Appendix 1

Appendix 1 Officials Conerned, Itinerary of Study Team, and Minutes of Discussion

1-1 Philippine Government and Baguio City Officials Concerned

NEDA (National Economic and Development Authority)

Mr. Jesus Sunga	-	Director, Infrastructure Depatment

LWUA (Local Water Utilities Administration)

Mr. Carlos C. Leano, Jr.	- General Manager
Mr. Alfredo B. Espino	- Manager, Planning Department (Project Manager)
Mr. Ednordo C. Santos	- Chief, Special Project Division
Mr. Eriberto R. Calubaquib	- Chief, Hydrogeology Division
Mr. Enrique O. Gita	- OIC, Electro-Mechanical Division

Baguio City

Mr. Ernesto H. Bueno	- City Mayor
Mr. Gaudencio Bert Floresca	- City Councillor, and Project Manager
Mr. David G. Borja	- City Engineer
Mr. Leonardo S. dela Cruz	- City Administrator
Mrs. Catherine A. Buccat	- General Services Department, Public Utilities Division
Mr. Mac B. Flores, Jr.	- City Development Coordinator

BENECO (Benguet Electric Corporation)

Mr. Peter Cosalan	- Manager
Mr. Efren Banayat	- Chief Engineer
Mr. Teodoro P. Oway	- Accountant
Mrs. Prinsilla A. Basquial	- Special Billing Supervision

1-2 Japanese Basic Design Study Team

Team Leader	: Tetsuo Murayama	: Public Sewarage Div., Sewarage and Sewage Purification Dept., City Bureau, Ministry of Construction
Project Coordinator	: Norio Shimomura	: Basic Design Div., Grant Aid Dept., Japan International Cooperation Agency (JICA)
Sewarage Planner	: Kenji Hori	: Nippon Jogesuido Sekkei Co., Ltd
Sewage Treatment Facilities	: Ikuo Miwa	: Nippon Jogesuido Sekkei Co., Ltd
Sewer System	: Masatoshi Momose	: Nippon Jogesuido Sekkei Co., Ltd
Electrical Facilities	: Kenichiro Masaoka	: Nippon Jogesuido Sekkei Co., Ltd

1-3 Itinerary of Study Team

Date	Day	Description
1984		
Feb. 8	Wed.	Flight from Tokyo to Manila (PA 011)
9	Thu.	Courtesy call on Japanese Embassy, JICA Office at Manila, National Economic Development Authority (NEDA) and Local Water Utilities Administration (LWUA)
10	Fri.	Travel from Manila to Baguio
11	Sat.	Investigate the proposed construction site and water pollution status of Balili River
12	San.	Inter-Team Meeting Study and analysis of collected data. Mr. Murayama, team leader, and other two engineers flight from Tokyo to Manila.
13	Mon.	1st meeting with Baguio City and LWUA. Mr. Murayama and others travel from Manila to Baguio.
14	Tue.	Confirmation of proposed construction site. Visit to Baguio Water District.
15	Wed.	Inter-Team meeting and preparation of the alternative plans.
16	Thu.	2nd meeting with Baguio City and LWUA. Sampling of sewage water.
17	Fri.	3rd meeting with Baguio City and LWUA. Preparation of land surveying and boring.
18	Sat.	Signing of the minutes of the discussions. Carrying out of land surveying and boring at the proposed construction site from Feb. 18 to Feb. 24.
19	Sun.	Inter-Team meeting and study on collected data.
20	Mon.	Survey and discussion with Baguio City on the existing sewer system. Study on capability of construction. Mr. Murayama, team leader, Mr. Simomura and Mr. Masaoka travel to Manila.

	21	Tue.	Measurement of Sewage. Collection of data on construction cost. Mr. Murayama and Mr. Shimomura visit to Japanese Embassy and JICA office at Manila. Mr.Masaoka's flight from Manila to Tokyo.
	22	Wed.	Measurement of flow rate of Balili River. Collection of data on construction cost.
	23	Thu.	Investigation of structure of existing treatment facilities. Visit to Benguet Electric Corporation (BENECO).
	24	Fri.	1st meeting of the 2nd part with Baguio City and LWUA.
	25	Sat.	Inter-Team meeting. Preparation of basic design plan and comments for the existing sewer system.
	26	Sun.	Study of collected data and preparation of basic design plan. Investigation of surrounding of drainage stream basin.
	27	Mon.	2nd meeting of the 2nd part with Baguio City and LWUA. Visit to NEDA, San Fernando. Travel from Baguio to Manila.
	28	Tue.	3rd meeting of the 2nd part with LWUA and Baguio City at LWUA, Manila.
	29	Wed.	Visit to Japanese Embassy and JICA office at Manila.
Mar.	1	Thu.	Flight from Manila to Tokyo (PR 432)

1-4 Minutes of Discussion

MINUTES OF DISCUSSIONS

In response to the request of the Government of the Republic of the Philippines, the Government of Japan has sent, through the Japan International Cooperation Agency (JICA) which is an official agency implementing the technical cooperation of the Government of Japan, a team headed by Mr. Tetsuo Murayama, Deputy Chief, Public Sewerage Div., Sewerage and Sewage Purification Dept., City Bureau, Ministry of Construction, to conduct a basic design study on the Construction Project of Sewage Disposal Treatment Facilities in Baguio City for 23 days from 8th February to 1st March 1984.

The team has carried a field survey and had series of discussions with the Government of the City of Baguio, LWUA (Local Water Utilities Administration) and the authorities concerned of the Government of the Republic of the Philippines.

As a result of the survey and discussions, both parties have agreed to recommend to their respective governments to examine the results of the study attached hereuith toward the realization of the project.

10th February 1984

MR. TETSUO MURAYAMA
Leader, Japanese Study Team
JICA

GEN. ERNESTO H. OCAMPO
Mayor, City of Baguio

MR. ALFREDO G. ESPINO
Manager, Planning Department
on behalf of General Manager
Local Water Utilities Administration
Republic of the Philippines

ATTACHMENT:

1. The objective of the project is to construct the waste water treatment facilities in Baguio City in order to: (1) improve the quality of the water environment and (2) safeguard the public health of the areas along the river of Balili in Benguet Province.

2. Baguio City has two separate collection system for sanitary waste and storm run-off respectively. The sanitary sewage connected to the system is conveyed through closed conduits to the septic tanks and stream outfall. The project aims to treat the sanitary sewage currently conveyed to the outfall of the River of Balili. The area to be covered by the project will be 14 Districts of the 25 Districts of Baguio City as shown in Annex 1.

3. The project will be implemented under the administration of Local Water Utilities Administration (LWUA) until the completion of its construction work. Baguio City will bear all the expenses other than those to be borne by the Grant necessary for the construction and operation of the project.

4. After the completion of the construction work, the project will be handed over to Baguio City and will be administrated, operated and maintained by the City.

5. The cost and expense necessary for the operation and maintenance of the project will be basically covered by charge which will be imposed upon the water consumers of the area covered by the project. Baguio City

has assured the team that the City will completely administrate, operate and maintain the project by establishing the collection system of charge and the City will subsidize additional fund when needed. The estimation of the cost and expense necessary for the operation and maintenance of the project is summarized in Annex II.

6. Baguio City has assured the team that the City will be responsible for disposing of the waste sludge which will be generated by the project that is roughly estimated 2 tons per day in dry basis.

7. Proposed site of the project is the land acquired by Baguio City near the boundary of the Municipality of La Trinided, Proposed site is shown in Annex III.

8. Baguio City has assured the team that the City will expropriate the necessary land and construct the access road to the site (including a small bridge) immediately upon the approval of the Project by both governments. The access road is shown in Annex III.

9. Baguio City has assured the team of the completion of the access road mentioned above before the start of construction works in the site.

10. Baguio City is ready to allocate the budget of 5 million pesos (approximately 75 million yen in current exchange rate) for the implementation of the project which is available in this fiscal year (January -

December, 1984).

11. Baguio City has assured the team that the City will prepare in the next fiscal year additional budget required for site preparation and others.

12. The capacity of the project will be defined based on the evaluation of the population and water supply within the area mentioned in item 2 above. The capacity will be approximately 3 MGD (3 million gallons per day or 11,000 m^3 per day).

13. Oxidation - Ditch Syetem will be selected for the treatment facility. A comparison between the alternative is shown in Annex IV.

