F I E L D R E P O R T

WATER AND WASTEWATER DEMONSTRATION PROJECTS FOR SMALL URBAN AREAS IN CHILE

WASH Field Report No. 362
June 1992

WATER AND SANITATION for HEALTH PROJECT

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WATER AND WASTEWATER DEMONSTRATION PROJECTS FOR SMALL URBAN AREAS IN CHILE

Prepared for the Bureau for Research and Development,
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by

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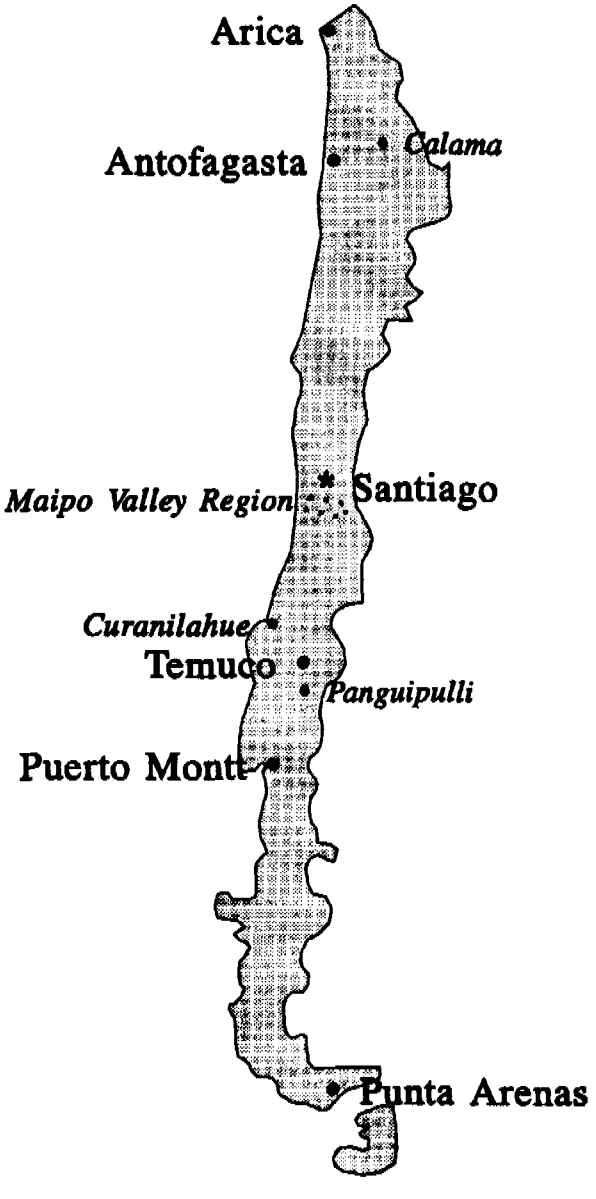
ACRONYMS

A.I.D.	United States Agency for International Development (Washington)
BHIF	Banco Hipotecario de Industria y Fomento
CESMES	Centro de Investigaciones Minero—Metalúrgicas
CONAMA	Comisión Nacional del Medio Ambiental
CORFO	Corporación de Fomento
DICTUC	Departamento de Investigaciones Científicas y Tecnológicas de la Universidad Católica
EMOS	Empresa Metropolitana de Obras Públicas, S.A.
ESSAL	Empresa de Servicios Sanitarios de los Lagos, S.A.
ESSAN	Empresa de Servicios Sanitarios Antofagasta, S.A.
ESSBIO	Empresa de Servicios Sanitarios de Bio-Bio, S.A.
FNDR	Fondo Nacional de Desarrollo Regional
IDB	Inter-American Development Bank
IBRD	International Bank of Reconstruction and Development (World Bank)
IIEC	International Institute for Energy Conservation
INDES	Instituto del Desierto
INTEC	Instituto de Investigaciones Tecnológicas
MINVIU	Ministerio de Vivienda y Urbanismo
RHUDO/SA	Regional Housing and Urban Development Office/South America, A.I.D.
USAID	United States Agency for International Development (overseas mission)

MAP

Chile


Arica
Antofagasta
Calama
Maipo Valley Region
Santiago
Curanilahue
Temuco
Panguipulli
Puerto Montt
Punta Arenas

EXECUTIVE SUMMARY

Chile's water resources have been extensively contaminated by municipal and industrial effluents. Several pollution control projects in major urban centers and major industries are receiving World Bank (IBRD) and Inter-American Development Bank (IDB) assistance, and the government is providing potable water supplies free from bacterial contamination for communities of all sizes. But little is being done for improper wastewater discharges in smaller communities. Government funds for this problem are likely to remain quite limited, apart from a substantial subsidy program that helps water users pay the tariffs to cover wastewater treatment costs.

The U.S. Agency for International Development (USAID) is funding feasibility studies and providing loan guarantees for up to four demonstration projects to show how private initiative can solve the water quality problems of such communities. This report discusses the design of these demonstration projects and the priorities according to which they should be selected if all cannot be funded together, and develops a detailed scope of work for each of them.

The projects will be confined to interventions that will improve the water supply or wastewater disposal systems of small urban or semi-urban communities, with at least some private participation, and that will address widespread problems so that they can serve as models for similar initiatives in other locations. All projects should be economically, socially, and environmentally sound, and technically and financially feasible.

Eight criteria should guide plan formulation and design:

- Water-quality control objectives
- Liability
- Efficiency
- Technology
- Monopoly
- Degree of privatization
- Equity
- Repayment capacity

Funding priorities for projects that may meet the eight criteria should be determined by the extent to which each project can serve as a model in similar situations elsewhere. A scale of priorities also could be based upon the estimated benefits from widespread replication of the projects.

