BASIC DESIGN STUDY REPORT

ON

THE BAGUIO SEWER SYSTEM REHABILITATION PROJECT

IN

THE REPUBLIC OF THE PHILIPPINES

(SUPPLEMENTARY STUDY)

NOVEMBER, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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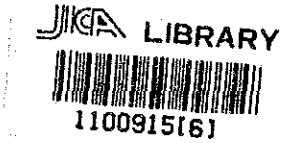


NOVEMBER, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study (supplementary study) on the Baguio Sewer System Rehabilitation Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Kenichi Osako, Manager of Facility Planning Division, Planning Department, Sewerage Bureau, Tokyo Metropolitan Government, from July 29 to August 9, 1991.

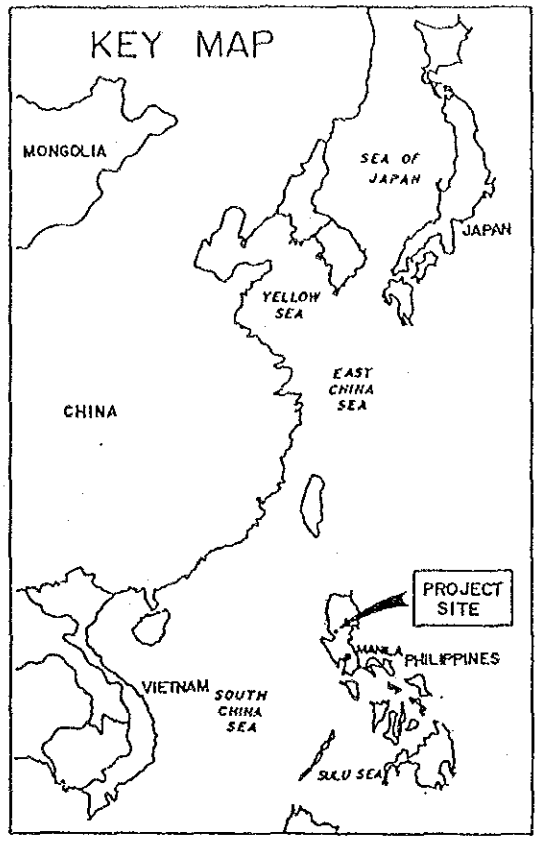
The team held discussions with the officials concerned of the Government of the Philippines, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the teams.

November, 1991

Kensuke Yanagiya
President
Japan International Cooperation Agency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MONGOLIA
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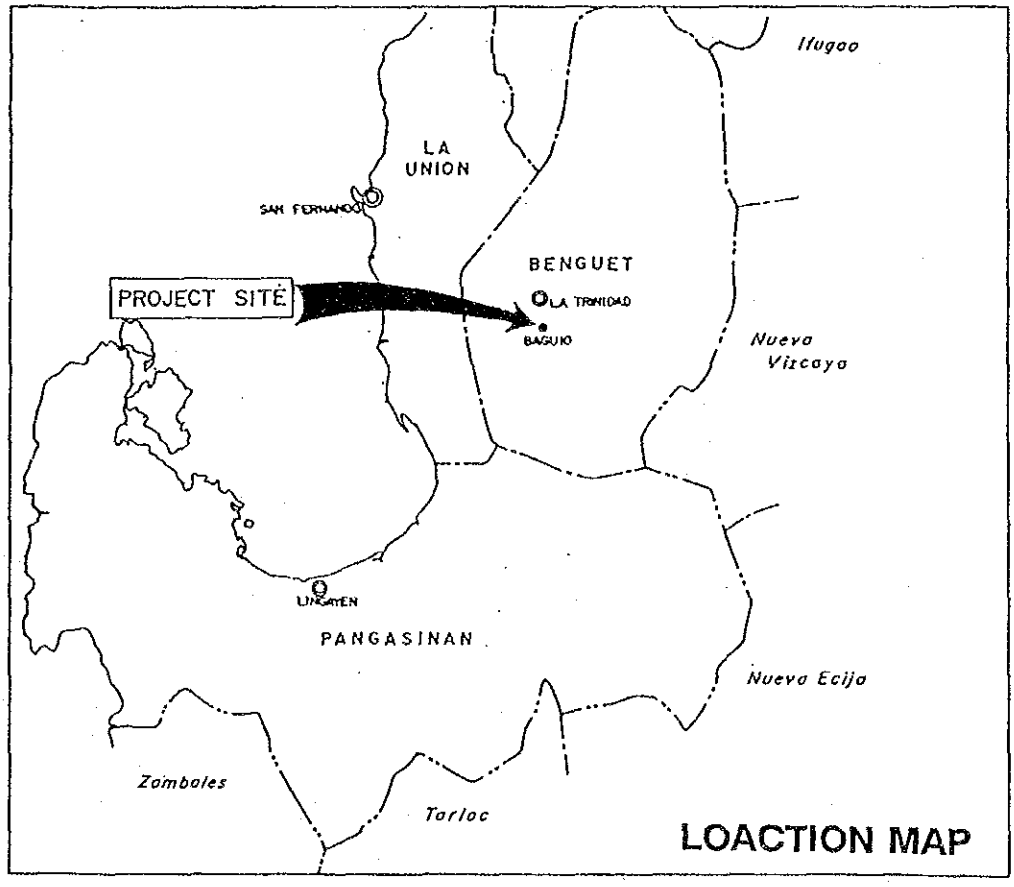
YELLOW SEA
EAST CHINA SEA
CHINA
PROJECT SITE
MANILA
PHILIPPINES
VIETNAM
SOUTH CHINA SEA
SULU SEA


Ifugao
LA UNION
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LOACTION MAP

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS

BCG	Baguio City Government
BENECO	Benguet Electric Corporation
BSTP	Baguio Sewage Treatment Plant
BWD	Baguio Water District
CAR	Cordillera Administrative Region
DOLG	Department of Local Government
DOH	Department of Health
DPWH	Department of Public Works and Highways
E/N	Exchange of Notes
GOJ	Government of Japan
GOP	Government of the Philippines
JICA	Japan International Cooperation Agency
LWUA	Local Water Utilities Administration
MWSS	Metropolitan Waterworks and Sewerage System
NEDA	National Economic and Development Authority
NPC	National Power Corporation
RWSA	Rural Waterworks and Sanitation Association
WD	Water District

ABBREVIATIONS

cu.m	cubic meter
ha	hectare
km	kilometer
lpcd or l/c.d	litre per capita per day
lps or l/s	litre per second
lps/m	litre per second per metre
m	meter
mg/l	milligram per litre
mm	millimeter
sq.km	square kilometer

BASIC DESIGN STUDY ON BAGUIO SEWER SYSTEM REHABILITATION PROJECT

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SUMMARY

Baguio City is located at the central highlands of Benguet Province at an altitude of 1,300 to 1,600 m, 208 km north of Manila and has an area of 48.9 km^2. During dry seasons, the population of 121,000 doubles with the influx of tourists.

The City, with its rapid development, is facing a daunting problem in relation to the public sewerage system, where great bulk of the untreated wastewater is being discharged into the rivers.

Baguio City had a sewerage system with sewage treatment facilities. However, due to lack of funds, these facilities were not completed and the sewer systems could not be utilized since it was aged and badly damaged. Thus, sewage from these broken sewers was directly discharged into creeks.

With the construction of the Baguio Sewage Treatment Plant (BSTP) from 1984 to 1986 by the Grant Aid of the Government of Japan (GOJ), Baguio would have been the first city in the Philippines to be fully serviced by a modern public sewerage system with treatment facilities. However, due to budgetary constraints, rehabilitation of the existing sewer system which was to be undertaken by the Baguio City Government (BCG) covered only a limited portion. Thus, the water pollution problem of the Balili River remains unsolved up to the present.

In recognition of the urgency and magnitude of the City's need, to help realize the effective operation of the BSTP and to alleviate water pollution of the Balili River, the Government of the Philippines(GOP) made a second request for Grant Aid for the rehabilitation of the existing sewer system. In response to this, GOJ sent experts through the Japan International Cooperation Agency (JICA) in July 1989 to study the existing condition of the system. Their findings revealed that the existing sewer system is considerably aged and damaged and the BSTP was not being utilized at full capacity thereby water pollution of the Balili River still could not be abated.

Based on this, the GOJ decided to conduct the basic design study

and subsequently JICA dispatched the Study Team to the Philippines to conduct a field survey from March 29 to April 27, 1990. After the analysis of data which was done in Japan, the Draft Final Report was prepared. The report was discussed by the Study Team with the government agencies concerned from July 9 to 15, 1990. Thereafter, the Final Report was prepared.

The basic design study conducted by the Study Team revealed that the BSTP was operating at only 16 to 28 percent of its full treatment capacity and with the implementation of the Project, it could be fully operational. The Local Water Utilities Administration (LWUA) has been designated as the executing agency in the construction stage to be supported by the Baguio City Government (BCG) and Baguio Water District (BWD). Regarding the operation and maintenance of the system, the agencies concerned agreed that the BCG would solely manage the sewage works as recommended by the Study Team.

The Project will involve the construction of new sewer mains under roads or in the creeks and the existing sewers are to be connected to the new mains. This will in turn lessen the load on existing sewers and solve the leakage problem. The existing sewers in the Business Section would be supplemented by new sewers. Another component of the Project is the donation of equipment by the GOJ to the GOP for the proper operation and maintenance of the system.

However, project implementation had to be suspended when an earthquake with a magnitude of 7.7 on the Richter Scale hit the north of the Luzon Island at 4:26 p.m. on July 16, 1990, and caused heavy damages to hotels, factories and schools in Baguio City.

In April 1991, the GOP requested the GOJ to resume the implementation of the Project since the first stage restoration work on damages by the earthquake had been undertaken.

The GOJ decided to conduct a supplementary study to the basic design study and subsequently the JICA dispatched the Study Team to the Philippines to conduct a field survey from July 29 to August 9, 1991. After the analysis of data in Japan, the Study Team discussed the Draft

Final Report with the government agencies concerned from October 4 to 11, 1991. Thereafter, the Final Report was prepared.

With the supplementary study, it was found that damage to sewerage facilities including the sewage treatment plant were minimal compared to other infrastructures. Therefore, the Project shall be implemented in principle in accordance with the previously proposed plan except for the following:

- The sewage line proposed within the area of Baguio Hyatt Terraces Hotel shall not be constructed since there are no plans to reconstruct the said hotel.

- An intake facility for sewage directly discharged from the houses along the river/creeks or leaked from the broken existing sewers upstream of the new trunk sewer network shall be constructed at three points in the river/creeks to ensure maximum benefits from the Project.

- Two sets of computers shall be added to the equipment to be supplied to alleviate the additional workload which accompanies the billing and collection of sewage fees

The Project is proposed to be implemented in two stages, three months for the detailed design stage and twelve months for the construction stage.

Upon completion of the Project, 80% of the 10,500 m^3/day sewage to be discharged to the Balili River basin will be collected by the rehabilitated sewer system and treated at the sewage treatment plant before final disposal. The BSTP will be operating at full capacity, water pollution in the Balili River would be abated and La Trinidad, located downstream may already utilize the water for vegetation. Baguio City will thus be the first urban center of the Philippines with a complete sewerage system which could serve as model for future sewerage systems. The proper operation and maintenance of a sewerage system could also be learned from observing the BSTP and its operations. More importantly, offensive odor

and appearance of the river environment shall be eliminated and the living conditions of the residents greatly improved.

In view of the above mentioned benefits to be derived upon completion of the system. The Study Team strongly recommends the implementation of the Project under the Grant Aid Program of the GOJ. Furthermore, it is Baguio City's only possible source of financial assistance since the project was not included under the Water Supply, Sewerage and Sanitation Master Plan Program.

The Study Team also recommends that the City consider requesting for a JICA short-term expert who will train the proposed City staff on the establishment of a new management system, operation and maintenance of the sewage treatment plant and rehabilitation of the existing sewers not included in the Project. And, to finally eliminate all possible sources of pollution, a complete garbage collection system should be established as soon as possible.

CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

The Local Water Utilities Administration (LWUA) and the Government of the Philippines (GOP) requested the Government of Japan for a Grant-Aid Program for the rehabilitation and expansion of the existing sewerage system of Baguio City.

The Japan International Cooperation Agency (JICA) dispatched Mr. Kenichi Osako, Manager, Design Section, Planning Division, Japan Sewage Works Agency and Mr. Kazuhito Isayama, Project Coordination Section, Sewerage Bureau, Fukuoka Municipal Government as short-term experts to conduct a study on the existing sewer system of the City from July 11-31, 1989. The study revealed that the existing sewer system is substantially aged and damaged and it discharges sewage directly to the creeks. Thus, there is a need to construct a new sewer main network for a more effective sewage collection system.

Based on this result, the GOJ decided to conduct the basic design study from March 29 to April 27,1990 and JICA dispatched a Study Team headed by Mr. Michio Kanda, Senior Assistant for Grant Aid, Grant Aid Division, Ministry of Foreign Affairs to the Philippines. The study team discussed the coverage of the project with the agencies concerned and conducted studies on population, water consumption, condition of existing sewers and operational status of the sewage treatment plant, and possible sewer main routes. Topographical survey and test pitting were also undertaken.

After the analysis of the data collected from the field survey, the Draft Final Report was prepared in Japan. JICA sent another Study Team headed by Mr. Kenichi Osako, Manager, Design Section, Planning Division, Japan Sewage Works Agency from July 9-15, 1990 to discuss the Draft Final Report with the agencies concerned.

Based on the results of discussion, the Final Report was prepared.

However, the implementation of the project had to be suspended when an earthquake with a magnitude of 7.7 on the Richter scale hit the north of the Luzon Island at 4:26 p.m. on July 16, 1990 and caused heavy dam-

ages to hotels, factories, universities and other infrastructure in Baguio City had to be suspended.

In April 1991, the GOP requested the GOJ to resume the implementation of the Project since the first stage of have been undertaken. The GOJ then decided to conduct a supplementary study to the basic design study and subsequently the JICA dispatched the Study Team to the Philippines to conduct a field survey from July 29 to August 9, 1991. The Study Team headed by Mr. Kenichi Osako, Manager of Facility Planning Division, Planning Department, Sewerage Bureau, Tokyo Metropolitan Government discussed the coverage of the Project with the agencies concerned, conducted studies on the damages caused by the earthquake, collected the latest data on population, water supply, sewerage facilities etc., and reviewed the effect of damages by the earthquake on the plan previously proposed.

After the analysis of the data, the Draft Final Report for the supplementary study was prepared in Japan. JICA sent another Study Team headed by Mr. Kenichi Osako, Manager of Facility Planning Division, Planning Department, Sewerage Bureau, Tokyo Metropolitan Government from October 4-11, 1991 to discuss the Draft Final Report with the agencies concerned. Thereafter, the Final Report was prepared.

The composition of study team members, schedule of basic design study, local agencies and officials met with and the minutes of discussions are shown in Appendices 1 to 4, respectively.

CHAPTER 2
BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 General Condition of Sewerage Sector

According to the Water Supply, Sewerage and Sanitation Master Plan of the Philippines from 1988 to 2000, as of the end of 1986, 355,741 households were directly connected to sewerage system. These were in Metro Manila Area, Baguio City, Zamboanga City, and Cebu City. The existing sewerage system in Metro Manila Area altogether covers only 750,000 people or 9.2% of the total population of the Area. Among these systems, the City of Manila has the largest sewer system in the Philippines with a served population of more than 6,000,000 people. Other systems in Quezon City, Makati and Las Pinas individually serve around 150,000 people in total.

The sewerage systems in Baguio City, Zamboanga City and Cebu City are servicing a very limited area. The system in Baguio City has a newly completed sewage treatment plant with a served population of around 10,400 people. Only the system in Zamboanga City is operated and maintained by a Water District. Although the served area is limited, the system collects and disposes of domestic sewage and other wastewater discharged from a large portion of the downtown area. There is no comprehensive program for the provision of sewerage system in other urban areas and the rural areas.

2.2 Related Plan and Program

The Water Supply, Sewerage and Sanitation Master Plan of the Philippines from 1988 to 2000, manifests the target of the Government of the Philippines in the sewerage sector. This master plan was prepared by an inter-agency undertaking involving, the Department of Public Works and Highways (DPWH), Department of Health (DOH), Department of Local Government (DOLG), National Economic and Development Authority (NEDA), Metropolitan Waterworks and Sewerage System (MWSS), and the National Water Resources Board (NWRB). This plan outlines the objectives, policies, strategies, programs, projects and institutional arrangements of each sector. The objectives of these sectors are: (1) to provide easily accessible, safe and reliable water supply to the majority of the households within the shortest period practicable in a cost-effective manner, (2) to

increase sanitation and sewerage service coverage, and (3) to execute institutional arrangements in relation to these public services.

In this master plan, the implementation period is divided into two stages, namely the First Stage covering 5 years from 1998 to 1992, and the Second Stage, 8 years from 1993 to 2000.

During the First Stage, METROSS I Project in the Metro Manila Area, and 12 projects in other cities involving 6 conventional sewerage systems and 6 sewerage systems with small bore sewer system and stabilization ponds will be implemented in the sewerage sector, as shown in Table 2-2-1.

METROSS II Project in the Metro Manila Area, and 12 projects in other cities involving 4 conventional sewerage systems and 8 sewerage systems with small bore sewer system and stabilization ponds are programmed for the Second Stage. The cumulative population served by a sewerage system in target year 2000 is expected to be a total of 2,950,000 people, 2,700,000 people in Metro Manila and 250,000 people in other cities.

Table 2-2-2 presents the allocation of the project and investment cost per region for the First Stage.

As shown in the table, project allocation is one system for each region. For Region I in which Baguio City is located, one sewerage system with stabilization pond is programmed to be constructed in 1990. For the Second Stage, the number of allocated projects per region is also one.

As of the end of July 1991, no project in Table 2-2-2 has been implemented due to budgetary constraints.

