x40 Blocks	unit	190	1.20	228	76
Sand	m ³	4	50.00	200	67
Gravel	m ³	2	50.00	100	33
Fill	m ³	2	20.00	40	13
Cement	bags	30	15.00	450	150
1x10x16 Framing	unit	6	40.00	240	80
2x4x14 Framing	unit	6	25.00	150	50
3/4 Plywood	unit	1	130.00	130	43
Nails	pound	10	1.00	10	3
3/8x30 Rebar	unit	20	8.50	170	57
1/4x20 Rebar	unit	16	5.00	80	27
Splicing Wire	pound	20	2.40	48	16
Iron Door	unit	1	350.00	350	117
Water	bucket	30	0.40	12	4
3/4 galvanized piping and connections				450	150
TOTAL				2658	886

NOTE: Costs do not include labor and transportation.

Appendix E

Viabie and Nonviable Sanitation Technologies

Viabie Sanitation Technologies

The Ventilated Improved Pit (VIP) Latrine

The two principal disadvantages of simple pit latrines—namely, that they smell and that they create a fly nuisance—are typically reduced in the Ventilated Improved Pit (VIP) latrine. The main improvement of a VIP over a traditional pit latrine is the addition of a minimum 4-inch diameter ventilation pipe to the pit to remove odor that might otherwise enter the superstructure. The ventilation pipe discharges above the roof, and the discharge end of the pipe is covered by an insect-proof mesh. A VIP, like a traditional pit latrine, is normally used until full, capped with soil and abandoned for a newly constructed pit.

Emptying pits manually or by suction tanker can be practiced if the owner chooses. Theoretically, full pits that have been sealed and left alone for two years or more are sufficiently inert that they can be re-excavated to construct another latrine. The excavated material has been proposed as a safe soil conditioner, but this has not been conclusively demonstrated in the literature. Handling of raw sludge with bucket or shovel must be done with extreme care because of health hazards from pathogens that may be present.

Realistic fill rates have been established for pit latrines that allow seepage of liquids to the ground. Unless more accurate information is available, a pit fill rate of 0.04 m³ per person per year can be used. A pit storage capacity should be about two thirds of the total volume of the pit to ensure adequate clearance between the top of the stored sludge and the underside of the superstructure floor.

There should be at least 4 feet of unsaturated and suitable permeable soil between the bottom of a proposed pit and the seasonally high water table or bedrock, in case the rock is fissured.

A construction sketch of a VIP latrine appears on the following page.

