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COLOMBIA

TIBITOC WATER TREATMENT FACILITY

(CO-0231)

ENVIRONMENTAL AND SOCIAL IMPACT REPORT

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TIBITOC WATER TREATMENT FACILITY ENVIRONMENTAL AND SOCIAL IMPACT REPORT

I. INTRODUCTION

- 1.1 One of the major issues facing the Capital District of Santafé de Bogotá (Bogotá) is the projected growth in water demand that will require major investments in developing new and more costly water sources to avoid rationing in the future. In 1994, Bogotá (including the surrounding municipalities) had a population of 6.5 million. The urban population is projected to reach 8.0 million by the end of the century and close to 9.5 million by the year 2010. Water demand studies indicate that with the present rate of growth coupled with the continued decline in unaccounted for water, that the existing water sources can, at best, serve the needs of the Capital District and surrounding municipalities through the year 2014. Better demand management can slow the pace of growth of demand. However, the sheer increase in population and income levels will continue to put pressure on the authorities to develop new water supplies.
- 1.2 The Empresa de Agua y Alcantarillado de Bogotá (EAAB) is responsible for water supply, sewerage and storm water services in the Capital area. EAAB is an industrial and commercial enterprise of the Capital District of Bogotá. On July 21, 1993, EAAB's legal status was defined by Decree / Law 1421 issued by the National Government and known as the Organic Statute for Santafé de Bogotá. Through this new legal status, EAAB acquired administrative, budgetary and contracting autonomy.
- 1.3 EAAB has three major sources of water supply to serve the Capital District and surrounding municipalities shown on Figure No. 1 and tabulated below.

Table 1-1
Water Supply (m³/s)
Capital District of Santafé de Bogotá

Water System	Current Reliable Capacity	Vulnerability Control Works Completed
Chingaza	14	14
Tibitoc	4±	10.5
Tunjuelo	1	0.5±
Total Flow	19 m³/s	25 m³/s

Estimates vary as to when the future water demand will approach 25 m³/s. These projections range between the year 2003 to 2015.

- 1.4 In order to address the concerns of potential water shortages and rationing, a vulnerability control component was incorporated in the Santafé I Water Supply and Sewerage Rehabilitation Program for Bogota, which is being partially financed by the World Bank. The specific goal of the vulnerability control component was to ensure reliable, safe water supply to Bogotá. The vulnerability control program identified three main components: (1) rehabilitation of the Tibitoc Water Treatment Plant in order to

restore its capacity to treat the nominal flow of 10.5 m³/s; (2) rehabilitation of a 31.3 km section of 2 m (78-inch) diameter pre-stressed concrete pressure pipe (PCCP) transmission main conveying potable water from the Tibitoc Water Treatment Plant to Bogotá's distribution system; and (3) construction of a backup Usaquen tunnel which will ensure that the treated water of the Wiesner Treatment Plant will reach the city at all times. The project under-consideration by the IADB addresses the rehabilitation of the Tibitoc Water Treatment Plant and the Tibitoc / Casablanca 2-meter diameter PCCP transmission main. Construction of the Usaquen tunnel is under a separate project.

- 1.5 EAAB has awarded a 20-year concession contract to a consortium to rehabilitate the Tibitoc water system. The consortium, known as Concesionaria Tibitoc is comprised of three parties: Compagnie General de Eaux (CGE); Corporación Financiera del Valle (CFV) and Fanalca. The latter two firms are Colombian finance companies. CGE will be responsible for all technical aspects of the project, including engineering, construction, operations and maintenance. CGE will perform the plant and pipeline rehabilitation work in the first three years of the concession contract. CGE will be provide technical assistance for operating and maintaining both the plant and a short length of the two transmission mains (between the plant and EAAB's effluent flow meters) for the entire duration of the 20 year concession.

II. PROJECT DESCRIPTION

A. Existing Facilities

- 2.1 The Tibitoc Treatment Plant, with a nominal capacity of 10.5 m³/s, has not been refurbished for the last 29 years. Under normal operating conditions, it supplies about 4 m³/s. Higher flows, if required, can be assured only for limited periods of time. The full capacity of the plant needs to be restored in order to ensure continuous water supply of high quality in cases of maintenance or emergencies at the Wiesner plant. The Tibitoc Plant, originally constructed in 1959 and expanded in 1969, is a conventional treatment facility, consisting of pre-sedimentation, coagulation, flocculation, sedimentation, filtration and disinfection. Figure 2 is a plan of the entire treatment plant site. A detailed plan of the treatment plant is shown in Figure 3. The Tibitoc plant normally receives water from the Bogota River, but also can receive water from the Tuesaca River. Solids removed through the treatment process are currently discharged to a 46-hectare spout solids lagoon on the plant site.
- 2.2 The treated Tibitoc water is conveyed to the city through two water mains. The larger main, known as the Tibitoc / Casablanca pipeline, is a 2 meter diameter pre-stressed concrete cylinder pipe (PCCP). It extends 55 km to the Casablanca storage tank. Due to corrosion problems, sections of the pipe have failed eleven times during the period 1978-1989. At present, the Tibitoc / Casablanca pipeline is operated at less than half of the design pressure and consequently conveys lower flows. Even with present reduced operation, the risk of pipe bursts still exists, exposing the population to flood risks and to unreliable supply in cases of emergency.

B. Rehabilitation Program

1. Tibitoc Water Treatment Plant

- 2.3 The proposed improvements to rehabilitate and enhance the Tibitoc Water Treatment Plant are briefly outlined below.
- 2.4 Civil and hydraulic upgrades will include:
- Construction of a new Bogotá River intake adjacent to the existing north river intake. The intake will consist of an inlet structure, trash screens, isolation gates and a piping connection to the pre-sedimentation basin.
 - Maintenance to the Tuesaca River intake and to the canal from the Aposentos Reservoir to the pre-sedimentation basin.
 - Removal of “buchon”, a plant species similar in appearance to hyacinths, from the surface of the pre-sedimentation basin.
 - Dredging of settled river solids from the floor of the pre-sedimentation basin. The concession contract estimates that the basin is roughly filled with 45 percent of solids, which would be equivalent to a volume of roughly 700,000 m³. The solids will be pumped as a slurry and deposited in drying beds.
 - Construction of drying bed of 7.2 hectares for the solids removed from the pre-sedimentation basin. The drying beds would be located immediately north of the pre-sedimentation basin. Existing eucalyptus and pine trees must be removed in order to create land area for the proposed drying beds. The location of the proposed solids drying bed is illustrated in Figure 4.
- 2.5 Process improvements will include:
- Optimization of chemical injection system used for coagulation.
 - Repair of cracks in the concrete walls of all flocculation tanks.
 - Upgrades to the sedimentation basin effluent collection channels.
 - Increase in depth of filter media beds and improvements to filter backwash systems.
 - Upgrades to chlorine (disinfection) and lime (pH control) feed systems.
- 2.6 Mechanical improvements to the Tibitoc Water Treatment Facility are required due to the fact that much of the equipment is 30 to 40 years old and has reached the end of its useful service life. Many of the pumps and valves are of models no longer manufactured and for which replacement parts are difficult to procure. At raw and finished water pumping stations, all pumps and motors will either be replaced or rehabilitated. Most valves at both the pumping stations and filter facility will be replaced or rehabilitated.
- 2.7 Various electrical upgrades are also proposed to increase reliability, including the replacement or rehabilitation of motor starters, transformers, protective equipment and lighting.
- 2.8 In order to improve the efficiency and reliability of the plant, an automated control system is proposed for automatic control and monitoring of pumping and treatment processes.

