Table 4-2-1 Agency Responsibility for Sewerage and Sanitation out of Metro Manila

Sector Agencies	Sewerage			Sanitation	
	LWUA	DPWH	DOH	LWUA (Urban Area)	DOH (Rural Area)
Function					
Planning	X		C	X	X
Programming		X		X	X
Financing		X		X	X
Institution	X			X	X
Engineering	X	C		X	X
Construction		X		X	X
Operation & Maintenance	WD			WD	RWSA

X - direct responsible C - coordination WD - Water District
RWSA - Rural Waterworks and Sanitation Association

4.2.3 Relation to Similar Projects and Other Assistance Program

As stated in Section 2.2, the construction of 12 sewerage systems during 1st stage from 1988 to 1992, and 12 systems during 2nd stage from 1993 to 2000 are programmed outside of Metro Manila based on the " Water Supply, Sewerage and Sanitation Master Plan of the Philippines 1988-2000". The Philippines is administratively divided into 12 regions, and one project seem to be allocated per stage per region. Region I, in which Baguio City is located, consists of 7 provinces located in north-western part of the Luzon Island, namely, Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Abra, Mountain Province, and Benguet. Since Baguio City is considered as a city having a sewerage system, programed new sewerage systems will be constructed in other cities. Therefore, this Project is not covered under the above-mentioned master plan.

There is no assistance program to be provided by other foreign countries for the sewerage system in Baguio City except this Project.

4.2.4 Project Components

This Project consists of the rehabilitation and extension of the sewer system and the donation of equipment by the GOJ.

The rehabilitation of the sewer system which was emphasized in the BSTP Construction Project in 1984 was not fully carried out due to financial constraints. This Project will therefore continue to undertake the supposed rehabilitation including construction of supplemental facilities in areas where the sewage can not be collected by the existing sewer system, and in areas where the existing sewer is insufficient.

The equipment to be donated shall consist of the equipment necessary for the operation and maintenance of the sewerage system. The equipment donated in 1984 shall still be utilized to complement the new equipment.

4.2.5 Equipment Requested for the Project

It is requested that the GOJ donate the following equipment to the GOP for the Project:

Dump Truck,	2 ton	2 units
Cargo Truck,	1 ton	1 unit
Utility Vehicle		2 units
Transit with tape and rods		1 unit
Dissolved Oxygen Meter		1 unit
Automatic Buret 25 ml		2 units
BOD Analyzer		1 set
BOD Bottle	100 ml	200 pcs.
Flow meter		1 unit
Computer Set		3 units

Transit is an indispensable survey equipment for planning the rehabilitation/construction of sewers.

For water quality, an automatic buret and BOD bottles have been donated previously. An additional supply shall be provided to increase the items that may be analyzed and the frequency of analysis. The BSTP still lacks data on water quality determination by diurnal examination which is vital to pollution control monitoring. Daily variation patterns of load and average sewage quality are indispensable for the establishment of an operation plan and future expansion plan and can only be obtained from sewage quality and quantity analysis results. Considering the importance

of such water quality analyses, the additional request for these equipment is reiterated.

The dissolved oxygen meter is requested for in-situ analyses, which is an effective measure for observation of water pollution conditions of the Balili River. In case of bio-chemical analysis in the laboratory, water samples shall be conditioned on-site by reagent and DO analysis shall be done in the laboratory.

In the BOD analysis, DO of water samples are measured first, and then samples are stored in an incubator for five days. After five days incubation, DO of water samples are again measured. The value of BOD_5 can be obtained by subtracting the last DO from the first DO. The BOD analyzer can directly indicate the daily change of DO of samples in BOD bottles stored in an incubator. Operation of the BOD analyzer is easy and it is an effective method of obtaining the qualitative characteristics of samples. Though this method is not authorized officially in Japan and the United States of America, many analyses and research laboratories introduce this equipment. This equipment requires CO_2 absorbing reagent (KOH) as consumables. Usually, this reagent is attached to the equipment with the required amount for 100 samples, thus another amount for 2 years use (6 units/week x 52 weeks/year = 624 units say 700 units) shall be added aside from that.

4.2.6 Need for Technical Cooperation

It is recommended that a JICA expert be dispatched to Baguio to ensure the outcome of the Project due to the following:

- o It is the first sewerage management system to be established in the country having the characteristic of a quasi-public enterprise.

- o At present, inflow quantity of the BSTP is much less than its treatment capacity, therefore satisfactory treatment can still be undertaken. However, after implementation of the Project, the BSTP shall be operated at its full capacity and operation might be quite difficult. Experienced engineers on the opera-

tion of oxidation ditches shall be required for technical instructions on operation and measures against abnormal conditions including water quality.

- o This Project does not cover all of the damaged or troubled sewers. A part of them will remain as they are and they shall be repaired or rehabilitated by the BCG in the future. Technology transfer on the planning of the rehabilitation program shall have to be conducted.

4.2.7 Basic Policy in Provision of Grant-Aid Program

Baguio City is not only a center of the CAR in the aspects of politics, culture and economy but a center of politics of the Philippines as it is called "the Summer Capital". In addition, it is known as one of prominent tourist resort with its fine nature and comfortable climate. However, severe polluted conditions of rivers and creeks flowing in the City spoil the beauty of environment and cause bad odor, and furthermore it restricts the utilization of river water in downstream. This water pollution is mainly caused by leaked sewage from existing damaged sewers, and the sewage treatment plant constructed in 1987 as a grant-aid project of the Japanese Government has not been operated with its full capacity. It may safely be said that the water pollution problem will ease after the rehabilitation of the sewer network so as to convey the leaked sewage to the BSTP for treatment. Thus this Project may be considered appropriate.

The BSTP constructed in 1987 is operated and managed in good condition at present. However, due to indistinctness in organization and management system, the budget for the sewer construction and rehabilitation has been insufficient, and even though it was already previously allocated, a part of it has been applied to restoration works for disasters, etc. Thus, the separation and independence of the organization for sewage works from the existing organization, and the provision of the necessary budget and power to it for self-sustenance are strongly felt to be necessary.

The Study Team recommended an alternative plan for a new organization as to make new independent organization within the administration structure of the BCG.

The effect of the Project, practicability, capability of the Philippine government were confirmed as stated above, and the effect by the Project is proper for the grant-aid system. Consequently, the implementation of the Project through a grant-aid program is recommendable.

On the assumption that the Project is executed as a grant-aid program, the outline of the Project is examined and the Basic Design is conducted in the following sections. However, as to the content of request, it seems to be appropriate to change a part of it as stated in the previous sections.

4.3 Outline of the Project

4.3.1 Management Structure

In March 1990, the BCG and the BWD agreed on the joint management of the sewerage system including the sewage treatment plant as follows:

- The City shall remain the owner of the sewerage system including the Sewage Treatment Plant;
- The City will retain its present employees who will remain as city employees;
- The City and the BWD will jointly manage, operate and administer the Sewage Treatment Plant and Baguio Sewerage System;
- The billing and collection of sewerage fees shall be done by the BWD, except fees which accrued before the signing and effectivity of this management contract;
- a public hearing to fix the sewerage fees shall be conducted by the City in coordination with the BWD;
- All collections must be deposited in a separate fund to be jointly managed by both parties, in accordance with auditing rules and regulations;

- The salaries of employee, cost and maintenance of operation shall come from the fund and that 10% of the gross collection of sewerage and other fees related thereto shall be given to the BWD for handling fees and the rest of the income shall go to the City of Baguio; however, in the event that the no income is derived from the operation of the system, the City shall assume the payment of salaries and wages of the City employees;

- This contract supersedes and cancels the temporary agreement dated December 27, 1989, which was signed by the parties, and was approved per RES. No. 347-89.

Based on this agreement, the organization shown in Figure 4-3-1 was planned. In this organization, NEDA and LWUA shall participate in "The Planning, Evaluation and Monitoring Unit" as members of the Unit, and the present officer in charge of the sewerage system is expected to be Executive Director.

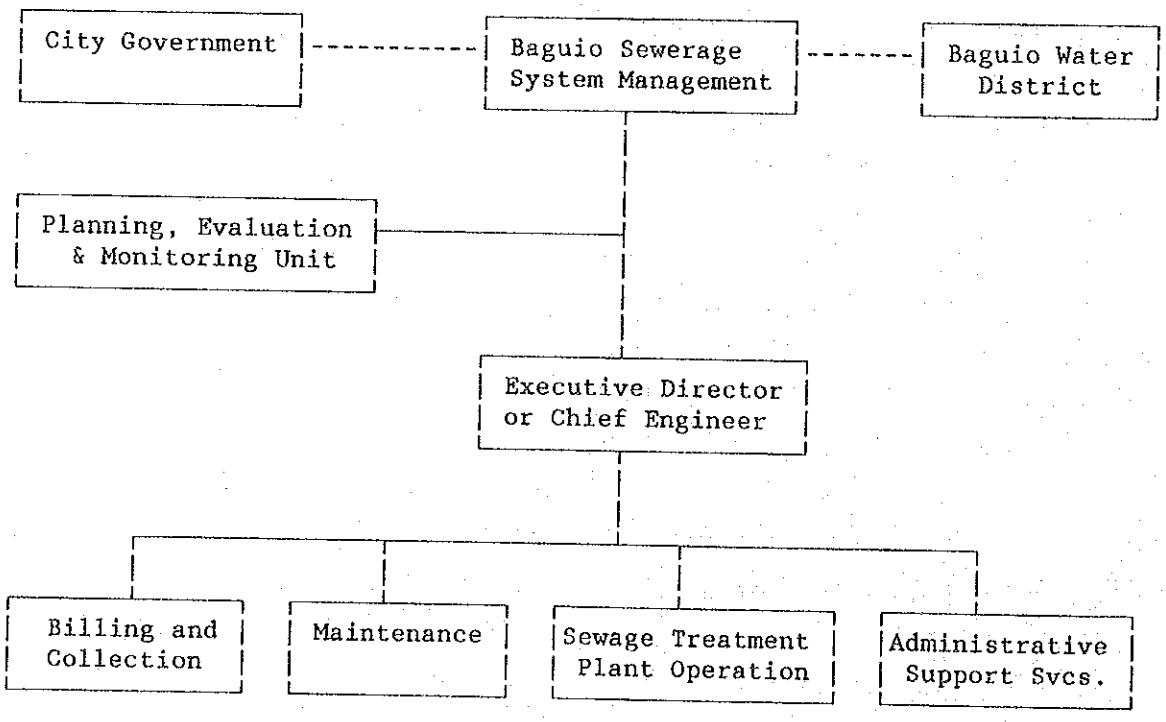


Figure 4-3-1 Planned Organization Structure for Management of Sewerage System (Joint Management)

In this plan, it is obvious that the new structure will be neither independent of the City Government nor the Water District, since the City Government will retain the owner of sewerage facilities and staff members shall participate in the joint management system while still retaining their positions at their respective offices. Although the Water District will undertake the billing and collection of sewerage fees and get the remuneration in proportion to the gross collection of sewerage fees, there is no description on how the Water District will concern the construction, operation and maintenance of the sewerage system and who will pay the remuneration for their works, furthermore who will make up the deficit in case that the cost for operation and maintenance of a sewerage system exceed the income. Since the board will be composed of both parties, consequently, responsibility for the management becomes indistinct and confusion may occur.

To make responsibility distinct, it is recommended that the sewerage department be established in the Local Government of Baguio City as mentioned below.

The Sewerage Section, which belongs to the Public Services Division which is under the Office of the City Mayor at present, shall be upgraded to a Sewerage Department, and all business related to sewage works shall be processed there (Figure 4-3-2). However, billing and collection of the sewerage fee will be entrusted to the BWD.

Accounting of the Sewerage Department shall be separated from that of the BCG, and a separate business accounting system will be done. If a deficit arises, it shall be supplied by the loan from the general account of the BCG. Profit shall be applied to the repayment of the loan at that time and the surplus will be retained as reserve. The sewerage fee shall be low at first with deficit supplied by the loan from the general account of the BCG, and then raised step by step in the future.

Functions of each section in the Sewerage Department shall be as follows:

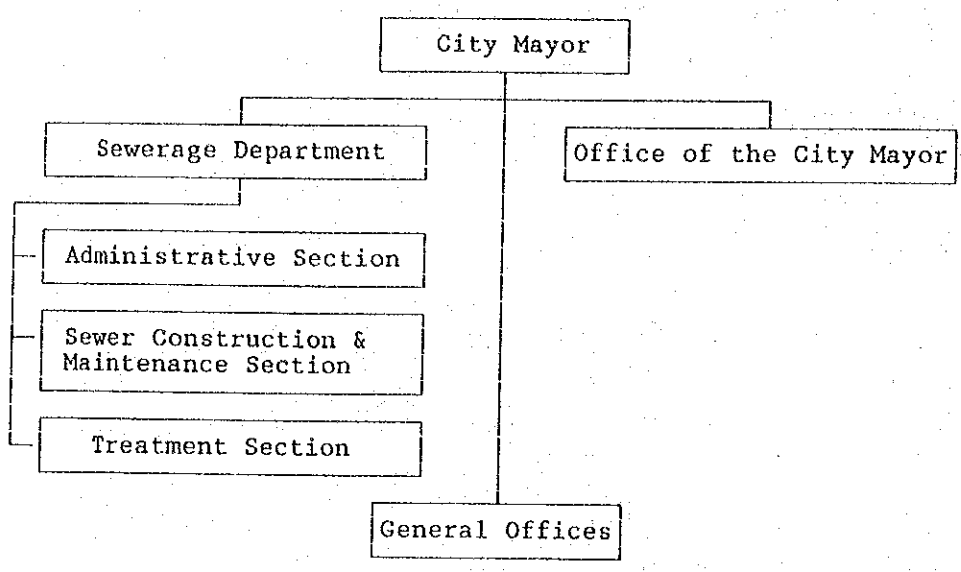


Figure 4-3-2 Planned Organization Structure for Management of Sewerage System (Baguio City Government)

o Administrative Section

- Enactment and revision of the sewerage ordinance
- Budget and settlement of account
- Public relations
- Personnel affairs, salary and etc.
- Public information
- Purchase of materials, contract of construction work
- Storage of materials
- Management of fixed assets
- Maintenance of buildings
- Arrangement with the BWD

o Sewer Construction & Maintenance Section

- Installation, direction and inspection of drainage facilities and flush toilets of houses
- Installation of house connections
- Cleaning and dredging
- Maintenance, repair and improvement
- Planning, designing and construction supervision for sewer system
- Survey on users

o Treatment Section:

- Operation of equipment in BSTP
- Maintenance, repair and improvement of equipment in BSTP
- Maintenance, repair and improvement of structure in BSTP
- Sewage treatment
- Sludge treatment and disposal
- Investigation and test on sewage treatment
- Analysis on sewage and sludge

- Water quality analysis on industrial wastewater and so on
- Installation, direction and inspection of pretreatment facilities

4.3.2 Project Plan

a) Main Sewers

As mentioned previously, the existing sewer system constructed before World War II have been broken, washed out, and heavily deteriorated. For that reason, a new main sewer will be constructed and connected to the existing sewers constructed in 1980's to form a reliable main sewer network. Consequently, this network will be operational, loads on existing sewers will be decreased and the problem of discontinuous sewer line will be solved. New house connection pipes shall be connected with the new main sewer network in the future.

When the city was not yet so developed and the houses were few, sewers were not always installed on roads. When new houses were to be constructed, the sewer lines could not be removed so the houses were constructed on top of them instead. Consequently, repair and replacement of these sewers became impossible. It is a must therefore that new main sewers be installed along roads. For sewage discharged from areas lower than roads, the main sewer will be installed along rivers/creeks. It will be difficult to connect sewer lines to the main sewer installed in river/creeks, therefore manholes shall be constructed for easy connection and repair work.

b) Lateral Sewers

There are many bulk water consumers in the Business Section, business and commercial center of the City. Most of the existing sewers in this district were installed before the War, and they are either deteriorated or insufficient for the discharged sewage. To supplement these sewers, new lateral sewers will be installed and existing sewers to be connected to them.

c) Design Sewage Volume

The design capacity of the sewerage system shall be based on the design sewage volume of the sewage discharged into the system. The treatment capacity of the BSTP was computed at 8,600 cu.m/day (daily average) for the target year of 1986 with 1983 as base year. However, four years from that target year has definitely brought substantial changes which therefore will require further study. The following points shall be considered in the review.

a. Population in 1989	152,193
b. Population within the Sewerage Service Area in 1989	72,604
c. Population in 1992	172,879
d. Population within the Sewerage Service Area in 1992	77,638
e. Water Consumption in 1989 (cu.m/day)	19,303
f. Number of Water Supply Service Connection in 1989	17,830
g. Water Consumption within the Sewerage Service Area in 1989 (cu.m/day)	11,252
h. Supplied Bulk Water Amount in 1989 (cu.m/day)	3,530 (=1,288,480 cu.m/year)
i. Number of Bulk Water Supply Service Connection in 1989	383
j. Water consumption per capita per day in 1989	106.4 lpcd (= (g-h)/b)

Amount of bulk water consumption (h) is excepted from the water consumption (g) because it originates from business activities.

k. Rate of Sewerage Service in 1989	85%
l. Rate of Collection	80%

Rate of flush toilet discharge collected by sewers.

