14. Alternative Feasibility Study

14.1 General

This section deals, as previously described in 1. General, with a study for a project comprising Phase I and Phase II in order to explore the feasibility.

14.2 Proposed Water Supply Plan

The project area for the target year covers approximately 1,480 ha, the population served increases to 39,240 and the total water demand is 9,130 cu m/d, which are described in the preceding sections of this part.

The schematic diagram and the location of major facilities for proposed water supply systems are shown in Figs 3.14.1, and 3.14.2. The facilities to be constructed are recapitulated in Table 3.14.1. The construction schedule is as Fig 3.14.3 and the project cost and disbursement schedule are shown in Table 3.14.2 and Table 3.14.3 respectively.

14.3 Financial Feasibility Analysis

14.3.1 Source of Funds and Rate of Interest on Borrowing

In this financial feasibility study, forecasts are constructed on the assumption that 20 % of the total capital investment is financed by government susidies and the rest by the government loans. Forecasts of loan disbursement and debt service are presented in Financial Table 3.

These estimates are based on the assumption that the Water District will be able to obtain loan funds through government sources (LWUA), which represent a blending of funds obtained locally and internationally.

The assumed interest rate is 9.0 percent per annum and other assumed terms include a six-year period (construction period) of grace on principal payment, and twenty-four year instalment repayment.

Approximately 60% of the project cost is composed of foreign currency portions and the rest composed of local currency portions. In view of the magnitude of foreign currency requirements, the government is recommended to seek loans from foreign sources such as the Overseas Economic Cooperation Fund, Japan (OECF), the World Bank or the Asian Development Bank, though the effect of such borrowing will not directly affect the forecasts of the Water District's financial performance.

14.3.2 Financial Feasibility

Carefully constructed financial forecasts based on the above mentioned assumptions indicate that the project covering Phases I and II will be positively viable in financial terms.

14.3.3 Water Rate

In calculating revenue, water rates for domestic user were projected less than 5% of the average household income of the Water District Area. (See Financial Table 7)

One of the salient features of the project is that the revenue units costs at 1981 constant prices of production toward the target year period 1990-1993, will be significantly lower than at present.

14.4 Economic Feasibility Analysis

14.4.1 Increase of Served Population and Area

Served population in the target year is estimated at 39,240 which is a gain of 120 % over the present served population. And the served area will increase from 400 ha to 1,480 ha in the target year.

14.4.2 Internal Economic Rate of Return

The internal economic rate of return calculated proved positive economic vaibility as to the recommended master plan as shown below.

1) Based on Cost Value without Conversion: 22 %
2) Based on Cost Value with Conversion A : 18 %
3) Based on Cost Value with Conversion B : 24 %
4) Based on Cost Value with Conversion C : 17 %

Daraga

(I + II)