- 2.9 The modification and enhancement of the existing treatment process/system was evaluated and selected as the most appropriate option based upon technical, environmental and financial considerations. The selection of the site for the drying beds was based upon minimizing the environmental impacts and financial costs associated with transportation and site acquisition in another area.

2. Tibitoc/Casablanca 78-Inch Transmission Pipeline

- 2.10 The Tibitoc/Casablanca potable water transmission main runs from the Tibitoc Water Treatment Plant to the Casablanca water storage tank in the southern sector of Bogotá. Approximately 31,300 meters of the 78-inch diameter pre-stressed concrete cylinder pipe (PCCP) transmission main will be rehabilitated. The 78-inch diameter PCCP Tibitoc transmission main has had multiple failures at joints and some external corrosion problems due to soil conditions.
- 2.11 The Concessionaire's proposed method for rehabilitating the existing 78-inch pipeline is described below and is illustrated in Figure 5:
- At intervals that will vary from 300 to 1000 meters along the length of the main, the top half of the existing pipe will be removed for a distance approximately 10 to 15 meters to create an "access pit".
 - The inner pipe surface will be cleaned of chemical scale.
 - 72-inch diameter steel pipe sleeves will be inserted within the existing concrete pipe. Each sleeve will be lowered into the access pit by a small crane. Then a rubber-wheeled cart already located inside the concrete pipe will be rolled into place and lift up the steel sleeve. A winch attached to the inside of the existing pipe will pull the spigot of the steel sleeve into the bell of the sleeve previously installed. Each joint will be made by completing a fillet weld from inside the sleeve.
 - Once all sleeves from an access pit have been installed, concrete mortar will be pumped under pressure to fill the annular space between the inside of the old pipe and the outside of the new sleeve (a space roughly 2 to 3 inches wide all around).

The rehabilitated pipe system should have a service life of 80 to 100 years. The 78-inch PCCP will be an external shell providing long-term protection against any corrosive soil conditions. The new internal steel pipe is designed to handle internal water pressures required to operate the line at the intended capacity.

- 2.12 The repair of the pipeline will be divided into five segments or sectors, as depicted in Figures 6 through 10.
- 2.13 Under the scope of the Concession Contract, the EAAB has identified bypass piping that must be installed by the Concessionaire prior to the rehabilitation of a given sector to maintain continuous water supply to all portions of the distribution network. This bypass piping will remain in place and become a permanent part of the distribution system. Bypass lines will consist of approximately 6,000 meters of 16-inch diameter piping, 4,000 meters of 24-inch piping, and 2,000 meters of 36-inch piping. Exact routing of bypass piping is still being determined between EAAB and the

Concessionaire. Once bypass piping has been tested and accepted, the EAAB will isolate, drain and turn over to the Concessionaire for rehabilitation a given sector of the 78-inch line.

3. Suba Pump Station and Storage Tank

- 2.14 An area within the north central section of Bogotá known as “Suba” requires improvement in the adequacy and coverage of their water service. Geographically, Suba is comprised of two hills, “Cerro Norte (“North Hill”) and “Cerro Sur” (“South Hill”). The following improvements are planned to improve service to both Cerro Norte and Cerro Sur: construction of a new pump station to serve both the Cerro Norte “middle” and “high” storage tanks, and construction of a new pump station and storage tank on Cerro Sur.

C. Project Cost and Schedule

- 2.15 The project costs for the rehabilitation work are estimated at approximately \$62 million.

The work will be carried out over a three –year period.

III. LEGAL AND INSTITUTIONAL ASPECTS

A. Institutional

- 3.1 In 1993 the Colombian government passed Law 99, in which (among other things) the Ministry of the Environment was created. The Ministry of Environment became responsible for all environmental functions of the Ministry of Health, including national environmental policy, regulations, planning and research. Law 99 also strengthened the role of the “Corporaciones Autonomas Regionales” (CAR), which are responsible for the Ministry of Environment’s policy implementation in the various departments and regions throughout the country.
- 3.2 CAR-Cundinamarca has jurisdiction for managing water, sewerage and wastewater treatment in the areas of the Bogotá River watershed outside the capital district of the city of Bogotá. Within the capital district, these functions fall under the jurisdiction of Bogota District Environmental Authority (DAMA).
- 3.3 The Empresa de Agua y Alcantarillado de Bogotá (EAAB) is responsible for water supply, sewerage and storm water services in the Capital area. EAAB is an industrial and commercial enterprise of the Capital District of Bogotá. On July 21, 1993, EAAB’s legal status was defined by Decree / Law 1421 issued by the National Government and known as the Organic Statute for Santafé de Bogotá. Through this new legal status, EAAB acquired administrative, budgetary and contracting autonomy.

B. Environmental License

- 3.4 The overall Santafé I Project contains components that will be constructed both within and outside the capital district. For example, in the Tibitoc component, the

rehabilitation of the 78-inch Tibitoc/Casablanca transmission main begins near the water treatment plant in the municipality of Tocancipa (outside the capital district) and finishes within the capital district at the intersection of Avenida Boyaca and Calle 80. An agreement was reached wherein CAR-Cundinamarca issued the environmental license for the overall project in May of 1997.

- 3.5 The Environmental Impact Assessment (EIA) prepared for the project is entitled *“Environmental Plan for the Construction and Development of the Santa Fe 1 Project – Component 1 – Control of Vulnerability”*. The overall report, prepared and submitted in November 1996, encompasses the entire Santa Fe 1 project. In the vulnerability component, a chapter is dedicated to each project component, including the rehabilitation of the Tibitoc Water Treatment Plant and the 78-inch Tibitoc / Casablanca Water Transmission Pipeline. Each chapter includes the following subsections: description of work; identification of environmental and socioeconomic impacts; evaluation of impacts; actions of mitigation, recuperation, correction and prevention; and environmental monitoring plan. A separate chapter presents the recommended Contingency Plan which identifies potential natural (e.g., earthquakes, floods) and artificial (e.g., labor strikes) risks to the project and recommends appropriate preventative measures and response actions for each risk.
- 3.6 The EAAB prepared and included the following documents as part of the environmental license application to CAR-Cundinamarca for the overall Santafé I project:
 - Environmental Plan, which includes sections on Environmental and Social Impacts, Mitigation Methods, Monitoring, and a Risk Assessment/Emergency Management Plan;
 - Technical Project Specifications;
 - A Solids Residuals Management Plan; and
 - EAAB’s Manual of Environmental Guidelines for Management of Civil Works in Water Supply and Sewerage.
- 3.7 CAR-Cundinamarca reviewed the application and issued an environmental license to the EAAB for the Santafé I project in May 1997. The license did not impose any special conditions not already addressed in the Environmental and Solids Residual Plans.
- 3.8 The environmental license includes functions of Environmental Education and Community Participation that are programmed to *“...generate a consciousness for the adequate management of the different environmental components of this project (Santafé I), and in addition, inform the public about topics such as administration, control, evaluation, and tracking of activities during the construction of the various projects. The functions are directed to the community and the personnel involved in the project.”* These functions are to be carried out by the EAAB and will include the following:
 - Educational conferences;
 - Workshops for the environmental management of solids, management of sanitary infrastructure (treatment of wastewater, management of domestic and industrial solids residuals); and