Table 2-2-1 National Sewerage Development Program (1988-2000)

Particulars	Physical Targets	First Stage (1988 - 1992)					Second Stage (1993 - 2000)				
		Invest. (Mil. P)	Pop. Served Add.	Pop. Served Cum.	% of Pop. served Add.	% of Pop. served Cum.	Invest. (Mil. P)	Pop. Served Add.	Pop. Served Cum.	% of Pop. served Add.	% of Pop. served Cum.
I Metro Manila and Its Contiguous Areas by MWSS											
1. METROSS I	Const. of sewer lines Const. of minor drainage Rehab. of existing sewer limes Inst. of new house sewer connect.	288.16	0.45	1.2	5	14					
2. METROSS II	Const. of 6 km new double barrel outfall to Manila Bay Const. of 80 km trunk sewer and interceptors Const. of 400 km sewer mains and laterals Const. of several sewerage lift stations Inst. of new house sewer connect. Const. of primary sewage treatment plant	1,068.69					6,383.00	1.5	2.7	18	32
II OTHER URBAN AREAS by LWUA and DPWH		1,500.00		0.09	0.50	0.50	500.00		0.25	0.51	1.01
1. Key Cities	6 Projects	1,440.00	0.04	0.06							
	4 Projects						480.00	0.08	0.14		
2. Key Urban Areas	6 Projects	60.00	0.03	0.03							
	8 projects						20.00	0.08	0.11		

Source: Water Supply, Sewerage and Sanitation Master Plan of the Philippines 1988 - 2000

Table 2-2-2 LWUA Development Program for Sewerage System in Phase I (1988-1992)

Upper : Type/No. of Sewerage System
Lower : Investment (Million Pesos)

Year	Administrative Region												Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1988	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-
1990	B	-	-	C	B	-	C	-	-	-	-	-	4
	10	-	-	240	10	-	240	-	-	-	-	-	500
1991	-	B	C	-	-	C	-	B	-	-	-	-	4
	-	10	240	-	-	240	-	10	-	-	-	-	500
1992	-	-	-	-	-	-	-	-	B	B	C	C	4
	-	-	-	-	-	-	-	-	10	10	240	240	500
Total	1	1	1	1	1	1	1	1	1	1	1	1	12
	10	10	240	240	10	240	240	10	10	10	240	240	1,500

C: Conventional Sewerage System
B: Small Bore Sewer System with Stabilization Ponds

2.3 Outline of the Request

Baguio City is located at the central highlands of Benguet Province at an altitude of 1,300 to 1,600 m, 208 km north of Manila and has an area of 48.9 sq. km. During dry season, the population of 121,000 doubles with the influx of tourists.

The City, with its rapid development, is facing a daunting problem in relation to the public sewerage system, where great bulk of the untreated wastewater is being discharged into the rivers.

Sanitary sewage collection in the City was introduced before World War II by the Americans, but at that time, collected sewage were discharged directly into the rivers without treatment. In the early 70's, water pollution of the Balili River became worst, and brought damage to vegetable cultivation and public hygiene, particularly along the downstream portion of Baguio City, the La Trinidad Valley. Residents of the affected area requested Baguio City to implement immediate solutions to the problem. This compelled the city planners to initiate construction of necessary sewage treatment facilities. However, construction was stopped due to lack of funds.

In 1984, in response to the request of the GOP, the GOJ decided to conduct the basic design study on the Baguio Sewage Treatment Plant (BSTP) and entrusted the study to JICA. Based on the result of this study, the GOJ decided to extend the Grant-Aid Program to the GOP for construction of the said BSTP. The detailed engineering design and construction work of the BSTP were carried out from 1985 to 1986.

The BSTP was finally put into operation in 1987 but is presently treating an average daily inflow of only approximately 20 percent of its design capacity (8,600 cu.m/day).

In connection with the construction of the BSTP, it was agreed between the GOP and GOJ that rehabilitation work on the existing sewer system was to be shouldered by Baguio City. The Baguio City Government then prepared the sewer system rehabilitation program and applied to the City Council for budget allocation. However, Baguio City could only avail of 5 million pesos for the fiscal year of 1986. This budget was further split with the other half going to the disaster recovery program due to typhoon damages. As a result, Baguio City was able to replace only about 30 percent of the originally planned sewers leaving majority of existing sewers unconnected to the BSTP.

The present management system of Baguio City for sewage works has the following problems:

- The sewerage section is only one of several sections in the office of the City Mayor and its works are not clearly distin-

guished from those of the inspection section which belongs to the public services division as well as the sewerage section.

- Although the sewage charge is being collected, it is regarded as one of the City's revenues and the sewerage section is managed with the City general budget

- The present sewage tariff does not include the recovery of the actual operation and maintenance cost which is expected to increase rapidly with the implementation of the Project.

- This Project will cover only a number of the main facilities and the City has to rehabilitate the facilities not covered. However, with the limited budget and organization for sewage works are too weak to do so.

The Water District under the jurisdiction of LWUA is authorized to provide, maintain and operate sewage collection, treatment and disposal facilities under Presidential Degree 198. The legislative body of the city shall enact a resolution which would contain among others, a statement of intent to transfer any and all sewerage facilities owned by the city to the district. The Water District is familiar with the management of this kind of business through experiences in water supply. The Baguio Water District has discussed the transfer of the ownership and management of the sewerage system including the BSTP with the Baguio City Government under the coordination of LWUA.

The GOP recognized both the necessity to rehabilitate the existing sewer system and to fully operate the BSTP for abatement of water pollution in the Balili River and the inability of Baguio City to carry forward the work due to financial constraints. The GOP then made the second request for Grant-Aid from the GOJ for the rehabilitation of the city's sewer system.

The GOJ decided to dispatch JICA experts to study the present condition of the sewerage system in consideration of the past Project background. JICA sent two experts to clarify the reason for the failure to carry out the rehabilitation work, to prepare the policy for rehabilita-

tion of the existing sewer system and to provide technical advice on appropriate operation and maintenance of the BSTP.

Based on the result of the study, the GOJ decided to conduct the basic design study and the JICA dispatched the Study Team to the Philippines to conduct a field survey from March 29 to April 27, 1990. After the analysis of data which was done in Japan, the Draft Final Report was prepared. The report was discussed by the Study Team with the government agencies concerned from July 9 to 15, 1990. Thereafter, the Final Report was prepared.

The contents of the project requested by the GOP and confirmed by the team were as follows:

- o rehabilitation and expansion of a city sewer systwm including a pumping station (stipulated in the application form)
- o supply of equipment (requested in the letter dated June 4, 1990 under joint signature of the BCG and the BWD)

The basic design study conducted by the Study Team revealed that the BSTP was operating at only 16 to 28 percent of its full treatment capacity and with the implementation of the Project, it could be fully operational.

The Local Water Utilities Administration (LWUA) has been designated as the executing agency in the construction stage to be supported by the Baguio City Government (BCG) and Baguio Water District (BWD). Regarding the operation and maintenance of the system, the agencies concerned agreed that the BCG would solely manage the sewage works as recommended by the Study Team.

The Project will involve the construction of new sewer mains under roads or in the creeks and the existing sewers are to be connected to the new mains. This will in turn lessen the load on existing sewers and solve the leakage problem. The existing sewers in the Business Section would be supplemented by new sewers. Another component of the Project is the donation of equipment by the GOJ to the GOP for the proper operation and maintenance of the system.

However, when the earthquake hit northern Luzon on July 16, 1990, hotels, factories and schools in Baguio City were heavily damaged. Consequently, project implementation had to be suspended.

In April 1991, the GOP requested the GOJ to resume the implementation of the Project since the first stage of restoration work on damages caused by the earthquake had been undertaken. Based on this, the GOJ decided to conduct a supplementary study to the basic design study and JICA sent the Study Team to the Philippines.

There was no change in the contents of the request by the GOP.

CHAPTER 3
OUTLINE OF THE PROJECT AREA

CHAPTER 3 OUTLINE OF THE PROJECT AREA

3.1 Location and General Condition of the Project Area

3.1.1 Location

Baguio City, the "Summer Capital of the Philippines" is located at the center of Benguet Province about 250 km north of Manila and 40 km east of San Fernando, La Union.

Baguio can be reached both by land and by air from Manila. However, there is only one daily flight to Baguio which is often canceled during the rainy season, hence, going by land is recommended. Baguio has three main entrances to welcome visitors: (1) Naguilian Rd. via Bauang, La Union, (2) Sto. Tomas Rd. (Marcos Highway) via Agoo, La Union, and (3) Kennon Rd. through Pangasinan. From Manila, Kennon Rd. is the most traveled route.

However, these roads were rendered impassable by the earthquake on July 16, 1990 and Naguilian Rd. and Sto. Thomas Rd. were passable afterward by restoration works. Kennon Rd. has been finally passable in September 1991.

Naguilian Rd. and Sto. Tomas Rd. are badly damaged. Sto. Tomas Rd. with a steep slope has big rocks that are exposed on the slope and which may fall down at any time. It is therefore dangerous to pass Sto. Tomas Rd. especially in the rainy season. While Naguilian Rd. with a loose slope has less danger of slope failures it takes 40 minutes more from Manila than Sto. Tomas Rd. Trucks which convey construction materials and equipment use this road.

3.1.2 Population

The history of Baguio City substantially began at the time when the Philippine Commission, which ruled the Philippines as a colony of the United States of America, passed a resolution declaring its intention to make "Baguio, in the province of Benguet, the summer capital of the archipelago". The population of Baguio at that time was only 489.

With development of Baguio City and as its name came to fame, population increased rapidly to 24,000 people in 1938. Although population increase ceased temporarily due to World War II, it grew again considerably after the war. The population increased to 85,000 by 1970 which is around three times of it before the war, and to 119,000 by 1980. In the 1980's, population growth slowed down, and population in 1985 was recorded at 137,000 (refer to Table 3-1-1 and Figure 3-1-1).

NEDA projects that the future population growth rate of Baguio City will slow down continuously. The future population is projected at 172,900 in 1995 (2.1%) and 187,300 in 2000 (1.6%). The future population of 129 barangays in Baguio City was also projected in accordance with the above mentioned projection.

According to the national population census conducted on May 1990, Baguio City has a total population of 183,102, a family population of 179,588 and households of 36,533 way over the projection of the NEDA-CAR which placed the annual growth rate of population at 2.54% for 1985-1990 compared to the actual rate at 5.91%, the biggest growth rate since 1918 (the growth rate of population for 1903-1918 was 17.46%).

With the same annual growth rate for 1991-2000 as used by NEDA-CAR, the future population is forecast at approximately 203,000 in 1995 and 207,000 in 2000, respectively.

Approximate population within the sewerage service area can be estimated by comparing the boundaries of barangays to the present sewerage service area. Served population in barangays spreading on the boundary line of the service area was estimated taking into account the ratio of served and unserved areas and the distribution condition of houses. The Population within the service area in 1990 is estimated at 76,888 as shown in Table 1 in Appendix 6. It is equivalent to 42.0% of 183,102, the total population of the City.

Table 3-1-1 Population Growth in Baguio City

Year	Actual	Projected	
		(1)	(2)
1903	489		
1918	5,464(17.46)		
1938	24,117 (7.71)		
1948	29,262 (1.95)		
1960	50,436 (4.64)		
1970	84,538 (5.30)		
1975	97,449 (2.88)		
1980	119,009 (4.08)		
1985	137,427 (2.92)		
1990	183,102 (5.91)	155,755 (2.54)	
1995		172,873 (2.11)	203,152 (2.11)
2000		187,263 (1.61)	206,504 (1.61)

(1) Estimated by NEDA-CAR based on population data by 1980.
(2) Estimated by the Study Team with the same annual growth rates as used by NEDA-CAR
Figures in parenthesis show the annual growth rate in percent.

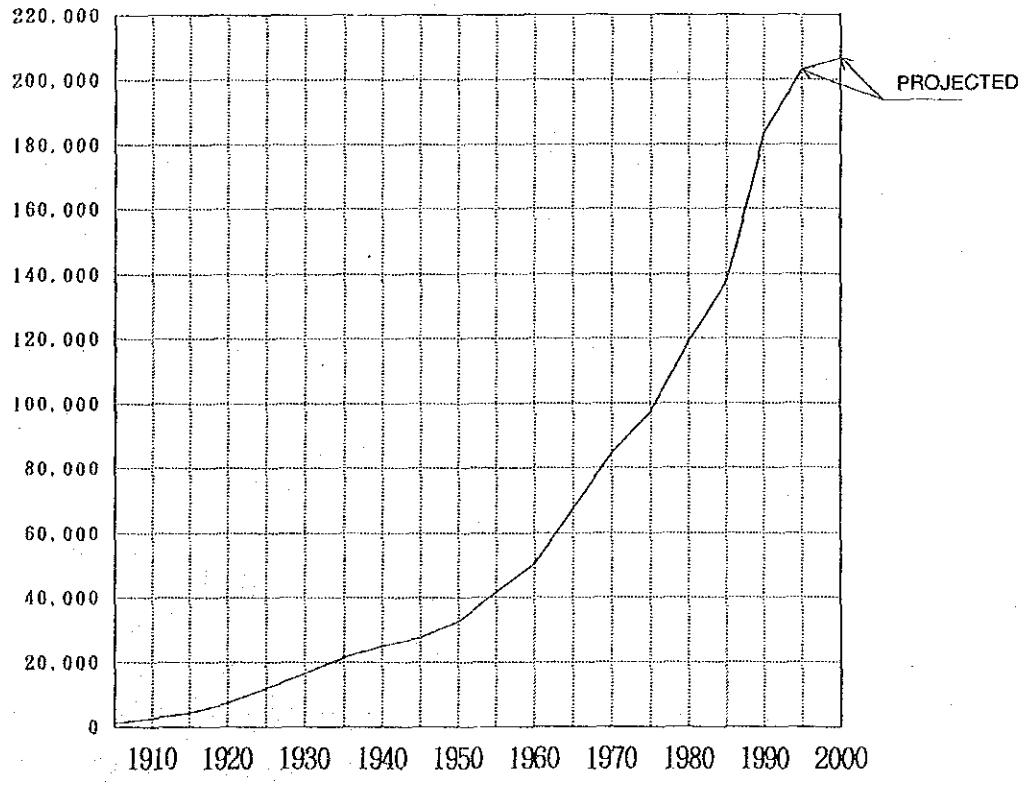
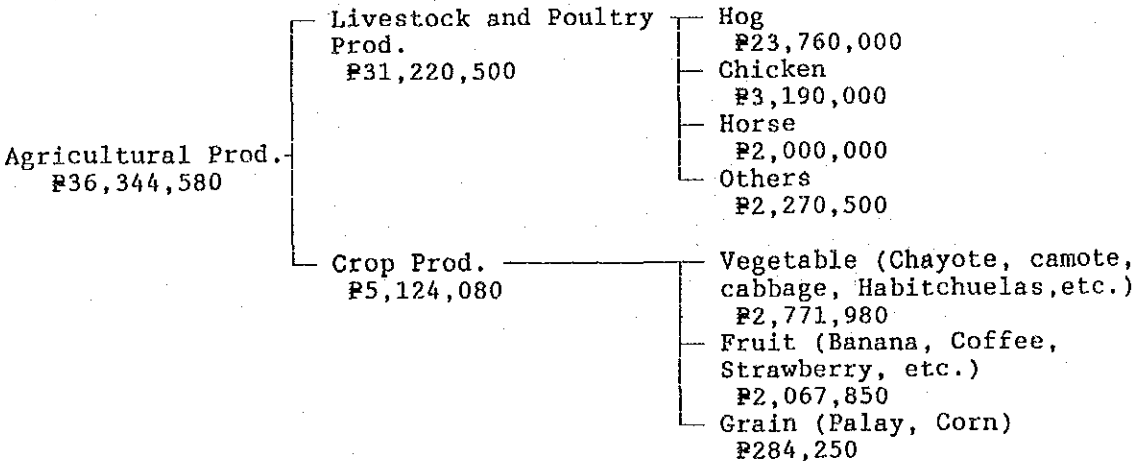


Figure 3-1-1 Transition of Population in Baguio City

3.1.4 Major Industries

a) Agriculture

Agricultural production was placed at ₱36,344,580 in 1985, out of which 85% or ₱31,220,500 was derived from the production of livelihood and poultry and the remaining 15% or ₱5,124,080 from crop production as shown below. Agricultural production structure is tightly connected with Baguio City as a consumer area.



b) Commerce and Industries

Mineral production in the form of limestone and limestone aggregate was valued at ₱644,986 in 1985.

The number of cottage industries established in 1985 was 209, which mainly consists of 47 establishments for metal work, 47 for garments, 44 for handicraft, and 26 for food processing.

There were 941 businesses established in 1985, which were composed of 576 establishments for wholesale and retail trade, 250 establishments for community, social and personnel services, and 115 other business establishments.

The Baguio City Export Processing Zone is located in the southeast part of the City near the airport. Total amount of import and export at the zone is as follows:

Total export amount was about 4,600 million pesos (exchange rate: ₱22.42 = US$100, December, 1989).

Table 3-1-2 Amount of Import and Export of the Baguio City Export Processing Zone

(Unit: US$ 1,000)

	1988	1989	Change (%)
Import	233,198	205,893	-7.55
Export	172,254	183,415	6.48
Balance	50,944	22,478	-55.88

c) Tourists

Many people visit Baguio to enjoy its comfortable climate and beautiful scenery. It is said that the population of Baguio is inflated to two times the ordinary level at the peak season which is usually during Lenten period. The number of tourists in Baguio City has doubled in the past 4 years as shown in Table 3-1-3. In this table, a tourist is defined as a person who stays in lodges listed on Table 3-1-4. The capacity of accommodation, however, almost remains unchanged as shown in Table 3-1-3. In the City, the tourists also stay in ordinary houses. Thus, the number of tourists recorded on statistics is different from actual condition.

Based on statistical data, the monthly number of tourists did not fluctuate very much through the year 1985, and its peak was recorded in December, Christmas season. In 1989, the fluctuation pattern of tourist arrival quite changed. The difference between months became conspicuous and a protrusive peak was found in April, the month including Holy Week. In general, peaks of tourist arrival occur in April and December.

However, the number of tourists has decreased due to heavy damages brought by the earthquake to hotels as shown in Table 3-1-3. For the first half of 1990, the population of tourists was 122,225, 38,091 in the second half of 1990 and 68,062 in the first half in 1991 way below the level in the previous year. The demolition work on the destroyed hotels including Baguio Hyatt Terraces Hotel has been currently going on and taking too much time to complete.

Table 3-1-3 Monthly Number of Tourists

Month	1985		1989		1990		1991	
	(pers.)	(%)	(pers.)	(%)	(pers.)	(%)	(pers.)	(%)
Jan.	15,542	7.1	43,328	9.5	22,569	14.1	9,832	
Feb.	16,289	7.4	32,204	7.1	19,210	12.0	11,995	
Mar.	18,424	8.4	38,635	8.5	17,983	11.2	11,856	
Apr.	23,271	10.6	86,651	19.0	28,688	17.9	12,828	
May	21,388	9.7	46,486	10.2	18,768	11.7	11,857	
Jun.	13,992	6.4	76,717	5.9	15,007	9.4	9,684	
Jul.	17,470	7.9	37,468	8.2	3,367	2.1		
Aug.	14,623	6.6	12,735	2.8	1,462	0.9		
Sep.	14,657	6.7	8,131	1.8	1,636	1.0		
Oct.	15,215	6.9	42,557	10.4	11,066	6.9		
Nov.	20,058	9.1	44,221	9.7	9,376	5.8		
Dec.	29,055	13.2	31,497	6.9	11,182	7.0		
Total	219,984	100.0	455,525	100.0	160,314	100.0		
	(100)		(207)		(73)			

Data Source: Philippine Tourism Authority, Baguio City

Table 3-1-4 Accommodation

Type	1985		1989	
	Estab'ts	Rooms	Estab'ts	Rooms
Hotel	22	1,126	24	1,218
Inn	20	563	21	507
Apatel	5	79	5	107
Youth Hostel	2	255	1	5
Lodging House	18	340	14	292
Motel	1	8	1	8
Resort	1	28	1	28
Pension House	6	91	7	91
Condominium	-	-	1	32
Total	75	2,490	75	2,288

Data Source: Philippine Tourism Authority, Baguio City

3.1.5 Socio-Economic Importance of the Project Area

Benguet Province where Baguio City is located, once belonged to Region I with 6 other provinces, namely, Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Abra, and Mountain Province. In 1989, however, Benguet Province was integrated into the Cordillera Administrative Region (CAR) with other same-racial provinces located in mountainous areas, namely, Abra, Ifugao, Kalinga-Apayao, and Mountain Provinces.