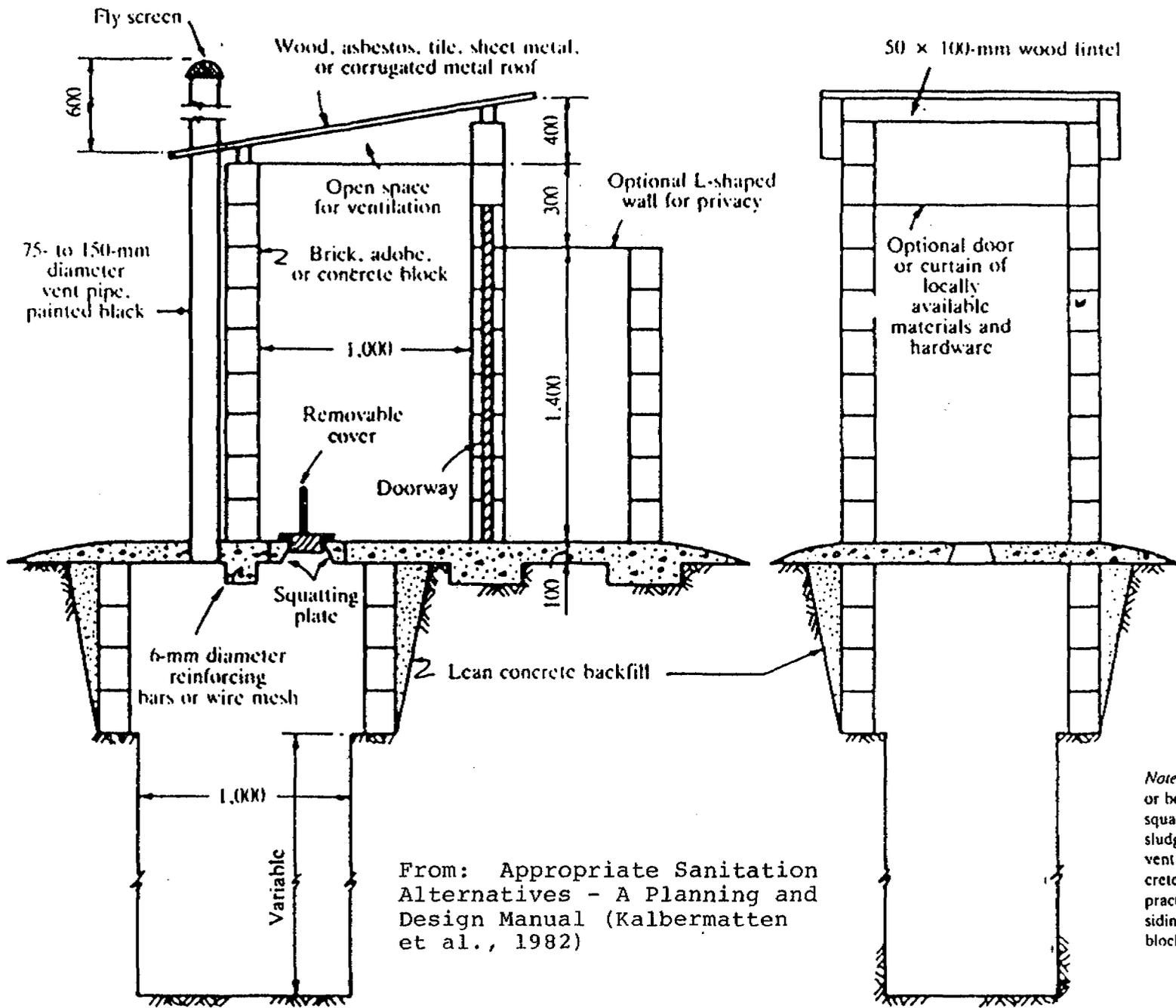
The Ventilated, Improved, Double-Vault Pit (VIDP) Latrine

Although the single-pit VIP latrine can be designed with a long life (up to 10 years or more) and can be desludged and used as a permanent structure, an alternative solution is the installation of a twin pit VIP latrine (VIDP). These are constructed with pits lined with cement to prevent any excreta from entering the surrounding soil. In this version, one pit is used until it is full. The second pit is then put into use. When the second is full, the first is emptied manually and used again.

If properly designed and maintained for a sufficient length of time, the excreta are not handled until they are at least 12 months but preferably 24 months old, when only a few *Ascaris* ova should be viable in the waste.

The use of VIDP latrines in low-income urban areas presupposes the existence of a pit-emptying program and its acceptance by the community. Pit emptying may be done by the householder if she or he is willing and able to use the material as a fertilizer. Pit emptying may alternatively be a municipal function, which in practice may have administrative difficulties, or it may be a private sector function.

A construction sketch of a VIDP latrine appears on the following page.