Using the above data, the planned sewage amount on a daily average basis can be obtained from the following equation:

(77,638 persons x 0.1064 cu.m/c/day x 0.85 + 3,530 cu.m/day) x 0.80
= 8,400 cu.m/day < 8,600 cu.m/day (treatment capacity)

Above calculation was based on the assumption that the rate of water supply service within the Sewerage Service Area will be 100% in 1992 and the per capita water consumption, the bulk water consumption and the rate

of sewerage service will not change until 1992.

Detailed design computations for the sewer lines are presented in Appendix 3.

4.3.3 Proposed Project Facilities

A total length of 19,225 km of sewer lines and 638 manholes are to be constructed. Besides these, around 190 connection works between existing sewers and new sewers are expected to be done. Table 4-3-1 presents in tabulation form the facilities to be constructed for the Project and which is also shown in Figure 4-3-3. Following is the specific location and present condition at the proposed sites.

a) M. Roxas Main

M. Roxas Main which covers the eastern and northern parts of the City starts at a point near Mines View Park, runs westward along Gibraltar Rd. and Leonard Wood Rd., and then northwestward from Leonard Wood Bridge along M. Roxas St. to join the existing main on Sanitary Camp Rd. The three sewer mains of Teacher's Camp, Aurora Hill Creek and A. Rimando shall be connected to M. Roxas Main. As this line has a steep ascent at Brookside, the sewer will be partly installed along the M. Roxas Creek.

b) Teacher's Camp Main

Teacher's Camp Main starts from Hotel Hyatt Terraces Baguio and runs along South Drive Rd. eastward and Teacher's Camp Rd. northward to join M. Roxas Main.

c) Aurora Hill Creek Main

Aurora Hill Creek Main will be constructed in the Aurora Hill Creek to collect sewage from the eastern slope of Aurora Hill and shall be connected with M. Roxas Main.

Table 4-3-1 Outline of Facilities to be Constructed

Name of Line	Sewer (m)								Manhole (nos.)		
	200	250	300	375	450	525	600	Total	Type 1	Type 2	Total
Magsaysay	1,027	457	317	-	1,512	122	575	4,010	96	7	103
	-	-	-	-	-	122	229	351			
Kisad	294	-	-	-	-	-	-	294	7	-	7
	-	-	-	-	-	-	-	-			
Harrison	296	368	39	-	-	-	-	703	15	-	15
	-	-	-	-	-	-	-	-			
Diego Silang	545	-	-	-	-	-	-	545	13	-	13
	-	-	-	-	-	-	-	-			
Abanao	395	-	-	-	-	-	-	395	9	-	9
	-	-	-	-	-	-	-	-			
Kayang	444	-	-	-	-	-	-	444	11	-	11
	-	-	-	-	-	-	-	-			
Session	508	-	-	-	-	-	-	508	12	-	12
	-	-	-	-	-	-	-	-			
Hilltop	353	-	-	-	-	-	-	353	9	-	9
	-	-	-	-	-	-	-	-			
Ferguson	-	200	1,222	-	-	-	-	1,422	41	-	41
	-	-	462	-	-	-	-	462			
A. Rimando C.	-	-	2,225	-	-	-	-	2,225	141	-	141
	-	-	2,225	-	-	-	-	2,225			
Magsaysay C.	-	-	855	-	-	-	-	855	53	-	53
	-	-	855	-	-	-	-	855			
M. Roxas	935	469	-	883	-	2,734	-	5,021	121	12	133
	-	-	-	-	-	607	-	607			
Teacher's Camp	313	983	-	146	-	-	-	1,442	37	-	37
	-	-	-	-	-	-	-	-			
Aurora Hill C.	-	-	608	-	-	-	-	608	45	-	45
	-	-	608	-	-	-	-	608			
A. Rimando	400	-	-	-	-	-	-	400	9	-	9
	-	-	-	-	-	-	-	-			
Total	5,510	2,477	5,266	1,029	1,512	2,856	575	19,225	619	19	638
	-	-	4,150	-	-	729	229	5,108			

Note: Lower figures show the length of sewers in creeks and are included in the total length shown in the upper row.

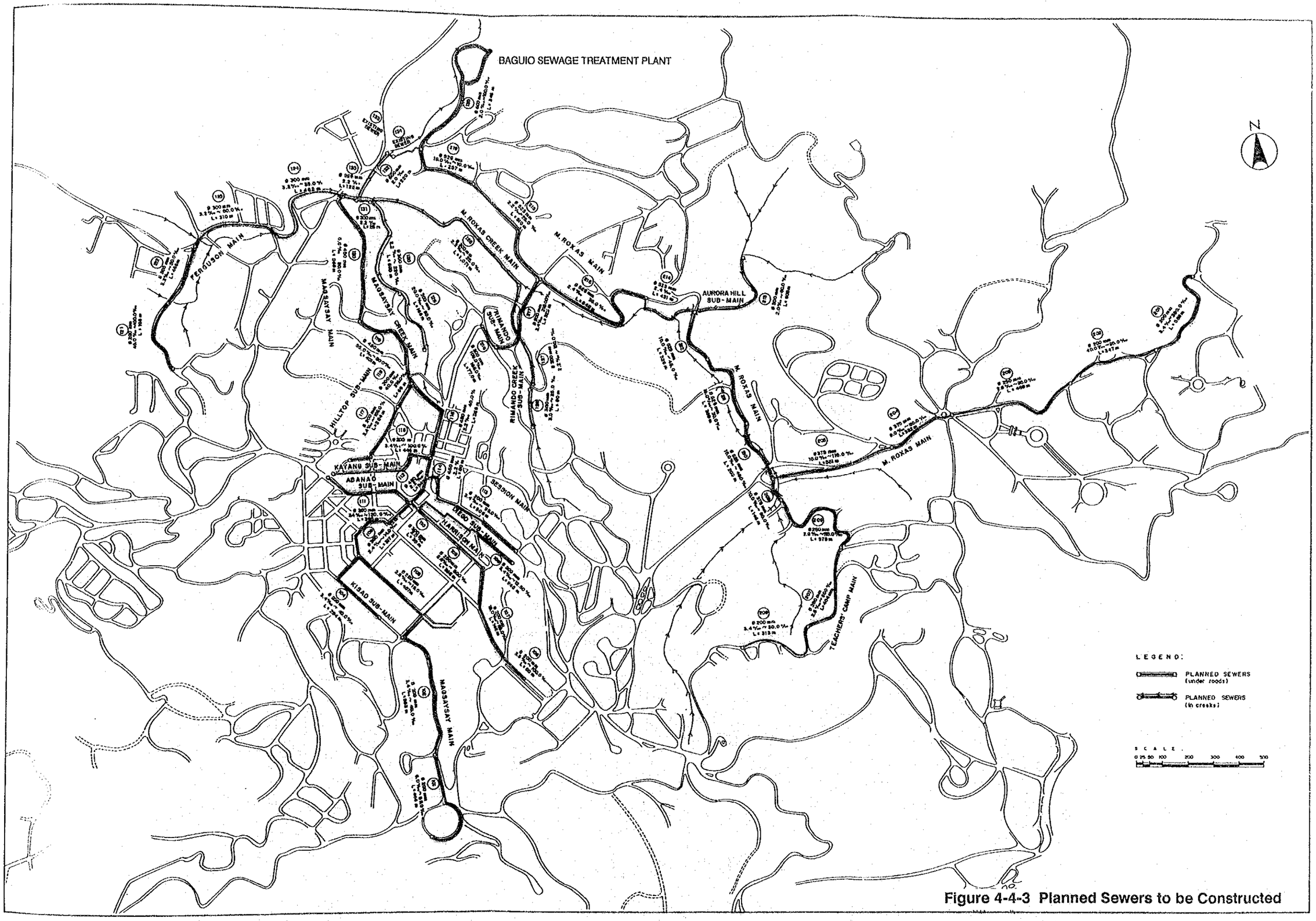


Figure 4-4-3 Planned Sewers to be Constructed

d) A. Rimando Main

A. Rimando Main will be installed along A. Rimando Rd. across the A. Rimando Creek and M. Roxas Creek starting from the rotonda near the St. Louis University and connected to M. Roxas Main.

e) Magsaysay Main

Magsaysay Main starts from the rotonda of the Baguio Central Hospital, runs northward through Kisad Rd., Lake Drive, Chanum St., and Magsaysay Ave. and joins the existing aqueduct across the Balili River. The service area of this main include the City core, the Business Section and the densely inhabited areas.

f) Kisad, Harrison, Diego Silang, Session, Abanao, Kayang and Hilltop Branches

These branches will be constructed to supplement existing sewers in the Business Section and shall be connected with Magsaysay Main.

g) Ferguson Main

Ferguson Main, the service area of which is the western part of the City passes through Ferguson Rd., Easter Rd. and the Ferguson Creek and joins Magsaysay Main.

h) A. Rimando Creek Main

This main is to be installed in the A. Rimando Creek to collect sewage in the low area between the Holy Ghost Hill and A. Bonifacio St. and shall be connected to Magsaysay Main.

i) Magsaysay Creek Main

Magsaysay Creek Main will be constructed in the Magsaysay Creek to collect sewage uncollected by Magsaysay Main, then it shall be connected to A. Rimando Main.

4.3.4 Outline of Equipment

The total length of planned sewers to be constructed is 19,225 km with 638 manholes. Besides those facilities, around 190 connection works between existing and new sewers are expected.

Names and use of equipment to be granted are as follows:

Name	Use
Topo. Survey Equipment	Topographic survey required for rehabilitation and extension of a sewer system.
DO Meter	In-situ analysis of Dissolved Oxygen (DO)
BOD Bottle	BOD analysis
Automatic Buret	Titration of reagents used in various water quality analysis

4.3.5 Operation and Maintenance

The sewerage system of the City consists of the sewer system and the sewage treatment plant. The sewer system further consist of sewers, manholes, house inlets, house connections, etc. As these facilities are closely related to daily life, appropriate operation and maintenance of the system shall be strictly enforced.

There is a need to maintain the system properly to secure sufficient flow capacity, to prevent damages caused by other works on the facilities, to prevent accidents originating from damaged facilities, and to prolong the actual life of sewers.

Maintenance work consists of the inspection, cleaning, repair and rehabilitation, protection and safeguarding, measures for and restoration work due to disasters and accidents, monitoring of pretreatment facilities and house connections, and etc.

a) Inspection

Regular inspection is conducted to check flow condition and deposits

in sewers to ensure the normal functioning of the facilities. Damages on the system and its general condition shall also be looked into to prevent accidents. These inspections shall have to be conducted regularly and findings recorded.

Items to be inspected at each facility are as follows:

Sewer

- Condition of flow and deposit
- Existence of ground subsidence
- Existence of damage
- Condition of groundwater intrusion
- Existence of harmful sewage inflow and poisonous gas

Manhole

- Condition of manhole cover
- Inside condition

Inlet and House Connection

- Condition of inlet and existence of deposit
- Existence of blockade and damage in house connection

It is recommended that inspections be conducted at least once a year. However, frequency shall be based on the condition of the area and facilities.

b) Cleaning

As sewer pipes are sometimes blocked by sedimented grit and the like, cleaning shall be conducted frequently. It is advisable to conduct cleaning based on the yearly work plan which reflects the findings in inspection. The cleaning plan including details of work and work period shall be made considering the traffic condition, and the condition of deposit. It is recommended that cleaning be conducted at least once in two years.

c) Repair and Rehabilitation

Repair and rehabilitation shall be executed immediately after finding the cause of damage to the facility or should a decline in efficiency be found at the time of inspection and cleaning. Before implementation, traffic condition, road condition, buried structures, sewage flow, sewer condition in upstream and downstream, and other conditions shall be examined, and a work plan established based on it.

d) Protection and Safeguarding

There are many cases wherein sewerage facilities are damaged by nearby excavation work, and it should not be disregarded accordingly. Precautionary measures shall have to be undertaken to prevent accidents and to safeguard the facilities.

When construction work other than sewage works is executed near the sewerage facility, maintenance work of the facility is sometimes hindered in various ways causing damage to facility with the lost of ground or construction machinery, and blocking of the sewer with the inflow of construction materials such as cement mortar due to carelessness.

Sufficient attention must therefore be given to nearby excavation work more specifically, driving of piles and sheet-piles. These can sometimes cause accidents such as a road cave-ins. It is therefore necessary that before any work of such origin is to be done, permission from the person in-charge of the system shall have to be given. Precautionary measures shall be adopted to prevent future damage.

The papers to be presented for approval shall include the project name, work period, and work location, relation to the sewerage facility (distance, depth, etc.) and any other information relevant to the request.

Some precautionary measures to be adopted include conducting a pre-meeting on safeguard work, monitoring patrol over the area, establishing disaster prevention system and confirmation of submitted documents.

e) Restoration Work Due to Disasters and Accidents

As sewer pipes do not immediately show any signs of damage, finding it is apt to be delayed. In case pinpointing is delayed, damage is neglected, or repair is poorly done, the earth and sand surrounding the sewer pipe flows into it, and may cause big accidents such as road cave-ins or damage to neighboring buried structures.

f) Monitoring of Pretreatment Facilities

The sewerage system conveys and treats not only the domestic sewage but industrial wastewater as well. However, if the amount of industrial wastewater becomes too much or its quality becomes worse, it may cause damage to the system and lessen its efficiency, lessen the treatment efficiency of the sewage treatment plant and make it difficult to maintain the quality of the treated water within the standard.

It is recommended that the sewerage system administration require those who are discharging industrial wastewater to install the necessary pretreatment facilities to maintain the quality of wastewater to be discharged to the sewerage system. The details of this facility shall be examined and a modification of the plan is to be done if necessary. To properly operate the facility, regular water quality analysis shall be required, reports prepared, site inspection conducted, investigation on discharged sewage done and operation and maintenance training undertaken.

g) House Connection

The sewerage system consists of the sewer system and the sewage treatment plant. However, the sewerage system is not completely achieved without the house connections to convey the domestic sewage into sewers without delay.

Thus, sufficient considerations on the planning, construction and maintenance of house connection (including flush toilets) shall be given same as that of the sewerage system.

4.3.6 Financial Considerations

a) Operation and Maintenance Cost

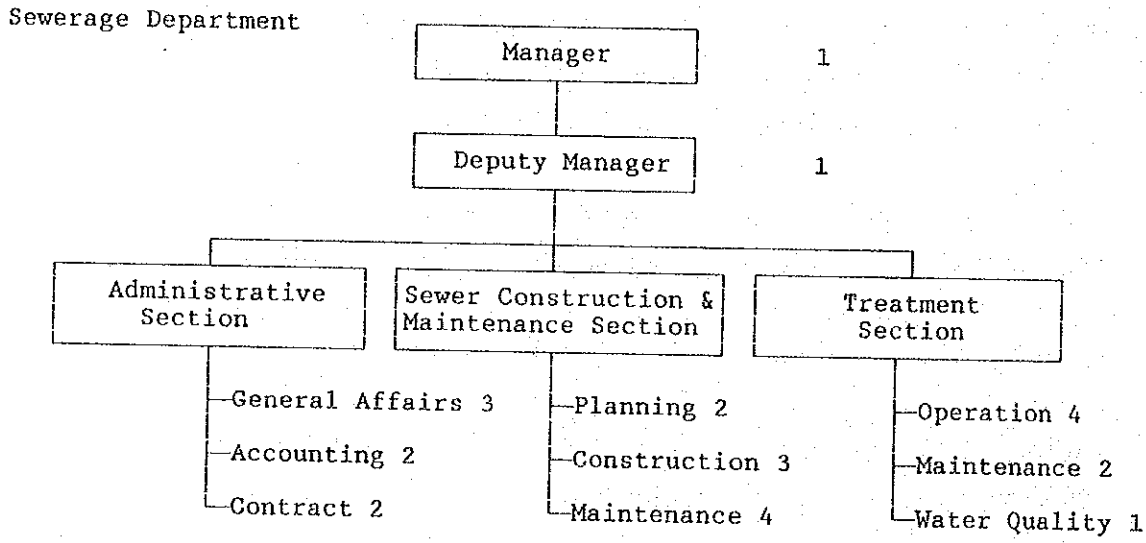
1) Personnel Expenses

For operation and maintenance, the following organization structure is assumed.

Average salary is assumed to be ₱3,000/month.

1) Personnel Expenses

= 26 x ₱3,000/month x 12 months/year = ₱936,000/year



2) Chemical Cost

Disinfectant to be used is chlorine, the amount of which is computed as follows:

Dosing rate : 3 mg/l

Cost : ₱27/kg

Chemicals Cost = 8,400 cu.m/day x 3 mg/l x ₱27/kg x 365 days

= ₱248,346/year

3) Power Cost

Power Cost is estimated at ₱1,977,897 per year based on Table 4-3-2.