- Brochures, posters, and environmental services.
- 3.9 The environmental license requires that the EAAB submit a report to CAR-Cundinamarca every three months regarding the progress of construction of each of the projects and updates on the execution of the Environmental Management Plan.
 - 3.10 The environmental impact assessment (EIA) for the Santefe I Project was prepared before a concession had been awarded for the rehabilitation and operation of the Tibitoc system. Since that time, the selected concession company has more clearly defined their proposed means and methods of construction. Assumptions made in the EIA regarding the treatment plant work remain valid. Now that the method and logistics of the pipeline rehabilitation are more clearly defined, certain assumptions made in the EIA in terms of potential impacts no longer apply. Revised impacts and mitigation/monitoring methods associated with the pipeline rehabilitation are discussed later in this report (Sections V and VI).
 - 3.11 In addition to the environmental license, per Decree 039, the Concessionaire must obtain an excavation permit from the Department of Planning at each of the pipeline rehabilitation access pits.

IV. ENVIRONMENTAL AND SOCIAL CONDITIONS

- 4.1 The City of Santafé de Bogotá is located approximately 2,600 meters above sea level along the eastern range of the Andean Mountains and is located in the middle section of the Bogotá River Basin. The Bogotá River is the most intensively used river in Colombia. Its principal uses are water supply for human consumption, irrigation, industry, electric power generation, transportation, disposal of wastewater, and some recreation in the upper basin. The regional area has several small drainage basins and depth to ground water varies. The regional area includes various wetlands that correspond to land that was originally part of the flooded plain of the Bogotá River and its branches. The population of the District Capital of Santafé de Bogotá (including the surrounding municipalities) was approximately 6.5 million in 1994. The population is projected to grow to approximately 9.5 million by 2010.
- 4.2 The Tibitoc Water Treatment Plant is located approximately 20 kilometers north of the Bogota city limits in the municipality of Tocancipa near the corporate limits of Sopo, between a commercial/tourist area called Briceno and the city of Zipaquirá. The surrounding population is dedicated primarily to farming and ranching. A smaller source of employment is a group of tourist attractions serving Bogota residents, including the Jaime Duque Amusement Park, Briceno, and a mini-car race track. Roadways in this region are paved and in good condition.
- 4.3 The treatment plant has been in existence for 38 years. The site has been modified from its original natural environment. The terrain on the treatment plant site is hilly and the landscape is comprised of grassy areas and forests of pipe and eucalyptus trees. Site specific soils/geology consist of 1 to 9 meters of surface organic materials mixed with clay; clay from 5 to 55 meters below ground surface; and fine sands (water present) greater than 55 meters below ground surface.

- 4.4 Raw water sources to the Tibitoc Water Treatment Plant are the Bogota and Tuesaca Rivers. Raw water from the two Bogota River intakes flow by gravity to the treatment plant's pre-sedimentation basin. Raw water from the Tuesaca River intake flows into the Aposentos Reservoir, from which it is pumped through an open channel to the pre-sedimentation basin. Due to pumping costs, the Tuesaca River is considered an emergency source of raw water and the primary source of raw water is the Bogota River.
- 4.5 The principal uses of raw water from the Bogota River are for potable water, hydroelectric power, and irrigation of farm and ranch land. The entity that controls and regulates the delivery of raw water from all sources within the Bogota watershed is called the Comité Hidrológico del Distrito (District Hydrological Committee). EAAB is represented on this committee as it is the principal user. For users of the Bogota and Tuesaca Rivers, the Tibitoc Water Treatment Plant has first priority of consumption over hydroelectric and irrigation users. The Tibitoc plant is located along the upper Bogota river basin. The major hydroelectric plants are located south of Bogota along the lower Bogota River Basin. Since approximately 80 percent of that volume is raw water delivered to the Tibitoc plant is consumed within Bogota and returned to the Bogota River within Bogota' as wastewater and the Bogota River flow is augmented from various tributaries within Bogota (the Fucha, Salitre and Tunjuelo Rivers), the consumption of raw water at the Tibitoc plant does not interfere significantly with the availability of raw water for hydroelectric power generation.
- 4.6 An accord exists between CAR-Cundinamarca and EAAB, under which the EAAB is guaranteed 10.5 m³/sec of raw water. This guarantee is made possible by the fact that upstream of the Tibitoc plant along the Bogota River, raw water is stored in three reservoirs (Tomine, Neusa and Sisga), with a total storage capacity of 888 million cubic meters. In 1997, while repairs were being made to the Usaquen Tunnel in the Chingaza water system, the Tibitoc plant was operated on an emergency basis at 11 m³/sec for 11 months. According to the EAAB, at no time was there a lack of water supply from the Bogota River. It should be noted that if the operation of the Tibitoc plant at 10.5 m³/sec were to create lower than desired flows in the Bogota River between Tibitoc and Bogota, the EAAB would have the option of decreasing consumption from the Bogota River and taking raw water from the Tuesaca River.
- 4.7 The Tibitoc-Casablanca Water Pipeline begins at the Tibitoc Water Treatment Plant and travels southeast across open hills until it turns south and runs parallel and west of the Autopista Norte, a major highway that connects Bogota to cities to its north. The pipeline travels approximately 20 miles south to the Bogota city limits, either along the west side of the highway or in the highway's wide central median. The area along the Autopista Norte north of the Bogota city limits is generally rural. Development is sparse but growing and includes modest homes, restaurants, general stores, a grain storage complex, and condominium complexes either recently constructed or under construction. On the west side of the highway approximately halfway between the treatment plant and the Bogota city limits is "Hato Grande", which is the vacation ranch of the President of Colombia. As the pipeline approaches the city limits, the surrounding areas are more densely developed.

- 4.8 Once within the Bogota city limits, the pipeline continues along Autopista Norte. The areas adjacent to the Autopista Norte are heavily developed and consist primarily of commercial and industrial businesses. Traffic along the highway within the city limits is frequently very congested. The pipeline turns west from the Autopista Norte and runs for approximately 2.4 kilometers along Calle 129 in a zone of Bogota known as Suba. Development along Calle 129 is characterized by a high density of commercial businesses such as low-cost retail stores and auto repair shops. The areas to both sides of Calle 129 are middle-income residential zones. From Calle 129 the pipeline follows the central separator of a principal north-south traffic artery of Bogota called Avenida Boyaca. The rehabilitation work ends along Avenida Boyaca just south of where the pipeline crosses the Salitre River near Calle 80.