Though Baguio City occupies less than 1% of the Cordillera Administrative Region (CAR), 13.71% of the total population dwells there leading to the provincial level as shown in Table 3-1-5. Population density of Baguio City is outstanding at 3,112 person/sq.km., having the highest population growth rate in the CAR, and still rising.

Table 3-1-5 Population, Land Area and Population Density by Province

Province/City	1987		1988		1989		Growth Rate		Land		'89 Pop. Density
	Level	Dist. (%)	Level	Dist. (%)	Level	Dist. (%)	'87-'88 (%)	'88-'89 (%)	Area (sq.km)	Dist. (%)	(p/sq.km)
Abra	175,967	16.47	177,931	16.33	179,770	16.19	1.12	1.03	3,975.60	21.73	45
Benguet	280,485	26.25	286,782	26.32	292,962	26.39	2.24	2.15	2,606.40	14.25	112
Ifugao	128,943	12.06	131,304	12.05	133,624	12.03	1.33	1.77	2,517.80	13.76	53
Kalinga-Apayao	222,489	20.82	227,676	20.89	232,786	20.97	2.33	2.24	7,047.60	38.52	33
Mt. Province	115,850	10.84	117,433	10.78	118,945	10.71	1.36	1.29	2,097.30	11.47	57
Baguio City	144,866	13.56	148,555	13.63	152,193	13.71	2.55	2.45	48.90	0.27	3,112
CAR	1,068,600	100.00	1,089,681	100.00	1,110,280	100.00	1.97	1.89	18,293.60	100.00	61

Source: NSO-CAR

Baguio City's economic activities play a significant role in the overall economic condition of Benguet Province. Shown in Table 3-1-6 and Table 3-1-7 are the number of established enterprises and employees for each of the 5 provinces that make up the CAR. Benguet has the most number of establishments mainly due to Baguio City's considerable number of established enterprises in the City being 941 in 1985.

This brisk economic activity is reflected in the Government's Income and Expenditure presented in Table 3-1-8 and Table 3-1-9. Baguio City's statistics prove to be even greater than those of the provinces.

Results of the Income Decile Survey in Baguio City place the average annual family income of the 1st decile at around ₱12,000. The 10th decile, Baguio City shows having an income of ₱275,000. As an overall average, Baguio City indicates an income of ₱71,000. Thus, the wealth of the people of Baguio City is outstanding (refer to Table 3-1-10 and Figure 3-1-2).

Table 3-1-6 Number of Establishments Based on Original Business Name Registration

Province	1988	1989	Change (%)
Abra	151	300	98.69
Benguet	553	868	56.96
Ifugao	40	119	197.50
Kalinga-Apayao	83	321	166.27
Mountain Province	22	217	886.36
CAR	849	1,725	103.18

Source: DTI

Table 3-1-7 Employment Generated Based on Original Business Name Registration

Province	1988	1989	Change (%)
Abra	929	1,502	61.68
Benguet	4,497	6,823	51.72
Ifugao	116	814	601.72
Kalinga-Apayao	292	380	30.14
Mountain Province	98	892	810.20
CAR	5,932	10,411	75.51

Source: DTI

Table 3-1-8 Local Government Income

(Unit: Million Pesos)

Province	1988	1989	Change (%)	Target 1989	Accom. (%)
Abra	12.653	19.721	55.86	20.224	97.51
Benguet	23.398	25.521	0.48	23.421	108.97
Ifugao	7.673	10.526	37.18	7.972	132.04
Kalinga-Apayao	17.269	18.289	5.91	19.074	95.88
Mountain Province	8.313	7.986	(3.93)	7.295	109.47
Baguio City	73.980	87.747	18.61	78.090	112.37
CAR	145.286	169.790	16.87	156.076	108.79

Source: BLGF-CAR

Table 3-1-9 Local Government Expenditure

(Unit: Million Pesos)

Province	1988	1989	Change (%)	Target 1989	Accom. (%)
Abra	11.900	18.365	54.33	14.205	129.28
Benguet	24.725	28.133	13.78	22.578	124.60
Ifugao	5.032	9.031	79.47	10.346	87.29
Kalinga-Apayao	16.142	16.336	1.20	17.663	92.49
Mountain Province	7.387	7.371	(0.22)	7.175	102.73
Baguio City	70.782	94.654	33.73	72.131	131.22
CAR	135.968	173.890	27.89	144.098	120.67

Source: BLGF-CAR

Table 3-1-10 Annual Family Income and Expenditure by Income Decile

Income Decile	Baguio City							Benguet Province						
	No. of Families	Income			Expenditure			No. of Families	Income			Expenditure		
		Total (₱1,000)	Dist. (%)	Average (₱)	Total (₱1,000)	Dist. (%)	Average (₱)		Total (₱1,000)	Dist. (%)	Average (₱)	Total (₱1,000)	Dist. (%)	Average (₱)
Total	26,760	1,892,436.5	100.00	70,719	1,594,180.3	100.00	59,573	51,390	1,603,191.1	100.00	31,197	1,500,057.9	100.00	29,190
1st Decile	2,676	32,955.2	1.74	12,315	36,390.0	2.28	13,599	5,139	66,053.8	4.12	12,853	66,427.8	4.43	12,926
2nd Decile	2,676	47,943.5	2.53	17,916	46,993.5	2.95	17,561	5,139	86,587.0	5.40	16,849	80,788.8	5.39	1,572
3rd Decile	2,676	59,234.0	3.13	22,135	52,143.2	3.27	19,486	5,139	98,219.1	6.13	19,112	91,423.0	6.09	17,790
4th Decile	2,676	75,011.5	3.96	28,031	71,548.2	4.49	26,737	5,139	106,285.8	6.63	20,682	93,452.1	6.23	18,185
5th Decile	2,676	101,852.2	5.38	38,061	96,513.5	6.05	36,066	5,139	116,300.6	7.25	22,631	117,308.9	7.82	22,827
6th Decile	2,676	117,415.9	6.20	43,877	110,934.4	6.96	41,455	5,139	134,355.4	8.38	26,144	116,256.3	7.75	22,622
7th Decile	2,676	149,732.5	7.91	55,954	156,289.1	9.80	58,404	5,139	154,113.5	9.61	29,989	132,988.8	8.87	25,878
8th Decile	2,676	211,238.7	11.16	78,938	214,244.2	13.44	80,061	5,139	169,852.9	10.59	33,052	157,759.0	10.52	30,698
9th Decile	2,676	361,354.2	19.09	135,035	291,558.2	18.29	108,953	5,139	228,864.8	14.28	44,535	182,085.0	12.14	35,432
10th Decile	2,676	735,698.8	38.88	274,925	517,566.0	32.47	193,410	5,139	442,558.2	27.60	86,118	461,568.2	30.77	89,817

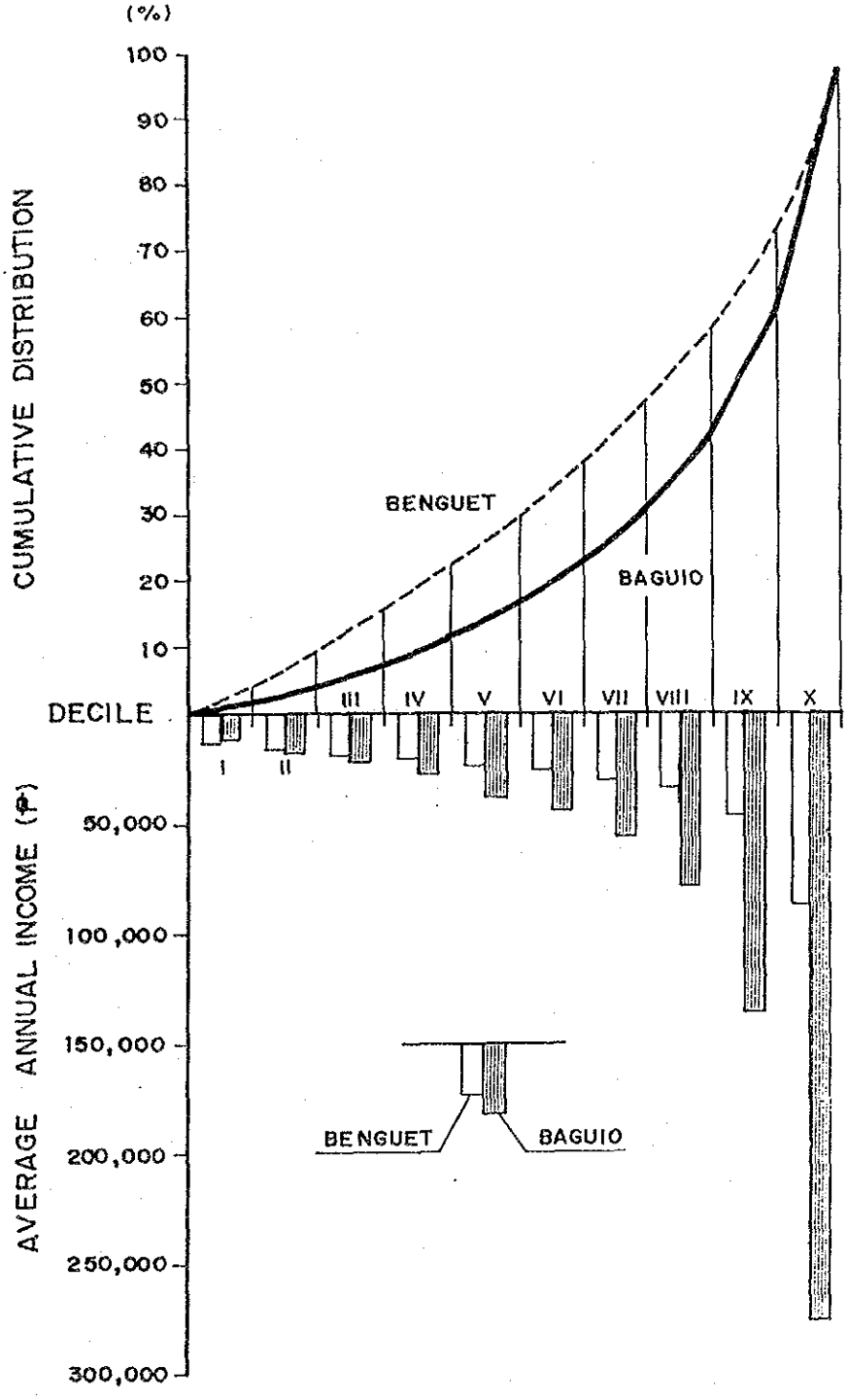


Figure 3-1-2

Annual Family Income
by Income Decile

3.2 Natural Condition

3.2.1 Topography

Baguio City itself is divided into three river basins; (1) Balili, (2) Camp City, and (3) Bued as shown in Figure 3-2-1.

The Balili River has its basin in the northern area of the City where it is divided by the line connecting the Quirino Hill, Quezon Hill, Dominican Hill, Camp John Hay and Aurora Hill. It has an area of 11.017 sq.km or 22.1% of the city area. The exit of the Balili River is located near the north boundary between the Quirino Hill and Aurora Hill which the Magsaysay Rd. for La Trinidad crosses. A number of tributaries and creeks converge into this point with confluence on the way forming a closed basin. Downstream of the exit is the La Trinidad Valley known as the Salad Bowl of the Philippines. The Balili River Basin shows a moderately rolling terrain and is probably a remnant of an old land formation. Camp Lagoon belongs to the Balili River Basin topographically but water cannot be discharged into the Balili River due to the depressed area and instead is drained by a sinkhole (vertical cave) into the Camp City River Basin. The Balili River flows north to the direction of the South China Sea at San Fernando, La Union. Most of the City proper is a part of the Balili River Basin.

Likewise, the Camp City River has its basin in the western area of the City where it is divided by the line connecting the Quirino Hill, Quezon Hill, Dominican Hill and Sto. Thomas Hill. It has an area of 14.738 sq.km including the Camp City area or 29.5% of the City area. The westerly flowing Camp City River drains into the Gulf of Lingayen at Agoo, La Union.

The remaining portion of the City area belongs to the Bued River Basin which has an area of 24.180 sq.km or 48.4% of the City area. The southerly flowing Bued River empties into the Gulf of Lingayen at Dagupan City, Pangasinan.

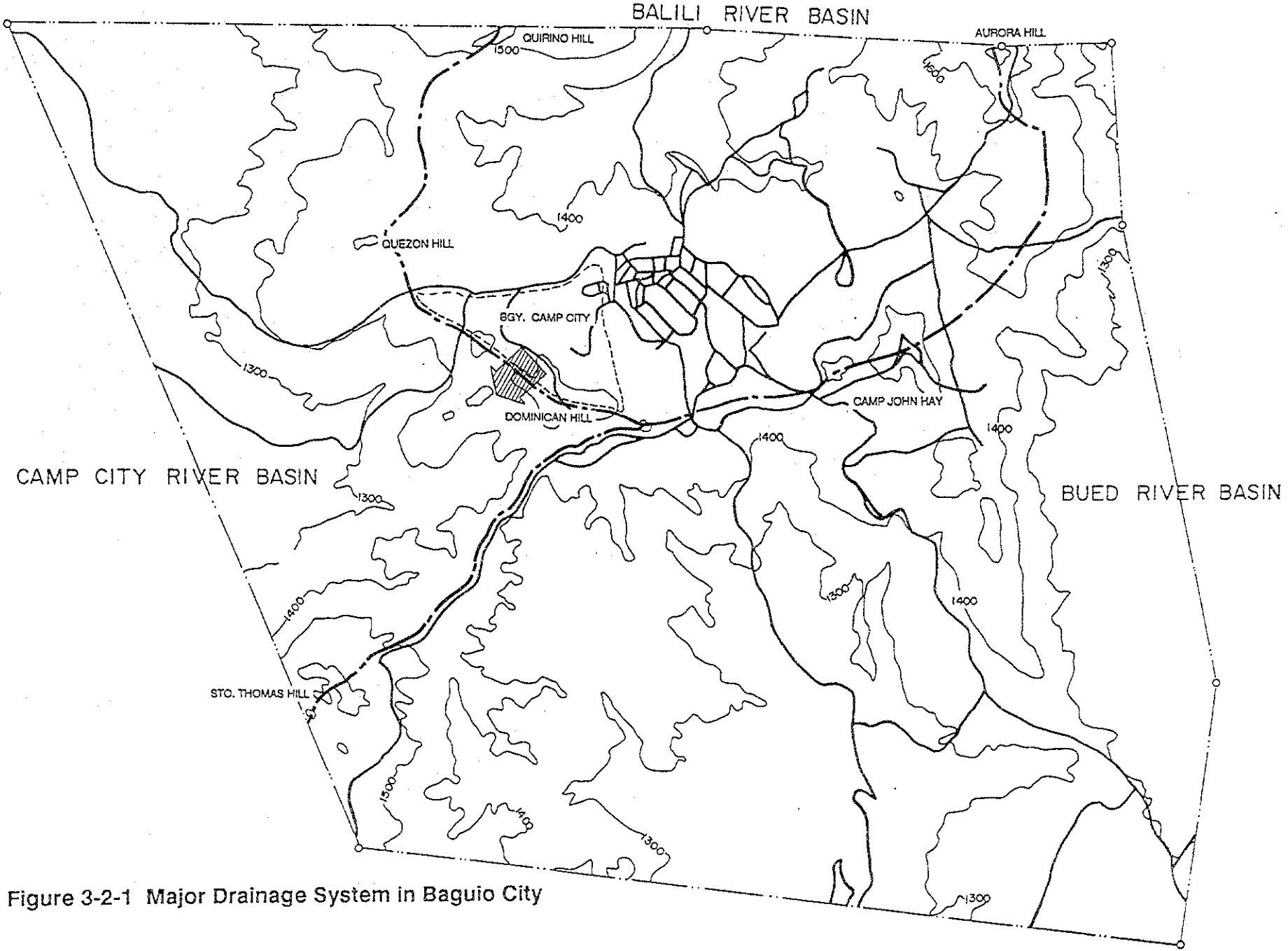


Figure 3-2-1 Major Drainage System in Baguio City

The river basins of Camp City and Bued have steeply sloping hillsides with V-shaped ravines which reflect a rapid erosional condition.

3.2.2 Climate

The climate of Baguio City is classified as Type I of the Philippine meteorological categories. In this type, there are two pronounced seasons: dry from November to April, and wet from May to October. The annual average rainfall from 1986 to 1990 is 4,210.4 mm (350.9 mm/month) as shown in Table 3-2-1, Table 3-2-2, and Figure 3-2-2. Monthly average rainfall during the dry season amounts to 28.0 mm while that of rainy season is at 673.8 mm. Monthly maximum rainfall is 964.2 mm in July, and minimum is 11.5 mm in January. The number of rainy days during the rainy season amounted to 138 days (75.0%) which means that there is no rain for less than two days a week.

The most dominant wind direction is southeast during the dry season and southwest during the rainy season.

Monthly mean temperature ranges from 17.6°C in December to 21.5°C in May, thus difference in monthly temperature is only 3.9°C and is otherwise stable throughout the year. Maximum temperature ranges between 26.1°C in December and 28.5°C in April. Mean temperature in Baguio is lower than that of Manila by 9°C.