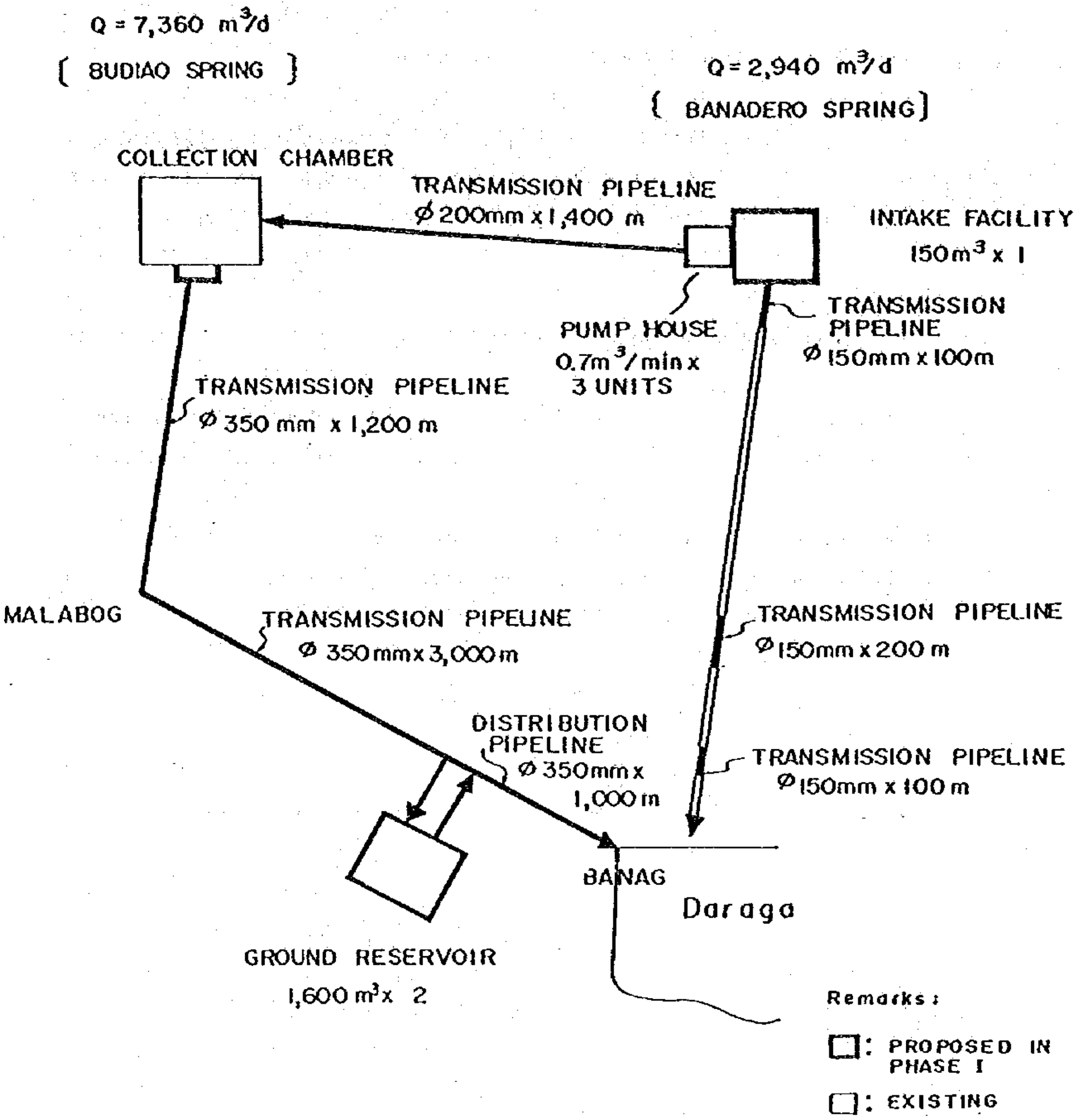


Fig 3.14.1 Schematic Diagram for Preliminary Design for Phase (I + II)