VIP Latrine

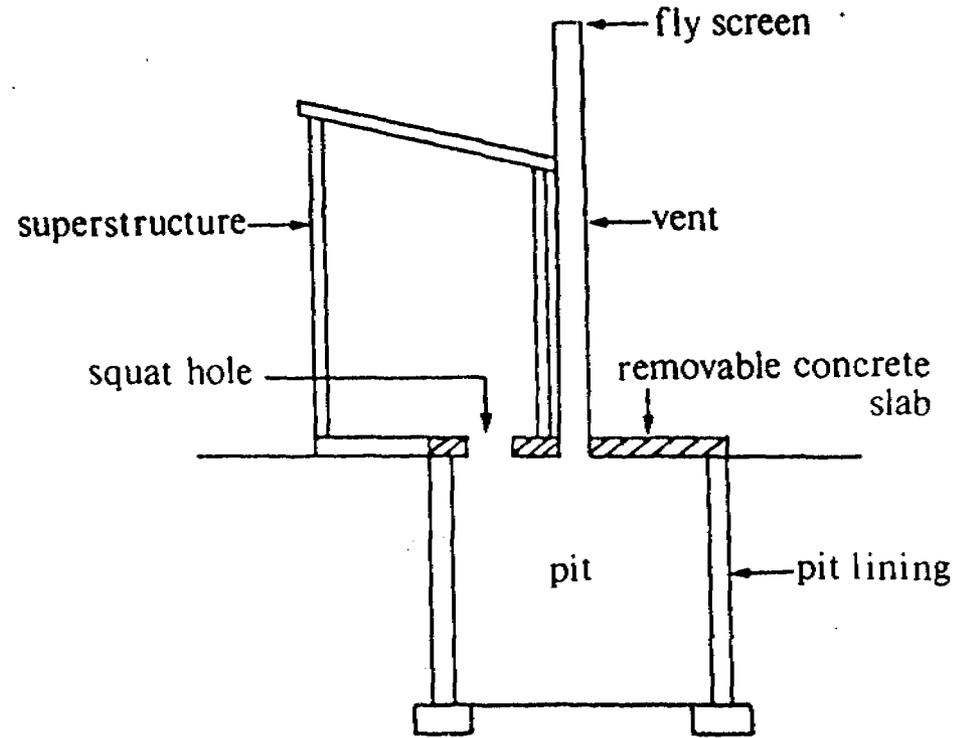
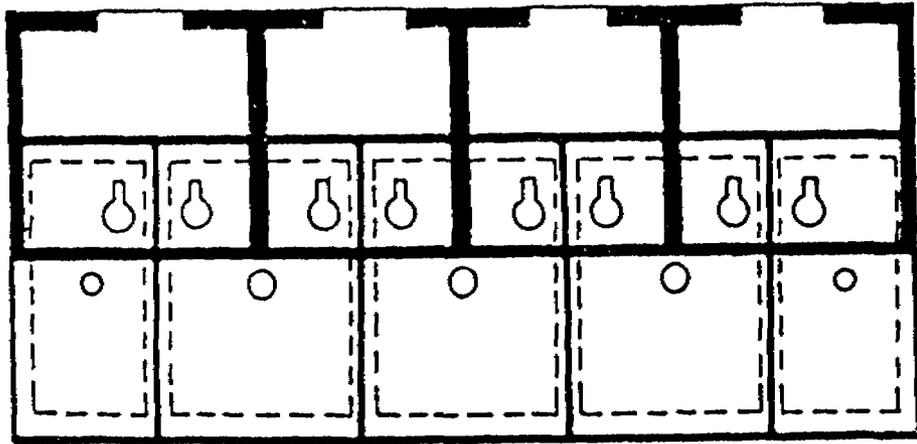
From: Appropriate Sanitation Alternatives - A Planning and Design Manual (Kalbermatten et al., 1982)

Note: In the side view, a pedestal seat or bench may be substituted for the squatting plate. An opening for de-sludging may be provided next to the vent. Dimensions of the bricks or concrete blocks may vary according to local practice. Wooden beams, flooring, and siding may be substituted for concrete block walls and substructure.