V. ENVIRONMENTAL AND SOCIAL IMPACTS

A. Environmental Impacts

1. Tibitoc Water Treatment Plant

- 5.1 The potential principal environmental impacts related to the Tibitoc Water Treatment plant are described below.
- 5.2 A temporary change of land use will result associated with the construction of a site for drying of solids excavated from the pre-sedimentation. The site construction for the solids drying beds will require the removal of approximately 7,000 to 10,000 pine and eucalyptus trees in an affected area of approximately 72,000 square meters. The removal of the trees will also create a negative visual impact.
- 5.3 Potential contamination of underlying soils, ground water and nearby surface waters due to leachate migration from the solids drying beds. The soils in the area of the solids drying beds are made up primarily of clays with a permeability of 1.2×10^{-4} to 1.4×10^{-4} . This suggests that the soil that will form the bottom of the excavated drying beds is essentially impermeable and will prevent the solids leachate from reaching the groundwater aquifer below. The leachate will flow back into the pre-sedimentation basins and subsequently into the treatment plant.
- 5.4 Solids from the solids drying beds will be used as fill material for river dikes or for a soil amendment for planting trees to replace those removed for construction of the drying beds, which may cause contamination if the solids were to contain heavy metals or pesticides. In order to assess the potential for environmental contamination if the solids from the drying beds were to contain heavy metals or pesticides, samples of the pre-sedimentation basin solids were analyzed by a local university laboratory. Very low levels of heavy metals were found and no pesticides were detected. All observed values were well below the USEPA Federal Sludge Regulations for land application. The sediments in the bottom of the pre-sedimentation basin consist of clean, inert particles transported by Bogotá River waters and settled in the basin. Therefore, the disposal of solids as fill material or as a soil amendment should not result in contamination of soil or groundwater in the surrounding environment.

- 5.5 There are potential impacts due to pests and aquatic insects associated with the pre-sedimentation basin. The prevalence of pests and aquatic insects in the pre-sedimentation basin should be no greater than that in the Bogotá River itself. Total coliform levels found in the raw water range between 100 and 1,000 MPN. This is equivalent to recreational water standards. The risk of insects carrying waterborne diseases is negligible. As such, no pest/insect control actions are expected to be necessary.
- 5.6 There is a potential for odors generated from the pre-sedimentation basin. The organic content of the sediments in the pre-sedimentation basin is negligible. As such, significant odors should not be generated from the basin. During present operations no noticeable or unpleasant odors exist. Any potential organic odors would only be released by the “stripping” action created by the discharge of dredged solids to the temporary stockpile area or the collection and unloading of the solids into the drying beds by earth moving equipment. The worst case would be for odors to be released and carried by wind currents to the school.
- 5.7 Chlorine is used for disinfection of treated wastewater. Chlorine is stored under pressure in one-ton steel cylinders, which are located in a building with open sides. Although the probabilities are low, during the handling of storage cylinders and their piping connections, the potential exists for an accidental leak and resulting release of chlorine gas. The potential impacts associated with the handling chlorine cylinders or accidental leaks, relate to both plant staff and the small school located about 1,150 feet north of the chlorine storage facility. A mathematical modeling analysis was performed of potential chlorine gas concentrations arriving at the school and showed the levels could be in the 1 ppm range (see Figure 12). This level corresponds to a recognized or definitive odor and possible irritation of eyes and nose (chlorine levels of 30 ppm present potential intense coughing). Due to the school location north of the chlorine facilities, 90 percent of time (9 out of 10 times), the wind would not carry the chlorine cloud toward the school. The area between the chlorine facility and the school is an uninhabited open hillside.
- 5.8 The generation of solid or hazardous waste, related primarily to the replacement or maintenance of equipment at the plant, may create impacts. In addition, the disposal of soil which may be contaminated may require special disposal methods.
- 5.9 A potential long-term environmental impact is that the lagoon that receives waste solids from the treatment plant does not have capacity to handle solids volumes projected over the next 20 years.

2. Tibitoc-Casablanca Water Supply Pipeline

- 5.10 Adjacent to each pipeline rehabilitation access (i.e., approximately 68 locations), a pit and small work area (approximately 60 to 80 square meters) will be established and include a small crane for lowering pipe into the pit, and a portable electric generator. Typical work areas will require two to four weeks to accomplish the required tasks. Potential significant environmental impacts associated with these activities include: soil erosion and waste water disposal (a portable self-contained chemical toilet will be located at each access pit in lieu a septic tank and drain field).

- 5.11 Portions of the 78-inch pipeline pass underneath the central medians along the Autopista Norte (North Highway) and Avenida Boyaca. Situated directly over the pipeline are trees planted by an organization called “Hojas Verdes” (“Green Leaves”). “Hojas Verdes” is a program sponsored by the Bogotá Chamber of Commerce in which trees are planted in public spaces as a memorial to deceased persons. In order to excavate some of the access pits in these areas it will be necessary to remove and replace, or relocate, some of these trees.

B. Traffic Impacts

- 5.12 There are no anticipated traffic impacts due to construction or operational activities associated with the Tibitoc Water Treatment Plant.
- 5.13 Associated with the Tibitoc-Casablanca Water Supply Pipeline, there will be 68 small work areas resulting in the most significant effect of the pipeline rehabilitation project to the citizens of Bogotá, i.e. the impact on traffic caused by the individual access pits/work areas. The most significant potential traffic impacts are summarized below.
- 5.14 In Sector 1 the pipeline rehabilitation will take place along a 2.4 kilometer stretch of Calle 129 between the Autopista Norte (North Highway) and Avenida Boyaca. Calle 129 has four traffic lanes (two in each direction, east-west) and carries heavy car, bus and truck traffic. Of the five rehabilitation access pits planned along Calle 129, one will be located in an empty lot north of Calle 129 immediately north of where the existing pipeline crosses the Cordoba drainage canal. The other four pits will be located over the center of Calle 129 and work at these locations will require the closure of one or both (one in each direction) of the inside traffic lanes.
- 5.15 In Sector 2, the pipeline rehabilitation will take place along a 20.9 kilometer segment of the Autopista Norte, either on the west side of the highway or in the wide central median. Access pits and work areas will be outside the limits of the roadway and no lane closures are anticipated..
- 5.16 In Sectors 3 and 4, a five kilometer span of the existing pipeline is located in the median between the Autopista Norte and its parallel west service road. Access pits and work areas will be confined within the median and no lane closures are anticipated.
- 5.17 In Sector 5, a 2.5 kilometer span of the pipeline is located along the central median of the Avenida Boyaca. Avenida Boyaca is one of Bogotá’s principal north-south traffic arteries. Avenida Boyaca contains six lanes (three lanes each way) and is characterized by heavy car, bus and truck traffic. A total of six access pits/work areas are planned in this span. Access pits and work areas will be confined within the median, and no lane closures are anticipated.
- 5.18 In Sectors 2, 3, 4 and 5, the delivery of pipe sleeves or equipment machinery to the work areas may cause momentary slowing of traffic.

C. Socio-Economic Impacts

1. Tibitoc Water Treatment Plant

- 5.19 The rehabilitation of the treatment plant will have no significant social or economic impacts to the surrounding areas/communities of Sopo, Tocancipa, Zipaquirá or Briceño; with the exception of possible impacts on the school situated on EAAB property north of the treatment plant. The area proposed for removal of 7,000 to 10,000 trees and construction and filling of solids drying beds will extend from just north of the Pre-sedimentation Basin to within approximately 100 to 200 meters of the school. The school serves roughly 20 to 30 students from rural, non-incorporated areas near the plant property. Impacts to the school may include noise from the removing and hauling away of the 7,000 to 10,000 trees; and safety concerns associated with school children entering this work area.