The four projects proposed by Ministerio de Vivienda y Urbanismo are: Calama, Panguipulli, Curanilague, and Maipo. Preliminary scopes of work for these projects are discussed in Chapters 3 to 6.

Chapter 1

INTRODUCTION

Chile's water resources—lacustrine, fluvial, underground, and marine—have been extensively contaminated by municipal and industrial effluents. Several large-scale projects to control pollution in major urban centers and major industries are currently receiving assistance from the IBRD and the IDB, and the government is working to provide communities of all sizes with potable water free from bacterial contamination. But little is being done to control improper wastewater discharges in smaller communities. Government funds for this purpose are likely to remain quite limited, apart from a substantial subsidy program that helps water users pay the tariffs to cover wastewater treatment costs.

USAID is financing feasibility studies and providing subsequent loan guarantees for up to four demonstration projects to show how private initiative can solve the water quality problems of such communities. This report discusses how these demonstration projects should be designed and how priorities should be set in the event that not all four can be funded together, and develops a detailed scope of work for each of them.

Chapter 2

CONCEPTS

The projects will be confined to interventions that will improve the water supply or wastewater disposal systems of small urban or semi-urban communities, with at least some private participation, and that will address widespread problems so that they can serve as models for similar initiatives in other locations. All projects should be economically, socially, and environmentally sound, and technically and financially feasible.

Interventions range from public education and technical assistance, generally characterized by the provision of information, to command and control options such as the establishment and enforcement of standards, whether for ambient water quality, discharges, or water quality-related technologies. The elements at both extremes require the application of government powers and are of limited relevance to private initiative. In the middle of the range, however, lie programs based upon the use of incentives, particularly economic incentives. where private initiative is likely to be most appropriate. It must be emphasized, however, that the demonstration projects and, to a greater degree, the extension of these projects to widespread application must include a balance of the elements of information, incentives, and command and control.

2.1 Plan Formulation Criteria

There are eight criteria that should guide the formulation of the plan:

- Water-Quality Control Objectives—Simply to state that water quality should be improved is insufficient. There must be specific objectives relating to the bodies of water to be improved and the water-quality parameters to be upgraded. In the past, lake and stream water quality has been considered before marine and groundwater quality. Similarly, bacterial and other parameters directly affecting human health have taken precedence over salinity, turbidity, oxygen demand, sediment, and suspended solids, and these over nutrients, toxic organic compounds, heavy metals, and radionucleides. The objectives will determine what concentrations are to be reduced and to what levels. They must also reflect community priorities.

  Historically, human health has come first, and this concern has been met by purifying drinking water. Agricultural and industrial water uses have come next, followed by fish and wildlife and aesthetics. Most recent, and most difficult to deal with, is concern for the degradation of the environment.

- Liability—Once a particular water-quality problem has been selected for attention, the liability for correcting it must be assigned. The traditional idea of leaving those affected by the problem to bear the cost of remedying it is no longer acceptable. Changing attitudes, reflected in a clause in the Chilean Constitution asserting the right of

everyone to a clean environment, assign liability to those responsible for environmental degradation and have led to such innovations as the "polluter pays" principle, which has long underlain U.S. policy to control industrial pollution but only recently has been applied to municipal pollution.

Although the right to a pollution-free environment is indisputable, it will remain an unattainable ideal as long as humans, the source of pollution, live on earth. Furthermore, the "polluter pays" principle may conflict with strongly held values of justice and equity, and, beyond a certain point, efforts to reduce, let alone eliminate, pollution are likely to be more costly than the benefits they produce.

- Efficiency—The most efficient level of pollution abatement must be determined by balancing costs against anticipated benefits, not all of them measured necessarily in monetary terms. Environmental benefit-cost analysis is now a well-developed field and should be a mandatory part of each design. Feasibility studies should not consider wastewater treatment the sole available option, even though this may offer the maximum opportunity for the involvement of private enterprise. Better alternatives, such as regulation or even no action, may exist in some cases, and these should not be displaced by end-of-line waste treatment for essentially arbitrary reasons.

- Technology—The technology selected should be one that can attain the established objectives economically and efficiently and that is practicable in the circumstances. Too often in the past design studies have proposed technologically advanced means beyond the capability or the inclination of the users to maintain.

- Monopoly—Water supply and wastewater treatment systems often tend to be natural monopolies by virtue of their ability to decrease production costs continually through economies of scale. If left unregulated, they could use their monopoly power to restrict production or charge arbitrary prices so as to achieve profits that would not be possible under competitive conditions.

  For this reason, it is a fairly common practice to establish regulatory boards or commissions to oversee their operations. If private enterprises are given opportunities that could position them to become natural monopolies, the system must be designed to include controls on monopolistic behavior. The difficulties of maintaining regulatory controls on monopolistic behavior. The difficulties of maintaining regulatory controls are well known, however, and it is probably best to avoid arrangements that foster the creation of natural monopolies.

  Water supply and wastewater treatment are declining-cost industries in relative terms within each system; in absolute terms, however, costs of supplying water rise over time due to use of more difficult and inaccessible sources, declining quantity of both surface and groundwater, and declining water quality leading to increased treatment costs.

- Degree of Privatization—Privatization can take many forms, and the one most appropriate to the circumstances should be carefully chosen. Sometimes a very limited

role for private enterprise may be the best, such as that assigned to vendors of services to Empresa Metropolitana de Obras Públicas (EMOS). A larger role is that of non-owner manager. Still larger is the role of the lessee, who enjoys most of the rights of ownership. The largest role is that of the concessionaire, who is given all the rights of ownership except that of alienation.