Table 4-3-2 Estimation of Power Cost

Facility	Machinery	Rated	Output	No.	Actual Amount	Power
Grit Chamber	Coarse Screen	1.5	1	1.5	1.5x24x0.7	25.2
	Discharge Pump	2.2	1	2.2	2.2x24x0.3	15.8
Primary Sedimentation Tank	Sludge Collector	1.5	1	1,5	1,5x24x0.8	28.8
	Sludge Pump	4.5	2(1)	4.5	4.5x24x0.3	32.4
Oxidation Ditch	Aerator	18.5	8	148	8.5x6.5x24	1,326.0
Final Sedimentation Tank	Sludge Collector	0.75	2	1.5	1,5x24x0.8	28.8
	No.1 Sludge Return Pump	7.5	2	15	15x24x0.75	270.0
	NO.2 Sludge Return Pump	3.7	4	14.8	14.8x24x0.75	266.4
	Excess Sludge Pump	2.2	2	4.4	4.4x24x0.3	31.7
Sludge Thickener	Sludge Collector	0.7	2	1.4	1.4x24x0.3	10.1
	Drain Valve	0.2	2	0.4	0.4x24x0.3	2.9
Sludge Storage Tank	Agitator	2.2	1	2.2	2.2x24x0.8	42.2
	Drain Pump	2.2	2(1)	2.2	2.2x24x0.3	15.8
Chlorine Contact Chamber	Pump	5.5	1	5.5	5.5x24x0.3	39.6
Drainage	Pump	1.5	2(1)	1.5	1.5x24x0.3	10.8
		5.5	1(1)	5.5	5.5x24x0.3	39.6
Sub-total				212.1		2,186.1
Lighting		15.6		15.6	15.6x24x0.3	112.3
Total				227.7		2,298.4

Therefore: Demand charge = 227.7 kW x ₱25.2/kW/month x 12 months/year
= ₱68,856/year

Energy Charge = 2,298 kWh/day x ₱2.276/kWh x 365 days/year
= ₱1,909,041/year

Total = ₱1,977,897/year

4) Repair Cost

Repair cost is estimated at ₱200,000/year

5) Office Running Cost

Office running cost is estimated at ₱60,000/year

6) Commission Charge to BWD

11% of total amount of Item a) to e) is ₱376,447/year

Commission Charge is assumed to be 10% of Collected Sewerage Fee.

As a result, total operation and maintenance cost per annum will be ₱3,798,690 or ₱316,558/month.

b) Sewerage Fee Determination

Revenues of the BCG amount to 62 to 65 million pesos per annum, (Table 4-3-3) and the maintenance cost of engineering services was estimated at ₱ 800,000. Consequently, it will be difficult to maintain the sewerage system without collection of sewerage fee.

On the assumption that the number of connections is 10,000, the monthly sewerage fee per connection will be 31.6 pesos and the sewerage fee per cu.m of sewage is ₱1.24.

₱316,558/month/10,000 connections = ₱31.6/month/connection

₱3,798,690/year/(8,400 cu.m/day x 365 days) = ₱1.24/cu.m

For reference, the average monthly water charge per connection was ₱147 and water charge per cu.m of water was ₱4.67 in 1988.

₱31,092,788.57/year/(17,589 connections x 12 months/year)
= ₱147/cu.m

₱31,092,788.57/year/6,659,836 cu.m/year = ₱4.67/cu.m

Average family income of the city was ₱70,719/year or ₱5,893/month, and the ratio of the sewerage fee to household expenses will be 0.54% (refer to Table 3-1-10).

Table 4-3-3 Distribution of Revenues and Expenditures of BCG

Item	1987 Amount	1987 Percent	1988 Amount	1988 Percent
Revenue				
Tax Revenue	39,453,524.88	61.6	35,789,985.91	57.3
Operating & Miscellaneous Revenue	13,452,006.76	21.6	16,615,515.04	26.6
Capital Revenue	198,140.36	0.3	157,923.95	0.2
Grants	863,265.00	1.3	2,171,394.53	3.5
Surplus Reg.	10,131,820.08	15.8	7,772,283.35	12.4
Total	64,098,757.08	100.0	62,507,102.78	100.0
Expenditures				
General Public Services			25,203,166.14	48.7
Education, Culture and Sports			4,004,465.54	7.7
Health, Nutrition and Population Control			11,563,779.31	22.4
Economic Services			--	--
Engineering Services (General Administration)			2,021,569.80	4.2
Engineering Services (Construction)			3,356,707.50	6.5
Engineering Services (Maintenance)			810,266.48	1.6
Other Social Services			4,269,385.86	8.3
Other Purposes			300,000,00	0.6
Total			51,709,340.63	100.0

Municipal Ordinance No. 636, implemented in August 13, 1975, fixed sewerage fees by type and by scale.

For private residences and apartments:

a. Occupied by 1 or 2 families	₱2.50
b. Occupied by 3 families	₱3.75
c. Occupied by 4 families	₱5.00
d. Occupied by 5 families	₱6.25
e. Occupied by 6 families	₱7.50
f. Occupied by more than 6 families, per family in excess of 6 families	₱1.00

For hotels and condominiums:

a. With 25 rooms or less	₱20.00
b. With 26 to 50 rooms	₱25.00
c. With 51 to 75 rooms	₱30.00
d. With 76 to 100 rooms	₱40.00

Considering the above mentioned unit cost, it will be hard to maintain the sewage works in the future using the above rating system.

Therefore, it is necessary to transfer the sewerage fee rate system to a meter-rate system.

The financial internal rates of return (FIRR) are 3.07% before depreciation and 3.01% after depreciation, however sewage charges are ₱ 1.9/cu.m in the former and ₱6.4/cu.m in the latter in 2010 (See Tables 8 and 9 in Appendix 6) as shown below. The depreciation periods are set at 30 to 50 years per facility.

Case	Sewage Charge in 1993	Rate of Increase Per annum	Sewage Charge in 2010	FIRR
Before Depreciation	₱1.0/cu.m	3.0%	₱1.9/cu.m	3.07%
After Depreciation	₱4.0/cu.m	3.0%	₱6.4/cu.m	3.01%

CHAPTER 5
BASIC DESIGN

CHAPTER 5 BASIC DESIGN CONSIDERATIONS

5.1 Design Policy

a) Natural Condition

The project area has a much undulation and declined to the BSTP in general. Thus, it is possible to convey the sewage to the BSTP by gravity. However, roads does not always exist along creeks, consequently in case the sewer is installed under the road, the depth of the sewer will be deep so that the installation work become difficult. In that case, the solution of problem can be obtained by the installation of sewer in rivers/creeks. The sewage discharged from the areas located on the place lower than roads is difficult to be collected by the sewer installed under roads so that the sewer will also be installed in rivers/creeks for these areas.

b) Socio-Economic Condition

After the completion of this Project, the BSTP is expected to be operated with its full capacity, and also the cost of operation and maintenance will be expensive accordingly. Thus, the sewer system is planned to be only in gravity flow as stated above, and no pumping facility will be installed. If a pumping station is constructed, various works become necessary such as removal of screenings, inspection on mechanical and electrical equipment, measures against power cut and so on.

c) Local Construction Condition

The most important construction material in the Project is sewer pipes. In the existing sewer system, the reinforced concrete pipes are used for underground sections, and the cast iron pipes and steel pipes are used for exposed or bridged sections. At the time of the selection of pipe materials, use of local made products will be considered with high priority.

However if its quality is poor, use of the pipe materials of good durability will be considered instead. The special equipment and con-

struction materials that is not available in the Philippines are considered to be imported from Japan.

d) Construction Method and Period

Ordinary method in the Philippines is applied to the construction of work of the facility.

Consultation with the administration of rivers will be taken for the installation of structures in rivers/creeks to lessen the influence to rivers to a minimum. Sufficient safety measures against flooding will be also taken.

As to construction period, 2-phased construction is expected to be implemented because of slow work progress during rainy season due to the world famous heavy rain in Baguio and traffic congestion caused by the construction work.

5.2 Design Fundamentals

a) Design Sewage Flow

Design sewage flow adopted shall be the maximum hourly sewage flow and sewer pipe diameters shall have a 100% additional capacity as calculated for the system.

b) Sewage Flow Calculation

As shown below, the flowing capacity of each sewer to receive the design sewage flow is calculated by multiplying the sewer's sectional area by average velocity in a sewer which is given by Manning formula. In case of a circular pipe, the flowing capacity is decided by the sewer size and slope. Velocity and slope of a sewer shall follow the rule as stated in c). The results of calculation is shown in Appendix 5.

$$Q = A \times V$$

$$V = (1/n) \times R^{2/3} \times I^{1/2}$$

Where:

			Circular Pipe
Q	=	flow quantity (cu.m/sec)	
A	=	flow area (sq.m)	$= \pi D^2/4$
V	=	flow velocity (m/sec)	
n	=	coefficient of roughness	= 0.013
R	=	hydraulic radius (m)	= D/4
I	=	inclination of energy grade line	
D	=	diameter (m)	

c) Sewage Flow Velocity

As a general rule, velocity of sewage flow shall be 0.6 m/sec minimum to 3.0 m/sec maximum. However, some cases may require a deviation from this rule such as for steep slope sections to avoid an increase in construction cost as a result of an equal increase in the number of manholes to be constructed.

d) Pipe Materials

Reinforced concrete pipes with socket joints shall be used for buried sections and fiber reinforced plastic mortar pipe for exposed sections.

e) Pipe Installation

A minimum earth cover of 1.2 m depth shall be adopted and earth pressure and loads should exceed the maximum bearing capacity of the sewer pipe, concrete or reinforced concrete encasement will be provided to protect the pipe from external pressure. Pipes shall have sandbedding in principle. Pipe connections shall be as follows:

- Water surface connection or pipe top connection shall be adopted for changes in pipe diameter at junctions of two pipes.

- In cases of steep slopes, sewer pipes shall be installed parallel to the ground slope regardless of changes in pipe diameter.

- The angle between centers of two pipes at a junction shall not exceed 60^o, and the radius of the curved sewer junction shall

be more than 5 times its inner diameter.

f) Manholes

Manholes shall be installed at the upper ends, at changes in alignment, grade, diameter or invert level, at the junctions of sewers and at places necessary for maintenance. Manholes may be installed even on straight sections at maximum intervals of 50 m for 300 mm diameters or less and at 75 m intervals for 600 mm diameters or less.

Manhole covers shall be of cast iron. The manhole riser and manhole cone (manhole wall) shall be made of pre-cast concrete sections and the manhole base of cast-in-place concrete, with invert provided for a smooth connection of pipes. Table 5-2-1 lists the types of manhole to be used in the Project.

Table 5-2-1 Type of Manhole

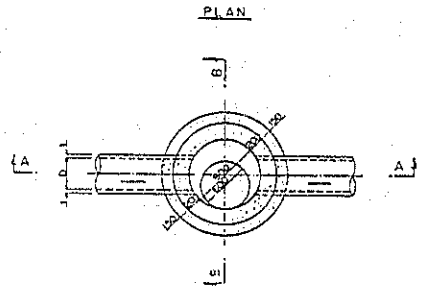
Type	Structure	Use
No. 1	Circular, Inner dia. 90cm	Upper end, Middle point of sewers less than 600 mm, Junction point of sewers less than 450 mm
No. 2	Circular, Inner dia. 120cm	Middle point of sewers less than 900 mm, Junction point of sewers less than 600 mm

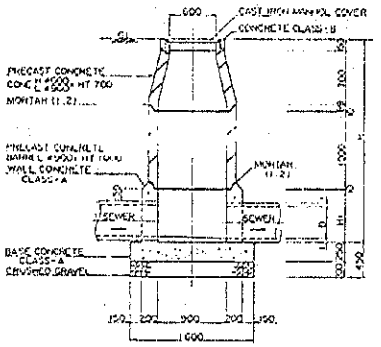
5.3 Basic Design

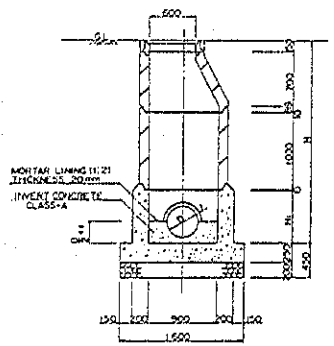
Based on the above design fundamentals, the planned sewers to be constructed, standard manhole and sewer installation plan in creeks are shown in Figures 4-3-3, 5-3-1 and 5-3-2, respectively.

TYPE-1 MANHOLE

SCALE 1:30

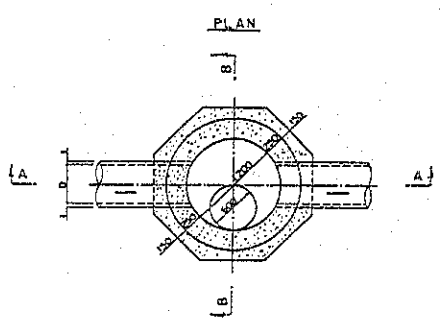


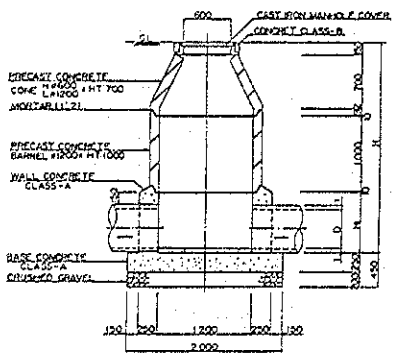




TYPE-2 MANHOLE

SCALE 1:30





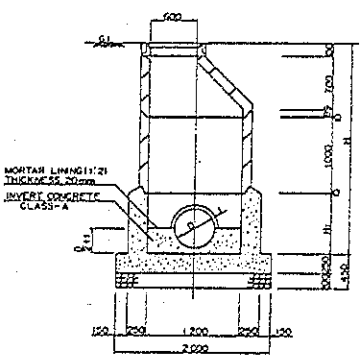
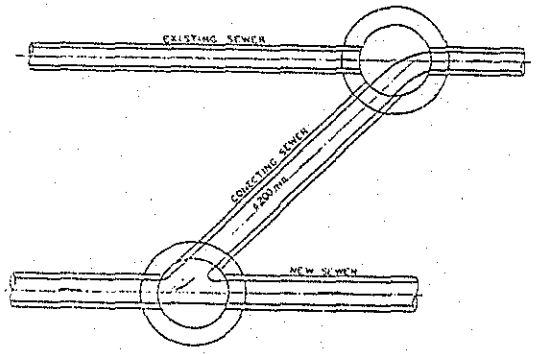


Figure 5-2-1 Plan of Manholes

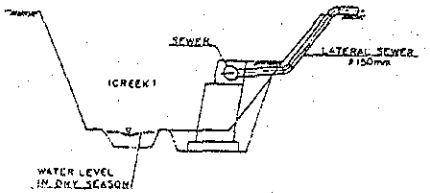
TYPICAL METHOD OF CONECTION
BETWEEN EXISTING SEWER AND NEW SEWER

SCALE 1:20



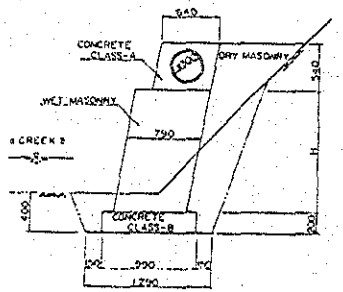
TYPICAL METHOD OF LATERAL SEWER
CONECTION IN CREEK

SCALE 1:N



SEWER LAYING IN CREEK

SCALE 1:25



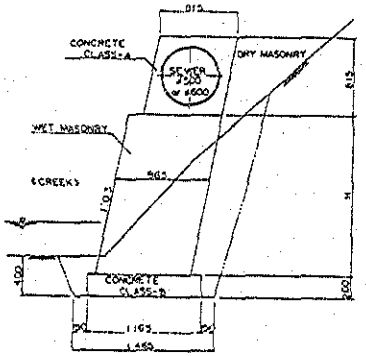


Figure 5-2-2 Sewer Installation Plan in Creeks

5.4 Project Implementation Plan

5.4.1 Construction Considerations

Construction work for drainage pipes have been done in the Philippines for years. The work itself is the same for sewerage as that for drainage except that the former shall carry sewage and the latter, storm-water. For the Project, most of the sewers are to be installed under roads and the rest on creeks.

a) Road Portion

- Construction work on the roads are apt to lead to traffic congestion due to the narrow widths of the roads. The contractor must discuss the construction period and method with the agencies concerned, decide whether traffic will be stopped half or fully, and detours done, and place sign boards at entrances to the particular road for the convenience of drivers and pedestrians.

- April and December being the peak season of tourists, construction works must not be undertaken in the Business Section and Burnham Park during those months.

- Since M. Roxas Road makes a steep ascent (approximately 18m) to Aurora Hill near Brookside, M. Roxas Main escapes into Pacdal Creek and M. Roxas Creek and then returns to M. Roxas Road at the place where elevation has gone down. In this section where M. Roxas Main returns to M. Roxas Road, the sewer will run at 10.3 m up from the riverbed, since the elevations of creek have also gone down.

- The roads run northwards in the City to join La Trinidad Road opposite the sewage treatment plant. Since new sewers shall run on these road, it is recommended not to construct M. Roxas Main, Magsaysay Main and Ferguson Main at the same time.

- To maintain the detour, construction work must not be done on parallel roads, for example, Harrison Road and Session Road, or Abanao and Kayan at the same time and Kayan Road specifically must be done nighttime.