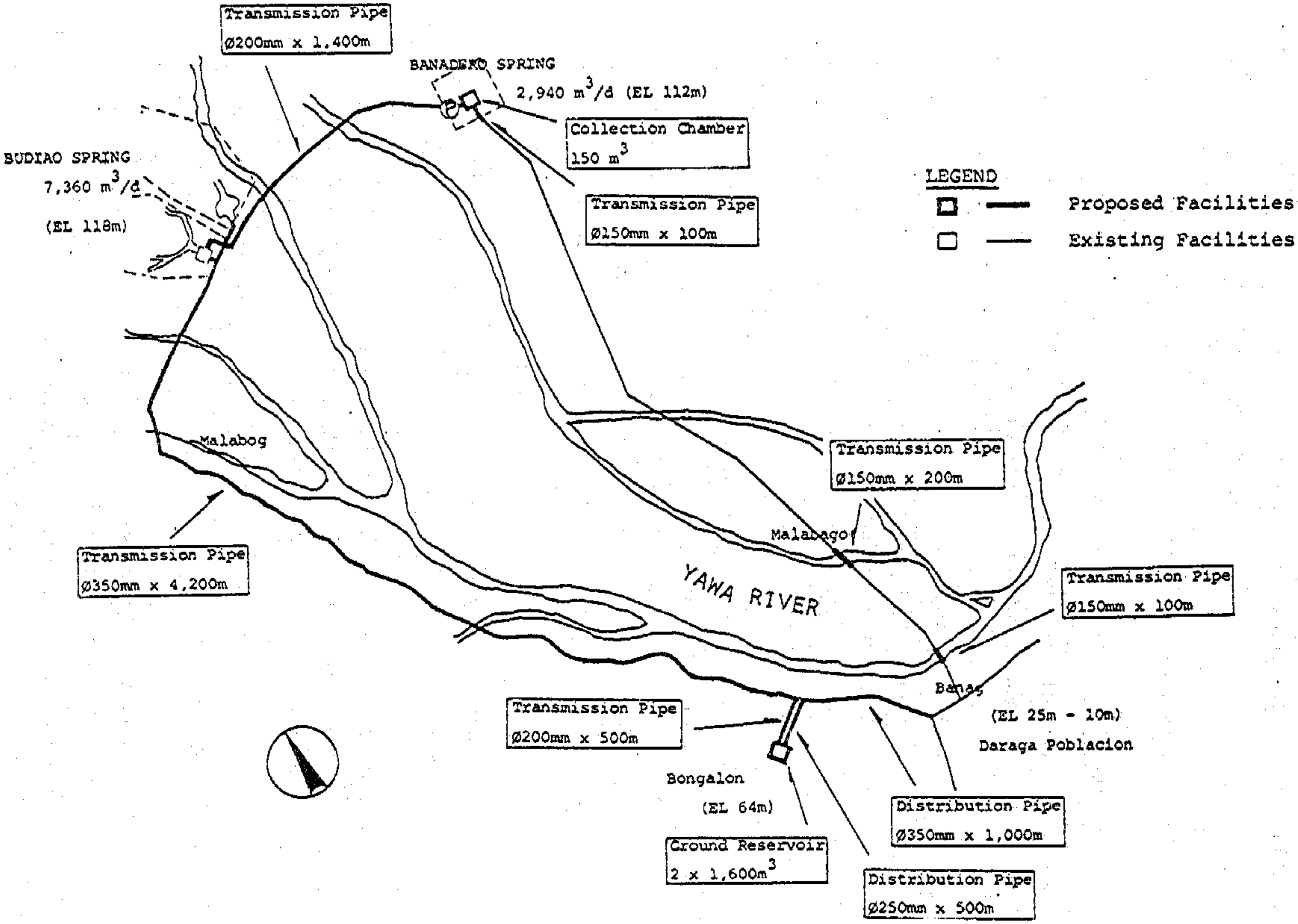


Fig 3.14.2 Location of Major Facilities (Phase I + II)

Table 3.14.1 Facilities Required

1) Bañadero System

a. Intake Facilities:

i. Collection Chamber
Made of reinforced concrete
Capacity and Number: 150 m^3 x 1 unit

ii. Intake Pipe
Perforated RC pipe

iii. Diameter and Length: ∅1,000 mm x 100 m
Cobble Stones and Gravels
Volume: 1,000 m^3

b. Repair of Transmission Pipeline:
Diameter and Length: ∅150 mm x 200 m at Malabago River Crossing
∅150 mm x 100 m at Bañag River Crossing
∅150 mm x 100 m at Collection Chamber

c. Intake Pump Station:
Type of pump: Turbine Pump
Capacity: 0.7 m^3/min x 30 m x 7.5 kw
Number of unit: 3 units

d. Installation of Transmission Pipeline:
(From the Bañadero Spring to the Budiao Spring)
Diameter and Length: ∅200 mm x 1,400 m

2) Budiao System

a. Installation of Transmission Pipeline:
(From the Budiao Spring to the Ground Reservoir)
Diameter and Length: ∅350 mm x 4,200 m
∅200 mm x 500 m

- to be continued -

b. Construction of Ground Reservoir:
(Constructed in Bongalon Area)
Made of reinforced concrete
Capacity and number of unit: 1,600 m^3 x 2 units

c. Installation of Transmission Pipelines:
(From the ground reservoir to Banag Junction)
Diameter and Length: ø350 mm x 1,000 m; and
ø250 mm x 500 m

3) Reinforcement and Expansion of Distribution Pipelines

a. ø300 mm x 1,200 m
b. ø200 mm x 1,400 m
c. ø150 mm x 2,160 m
d. ø100 mm x 5,300 m
e. ø 75 mm x 5,300 m
f. ø 50 mm x 14,040 m

4) Other Equipment:

a. Service Meter:
ø13 mm x 7,012 pcs

b. Bulk Meter:
ø350 mm x 2 pcs
ø300 mm x 1 pc.
ø250 mm x 3 pcs
ø200 mm x 6 pcs

c. Valve:
ø300 mm x 4 pcs
ø200 mm x 5 pcs

- to be continued -

Daraga

(I + II)