In Chile at present, concessions are available for four types of water-related services: treatment and provision of potable water supplies; distribution of potable water supplies; construction and operation of wastewater collection systems; and treatment and disposal of effluents. An application to the Superintendent of Sanitary Services for a concession is published to enable competing enterprises to submit offers. After 90 days, the Superintendent awards the concession to the applicant with the best offer.

- Equity—Equity considerations have already been mentioned as a possible barrier to the adoption of the "polluter pays" principle. Governments may balk at imposing substantial pollution control costs upon disadvantaged elements of the population for either moral or political reasons. The usual course then is to subsidize these costs, a line of action that may achieve the goal of equity but is likely to deter efficiency by removing the incentive to curb polluting activities. Subsidy programs can be designed to avoid negative impacts upon efficiency, and this aspect should be considered in any feasibility studies that incorporate subsidization.

- Repayment Capacity—Related to the issue of equity is that of repayment capacity. Any project relying upon private enterprise should ensure that the services to be provided are sold at prices that permit full cost recovery. These prices may or may not require subsidies or have to be regulated to prevent monopolistic exploitation, but they must offer private enterprise a fair return on investment. This principle is applicable equally to public enterprises, although its implications can be avoided for longer periods.

2.2 Priorities for Project Selection

Priorities for selecting projects, all of which may meet the eight criteria, should be determined solely by the extent to which each project can serve as a model in similar situations elsewhere. Thus, a project in the central valley, which is heavily populated and a major agricultural area, might receive a higher priority than a project in the northern arid region, which has only a small fraction of the population, economic activity, and water resources of the nation. But this would assume that the problems of the northern region, although fewer in number, are also less severe. A scale of priorities also could be based upon the estimated net benefits from widespread replication of the projects. The pilot project that promised the greatest national benefits would receive the highest priority for funding.

Chapter 3

CALAMA PROJECT

3.1 Problem Statement

a. Description of Study Area

The city of Calama with about 100,000 inhabitants is located on the banks of the Loa, the longest river in the country, in the arid northern mining region of Antofagasta.

b. Water-Quality Problems

The river, contaminated by discharges from the mining industry, contains high concentrations of boron, arsenic, and salts (arsenic = 0.7 to 1.2 mg/l; boron = 9 to 12.3 mg/l; salts = 5,300 to 6,000 mmhos) and is not suitable for irrigation, except for the most resistant plant species. Furthermore, using these waters for irrigation would cause extensive salinization and eventually render the land unsuitable for agriculture.

The city water supply, which comes from the upper reaches of streams draining the western slopes of the Andes, is treated for removal of arsenic. As a result, the wastewater has a better chemical quality than the river does (arsenic = 0.02 to 0.06 mg/l; boron = 4.5 to 7.2 mg/l; salts = 2,000 to 2,500 mmhos) and has been used for irrigation (recommended values for irrigation are: arsenic = 0.1 mg/l; boron = 2 to 4 mg/l; salts = 1,400 to 2,700 mmhos). But it contains numerous pathogenic microorganisms that restrict its use. Only non-edible crops or edible crops whose products do not come in contact with the wastewater can be irrigated safely. Farmers are eager to have it treated so that it will be safe for general use and thus increase agricultural production. Because of the scarcity of water in the area, industrial users are also interested in treated wastewater.

The regional authority, Empresa de Servicios Sanitarios Antofagasta, S.A. (ESSAN), and the municipality of Calama have engaged the University of Antofagasta's Instituto del Desierto (INDES) to design a pilot plant to treat 30 percent (30 l/s) of the total wastewater flow in the area of Cerro Negro. The design has been completed, and 1.5 hectares of land have been acquired by the farmers of Cerro Negro to build the plant. The plant will consist of a control chamber, screen and grit removal chamber, a 690m^2 anaerobic lagoon 1.9m deep, a 2,010m^2 facultative pond 3m deep, and an 8,534m^2 facultative pond 3m deep. At the end of the plant there will be a control chamber and a pumping station.

The wastewater will be taken from a sewer that passes through the plant site to join two other sewers that together discharge about 100 l/s into a creek that flows into the river. As indicated earlier, there is another group of farmers and industrialists interested in reusing the remainder of the flow (70 l/s), but there is no plan at present for treating this.

c. Socioeconomic Environment

The economy of the Antofagasta region is dominated by the mining industry, which generates substantial income and is responsible for a large share of the country's export earnings. Irrigated agriculture is also important, producing high-value specialty crops, some of which are exported. The region is a net importer of food and fiber, however, because the scarcity of water limits total yield.

The northern region has less than 6 percent of the country's population. Because of its high income-generating capacity, it does not suffer the same degree of poverty as other regions in Chile. The potential productivity of additional supplies of relatively clean water, together with the financial capacity to pay for improvements, makes the Antofagasta region particularly attractive for future water treatment projects.

However, like the rest of Chile, it is hampered by an inordinately complex and centralized government structure and a poorly developed private sector. People still look to government for solutions that private enterprise could provide more efficiently, a tendency that has inhibited the growth of private initiative. At the same time, a distrust of government intervention has weakened support for such needed action as environmental regulation and control of monopolistic enterprises.

The people of Calama appear to recognize that increased supplies of usable water will create opportunities for enhancing incomes and improving the quality of life. But there is no evidence of private initiatives to treat and utilize effluent or regulation to limit mining discharges. Admittedly, the control of mining discharges is a matter of national environmental policy. But effluent treatment and distribution by local entrepreneurs could be stimulated by loans from U.S. financial institutions (through the Ministerio de Vivienda y Urbanismo [MINVIU]), backed by USAID and Chilean government guarantees.