- Since construction works will bring about much inconvenience to residents along the roads, the understanding and cooperation of residents must be obtained through the City Mayor and Barangay Captains.

b) Creek Portion

- Baguio City is famous for heavy rains and the river immediately rises during these times. Therefore, it is recommended that sewers in the creeks be constructed in the dry season. Beforehand, the contractor must collect information on the river condition during past heavy rains and take precautionary measures.

- As the creeks are mostly natural formations, explosion work might have to be resorted to remove the big boulders and to excavate the area. Care should be taken to ensure that no harm will come to the nearby residents and workers.

- Houses are located on both sides of the creeks. There is a need to construct temporary roads for transporting materials and equipment. In view thereof the approval and coordination of the residents must be acquired.

5.4.2 Construction Method and Period

The construction of the sewers will be by the open-cut method, a special method to be introduced locally. The works shall be undertaken separately for road and creek portions. The river portion shall be constructed in the dry season, while the road portion may be done in the wet season considering climatological conditions in the area. However, work with deep excavation will also be done in the dry season on the road.

The Construction work shall be divided into two stages as it is expected that work progress will be delayed by heavy rains and traffic congestion. The first stage will be contracted by the end of March 1991 and the whole work will be completed by the end of February 1993 with all construction works undertaken by a Japanese contractor.

5.4.3 Construction Supervision

Taking into account the nature of works, one Japanese civil engineer will be assigned at the site to supervise construction to be assisted by two local civil engineers employed in the Philippines.

Consultations with government officials shall be observed to eliminate any possible conflicts that may arise upon the construction of works.

The supervisory engineer shall issue construction orders and adopt measures necessary to avoid traffic congestion and to provide safety at the construction site.

The new sewers will run parallel to existing sewers which may have house connections on one or both sides. In such cases, the supervisory engineer will decide whether such house connections shall be reconnected to new sewers or the profile of new sewers shall be changed.

Since Baguio is most frequently visited by typhoons, the engineer shall determine beforehand safety measures to be undertaken should such case happen.

5.4.4 Procurement Plan

The materials and equipment to be utilized for the Project will be procured in the Philippines as much as possible. However, should problems arise in availability, quality, quantity and delivery time of materials, such may be imported from Japan. The materials and equipment to be imported from Japan shall be shipped from Yokohama to Manila and then transported to Baguio by trucks.

Local materials to be used include sand, gravel, crusher run, cement, steel bars, structural steel, concrete pipes, reinforced concrete pipes, lumber, plywood, concrete block, dynamite, manhole cone block, manhole rising block, gasoline, diesel oil, fuel, etc. Foreign materials include fiber reinforced plastic mortar pipes and fiber reinforced plastic manholes.

Major construction equipment do not pose any problem as they are readily available by lease in the Philippines.

5.4.5 Implementation Schedule

The Project shall include the preparation of the detailed design, prequalification of bidders, bidding for the construction works, procurement of materials and equipment and finally, construction.

Japanese Consultants shall sign a contract for detailed design and construction supervision with the Philippine Government and, after approval of the contract by the Japanese Government, will start the detailed design and preparation of drawings, specifications and tender documents.

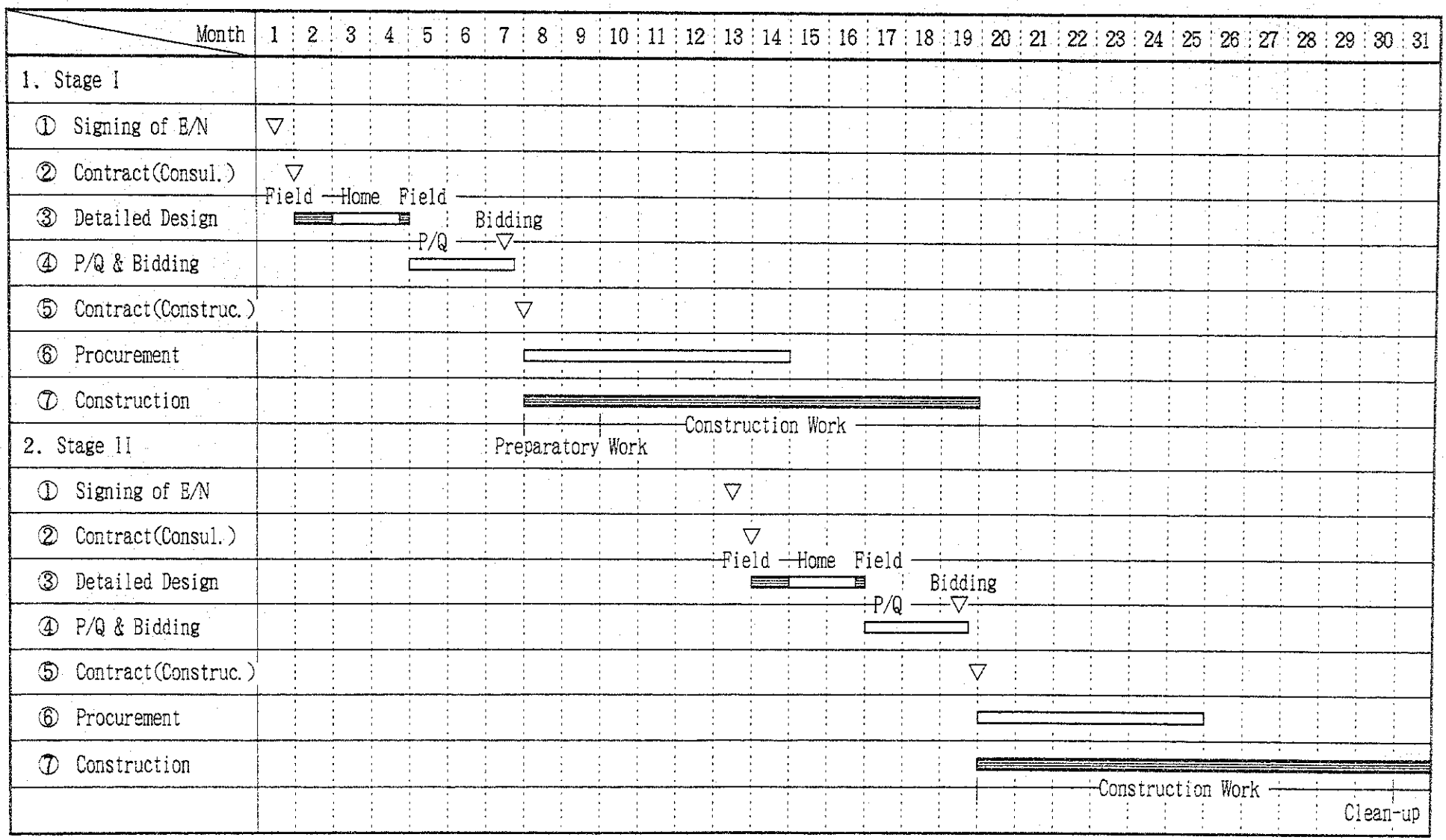
Bidders shall be prequalified and then invited to bid on the Project. The successful bidder after evaluation of bids has been done will make a contract with the Philippine Government for construction and thereafter commence work after approval of the contract by the Japanese Government.

Detailed design period is three months and construction is twelve months in each stage. The construction period includes that for manufacturing and transportation of materials and equipment. The whole implementation schedule is shown in Figure 5-4-1.

5.4.6 Share of Cost

The total project cost comprise of the consulting fees for detailed design and construction supervision, direct and indirect cost for con-

Figure 5-4-1 Implementation Plan



struction and equipment procurement cost. The cost necessary for the construction of sewers as previously mentioned shall be borne by the Japanese government to include consulting fees and equipment procurement cost. All else shall be borne by the Philippine government including services of local counterparts, land expropriation, etc.

CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

CHAPTER 6 CONCLUSION AND RECOMMENDATION

The objective of this study is to clarify and confirm the background and scope of works of the proposed Project and to determine its appropriateness for implementation through the Grant-Aid Program.

After a detailed evaluation of the existing sewerage system of Baguio City, the Study Team hereby recommends the implementation of the Project in view of the following:

- Operation of the Baguio Sewage Treatment Plant shall be maximized making full use of its original designed capacity.

- Water pollution of the Balili River will be greatly alleviated since 80% of the 10,500 cu.m/day sewage generated and discharged to the Balili River will first be collected by the rehabilitated sewer system and subject such to treatment before final disposal.

- La Trinidad Area downstream of Baguio City can again utilize the Balili River for irrigation after water quality has been greatly improved.

- Offensive odor and appearance of the river environment caused by sewage leaking from existing sewers shall be eliminated.

- Standard of living of the residents particularly those living near broken sewers shall be greatly improved.

- Baguio City shall become the first urban center with a complete municipal sewerage system which other future system could be patterned after.

- Knowledge of the proper operation and maintenance of sewerage systems could be derived from training to be provided for by the Project.

To maximize the benefits of the Project, the Study Team further recommends that the following be undertaken:

- LWUA shall request JICA to dispatch a long-term expert to train the proposed staff on the establishment of a new management system, operation and maintenance of sewage treatment plant and rehabilitation of existing sewer not included in the Project.

- The BCG shall establish a complete garbage collection system as early as possible since garbage dumping is a main source of river pollution which reduces the benefits to be derived from the Project.

APPENDICES

APPENDIX 1 MEMBER OF STUDY TEAM

1. Basic Design

Name	Assignment	Position
Mr. Michio Kanda	Team Leader	Senior Assistant for Grant Aid, Grant Aid Division, Department of Economic Cooperation, Ministry of Foreign Affairs
Mr. Kenichi Osako	Advisor	Manager, Design Section, Planning Division, Japan Sewage Works Agency
Ms. Naoko Mizobe	Coordinator	First Basic Design Study Division, Gland Aid Planning & Survey Department, Japan International Cooperation Agency (JICA)
Mr. Ikuo Miwa	Planning of Sewer System	Nippon Jogesuido Sekkei Co., Ltd. (NJS Consultants)
Mr. Tetsuo Yanagida	Design of Sewer System 1	-ditto-
Mr. Tatsuyuki Kikuta	Design of Sewer System 2	-ditto-

2. Discussion on Draft Final Report

Name	Assignment	Position
Mr. Kenichi Osako	Team Leader	-mentioned above-
Mr. Masashi Furuya	Coordinator	Grant Aid division, Bureau of Economic Cooperation, Ministry of Foreign Affairs
Mr. Ikuo Miwa	Planning of Sewer System	-mentioned above-
Mr. Tetsuo Yanagida	Design of Sewer System 1	-mentioned above-

APPENDIX 2 SCHEDULE OF STUDY TEAM

1. Field Survey (March 29 to April 27, 1990)

Date	Group A (Kanda, Osako & Mizobe)	Group B (Miwa, Yanagida & Kikuta)
March 29 Thu.		Arrival in Manila
		Courtesy call to JICA
30 Fri.		Courtesy call to LWUA & EOJ
31 Sat.		Move to Baguio
April 1 Sun.		Field survey
2 Mon.		-ditto-
3 Tue.	Arrival in Manila	-ditto-
	Courtesy call to JICA & EOJ	
4 Wed.	Courtesy call to NEDA & LWUA	-ditto-
	Move to Baguio	
5 Thu.	Courtesy call to City Hall	
	Explanation of Inception Report	
6 Fri.	Signing of Mimutes	
	(Team, BCG & BWD)	
7 Sat.	Inspection of BSTP and sites	
8 Sun.	Move to Manila	
9 Mon.		Field survey
10 Tue.	Signing of Minutes (LWUA)	-ditto-
11 Wed.	Leave for Tokyo	-ditto-
12 Thu.		-ditto-
13 Fri.		-ditto-
14 Sat.		-ditto-
15 Sun.		
16 Mon.		Field survey
17 Tue.		-ditto-
18 Wed.		-ditto-
19 Thu.		-ditto-
20 Fri.		-ditto-
21 Sat.		-ditto-
22 Sun.		

Date	Group A (Kanda, Osako & Mizobe)	Group B (Miwa, Yanagida & Kikuta)
April 23 Mon.		Field survey
24 Tue.		Discussion with City offials
25 Wed.		Move to Manila
		Courtesy call to JICA, EOJ & LWUA
26 Thu.		Data Arrangement
27 Fri.		Leave for Tokyo

2. Discussion of Draft Final Report (July 9 to 15, 1990)

July	9 Mon.	Arrival in Manila
		Courtesy call to JICA & EOJ
	10 Tue.	Courtesy call to LWUA
		Move to Baguio
		Courtesy call to City Hall
	11 Wed.	Explanation of Draft Final Report to City Officials
	12 Thu.	Explanation of Draft Final Report to City Councilars
		Signing of Minutes (Team & BCG)
	13 Fri.	Signing of Minutes (BWD)
		Move to Manila
		Signing of Minutes (LWUA)
		Courtesy call to JICA & EOJ
	14 Sat.	Data arrangement
	15 Sun.	Leave for Tokyo

APPENDIX 3 LOCAL AGENCIES AND OFFICIALS MET WITH

Local Water Utilities Administration (LWUA)

Mr. Ricardo T. Quebral	Administrator
Mr. Alfredo B. Espino	Project Manager

Baguio City Government (BCG)

Mr. Jaime R. Bugnosen	City Mayor
Mr. Antonio Tabora	Vice City Mayor
Mr. Leonides C. Bautista	Councilar
Mr. Antonio S. Monalo	Councilar
Mr. Lito M. Pagnilinan	Councilar
Mr. Parina	Councilar
Mr. Quitania	Councilar
Mr. Leonardo T. dela Cruz	City Administrator
Mr. Mac. Flores, Jr.	Coordinator, Office of the City Planning & Development
Mr. Valentino Julian	City Engineer
Ms. Catherine A. Buccat	Senior Safety Engineer
Mr. Osward Alvaro	Secretary to the Mayor

Baguio Water District (BWD)

Atty. Moises P. Cating	Chairman, Board of Directors
Mr. Juan R. Zarate, Jr.	Director
Ms. Teresita P. De Guzman	General Manager
Ms. Godiula Guinto	Officer-in-charge
Mr. Isidro R. Buen, Jr.	Assistant General Manager
Mr. Albert Buen P. Arenas	Manager, Engineering Division

National Economic and Development Authority (NEDA)

Ms. Teresita C. Madamba	Senior Development Specialist

Embassy of Japan (EOJ)

Mr. Takuya Ikeda	Second Secretary

Japan International Cooperation Agency, Philippine Office (JICA)

Mr. Moriya Miyamoto	Resident Representative
Mr. Katsuhiko Ozawa	Asst. Resident Representative

APPENDIX 4 MINUTES OF DISCUSSIONS

1. Field Survey (April 10, 1990)

2. Discussion on Draft Final Report (July 13,1990)

M I N U T E S O F D I S C U S S I O N

BASIC DESIGN STUDY
ON
THE BAGUIO SEWER SYSTEM REHABILITATION PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES

In response to the request made by the Government of the Republic of the Philippines for the Baguio Sewer System Rehabilitation Project (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), a team headed by Mr. Michio Kanda, Senior Assistant for Grant Aid, Grant Aid Division, Ministry of Foreign Affairs, to conduct a basic design study from March 29 to April 27, 1990. The team has carried out a field survey, held a series of discussions and exchanged views with the authorities concerned from the Government of the Republic of the Philippines.

As a result of the study and discussions, both parties have agreed to recommend to their respective Governments that the major points of understanding reached between them as indicated in the Attachment, should be examined towards the realization of the Project.

Manila, Philippines, April 10, 1990

For JICA

MICHIO KANDA
Team Leader
Basic Design Study Team

For the Government of the Philippines

RICARDO T. QUEBRAL
Administrator
LWUA

Signed in the presence of:

JAIME R. BUGNOSEN
Mayor
Baguio City

TERESITA DE GUZMAN
General Manager
BWD

ATTACHMENT

1. This Project was conceived in line with one of the development thrusts of the Government of the Philippines, which is the alleviation of water pollution in public water bodies for natural environmental protection and improvement of sanitation condition.

2. The proposed sites of the Project are located in the City of Baguio (hereinafter referred to as "the Project Site").

3. Items requested by the Government of the Philippines for the Project are listed hereunder. The Japanese Study Team will prepare a Draft Final Report through the Technical Study in Japan based on the findings and discussions with people concerned stemming from the field work in the Philippines.

   a. Facilities

   (1) Rehabilitation of main and sub-main sewers.
   (2) Rehabilitation and expansion of lateral sewers in the highly populated sub-service area.
   (3) Rehabilitation of lateral sewers which are discharging raw sewage directly into the Balili River and not included in Item (2).

   Location of the line covered by Item (1) and the area covered by Item (2) are shown in Figure attached hereto.

   b. Equipment and Service Vehicles

   The Draft Final Report within the scope of Japanese economic cooperation program in grant form will be presented to the Government of the Philippines.

4. The Government of the Philippines has understood Japan's Grant-Aid system as explained by the Team which includes a principle on the use of a Japanese Consultancy Firm and a Japanese General Contractor for the implementation of the Project.