Table 3-2-1 Average Climatological Normal (1986 - 1990)

Indicators	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Prevailing Wind Direct.	SE	SE	SE	SE	SW	SW	SW	SW	SW	SE	SE	SE	SE
Ave. Wind Speed (knot)	2	1	2	1	1	2	2	2	2	2	2	2	2
Precipitation (mm)	16.2	22.4	27.0	43.9	345.9	517.2	964.2	873.9	831.2	510.1	46.5	11.5	350.9
No. of Rainy Days (days)	2	3	3	7	21	23	26	26	25	17	7	4	14
Mean Rel. Humidity (%)	84	84	82	80	88	91	91	92	92	88	88	85	87
Mean Sea Level Pres.(MBS)	1011.3	1010.6	1010.8	1008.6	1007.1	1006.2	1006.3	1005.7	1006.5	1007.2	1008.8	1011.6	1008.4
Mean Temp. (°C)	18.2	18.9	19.4	21.2	21.5	21.1	21.1	19.7	20.6	19.5	19.4	17.6	19.8
Normal Wet Bulb Temp.(°C)	15.3	15.5	16.7	18.1	18.5	18.2	18.1	18.0	17.9	17.9	17.1	15.5	17.2
Normal Max. Temp. (°C)	26.7	26.6	28.2	28.5	27.7	27.3	26.9	26.4	27.0	26.6	27.0	26.1	27.1

Data Source: PAG-ASA Office, Baguio City

Table 3-2-2 Climatological Normal (1990)

Indicators	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Prevailing Wind Direct.	SE	SE	SE	SE	SE	SE	W	W	N	SE	SE	SE	SE
Ave. Wind Speed (knot)	1	1	1	1	1	2	2	1	2	1	2	2	1
Precipitation (mm)	0	0	6.9	15.7	346.9	1088.1	585.4	1599.9	861.5	1095.0	51.5	8.5	471.6
No. of Rainy Days (days)	0	0	2	2	22	24	29	25	23	14	10	3	13
Mean Rel. Humidity (%)	84	83	82	80	87	92	91	93	91	82	84	82	86
Mean Sea Level Pres.(MBS)	1011.5	1011.6	1011.7	1008.3	1007.0	1005.9	1006.3	1004.3	1006.1	1008.9	1008.4	1011.4	1008.5
Mean Temp. (°C)	18.9	19.5	19.4	21.4	21.6	21.0	21.4	19.6	19.7	20.9	19.8	18.7	20.2
Normal Wet Bulb Temp.(°C)	15.3	16.0	16.4	17.9	18.4	18.1	18.2	18.2	17.7	17.6	17.1	16.6	17.3
Normal Max. Temp. (°C)	27.0	26.7	26.7	29.0	27.3	27.3	27.2	25.0	26.8	27.2	27.0	26.3	27.0

Data Source: PAG-ASA Office, Baguio City

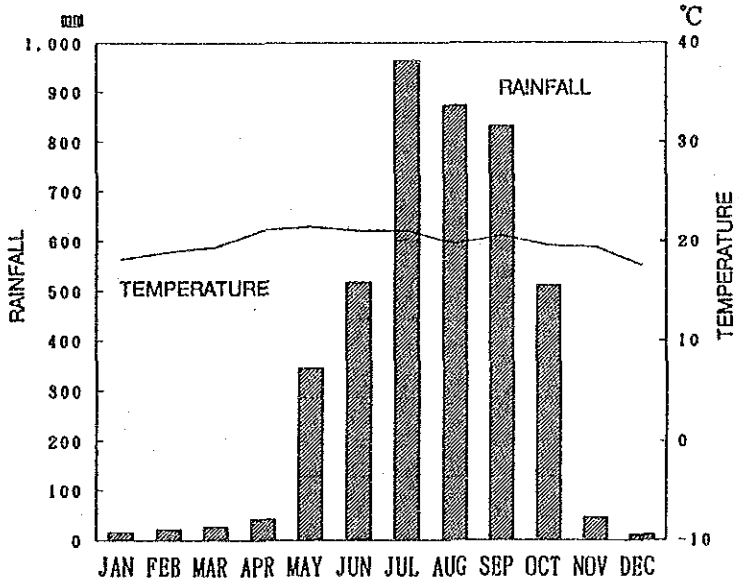


Figure 3-2-2
Temperature and Precipitation

3.2.3 Geology

The youngest rock formation blanketing most of the Baguio City area is called the Baguio Formation which is dated pliocene. This formation consists of interbedded agglomerate, volcanic breccia, tuff breccia, lapilli tuff, tuff with minor pebbly sandstone, and claystone beds. This rock unit is particularly vulnerable to alternation by circulating volatile solution. The geologic section of the Baguio Plateau is shown in Figure 3-2-3.

Top soil in the Baguio City area is mainly classified into three soils, namely (1) the Bakakeng Sandy Clay Loam, (2) the Mirador Clay Loam, and (3) the Tacdian Loam. As shown in Figure 3-2-4, the Bakakeng Sandy Clay Loam covers the eastern half and the northwestern part of the City, and the Mirador Clay Loam spreads on the southwestern part, and the Tacdian Loam lies on the central northern part.

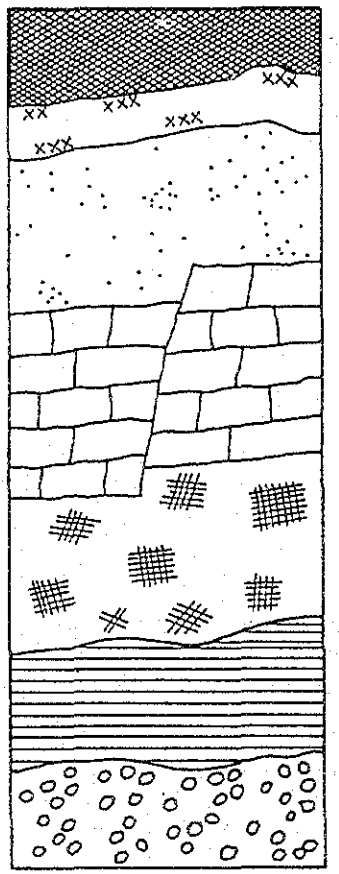
MAP SYMBOL	GEOLOGIC SECTION	FORMATION DESCRIPTION	SERIES	PERIODS
Qat		ALLUVIAL AND RESIDUAL DEPOSITS RED TO BROWN, SANDS, SILTS, AND CLAYS.	RECENT	QUARTENARY
Tqi		ANDESITE INTRUSIVES - APANITHIC TO PORPHYRITHIC DYKES AND SILLS	PLEISTOCENE	
Tkc		KLONDYKE CONGLOMERATE - MEDIUM TO COARSE, WELL TO POORLY SORTED RED TO BROWN. INTERBEDDED WITH WHITE TO BUFF TUFFACEOUS SANDSTONE, CLAYSTONE AND VOLCANIC ASH.	PLIOCENE (UNCONFORMITY)	
Tml		MIRADOR LIMESTONE - GREY TO BUFF, MASSIVE FOSSILFEROUS LIMESTONE WITH LAYERS OF DENSE NON-FOSSILFEROUS HIGHLY WEATHERED AND FAULTED AND FRACTURED SURFACES.	PLIOCENE UPPER MIOCENE	
Ta		ITOGON DIORITE - LIGHT GREY TO GREY, COARSE GRAINED, EQUIGRANULAR TO PORPHYRITHIC HIGHLY FRACTURED AND MINERALIZED WITH NUMEROUS PRODUCING ORE DEPOSITS.	MIDDLE MIOCENE	TERTIARY
Tpy		PYROCLASTICS - RED TO BROWN AGGLOMERATES, TUFFACEOUS SHALES SANDSTONES, CLAYSTONE AND SILICIFIED VOLCANIC BRECCIAS.	MIDDLE MIOCENE	
Tz		ZIGZAG SERIES - MODERATE TO HIGHLY INDURATED: THICK TO MASSIVE CONGLOMERATES: GREYWACKES, RED SHALES AND SHALY CONGLOMERATES.	LOWER MIOCENE	

Figure 3-2-3

Geological Section of Baguio Plateau

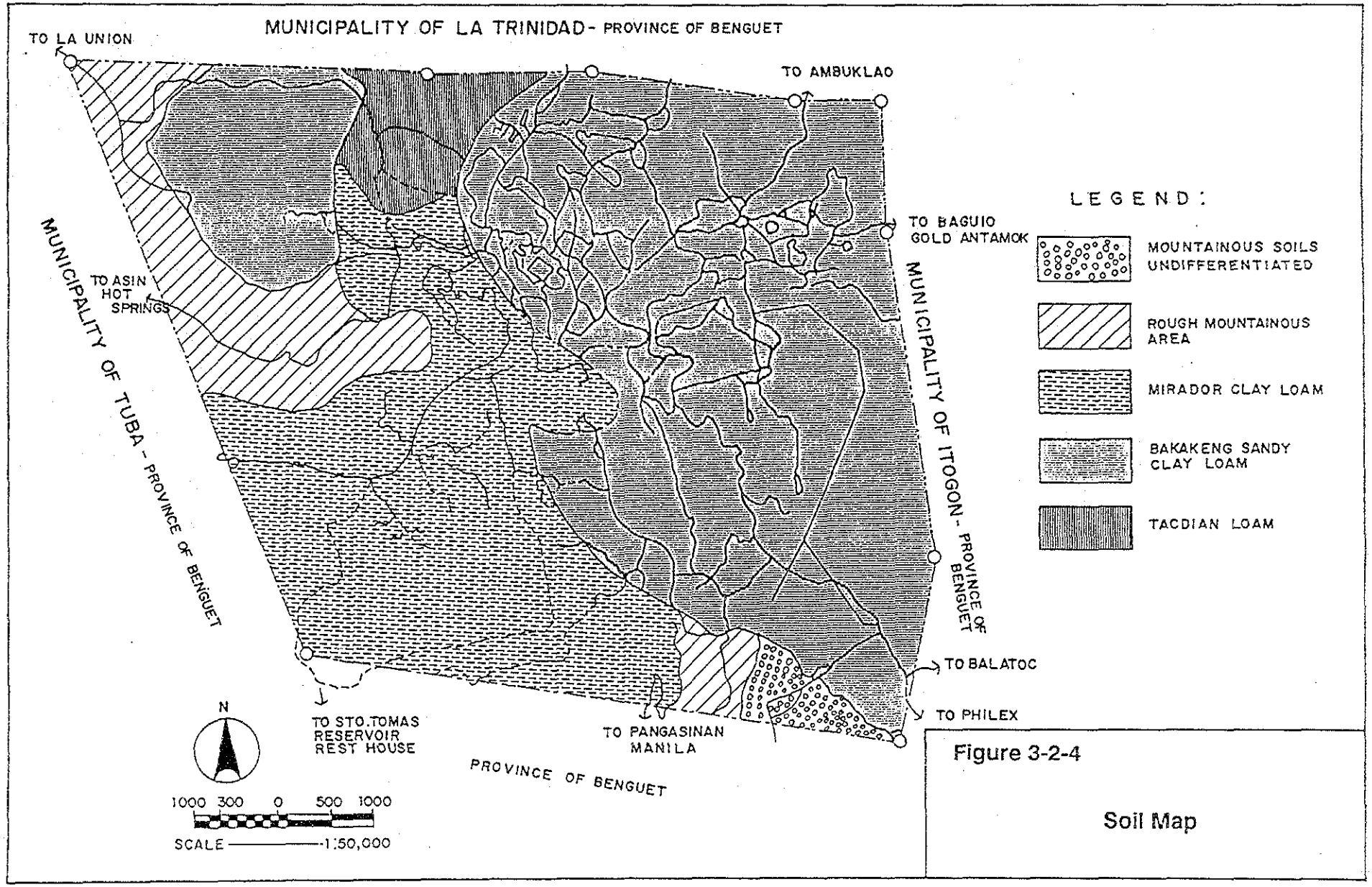


Figure 3-2-4

Soil Map

3.3 Social Condition

3.3.1 Infrastructure

a) Transportation

Baguio City has roads with a total length of 336.8 km, of which 69.3 km or 20.6% are administrated by the national government, 150.5 km or 44.7% by the city government, and 117.0 km or 34.77% by the barangays. By surface type, 217.0 km or 64.4% of the road length are asphalted, 16.7 km or 5.0% concreted, and 103.2 km or 30.6% unpaved. Out of these unpaved roads, 86.1% or 88.7 km are administrated by barangays.

The damages seen along major roads in Baguio City are outlined as follows:

a) Naguilian Road - with a number of slope failures along this road. Rock failure at KM261-KM262 is especially large.

b) Kennon Road - sinking and cracks were seen near KM247. One side of the road at this point has a steep slope and on the other side of the road is pulled out water pipe joint 55 cm. in diameter. The inner diameter of the pipe was measured at 75 mm. At a point further to the Lions Club Welcome Market, a mound of rocks caused by slope failure prevents vehicles to go ahead.

c) Marcos Highway - embankment failures, scales of which are longer compared to the first three roads, were seen at several points at this highway. Along KM278-KM277, a little more ahead to the Badiwan Bridge, gigantic mass of rocks and soil covered the highway surface for about 40 meter long.

Per the CAR report, the total cost of damages for roads and bridges in Baguio city is estimated at Peso 85 million while for Benguet is about Peso 606 million.

b) Telecommunications

In the City, telecommunications services by telephone, telex and facsimile are available through the Philippine Telephone Inc. (PILTEL), the Philippine Long Distance Telephone Co. (PLDT), the Philippine Telegraphic and Telephone Co. (PT&T), and Radio Communication of the Philippines Inc. (RCPI).

Land transportation offices and their equipment as well as telecommunication offices, including radio facilities, antennae, and transmitter lines were damaged. Post offices were also affected and a number were reported to be relocated due to the destruction of the office buildings. For the whole Cordillera region, the infrastructure damage with respect to transportation and communication is estimated at Peso 51 million, of which Peso 26 million is the cost of damage in Baguio city.

c) Electricity

The National Power Corporation (NPC) maintains two hydraulic power plants in the Benguet Province, i.e., the Ambuklao and the Binga plants. Power is supplied from these plants to Benguet province and Baguio city through 230 kv and 115 kv transmission lines.

The Benguet Electric Cooperative, Inc. (BENECO) handles the power distribution and has about 41,000 connections, including 33,000 connections in Baguio City. BENECO has 7 substations including 2 substations in Baguio.

The earthquake brought moderate damage to NPC's two dams in Benguet. In Ambuklao, longitudinal cracks developed at the crest of 129m high rock fill dam. More serious damage was found at nearby substation. Lightning arresters and CCPD (current communication potential devices) failed due to strong ground shaking and falling of bolders in 230 kv switchyard. After two weeks from July 16, the substation was repaired and operations for power from the grid started. On the other hand, in Binga longitudinal cracks also developed at the crest of 107 m high rock fill dam. The damage was less than that of Ambuklao.

No severe damage was reported for transmission towers and cables. NPC started its power supply to BENECO within two days after the earthquake using one of the dual lines.

The damage at BENECO was, however, severe. At one of Baguio city's substations near the Baguio Water District, switch bolts were totally destroyed. Temporary repair enabled the substation to supply power to the city.

BENECO started its restoration work on July 17, a day after the earthquake. As of Aug. 22, 1990, however, about 15% of the energizable connections still remain unenergizable shall require total reconstruction.

Per the CAR report, total damages with respect to power and energy amounted to Peso 122 million. This amount covers the losses incurred by NPC and the electric cooperatives in terms of destroyed transformers, circuit lines, electric posts, hydroelectric plants and feeders.

d) Water Supply

Water supply service in the City is administrated by the Baguio Water District (BWD), a quasi-government establishment.

Water sources consists of 30 deep wells and 9 surface water sources, of which 8 are springs, 4 of them operated in 1988. Depth of the deep wells range from 40 to 220 m and their annual yield range from 20,000 to 2,100,000 cu.m/year (refer to Table 3-3-1). The biggest well, the Amparo III located in Barangay Camp 7 yields 2,104,837 cu.m/year. Based on the 1988 record, around 80% of total water produced was derived from deep wells and the remaining 20% from surface water sources.

Water consumption and the number of service connection increase constantly as shown in Table 3-3-2 and Table 2 in Appendix 6, and Figure 3-3-1. Water production in 1988 was 10,830,136 cu.m and distributed water was 6,651,475 cu.m. Thus, non-revenue water or unaccounted-for-water amounted to 4,178,661 cu.m which was calculated at 38.58% of total water production. As to service connection, out of 18,572 total connections, only 17,589 were utilized.

In 1985, actual water production of Baguio City exceeded the projected amount for 1990, yet this was not sufficient to meet the demands thereby confirming that water shortage is a perennial problem of the City. Consequently, the BWD is continuously developing new water sources, and is regulating water supply at a rate of 12 hours a day only for each of the five water supply zones. This water supply control may be the reason why the influx of tourists does not show an increase in the monthly variation pattern of water consumption, even in April and December, these months being peak seasons in Baguio City as shown in Table 3-1-2. Therefore, water consumption will greatly increase whenever a new water source is developed and until the water supply capacity balances with the water demand, new water sources shall have to be developed.

Since the BWD has been collecting statistics on several data by each of 20 zones in the service area, data on water production and number of service connections by zone are available.

Approximate water consumption and service connection number within the sewerage service area can be estimated by overlapping of said zone boundaries on the present sewerage service area as shown in Figure 3-3-3. As to the zones covering the boundary line of the sewerage service area, the ratio to be included in the service area was estimated taking account of the ratio of areas in and out of the boundary and distribution condition of houses. As shown in Table 3-3-3 and Table 3 in Appendix, zones completely located in the service area are zones No. 1, 2, 4, 6, 12, 13, 15, and 18, partially included zones are zones 5, 7, 11, 14, 16, 17, 19, and 20, and zones located out of the boundary are zones 3, 8, 9, and 10. Water consumption in the sewerage service area in 1989 is estimated at 11,252 cu.m/day, and number of service connection at 10,364 as shown in Table 3-3-3 and Table 3 in Appendix. Population in the sewerage service area is estimated at 76,888 in 1990 as stated in Section 3.1.2 "Population", thus, population in 1989 is estimatrd at 72,597 with an annual average growth rate of 5.91% and population per service connection is placed at 7.0.