Side view (section)

Front view (superstructure;

L-shaped wall and vent not shown)



Multiple Alternating Pit VIP Latrine

From: Information and Training
for Low-Cost Water Supply and
Sanitation - On-Site Sanitation
(World Bank, 1986)

Vault Latrines (cesspool) and Suction Tanker Collection

The vault, in this case, is a watertight masonry tank, sized to collect and store wastewater. This structure would be similar in size and material to one of the vaults built to serve a VIDP latrine. It is important for the use of these systems that water use is minimized, and therefore only essential foul waste (blackwater) should be flushed into the vault. Greywater should ideally be directed elsewhere to reduce the frequency of pumping. Regular and frequent emptying of the vault is necessary in order to prevent overflowing.

Nonviable Sanitation Technologies

Sanitation alternatives that require water for operation and substantial soil absorptive capacity for waste disposal, such as the Single Pour-Flush Pit Latrine (a single-pit latrine that incorporates a waterseal pan in a squat plate), Double Pour-Flush Pit Latrine (the same as a Single Pour-flush Pit Latrine but incorporating a second absorption pit to prolong the life of the system), and the Tank-Flush Toilet with Absorption Pit (a tank-flush toilet connected to an absorption pit) are not viable technologies for use in Cité Soleil due to the high groundwater table, population density, and general lack of readily available water for flushing.

More complex systems such as Tank-flush Toilets with a Septic Tank and Soakaway or a Tank-flush with Septic Tank and Tile Field are not viable sanitation solutions for use in Cité Soleil due to their requirement of large, reliable volumes of water to make the septic tank operate correctly. Septic tanks require consistent and relatively large inflows of wastewater to ensure the anaerobic degradation of waste accumulated in the tank.

Composting latrines are frequently thought to be the most complete response to the requirement that household wastes be disposed of on-site. What is frequently not fully appreciated is that considerable user care is needed to ensure the satisfactory operation of composting latrines. It is typically not possible in either developed or underdeveloped settings for a community to undertake such a responsibility or the introduction of such requirements. While composting latrines may be a theoretically viable solution for better-off householders or for locations with specific problems, they should never be recommended without considering the willingness and the capacity of the users to maintain them. Because it is not expected that the residents of Cité Soleil would operate composting latrines in a hygienic manner, this technology is not viable for use in that community.

Alternative wastewater collection systems, such as small-bore sewers or condominium sewers, are not viable for use in Cité Soleil due to (1) the nonexistence of any centralized sewage treatment facility which could serve the area, and (2) the low volume of wastewater generated by the community, and (3) the unavailability of land of sufficient size or permeability to handle a centralized amount of wastewater.

Manual wastewater cartage systems may at some future time be a viable technology for use in Cité Soleil. At the present time, however, no location exists near Cité Soleil where the sludge collected by such a system could safely be disposed. It is possible that a large, centralized underground vault could be constructed for deposition of collected material. Pump trucks could then regularly empty the accumulated sludge. Such an undertaking would require a substantial commitment of funds, management, and operation, none of which are available in the country at this time.

Appendix F

Beneficial Greywater Reuse

It may be appropriate to include means of disposing of liquid wastes other than those originating from the toilet (e.g., wastes from the kitchen, bathing, and laundry). Collectively, these are known as "greywater" or sullage.

The components of such a system are:

- (a) A grease trap to prevent grease from cooking and dishwashing, soap scum, etc., from blocking downstream units
- (b) A sand filter to prevent gross solids from reaching the downstream disposal system
- (c) An attenuator tank to ensure a slow discharge to the treatment system and prevent surges such as would occur, for example, if a tub of water were allowed to freely discharge into the system
- (d) An evapotranspiration bed to enable the greywater to be taken up by growing plants while preventing discharge of greywater from the site

Construction components include trenching, sand, gravel, 4" PVC piping, and block construction, and the estimated cost would be expected to be on the order of \$300 to \$600

Calculating the required surface area of soil to handle the applied wastewater can be done by using the following formula:

$$A = (V \times N) / R$$

A = total infiltrative surface area (m²)

V = volume of liquid to be disposed of (liters/person/day)

N = number of persons served by the system

R = effluent application rate to infiltrative surfaces
(liters/day/m²)

It is recommended that the following percolation values and application rates be used in designing wastewater disposal systems utilizing the absorptive capacity of the soil:

Percolation Value (min/in)	Application Rate (liters/day/m ²)
< 1.1	not suitable
1.1 - 5.1	60
5.5 - 15.2	40
15.7 - 30.5	30
30.9 - 60.5	20
> 61	not suitable

A suggested percolation test procedure is presented below (borrowed from the National Building Code of Jamaica).