5. The Government of the Philippines will take the following necessary measures on condition that the grant assistance by the Government of Japan is extended to the Project:

   a. To secure the right-of-way or expropriation of the land area for construction/installation of the pipeline and sewerage facilities, the required permit and fees for excavation and other civil works shall be on the account of City of Baguio.

   b. To provide necessary data and information for basic design study.

c. To ensure prompt unloading, tax exemption, customs clearance at ports of disembarkation in the Philippines, and prompt internal transportation therein of the products purchased under the grant.

d. To utilize properly and effectively as well as maintain the facilities constructed and equipment purchased under the grant.

e. To undertake incidental civil works including electric supply facilities, if needed.

f. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Philippines with respect to the supply of the products and services under the verified contracts.

g. To accord any Japanese national whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the Philippines and stay therein for the performance of their work.

6. The Project will be implemented under the administration of Local Water Utilities Administration until completion of its construction work. The Government of the Philippines through LWUA will take necessary measures for proper monitoring and operation and maintenance of sewerage facilities.

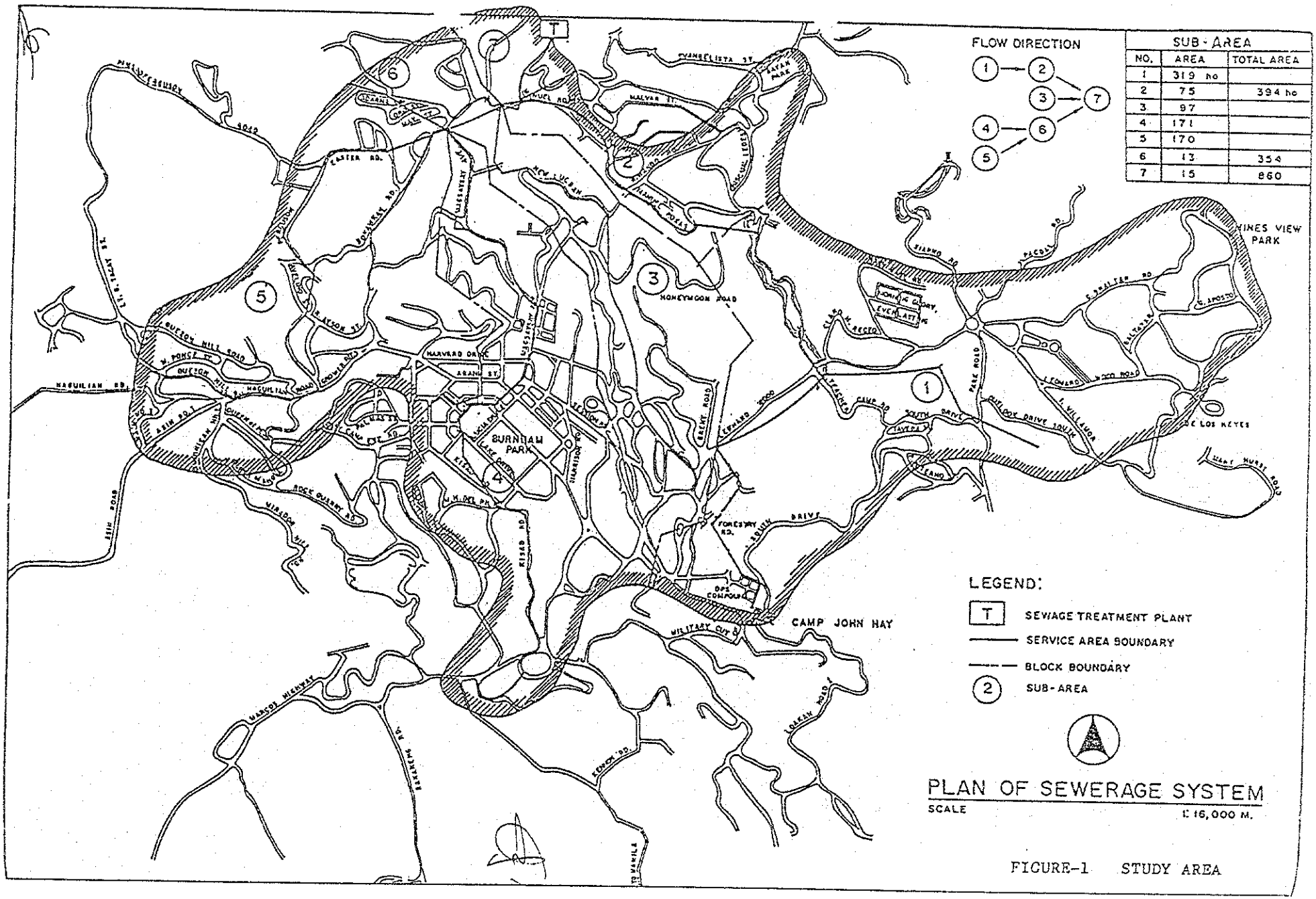


FIGURE-1 STUDY AREA

MINUTES OF DISCUSSION

BASIC DESIGN STUDY

ON

THE BAGUIO SEWER SYSTEM REHABILITATION PROJECT

IN

THE REPUBLIC OF THE PHILIPPINES

In response to the request made by the Government of the Philippines for the Baguio Sewer System Rehabilitation Project (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Cooperation Agency(hereinafter referred to as "JICA"), a team to carry out the Basic Design Study for 30 days from March 29 to April 27, 1990.

As a result of the study, JICA has referred the Draft Final Report of the Basic Design Study and has sent a team headed by Mr. Kenichi Osako, Manager, Design Division, Planning Department, Japan Sewage Works Agency, to submit and explain the report from July 9 to 15, 1990.

Both parties have had a series of discussions on the Report. Major points of understanding are summarized in the attachment.

Manila, Philippines, July 13, 1990

For JICA

KENICHI OSAKA
Team Leader
Japanese Study Team

For the Government of the Philippines

RICARDO T. QUEBRAL
Administrator
Local Water Utilities Administration

Signed in the presence of:

JAIME R. BUGNOSEN
Mayor
Baguio City

MOISES P. CATING
Chairman
Baguio Water District

ATTACHMENT

1. The Philippine side has principally agreed to the proposed project as contained in the Draft Final Report.

2. The Philippine side requested that the rehabilitation works in the existing sewer near the slaughterhouse in the early stage of the construction to alleviate the unsanitary condition in the area.

3. The Government of Baguio City (hereinafter referred to as "the City Government") will bear the cost of local counterparts, land expropriation, banking charges and other incidental expenses during the project implementation.

4. The City Government will bear the cost of preparatory works such as garbage clean-up in the creeks and so on which is not included in the undertakings of the Japanese side.

5. The City Government will provide all the necessary construction permits at no cost to the project.

6. During the construction stage, the City Government will take necessary steps in re-routing traffic in the affected areas of the city.

7. The City Government will analyze water quality at at least five points of the Balili River and its tributaries every two months in dry season for one year before and two years after completion of the Project to follow up the effect of the Project and report the result to JICA Manila Office.

8. LWUA will provide counterpart personnel in the project implementation.

9. Regarding the management system of the sewage works, both parties have agreed that:

   (1) The City Government would manage sewage works and establish a new structure which will have an independent business accounting system from the City organization.

   (2) The Baguio Water District would undertake the billing and collection of sewage fees with remuneration, and

   (3) The City Government would subsidize the new structure in case of deficient revenue.

APPENDIX 5 CONDITIONS FOR CALCULATIONS

1. Design Flow

- Capacity of each sewer is decided based on the maximum hourly sanitary sewage flow.
  (Total: 16,800 cu.m/day)

- Sanitary sewage flow is divided into two categories based n the sewage volume.

- Sanitary sewage flow derived from each big discharge is allotted to the particular sewer based on his location and sewage volume.
  (Total: 5,415 cu.m/day)

- Sanitary sewage flow derived from small dischargers is allotted to each sewers in proportion to its tributary area
  (Total: 16,800 - 5,415 = 11,385 cu.m/day)

2. Sewer

- The minimum size of sewers is 200 mm in diameter for the road portion but 300 mm for the creek portion to facilitate the connection work from factories, offices and houses.

- The pipe materials are concrete or reinforced concrete pipes for the road portion and fibor-reinforced plastic mortar pipes for the creek portion.

- The coefficient of roughness is 0.013 for Manning's Formula.

- Each pipe has 100% allowance to the design sanitary sewage flow.

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small		①	Big	②	Maximum Volume of Sewage ③=①+②		Design Profile					Remarks
		Tributary Area		Volume of Sewage	Each	Cumulative			Size	Slopes	Length	Velocity	Capacity	
		Each	Cumulative											
		ha	ha	m³/day	m³/day	m³/day	m³/day	m³/sec	mm	‰	m	m/sec	m³/sec	
101		10 : 1	10 : 1	147	336	336	483	0.006	⊙200	(3.4) 6.0~65	444	(0.609)	(0.019)	
102		7 : 4	17 : 5	254	—	336	590	0.007	⊙200	3.4~45	583	0.609	0.019	
103		14 : 8	32 : 3	469	—	336	805	0.009	⊙250	2.6~15	457	0.618	0.030	
	105													
104		8 : 7	8 : 7	126	138	138	264	0.003	⊙200	3.4~40	294	0.609	0.019	
105		15 : 6	56 : 6	822	199	673	1.495	0.017	⊙300	2.4~14	317	0.670	0.047	
	112													
106		6 : 6	6 : 6	96	—	—	96	0.001	⊙200	(3.4) 35~100	150	(0.609)	(0.019)	
107		14 : 8	21 : 4	311	303	303	614	0.007	⊙200	(3.4) 15~85	146	(0.609)	(0.019)	
108		14 : 3	35 : 7	519	193	496	1.015	0.012	⊙250	2.6~50	368	0.618	0.030	
	110													
109		3 : 1	3 : 1	45	274	274	319	0.004	⊙200	3.4~125	545	0.609	0.019	
110		0 : 1	38 : 9	565	—	771	1.336	0.015	⊙300	2.0	39	0.612	0.043	
	112													
111		5 : 6	5 : 6	81	207	207	288	0.003	⊙200	3.4~120	395	0.609	0.019	
112		0 : 6	101 : 7	1.477	6	1.656	3.133	0.036	⊙450	2.2	94	0.841	0.134	
	114													
113		6 : 7	6 : 7	97	237	237	334	0.004	⊙200	3.4~95	508	0.609	0.019	
114		0 : 4	108 : 8	1.580	26	1.920	3.500	0.041	⊙450	2.2	80	0.841	0.134	
	116													
		108 : 8												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small			Big		Maximum Volume of Sewage ③=①+②		Design Profile					Remarks
		Tributary Area		① Volume of Sewage	Each	② Cumulative			Size	Slopes	Length	Velocity	Capacity	
		Each	Cumulative											
		ha	ha	m³/day	m³/day	m³/day	m³/day	m³/sec	mm	‰	m	m/sec	m³/sec	
115		3 0	3 0	44	127	127	171	0.002	⊙200	3.4～100	444	0.609	0.019	
116		8 9	120 7	1.754	271	2.318	4.072	0.047	⊙450	2.2～40	369	0.841	0.134	
	119													
117		4 3	4 3	63	6	6	69	0.001	⊙200	(3.4) 40～155	240	0.609	0.019	
118		2 4	6 7	97	——	6	103	0.001	⊙200	(3.4) 40～315	69	(0.609)	(0.019)	
119		6 0	133 4	1.937	18	2.343	4.280	0.050	⊙450	(2.2) 55～80	401	(0.841)	(0.134)	
120		6 0	139 4	2.025	34	2.376	4.401	0.051	⊙450	(2.2) 6.0～80	568	(0.841)	(0.134)	
	125													
121		62 7	62 7	911	244	244	1.155	0.013	⊙250	(3.2) 45～100	165	(0.685)	(0.034)	
122		4 8	67 5	981	40	283	1.264	0.015	⊙300	3.2～20	485	0.774	0.055	
123		12 3	79 8	1.159	20	303	1.462	0.017	⊙300	3.2～50	310	0.774	0.055	
124		20 4	100 2	1.456	69	372	1.828	0.021	⊙300	3.2～35	462	0.774	0.055	
125		27 5	267 1	3.880	149	2.897	6.777	0.078	⊙525	2.2	122	0.932	0.202	
	132													
126		43 5	43 5	632	153	153	785	0.009	⊙300	(2.2) 3.0～25	80	(0.642)	(0.045)	CREEK
127		8 7	52 2	758	——	153	911	0.011	⊙300	2.2～150	1.049	0.642	0.045	CREEK
128		37 5	89 7	1.303	20	173	1.476	0.017	⊙300	2.2～25	1.071	0.642	0.045	CREEK
	131													
129		8 1	8 1	118	213	213	331	0.004	⊙300	(2.2) 20～95	166	(0.642)	(0.045)	CREEK
130		7 9	16 0	232	17	230	462	0.005	⊙300	2.2～220	689	0.642	0.045	CREEK
		264 0												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small: Tributary Area Each (ha)	Small: Tributary Area Cumulative (ha)	Small: ① Volume of Sewage (m³/day)	Big: Each (m³/day)	Big: ② Cumulative (m³/day)	Maximum Volume of Sewage ③=①+② (m³/day)	Maximum Volume of Sewage ③=①+② (m³/sec)	Design Profile: Size (mm)	Design Profile: Slopes (‰)	Design Profile: Length (m)	Design Profile: Velocity (m/sec)	Design Profile: Capacity (m³/sec)	Remarks
131		0.6	106.3	1.544	—	403	1.947	0.023	⊙300	2.2	25	0.642	0.045	CREEK
132		22.0	395.4	5.743	162	3.463	9.206	0.107	⊙600	2.0	229	0.971	0.275	CREEK
133		0.0	395.4	5.743	—	3.463	9.206	0.107	⊙400	(10.6)	—	(1.704)	(0.214)	EXISTING WATER BRIDGE
134		1.8	397.2	5.769	11	3.473	9.242	0.107	⊙600	(1.2)	—	(0.757)	(0.214)	EXISTING SEWER
	135													
201		9.6	9.6	139	54	54	193	0.002	⊙200	3.4～390	588	0.609	0.019	
202		5.6	15.2	221	—	54	275	0.003	⊙200	(3.4) 40～85	347	(0.609)	(0.019)	
203		39.6	54.8	796	365	418	1.214	0.014	⊙250	2.6～95	469	0.618	0.030	
204		46.5	101.3	1.472	142	561	2.033	0.024	⊙375	(1.6) 8～80	352	(0.635)	(0.070)	
205		3.7	105.0	1.525	—	561	2.086	0.024	⊙375	(1.6) 15～115	531	(0.635)	(0.070)	
	210													
206		11.8	11.8	172	359	359	531	0.006	⊙200	3.4～30	313	0.609	0.019	
207		9.2	21.0	305	34	392	697	0.008	⊙250	2.6～80	404	0.618	0.030	
208		4.5	25.5	371	18	411	782	0.009	⊙250	2.6～115	579	0.618	0.030	
209		107.2	132.7	1.927	541	951	2.878	0.033	⊙375	(2.4) 10～50	146	(0.778)	(0.086)	
210		17.5	255.2	3.707	107	1.619	5.326	0.062	⊙525	(2.4) 15～45	203	(0.973)	(0.211)	
211		22.7	277.9	4.036	—	1.619	5.655	0.065	⊙525	(2.4) 15～30	359	(0.973)	(0.211)	
212		2.6	280.5	4.075	—	1.619	5.694	0.066	⊙525	(2.4) 15～45	326	(0.973)	(0.211)	
	214													
213		39.6	39.6	575	5	5	580	0.007	⊙300	2.0～60	608	0.612	0.043	CREEK
		344.5												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small: Tributary Area Each (ha)	Small: Tributary Area Cumulative (ha)	Small: ① Volume of Sewage (m³/day)	Big: Each (m³/day)	Big: ② Cumulative (m³/day)	Maximum Volume of Sewage ③=①+② (m³/day)	Maximum Volume of Sewage ③=①+② (m³/sec)	Design Profile: Size (mm)	Design Profile: Slopes (‰)	Design Profile: Length (m)	Design Profile: Velocity (m/sec)	Design Profile: Capacity (m³/sec)	Remarks
214		16.9	337.0	4.895	34	1.658	6.553	0.076	⊙525	2.4	431	0.973	0.211	
215		8.7	345.7	5.022	6	1.664	6.686	0.077	⊙525	2.4～35	648	0.973	0.211	
	218													
216		4.2	4.2	61	14	14	75	0.001	⊙200	(3.4) 105～165	77	(0.609)	(0.019)	
217		11.0	15.2	221	199	213	434	0.005	⊙200	3.4～215	323	0.609	0.019	
218		15.6	376.5	5.469	38	1.915	7.384	0.085	⊙525	2.4～25	510	0.973	0.211	
219		6.5	383.0	5.563	26	1.941	7.504	0.087	⊙525	(2.4) 15～100	257	(0.973)	(0.211)	
135		3.6	783.8	11.385	—	5.415	16.800	0.194	⊙600	2.0～100	346	0.971	0.275	
	STP													
		66.5												