The water supply system in Baguio City suffered heavy damages from the earthquake which include the following as of August 18, 1990:

Table 3-3-1 Water Sources of Baguio Water District

WELL SOURCES

Well	Depth (m)	Capacity of Pump Installed (GPM)	1988 Production (cu.m)
Ambiong	107	300	564,377
Amparo I	81	2,200	1,431,291
Amparo II	100	300	96,998
Amparo III	89	2,500	2,104,837
Amsing	67	40	35,004
Athletic Bowl	41	100	127,842
Buyog	156	100	255,164
Cabinet	110	200	271,994
Camp 8	100	250	581,378
Easter	92	100	113,478
Evangelista	100	100	65,502
Ferguson	107	100	214,905
Gibraltar	60	80	106,985
Guisad	181	100	146,073
Happy Glenn	120	150	273,811
Harrison	120	150	129,998
Idisan	156	150	238,621
Kisad	152	40	1,886
Labsan	87	120	184,287
Market	60	40	5,699
Milo	206	450	408,544
M. Roxas	109	320	659,247
MRR	74	150	190,145
Pacdal	66	40	44,475
Palos	120	120	N.I.O.
P. Burgos	61	40	68,028
Ramsey	97	250	210,202
Riverwell	100	80	17,884
Skating Rink	70	40	27,518
Teacher's Camp	106	250	514,355

SURFACE WATER SOURCES

Source	No. of Springs	1988 Production (cu.m)	Means of Transmission	Pt. of Discharge
Stage 1	-	765,005	Pumped	Km. 8 Reservoir
Stage 8	3	-	Gravity	Camp 8 Tank
Crystal C	2	-	Pumped	Crystal Cave Sump
Amliang	1	239,419	Gravity	Km. 8 Reservoir
Amsing	2	2,647	Gravity	Pacdal Sump
Idisan	3	-	Gravity	Idisan Tank
Buyog	1	-	Gravity	Buyog Sump
Lamut	1	35,107	Gravity	Idisan Tank
Rain Basi	1	624,894	Gravity	Km. 8 Reservoir

Source: Annual Report 1988, BWD

Table 3-3-2 Actual Water Consumption by Zone (1979 - 1990)

(Unit : cu. m/d)

Zone	1979		1980		1981		1982		1983		1984		1985		1986		1987		1988		1989		1990		Growth Rate
	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	Ave.	Share (%)	'89/'79 (%)
1	541	6.74	433	5.33	483	6.17	743	6.85	1,082	7.43	1,024	6.83	778	5.09	899	5.73	837	5.21	1,032	5.69	1,002	5.19	838	4.85	185
2	359	4.48	345	4.25	334	4.27	441	4.06	546	3.75	541	3.61	557	3.64	617	3.93	625	3.89	703	3.88	717	3.71	707	4.09	200
3	317	3.95	278	3.42	283	3.62	459	4.23	1,099	7.54	1,407	9.39	1,726	11.29	1,945	12.4	1,782	11.1	2,036	11.23	2,221	11.51	2,281	13.20	701
4	408	5.09	388	4.78	388	4.96	563	5.19	1,034	7.1	963	6.43	983	6.43	1,022	6.51	841	5.24	894	4.93	1,042	5.40	873	5.05	255
5	407	5.07	367	4.52	405	5.18	561	5.17	839	5.76	976	6.51	868	5.68	870	5.54	911	5.68	31	0.17	1,163	6.02	1,049	6.07	286
6	608	7.58	673	8.29	622	7.95	726	6.69	778	5.34	843	5.63	835	5.46	783	4.99	763	4.75	913	5.04	803	4.16	808	4.67	132
7	444	5.54	383	4.72	375	4.79	574	5.29	921	6.32	907	6.05	909	5.95	876	5.58	1,024	6.38	1,083	5.97	1,162	6.02	1,023	5.92	262
8	596	7.43	501	6.17	503	6.43	828	7.63	1,076	7.39	1,158	7.73	1,212	7.93	1,258	8.02	1,385	8.63	1,519	8.38	1,708	8.85	1,422	8.23	287
9	312	3.89	318	3.92	356	4.55	457	4.21	511	3.51	480	3.2	509	3.33	547	3.49	632	3.94	718	3.96	783	4.06	593	3.43	251
10	268	3.34	232	2.86	249	3.18	409	3.77	474	3.25	457	3.05	478	3.13	496	3.16	496	3.09	580	3.2	636	3.29	549	3.18	237
11	435	5.42	471	5.8	374	4.78	611	5.63	735	5.05	733	4.89	768	5.02	709	4.52	788	4.91	908	5.01	1,024	5.30	837	4.84	235
12	171	2.13	175	2.16	160	2.05	196	1.81	280	1.92	295	1.97	319	2.09	323	2.06	330	2.06	396	2.18	379	1.96	305	1.76	222
13	544	6.78	544	6.7	514	6.57	585	5.39	629	4.32	628	4.19	648	4.24	588	3.75	651	4.06	755	4.16	742	3.84	589	3.41	136
14	379	4.73	430	5.3	343	4.38	572	5.27	675	4.63	652	4.35	675	4.41	645	4.11	581	3.62	682	3.76	756	3.92	634	3.67	199
15	492	6.13	559	6.89	541	6.92	643	5.92	754	5.18	727	4.85	742	4.85	728	4.64	778	4.85	809	4.46	786	4.07	790	4.57	160
16	480	5.98	532	6.55	524	6.7	574	5.29	638	4.38	603	4.02	661	4.32	610	3.89	596	3.71	668	3.68	712	3.69	690	3.99	148
17	283	3.53	327	4.03	319	4.08	395	3.64	547	3.76	573	3.82	599	3.92	587	3.74	615	3.83	669	3.69	733	3.80	703	4.07	259
18	391	4.87	426	5.25	384	4.91	544	5.01	698	4.79	778	5.19	743	4.86	770	4.91	834	5.2	1,014	5.59	1,045	5.41	923	5.34	267
19	256	3.19	291	3.58	233	2.98	388	3.57	528	3.62	565	3.77	596	3.9	666	4.24	730	4.55	778	4.29	826	4.28	679	3.93	323
20	333	4.15	445	5.48	432	5.52	587	5.41	724	4.97	675	4.51	683	4.47	754	4.81	851	5.3	916	5.05	912	4.72	833	4.82	274
Delivery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0.04	44	0.25	
Hauling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	144	0.75	118	0.68	
Total	8,021	99.99	8,119	100.01	7,823	100.01	10,854	100	14,566	100.01	14,982	100	15,289	100	15,690	99.99	16,050	100	18,130	100.01	19,303	100.00	17,285	100.02	241

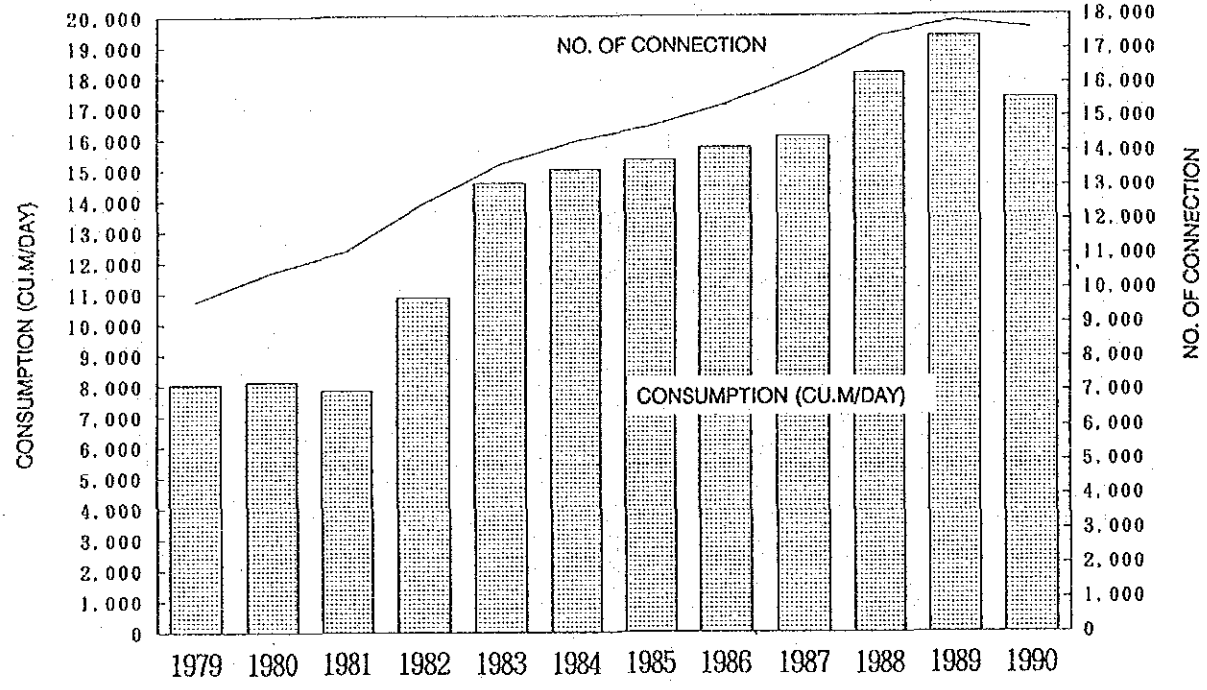


Figure 3-3-1 Transition of Water Consumption and No. of Connections

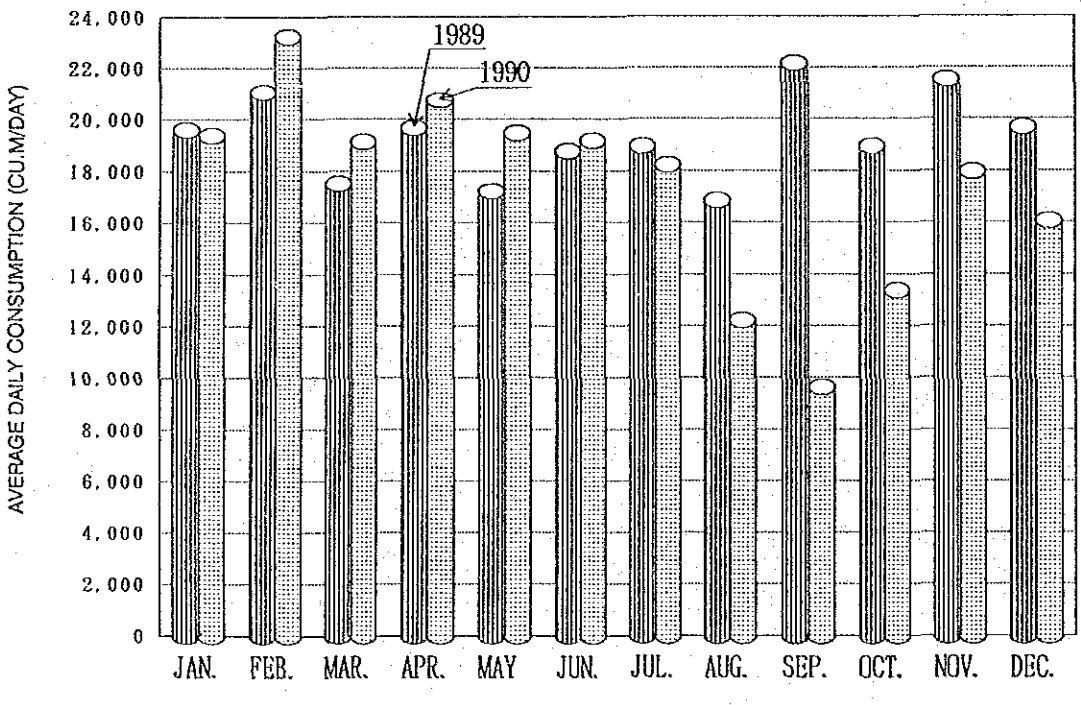


Figure 3-3-2 Monthly Variation of Water Consumption

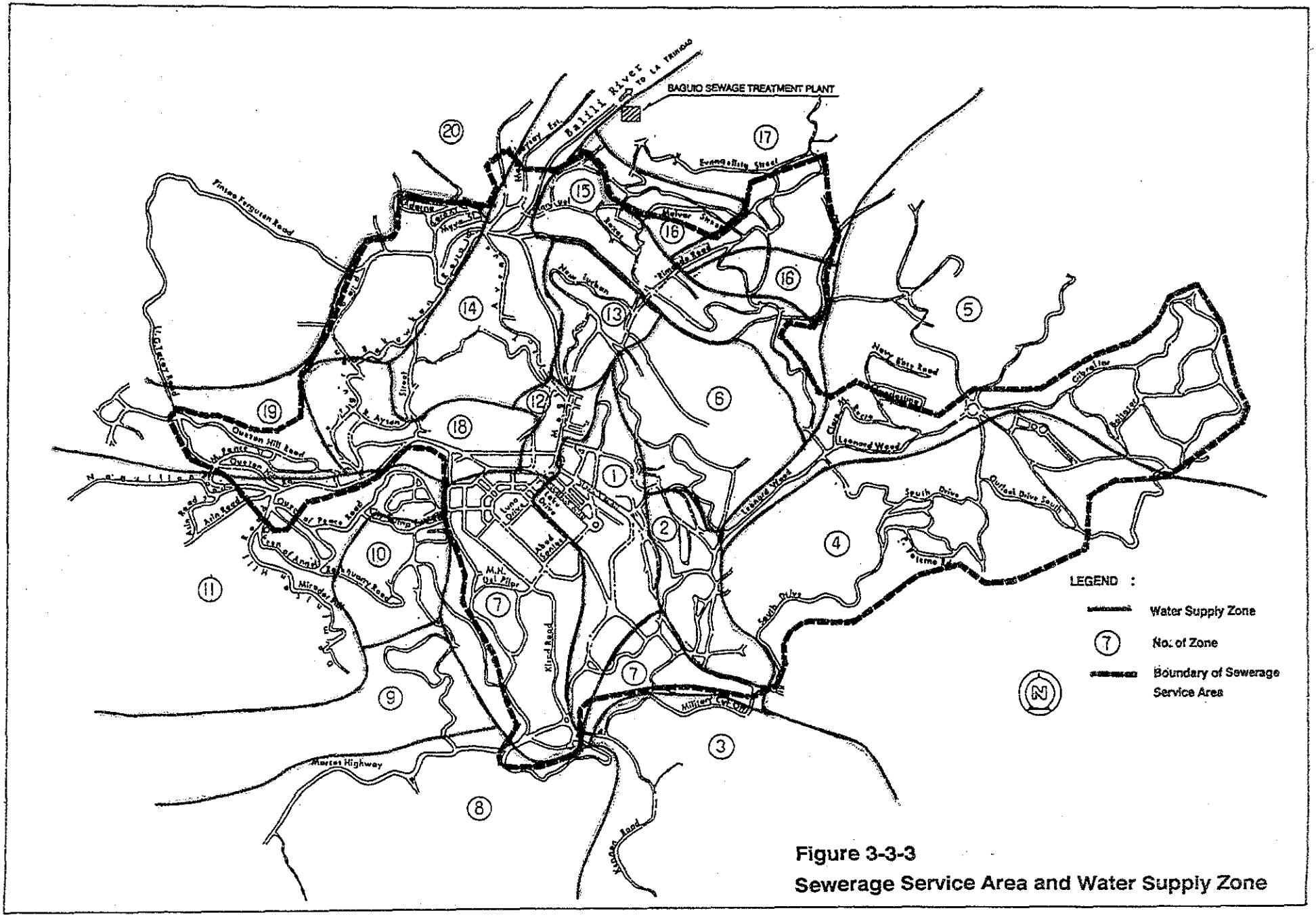


Figure 3-3-3
Sewerage Service Area and Water Supply Zone

Table 3-3-3 Actual Water Consumption by Zone (1989)

Zone	Jan. (cu. m/mo)	Feb. (cu. m/mo)	Mar. (cu. m/mo)	Apr. (cu. m/mo)	May (cu. m/mo)	Jun. (cu. m/mo)	Jul. (cu. m/mo)	Aug. (cu. m/mo)	Sep. (cu. m/mo)	Oct. (cu. m/mo)	Nov. (cu. m/mo)	Dec. (cu. m/mo)	Total (cu. m/y)	Average (cu.m/d)	Share (%)	Sewerage (%)	Area (cu.m/d)
1	33,356	30,354	29,081	29,402	27,933	29,421	29,812	25,150	35,651	31,250	33,230	31,147	365,787	1,002	5.19	100	1002
2	23,557	21,369	22,952	22,293	21,693	20,642	19,937	16,590	24,206	22,267	23,787	22,488	261,779	717	3.71	100	717
3	75,758	81,319	59,257	56,777	52,452	68,501	71,570	41,315	72,533	73,875	75,214	80,077	810,649	2,221	11.51	0	0
4	33,010	29,797	29,372	34,549	32,294	32,030	33,713	26,258	33,850	28,450	32,283	34,817	380,423	1,042	5.40	100	1042
5	35,111	33,479	35,042	37,870	34,137	35,803	36,635	29,353	37,967	32,133	38,470	38,334	424,334	1,163	6.02	90	1047
Sub-Total	200,793	186,318	175,704	182,889	168,509	186,397	191,667	138,666	204,207	187,975	202,984	206,863	2,242,972	6,145	31.83		3,808
6	25,795	28,212	24,141	25,042	20,644	19,567	20,080	20,886	30,064	23,949	30,671	24,242	293,213	803	4.16	100	803
7	34,612	34,646	28,542	37,803	33,522	35,321	33,237	31,960	41,573	33,730	40,643	39,005	424,194	1,162	6.02	90	1046
8	48,499	52,445	45,649	49,692	49,046	49,080	54,210	49,568	59,813	54,378	56,519	55,596	623,495	1,708	8.85	0	0
9	24,856	22,888	20,094	22,477	21,471	21,204	24,096	25,648	27,860	22,959	27,161	24,948	285,662	783	4.06	0	0
10	19,863	19,326	17,660	19,810	19,499	18,135	19,142	17,556	21,457	19,015	21,586	19,862	232,111	636	3.29	0	0
Sub-Total	153,625	157,517	136,286	154,824	142,182	143,307	150,765	145,538	180,767	154,031	176,580	163,253	1,858,675	5,092	26.38		1,849
11	33,272	30,604	27,742	32,880	27,129	28,036	32,280	29,035	34,000	30,755	36,215	31,736	373,684	1,024	5.30	10	102
12	11,428	10,516	10,145	11,487	9,622	9,434	12,964	10,811	13,584	13,293	13,249	11,722	138,255	379	1.96	100	379
13	23,225	23,485	21,807	22,308	19,667	19,283	22,950	24,316	27,722	20,884	23,168	22,935	270,850	742	3.84	100	742
14	23,527	23,309	20,395	22,774	18,332	22,777	22,724	24,744	27,549	22,984	25,169	21,526	275,830	756	3.92	80	605
15	21,863	23,870	22,409	23,226	21,508	24,448	24,835	24,552	28,302	24,420	24,659	23,547	286,839	786	4.07	100	786
Sub-Total	113,315	110,984	102,498	112,675	96,258	103,978	115,753	113,458	131,157	112,336	122,460	110,566	1,345,458	3,686	19.10		2,614
16	20,798	19,803	19,921	22,305	18,537	23,407	21,699	19,961	25,343	22,221	24,759	21,258	259,952	712	3.69	70	498
17	23,477	21,170	20,931	21,825	23,728	22,312	22,543	20,608	24,066	22,686	23,848	20,336	267,522	733	3.80	70	513
18	33,805	27,691	31,036	31,269	24,197	26,401	30,761	32,429	41,012	37,883	36,031	29,042	381,557	1,045	5.41	100	1045
19	28,576	25,280	23,651	26,118	24,030	22,176	23,165	23,251	27,555	24,184	27,276	26,045	301,315	826	4.28	90	743
20	28,225	27,134	24,986	30,314	28,417	31,408	26,270	23,983	27,605	25,343	30,882	27,987	332,764	912	4.72	20	182
Sub-Total	134,881	121,086	120,525	131,831	118,909	125,704	124,438	120,164	145,781	132,317	142,806	124,668	1,543,110	4,228	21.90		2,981
Delivery					795	802	258	142	161	166	258	257	2,839	8	0.04		
Hauling	4,984	4,182	7,504	8,416	7,014	3,154	4,106	4,068	3,002	644	1,109	4,234	52,417	144	0.75		
Total	607,598	590,087	542,517	590,635	533,667	563,342	586,987	522,036	665,075	587,469	646,217	609,841	7,045,471	19,303	100.00		11,252
Average (cu. m/d)	19,600	21,075	17,501	19,688	17,215	18,778	18,935	16,840	22,169	18,951	21,541	19,672					
Variation	1.02	1.09	0.91	1.02	0.89	0.97	0.98	0.87	1.15	0.98	1.12	1.02					

Damaged facilities of the Sto. Tomas Reservoir include the intake dam covered by landslide, clogged conveyance line going to reservoir, cracked dam and torn-off hypalon liner. The dividing walls of the Km. 8 Reservoir collapsed and the riprap walls had cracks on the side and bottom.