Jamaican Building Code:

Section 4 Subdivisions, Percolation Test, page 54

Percolation Test Procedures

- (a) Prepare a test hole in the disposal area of at least 460 cm in diameter with vertical sides at least 450 cm deep, terminating in the soil at the elevation of the bottom of the proposed or intended leaching trench, bed, or seepage pit.
- (b) Establish a fixed point at the top of the test hole from which all measurements can be taken.
- (c) Scratch the bottom and sides of the test hole to remove any smeared soil surface. Either add 5 cm of coarse sand to protect the bottom from scouring, or insert a board or other impervious object in the hole so that water may be poured down or on it during the filling operation.
- (d) Carefully fill the hole with clear water to a minimum depth of 30 cm, and maintain the water level by adding water as necessary for purposes of sub-soil saturation, but in no case less than 15 minutes after saturation.
- (e) After saturation, if the water level drops to a depth of 23 cm in less than 30 minutes, measure the length of time in minutes for it to drop from a depth of 23 cm to a depth of 15 cm.
If the drop per minute is erratic, that is increasing or decreasing, the hole should be refilled and soaked until the drop per increment of time is steady. The time divided by three for the level to drop 7.5 cm will be the percolation rate.
- (f) If the initial 7.5 cm drop requires more than 30 minutes (rate equal to more than 4 minutes per cm), the soil should be saturated by filling the hole to the top and maintaining it full for at least four hours.

The soil should then be permitted to swell overnight, so that the soil condition will approach that which exists during the wettest season of the year.

After the overnight swelling period, the test should be made again by filling the hole to 30 cm depth, and measuring the 23 to 15 cm depth drop as in (d) and (e) above.

Appendix G

Management Action Plan

Actions accomplished November 1995 - March 1996

- Key staff of the District identified and hired - General Manager, Chief Engineer, and Community Liaison
- Temporary office space located and occupied

Actions accomplished March 1, 1996 - April 1, 1996

- Steering committee established to advise CDS on the creation of the District
- Permanent office space located and furniture and office equipment procured

Actions to be undertaken:

Action	Date	Responsible Person
Hold monthly meetings with the steering committee. These should be run by the general manager of the District. Issues to be discussed include water rates, selection of pilot projects, formation of Consultative Board (roles and members), and role of community organizations in solid waste and water selling.	Ongoing	Supplice
Develop administrative and financial procedures (cash management, accounting, budgeting) - write terms of reference for contracting a firm to develop procedures and recommend software - award contract - develop procedures	May - July 1996	Supplice
Write contract to be used between District and fountain committees	May 1996	Supplice/St. Louis
Write the by-laws of the District and seek necessary approvals	June - July 1996	Supplice
Write job descriptions and hire rest of central office staff including solid waste supervisor	April - June 1996	Supplice/Genois
Specify inventory requirements, budget these, and procure them. Equip a secure area to store the inventory	June - July 1996	Supplice/Genois

Action	Date	Responsible Person
Develop rules and regulations for purchasing	May 1996	Supplice
Submit a rate proposal to the Consultative Board for approval. Include an automatic inflation adjuster.	May 1996	Supplice
Finalize roles and responsibilities between District and CAMEP including fees to be paid to CAMEP	May 1996	Supplice
Establish source and cost of chlorine	June 1996	Genois
Train central office staff in the administrative and financial procedures	July 1996	Supplice
Set up bank account for the District	July 1996	Supplice
Select permanent Consultative Board	November 1996	Supplice
Initiate discussions on establishing legal autonomy for the District	January 1997	Supplice
Assess progress against indicators	January 1997	Supplice
Arrange for external financial audit	February 1997	Supplice
Evaluate progress of District in relation to plan developed by EHP	March 1997	Supplice