However, the processing of effluent is complicated by the fact that the legal right to effluent inheres in ESSAN, which maintains the sewerage system. The farmers of Cerro Negro, who are using some of the untreated effluent to irrigate crops, in fact are doing so illegally.

3.2 Scope of Work

A feasibility study should be undertaken to determine the most cost-effective method of treating the entire flow so that all demands for treated wastewater are met. Specifically this study should:

- Review the planning done to date for the proposed plant
- Compare the feasibility and cost effectiveness of the following alternatives:
  - A single treatment plant for the entire flow (100 l/s)
  - One 30 l/s plant at the present location and one near the other interceptors for the rest of the flow

- Three plants at three different sites

- Compare the environmental impacts of the alternatives analyzed

a. Cost-Benefit Analysis

The contractor should perform a cost-benefit analysis to ensure that benefits exceed costs. The most likely benefits will be an increase in irrigated cultivation, particularly the conversion to higher-value crops, when the danger of bacterial contamination has been eliminated. Small local industries also are likely to profit from augmented supplies of water of improved quality. It is unlikely that major environmental benefits or costs will be found, since most of the effluent is lost to seepage and evaporation. In addition, return flows will be diminished by increased water utilization.

The most important part of the cost-benefit analysis will be a farm budgeting study of alternative cropping patterns. Data for such a study may be difficult to find in Chile, but data from other arid regions (Israel and the southwestern U.S.) can be extrapolated with appropriate adjustments for local conditions. Also important will be demand analyses for agricultural produce in both local and export markets.

b. Financial Analysis

The contractor should perform a financial feasibility analysis of the project. If water users such as the farmers of Cerro Negro form an association to operate a wastewater treatment facility and distribute the treated effluent, there must be sufficient cash flow to cover operation and maintenance costs (including depreciation) and repay the construction loan. There is little possibility of developing this cash flow without conversion to higher-value crops and instituting the marketing arrangements to collect, transport, and export these crops. (The potential of local markets to absorb these crops should be assessed.)

If, on the other hand, a private entity is formed to construct and operate a facility and sell treated effluent, there must be sufficient revenue-generating potential to cover costs and generate profits. A more elaborate metering and billing system will be needed in this case.

c. Institutional Analysis

The contractor should perform an institutional analysis to identify deficiencies and recommend needed changes. Regional and local government institutions should be evaluated for their ability to perform the necessary functions of management (if this is involved), to set and enforce performance standards and any other required regulations, and to monitor the performance of any private entity assuming public utility responsibilities.

The possibilities for privatizing parts of the effluent treatment and distribution system should be examined, particularly the provision of services such as treatment plant operation, broader management responsibility under contract to a public entity (presumably ESSAN), construction and lease-back arrangements, concessions, full ownership and operation under a public utility

scheme, and complete privatization as contemplated by the farmers of Cerro Negro. The analysis must include an assessment of the capacity to repay any construction loans.

Although seldom framed as an institutional issue, the conflict between the right to pollute and the right to a pollution-free environment must be considered. Calama does not use the Loa river for its municipal water supply because of heavy pollution by upstream mining. But the responsibility of the mining industry to reduce such contamination cannot be ignored if the constitutional right to a pollution-free environment is even partially respected. The issue of irrigation water supply could change dramatically if such regulations are adopted and enforced.

d. Team Composition

The study team should consist of an environmental engineer qualified to assess water quality and wastewater treatment options; an agricultural economist qualified to evaluate both alternative cropping patterns and broader project benefit and cost considerations; and an institutional analyst qualified to evaluate water laws, government organization, and privatization options. The team jointly should be able to evaluate financial feasibility.

The study will require an estimated 20 person-days of effort by each of the three specialists.

e. Study Output

The study output should be a final report containing: (1) a recommendation for one or more facilities for effluent treatment and delivery to end-users; (2) a recommendation for an institutional arrangement to construct and operate the proposed facilities; (3) a recommendation for a method to ensure repayment of any USAID-guaranteed loan to implement the first two recommendations; (4) a description of alternatives to the recommended plan; (5) a technical, economic, financial, and institutional analysis justifying the superiority of the recommended plan over the alternatives; (6) an evaluation of the extent to which the recommended plan can serve as a model for other areas in the country; and (7) recommendations for government actions that would facilitate the solution of water-quality problems of the type encountered in Calama.

Chapter 4

PANGUIPULLI PROJECT

4.1 Problem Statement

a. Description of Study Area

The city of Panguipulli is located on Panguipulli bay to the northwest of Panguipulli lake in the lake region of southern Chile. It has about 9,000 permanent residents and as many as 30,000 visitors during the tourist season. About 5,000 people have sewer connections.

b. Water-Quality Problems

Nutrients in Panguipulli lake have increased in the last few years as a result of wastewater discharges from the city of Panguipulli, the slaughter house, and a milk processing plant. There is concern that this pollution will mar the appeal of the lake for tourism and for recreational use. In 1991, the municipality received a proposal from the University Austral to study the causes and effects of pollution, and although the study was never carried out, the proposal did contain useful information on previous studies of the lake.

The discharge from one of the city's two wastewater outlets is partially treated in a large septic tank that is cleaned periodically. The discharge from the other receives no treatment. The city owns a large piece of land near the outlets slated for use in wastewater treatment.

c. Socioeconomic Environment

The lake region is a mountainous forested area of great natural beauty lightly populated and settled much more recently than the central valley region. Its economy is based primarily upon the forest products industry, although hydroelectric power and livestock also make a contribution. It lacks the irrigable land and appropriate climate for large-scale crop cultivation. Tourism is a substantial part of the economic base in towns such as Panguipulli and is expected to grow.

Incomes in general are not very high. Were it not for the vulnerability of the lakes to accelerated eutrophication (the waters are unusually warm for this latitude because of hot spring discharges), water quality problems would probably be less severe than in the northern deserts or the central valley. The potential economic value of clean lakes and the relative ease of protecting them at the present early stage of development make the region particularly attractive for projects of these types.

A small group, mainly of industrialists, that owns farms and vacation homes around the lake favors intercepting and treating effluent before it reaches the lake. Although incomes in the town of Panguipulli itself are modest, its commitment to environmental protection and the

interest of these more affluent property owners augur well for the success of the project, particularly if a loan can be obtained to finance the initial capital investment.

4.2 Scope of Work

A feasibility study should be undertaken to determine the most cost-effective method of treating the wastewater. Specifically this study should:

- Review previous lake studies
- Determine the degree of treatment required before discharge
- Consider treatment alternatives such as oxidation ditches, trickling filters, and aerated lagoons, and investigate the use of wetlands or land treatment, using the available land nearby, for nutrient removal
- Compare the environmental impacts of the alternatives analyzed

a. Cost-Benefit Analysis

The contractor should perform a cost-benefit analysis to ensure that benefits exceed costs. The most likely benefits will be a diminution in the rate of eutrophication of Panguipulli lake and the attendant boost to tourism. To these should be added such non-market benefits as option and existence values that can be estimated only from site-specific surveys. The lake is now used for both fishing and water sports but not as a potable water source. This is another benefit that could follow reduced bacterial contamination.

b. Financial Analysis

The contractor should perform a financial feasibility analysis of the project. If entrepreneurs such as the property owners around the lake form an association to operate a wastewater treatment facility and distribute treated effluent, there must be sufficient cash flow to cover operation and maintenance costs (including depreciation) and repay the construction loan. It will probably be necessary to recover wastewater treatment costs through the billing system for potable water, but an increase in water rates is likely to encounter stiff resistance. A charge might be levied on riparian property owners, several of whom have indicated a willingness to pay. But this may not be desirable in principle because, although they share in the costs of eutrophication, they are not the major source of the problem.

c. Institutional Analysis

The contractor should perform an institutional analysis like that for the Calama project. Since the municipality is interested in taking over and operating the existing water supply and wastewater collection system and in building and operating the proposed wastewater treatment plant, there may not be a role for private enterprise, although the availability of a U.S. Agency

for International Development (A.I.D.)-backed construction loan could change this. However, private participation would be limited to providing services or to operations under a contract.

If Empresa de Servicios Sanitarios de los Lagos, S.A. (ESSAL), the regional water and sewerage agency, showed an interest in the project, a similar limited role for private enterprise might be created, particularly under the stimulus of an A.I.D.-backed construction loan.

As with the Calama project, the institutional analysis should assess the possibilities for privatizing parts of the effluent treatment and distribution system, as well as the existing water supply and wastewater collection system.

The main source of both bacterial contamination and nutrient loading is the town of Panguipulli itself, although some non-point source pollution comes from agricultural enterprises around the lake. But the responsibility of the municipality and ESSAL to reduce contamination cannot be ignored if the constitutional right to a clean environment is even partially enforced.

d. Team Composition

The study team should consist of: an environmental engineer qualified to assess water-quality and wastewater treatment options and lake eutrophication; an environmental economist qualified to evaluate impacts upon option and existence values and benefit and cost considerations; and an institutional analyst qualified to evaluate government organization and privatization options. The team jointly should be able to evaluate financial feasibility.

The study will require an estimated 20 person-days of effort by each of the three specialists.

e. Study Output

The study output should be a final report containing: (1) a recommendation for one or more facilities for effluent treatment; (2) a recommendation for an institutional arrangement to construct and operate the proposed facilities; (3) a recommendation for a method to ensure repayment of any USAID loan to implement the first two recommendations; (4) a description of alternatives to the recommended plan; (5) a technical, environmental, economic, financial, and institutional analysis justifying the superiority of the recommended plan over the alternatives; (6) an evaluation of the extent to which the recommended plan can serve as a model elsewhere in Chile; and (7) recommendations for government actions that would facilitate the solution of water-quality problems like those of Lake Panguipulli.

Chapter 5

CURANILAGUE PROJECT

5.1 Problem Statement

a. Description of Study Area

The city of Curanilague is located on the banks of the Descabezado river, which flows into the Curanilague river, in the coal mining area in the southern part of Chile. It has about 35,000 residents, of whom about 16,000 have sewer connections. Curanilague's main economic activity is coal mining, and the coal washing operations discharge solids and sulfur compounds into the river.

b. Water-Quality Problems

With funds from the Fondo Nacional de Desarrollo Regional (FNDR), the city is completing a project to provide 95 percent of the population with sewerage service. But most of the untreated wastewater is discharged into the river. The municipality is concerned about this, especially since two cities downstream (Los Alamos and Lebu) use the river as a source of water. Preliminary studies have been completed for the construction of a sewer interceptor along the river and a wastewater treatment plant, which will have two aerated lagoons, each 65m x 130m x 3m, and two maturation ponds, each 224m x 70m x 3m. A site for the plant has been selected but not yet acquired.

c. Socioeconomic Environment

The BioBio region in which Curanilague is located is a hilly forested area underlain by substantial lignite deposits. Lignite mining and a highly mechanized forest products industry provide the area's economic base. The mining industry uses relatively primitive technology to produce a low-quality coal. It has lost many of its markets to foreign competition and is now in an advanced state of decline. The region is characterized by high unemployment.

The region is less heavily populated than the older and more settled and urbanized central valley. Incomes in general are low, particularly since the decline of the lignite mining industry. The government must decide whether to arrest the current economic decline, to facilitate the movement of the population to areas of greater opportunity, or to allow events to take their course. Any investments in water pollution control for Curanilague and similar economically depressed communities should be made with these policy decisions in mind.

The interest in improving water quality is stimulated in part by the notion that halting environmental degradation may help to attract new industries and, thus, new sources of employment and income. There is less interest in restricting the pollution from lignite mining activity, because this could mean shutting down even the marginal operations that now provide some employment.

5.2 Scope of Work

A feasibility study should be undertaken to determine the most cost-effective method of treating the wastewater. Specifically this study should:

- Review previous planning for the proposed plant
- Consider treatment alternatives such as oxidation ditches, trickling filters, and facultative ponds
- Compare the environmental impacts of the alternatives analyzed

a. Cost-Benefit Analysis

The contractor should perform a cost-benefit analysis to ensure that benefits exceed costs. The most likely benefits will be an improvement in the quality of the Descabezado river and of the water supplies of the two downstream communities, and a more aesthetic environment in the immediate Curanilague area. The river could be used for fishing if the pollution from mining discharges and domestic wastewater is reduced, and there would also be a lower risk to human health.

The estimate of project costs should reflect the fact that, in a region of high unemployment like Curanilague, a supply of cheap labor is readily available.

b. Financial Analysis

The contractor should perform a financial feasibility analysis of the project. Whatever the mix of public and private enterprise to construct and operate a wastewater treatment facility and dispose of treated effluent, there must be sufficient cash flow to cover operation and maintenance costs (including depreciation) and repay the construction loan. It will probably be necessary to recover wastewater treatment costs through the billing system for potable water, but it would be very difficult to impose an increase in water rates. It is unclear how far the prospective grant from the FNDR would help.

Some form of subsidy from the national government seems necessary if the Curanilague project is to go forward. This would not be inconsistent with privatization. Current law provides for the full recovery of water and wastewater treatment costs through utility billing, but also provides for a municipal subsidy of 40 percent to 75 percent, depending upon the user's ability to pay. If this law is followed, the Curanilague project would be financially feasible, provided the municipality received the necessary funds from the national government. This is a question of national policy that would apply to other communities like Curanilague as well.

c. Institutional Analysis

The contractor should perform an institutional analysis like that for the other projects. Since the municipality operates the existing wastewater collection system and is interested in building and operating the proposed wastewater treatment plant, there may not be a role for private

enterprise, although the availability of an A.I.D.-backed construction loan could alter this. However, private involvement would be limited to providing services or to operations under a contract. If the regional water and sewerage enterprise expressed an interest in the project, a similar limited role for private enterprise might be created, particularly under the stimulus of an A.I.D.-backed construction loan.

The institutional analysis should assess the possibilities for privatizing the wastewater treatment system and the existing water supply and wastewater collection system, as with the other three projects. It should also examine the feasibility of establishing a river basin management authority, on which both the generators and victims of environmental pollution might be represented, and which could fairly allocate the costs of remediation.

d. Team Composition

The study team should consist of: an environmental engineer qualified to assess water quality and wastewater treatment options; an environmental and natural resource economist qualified to evaluate the implications of environmental controls and broader project benefits and costs, including the effects of declining extractive industries on employment and capital resources, and an institutional analyst qualified to evaluate government organization and privatization options, including a river basin management authority. The three should be able jointly to evaluate financial feasibility.

The study will require about 20 person-days of effort by each of the three specialists.

e. Study Output

The study output should be a final report containing: (1) a recommendation for facilities for effluent treatment and discharge; (2) a recommendation for an institutional arrangement to construct and operate the proposed facilities; (3) a recommendation for a method to ensure repayment of any USAID-guaranteed loan to implement the first two recommendations; (4) a description of alternatives to the recommended plan; (5) a technical, environmental, economic, financial, and institutional analysis justifying the superiority of the recommended plan over the alternatives; (6) an evaluation of the extent to which the recommended plan can serve as a model elsewhere in Chile; and (7) recommendations for government actions that would facilitate the solution of water-quality problems like those in Curanilague, and a discussion of the public policy considerations involved in declining economies.

Chapter 6

MAIPO PROJECT

6.1 Problem Statement

a. Description of Study Area

San José de Maipo and Isla de Maipo are two communities in the agricultural central valley in the metropolitan region that discharge their wastewater untreated into the river, which also is polluted by discharges upstream.

b. Water Quality Problems

Irrigation from the river can be used only for crops whose produce does not come into contact with the contaminated water.

c. Socioeconomic Environment

The region contains much of the nation's best agricultural land and the capital, Santiago, whose eight million inhabitants account for 75 percent of the nation's population. Industry in the region is diverse and is responsible for a large share of the country's export earnings. Irrigated agriculture is also important, producing crops for both domestic consumption and export. Because of wide disparities in income, wealth and poverty are found side by side. Water supplies are limited, particularly during the dry summer season, and the use of effluent for irrigation is common.

6.2 Scope of Work

A feasibility study should be undertaken to determine the most cost-effective method of treating effluent. Specifically this study should:

- Review the planning done to date
- Consider treatment alternatives such as oxidation ditches, trickling filters, and facultative ponds
- Compare the environmental impacts of the alternatives analyzed
- Compare the feasibility and cost effectiveness of a single treatment plant and two plants at two different sites

a. Cost-Benefit Analysis

The contractor should perform a cost-benefit analysis to ensure that benefits exceed costs. The most likely benefits will be the reduction of health risks and the potential increase in export

earnings from the use of treated effluent in the cultivation of irrigated crops. Demand analyses for agricultural produce in both local and export markets are important. The value to small industries of augmented supplies of water of improved quality should be considered also. The metropolitan region's interest in a cleaner environment for its own sake should enable estimates of existence and option values.

b. Financial Analysis

The contractor should perform a financial feasibility analysis of the project. If water users form an association to operate a wastewater treatment facility and distribute treated effluent, there must be sufficient cash flow to cover operation and maintenance costs (including depreciation) and repay the construction loan.

If a private entity is formed for this purpose, there must be sufficient revenue-generating potential to cover costs and generate profits, and a more elaborate metering and billing system will be needed.

The analysis should consider a possible arrangement under which a private concessionaire might construct and lease the facility to a regional authority such as Empresa Metropolitana de Obras Públicas, S.A. (EMOS) and be paid in the form of treated effluent that could be marketed.

c. Institutional Analysis

The contractor should perform the same kind of institutional analysis as for the other three projects and assess the possibilities for privatizing parts of the effluent treatment and distribution system.

d. Team Composition

The study team should consist of: an environmental engineer qualified to assess water quality and wastewater treatment options and evaluate human health benefits and costs; an agricultural marketing economist who can evaluate marketing and foreign trade aspects and non-market environmental benefits; and an institutional analyst qualified to evaluate government organization and privatization options. Members of the team should be able jointly to evaluate financial feasibility.

The study will require about 20 person-days of effort by each of the three specialists.

e. Study Output

The study output should be a final report containing: (1) a recommendation for one or more facilities for effluent treatment and delivery to end-users; (2) a recommendation for an institutional arrangement to construct and operate the proposed facilities; (3) a recommendation for a method to ensure repayment of any USAID loan to implement the first two recommendations; (4) a description of alternatives to the recommended plan; (5) a

technical, economic, financial, and institutional analysis justifying the superiority of the recommended plan over the alternatives; (6) an evaluation of the extent to which the recommended plan can serve as a model for other areas in Chile; and (7) recommendations for government actions that would facilitate the solution of water-quality problems like those in the central valley.

Appendix

SUMMARY OF INTERVIEWS AND FIELD TRIPS

Summary of Interviews

March 9, 1992—Santiago

Meeting with: Mr. Claude J.J. Bovet, USAID Regional Housing Policy and Financial Advisor
Mr. Paul Fritz, USAID/Chile

Discussed the scope of the project and the general goals of the loan program. Highlights of the comments are: Chile wants to deal with its environmental problems to be better prepared to enter into a free trade agreement with the United States. Chilean institutions are in the development stage with help from A.I.D. democratic initiatives. Private pension funds are looking for safe investments that could include sanitation projects. Regional water and sewerage agencies are quasi-private.

Meeting with: Mr. Vicente Dominguez, Jefe Asesor del Ministerio de Vivienda y Urbanismo (MINVIU)
Mr. Sergio Almarza Alamos, Asesor Ministerial, MINVIU
Mr. Sergio Gonzales Tapia, Asesor Ministerial, MINVIU
Mr. Daniel A. Sunico H., Asesor Ministerial, MINVIU

Discussed the scope of the project. Discussed the communities to be visited and the schedule. Discussed environmental protection and impact analysis laws. Indicated that the Ministries of Housing and Urbanism and Public Works will have their own environmental units. Discussed the institutional arrangements of the water and sewerage enterprises and their relationship with the Corporación de Fomento (CORFO), the corporation set up by the government to privatize public institutions.

Meeting with: Mr. Gonzalo Duarte, Alcalde de La Florida
Mrs. Veronica Silva, Jefe de Acción Social
Mr. José Pedro Campo, Asesor Urbanista

Discussed paving program by the municipality of La Florida that includes 25 percent subsidy by the municipality, 25 percent saved prior to project implementation by beneficiaries, and 50 percent financed by funding agencies.

Meeting with: Mr. Juan Barrientos Fuller, Arq. and Consultant

Discussed the Calama project and the interest of industry in the project.

Meeting with: Mr. Nelson Belmar M., Environmental Engineer, Comisión Nacional del Medio Ambiental (CONAMA).

CONAMA includes an operative committee and a technical secretariat presently coordinating environmental policy in the different ministries, regulating environmental impact, and compiling about 2,000 laws related to the environment. The Ministry of Planning has an environmental impact unit. There is also a Metropolitan Service for the Environment and a National Institute for Regulation, and the Ministries of Health and Agriculture are interested in the environment. There are regulations on water quality.

Meeting with: Mr. Ruben Perelis Fleisman, IDB Sectorial Specialist.

Indicated that water supply coverage is 98 percent in urban areas and about 80 percent in rural areas. Sewerage has not been considered a priority. IDB is not contemplating doing small sewerage projects. Discussed the new system of semi-private enterprises that own and operate the water and sewerage systems in the country.

March 10, 1992

Meeting with: Mr. Fernando Leniz C., President of Anagra
Mr. Francisco Bascunan, Sociedad Agroindustrial Panguipulli.

Discussed the Panguipulli project.

Meeting with: Ms. Raquel Alfaro Fernandois, General Manager, EMOS
Ms. Amparo Nunez, Manager of Planning, EMOS
Ms. Sigrid Stranger, Planning Department, EMOS

Discussed the EMOS system and methods of constructing wastewater treatment systems with innovative methods of financing such as lease back arrangements, investments refundable by bonds, EMOS stock, or promises to pay. EMOS will consider all alternatives that are presented to it.

Meeting with: Ms. Paulina Lobos, (CORFO)

Discussed CORFO's role in the water and sanitation programs in the country. CORFO determines priorities for projects. Methods of financing could include funds given to the empresas which must be paid back in 15 years at an interest rate fixed by the Ministry of Planning. CORFO owns 99 percent of the stock of the empresas and the state owns the remaining 1 percent in most cases.

Meeting with: Ms. María Angelica Moreno A., Business Manager, Instituto de Investigaciones Tecnológicas (INTEC).
Ms. Carmen Gloria Palma Heldt, Engineering Manager, INTEC

Discussed the technical capabilities of INTEC. They can do most tests in their laboratory. They do a lot of industrial tests. There are other laboratories, including Centro de Investigaciones Minero—Metalúrgicas (CESMES) and Departamento de Investigaciones Científicas y Tecnológicas de la Universidad Católica (DICTUC).

Meeting with: Mr. Luís Duran Branchi, Jefe Departamento Programas Solidarios, Ministry of Interior.
Mr. Pedro Ríos, Fondo Nacional de Desarrollo Regional, Ministry of Interior.

Discussed the sewerage project of the Fondo Nacional de Desarrollo Regional (FNDR) in Curanilague.

March 11 and March 12, 1992

Trip to Calama. Party included:
Mr. Claude J.J. Bovet
Mr. Daniel Sunico
Mr. Rene Roco Inostrosa, General Manager, ESSAN
Mr. William Lord, WASH
Mr. Fernando Requena, WASH

Visited the municipality of Calama and interviewed:

Mr. Alfonso Espinoza Hurtado, Mayor
Mr. Javier Sandoval, Secretary of Planning
Mr. Jorge Rubio, Secretary
Mr. Arnaldo Díaz, Farmers Association
Mr. Ubaldo Arguellez Toro, ESSAN

Discussed the Calama project and visited the wastewater treatment plant site.

March 13, 1992

Trip to Panguipulli. Party included:
Mr. Claude J.J. Bovet
Mr. Daniel Sunico
Mr. Mario Tellerias, MINVIU
Mr. William Lord, WASH
Mr. Fernando Requena, WASH
Mr. Francisco Bascunan
Mr. John Lebens, International Institute for Energy Conservation (IIEC)

Visited the municipality of Panguipulli and interviewed:

Mr. Luis Ernaldia, Mayor
Mr.Ricardo Salas, ESSAL

Discussed the Panguipulli project and visited the wastewater treatment plant site.

March 14, 1992

Trip to Curanilague. Party included:
Mr. Claude J.J. Bovet
Mr. William Lord, WASH

Mr. Fernando Requena, WASH
Mr. Daniel Sunico
Mr. John Lebens, IIEC

Visited the municipality of Curanilague and interviewed:

Mr. Patricio Tapia Rodríguez, Mayor
Mr. Marcos Salinas, Director of Public Works
Mr. Ricardo Vargas, Empresa de Servicios Sanitarios de BioBio, S.A. (ESSBIO)
Mr. Ivan Campos, Municipality
Mr. Juan Araneda, Municipality
Ms. Ilse Palma, Municipality
Mr. Claudio Pizarro, Consultant
Mr. Alejandro Pizarro, Consultant
Mr. Pedro Ríos, FNDR
Mr. Andrés Gutiérrez Gutiérrez, Consultant

Discussed the Curanilague project and visited the wastewater treatment plant site.

March 17, 1992

Visit to Melipilla. Party included: Mr. Daniel Sunico
Mr. Fernando Requena, WASH

Visited a trickling filter plant (60 l/s) that has sludge digestion and sludge drying beds. There are also two sets of lagoons, one for 5 l/s and the other in Esmeralda for 50 l/s. Interviewed Mr. Jorge Maturana, Chemist.

March 18, 1992

Met with Mr. Edmundo Hermosilla, General Manager of the Banco Hipotecario de Industria y Fomento (BHIF).

Discussed intervention of private banking in the sanitation field. Indicated that $5 million was too small an amount to interest private banks. MINVIU should negotiate with a bank directly rather than invite a proposal to administer the loan.

March 20, 1992

Met with Mr. Eugenio Celedón Silva, Superintendent of Sanitary Services, and Mr. Jaime Vivanco Pineiro, Chief of the Department of Regulation and Control, of the Superintendencia de Servicios Sanitarios. Discussed the role of the Superintendencia in the review of projects, adjudication of concessions, tariff setting, and other matters.

Debriefing with A.I.D. Present were: Mr. Paul Fritz, USAID/Chile
Mr. Claude J.J. Bovet, USAID Regional Adviser

Mr. William H. Yaeger III, Director, Regional Housing and Urban Development Office/South America (RHUDO/SA), USAID
Mr. L. Fernando Requena, WASH
Mr. William Lord, WASH

WATER AND SANITATION
FOR HEALTH PROJECT
Operated by CDM and Associates

Sponsored by the U.S. Agency
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June 30, 1992

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Dear Colleague,

On behalf of the WASH Project, I am pleased to provide you with five copies of WASH field report No. 362, "Water and Wastewater Demonstration Projects for Small Urban Areas in Chile," by Fernando Requena and William Lord. This report discusses the design of wastewater-treatment demonstration projects in four locations in Chile which are being considered for funding under a housing guarantee loan. It determines the priorities according to which they should be selected of all cannot be funded together, and develops a detailed scope of work for conducting a feasibility study for each of them.

If you have any questions or comments about the findings or recommendations contained in this report, we will be happy to discuss them. Please contact Eduardo Perez at the WASH Operations Center. Please let us know if you would like additional copies.

Sincerely,

J. Ellis Turner
Project Director

Enclosure