The transmission line had damages at the 300 m long 250 mm GI pipe from Sto. Tomas Reservoir, 350 m long 250 mm GI pipe from Amliang Spring, 300 m long 250 mm GI pipe from Ramsey Deepwell, 900 m long 100 mm GI pipe on Naguilian Rd., 2,500 m long 200 mm GI pipe going to the Baguio Export Processing Zone and 2,000 m long 50 mm GI pipe on Balacbac Rd..

The deepwells were also damaged by the earthquake. Out of 35 deepwells, only 22 wells were operational, with only about half operating normally and the other half on an on-and-off basis. The remaining 13 wells were not operational due to damage in structure and equipment. For example , the collapse of Hilltop Hotel building caused fatal damage to the its deepwell and pump station.

Pipeline was broken at numerous points other than those mentioned above.

Those damages has been restored gradually but water supply capacity has not yet reached to the level before the earthquake. Annual water consumption amounts to 6,656,716 cu.m before the earthquake and 5,643,280 cu.m which is equivalent to 84.4% of the former.

The bulk water consumer whose monthly consumption exceeded 100 cu.m in only one month in 1989 counted 383 in connection number and 1,288,480 cu.m in annual consumption, out of which nine(9) connections with an annual consumption of 117,474 cu.m in 1989 stopped to receive water supply due to the damages by the earthquake. Such consumption was equivalent to 9.1% of bulk water consumption and 2.9% of the total water consumption in the sewerage service area and has less affect on the design sewage flow.

3.3.2 Living Environment

a) Public Health

There are 8 hospitals with a total of 836 beds operating in the City, 6 of which are privately operated and 2 government owned public hospitals. Considering that the required bed is one for every 1,000 people, the City has beds five times as many as required causing the City to accept not only the local people but the people from other areas as well. Besides these hospitals there are many non-hospital health facilities such as District Health Centers, Family Planning Clinics, and School Clinics which cater to the health needs of the population.

The occurrence of food and water-borne diseases in the City is shown in Table 3-3-4. Diarrhea is most prevalent in Baguio followed by Typhoid Fever and Dysentery. Diarrhea is always ranked first having a rate of incidence per 100,000 people for the past five years (1984 to 1988) at 1,111.45 compared to that of Bronchitis at 824.05.

Table 3-3-4 Food and Water-borne Diseases

Causes	1984	1985	1988	1989	5-yr Ave. (1984-88)
Diarrheas	1,802	1,335	1,983	2,742	1,576
Typhoid Fever	123	189	275	238	198
Dysentery	275	210	215	141	201
Food Poisoning			17	10	6

Data Source: Baguio Health Department

b) Solid Waste Disposal

The report on the "Feasibility Study for Solid Waste Disposal Systems for Baguio City and La Trinidad, Benguet" prepared in 1987 states that:

> For Baguio City, 75% of the population is served by the existing collection system. Approximately 88,770 persons are served out of the total population of 118,611. The existing collection fleet

consist of six dump trucks which were acquired between 1969 and 1978. The collection truck is designed to carry 7 cu.m. of garbage per trip. Each truck could make two round trips per day between the collection area and disposal site. The existing collection rate averages 1.62 liters/person-day which is 40-60% lower than the average solid wastes generation rate in Philippine Cities of similar state of development as Baguio City. Actual sampling from residences carried out on February 7 to 11 showed an average solid waste generation rate of 1.13 to 1.8 kg/person-day. The average wastes density for residential areas is 400 kg/cu.m. Hence, the average solid waste generation rate in terms of volume is 2.83 to 4.5 liter/person-day which would make it equal to typical solid waste generated in other cities. The uncollected solid wastes are often dumped, burned in the backyard or used as filling materials. Further, improvement in the collection efficiency would involve increasing the collection area by 10% since the remaining 15% of Baguio City are inaccessible. The solid waste density of 400 kg/cu.m. would decline in the future due to extensive use of plastic and paper compared to banana leaves as wrapping materials.

The open dump at Irisan along Naguilian road is a health hazard to downstream communities specially the densely populated towns of La Union Province. The garbage are washed out to the Naguilian River during heavy rains. Leachate is a serious problems due to the limestone formation in the immediate vicinity of the open dump. During summer months the smoke from the burning garbage is a nuisance and a hazard to the traffic along the national highway. In addition to the odor and smoke problem, particles of garbage are blown by the wind to nearby residences and tourist resorts.

Two of the collection trucks for Baguio are more than 15 years old which are operated beyond its useful life. Those trucks including the Isuzu States body truck acquired from the Water District will have to be phased out or utilized only for the market areas. The other three collection trucks will have to be phased out in 1988. Due to the rolling terrain of the service area the trucks are depreciated faster than in flat areas. La Trinidad will need one new truck with ten cu.m. capacity and one small jeepney. The

present dump truck is non-serviceable.

Collection efficiency is lowered by garbage scattered along the roadside and open areas. The collection crew have to sweep the garbage before they load it into the trucks. Garbage are scattered due to failure of the collection crew to collect the garbage regularly due to breakdown of the trucks.

The City has an affluent natural environment, the condition of rivers has been becoming worse. The major causes of pollution are inflow of sewage, and dumping of garbage. Sewage inflow, will be improved remarkably with the implementation of the Project, however, the environment of rivers will not be improved as long as the solid waste disposal condition is left as it is. It is recommended that comprehensive measures against the solid waste disposal problem be taken immediately involving reinforcement of collection capacity, solution of access problem, enlightenment of people's awareness, etc.

3.3.3 Water Pollution Condition in the Balili River

Water quality analyses on the Balili River were conducted during the field survey period. Measuring points are shown in Figure 3-3-4. Results of analyses are compared with the results obtained in 1984 in Table 3-3-5.

The M. Roxas Creek originating from the vicinity of the Baguio Water District runs along M. Roxas Street joining creeks of Teachers Camp, Leonard Wood, Pacdal, A. Rimando, and Magsaysay and flows into the Balili River together with the Ferguson Creek. Those creeks have previously been clean due to the inflow of spring water but are now heavily polluted with the inflow of sanitary sewage that leaked from the existing sewer system and directly discharged from the houses. The M. Roxas Creek with a BOD value of 62 mg/l at Point 1 beside a basketball court in Teacher's Camp, is polluted to 170 mg/l at Point 2 downstream immediately after joining the Teacher's Camp Creek which receives wastewater from Hotel Hyatt Terraces Baguio. The water quality of the M. Roxas Creek is then improved upon joining the Pacdal Creek which is the only creek left which not so polluted and worsened to 170 mg/l at Point 5 upon joining the A. Rimando

Creek, which passes through the densely inhabited area of the Aguinaldo Park and has a value of 243 mg/l at Point 4. The Creek joins the Magsaysay Creek which receives wastewater with a BOD value of 490 mg/l at Point 6 from the city core or the business section and flows into the Balili River.

The Ferguson Creek, the water quality of which is 11 mg/l in BOD at Point 7 but changes hourly, also joins the Balili River. The sample at Point 8 is an overflow from the manhole and has a BOD value of 165 mg/l. The Balili River shows 150 mg/l in BOD downstream of the sewage treatment plant.

The results of the survey in April 1990 shows almost the same trend as that in February 1984, though it should be noted that the creek water always varies in appearance and quantity.

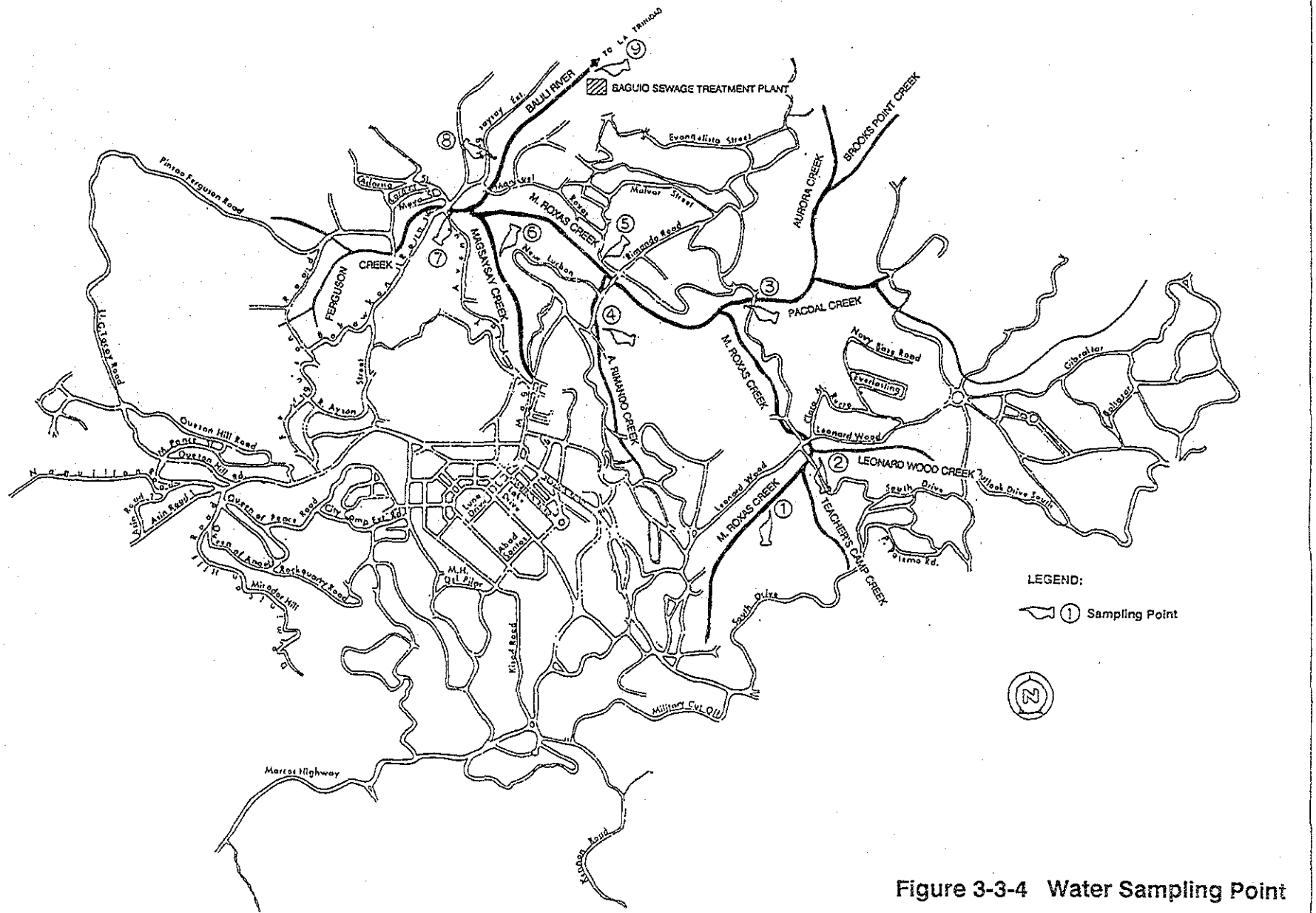


Figure 3-3-4 Water Sampling Point

Table 3-3-5 Results of Water Quality Analysis

Parameter	Temp. °C	pH	ORP mV	SS mg/l	NH_4-N mg/l	T-N mg/l	Cl mg/l	DO mg/l	COD mg/l	BOD mg/l
1. Teacher's Camp*	22.8	7.05	-	190	-	-	-	0	107	62
Basketball Court	-	-	-	-	-	-	-	-	-	-
2. Teachers's Camp	21.7	7.1	-	210	-	-	-	1.0	111	170
Bridge	19	7.46	-50	10	6.00	21.6	150	0	40	18
3. Brookside	-	-	-	-	-	-	-	-	-	-
	22.5	8.04	104	6	0.10	0.7	82	7.9	10	1.2
4. Rimando Rd.*	23.2	6.95	-	450	-	-	-	0	173	234
(Upstream)	-	-	-	-	-	-	-	-	-	-
5. Rimando Rd.*	23.7	7.1	-	200	-	-	-	0	109	170
(Downstream)	-	-	-	-	-	-	-	-	-	-
6. Magsaysay	22.2	6.8	-	1,020	-	-	-	0	262	490
Private Rd.	22	7.66	180	530	7.60	74.6	266	0	520	190
7. Magsaysay	21.6	7.05	-	10	-	-	-	4.7	16	11
Bridge	22	7.52	-18	3	1.70	4.6	150	0	40	60
8. Pines Hospital*	22.6	7.35	-	230	-	-	-	0	109	165
	21	7.01	-220	140	8.30	55.8	196	0	260	120
9. Sanitary Camp	21.1	6.9	-	370	-	-	-	0	98	150
	22	7.37	-150	460	7.30	125.0	242	0	700	370

Upper: Sampled on Apr. 5 (not *-marked) and 11 (*-marked), 1990
Lower: Sampled on Feb. 15, 1984 for field analysis (Temp., pH and ORP) and on Feb. 16, 1984 for laboratory analysis (other parameters)

3.4 Outline of the Sewerage Sector

3.4.1 Sewers

The study area is on undulating land as stated in Section 3.2.1 "Topography", and leans to the point where the La Trinidad Road, administrated by the national government, passes through to La Trinidad. The BSTP is located near the city boundary on the other side of the Balili River opposite the La Trinidad Road. Hence, the sewage discharged within the Balili River Basin can be collected and transported to the BSTP by gravity. However, a road network does not always exist along creeks, even if a road runs along a creek, it sometimes detours and is at a higher

elevation, thus the longitudinal profile of roads have undulations not like creeks. Consequently, in case sewer pipes are installed under roads, depth of sewer should be such that collected sewage will flow to the BSTP by gravity.

- Sewer constructed before the War were broken or washed out by heavy rains at many places as shown in Figure 3-4-1, and sewage has been flowing into creeks. Concrete pipes for buried sections, and steel or cast iron pipes for exposed sections including bridge sections were used. Invert of concrete pipes are rough due to erosion and corrosion, and have been deteriorated. Steel pipes are severely corroded and having holes in their walls.

- Replacement of sewer lines has been executed partially in line with the concrete paving of roads from 1983. However, this replacement was executed for concrete pipes only, and steel pipes remained as is. These replaced pipes have not had any problems as yet.

- Some sewer pipes on river crossings were bridged without any pier or support. For small creeks, however, crossing on posts is common. There used to be cable-suspended wire-hanging sewer pipes but at present, only a few exist.

- Principal sewer route is shown in Figure 3-4-1 with the location of washed out or damaged sewer pipes indicated. It can be understood from the figure that only the sewage discharged from the area of Sanitary Camp and Aurora Hill flow into the BSTP.

- In some areas located at places lower than the roads with sewer pipes, sewer pipes are installed separately, however only a few sections are working. The sewer pipes installed out of roads mostly exist in private lands and some of them run under the houses. The route of the sewer pipes in the Business Section were changed to connect with drainage pipes because of the insufficient flow capacity of the sewer pipes.

The damage by the earthquake to a sewer system was less in comparison with those to a water supply system. This might be caused by the fact that sewage had leaked from the numerous breakages of the existing sewers into the river/creeks, therefore the damage to the existing sewers were not easily identified.

Three damages to the existing sewers are reported; (1) breakage of 300 mm concrete pipe at Magsaysay Rd. due to ground settlement, (2) falling of 150 mm GI pipe at Rimando Rd. crossing the M. Roxas Creek, and (3) breakage of 250 mm concrete pipe at Ferguson Rd. due to movement of the shoulder. Only a breakage at Ferguson Rd. was restored.

The BCG has already replaced the broken steel pipes behind the slaughter house with other steel pipes to solve the problem of sewage leakage

3.4.2 Sewage Treatment Plant

Operational condition of the sewage treatment plant before the earthquake are as follows:

The Baguio Sewage Treatment Plant (BSTP) constructed as a grant-aid project of the Japanese Government was inaugurated in March, 1987, and is presently in good condition. Present sewage inflow ranges between 1,400 and 2,400 cu.m/day in dry season (November to April), and 2,500 and 5,000 cu.m/day in rainy season (May to September) as shown in Figure 3-4-2 which obviously implies the existence of rain water intrusion. (The operational condition from February to March, 1990 seems to be abnormal and it should be ignored in consideration). Design treatment capacity of the BSTP is 8,600 cu.m/day, thus it is operated under the load of 16 to 28% of its capacity in dry season. There are 4 oxidation ditches as main facilities. Though the 1-ditch-operation is enough considering its treatment capacity, 2 ditches were operated at the same time of field survey (April, 1990). Power consumption ranges between 250 and 510 kwh/day, and the power consumption per 1 cu.m of sewage inflow was 0.15 to 0.17 kwh in dry season and 0.08 to 0.20 kwh in wet. It has a tendency to decrease according to the increase of sewage inflow.