Social Action Plan

A. Community Participation

Actions accomplished November 1, 1995 - March 1, 1996

- List of local organizations developed
- Information on community perceptions collected

Actions to be undertaken:

Action	Date	Responsible Person
Form fountain committees - identify community organizations around each fountain - assist community organizations to form a fountain committee - develop prototype contract between District and fountain committee and sign contract with each committee	March - April 1996	St. Louis
Train the fountain operators	May 1996	Genois and St. Louis
Organize a zonal committee in one zone	May 1996	St. Louis
Work with the zonal committee to select and mobilize the first solid waste crew.	May 1996	Genois and St. Louis
Organize and mobilize the zonal committees in the other zones	August-September 1996	Genois and St. Louis

B. Behavior Change

Actions accomplished November 1995 - March 1996

- Questionnaire developed for focus groups
- 15 focus group interviews conducted and data translated into French
- Data analyzed and key messages developed

Key actions to be undertaken:

Action	Date	Responsible Person
Work with GreenCOM to design a communication strategy - organize meetings with community associations - organize workshops to develop strategy - organize strategy presentations	March 1996	St. Louis
Implement first phase of communications strategy, using \$20,000 from demonstration projects	April - June 1996	St. Louis
Seek funding for implementation of second phase of communication strategy	July - September 1996	St. Louis
Implement second phase of communications strategy	October 1996 - March 1997	St. Louis

Technical Action Plan

Actions accomplished November 1995 - March 1996

- Complete written description of appropriate facilities to manage human waste, wastewater, and greywater
- Completed water balance for Cité Soleil using a water truck count and discussions with the Salesian fathers
- Coordinate District activities with related projects supported by IDB, Plan International, GRET, and UNICEF
- Complete design of solid waste program including capital investments
- Develop preliminary operation and maintenance procedures
- Agreement reached with Plan International for financing of 18 water fountains

Actions to be undertaken:

Action	Date	Responsible Person
Complete a comprehensive site plan for Cité Soleil including citing of (1) current landfill, (2) 2 well sites, (3) all roads, (4) measurement of area covered by fountains, (5) total kilometers of drains to clean, (6) total kilometers of streets, (7) locations where free water is distributed, (8) schools, (9) clinics, (10) significant point pollution sources, (11) all public buildings, (12) the water distribution system, and (13) offices operated by CDS	May 96	McGahey
Locate, contract for, and oversee construction of 20 UNDP-funded water fountains	May - June 96	Genois
Enter into a work order contract with a private firm to provide backup maintenance	May - June 96	Genois
Obtain testing kits for water quality	June 96	Genois
Finalize written operation and maintenance procedures (including meter reading), and distribute to staff	June 96	Genois
Write job descriptions and hire operation and maintenance staff and solid waste supervisor	June - July 96	Genois

Action	Date	Responsible Person
Locate, contract for, and oversee construction of 18 additional water fountains	June - Aug 96	Genois
Plan and oversee upgrading of Belekou communal latrine	July 96	Genois
Establish mechanism to stock supplies and equipment for operation and maintenance of water system	July 96	Genois
Finalize contract for hauling of solid waste out of Cité Soleil	July 96	Genois
Purchase equipment for solid waste teams	July 96	Genois
Train operation and maintenance staff in technical procedures	July 96	Genois
Train water supply operation and maintenance staff in technical procedures	July 96	Genois
Implement solid waste demonstration project	Aug - Sept 96	Genois
Seek funding for expansion of water system	Aug 96 - March 97	Genois/Supplice
Direct technical aspects of demonstration projects	Aug 96 - Mar 97	Genois
Expand solid waste program to cover all of Cité Soleil	Oct - Dec 96	Genois/Supplice