Note : Figures in parentheses show the minimum velocity and capacity

APPENDIX 6 DATA

Table 1 Projected Population by Barangay

BARANGAY	1980	1985	1989	1990	1991	1992	1993	1994	1995	2000	SEWERAGE AREA		
											Coverage (%)	1989	1992
BAGUIO CITY	119,009	137,426	152,193	155,758	159,261	162,745	166,179	169,558	172,879	187,264		72,604	77,638
ABANAO-ZANDUETA CHUGUM-OT	653	754	835	855	874	893	912	930	949	1,028	100	835	893
ALFONSO O. TABORA	1,254	1,448	1,604	1,641	1,678	1,715	1,751	1,787	1,822	1,973	100	1,604	1,715
AMBIONG	705	814	902	923	943	964	984	1,004	1,024	1,109	0	0	0
APUGAN LOAKAN	424	490	542	555	567	580	592	604	616	667	0	0	0
ASIN ROAD	1,081	1,248	1,382	1,415	1,447	1,478	1,509	1,540	1,570	1,701	0	0	0
ATOK TRAIL	345	398	441	452	462	472	482	492	501	543	0	0	0
A. BONIFACIO-CAGUIOA-RIMA	857	990	1,096	1,122	1,147	1,172	1,197	1,221	1,245	1,349	100	1,096	1,172
BAGONG LIPUNAN	443	512	567	580	593	606	619	631	644	697	100	567	606
BAGUIO GEN. HOSPITAL COMP	653	754	835	855	874	893	912	930	949	1,028	100	835	893
BAKAKENG CENTRAL	839	969	1,073	1,098	1,123	1,147	1,172	1,195	1,219	1,320	0	0	0
BAKAKENG NORTE	715	826	914	936	957	978	998	1,019	1,039	1,125	0	0	0
BALSIGAN	1,006	1,162	1,287	1,317	1,346	1,376	1,405	1,433	1,461	1,583	100	1,287	1,376
BAYAN PARK	751	867	960	983	1,005	1,027	1,049	1,070	1,091	1,182	100	960	1,027
BAYAN PARK	470	543	601	615	629	643	656	670	683	740	100	601	643
BROOKE'S POINT	322	372	412	421	431	440	450	459	468	507	100	412	440
BROOKSIDE	2,590	2,991	3,312	3,390	3,466	3,542	3,617	3,690	3,762	4,075	100	3,312	3,542
CABINET HILL-TEACHER'S CA	1,239	1,431	1,584	1,622	1,658	1,694	1,730	1,765	1,800	1,950	100	1,584	1,694
CAMDAS SUBDIVISION	1,403	1,620	1,794	1,836	1,878	1,919	1,956	1,999	2,038	2,208	0	0	0
CAMP 7	1,134	1,309	1,450	1,484	1,518	1,551	1,583	1,616	1,647	1,784	0	0	0
CAMP 8	867	1,001	1,109	1,135	1,160	1,186	1,211	1,235	1,259	1,364	0	0	0
CAMP ALLEN	730	843	934	955	977	998	1,019	1,040	1,060	1,149	100	934	998
CAMPO FILIPNO	1,502	1,734	1,921	1,966	2,010	2,054	2,097	2,140	2,182	2,364	100	1,921	2,054
CARINO-PALMA	1,231	1,422	1,574	1,611	1,647	1,683	1,719	1,754	1,788	1,937	0	0	0
CENTRAL GUISAD	985	1,137	1,260	1,289	1,318	1,347	1,375	1,403	1,431	1,550	0	0	0
CITY CAMP CENTRAL	1,597	1,844	2,042	2,090	2,137	2,184	2,230	2,275	2,320	2,513	0	0	0
CITY CAMP PROPER	2,032	2,346	2,599	2,659	2,719	2,779	2,837	2,895	2,952	3,197	0	0	0
COUNTRY CLUB	1,350	1,559	1,726	1,767	1,807	1,846	1,885	1,923	1,961	2,124	0	0	0
CRESENCIA VILLAGE	1,260	1,455	1,611	1,649	1,686	1,723	1,759	1,795	1,830	1,983	100	1,611	1,723
DEPT. OF PUBLIC SERVICES	877	1,013	1,122	1,148	1,174	1,199	1,225	1,250	1,274	1,380	100	1,122	1,199
DIZON SUBDIVISION	952	1,099	1,217	1,246	1,274	1,302	1,329	1,356	1,383	1,498	0	0	0
DOMINICAN-MIRADOR	544	628	696	712	728	744	760	775	790	856	0	0	0
DONTOGAN	684	790	875	895	915	935	955	975	994	1,076	0	0	0
EAST BAYAN	347	401	444	454	464	475	485	494	504	546	20	89	95
EAST MODERNSITE	2,051	2,368	2,623	2,684	2,745	2,805	2,864	2,922	2,979	3,227	100	2,623	2,805
EAST QUIRINO HILL	628	725	803	822	840	859	877	895	912	988	0	0	0
ENGINEER'S HILL	1,491	1,722	1,907	1,951	1,995	2,039	2,082	2,124	2,166	2,346	100	1,907	2,039
FAIRVIEW	998	1,152	1,276	1,306	1,336	1,365	1,394	1,422	1,450	1,570	50	638	683
FERDINAND	701	809	896	917	938	959	979	999	1,018	1,103	0	0	0
FORT DEL PILAR	2,093	2,417	2,677	2,739	2,801	2,862	2,923	2,982	3,040	3,293	0	0	0
GABRIELA SILANG	1,067	1,232	1,365	1,396	1,428	1,459	1,490	1,520	1,550	1,679	0	0	0
GIBRALTAR	1,210	1,397	1,547	1,584	1,619	1,655	1,690	1,724	1,758	1,904	70	1,083	1,159
GREEN WATER VILLAGE	774	894	990	1,013	1,036	1,058	1,081	1,103	1,124	1,218	0	0	0
GUSAD SURONG	1,068	1,233	1,366	1,398	1,429	1,460	1,491	1,522	1,551	1,681	0	0	0
HAPPY HOLLOW	316	365	404	414	423	432	441	450	459	497	0	0	0
HAPPY HOMES-LUCBAN	1,249	1,442	1,597	1,635	1,671	1,708	1,744	1,780	1,814	1,965	0	0	0
HARRISON-CLAUDIO CARANTES	310	358	396	406	415	424	433	442	450	488	100	396	424
HILLSIDE	934	1,079	1,194	1,222	1,250	1,277	1,304	1,331	1,357	1,470	0	0	0
HOLY GHOST EXTENSION	1,296	1,497	1,657	1,696	1,734	1,772	1,810	1,847	1,883	2,039	100	1,657	1,772
HOLY GHOST PROPER	1,597	1,844	2,042	2,090	2,137	2,184	2,230	2,275	2,320	2,513	100	2,042	2,184
HONEYMOON	1,292	1,492	1,652	1,691	1,729	1,767	1,804	1,841	1,877	2,033	100	1,652	1,767
IMELDA R. MARCOS (LA SALL	535	618	684	700	716	732	747	762	777	842	0	0	0
IMELDA VILLAGE	562	649	719	736	752	769	785	801	816	884	100	719	769
IRISAN	1,797	2,075	2,298	2,352	2,405	2,457	2,509	2,560	2,610	2,828	0	0	0
KABAYANIHAN	545	629	697	713	729	745	761	777	792	858	100	697	745
KAGITINGAN	605	699	774	792	810	827	845	862	879	952	100	774	827
KAYANG EXTENSION	1,045	1,207	1,336	1,368	1,398	1,429	1,459	1,489	1,518	1,644	100	1,336	1,429
KAYANG-HILLTOP	1,235	1,426	1,579	1,616	1,653	1,689	1,725	1,760	1,794	1,943	100	1,579	1,689
KIAS	1,123	1,297	1,436	1,470	1,503	1,536	1,568	1,600	1,631	1,767	0	0	0
LEGARDA-BURNHAM	905	1,045	1,157	1,184	1,211	1,238	1,264	1,289	1,315	1,424	100	1,157	1,238
LIWANAG	653	754	835	855	874	893	912	930	949	1,028	100	835	893
LOAKAN	874	1,009	1,118	1,144	1,170	1,195	1,220	1,245	1,270	1,375	0	0	0
LOPEZ JAENA	712	822	911	932	953	974	994	1,014	1,034	1,120	100	911	974
LOURDES SUBDIVISION EXT.	532	614	680	696	712	728	743	758	773	837	0	0	0
LOURDES SUBDIVISION PROPE	380	439	486	497	509	520	531	541	552	598	0	0	0

Table 1 Projected Population by Barangay (cont'd)

BARANGAY	1980	1985	1989	1990	1991	1992	1993	1994	1995	2000	SEWERAGE AREA Coverage (%)	1989	1992
BAGUIO CITY	119,009	137,426	152,193	155,758	159,261	162,745	166,179	169,558	172,879	187,264		72,604	77,638
LOWER BOKAWKAN (ANDRES BO	908	1,049	1,161	1,188	1,215	1,242	1,268	1,294	1,319	1,429	100	1,161	1,242
LOWER DAGSIAN	379	438	485	496	507	518	529	540	551	596	0	0	0
LOWER GENERAL LUNA	253	292	324	331	339	346	353	360	368	398	100	324	346
LOWER LOURDES SUBD.	162	187	207	212	217	222	226	231	235	255	0	0	0
LOWER MAGSAYSAY	768	887	982	1,005	1,028	1,050	1,072	1,094	1,116	1,208	100	982	1,050
LOWER QUIRINO HILL	653	754	835	855	874	893	912	930	949	1,028	0	0	0
LOWER QUIRINO-MAGSAYSAY	1,435	1,657	1,835	1,878	1,920	1,962	2,004	2,045	2,084	2,258	0	0	0
LOWER ROCK QUARRY	1,082	1,249	1,384	1,416	1,448	1,480	1,511	1,542	1,572	1,703	0	0	0
LUALHATI	684	790	875	895	915	935	955	975	994	1,076	100	875	935
LUCNAB	455	525	582	595	609	622	635	648	661	716	0	0	0
MALCOLM SQUARE	283	327	362	370	379	387	395	403	411	445	100	362	387
MALVAR-SGT. FLORESCA	656	758	839	859	878	897	916	935	953	1,032	100	839	897
MANUEL ROXAS-TEACHER'S CA	489	565	625	640	654	669	683	697	710	769	100	625	669
MARCOVILLE (BAL-MARCOVILL	682	788	872	893	913	933	952	972	991	1,073	0	0	0
MIDDLE QUIRINO HILL	599	692	766	784	802	819	836	853	870	943	0	0	0
MIDDLE ROCK QUARRY	1,072	1,238	1,371	1,403	1,435	1,466	1,497	1,527	1,557	1,687	0	0	0
MILITARY CUT-OFF	1,311	1,514	1,677	1,716	1,754	1,793	1,831	1,868	1,904	2,063	0	0	0
MINES VIEW PARK	441	509	564	577	590	603	616	628	641	694	20	113	121
MRR QUEEN OF PEACE	1,326	1,531	1,696	1,735	1,775	1,813	1,852	1,889	1,926	2,086	0	0	0
NEW LUCBAN	2,004	2,314	2,563	2,623	2,682	2,740	2,798	2,855	2,911	3,153	100	2,563	2,740
NORTH CENTRAL AURORA HILL	463	535	592	606	620	633	647	660	673	729	100	592	633
NORTH SANITARY CAMP	375	433	480	491	502	513	524	534	545	590	0	0	0
OUTLOOK DRIVE	554	640	708	725	741	758	774	789	805	872	0	0	0
PACDAL	2,269	2,620	2,902	2,970	3,036	3,103	3,168	3,233	3,296	3,570	30	871	931
PADRE BIRGIS (MIDDLE P. B	815	941	1,042	1,067	1,091	1,115	1,138	1,161	1,184	1,282	100	1,042	1,115
PADRE ZAMORA (UPPER P. BU	1,858	2,146	2,376	2,432	2,486	2,541	2,594	2,647	2,699	2,924	100	2,376	2,541
PHIL-AM	373	431	477	488	499	510	521	531	542	587	100	477	510
PINGET	1,281	1,479	1,638	1,677	1,714	1,752	1,789	1,825	1,861	2,016	0	0	0
PINSAO PILOT PROJECT	1,484	1,714	1,898	1,942	1,986	2,029	2,072	2,114	2,156	2,335	0	0	0
PINSAO(PROPER)	613	708	784	802	820	838	856	873	890	965	0	0	0
POLIWES	879	1,015	1,124	1,150	1,176	1,202	1,227	1,252	1,277	1,383	0	0	0
PUKSUSAN	296	342	379	387	396	405	413	422	430	466	0	0	0
QUEZON HILL PROPER	668	771	854	874	894	913	933	952	970	1,051	100	854	913
QUEZON HILL SUBDIVISION	1,173	1,355	1,500	1,535	1,570	1,604	1,638	1,671	1,704	1,846	100	1,500	1,604
RIZAL MONUMENT	428	494	547	560	573	585	598	610	622	673	100	547	585
SAINT JOSEPH VILLAGE	1,373	1,585	1,756	1,797	1,837	1,878	1,917	1,956	1,994	2,160	70	1,229	1,315
SALUD MITRA	1,314	1,517	1,680	1,720	1,758	1,797	1,835	1,872	1,909	2,068	100	1,680	1,797
SAN ANTONIO VILLAGE	964	1,113	1,233	1,262	1,290	1,318	1,346	1,374	1,400	1,517	0	0	0
SAN LUIS	1,318	1,522	1,686	1,725	1,764	1,802	1,840	1,878	1,915	2,074	40	674	721
SAN ROQUE	577	666	738	755	772	789	806	822	838	908	0	0	0
SAN VICENTE	1,536	1,774	1,964	2,010	2,056	2,100	2,145	2,189	2,231	2,417	0	0	0
SANTA ESCOLASTICA VILLAGE	930	1,074	1,189	1,217	1,245	1,272	1,299	1,325	1,351	1,463	0	0	0
SANTO ROSARIO	846	977	1,082	1,107	1,132	1,157	1,181	1,205	1,229	1,331	0	0	0
SANTO TOMAS PROPER	790	912	1,010	1,034	1,057	1,080	1,103	1,126	1,148	1,243	0	0	0
SANTO TOMAS SCHOOL AREA	304	351	389	398	407	416	425	433	442	478	0	0	0
SCOUT	1,205	1,391	1,541	1,577	1,613	1,648	1,683	1,717	1,750	1,896	0	0	0
SESSION	329	380	421	431	440	450	459	469	478	518	100	421	450
SLAUGHTER COMPOUND	1,631	1,883	2,086	2,135	2,183	2,230	2,277	2,324	2,369	2,566	100	2,086	2,230
SLU-SUP HOUSING VILLAGE	838	968	1,072	1,097	1,121	1,146	1,170	1,194	1,217	1,319	0	0	0
SOUTH CENTRAL AURORA HILL	906	1,046	1,159	1,186	1,212	1,239	1,265	1,291	1,316	1,426	100	1,159	1,239
SOUTH DRIVE	180	208	230	236	241	246	251	256	261	283	100	230	246
SOUTH SANITARY CAMP	1,234	1,425	1,578	1,615	1,651	1,687	1,723	1,758	1,793	1,942	40	631	675
TEODORA ALONZO	1,236	1,427	1,581	1,618	1,654	1,690	1,726	1,761	1,795	1,945	100	1,581	1,690
TRANCOVILLE	2,041	2,357	2,610	2,671	2,731	2,791	2,850	2,908	2,965	3,212	100	2,610	2,791
UPPER DAGSIAN	353	408	451	462	472	483	493	503	513	555	0	0	0
UPPER GENERAL LUNA	1,013	1,170	1,295	1,326	1,356	1,385	1,415	1,443	1,471	1,594	100	1,295	1,385
UPPER MAGSAYSAY	410	473	524	537	549	561	573	584	596	645	100	524	561
UPPER MARKET SUBDIVISION	541	625	692	708	724	740	755	771	786	851	100	692	740
UPPER QUEZON HILL	1,157	1,336	1,480	1,514	1,548	1,582	1,616	1,649	1,681	1,821	90	1,332	1,424
UPPER QUIRINO-MAGSAYSAY	1,416	1,635	1,811	1,853	1,895	1,936	1,977	2,018	2,057	2,228	0	0	0
UPPER ROCK QUARRY	1,032	1,192	1,320	1,351	1,381	1,411	1,441	1,470	1,499	1,624	0	0	0
VICTORIA VILLAGE	668	771	854	874	894	913	933	952	970	1,051	30	256	274
WEST MODERNSITE	1,036	1,196	1,325	1,356	1,386	1,417	1,447	1,476	1,505	1,630	100	1,325	1,417
WEST QUIRINO HILL	240	277	307	314	321	328	335	342	349	378	0	0	0

Table 2 Number of Connections by Zone (1979-1989)