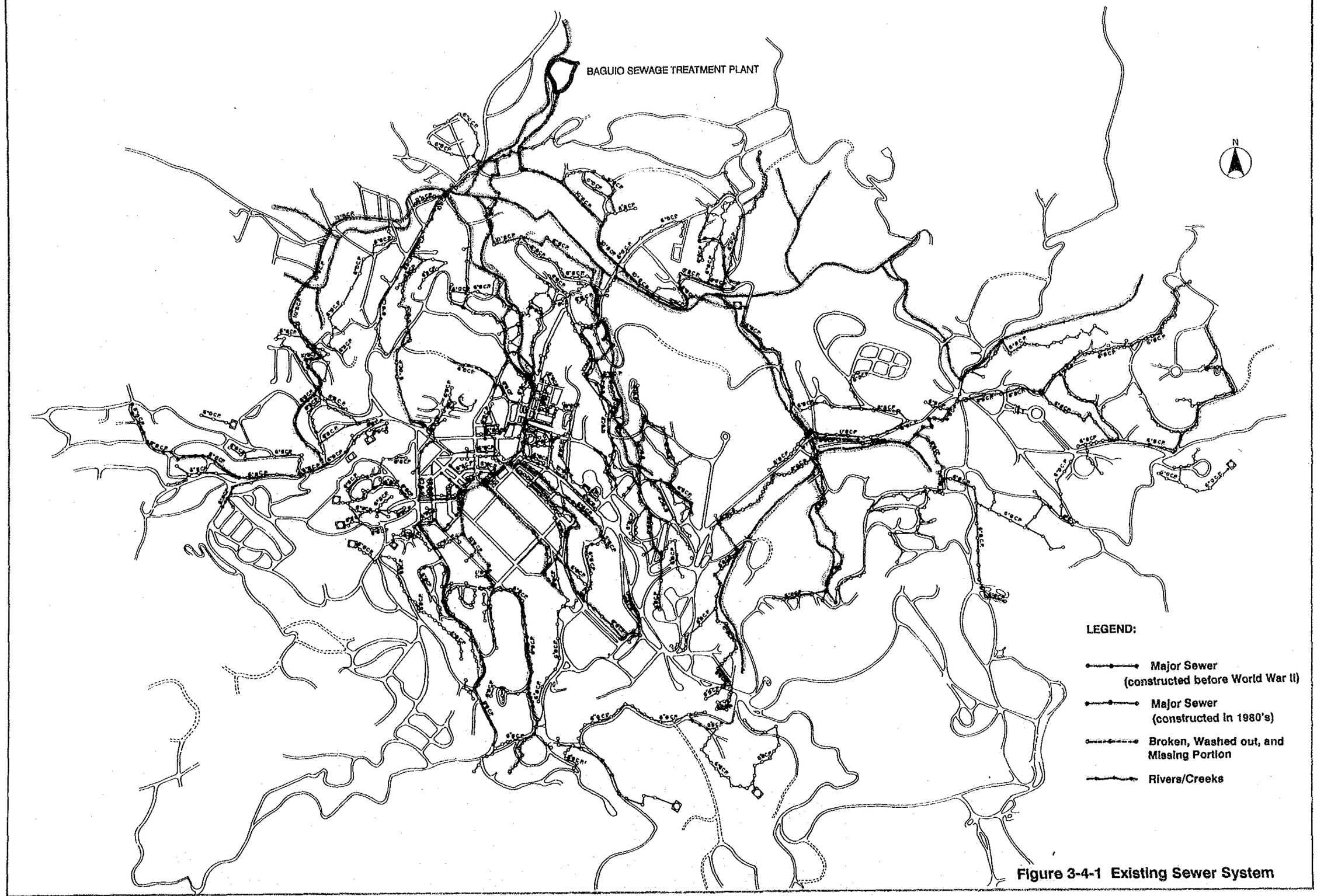


Figure 3-4-1 Existing Sewer System

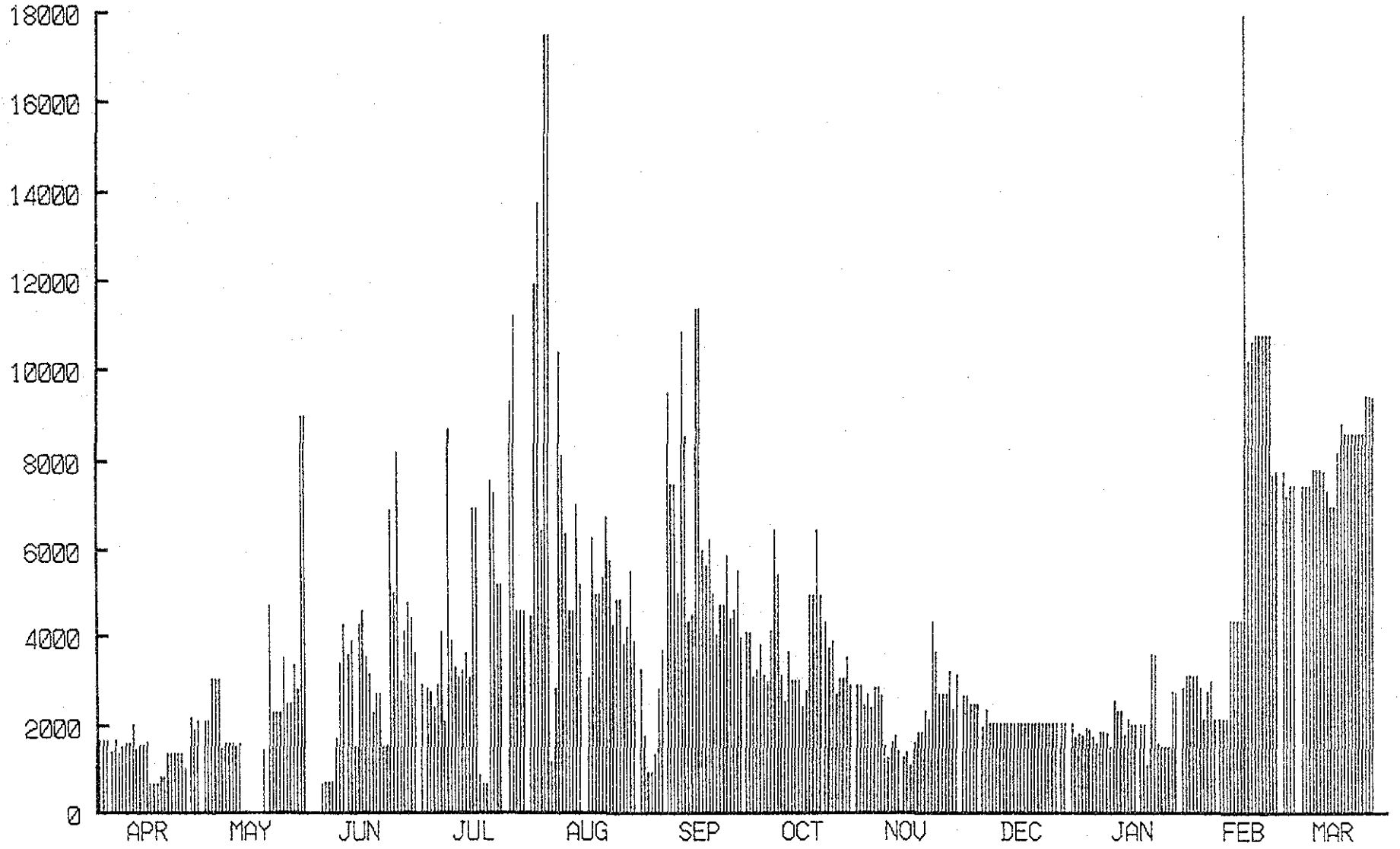


Figure 3-4-2 Inflow of Sewage Treatment Plant (April 1989 - March 1990)

Water quality analyses on pH, transparency of the influent and effluent, and pH and SV of the mixed liquid in the oxidation ditches are conducted every day in general. Analyses on T-BOD, S-BOD, T-COD, S-COD of the influent and effluent in 2 to 4 times a month, and MLSS of the mixed liquid in the oxidation ditches in 3 to 5 times a month have been conducted likewise. Incubating bottles being used for BOD analyses is equipped to cope with 4 samples at a time (4 bottles each for BOD and DO, 8 bottles in total are used for 1 sample).

Thus, when the analyses on T-BOD and S-COD of influent and effluent is prepared at the same time, the next analysis could not be conducted until 5 days has passed. Table 3-4-1 shows the results of these analyses (See Table 7 in Appendix 6).

As to water quality of influent and effluent during the dry season, in which rain water intrusion is less, it can be summarized as follows:

Table 3-4-1 Quality of Influent and Effluent in the BSTP

Item	Influent			Effluent			Removal Rate (%)
	Number of Samples	Range	Average	Number of Samples	Range	Average	
SS (mg/l)	17	236-760	458	21	4-30	12	97.4
T-COD(mg/l)	1	167	167	1	14	14	91.6
S-COD(mg/l)	1	91	91	1	16	16	82.4
pH	36	6.65-7.65		36	5.55-6.60		
Trans.(cm)	36	1.75-4.76	2.67	36	27-30	30	
T-BOD(mg/l)	12	142-447	309	13	2-24	12	96.1
S-BOD(mg/l)	13	51-310	160	13	2-26	13	91.9

The result of these water quality analyses shows:

o High SS, T-BOD, and S-BOD of influent such as 458 mg/l, 309

mg/l, and 160 mg/l respectively even in average.

- o These were treated to less than 20 mg/l, and average removal rate exceeds 90%.

Draw off of the excess sludge from final sedimentation tanks is not being done at present; the sludge in the tank is returned to oxidation ditches by return sludge pumps with a rate of 10 minutes 3 times a day. Based on the experience of the City, the treatment efficiency become worse when the MLSS of oxidation ditch become less than 3,000 mg/l, and better when the MLSS is over 4,000 mg/l. Present operation method is in line with this goal.

The BSTP also accepts water quality analyses from outsiders mostly involving the Department of Environment and Natural Resources (DENR). Besides the BSTP, the St. Louis University is capable of conducting water quality analyses, but the governmental agencies prefer the BSTP due to the lower rates of the charge for analyses which are as follows:

BOD	₱ 150/sample
COD	₱ 100
SS	₱ 50
DO	₱ 60
pH	₱ 50 (in-situ analyses)
Transparency	₱ 10

The status of operation and maintenance after the earthquake are as follows:

The sewage treatment plant has almost no damage by the earthquake. In this connection, the following are specified:

- o Some glasses including a transparency vessel were broken at the time of earthquake.
- o The operation of the plant was forced to suspend for nine(9) days due to power failure.
- o Water quality analysis could not be done till the end of September since the laboratory staff were busy for repair of their own houses and rescue activity in the city.

- The sludge drying beds with a roof was open to residents upon request of the barangay captains and the people had sleeps at the drying beds in night and repaired their own houses in daytime for one month.

The interval of meter reading for sewage flow and power consumption becomes longer. The meter reading was done once 10 days at longest before the earthquake but once a month from time to time after the earthquake, therefore it is difficult to identify the tendency of those daily fluctuation.

Present sewage inflow ranges between 1,050 and 4,350 cu.m/day in dry season (November to April), and 940 and 4,630 cu.m/day in rainy season (May to September) which implies the existence of rain water intrusion (See Table 4 in Appendix 6). Though the 1-ditch-operation is enough considering its treatment capacity, 2 ditches were operated at the time of field survey (July, 1991). Power consumption ranges between 560 and 810 kwh/day, and the power consumption per 1 cu.m of sewage was 0.32 to 1.30 kwh in dry season and 0.15 to 1.30 kwh in rainy season. However, those results are doubtful due to the problem in data as mentioned earlier (See to Tables 5 and 6 in Appendix 6).

The frequency of water quality analysis is also irregular and ranges between zero to six(6) times a month for parameters excluding pH and transparency.

The average SS, total BOD and soluble BOD are 296, 184 and 107 mg/l in influent, respectively and less than 20 mg/l for each case in effluent in dry season. The average removal rates are above 90%.

The 9-day power failure seems to have caused the death of some activated sludge in the oxidation ditches of which the concentration was 2,290 mg/l in September when the analysis was resumed, but 4,570 mg/l immediately before the earthquake. The concentration was in an unstable condition till exceeding 3,000 mg/l in January 1991, then increased gradually and at present has recovered the same level as that before the earthquake. The sludge volume has been kept at 10 to 20% in 1991 which implies that the activated sludge has a good settlability.

Table 3-4-2 Quality of Influent and Effluent in the BSTP

Item	Influent			Effluent			Removal Rate (%)
	Number of Samples	Range	Average	Number of Samples	Range	Average	
SS (mg/l)	14	160-730	296	14	4.0-38.7	11.6	96.1
T-COD(mg/l)	15	16.8-291	123	14	12.0-25.7	12.2	90.1
S-COD(mg/l)	15	57.6-166	70.1	14	2.4-21.6	9.9	85.9
pH	52	7.35-7.95		51	5.70-7.25		
Trans.(cm)	48	2.0-3.5	2.2	49	15.0-30+	30+	
T-BOD(mg/l)	11	154-346	184	12	1.9-17.5	7.7	95.8
S-BOD(mg/l)	11	60.4-197	107	10	4.3-15.9	4.9	95.4

The laboratory staff is now training the students for water quality analysis who major in sanitary engineering at the request of Baguio University.

3.4.3 Organization and Management of the Sewerage System

The Office of the City Mayor which is indirectly in charge of the management of the BSTP consists of the following 6 divisions directly under the control of the Mayor:

- Administrative Division
- Personnel Services Division
- Special Services Division
- Public Services Division
- Civil Security Unit
- Emergency/Casual Employees

An organization structure of the BCG is presented in Figure 3-4-3.

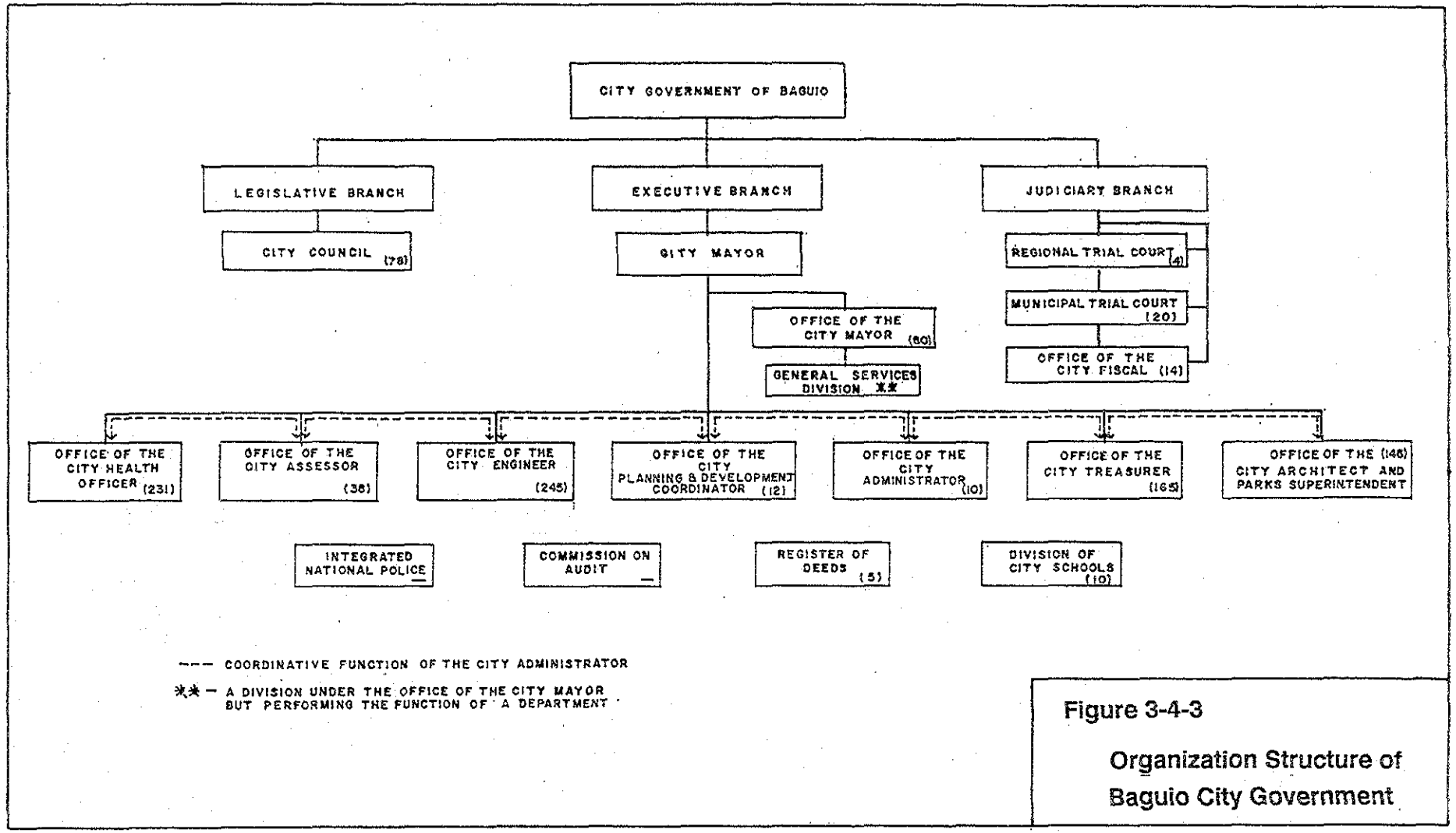


Figure 3-4-3

Organization Structure of Baguio City Government

The Public Services Division has two sections, the Inspection Section and the Sewerage Section. The Inspection Section is in charge of inspection on the mechanical, electrical and plumbing equipment and facilities of houses and buildings, and maintenance of street lights. The Sewerage Section is in charge of operation and maintenance of sewerage system.

Though the prescribed number for the Inspection Section is 16 and 11 for the Sewerage Section, 4 and 5 positions are vacant respectively. Mrs. Catherine A. Buccat, Senior Safety Engineer, manages both sections.

The BSTP has 4 staffs in charge of civil work, machinery, electric equipment and water quality respectively, and 2 laborers for cleaning of grit chambers and final sedimentation tanks. The staff in charge of water quality always stays in the BSTP and should the need arise, the staff in charge of civil works is also called on the cope with matters on machinery, electrical equipment, and water quality. He however belongs to the Inspection Section and is senior plumbing inspector. He is familiar with not only the sewage treatment plant but sewer systems as well.

The present management system of Baguio City for sewage works has the following problems:

- The sewerage section is only one of sections in the office of the City Mayor and its works are not clearly distinguished from those of the inspection section which belongs to the public services division as well as the sewerage section. Therefore, the staff has two different kinds of work to do and does not exclusively work for the sewerage section.

- Although the sewage charge is being collected, it is regarded as one of the City's revenues and the sewerage section is managed with the City general budget. For this reason, the budget for the sewerage section has been reduced due to the financial condition of the Baguio City Government or split to the disaster recovery program.

- The present sewage tariff has not been decided to recover the

actual operation and maintenance cost which is expected to increase rapidly by the implementation of the Project.

- This Project will cover the main facilities but not all facilities and the City has to rehabilitate the facilities not to be covered. However, the present budget and organization for sewage works are too weak to do so.

- The present sewerage tariff will be presumably transferred from the flat rate system by type to a meter-rate system. In such a rating system, it is dispensable for the Baguio City Government to cooperate with the Baguio Water District. The City Government could decide the sewerage rate with its own data in a flat rate system by type but cannot by itself due to no data in a meter-rate system. The Water District, which has the data on water supply and a collection system of water charge, may undertake the collection work of sewerage fee which will be useful in simplifying the work of the sewerage section.