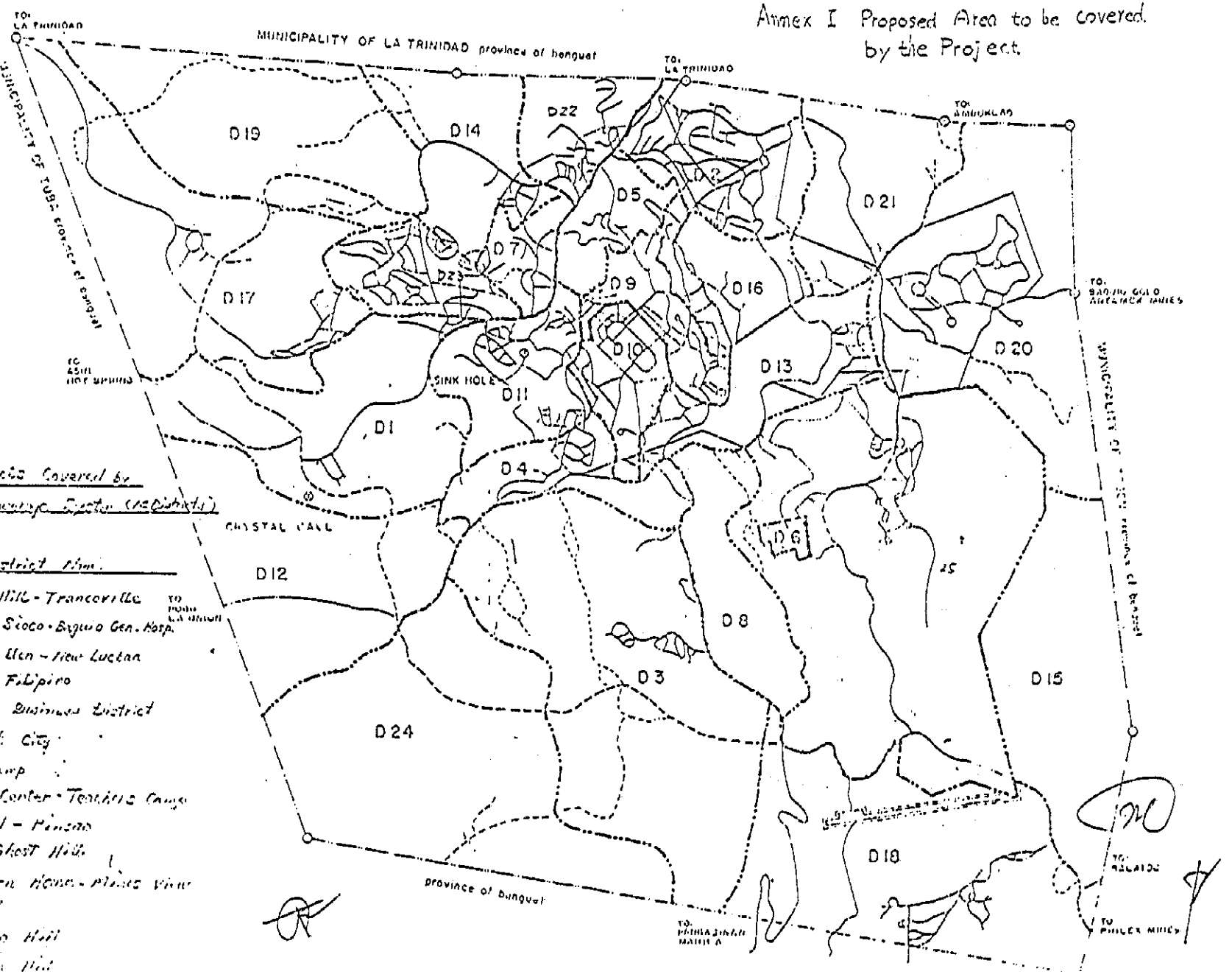
14. The team will convey to the Government of Japan the desire of the Government of the Republic of the Philippines and the City of Baguio that the former takes necessary measures to cooperate in implementing the project and provides the facilities as listed in Annex V within the scope of Japanese economic cooperation in grant form.

15. The Government of the Republic of the Philippines and the City of Baguio will take necessary measures on condition that the grant assistance by the Government of Japan is extended to the project:

    1. to provide data and information for design and construction

2. to secure land necessary for the project
3. to remove and demolish the existing structures shown in Annex III
4. to remove the houses and people living in the site
5. to clear, fill and level the project site as needed before the start of the construction
6. to construct the access road (mentioned in item 9)
7. to provide other items listed in Annex VI
8. to ensure prompt unloading and customs clearance in the Philippines of imported materials and equipment for the construction and also to facilitate the internal transportation for them
9. to exempt Japanese nationals concerned from customs duties, internal taxes and other fiscal levies which may be imposed in the Philippines on the occasion of the supply of materials and services for construction.
10. to provide and accord necessary permissions, licenses and other authorization required for carrying out the project.

Annex I Proposed Area to be covered by the Project



Districts Covered by the Coverage Factor (12 Districts)

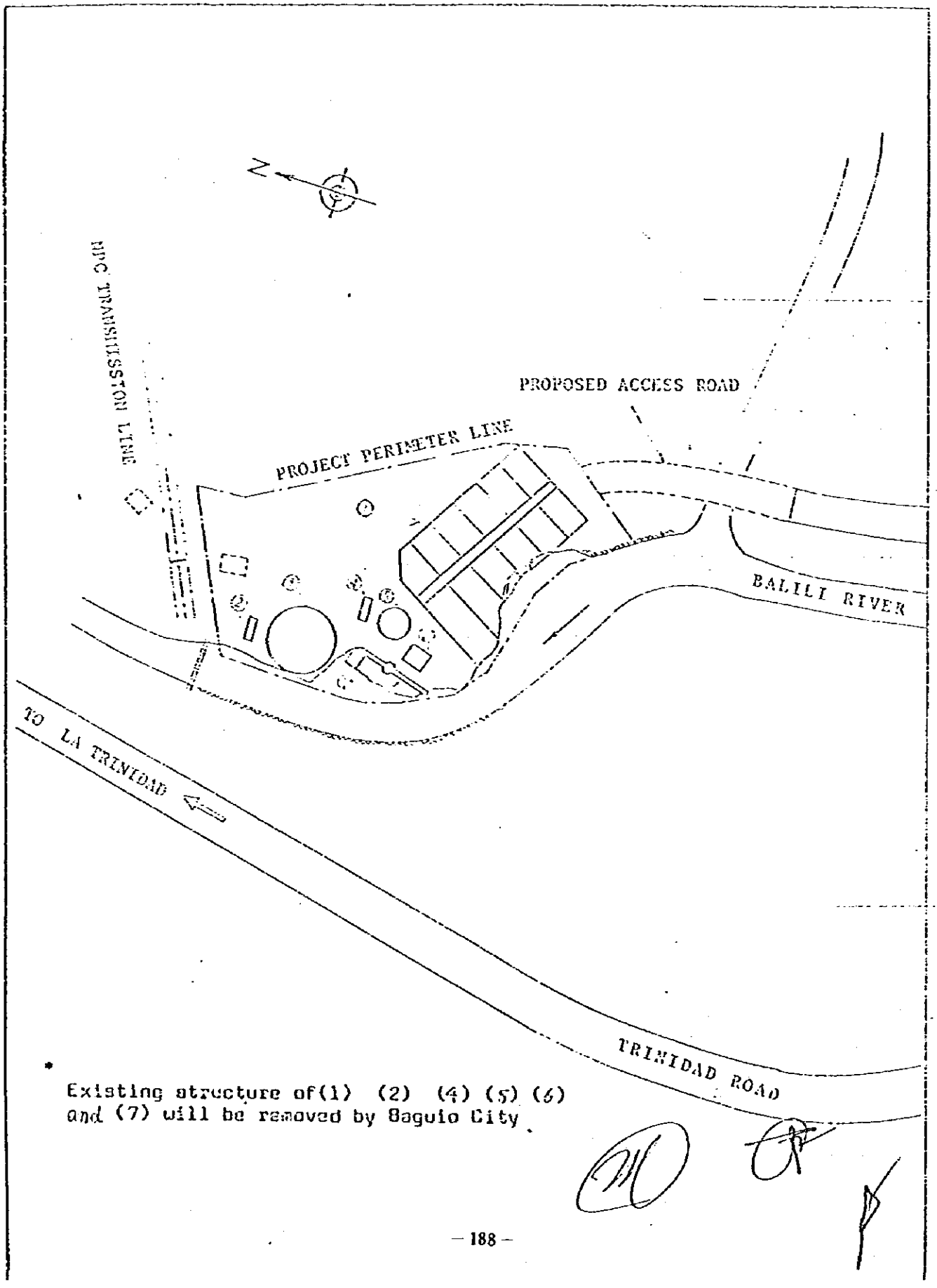
No.	District Name
2	Aurora Hill - Trancoville
4	Campo Sioco - Baguio Gen. Hosp.
5	Camp Allen - New Lucban
7	Campo Filipino
9	Central Business District
10	Central City
11	City Camp
12	Gov't Center - Teachers Camp
13	Guisad - Pinsao
16	Holy Ghost Hill
20	Mansion House - Plaza View
21	Pacdal
22	Quezon Hill
23	Session Hill

ANNEX 11 ROUGH ESTIMATION OF OPERATION AND MAINTENANCE COST

Labor	₱ 80,000/year
Power	₱ 1,500,000/year
Chemical	₱ 320,000/year
Repair & Others	₱ 1,000,000/year
TOTAL	₱ 2,900,000/year

NOTE: Power cost can be reduced depending on negotiation of special rate, similar to Baguio Water District, between the City of Baguio and Benguet Electric Cooperative.