Zone	1979 Ave.	1979 Share (%)	1980 Ave.	1980 Share (%)	1981 Ave.	1981 Share (%)	1982 Ave.	1982 Share (%)	1983 Ave.	1983 Share (%)	1984 Ave.	1984 Share (%)	1985 Ave.	1985 Share (%)	1986 Ave.	1986 Share (%)	1987 Ave.	1987 Share (%)	1988 Ave.	1988 Share (%)	1989 Ave.	1989 Share (%)	Growth Rate 1989/1979 (%)
1	380	3.93	377	3.58	392	3.52	420	3.36	435	3.19	435	3.04	426	2.89	449	2.92	432	2.65	429	2.47	416	2.33	109
2	465	4.81	489	4.65	510	4.58	650	5.20	682	5.00	688	4.81	693	4.70	721	4.69	747	4.58	776	4.46	784	4.40	169
3	331	3.43	382	3.63	401	3.60	508	4.07	671	4.92	783	5.47	822	5.58	941	6.12	1,073	6.58	1,297	7.46	1,379	7.73	417
4	398	4.12	423	4.02	439	3.95	462	3.70	482	3.54	485	3.38	506	3.43	521	3.39	539	3.31	555	3.19	579	3.25	145
5	441	4.56	475	4.52	549	4.93	644	5.16	723	5.30	850	5.94	880	5.97	887	5.77	995	6.10	1,049	6.03	1,080	6.06	245
Sub-Total	2,015	20.86	2,146	20.41	2,291	20.58	2,684	21.49	2,993	21.95	3,241	22.64	3,327	22.57	3,519	22.89	3,786	23.22	4,106	23.60	4,238	23.77	210
6	542	5.61	592	5.63	805	5.71	867	5.94	778	5.71	843	5.89	835	5.67	783	5.09	763	4.68	913	5.25	786	4.41	145
7	325	3.36	351	3.34	351	3.15	509	4.08	513	3.76	511	3.57	519	3.52	581	3.78	566	3.47	595	3.42	618	3.47	190
8	542	5.61	626	5.95	671	6.03	745	5.97	858	6.29	952	6.65	1,038	7.04	1,153	7.50	1,329	8.15	1,470	8.45	1,542	8.65	285
9	477	4.94	506	4.81	535	4.81	583	4.67	629	4.61	648	4.53	678	4.60	725	4.72	759	4.66	793	4.56	840	4.71	176
10	463	4.79	491	4.67	529	4.75	591	4.73	622	4.56	660	4.61	659	4.47	659	4.29	690	4.23	706	4.06	730	4.09	158
Sub-Total	2,349	24.31	2,566	24.40	2,721	24.46	3,095	24.78	3,400	24.94	3,614	25.25	3,729	25.30	3,901	25.30	4,107	25.19	4,477	25.74	4,516	25.33	192
11	673	6.97	727	6.91	758	6.81	813	6.51	894	6.56	927	6.48	991	6.72	985	6.41	1,072	6.58	1,125	6.47	1,260	6.73	178
12	239	2.47	281	2.67	275	2.47	283	2.27	310	2.27	328	2.29	313	2.12	308	2.00	325	1.99	334	1.92	345	1.93	144
13	623	6.45	635	6.04	637	5.73	684	5.48	724	5.31	743	5.19	742	5.03	754	4.90	780	4.78	805	4.63	813	4.56	130
14	440	4.55	480	4.59	495	4.45	536	4.29	586	4.31	619	4.32	648	4.38	632	4.13	656	4.02	678	3.90	697	3.91	158
15	641	6.63	711	6.76	737	6.62	803	6.43	853	6.26	904	6.32	928	6.30	985	6.43	1,031	6.32	1,059	6.09	1,059	5.94	165
Sub-Total	2,616	27.08	2,837	26.98	2,902	26.08	3,119	24.98	3,369	24.71	3,521	24.60	3,620	24.56	3,668	23.86	3,864	23.70	4,001	23.00	4,114	23.07	157
16	705	7.30	738	7.02	770	6.92	747	5.98	771	5.65	802	5.60	788	5.35	832	5.41	861	5.28	895	5.15	918	5.15	130
17	468	4.82	483	4.59	513	4.61	694	5.56	758	5.54	785	5.34	805	5.46	839	5.46	884	5.42	930	5.35	962	5.40	206
18	556	5.76	614	5.84	639	5.74	695	5.57	734	5.38	738	5.10	742	5.03	753	4.90	809	4.96	855	4.92	870	4.88	156
19	405	4.19	443	4.21	476	4.28	541	4.33	620	4.55	735	5.13	815	5.53	877	5.70	946	5.80	1,023	5.88	1,069	6.00	264
20	549	5.68	690	6.56	814	7.32	913	7.31	992	7.28	908	6.33	912	6.19	984	6.40	1,045	6.41	1,108	6.37	1,136	6.38	207
Sub-Total	2,681	27.75	2,968	28.22	3,212	28.87	3,590	28.75	3,873	28.40	3,938	27.51	4,062	27.56	4,285	27.87	4,545	27.88	4,811	27.66	4,957	27.80	185
Delivery	0	0.00	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	
Hauling	0	0.00	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.03	
Total	9,661	100.00	10,517	100.01	11,126	100.00	12,488	100.00	13,835	100.00	14,314	100.00	14,738	99.99	15,373	100.00	16,302	99.99	17,395	100.00	17,836	100.00	185

Table 3 Number of Connections by Zone (1989)

Zone	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Share (%)	Sewerage Area (%)	
1	428	422	430	432	423	427	422	422	421	415	419	416	2.33	100	416
2	778	778	780	790	784	782	787	787	786	765	783	784	4.40	100	784
3	1,312	1,327	1,347	1,355	1,352	1,352	1,376	1,372	1,373	1,360	1,379	1,379	7.73	0	0
4	557	562	569	575	571	571	577	576	575	575	578	578	3.25	100	578
5	1,054	1,054	1,063	1,081	1,075	1,084	1,081	1,077	1,083	1,083	1,076	1,080	6.06	90	972
Sub-Total	4,129	4,143	4,189	4,233	4,205	4,216	4,243	4,234	4,238	4,198	4,235	4,236	23.77		2,751
6	791	789	791	795	796	798	799	799	799	785	791	786	4.41	100	786
7	603	607	614	616	622	622	628	619	627	625	616	618	3.47	90	556
8	1,487	1,505	1,532	1,543	1,542	1,549	1,555	1,560	1,552	1,545	1,547	1,542	8.65	0	0
9	805	802	806	812	813	816	822	826	833	829	835	840	4.71	0	0
10	708	714	715	720	720	724	725	699	699	725	724	730	4.09	0	0
Sub-Total	4,394	4,417	4,458	4,486	4,493	4,509	4,529	4,494	4,501	4,509	4,513	4,516	25.33		1,342
11	1,139	1,152	1,172	1,178	1,181	1,187	1,187	1,180	1,184	1,186	1,181	1,200	6.73	10	120
12	334	334	340	342	342	344	345	346	345	345	348	345	1.93	100	345
13	810	803	809	809	804	813	814	806	816	813	818	813	4.56	100	813
14	677	683	684	689	677	693	696	687	700	701	701	697	3.91	80	558
15	1,038	1,034	1,045	1,051	1,034	1,049	1,054	1,053	1,057	1,052	1,058	1,059	5.94	100	1059
Sub-Total	3,998	4,006	4,050	4,069	4,038	4,086	4,096	4,072	4,102	4,097	4,106	4,114	23.07		2,895
16	901	906	909	910	917	926	928	921	930	927	927	918	5.15	70	643
17	934	937	939	940	949	954	957	949	953	951	962	962	5.40	70	673
18	854	859	865	864	870	862	880	868	877	872	872	870	4.88	100	870
19	1,039	1,058	1,063	1,069	1,069	1,079	1,077	1,055	1,064	1,062	1,073	1,069	6.00	90	962
20	1,121	1,124	1,135	1,136	1,140	1,140	1,148	1,127	1,136	1,125	1,131	1,138	6.36	20	228
Sub-Total	4,849	4,884	4,911	4,927	4,945	4,961	4,998	4,921	4,960	4,937	4,965	4,957	27.80		3,376
Delivery													0.00		
Hauling	4	5	7	9	9	9	6	7	5	5	4	5	0.03		
Total	17,374	17,455	17,615	17,724	17,690	17,781	17,864	17,728	17,806	17,746	17,823	17,830	100.00		10,364

Table 4 Inflow of Sewage Treatment Plant (April 1989 - March 1990)

(April 1989 - March 1990)

(Unit : cu. m/d)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1	1,693.73	2,136.63	*3	2,953.40	4,474.50	3,321.20	4,152.50	2,948.66	2,721.75	2,067.30	2,866.30	7,806.55
2	1,693.73	2,136.63	*3	3,099.00	11,991.10	1,794.60	4,152.50	2,948.66	2,721.75	1,758.80	3,167.68	7,264.10
3	1,693.73	3,054.26	678.20	2,865.30	13,802.70	957.90	3,143.10	2,503.00	2,513.20	1,837.00	3,167.68	7,473.26
4	1,425.65	3,054.26	693.83	2,780.40	6,451.20	957.90	3,300.00	2,740.10	2,513.60	1,790.00	3,167.68	7,473.26
5	1,425.65	3,054.26	693.83	2,433.10	17,516.80 *4	1,366.60	3,864.00	2,442.60	2,511.60	1,950.50	3,167.68	7,473.26
6	1,683.40	1,508.20	693.83	2,955.10	17,516.80 *4	2,880.60	3,180.90	2,929.20	2,031.00	1,942.30	2,881.10	7,473.26
7	1,390.40	1,625.36	1,739.40	4,135.20	1,195.90	3,755.20	3,047.00	2,929.30	2,022.20	1,789.10	2,171.20	7,473.26
8	1,542.90	1,625.36	3,486.60	2,111.10	2,867.00	3,801.70	4,159.50	2,715.00	2,395.80	1,618.80	2,786.40	7,473.26
9	1,612.80	1,625.36	4,289.50	8,760.10	10,452.30	9,517.20	6,496.80	1,565.60	2,067.30	1,881.00	3,034.00	7,473.26
10	1,612.80	1,551.30	4,982.30	3,945.10	8,161.20	7,527.65	5,455.20	1,289.10	2,067.30	1,891.30	2,164.00	7,822.37
11	2,053.90	1,613.30	3,604.30	3,354.90	6,375.40	7,527.65	3,182.60	1,659.30	2,067.30	1,841.20	2,164.00	7,822.37
12	1,459.40	46.00 *1	3,957.10	3,105.30	4,611.00	5,044.10	2,603.00	1,791.00	2,067.30	1,532.10	2,164.00	7,822.37
13	1,564.95	35.55 *1	1,540.00	3,256.00	4,611.00	10,909.20	3,704.00	1,455.20	2,067.30	2,616.60	2,164.00	7,801.10
14	1,564.95	35.55 *1	4,280.10	3,662.60	7,059.00	8,603.00	3,070.87	2,046.80	2,067.30	2,355.00	2,164.00	7,381.50
15	1,664.90	35.55 *1	4,608.40	3,095.90	5,232.00	4,358.80	3,070.87	1,286.30	2,067.30	2,355.00	4,366.92	7,031.20
16	651.57	35.55 *1	3,602.60	6,869.85	5,275.70	4,512.00	3,070.87	1,414.10	2,067.30	1,821.70	4,366.92	7,031.20
17	651.57	37.10 *1	3,190.00	6,969.05	4,724.30	11,433.15	2,475.80	1,101.00	2,067.30	2,156.20	4,366.92	8,249.00
18	651.57	1,436.20	2,334.90	807.70	3,127.60	11,433.15	2,832.00	1,648.60	2,067.30	2,040.22	4,366.92	8,858.90
19	807.00	6,458.20	2,772.05	682.10	6,301.10	6,823.90	5,002.50	1,901.00	2,067.30	2,040.22	21,834.60	8,640.17
20	807.00	4,728.10	2,772.05	682.10	5,016.10	5,679.30	5,002.60	1,901.00	2,067.30	2,040.22	10,242.20	8,640.17
21	1,374.40	2,334.40	1,539.30	7,622.20	5,016.10	6,278.50	6,491.20	2,361.50	2,067.30	2,040.22	10,680.20	8,640.17
22	1,392.75	2,334.40	1,566.90	7,338.30	5,391.80	5,055.50	5,005.50	2,170.40	2,067.30	2,040.22	10,850.22	8,640.17
23	1,392.75	2,334.40	6,926.00	5,226.50	6,768.10	4,078.40	5,005.60	4,360.80	2,067.30	1,117.00	10,850.22	8,640.17
24	1,392.75	3,548.00	5,034.10	5,226.50	5,781.10	4,751.05	4,384.80	3,694.40	2,067.30	3,606.00	10,850.22	8,640.17
25	1,392.75	2,524.20	8,239.10	3,867.70	4,281.10	4,751.05	3,793.30	2,768.77	2,067.30	3,606.00	10,850.22	9,461.50
26	1,026.60	2,524.20	3,011.10	6,425.30	4,870.00	5,895.30	3,932.10	2,768.77	2,067.30	1,621.00	10,850.22	9,461.50
27	1,436.60	3,378.80	4,138.00	9,353.50	4,870.00	4,445.40	2,739.40	2,768.77	2,067.30	1,536.37	7,740.00	9,401.00
28	2,299.80	2,847.90	4,805.70	11,260.90	3,850.20	4,658.40	3,095.00	3,287.90	2,067.30	1,536.37	7,806.55	5,051.00
29	1,926.40	9,028.75	4,435.00	4,623.33	4,271.30	5,547.50	3,095.00	2,411.50	2,067.30	1,536.37		908.70
30	2,136.63	9,028.75	3,657.50	4,623.33	5,533.50	4,036.10	3,570.40	3,186.80	2,067.30	2,811.50		0.00
31		0.00 *2		4,623.33	3,938.50		2,948.66		2,067.30	2,738.80		
Total (cu. m/mo)	43,333.03	75,710.52	93,191.69	138,873.49	201,320.40	160,932.20	119,027.57	70,994.33	66,976.80	63,513.61	107,252.05	223,928.20
Average (cu. m/d)	1,444.00	2,524.00	3,328.00	4,480.00	6,494.00	5,364.00	3,840.00	2,366.00	2,161.00	2,049.00	5,973.00	7,464.00

*1 due to filling O.D. 1, 2 and 4 up with sewage
*2 close a inflow gate due to heavy rain
*3 not functioning due to float ball cut-off
*4 due to heavy rain

Table 5 Power Consumption of Sewage Treatment Plant (April 1989 - March 1990)

(Unit : kwh/d)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1	258.00	338.00	765.00 *3	495.00	544.00	472.00	457.50	492.33	270.50	335.04	302.00	438.50
2	258.00	338.00	505.00 *3	545.00	535.00	398.00	457.50	492.33	270.50	444.00	420.50	401.00
3	259.00	310.00	885.00	495.00	535.00	465.00	340.00	320.00	324.00	321.00	420.50	373.00
4	276.00	310.00	283.33	535.00	540.00	465.00	404.00	452.00	325.50	416.00	420.50	373.00
5	276.00	310.00	283.33	540.00	507.00 *4	480.00	414.00	451.00	325.50	322.00	420.50	373.00
6	228.00	260.00	283.33	555.00	508.00 *4	440.00	394.00	417.00	350.00	336.00	482.00	373.00
7	290.00	420.00	580.00	500.00	505.00	500.00	425.00	417.00	345.00	381.00	350.00	373.00
8	263.00	420.00	420.00	482.00	570.00	485.00	485.00	440.00	340.00	318.00	421.00	373.00
9	132.00	420.00	480.00	553.00	521.00	550.00	477.00	468.00	335.04	323.00	285.00	373.00
10	131.00	470.00	480.00	510.00	509.00	410.00	450.00	437.00	335.04	325.00	320.40	480.00
11	235.00	485.00	485.00	455.00	555.00	410.00	378.00	402.00	335.04	273.00	320.40	480.00
12	285.00	485.00 *1	490.00	490.00	534.00	440.00	411.00	452.00	335.04	360.00	320.40	480.00
13	227.00	485.00 *1	472.00	495.00	533.00	460.00	468.00	367.00	335.04	309.00	320.40	478.00
14	228.00	485.00 *1	472.00	500.00	558.00	400.00	453.67	348.00	335.04	356.00	320.40	476.00
15	290.00	485.00 *1	491.00	461.00	491.00	380.00	453.67	385.00	335.04	356.00	330.40	455.50
16	213.33	485.00 *1	480.00	269.00	549.00	448.00	453.67	309.00	335.04	331.00	330.40	455.50
17	213.33	510.00 *1	560.00	269.00	265.00	573.50	489.00	366.00	335.04	327.00	330.40	482.00
18	213.33	485.00	403.00	476.00	375.00	573.50	485.00	399.00	335.04	282.60	330.40	511.00
19	235.00	305.00	548.00	506.00	600.00	398.00	348.00	418.00	335.04	282.60	330.40	434.83
20	235.00	565.00	549.00	507.00	520.00	485.00	348.00	418.00	335.04	282.60	474.00	434.83
21	290.00	615.00	510.00	521.00	521.00	430.00	440.00	460.00	335.04	282.60	361.00	434.83
22	272.50	615.00	520.00	521.00	563.00	410.00	468.00	380.00	335.04	282.60	337.00	434.83
23	272.50	615.00	520.00	483.00	531.00	530.00	460.00	315.00	335.04	341.00	337.00	434.83
24	272.50	850.00	560.00	483.00	502.00	445.00	446.00	270.00	335.04	335.50	337.00	434.83
25	272.50	488.00	585.00	494.00	461.00	445.00	452.00	346.00	335.04	335.50	337.00	410.00
26	275.00	487.00	519.00	525.00	444.00	405.00	477.00	346.00	335.04	325.00	337.00	410.00
27	225.00	500.00	504.00	528.00	443.00	445.00	414.00	346.00	335.04	206.67	461.00	381.00
28	260.00	480.00	522.00	585.00	474.00	430.00	447.00	319.00	335.04	206.67	438.50	366.00
29	285.00	670.00	520.00	417.67	494.00	440.00	447.00	293.00	335.04	206.67		416.00
30	338.00	670.00	525.00	417.67	498.00	430.00	434.00	269.00	335.04	223.00		344.00
31		865.00 *2		417.67	496.00		493.33		335.04	325.00		
Total (kwh/mo)	7,508.99	15,127.00	15,179.99	15,051.01	15,679.00	13,635.00	13,572.34	11,594.66	10,256.92	9,662.05	10,195.50	12,676.48
Average (kwh/d)	250.00	488.00	506.00	486.00	506.00	455.00	438.00	386.00	331.00	312.00	364.00	423.00