CHAPTER 4
OUTLINE OF THE PROJECT

CHAPTER 4 OUTLINE OF THE PROJECT

4.1 Objectives

The Baguio Sewage Treatment Plant was constructed as a grant-aid project by the GOJ to solve the water pollution problem of the Balili River, and it started operations in 1987. However, rehabilitation work on the existing sewer system had to be undertaken to supplement the BSTP but due to financial constraints only a limited portion was rehabilitated. As a result, the BSTP is able to treat sewage inflow which is approximately 20% only of its design capacity, and the rest of the sewage flow directly into the Balili River from leaking points of the sewer system. Thus, the water pollution problem of the Balili River remains unsolved up to the present.

The objective of this Project is to improve water pollution of the Balili River with the rehabilitation of the sewer system and to utilize the BSTP at its full capacity.

4.2 Examination on the Request

4.2.1 Appropriateness and Necessity of the Project

Based on the results of water quality analysis on the Balili River, it is obvious that the water pollution status of the river has not been improved in comparison with the condition in 1984. This matter is also presumable from the fact that only a part of the sewage discharged from the service area flows into the BSTP, and most of the sewage discharged from the service area including the City proper flow into creeks through damaged sewer pipes. (Dumping of garbage is one of the causes of water pollution of the Balili River. However, a degree of influence by decaying and leaching of garbage is not definite.)

The BSTP with a treatment capacity of 8,600 cu.m/day was inaugurated in March, 1987. Its inflow sewage, however, amounts to only 16 to 28% of its treatment capacity, and most of the facilities are not in use. Presently, operation and maintenance of the BSTP is in good condition.

The existing sewer system in the City covers almost all of the Balili River basin. However due to breakage, washing out, and absence of sewer pipes in many places, most of the sewage flow into the Balili River, with the exception of the districts of Aurora Hill and Sanitary Camp which are located near the BSTP.

Therefore, the improvement of the water pollution condition in the Balili River can be expected with the increase of sewage inflow to the BSTP through the rehabilitation of the sewer system. However, since the BCG does not have enough funds, the repair works of the sewer has proceeded very slowly. Thus, that situation is not expected to improve in future.

The implementation of the Project will improve this situation drastically, and an immediate effect by the Project is greatly expected. Consequently, this Project meets the purpose of the grant-aid project of the GOJ sufficiently.

4.2.2 Executing Agency

With the assumption that this Project is a Grant-Aid Project of the GOJ, the government agency concerned with the implementation of the project is LWUA during the construction period. All planning, institutional and engineering aspects of project implementation are LWUA's concern while programming, financing and construction are under DPWH. The functions and responsibilities of government agencies for sewerage and sanitation outside Metro Manila are shown in Table 4-2-1.

The implementing agency is LWUA during the construction and the BCG during the operation and maintenance to which the facilities will be turned over after completion of the Project. The BCG and the BWD, which will participate in the billing and collection of the system based on the agreement with the BCG, will cooperate with LWUA during the construction.

LWUA was the executing agency of the BSTP Construction Project in 1984, and it also executed the study on the improvement of the sewer system of Baguio City by request of the BCG. Therefore, LWUA is well

acquainted with the sewerage system of the City, and has no problem as an executing agency of the Project during the construction.

The BCG owns and maintains the existing sewerage system including the BSTP and the new system will compose a part of the system. Hence the BCG is suited for an executing agency after completion of Project as it has much experience in operation and maintenance of the system..

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

The contents of the request on the Philippine side confirmed was to implement the project as previously planned, which was accepted in principle in the present plan although including some deletion and addition.

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 intake facility to take sewage flowing in the river will be also constructed

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

The following equipment is considered appropriate to the equipment supply.

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.

The following which was retained in the previous plan due to the vague details is added to the equipment supply.

Computer sets are requested by the BWD which will undertake the billing and collection of sewage fees. The BWD has presently two sets of computer which were used for billing of water charge, however due to the lack of capacity, the bills were issued in the form of computer output for one half and handwriting for the remaining half which caused the complaints in the users. For this reason all of the bills are hand-written at present and the computer is used for payroll and inventory control only. As the working volume in the BWD is expected to be 50% up by undertaking the billing of sewage fees, it is necessary to improve the efficiency of the work by introduction of new computer sets which also make a various kind of data analysis possible.

4.2.6 Need for Technical Cooperation

It is recommended that a JICA short-term expert be dispatched for three months in around April 1994, when the project is expected to complete, to Baguio to ensure the outcome of the Project due to the following:

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

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

- 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 Philip-

pine 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;

- o 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;
- o 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.

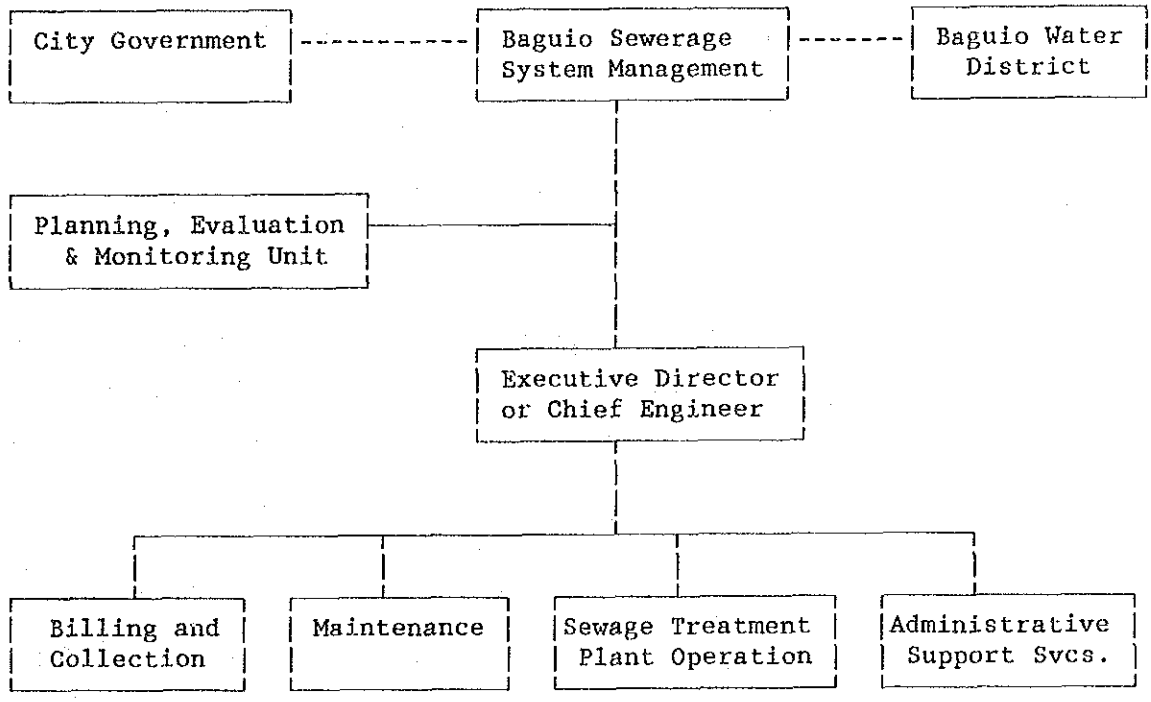


Figure 4-3-1 Planned Organization Structure for Management of Sewerage System (Joint Management)

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:

- 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

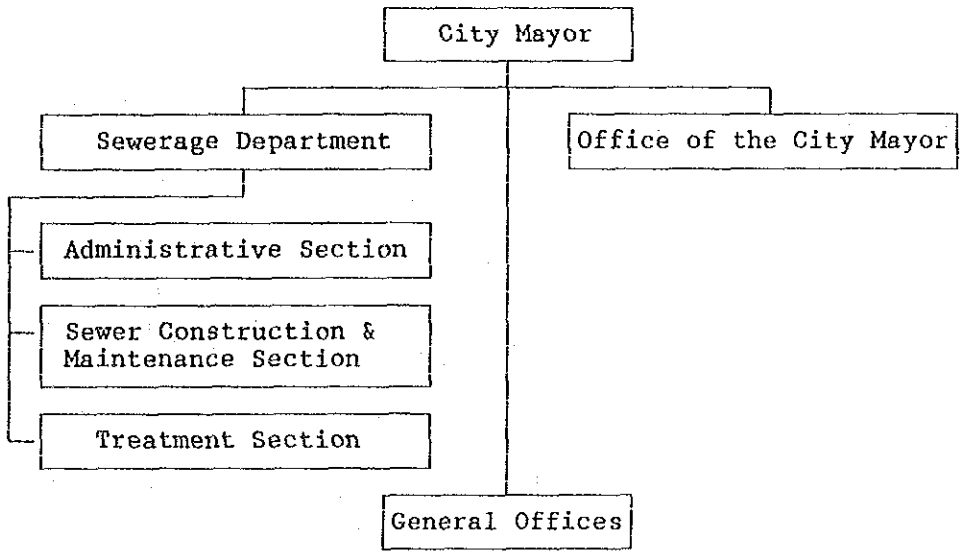


Figure 4-3-2 Planned Organization Structure for Management of Sewerage System (Baguio City Government)

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

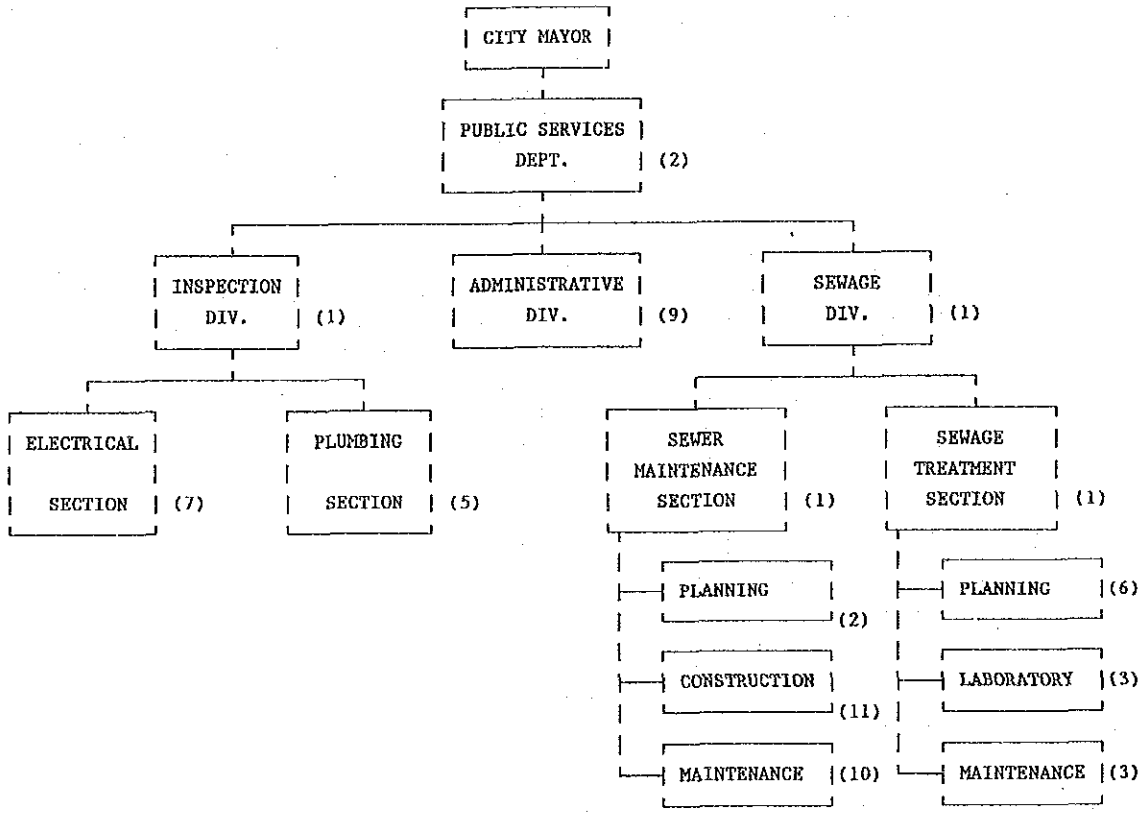


Figure 4-3-3 Organization Structure for Management of Sewerage System Newly Proposed by Baguio City Government

This organization is similar to that proposed by the Study Team except for the inspection division which is originally responsible for inspection of building equipment and is planned to undertake the inspection of house connection works in the new structure.

The number of personnel is expected at 49 persons while 29 persons proposed by the Study Team. Excess manpower requirement will cause the

increase of the expenditure for sewage works, therefore it is recommended to minimize the number of personnel at the beginning for sound management and augment gradually as required.

Regarding the new organization for sewage works, the BCG has a plan to coordinate internally in future and get the approval of the assembly by May 1992.

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.

The intake facility with a weir will be constructed additionally at three points in the river/creeks to collect sewage which are directly discharged from the houses along the river or leaked from the broken existing sewers upstream of the new trunk sewer network, although not being included in the previous plan

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	172,885
b. Population within the Sewerage Service Area in 1989	72,597
c. Population in 1992	190,873
d. Population within the Sewerage Service Area in 1992	80,151
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 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:

(80,151 persons x 0.106 cu.m/c/day x 0.85 + 3,530 cu.m/day) x 0.80
= 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

Although the stating point of the line was placed at Baguio Hyatt Terraces Hotel in the previous plan, the line is partly cut and the start-

ing point is moved to the south entrance of Teacher's Camp due to the unknown schedule for reconstruction of the Hotel in this plan. Teacher's Camp Main runs Teacher's Camp Rd. northward to join M. Roxas Main. However, the size and elevation of the sewer at the starting point is set so as to receive sewage from the Hotel.

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.

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 rotary near the St. Louis University and connected to M. Roxas Main.

e) Magsaysay Main

Magsaysay Main starts from the rotary 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.

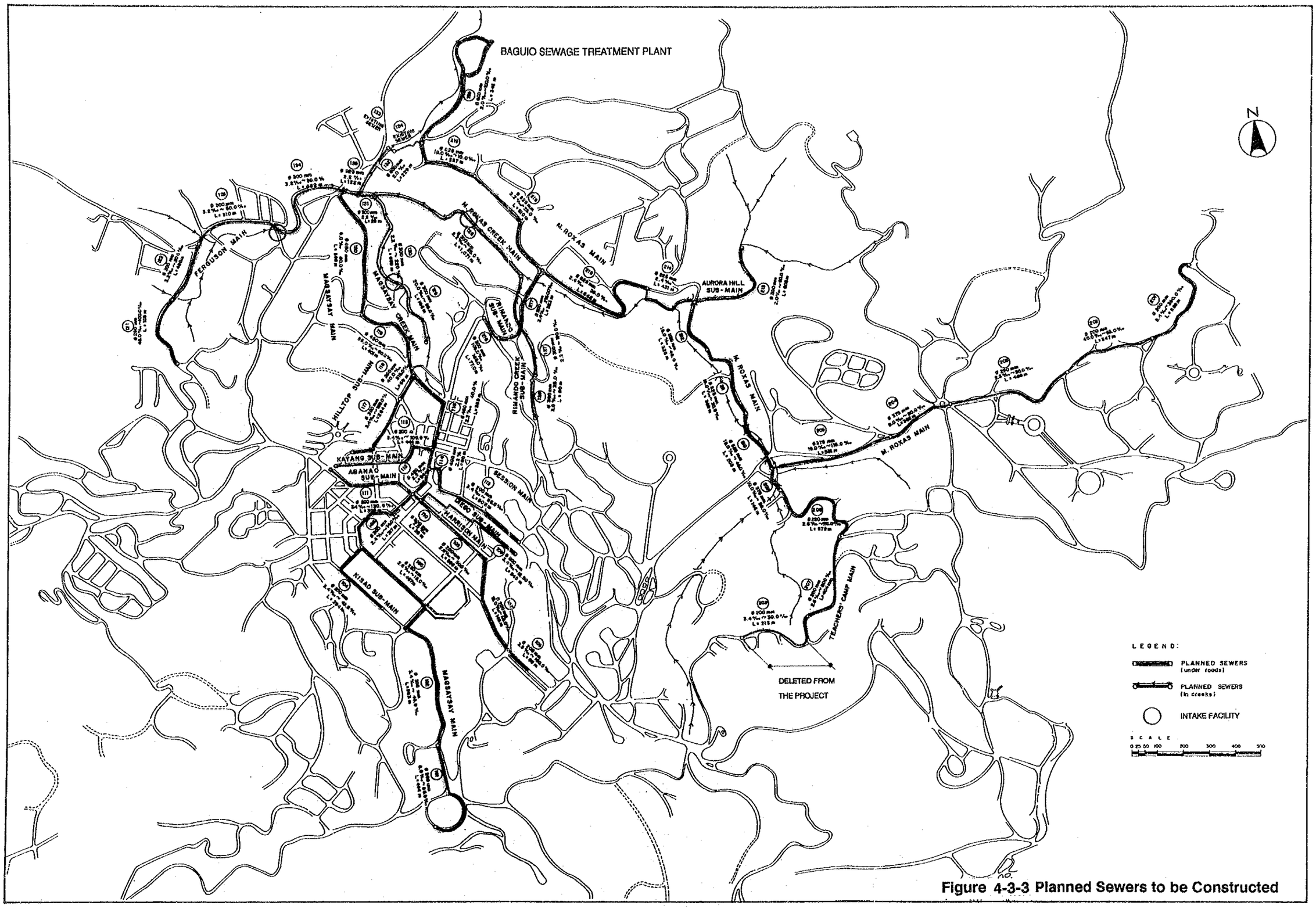


Figure 4-3-3 Planned Sewers to be Constructed

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	-	-	-	-	1,222	41	-	41
	-	-	462	-	-	-	-	462			
A. Rimando C.	-	-	1,129	-	-	-	-	1,129	81	-	81
	-	-	1,129	-	-	-	-	1,129			
M. Roxas C.	-	-	1,096	-	-	-	-	1,096	60	-	60
	-	-	1,096	-	-	-	-	1,096	60	-	60
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	-	513	-	146	-	-	-	659	17	-	17
	-	-	-	-	-	-	-	-			
Aurora Hill C.	-	-	608	-	-	-	-	608	45	-	45
	-	-	608	-	-	-	-	608			
A. Rimando	400	-	-	-	-	-	-	400	9	-	9
	-	-	-	-	-	-	-	-			
Total	5,197	2,007	5,266	1,029	1,512	2,856	575	18,442	599	19	618
	-	-	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.

The intake facility, which was not included in the previous plan, will be constructed to collect sewage flowing in the creek.

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.

The intake facility, which was not included in the previous plan, will be constructed downstream of the confluence with the M. Roxas Creek to collect sewage flowing in the creek.

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.

The intake facility, which was not included in the previous plan, will be constructed to receive collect flowing in the creek.

4.3.4 Outline of Equipment

The total length of planned sewers to be constructed is 18,442 km with 618 manholes. Besides those facilities, around 190 connection works between existing and new sewers are expected. The project also involves the construction of three intake facilities in creeks.

Computer sets are added to the equipment to be granted as follows: