CHAPTER 3 Development and Conservation Plan

3.1 Groundwater Development and Conservation Project in Eastern Hills of Bogotá Plain (Eastern Project)

(1) **Project Area**

Areas of this project are located in Eastern Hills that includes Soacha area, Vitelam area, San Diego area, Santa Ana & Chico area, Cerros Norte area, Yerba Buena and Suba area.

(2) **Purpose of project**

This project is public works of environmental improvement with purpose of water supply and improvement of water environment.







Figure-3.2 Well Plan for Development and Conservation of Groundwater

<Water supply for Bogotá City>

The amount of current water supply by EAAB to Bogotá City and neibouring cities is $15m^3/s$. Amount of water supply is predicted to be $23m^3/s$ in the year of 2015. The current water supply system of EAAB consists of three systems. Namely, Weisner System (Maximum purification capacity: $12m^3/s$), Tibitoc System (maximum purification capacity: $11m^3/s$), Southern System (maximum purification system: $2m^3/s$).

Total amount of purification capacity reaches to $25m^3/s$. However, it is difficult to continue water supply of $25m^3/s$ because of fluctuation of water volume at each water resource and interruption of operation for maintenance of purification plants. Especially, amount of current operation of Tibitoc purification plant is $6m^3/s$. Considering water quality improvement of Bogotá river by increase of discharge, irrigation use and hydroelectric power generation, EAAB is planning to reduce operation amount to $2m^3/s$ in the near future though it is not decided when it will be implemented. Based on such a background, development of new water resource for water supply is urgently expected.

There is another subject on water supply in case of emergency. Weisner System has vulnerability against natural disaster such as earthquake, because in this system water is conveyed from Chingasa Dam, which is located 40km from the purification plans, through water tunnel in mountain area. In 1997, water supply was stopped from this system during 9 months. Moreover, development of new water resource in case of large-scale repairing of purification plant and pipeline is also important subject.

Based on background above, groundwater of $2m^3/s$ (for usual case: all year) and $4m^3/s$ (for emergency: during 6 months, once/15 years) will be developed in proposed project.

<Improvement of water environment>

New groundwater development for water supply will decrease water-intake at Tibitoc treatment plant. This decreased water-intake means increase of net discharge of Bogotá River and will contribute to improvement of water quality of Bogotá River.

Increased discharge of Bogotá River will increase dissolved oxygen and contribute improvement of water quality in the down-stream of Tibitoc purification plan, and will contribute to increase of hydroelectric generation of power station (Current operation of $20m^3/s$ for all year) that is located at down most of Bogotá Plain.

(3) Content of Project

Production wells are designed to achieve propose of project considering groundwater potential and design water demand. Moreover, artificial recharge wells are designed for conservation of groundwater of the area. In this area, total amount of 0.5m³/s can be used for artificial recharge, which is currently taken by Vitelma purification plant in San Cristibal River and San Diego plant of San Francisco River. This water will become surplus water for artificial recharge, because both plants has been decided to be out of use. However, in case of emergency, recharge wells will be used for production wells. Specification and number of production and recharge well is shown in Table-3.1. Well arrangement in each block is as follows:

Cerros Norte area, Santana/Chico area, Suba Area, Soacha Area

New wells will be drilled next to existing tank for water supply. Pumped groundwater will be stored in existing tank for usual and emergent water supply. Facilities for purification will be constructed beside existing tank.

Vitelma Area and San Diego Area

Production wells will be newly drilled along San Cristobal and San Francisco River. Groundwater pumped up form wells will be used though newly constructed purification facilities using existing pipelines for usual and emergent water supply to Eastern Hills Area of Bogotá City and Soacha Area. Artificial recharge wells will be drilled near production wells to use surplus river water, which can be used by abolition of Vitelma and San Diego purification plants.In case of emergency, groundwater will be pumped up even from artificial recharge wells against water shortage.

<u>Yerba Buena Area</u>

Production wells will be drilled in hills of Yerba Buena Area. Groundwater from wells will be joined to existing water supply system (Tibitoc – Bogotá City) though newly constructed purification facilities.

Area	Aquifer	Well size	Well number	Maximum Capacity (m ³ /s)
Cerros Norte, Santana/Chico, Suba area. New wells will be drilled next to existing tank for water supply	Cretaceous	Well length: 300m Well diameter 10 inch Yield: 3,000m ³ /day/well Injection: 3,000m ³ /day/well	12	0.42
Soacha area. New wells will be drilled next to existing tank for water supply.			8	0.28
Vitelma and San Diego area.			Production wells: 13 Recharge wells: 13	0.45
Hills of Yerba Buena area, north of Bogotá City.			30	1.04
Total			Production wells: 63 Recharge wells: 13	<production> Usual: 2.19 Emergency: 4.00 <recharge> Usual: 0.45</recharge></production>

 Table-3.1 Well Plan of Eastern project

(4) **Beneficiaries of Project**

Population of direct beneficiaries by water supply of this project is 1.3 million. Population of beneficiaries by water supply in case of emergency is more than 7.7 million that is the same as all supplied population by EAAB.

3.2 Groundwater Conservation Plan of Area of High Groundwater Use in Bogotá Plain

(Western Project)

(1) **Project Area**

Area of this project is Subachoque River Basin, Chicu River Basin, Frio River Basin and area along middle reach to down-stream of Bogotá River, where groundwater is highly used. These areas are in western and center of Bogotá Plain, where groundwater is pumped up from Quaternary aquifer by more than 6,000 wells. In recent year, over-pumping is pointed out in these areas.

(2) **Purpose of Project**

This project is public works for environment with purpose of improvement of water quality as explained below:

<Groundwater recharge>

Purpose of this project is sustainable groundwater use without any trouble accumulation of groundwater potential for additional groundwater use in area where groundwater is highly used for irrigation and flower production.

<Lightening of burden from groundwater in water use>

In order to lighten the burden from groundwater in area where groundwater is highly used, research and development of technology should be implemented until practical level. This study should include utilization of alternative water resource for irrigation and flower production improvement of efficiency for irrigation.

(3) Content of project

In order to achieve purpose of project, two sub-projects should be implemented. Namely, groundwater recharge project and research and development of technology for groundwater use.

<Groundwater recharge project>

Artificial recharge should be implemented in up-stream of area where pumping wells distribute. Water resource for artificial recharge is river water of torrent in up-stream of Subachoque, Chicu and Frio River basins. In these areas, river water is highly used. Therefore, surplus water in flood in rainy season should be used for artificial recharge. Artificial recharge plan is shown in Table-3.2.

Area	Aquifer	Well size	Number of	Maximum
			recharge well	recharge capacity
Subachoque	Quaternary	Well length 300m	8 wells in 4 sites	0.14
Basin		Well diameter 10 inch		
Chicu Basin		Injection rate : 1,500m ³ /day/well/2	10 wells in 5 sites	0.18
Up-stream of Frio		sites	10 wells in 5 sites	0.18
Basin				
Total	-	-	28 wells in 14 sites	0.50

Table-3.2 Well Plan of Western Project

<Research and development of technology for groundwater use>

Technology for groundwater use should be researched and developed to lighten the burden of groundwater use in the project area.

- Reuse of drained water of irrigation
- Use of rainfall for irrigation
- Use of water of Bogotá River for irrigation
- Removal to new sites for flower production
- Improvement of irrigation efficiency

(4) **Beneficiaries of Project**

Population of beneficiaries of this project reaches 200 thousand that belongs to agricultural sector.