*1 due to filling O.D. 1, 2 and 4 up with sewage
*2 close a inflow gate due to heavy rain
*3 not functioning due to float ball cut-off
*4 due to heavy rain

Table 6 Unit Power Consumption of Sewage Treatment Plant

(Unit : kwh/cu. m sewage)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1	0.152	0.158	*3	0.168	0.122	0.142	0.110	0.167	0.099	0.162	0.105	0.056
2	0.152	0.159	*3	0.176	0.045	0.222	0.110	0.167	0.099	0.252	0.133	0.055
3	0.153	0.161	1.305	0.173	0.039	0.485	0.108	0.128	0.129	0.175	0.133	0.050
4	0.194	0.161	0.408	0.192	0.084	0.485	0.122	0.165	0.130	0.232	0.133	0.050
5	0.194	0.161	0.408	0.222	0.029 *4	0.351	0.107	0.185	0.130	0.165	0.133	0.050
6	0.135	0.172	0.408	0.188	0.029 *4	0.152	0.124	0.142	0.172	0.173	0.167	0.050
7	0.209	0.258	0.333	0.121	0.422	0.133	0.139	0.142	0.171	0.168	0.161	0.050
8	0.170	0.258	0.123	0.228	0.199	0.128	0.119	0.162	0.142	0.196	0.151	0.050
9	0.092	0.258	0.112	0.063	0.050	0.058	0.073	0.299	0.162	0.172	0.094	0.050
10	0.081	0.303	0.096	0.129	0.062	0.054	0.082	0.339	0.162	0.172	0.148	0.061
11	0.114	0.288	0.129	0.136	0.087	0.054	0.119	0.242	0.162	0.148	0.148	0.061
12	0.195	10.543 *1	0.124	0.158	0.115	0.087	0.158	0.252	0.162	0.235	0.148	0.061
13	0.145	13.080 *1	0.306	0.152	0.115	0.042	0.126	0.252	0.162	0.115	0.148	0.050
14	0.146	13.080 *1	0.116	0.137	0.079	0.046	0.148	0.170	0.162	0.151	0.148	0.064
15	0.174	13.080 *1	0.107	0.155	0.094	0.087	0.148	0.299	0.162	0.151	0.076	0.065
16	0.327	13.080 *1	0.133	0.039	0.104	0.098	0.148	0.219	0.162	0.182	0.076	0.065
17	0.327	13.747 *1	0.176	0.039	0.056	0.050	0.198	0.332	0.162	0.152	0.076	0.058
18	0.327	0.338	0.173	0.549	0.120	0.050	0.171	0.242	0.162	0.139	0.076	0.059
19	0.291	0.047	0.198	0.742	0.095	0.066	0.070	0.220	0.162	0.139	0.015	0.050
20	0.291	0.119	0.198	0.743	0.104	0.085	0.070	0.220	0.162	0.139	0.046	0.050
21	0.211	0.263	0.331	0.068	0.104	0.068	0.068	0.195	0.162	0.139	0.034	0.050
22	0.196	0.263	0.332	0.071	0.104	0.081	0.092	0.175	0.162	0.139	0.031	0.050
23	0.196	0.263	0.075	0.092	0.078	0.130	0.092	0.072	0.162	0.305	0.031	0.050
24	0.196	0.240	0.111	0.092	0.087	0.084	0.102	0.073	0.162	0.093	0.031	0.050
25	0.196	0.193	0.071	0.128	0.108	0.094	0.119	0.125	0.162	0.093	0.031	0.043
26	0.268	0.193	0.172	0.082	0.091	0.069	0.121	0.125	0.162	0.200	0.031	0.043
27	0.157	0.148	0.122	0.056	0.091	0.100	0.151	0.125	0.162	0.135	0.060	0.041
28	0.118	0.169	0.108	0.052	0.123	0.092	0.144	0.097	0.162	0.135	0.056	0.065
29	0.148	0.074	0.117	0.090	0.116	0.079	0.144	0.122	0.162	0.135		0.458
30	0.158	0.074	0.144	0.090	0.090	0.107	0.122	0.084	0.162	0.079		
31		*2										
Average (kwh/cu.m)	0.173	0.200	0.163	0.108	0.078	0.085	0.114	0.163	0.153	0.152	0.061	0.057

Table 7 Quality of Influent and Effluent at the Sewage Treatment Plant

Date	Time	Raw Sewage							Treated Sewage							Oxidation Ditch Mixed Liquor					Eff.
		SS (mg/l)	T-COD (mg/l)	S-COD (mg/l)	pH	Trans	T-BOD (mg/l)	S-BOD (mg/l)	SS (mg/l)	T-COD (mg/l)	S-COD (mg/l)	pH	Trans	T-BOD (mg/l)	S-BOD (mg/l)	pH	SV	SVI	MLSS (mg/l)	Temp.	Re. Cl (mg/l)
Oct. 3	8:30 AM	186.67	94.35	64.38	7.25	4.00	-	-	33.33	40.70	34.41	6.90	15	-	-	6.95	-	-	970	22.70	-
4	12:10 PM	-	-	-	6.65	8.00	100.01	65.42	-	-	-	6.70	17	48.70	38.10	6.80	8.5	-	-	22.90	-
10	8:30 AM	-	-	-	6.90	4.75	-	-	35.00	-	-	6.85	15	-	-	6.85	8.0	-	1,790	22.40	-
12	8:45 AM	-	-	-	7.00	5.00	145.07	106.19	-	-	-	7.05	25	34.43	33.33	7.15	11.5	-	-	21.70	-
13	8:45 AM	25.00	-	-	6.95	5.75	-	-	18.00	-	-	6.85	28	-	-	6.75	11.8	-	2,160	22.00	-
20		20.00	-	-	6.35	8.75	-	-	10.00	-	-	6.80	30	-	-	6.60	10.8	-	4,150	21.30	-
21	9:00 AM	-	82.12	65.21	6.55	6.00	-	-	-	20.34	21.09	6.75	30	-	-	6.75	10.0	-	-	21.80	-
23	8:40 AM	-	-	-	6.75	5.50	158.26	91.06	-	-	-	6.75	30	31.10	25.30	6.45	8.5	-	-	-	-
26	9:30 AM	137.50	-	-	6.60	5.50	-	-	26.00	-	-	6.45	24	-	-	6.40	11.0	-	3,860	-	-
Nov. 5	9:35 AM	238.00	-	-	6.95	3.00	-	-	8.00	-	-	6.35	30	-	-	6.05	7.0	-	2,470	22.30	-
7	8:25 AM	-	-	-	7.10	3.50	326.32	167.88	-	-	-	6.20	30	24.10	26.30	6.00	8.0	-	-	21.60	-
9	7:25 AM	253.33	-	-	7.35	4.76	-	-	6.86	-	-	6.50	30	-	-	6.20	9.5	-	2,880	21.80	-
13	8:15 AM	443.33	-	-	7.30	3.25	-	-	22.00	-	-	6.15	30	-	-	6.05	10.0	-	3,060	21.40	0.6
14	8:50 AM	-	-	-	7.20	3.00	273.98	158.53	-	-	-	6.15	30	15.90	18.50	6.05	9.5	-	-	-	-
16	8:50 AM	-	106.50	91.02	7.15	3.50	-	-	-	14.21	16.28	6.35	30	-	-	6.15	9.5	-	-	21.00	-
22	7:20 AM	395.00	-	-	7.50	2.75	340.55	136.93	14.00	-	-	6.35	30	11.70	17.43	6.15	12.0	-	3,430	-	-
27	9:25 AM	246.67	-	-	7.25	3.50	-	-	16.00	-	-	6.60	30	-	-	6.30	8.0	-	2,480	-	-
30	10:00 AM	-	-	-	6.95	2.25	409.21	191.84	-	-	-	6.45	30	14.80	18.87	6.25	8.0	-	-	-	-
Dec. 1	8:50 AM	-	-	-	7.35	2.50	-	-	8.00	-	-	6.15	30	-	-	6.25	-	-	1,860	-	-
5	5:30 PM	-	-	-	6.70	4.25	-	-	4.00	-	-	6.25	30	-	-	6.00	-	12.00	3,310	-	-
7	4:15 PM	-	-	-	6.95	4.00	342.48	80.51	-	-	-	6.20	30	10.85	17.80	6.05	-	11.50	-	-	-
13	10:00 AM	-	-	-	7.00	2.50	-	-	20.00	-	-	6.25	30	-	-	5.95	-	14.00	4,040	-	-
18	11:30 AM	-	-	-	6.90	4.00	-	-	6.00	-	-	6.45	30	-	-	6.20	-	13.50	3,610	-	-
19	8:30 AM	-	-	-	7.45	2.25	446.92	262.40	-	-	-	6.35	30	19.90	16.53	6.10	-	13.50	-	-	-
23	12:30 PM	-	-	-	6.80	3.00	-	-	10.00	-	-	6.30	30	-	-	6.10	-	17.50	3,980	-	-
28	8:25 AM	-	-	-	7.10	1.75	-	-	-	-	-	6.30	30	-	-	6.15	-	15.50	4,020	-	-
29	9:30 AM	-	-	-	7.05	1.75	350.42	138.85	-	-	-	6.25	30	11.07	12.15	6.35	-	16.00	-	-	-
Jan. 3	9:15 AM	420.00	-	-	7.40	2.75	-	-	8.00	-	-	6.45	30	-	-	6.05	16.0	-	4,020	-	-
5	9:10 AM	-	-	-	7.55	2.50	381.09	167.56	-	-	-	6.15	30	21.00	15.55	5.95	16.0	-	-	-	-
8	9:00 AM	625.00	-	-	7.45	2.00	-	-	20.00	-	-	6.05	30	-	-	6.05	16.5	-	4,080	-	-
12	1:45 PM	-	-	-	6.85	2.25	348.69	122.81	-	-	-	6.15	30	9.90	15.03	6.05	16.0	-	-	-	-
16	3:45 PM	650.00	-	-	6.75	1.75	-	-	6.00	-	-	6.10	30	-	-	6.05	19.0	-	5,020	-	-
19	5:10 PM	-	-	-	6.65	3.00	148.07	51.02	-	-	-	6.05	30	2.46	2.09	5.95	19.0	-	-	-	-
24	2:20 PM	250.00	-	-	6.85	3.50	-	-	4.00	-	-	5.35	30	-	-	6.20	17.0	-	4,330	-	-
31	9:45 AM	430.00	-	-	7.35	2.75	-	-	6.00	-	-	6.40	30	-	-	6.20	17.0	-	4,660	-	-
Feb. 6	8:50 AM	760.00	-	-	7.65	1.75	-	-	28.00	-	-	6.35	30	-	-	5.95	20.0	-	5,930	-	-
7	1:30 PM	-	-	-	6.85	1.75	303.01	165.55	-	-	-	5.85	30	2.50	3.81	5.65	20.0	-	-	-	-
13	9:00 AM	630.00	-	-	7.40	2.25	-	-	20.00	-	-	6.10	30	-	-	5.95	19.5	-	5,720	-	-
21	3:45 PM	420.00	-	-	6.75	2.50	-	-	6.00	-	-	6.20	30	-	-	5.85	20.0	-	5,870	-	-
28	9:00 AM	540.00	-	-	7.50	2.00	-	-	12.00	-	-	6.15	30	-	-	5.75	19.0	-	5,500	-	-
Mar. 2	8:30 AM	-	-	-	7.65	2.00	-	310.10	-	-	-	6.15	30	8.67	5.56	5.65	22.0	-	-	-	-
5	9:00 AM	470.00	-	-	7.25	2.00	-	-	6.00	-	-	6.15	30	-	-	5.65	21.0	-	5,410	-	-
10	11:30 AM	480.00	-	-	7.20	2.80	-	-	30.00	-	-	5.65	30	-	-	5.25	14.0	-	4,230	-	-
21	2:00 PM	-	-	-	7.20	2.80	235.39	125.90	-	-	-	5.60	28	6.70	5.37	5.05	17.0	-	-	-	-
23		530.00	-	-	7.15	2.00	-	-	13.33	-	-	5.55	27	-	-	5.05	17.5	-	4,780	-	-
Samples		17	1	1	36	36	12	13	22	1	1	36	36	13	13	36	27	8	23	5	1
Maximum		760	167	91	7.65	4.76	447	310	30	14	16	6.90	30.00	24	26	6	22	18	5,930	22	1
Minimum		238	167	91	6.65	1.75	142	51	4	14	16	5.55	27.00	2	2	5	7	12	1,860	21	1
Average		458	167	91		2.67	309	160	12	14	16		29.86	12	13	6	15	14	4,170	22	1

Table 8 Financial Internal Rate of Return before Depreciation

Unit: Peso

YEAR	Cost						Total Cost	Benefit	Net Benefit	Sewerage Inflow (Year)	Sewerage Charge (P/cu.m)
	Personnel	Chemical	Power	Repair	Other	Depreciation					
1990	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	600,000	-2,828,141	3,024,000	0.2
1991	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	907,200	-2,520,941	3,024,000	0.3
1992	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	1,512,000	-1,916,141	3,024,000	0.5
1993	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	2,419,200	-1,008,941	3,024,000	0.8
1994	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,024,000	-404,141	3,024,000	1.0
1995	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,144,960	-283,181	3,024,000	1.0
1996	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,270,758	-157,383	3,024,000	1.1
1997	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,401,589	-26,552	3,024,000	1.1
1998	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,537,652	109,511	3,024,000	1.2
1999	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,679,158	251,017	3,024,000	1.2
2000	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,826,325	398,184	3,024,000	1.3
2001	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,979,378	551,237	3,024,000	1.3
2002	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,138,553	710,412	3,024,000	1.4
2003	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,304,095	875,954	3,024,000	1.4
2004	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,476,259	1,048,118	3,024,000	1.5
2005	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,655,309	1,227,168	3,024,000	1.5
2006	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,841,521	1,413,380	3,024,000	1.6
2007	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,035,182	1,607,041	3,024,000	1.7
2008	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,236,590	1,808,449	3,024,000	1.7
2009	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,446,053	2,017,912	3,024,000	1.8
2010	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,663,895	2,235,754	3,024,000	1.9
TOTAL	19,656,000	5,339,439	41,535,522	4,200,000	1,260,000	0	71,990,961	77,099,677	5,108,716	63,504,000	

FIRR = 3.07%

Table 9 Financial Internal Rate of Return after Depreciation

Unit: Peso

YEAR	Cost						Total Cost	Benefit	Net Benefit	Sewerage Inflow (Year)	Sewerage Charge (P/cu.m)
	Personnel	Chemical	Power	Repair	Other	Depreciation					
1990	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	600,000	-9,884,857	3,024,000	0.2
1991	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	3,024,000	-7,460,857	3,024,000	1.0
1992	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	6,048,000	-4,436,857	3,024,000	2.0
1993	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	9,072,000	-1,412,857	3,024,000	3.0
1994	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,096,000	-1,188,260	3,024,000	4.0
1995	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,458,880	-825,380	3,024,000	4.1
1996	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,832,646	-451,614	3,024,000	4.2
1997	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	13,217,626	-66,635	3,024,000	4.4
1998	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	13,614,155	329,894	3,024,000	4.5
1999	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,022,579	738,319	3,024,000	4.6
2000	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,443,257	1,158,996	3,024,000	4.8
2001	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,876,554	1,592,294	3,024,000	4.9
2002	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	15,322,851	2,038,591	3,024,000	5.1
2003	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	15,782,536	2,498,276	3,024,000	5.2
2004	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	16,256,013	2,971,752	3,024,000	5.4
2005	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	16,743,693	3,459,432	3,024,000	5.5
2006	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	17,246,004	3,961,743	3,024,000	5.7
2007	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	17,763,384	4,479,123	3,024,000	5.9
2008	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	18,296,285	5,012,025	3,024,000	6.1
2009	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	18,845,174	5,560,913	3,024,000	6.2
2010	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	19,410,529	6,126,269	3,024,000	6.4
TOTAL	19,656,000	5,339,439	41,535,522	4,200,000	1,260,000	195,780,896	267,771,857	281,972,165	14,200,309	63,504,000	

FIRR = 3.01%