Annex III PROPOSED CONSTRUCTION SITE



* Existing structure of(1) (2) (4) (5) (6) and (7) will be removed by Baguio City

ANNEX IV A COMPARISON BETWEEN POSSIBLE ALTERNATIVE

	High-Rate Trickling Filter	Oxidation Ditch
1. Expected Effluent Water Quality		
o BOD Removal	65 - 75%	80-90%
o Appearance	Muddy White	Clean
2. Environment Impact to the Surrounding Area		
	Offensive Odor	Offensive Odor
	Filter Fly	Noise
	(but will not be sufficient to be considered as nuisance)	
3. Problems in Maintenance		
o Occurence of troubles affected by the Nitrification		
	o Scum floating in the final sedimentation	o Avoidable by denitrification
	o Bulking	
	o Muddiness of effluent	
	o PH reduction of effluent	
o Reliability to the fluctuation of influent flow and BOD loading	- fair	- good
4. Land Requirement	- moderate	- large
5. Operation & Maintenance Cost (per year)	Approx. P2.5M	P2.9M

ANNEX V. ITEMS WHOSE COST WILL BE BORNE BY THE GOVERNMENT OF JAPAN

NAME OF MAIN FACILITIES

Inflow Pipe
Grit Chamber
Main Pumping Station
Primary Sedimentation Tank
Oxidation Ditch
Final Sedimentation Tank
Chlorination Tank
Sludge Thickener
Sludge Storage Tank
Sludge Drying Bed
Sludge Pumping Room
Administrative Building
Others

ANNEX VI ITEMS WHOSE COST WILL BE BORNE BY BAGUIO CITY

1. Water supply mains to the site
2. Electrical power main line to the site
3. Telephone lines to the site
4. Exterior facilities and landscaping
5. Provision of space necessary for such construction as temporary office, working area, stockyard and others
6. Furniture, carpets, curtains and other furnishings in Administration Office
7. Maintenance and operation cost and expense of the project
8. Rehabilitation and expansion cost and expense for sewage pipe line

1-3 Site Investigation for Confirmation of Basic Design

1-3-1 Japanese Basic Design Study Team

Team Leader	: Tetsuo Murayama	: Public Sewerage Div., Sewerage and Sewage Purification Dept., City Bureau, Ministry of Construction
Project Coordinator	: Norio Shimomura	: Basic Design Div., Grant Aid Dept., Japan International Cooperation Agency (JICA)
Sewerage Planner	: Kenji Hori	: Nippon Jogesuido Sekkei Co., Ltd.
Sewage Treatment Facilities	: Ikuo Miwa	: Nippon Jogesuido Sekkei Co., Ltd.
Electrical Facilities	: Kenichiro Masaoka	: Nippon Jogesuido Sekkei Co., Ltd.

1-3-2 Itinerary of Study Team

Date	Day	Description
1984		
April 22	Sun.	Flight from Tokyo to Manila (PA 015).
23	Mon.	Courtesy call on Japanese Embassy and JICA Office.
		Travel from Manila to Baguio
24	Tue.	The first meeting with Baguio City (Briefing of the report).
25	Wed.	The second meeting with LWUA & Baguio City (Briefing of the report and conference).
26	Thu.	Mr. Murayama, team leader and Mr. Shimomura travel to Manila.
		Other member investigation of project site.
27	Fri.	Mr. Murayama and Mr. Shimomura and visit Japanese Embassy and JICA office and flight from Manila to Japan.
		Other member visit St. Thomas, reservoir construction site.
28	Sat.	Travel from Baguio to Manila
29	Sun.	Flight from Manila to Tokyo (PR 432).

1-3-3 Minutes of Discussions

At the request of the Government of the Republic of the Philippines, the Government of Japan has sent a team to carry out the Basic Design Study for the Construction Project of Sewage Disposal Treatment Facilities in Baguio City through Japan International Cooperation Agency (JICA) for 23 days from 8th February to 1st March, 1984.

As a result of the study, JICA has prepared the Draft Report of the Basic Design Study and has sent a team to submit and explain the Report from 22nd to 29th April, 1984.

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

25th April 1984

MR. TETSUO MURAYAMA
Leader
Japanese Study Team
JICA

GEN. ESMESIG H. AUSNO
Mayor, City of Baguio

MR. ALFREDO B. ESPINO
Manager, Planning Department
On behalf of General Manager
Local Water Utilities Administration
Republic of the Philippines

ATTACHMENT:

1. The Philippines side has principally agreed to the basic design proposed in the Report except for possible minor change in the selection between the vertical type surface aerator as against the proposed horizontal type taking into account the energy cost for each type.

2. The City of Baguio will complete the construction of the access road and site preparation before starting the construction of the Project that is supposed to be November 1984. The access road can be temporary structure during the construction period of the Project. The temporary access road should enable the transportation of heavy construction machinery (maximum 10 tons) to the site.

   The City of Baguio will allocate the necessary budget in fiscal year 1984.

3. The City of Baguio will complete (1) Water and Power supply to the site; (2) Laying of inflow pipe to the site and repair of existing primary pipe lines before starting the test run of the Project that is supposed to be January 1986.

4. The City of Baguio will immediately start and complete as soon as possible the construction mentioned below after the completion of the item 2 and 3 above:

   (a) Access road (permanent)
   (b) Repair of existing pipe line network
   (c) Gate and Fence
   (d) Landscaping
   (e) Telephone line

5. Timing mentioned in item 2 and 3 above is based on the condition that the Note for the Project is signed and exchanged by both Governments in June 1984.

CALENDAR YEAR
1984
1985
1986
JUN.
OCT.
DEC.
JAN.
FEB.
MAR.
DEC.
HAND OVER OF PROJECT TO THE PHILIPPINES
E/N
DETAILED DESIGN
TENDER
CONSTRUCTION OF PLANT
WORK
TEST RUN
PHILIPPINE FISCAL YEAR
WORKS TO BE COVERED BY E/N
BAG MOBILIZATION
ACCESS ROAD (TEMPORARY)
SITE PREPARATION
(a) DEMOLITION OF EXISTING STRUCTURES EXCEPT PRIMARY SEDIMENTATION TANK
(b) EXCAVATION OF THE SITE
POWER AND WATER SUPPLY
LAYING OF INFLOW PIPE
REPAIR OF PIPING LINE
REPAIR OF PIPING LINE
GATE AND FENCE
LANDSCAPING
TELEPHONE LINE
ACCESS ROAD (PERMANENT)

Appendix 2

Appendix 2 Results of Field Measurement

1. Present Sewage Flow Discharged from Balili River Basin

1-1 Objectives

(1) To obtain information on the daily sewage flow discharged from the Balili River basin as a reference to determine an appropriate capacity of the sewage treatment plant.

(2) To investigate the variation of sewage flow.

1-2 Measurement Points

The existing sewerage system is divided into two such collection systems. Main sewers for these collection systems join after reaching to the Balili River. Measurement of sewage flow should be conducted downstream of the junction point of the main sewers. However, it was concluded that sewage flows at present and when existing sewers have been improved or expanded cannot be estimated using the data from several distinct points of sewers. Field survey revealed the present situation of sewers including overflow of sewage from manholes to creeks and damaged main sewers at the end of the sewer system at the end of sewer system near the Balili River. The measurement of sewage flow was carried out at a point on the Balili River beside the Sanitary Camp Office, just downstream of the built up area of the city.

1-3 Measurement Date

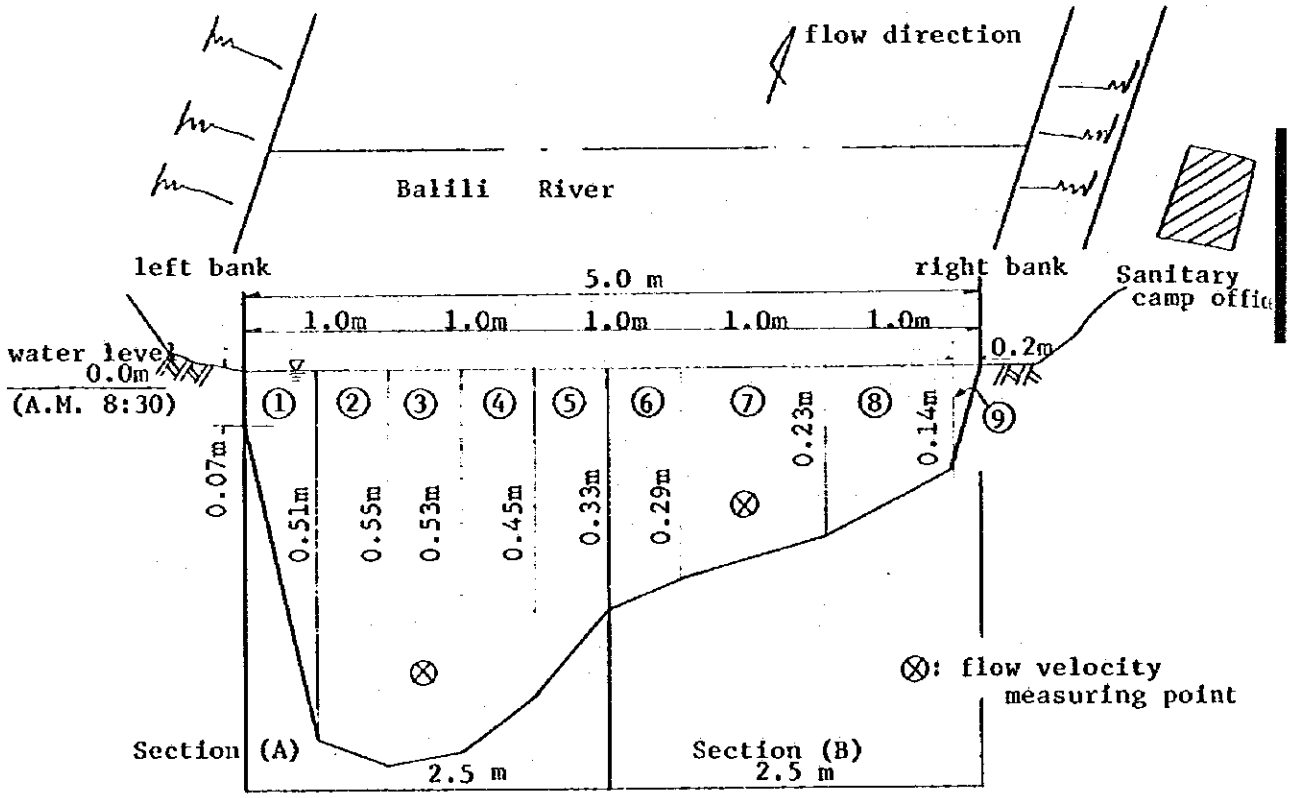
Feb. 22, 08:00 to Feb. 23, 08:00

1-4 Cross Section of the River at Flow-Rate Measurement Point

See Figure 2-1

Fig. 2-1 Cross Section of the River

Cross section of the river at measurement point



Cross sectional area below water level at 08:30

(1) 1/2 x (0.51 + 0.07) x 0.5 = 0.145
(2) 1/2 x (0.51 + 0.55) x 0.5 = 0.264
(3) 1/2 x (0.55 + 0.53) x 0.5 = 0.270
(4) 1/2 x (0.53 + 0.45) x 0.5 = 0.245
(5) 1/2 x (0.45 + 0.33) x 0.5 = 0.195 Sub-total 1.120 m^2: Section (A)
(6) 1/2 x (0.33 + 0.29) x 0.5 = 0.155
(7) 1/2 x (0.29 + 0.23) x 1.0 = 0.260
(8) 1/2 x (0.23 + 0.14) x 0.8 = 0.148
(9) 1/2 x 0.14 x 0.2 = 0.014 Sub-total 0.577 m^2: Section (B)

Total 1.697 m^2 ≒ 1.70 m^2

1-5 Measurement of Water Level and Flow Velocity

Measurement of water level in the river was conducted every hour from 08:30 to 18:00 on Feb. 22. Flow velocity was also measured at the same time as water level measurement at the two points shown in Figure 1-1 using a current meter. Water level measurement was carried out during the period from 19:00 to 22:00 on Feb. 22 and from 05:00 to 07:00 on Feb. 23.

1-6 Results of Measurement of Flow of the Balili River

It was observed that there were piles of refuse disturbing the flow of the river and that there was sedimentation of sludge. The bottom of the river was under anaerobic condition giving off methane gas and there were mosquito and other larvae. A considerable change of water quality caused by variations in sewage flow was noticed between morning and afternoon.

1-6-1 Flow Velocity (see Figure 2-2)

Cross section (A) (point near the left bank) : varied in the range 0.10 m/sec to 0.17 m/sec, having recorded maximum and minimum flow velocities at 14:00 and 09:00, respectively.

Cross Section (B) (point near the right bank) : Most flow velocities were within the range 0.10 m/sec to 0.11 m/sec with a minimum of 0.09 m/sec at 14:00.

1-6-2 Water Level (see Figure 2-2)

Variation in water level throughout the day to that measured at 08:30 was within $\pm$ 1 cm. The flow rate was affected by flow velocity and not by the change of water level because of the large cross section.

1-6-3 Flow Rate (see Figure 2-3)

Measured flow rate ranged from 0.19 m^3/sec to 0.22 m^3/sec (700 m^3/hour to 800 m^3/hour). The variation in flow rate was proportional to the flow velocity at cross section (A) and maximum flow rate occurred at around 14:00 with the most deteriorated water quality.

In the calculation of daily flow, flow rates for the period from 23:00 to 05:00 the following day were assumed to be the same as that at 09:00, which was the lowest rate.

The following table shows estimated daily flow of the river by aggregation of hourly flow rates throughout the day.

Table 2-1 Estimation of Daily Flow of the River

Time	Flow Rate (m^3/hour)	Time	Flow Rate (m^3/hour)	Time	Flow Rate (m^3/hour)
08:00	813	19:00	803	06:00	813
09:00	652	20:00	799	07:00	810
10:00	724	21:00	796		
11:00	770	22:00	788		18,042 m^3/day
12:00	864	23:00	652	Total	≒
13:00	832	24:00	652		18,000
14:00	929	01:00	652		
15:00	792	02:00	652		
16:00	756	03:00	652		
17:00	734	04:00	652		
18:00	803	05:00	652		

Fig. 2-2 Variation of Water Leval and Flow Velocity

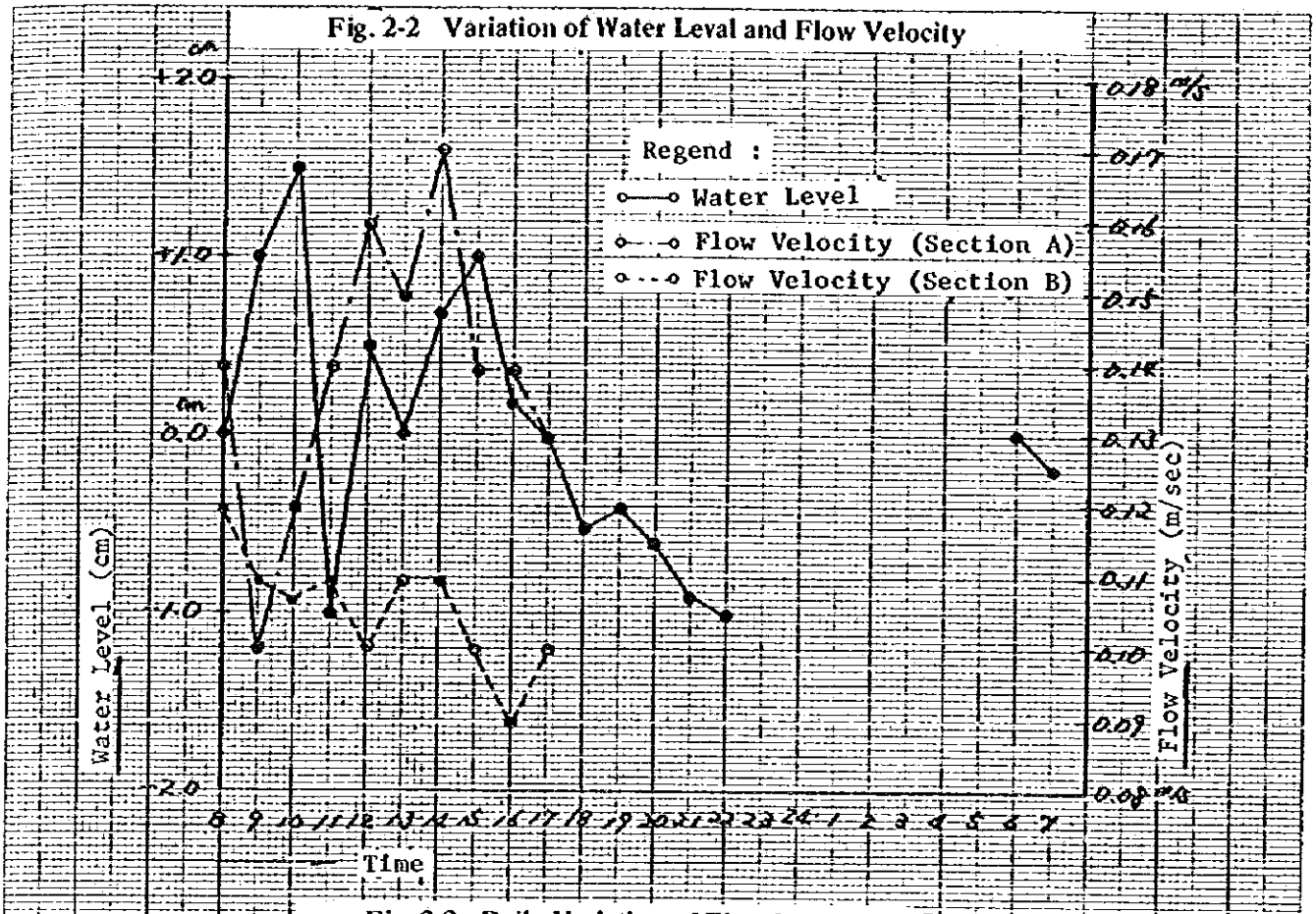
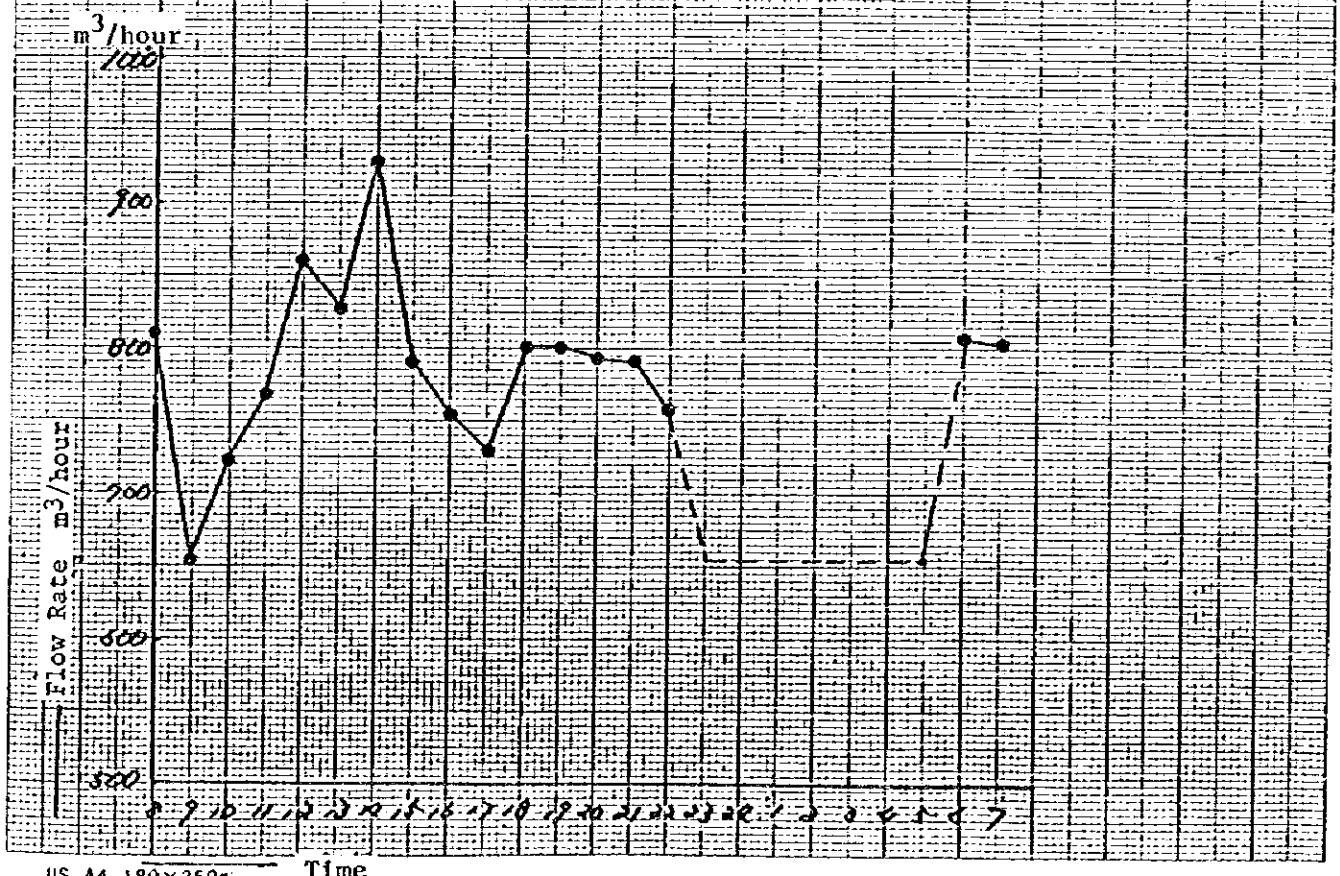


Fig. 2-3 Daily Variation of Flow Rate



JIS A4 180×250

Table 2-2 Data Sheet for Measurement of Flow Velocity and Water Level

Flow Velocity Formula V = 0.117 N + 0.021
Measured Point : Beside Sanitary Camp Office

Time	Variation of Water Level	Current Meter Reading (A) Flow Left Bank	Current Meter Reading (B) Flow Right Bank	Cross Sectional Area (A) m^2	Cross Sectional Area (B) m^2	Flow Rate m^3/sec
				m^3/sec	m^3/sec	m^3/hour
Feb. 22, 1984						
1. 08:30	0.00 cm	1:23	1:40	1.120 m^2	0.577 m^2	0.266
(08:00)	20.00 m/s	0.14 m/s	0.12 m/s	0.157 m^3/s	0.069 m^3/s	813
2. 09:00	+1.00	1:56	1:48	1.145	0.602	0.181
	19.0	0.10	0.11	0.115	0.066	652
3. 10:00	+1.50	1:37	1:55	1.158	0.615	0.021
	18.5	0.12	0.10	0.139	0.062	724
4. 11:00	-1.00	1:24	1:48	1.095	0.552	0.214
	21.0	0.14	0.11	0.153	0.061	770
5. 12:00	+0.50	1:15	1:54	1.133	0.590	0.240
	19.5	0.16	0.10	0.181	0.059	864
6. 13:00	0.00	1:18	1:46	1.120	0.577	0.231
	20.00	0.15	0.11	0.168	0.063	832
7. 14:00	+0.70	1:08	1:46	1.138	0.595	0.258
	19.3	0.17	0.11	0.193	0.065	929
8. 15:00	+1.00	1:25	1:59	1.145	0.602	0.220
	19.0	0.14	0.10	0.160	0.060	792
9. 16:00	+0.20	1:23	2:04	1.125	0.582	0.210
	19.8	0.14	0.09	0.158	0.052	756
10. 17:00	0.00	1:32	1:59	1.120	0.577	0.204
	20.0	0.13	0.10	0.146	0.058	734
11. 18:00	-0.50			1.108	0.565	0.223
	20.5	0.14	0.12	0.155	0.068	803
12. 19:00	-0.40			1.110	0.567	0.223
	20.4	0.14	0.12	0.155	0.068	803
13. 20:00	-0.60			1.105	0.562	0.222
	20.6	0.14	0.12	0.155	0.067	799
14. 21:00	-0.90			1.098	0.555	0.221
	20.9	0.14	0.12	0.154	0.067	796
Feb. 23						
15. 20:00	-1.00			1.095	0.552	0.219
	20.0	0.14	0.12	0.153	0.066	788
16. 05:00	-1.00			1.095	0.552	0.219
	21.0	0.14	0.12	0.153	0.066	788
17. 06:00	0.00			1.120	0.577	0.226
	20.0	0.14	0.12	0.157	0.069	813
18. 07:00	-0.20			1.115	0.572	0.225
	20.2	0.14	0.12	0.156	0.069	810
19. 08:00	-0.40			1.110	0.567	0.223
	20.4	0.14	0.12	0.155	0.068	803

2. Water Quality Examination

2-1 Objectives

(1) To obtain information about the extent of water pollution in creeks in the city.

(2) To ascertain quality of effluent overflowing from manholes.

(2) To investigate comparative sewage quality of the creeks and to forecast quality of influent to the sewage treatment plant.

(3) To determine the approximate assimilative capacity of the Balili River.

(4) To obtain information about water quality in the irrigation channel in La Trinidad.

2-2 Preliminary Investigation

A preliminary survey and water sampling were carried out on Feb. 15th and 16th, respectively, under the constraints of allowable time for the survey and inconvenient location of laboratory. Thirteen sampling points (see Figure 2-4) were selected in consultation with city staff members. During the preliminary survey, measurements of water temperature, ORP and pH were taken. Table 2-3 shows the measuring points and the results of measurement.

Because water quality in the river is most deteriorated in the afternoon, a supplementary ORP measurement was taken at around 14:00 on Feb. 24th.

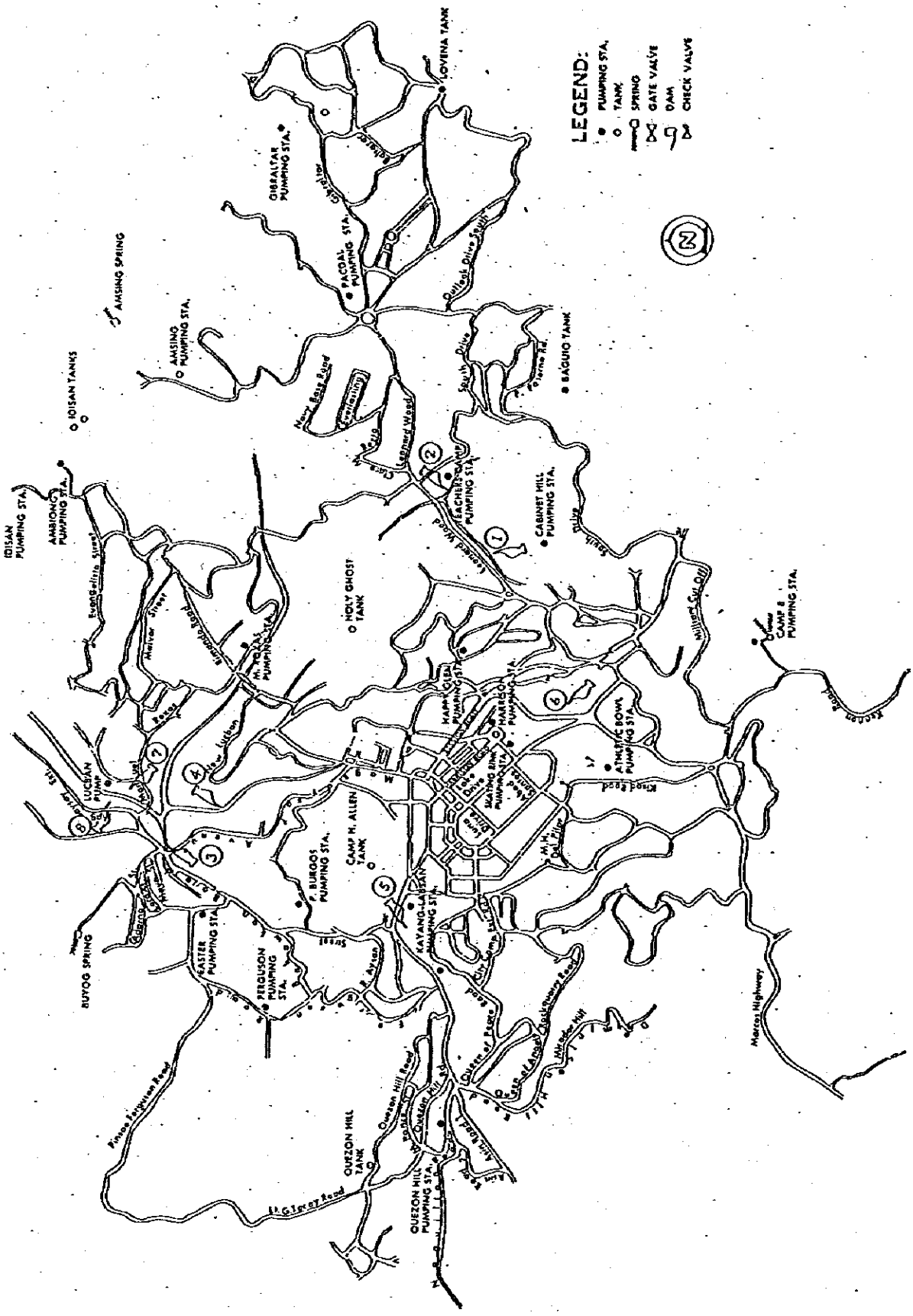


Fig. 2-4 Water Sampling and Field Measurement Points

Table 2-3 Water Sampling and Field Measurement Points

Date : Feb. 15, 1984
Feb. 24, 1984

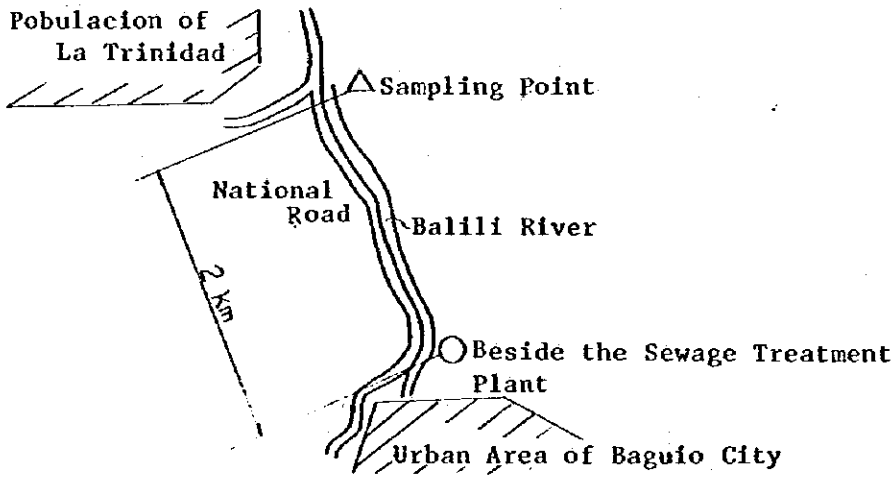
Sampling and Measurement Point	Results of Preliminary Survey (Measurement) Water Temp.	ORP (mv)	pH	Remarks
(A) Creeks in Baguio City				
No.1 Teachers' Camp.	19 °C	- 50	7.46	Creek
No.2 Brookside	22.5	104	8.04	Spring Water
No.3 Magsaysay Bridge	23	- 18	7.52	Creek
No.4 Magsaysay Private Road	22	- 80	7.66	Creek
(B) Effluent Overflowing from Manholes				
No.5 Naguilian & Kayang	21	- 220	7.11	
No.6 Pinas Hotel				Laundry Water
(C) Sewage in Sewer				
No.7 Sanitary Camp/ Trancoville	22	- 150	7.37	Effluent from manhole
No.8 Pines Hospital	21	- 220	7.01	
(D) Water of Balili River				
No.9 Beside Sewage Treatment Plant (08:00)	25	- 140		Measured at 14:00 raw sewage
No.10 Beside Sewage Treatment Plant (09:00)				
No.11 La Trinidad (09:50)	25	- 10		Raw Sewage Measured at 14:30
No.12 La Trinidad (10:50)				
(E) Irrigation Water				
No.13 Irrigation Channel in La Trinidad				

2-3 Procedure to Estimate the Assimilative Capacity of the Balili River

During the preliminary survey, self-purification of the river was observed in the promotion of sedimentation of suspended solids.

This observation involved water sampling and flow rate measurement at two points: beside the sewage treatment plant and at the entrance of La Trinidad.

Fig. 2-5 Relationship Between the Two Selected Points



Distance apart: about 2 km
Average flow velocity : 0.3 m/sec. (1,080 m/hour)
Assuming 1.85 hours (1 hour and 50 minutes) of run-off time between the two points, the following times were established.

No. 9. Beside S.T.P.	08:00	No.11 La Trinidad	09:50
No.10. "	09:00	No.12 "	10:50

2-4 Measurement of Flow Rate

Measurements of cross section and flow velocity were conducted on Feb. 16th. Almost the same flow rate at both points was obtained within a range of 0.3 m^3/sec to 0.4 m^3/sec.

2-5 Water Quality Indices

Although the number of BOD tests was limited because of the lack of adequate laboratory facilities in the Philippines and because of delay due to transportation of samples, samples were taken during the morning. Water quality indices covered to meet requirements for this study are the following:

pH, BOD, COD, SS, TN, NH_3-N, Cl^-, coliform group bacteria.

2-6 Results of Water Examination

The following table presents the results of water quality analysis.

Table 2-4 Water Quality Analysis, Baguio City

STATION NUMBER	LOCATION	CHEMICAL								BACTERIOLOGICAL
		pH (units)	Total Suspended Solids (mg/l)	NH_3-N (mg/l N)	Total Nitrogen (mg/l)	Chloride (mg/l)	Dissolved Oxygen (mg/l)	COD (mg/l)	BOD (5-day) (mg/l)	Total Coliform Count (MPN/100ml)
	A. Channel									
01	Teacher's Camp	7.0	10	6.00	21.6	150	0	40	18	$\geq 2.4 \times 10^4$
02	Brook Side	7.1	6	0.10	0.7	82	7.9	10	1.2	$\geq 2.4 \times 10^4$
03	Magsaysay Bridge	6.5	3	1.70	4.6	150	0	40	60	1.1×10^4
04	Magsaysay Private Road	6.7	530	7.60	74.6	266	0	520	190	1.1×10^4
	B. Septic Tank (overflow water)									
05	Naguilian & Kayang	7.1	340	9.30	108.0	308	0	490	400	$\geq 2.4 \times 10^4$
06	Pines Hotel	6.9	16	0.31	2.1	82	0	150	40	$\geq 2.4 \times 10^4$
	C. Sewer									
07	Sanitary Camp/Trancoville	2.3	460	7.30	125.0	242	0	700	370	$\geq 2.4 \times 10^4$
08	Pines Doctor Hospital	7.0	140	8.30	55.9	196	0	260	120	$\geq 2.4 \times 10^4$
	D. Balili River									
09.	Beside STP; 8:00 A.M.	7.1	45	6.90	20.3	150	0	90	60	1.1×10^4
10	Beside STP; 9:00 A.M.	7.1	170	10.00	27.9	174	0	180	74	1.1×10^4
11	La Trinidad; 9:50 A.M.	7.2	4	4.76	13.2	150	4.9	40	7.3	$\geq 2.4 \times 10^4$
12	La Trinidad, 10:50 A.M.	7.2	10	3.52	11.9	150	3.1	60	15	$\geq 2.4 \times 10^4$
13	Channel in La Trinidad	6.9	4	2.32	4.9	104	2.0	20	14	$\geq 2.4 \times 10^4$
14	Beside STP: 11:00 A.M.	7.0	280	9.70	53.6	220	0	320	60	$\geq 2.4 \times 10^4$

Date Sampled: February 16, 1984

Appendix 3

Appendix 3 Capacity Calculation Sheet for Baguio Sewage Treatment Plant

3-1 Outline of Plant

3-1-1 Fundamentals

1)	Name	Baguio City Sewage Treatment Plant
2)	Location	Lucban Valley, Baguio City
3)	Site Area	
4)	Ground Level	Present - 1,378 m (Average) Planned - 1,379 m
5)	Surrounding Land Use	North - Field East - Residential Area West - Field South - Residential Area
6)	Sewerage System	Separate System
7)	Treatment and Disposal System	Sewage - Oxidation Ditch Process Sludge - Thickening - Storage - Drying
8)	Receiving Water Body	Name - Balili River (Bayangan River) High Water Level - 1,377 m Planned Discharge Water Level - 1,377 m

3-1-2 Basic Figure

1) Planned Sewage Flow

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Planned Daily Maximum Flow	8,600	358	6.0	0.100
Planned Hourly Maximum Flow	17,200	717	11.9	0.199

2) Influent Water Quality and Performance

Item	Influent	Primary Treatment		Secondary Treatment		Overall
		Removal	Effluent	Removal	Effluent	Removal
	mg/l	%	mg/l	%	mg/l	%
BOD	200	30	140	78.6	30	85
S S	200	40	120	75	30	85

3) Loading on Main Facilities

ITEM	BOD	S S
Primary Treatment		
Inflow	$8,600 \times 200 \times 10^{-3}$ = 1,720	$8,600 \times 200 \times 10^{-3}$ = 1,720
Removal	1,720 x 0.30 = 516	1,720 x 0.40 = 688
Secondary Treatment		
Inflow	1,720 - 516 = 1,204	1,720 - 688 = 1,032
Removal	1,462 - 516 = 946	1,462 - 688 = 774
Outflow	1,720 x 0.85 = 1,462	1,720 x 0.85 = 1,462

4) Sludge Generation

(a) Raw Sludge

Moisture Content: 98 %

Dry Solid: $8,600 \times 200 \times 0.40 \times 10^{-3} = 688$ kg/day

Sludge: $688 \times \frac{100}{100 - 98} \times 10^{-3} = 34.4$ m^3/day

(b) Excess Sludge

Moisture Content: 99.3 %

Dry Solid: $8,600 \times 120 \times 0.75 \times 0.7 \times 10^{-3}$ = 542 kg/day

Sludge: $542 \times \frac{100}{100 - 99.3} \times 10^{-3} = 77.4$ m^3/day

(c) Thickened Sludge

Moisture Content: 97 %

Dry Solid: 688 + 542 = 1,230 kg/day

Sludge	$1,230 \times \frac{100}{100 - 97} \times 10^{-3} = 41.0\ m^3/day$

(d) Sludge Cake

Moisture Content	78 %
Dry Solid	1,230 kg/day
Sludge	$1,230 \times \frac{100}{100 - 78} \times 10^{-3} = 5.6\ m^3/day$

3-2 Sewage Treatment Facilities

3-2-1 Inflow Pipe

Present Ground Level	
Planned Ground Level	
Pipe Size	ϕ 600 mm
Gradient	2.5/1,000
Pipe Bottom Elevation	
Full Pipe Flow	
Full Pipe Velocity	
Water Level in a Pipe	

3-2-2 Grit Chamber

Type	Parallel Flow
Planned Flow	$17,200\ m^3/day = 0.199\ m^3/sec$
Objective Particle for Removal	0.2 mm (Settling Velocity: 0.021 m/sec)
Overflow Rate	$1,800\ m^3/m^2.day$
Required Surface	$17,200 \div 1,800 = 9.6\ m^2$
Effective Water Depth	0.30 m
Average Velocity	0.30 m/sec
Chamber Width	$\frac{0.199}{0.3 \times 0.30} = 2.21$ m
Chamber Length	$9.6 \div 2.21 = 4.34$ m
Quantity of Flow	Two including one standby

Dimension	W 2.20 m x L 4.30 m x D 0.30 m
Surface	$2.20 \times 4.30 = 9.46\ m^2$
Check	
Overflow Rate	$17,200 \div 9.46 = 1,818\ m^3/m^2.day$
Average Velocity	$\frac{0.199}{2.20 \times 0.30} = 0.30$ m/sec

3-2-3 Primary Sedimentation Tank

Type	Radial Flow Circular Tank
Planned Flow	$8,600\ m^3/day = 358\ m^3/hr$
Sedimentation Time	2.0 hr
Required Volume	$358 \times 2.0 = 716\ m^3$
Overflow Rate	$35\ m^3/m^2.day$
Required Surface	$8,600 \div 35 = 246\ m^2$
Effective Water Depth	$716 \div 246 = 2.91$ m
Weir Rate	$200\ m^3/m.day$
Required Weir Length	$8,600 \div 200 = 43.0$ m
Quantity	One (Existing)
Dimension	ϕ 21.34 m (70') x D 3.60 m
Volume	$1/4 \times 3.14 \times 21.34^2 \times 3.60 = 1,287\ m^3$
Surface	$1/4 \times 3.14 \times 21.34^2 = 357\ m^2$
Weir Length	$3.14 \times 21.34 = 67.0$ m
Check	
Sedimentation Time	$1,287 \div 358 = 3.59$ hr
Overflow Rate	$8,600 \div 357 = 24.1\ m^3/m^2.day$
Weir Rate	$8,600 \div 67.0 = 128\ m^3/m.day$

3-2-4 Oxidation Ditch

Type	Recirculation Flow
Planned Flow	8,600 m^3/day = 358 m^3/hr
Inflow BOD Loading	1,204 kg/day
BOD-SS Loading	0.055 kg/SS-kg.day
BOD Volumetric Loading	0.20 kg/m^3.day
MLSS	3,500 mg/l
Sludge Age	18 days
Aeration Time	18 hr
Sludge Return Ratio	100 %
Required Volume	Based on BOD-SS Loading
	$\frac{1,204}{3,500 \times 10^{-3} \times 0.055} = 6,255\ m^3$
	Based on BOD Volumetric Loading
	$1,204 \div 0.20 = 6,020\ m^3$
	Based on Sludge Age
	$\frac{8,600 \times 140 \times 18}{3,500} \times 6,192\ m^3$
	Based on Aeration Time
	$358 \times 18 = 6,444\ m^3$
Quantity	Four
Dimension	W 10.00 m x L 56.00 m x D 3.00 m
Volume	$(1/4 \times 3.14 \times 10.00^2 + 10.00 \times 46.00) \times 3.00 \times 4 = 6,462\ m^3$

Check

BOD-SS Loading	$\frac{1,204}{6,462 \times 3,500 \times 10^{-3}}$ = 0.053 kg/SS-kg.day
BOD Volumetric Loading	1,204 ÷ 6,462 = 0.186 kg/m^3.day
Sludge Age	$\frac{6,462 \times 3,500}{8,600 \times 140}$ = 18.8 days
Aeration Time	6,462 ÷ 358 = 18.1 hr

3-2-5 Final Sedimentation Tank

Type	Radial Flow Circular Tank
Planned Flow	8,600 m^3/day = 358 m^3/hr
Sedimentation Time	3 hr
Required Volume	358 x 3 = 1,074 m^3
Overflow Rate	25 m^3/m^2.day
Required Surface	8,600 ÷ 25 = 344 m^2
Effective Water Depth	1,074 ÷ 344 = 3.12 m
Weir Rate	120 m^3/m.day
Required Weir Length	8,600 ÷ 120 = 71.7 m
Quantity	Two
Dimension	ϕ 15.00 m D 3.20 m
Volume	1/4 x 3.14 x 15.00^3 x 3.20 x 2 = 1,130 m^3
Surface	1/4 x 3.14 x 15.00^2 x 2 = 353 m^3
Weir Length	3.14 x 15.00 x 2 = 94.2 m

Check

Sedimentation Time	1,130 ÷ 358 = 3.16 hr
Overflow Rate	8,600 ÷ 353 = 24.4 m^3/m^2.day
Weir Rate	8,600 ÷ 94.2 = 91.3 m^3/m.day

	Check	
	Thickening Time	127 ÷ 4.7 = 27.0 hr
	Solid Loading	1,230 ÷ 42.5 = 28.9 kg/m^2.day
3-3-2	Sludge Storage Tank	
	Type	Rectangular Tank
	Planned Flow	41.0 m^3/day
	Storage Time	2 days
	Required Volume	41.0 x 2 = 82.0 m^3
	Quantity	One
	Dimension	W 6.00 m x L 6.00 m x D 2.50 m
	Volume	6.00 x 6.00 x 2.50 = 90.0 m^3
	Check	
	Storage Time	90.0 ÷ 41.0 = 2.2 days
3-3-3	Sludge Drying Bed	
	Type	Covered Air Drying Bed
	Planned Flow	41.0 m^3/day
	Drying Time	15 days
	Thickness of Sludge Layer	0.30 m
	Required Area	$\frac{41.0 \times 15}{0.30}$ = 2,050 m^2
	Quantity	Fifteen
	Dimension	W 11.00 m x L 13.50 m
	Area	11.00 x 13.50 x 15 = 2,228 m^2
	Check	
	Drying Time	$\frac{2,228 \times 0.30}{41.0}$ = 16.3 days

3-2-6 Disinfection Tank

Type	Horizontally Baffled Flow Rectangular Tank
Planned Flow	8,600 m^3/day = 6.0 m^3/min.
Contact Time	15 min.
Required Volume	6.0 x 15 = 90.0 m^3
Quantity	One
Dimension	W 2.00 x L 6.00 m x 4 channels x D 2.00 m
Volume	2.00 x 6.00 x 4 x 2.00 = 96.0 m^3
Check	
Contact Time	96.0 ÷ 6.0 = 16.0 min.

3-3 Sludge Treatment Facilities

3-3-1 Sludge Thickener

Type	Radial Flow Circular Tank
Planned Flow	34.4 + 77.4 = 111.8 m^3/day = 4.7 m^3/hr
Planned Solid	1,230 kg/day
Thickening Time	24 hr
Required Volume	4.7 x 24 = 113 m^3
Solid Loading	30 kg/m^2.day
Required Surface	1,230 ÷ 30 = 41.0 m^2
Effective Water Depth	113 ÷ 41.0 = 2.76 m
Quantity	Two
Dimension	ϕ 5.20 m x D 3.00 m
Volume	1/4 x 3.14 x 5.20^2 x 3.00 x 2 = 127 m^3
Surface	1/4 x 3.14 x 5.20^2 x 2 = 42.5 m^2

Appendix 4

Fig. 4-1 Profile of Planned Main Sewar Case 1

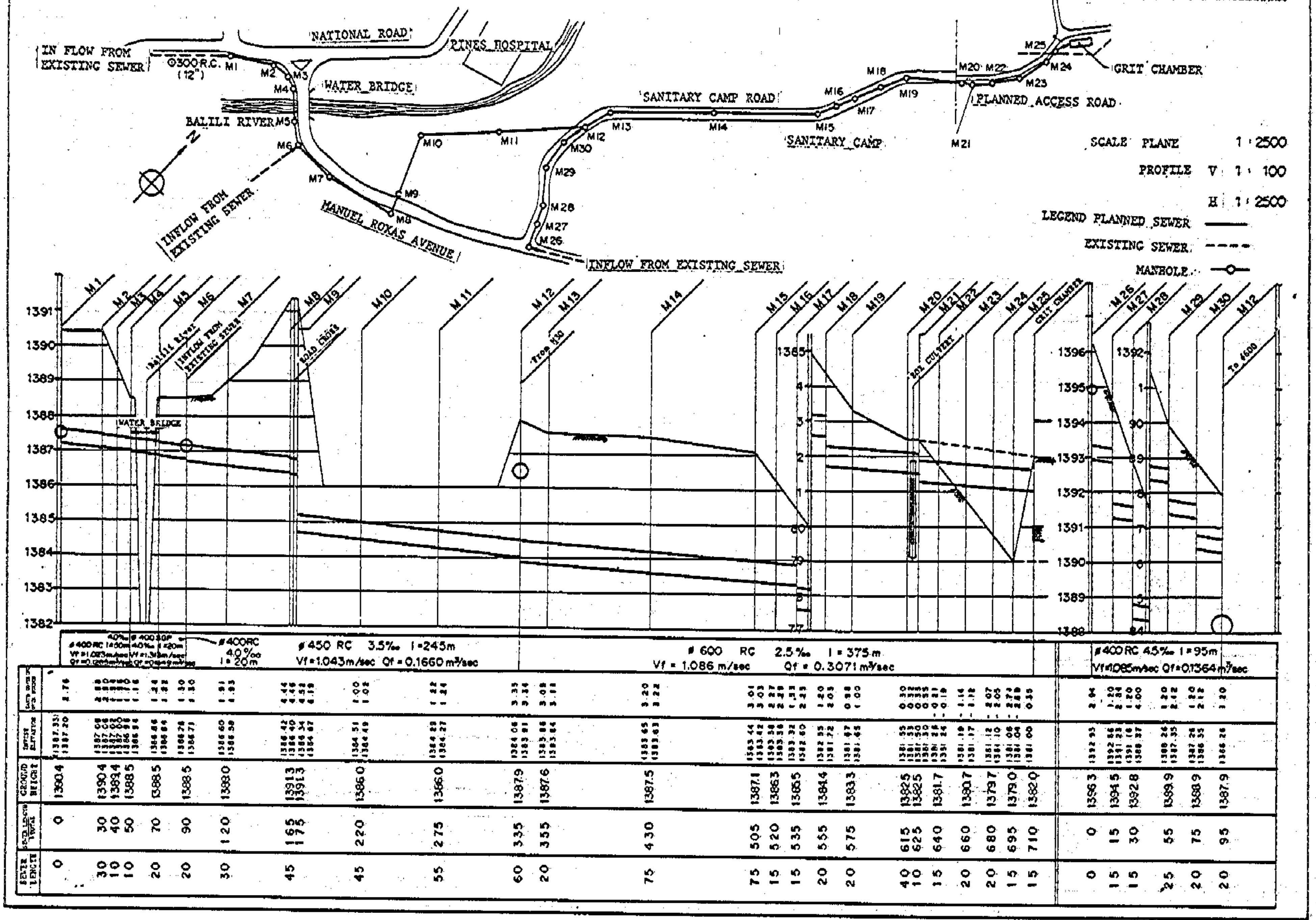


Fig. 4-2 Profile of Planned Main Sewer Case 2