2. Tibitoc-Casablanca Water Supply Pipeline

- 5.20 No resettlement will be required associated with the project activities of pipeline rehabilitation.
- 5.21 The arrival of construction workers to the work areas will result in a slight increase in the demand for goods and services (food, lodging, commercial products, etc.).
- 5.22 The potential that construction activities for rehabilitation of the pipeline could restrict access to commercial businesses along Calle 129.
- 5.23 Traffic rerouted from Calle 129 to adjacent side streets will result in increased traffic congestion in adjacent residential neighborhoods.

D. Project Benefits

- 5.24 Rehabilitation of the Tibitoc Water Treatment Plant and the Tibitoc/Casablanca transmission main will improve the capacity, operating efficiency (and therefore operating costs), and reliability of the Tibitoc system to provide potable water to the citizens of Bogotá. The ability to routinely operate the system at its full design capacity of 10.5 m³/sec will provide greater reliability in the Bogotá water supply system as a whole by providing a backup if portions of the Chingaza system go out of service, to avoid resorting to water rationing.
- 5.25 Construction of additional pump stations and storage tank at Suba will provide reliable potable water service to that area.
- 5.26 The enhanced water treatment process at the Tibitoc Water Treatment Plant will produce a higher quality water with less bacteria and waterborne pathogens. This enhancement is demonstrated by reductions in turbidity which has been correlated to bacteria and waterborne pathogen levels (see Fig. 11). After 18 months operation, the treated water turbidity must be reduced to less than 0.5 ntu. It is estimated that the treatment works will produce a finished water in the 0.1 to 0.4 ntu turbidity range. In 1997, potable water turbidities averaged about 1.0 ntu with maximum levels of 5.0 ntu. At a flow rate of 5.0 m³/s, about 2,600,000 people (165 LCD) are delivered potable water from the Tibitoc Water Plant. Finished water turbidity levels will be reduced more than 50 percent below current levels. The associated reduction of bacteria and waterborne pathogens and parasites in the finished water should reduce the

occurrence of gastrointestinal illnesses in the general population and improve in public health and quality of life.

- 5.27 The construction of the treatment plant and pipeline will create employment opportunities in the surrounding communities for non-skilled and skilled construction labor.

VI. ENVIRONMENTAL AND SOCIAL MITIGATION AND MONITORING

A. Mitigation Measures

1. Environmental

(a) Tibitoc Water Treatment Plant

- 6.1 The change of land use due to the construction of the solids drying beds is temporary. When all solids have dried and been removed for use as a soil amendment or as fill material for river dikes or low areas on the plant site, the area will be restored to its previous condition as a forest by planting an equivalent number and type of trees as those removed. According to the capacity of the dredging machine and the estimated quantity of solids to be removed, the dredging process should last approximately two years. A portion of these solids drying beds will be maintained for annual dredging of the pre-sedimentation basin. The balance of the replacement trees will be planted elsewhere on the treatment plant site.
- 6.2 The soils in the area of the solids drying beds soils are made up primarily of clays with a permeability of 1.2×10^{-4} to 1.4×10^{-4} . These soils will form the bottom of the excavated drying beds and will be essentially impermeable and will prevent the solids leachate from reaching the groundwater aquifer below. The leachate will flow back into the pre-sedimentation basins and subsequently into the treatment plant. Percolation tests will be conducted to verify soil permeability, and should the soil be less impermeable than required, an impermeable layer of clay will be placed at the bottom of the beds. If necessary other mitigation measures and monitoring programs will also be implemented.
- 6.3 The potential for generation of solid or hazardous waste during the replacement or maintenance of equipment at the plant is mitigated by the Solids Residuals Management Plan submitted separately as part of the environmental license application.
- 6.4 In terms of chlorine tanks, there are in place emergency procedures to respond to an accidental leak. The Concessionaire will upgrade the existing chlorine gas response plan and conduct training for all personnel in the vicinity of the chlorine gas containers. The probability of accidental release of chlorine is extremely small coupled with a 10 percent probability of the wind direction carrying the chlorine cloud toward the school as well as the distance (1,150 feet), the overall danger to the school from a chlorine leak is nonexistent, or at worst a nuisance. Regardless, in the event of a chlorine leak, procedures will be in place to immediately notify school officials.
- 6.5 No significant odors should be generated from the solids basin. However, in the worst case, if odors are released and carried by wind currents to the school and are detected, the concessionaire should stop solids dredging and transport operations when wind is blowing in the direction of the school.
- 6.6 If excavated or disturbed soil is found to be contaminated based upon visual or odor observations, the soil will be tested and disposed of in accordance with Colombian

environmental regulations.

- 6.7 Should additional spent solids lagoons be constructed in the future to address projected solids generation projections, human access to the lagoon will be limited to prevent the danger of anyone “sinking into” the gelatinous alum solids material.
- 6.8 Since the existing spent solids lagoon does not have adequate capacity to handle solids volumes projected over the next 20 years, the EAAB and the Concessionaire should survey the existing lagoon to determine the remaining available disposal capacity. Based on the available capacity and projected spent solids generation, long-term provisions should be made to (a) construct new solids disposal lagoons on the plant; (b) raise containment dikes to increase the capacity of the existing lagoons; or (c) install a solids drying process to reduce volumes of solids to be disposed.

(b) Tibitoc-Casablanca Water Supply Pipeline

- 6.9 Soil removed as a result of each work encampment and pipeline access pit would be replaced after pipeline rehabilitation in that area is complete.
- 6.10 The construction areas for each pipeline rehabilitation access pit will have a portable, self-contained chemical toilet. Therefore, wastewater will be disposed of by hauling away the portable toilet and emptying its contents into a discharge site approved by CAR-Cundinamarca
- 6.11 Given the high traffic volume along the pipeline rehabilitation corridor, the additional noise and air pollution from the rehabilitation work will be negligible and no special mitigation measures are recommended.
- 6.12 Surface vegetation removed as a result of the temporary work sites will be restored to its original condition when work in a given area is complete.

2. Traffic

- 6.13 According to standard Colombian traffic design criteria, the following parameters must be maintained within allowable limits during infrastructure projects within roadways:
- The Relative Degree of Saturation (RDS), which is equal to the vehicular volume divided by the vehicular capacity of a given roadway, cannot exceed 120 percent of its normal value between 6:00 a.m. and 9:00 p.m. and cannot exceed 90 percent of its normal value between 9:00 p.m. and 6:00 a.m.
 - Regarding Occupancy of Roadways, an infrastructure project within a roadway cannot result in more than a 30 percent closure of lanes between 6:00 a.m. and 9:00 p.m. or more than a 50 percent closure of lanes between 9:00 p.m. and 6:00 a.m.
- 6.14 Per Decree 114, heavy truck or bus traffic is not allowed to travel on the Autopista Norte and the Avenida Boyaca during peak traffic hours, which are 6:00 a.m. to 9:00 a.m. and 5:00 p.m. to 8:00 p.m. Therefore, the Concessionaire will not be allowed to deliver pipe sleeves to access pits in any of the sectors during these hours. Note that

this includes the access pits on Calle 129, since trucks delivering pipe sleeves must travel the Autopista Norte to reach Calle 129.

6.15 Traffic detours will be required at three access pits/work areas along Calle 129. Recommendations for detours are based on traffic counts taken in March 1998 and recent vehicular volume data along Calle 129 from the Secretary of Transit. The Concessionaire should coordinate with the Secretary of Transit and the Metropolitan Police to employ traffic police to direct traffic detours.

- At Access Pit No. 1-5, located along the center divider of Calle 129 at Carrera 37, one or both of the two inside lanes (closest to the divider) must be closed, depending on the exact location of the centerline of the existing pipeline. Assuming the worst case, that both inside lanes must be closed, the two outside lanes would remain open (one lane in each direction). Vehicular volume data indicates that the Relative Saturation Density at peak hours would exceed allowable limits and that a portion of the traffic must be detoured to adjacent side streets. Given the small width and tight turning radii of the side streets, it is recommended that heavy traffic (trucks and buses) travel straight through Calle 129 in the open outside lanes and that car traffic be detoured past the work area via side streets as required to maintain the Relative Saturation Density along Calle 129 within allowable limits. A layout of the recommended detour plan is illustrated in Figure 13.
- At Access Pit No. 1-4, located along the north side of Calle 129 just east of the Cordoba drainage canal, it is likely that the outside westbound lane must be closed, leaving the inside westbound lane and both eastbound lanes open to normal traffic flow. Based on vehicular volume data, a portion of the traffic must be detoured during peak hours. As Calle 129 is the only street in the area that crosses the Cordoba canal, we recommend that all westbound traffic (cars, trucks, and buses) be allowed to use two lanes to travel in the westbound direction over the canal bridge. This will require that the inside eastbound lane be temporarily converted to a westbound lane. The one remaining eastbound lane would be used primarily to allow heavy traffic (trucks and buses) to pass straight through on Calle 129. A portion of the eastbound car traffic must be diverted to side streets during peak hours. A layout of the recommended detour plan is illustrated in Figure 14.
- At Access Pit No. 1-3, located along the center divider of Calle 129 at Carrera 51, a traffic management plan similar to that described above in (a) is recommended. A layout of the recommended detour plan is illustrated in Figure 15.
- For each of the three detours along Calle 129 described above, proper signage and signalization is required to maintain an optimum flow of traffic and enhance traffic safety. A schematic plan of recommended signage and signalization along Calle 129 is shown in Figure 16.

6.16 The access pits/work areas along Sectors 2, 3, 4 and 5 will be located outside of roadway limits and should have no direct impact on traffic along the Autopista Norte and Avenida Boyaca. However the trucks delivering pipe sleeves to work areas along the side of Autopista Norte or in the central medians of Autopista Norte or Avenida Boyaca may cause traffic to slow when they exit from the roadway to the work areas and re-enter the roadway from the work areas. At these locations, access roads should be constructed from the roadway to the access pit and from the access pit back to the roadway to avoid having delivery trucks parked along the curb and disrupting traffic.

The access roads and the traffic lanes leading to and from the access roads should be provided with proper signage and signalization. An example of a properly designed access of this type is illustrated in Figure 17.

- 6.17 In Sector 2 of the pipeline rehabilitation, from the city limits north, the Autopista Norte is operated by a private concession called the "Union Temporal - Desarrollo Vial del Norte de Bogota. The highway concession is currently completing a project to widen a large span of the Autopista Norte in Sector 2 of the pipeline rehabilitation. As the Union Temporal is responsible for maintenance, safety (control of accidents) and stability of the highway, the pipeline Concessionaire should reach an agreement with the highway concession regarding the manner in which the trucks delivering pipe sleeves and materials to the various access pits will exit and re-enter the Autopista Norte.
- 6.18 The Concessionaire should develop a comprehensive traffic management plan to mitigate the traffic impacts created by the access pits on Calle 129 and the delivery of materials to the work areas along the Autopista Norte and Avenida Boyaca. The following local resources are available to assist in developing the plan: (1) 1992 edition of the Bogota Traffic Manual (Manual Sobre Disposición para Control de Transito de Calles y Carreteras), which includes official regulations on signs, signals, detours, etc.; (2) Resolution 1937 establishes minimum requirements for temporary signage, signals, traffic cones, detours for work areas within roadways; (3) the Division of Semaforizacion (Stoplights) of the Empresa of Telecommunications of Santa Fe de Bogota is available to coordinate/approve any necessary changes in stoplight synchronization required by the proposed traffic management plan; and (4) the Master Plan of Transport by the Japanese agency JICA is available at the Secretary of Transport, Unit of Operation of Troncales.
- 6.19 In terms of the Tibitoc-Casablanca Water Supply Pipeline, to mitigate the lane closures on Calle 129, all traffic in the affected direction must be detoured to adjacent side streets in residential neighborhoods. Potential detour streets, including Diagonal 128D, Carrera 43 and Carrera 45, pass through residential areas and would have to be rehabilitated to support heavy traffic loads detoured from Calle 129. No parking should be allowed along the curbs of Calle 129 or of the detour streets to allow traffic to flow more freely.
- 6.20 Although work areas along Sector 2 will have no direct traffic impacts, the placement of adequate signage to inform drivers of the rehabilitation work since there is a high volume of high-speed traffic along the Autopista Norte.
- 6.21 Work areas along Avenida Boyaca will not have a direct impact on traffic. However, due to the high volume of traffic along Avenida Boyaca, the delivery of equipment or materials to the work area not be allowed during peak traffic hours to lessen potential traffic congestion.

3. Socio-Economic

(a) Tibitoc Water Treatment Plant

- 6.22 As required by the project Environmental License, various environmental education and community participation functions will be performed (see paragraph 3.8).

6.23 The following measures will be taken to mitigate impacts from the construction and operation of the solids drying beds on the adjacent school:

- Construction work in solids drying area No. 1 (see Figure 4) within 300 meters of the school should be scheduled after the students are finished or on weekends.
- The raw water canal from the Tuesaca River serves as a barrier between the school and the solids drying areas. To further mitigate the risks associated with the school children being exposed to the drying or transportation activities, the Concessionaire or EAAB shall install appropriate barricades and signage and coordinate their activities with school administrators.

(b) Tibitoc/Casablanca Water Supply Pipeline

6.24 The removal of “Hojas Verdes” trees at an access pit can be mitigated by maintaining and replanting the removed trees after work at that access pit is complete; or by purchasing a replacement tree from the Bogotá Chamber of Commerce, which maintains a tree farm for the “Hojas Verdes” program. If notified in advance, the “Hojas Verdes” program has a history of cooperation with infrastructure projects.

6.25 As the access pits/work areas are spaced from 500 to 1,000 meters apart, the traffic impacts to business owners along Calle (Street) 129 will be isolated. Work at each access pit should last two to four weeks. The access pits will be centered over the existing pipeline, which runs underneath the center divider of Calle (Street) 129. The width of the work areas at each access pit can be limited to allow one lane of traffic to travel in each direction. Designated parking beyond the curb limits of the street will remain available. As such, access to and parking for commercial businesses can be maintained during construction activities.

6.26 Proper signage should be installed to control traffic velocity on the residential side street detours from Calle 129. A policeman should be employed to control the volume of detoured traffic. The duration of detours on any given side street should be from two to four weeks.

B. Monitoring Programs

1. Tibitoc Water Treatment Plant

6.27 The quantity of “buchon” (similar to water hyacinths) from the pre-sedimentation basin will be monitored to ensure sufficient quantities exist for natural purification of raw water through the uptake of any trace heavy metals and organic matter.

6.28 Monitoring will be performed of the pine and eucalyptus trees to be replaced within the treatment plant boundaries to verify that the correct number and type of trees are successfully replanted.

6.29 The Solids Residuals Management Plan requires the Concessionaire to submit a monthly report of solids residuals management through EAAB to CAR-Cundinamarca. The report should indicate the frequency and schedule of residuals collection, the system for separating the different types of residuals, location of residuals containers,

any recycling processes, management and state of the on-site incinerator, and location of final residuals disposal.

- 6.30 The environmental license includes the following monitoring requirements related to the potential for contamination of soil or groundwater adjacent to the proposed solids drying beds at the Tibitoc plant: (1) bimonthly sampling and chemical analysis by EAAB of solids from the pre-sedimentation basin solids drying beds; and (2) bimonthly sampling and chemical analysis by EAAB of groundwater in areas adjacent to the pre-sedimentation basin solids drying beds.

2. Tibitoc / Casablanca Water Supply Pipeline

- 6.31 The replacement of “Hojas Verdes” trees will be monitored to ensure the work is done to the satisfaction of the Bogotá Chamber of Commerce and the “Hojas Verdes” program.
- 6.32 The pipeline rehabilitation work along Calle 129 will be closely monitored to ensure that impacts to traffic and public access to commercial businesses are properly mitigated.

C. Costs

- 6.33 In accordance with the Concession Contract, any work required for mitigation of environmental and social project impacts as per the environmental license will be designed and supervised by the Concessionaire. However, the EAAB will be responsible for selecting and paying local Colombian contractors to perform the actual work.
- 6.34 The following table presents the estimated costs for some of environmental and social mitigation and monitoring activities for construction work related to the plant and pipeline rehabilitation projects to be incurred by the EAAB over the first three years of the Concession Contract: (Note: Many of the costs for mitigation measures are grouped as part of the project operation and maintenance budget).

Table 9-1
Estimated Costs for Select Environmental Mitigation and Monitoring

i)	Item	Cost (\$US)
	Tree Replacement @ Solids Drying Beds	\$ 20,000
	Environmental Training Workshops	\$ 11,240
	Community Information Workshops	\$ 20,000
	Environmental Monitoring	\$ 5,620
ii)	Total	\$ 56,860

D. Responsibilities

- 6.35 The EAAB has formed an Environmental Committee, which reports directly to the EAAB's Vice President for Planning. The Committee is comprised of two full-time members and a group of temporary members. The two full-time members would be (1) an environmental engineer from the Planning Vice Presidency, and (2) an environmental consultant hired by an audit team external to the EAAB. Temporary members would include representatives from other areas of expertise within the EAAB, including real estate, natural resources, community development and others.
- 6.36 The Environmental Committee will be responsible for implementing the Santafé I EIA/ESMP, environmental training of contractors, coordination with other environmental agencies and NGO's, and public consultation.
- 6.37 The Environmental Committee will also be responsible for carrying out all sampling and reporting requirements of the environmental license.
- 6.38 Under the concession contract, the Concessionaire must prepare and submit to EAAB a detailed Quality Control Plan. The plan will address organizational, operational, and documentation procedures to ensure that all water quality and quantity requirements of the contract are met.
- 6.39 The Concessionaire will conduct training sessions to instruct construction and operating personnel on environmental standards, specific project environmental issues, and environmental mitigation and monitoring requirements of the project's environmental license.

VII. RISK MANAGEMENT/CONTINGENCY PLAN

- 7.1 The EIA includes a Contingency Plan which is to provide an efficient tool to quickly and effectively respond to an emergency in order to protect public life, health and property. The EIA contingency plan was developed based on an analysis of risks, such as natural events (e.g. earthquakes, landslides, floods, etc.) or manmade events (e.g. labor strike, sabotage, etc.). Risks which may be associated with construction of the project and their mitigations are as follows:
 - 1. Contamination of Natural Waterways. Surface waters could be contaminated by the discharge of untreated waste waters from construction work encampments, or by the discharge of excavated materials directly into the waterway. At the Tibitoc Treatment Plant, workers will use existing restrooms in the Control Building or potable, self-contained chemical toilets. At work sites at access pits for rehabilitation of the Tibitoc/Casablanca pipeline, self-contained chemical toilets will be used and the waste water disposed at a governmentally authorized location.

Excavation of the solids drying beds at the plant and of access pits for the pipeline rehabilitation pose no threat of contamination to surface waters (refer to sections V and VI for details).

2. Damage to Structures or Earthen Slopes due to Seismic Activity or Geotechnical Failures. In the Bogotá area, the risk of an earthquake is low due to its distance from active seismic faults and the lack of volcanic activity. If foundations are properly compacted, the risk of a geological failure is low due to the fact that surface soil layers are well-consolidated and have a plastic deformation of virtually zero.
3. Workplace Accidents. Potential for injuries to workers due to physical accidents, diseases, lack of oxygen in confined spaces (e.g. pipeline rehabilitation), or exposure to toxic gases (e.g. chlorine at the water treatment plant) can be prevented by the employment of a proper safety program.
4. Fires. The risk of fire is directly related to the Concessionaire's proper installation of electrical wiring and proper management of combustibles and flammable materials, and is very minimal for the Tibitoc project.
5. Increased Noise Level. At the Tibitoc plant, noise will be generated from the removal of trees for construction of solids drying beds and transport of solids from the pre-sedimentation basin to the solids drying beds. The noise will be dampened by surrounding forested areas on the plant site and should not impact the surrounding communities. Noise impacts on the adjacent school (on the plant site) are discussed in Section V.
6. Increased Odors. None of the Tibitoc construction or operating activities are expected to generate offensive odors. The solids to be removed from the pre-sedimentation basin is made up principally of non-odorous inorganic sediments.

- 7.2 As a requirement of the Concession Contract, the Concessionaire must prepare a specific Risk Management/Contingency Plan. At this early stage in the project, the Concessionaire has not completed the plan, but has prepared a plan outline for the EAAB's review. According to the outline, the plan will be geared towards risks associated with the operation of the Tibitoc Water Treatment Plant. The plan will identify all potential risks, their potential impacts on each component of the water treatment and pumping systems, and preventive measures and response actions in the event a risk / emergency occurs.

VIII. PUBLIC CONSULTATION

- 8.1 As preparations for the environmental license, a public audience was held on April 11, 1997 to review the public's view of the overall Santafé I project. A review of the meeting minutes indicates that no comments were made by the attending public on the Tibitoc component of the Santafé I project.
- 8.2 As recommended in the project EIA, a socioeconomic plan will be developed and include the items listed below.
 - For the rehabilitation of the Tibitoc Water Treatment Plant, information workshops should be conducted with the surrounding communities of Sopo, Bricero and Tocancipa. Subjects to be addressed at the workshops should include a

description of the construction project; the project's area of influence; potential impacts to the community; details on plans for mitigation and monitoring of social and environmental project impacts; and an open forum to allow the community to voice their concerns. The workshop should serve as a means to develop an ongoing dialogue between the Concessionaire and the community to ensure that the interests of both parties are properly served.

- For the rehabilitation of the Tibitoc/Casablanca pipeline, information workshops should be conducted with all affected communities. In particular, the most affected community will be that of Suba, where pipeline rehabilitation will occur along Calle (Street) 129 from the Autopista Norte to the Avenida Boysca. The Concessionaire should establish contact with the appropriate Community Action Council or Neighborhood Association to ensure full public participation in the information workshop. Subject matter to be addressed in the workshop should be similar to that described above.

IX. RECOMMENDATIONS

9.1 The Bank will require the Project Sponsors/Company:

1. Obtain and comply with all necessary environmental, health and safety authorizations, permits and licenses required related to the project;
2. Comply with the actions and requirements listed in the documents submitted as part of the environmental license application (e.g., Environmental Plan, Solids Residuals Management Plan, etc.);
3. Comply with applicable requirements established in the project Environmental Impact Assessment;
4. Comply with the mitigation measures and monitoring programs presented in the Bank's Environmental and Social Impact Report; and
5. Comply with the environmental and social covenants in the concession contract.

9.2 Prior to Project financial closure, the following conditions are required to be fulfilled by the Borrower:

1. Present finalized estimated costs for all individual environmental and social mitigation measures and monitoring programs; and
2. Present a Project Supervision Plan, subject to Bank's approval, which should include procedures and activities that will be implemented to ensure quality control of the project environmental and social mitigation measures and monitoring programs (e.g., procedures to ensure measures are properly and completely implemented).

9.3 Prior to first disbursement, the following conditions are required to be fulfilled by the Borrower:

1. Present the required project Environmental and Education and Community Participation Plan, as referenced in the project environmental license.
2. Present, subject to the Bank's approval, the proposed environmental and social mitigation measures and monitoring programs for the: (a) installation of

approximately 12,000 meters of bypass piping to maintain water service to customers during rehabilitation of individual sectors of the 78-inch Tibitoc/Casablanca pipeline, and (b) construction of two new pump stations, one new storage tank, and interconnecting piping for improvements to water supply for Suba;

3. Present a traffic management plan. The plan and construction activities should be coordinated with the appropriate local authorities, including the Secretary of Transit, the Metropolitan Police and The Division of Semaforizacion (Stoplights) of the Empresa of Communications. The traffic management plan should be prepared in conjunction with a local traffic engineer and address all potential traffic impacts associated with the pipeline rehabilitation. The plan should specifically include, as a minimum, the following: (a) actions related to rerouting of traffic around work sites along Calle 129; (b) traffic police should be employed to control the volume and velocity of traffic that is rerouted from Calle 129 to adjacent residential side streets in order to minimize the impact of noise and congestion to residences and assist in public safety; and (c) use of properly configured access roads from the Autopista Norte and Avenida Boyaca to access pits/work sites to allow for the delivery of pipe sleeves and equipment/machinery without causing excessive slowdowns of traffic on these roadways.
4. Present a Construction Contingency Plan, which will identify preventative measures and response actions in the event a risk/emergency occurs.
5. Demonstrate that the Construction Contractor has implemented a Safety Program with confined space entry provisions for the pipeline rehabilitation contractor in order to do all that is practical to prevent injury to persons and damage to property, and to protect the interest of employees, the construction contractor, EAAB and the public from the results of accidents.

9.4 No later than 180 days after project completion as defined in the project agreement, the Borrower shall submit a Final Report on the Construction Component of Environmental and Social Management Plan, including the following:

1. Certification by the Borrower that the project has been successfully implemented and completed all required measures and activities and complied with all material regulatory requirements;
2. Any material deviation from the original construction plan, including a brief technical description and major reasons for such changes, as well as any adjustment to the relevant environmental and social measures that have been taken;
3. Description of any existing or anticipated environmental or social liability, risk or non-compliance; and
4. Copies of any major environmental or social report or document prepared in order to satisfy regulatory requirements, except those already submitted with the reports during construction period.

9.5 For the last disbursement, the following conditions are required:

1. Certification by the Borrower that all necessary licenses, authorizations and permits have been obtained according to the regulations and that the project is in material compliance with all license/authorization requirements;
2. Certification by the Borrower that the project is in material compliance with all design and operational regulatory requirements according to the regulations;

3. Description of any existing or anticipated environmental or social liability, risk or non-compliance; and
 4. Present a plan to address long-term disposal requirements, given that the existing lagoon that receives spent solids from the treatment processes does not have adequate capacity to handle projected future volumes of solids generation. Potential options included: (a) construct new lagoons or solids holding cells on native area adjacent to the existing lagoons or on the plant site; (b) raise containment dikes to provide more volume; and (c) install an alum sludge drying and removal process and dewatered sludge can be disposed of in dedicated landfills or recycled via land application.
- 9.6 During the entire tenor (life) of the loan, the Borrower will prepare and submit an annual Environmental and Social Compliance Report. This report will be reviewed by the Bank to assess compliance with the environmental and social loan covenants and Project related environmental and social requirements, and including the following:
1. Certification by the Borrower that all necessary licenses, authorizations and permits for all project phases and activities have been obtained or renewed according to the regulations;
 2. Certification by the Borrower that all material design and operational regulatory requirements for all project phases and activities have been complied with according to the regulations;
 3. Any material deviation from the original planned construction or operation, including a brief technical description and major reasons for such changes, as well as any adjustment to the relevant environmental and social measures that have been taken;
 4. Description of any existing or anticipated environmental or social liability, risk or non-compliance, including corrective actions/measures; and
 5. Copies of any major environmental or social report or document prepared in order to satisfy regulatory requirements (e.g., EAAB trimestral report to CAR, etc.)
- 9.7 The Loan Agreement will also include the following obligations on the part of the Sponsors:
1. The Bank should be consulted prior to approval/implementation of any substantive changes that have significant environmental or social impacts.
 2. Written notification within 30 days of any project material non-compliance, significant accident, or significant negative environmental or social impact, actions taken to resolve problem, actions taken to prevent similar event in the future, governmental authorities contacted/notified, and estimated costs related to the event.
 3. The Project Sponsor will implement an Environmental, Health and Safety Management System.
 4. Present to the Bank, according to the project schedule agreed with EAAB, a copy of the required project specific Operation Risk Management/Contingency Plan, which will identify and assess all potential risks, their potential impacts on each component of the water treatment and pumping systems, and preventative measures and response actions in the event a risk / emergency occurs; the contingency plan must specifically include measures related to potential accidental releases of chlorine and associated effects on plant workers and the nearby school

(e.g., moving school, etc.)

APPENDIX A

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