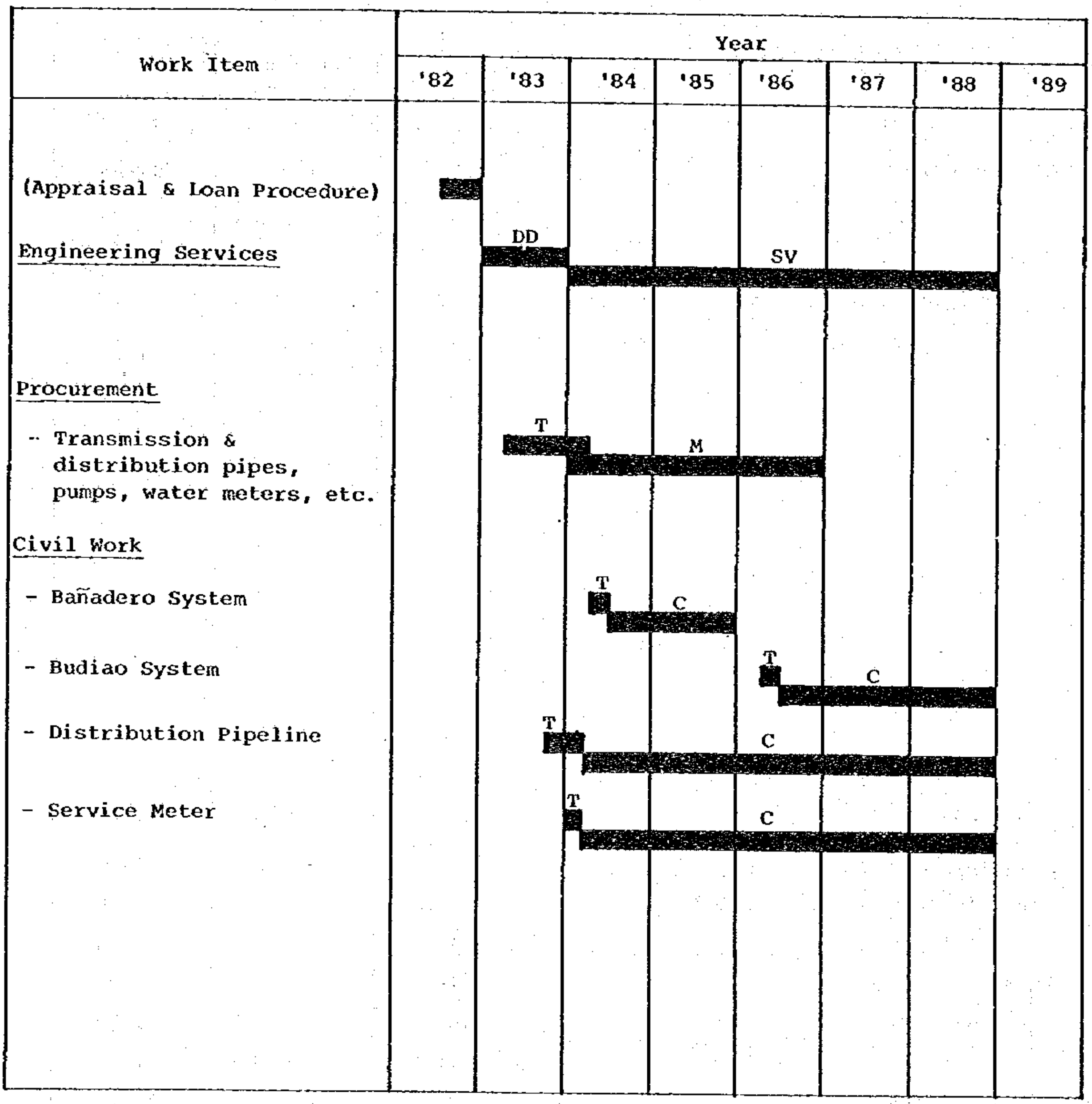
ø150 mm x 8 pcs
ø100 mm x 18 pcs
ø 75 mm x 17 pcs

d. Fire Hydrant:
68 pcs

e. Chlorinator:
3 sets

f. Vehicle:
3 units

Fig 3.14.3 Construction Schedule



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

Daraga

(I + II)

Table 3.14.2 Project Cost

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Banadero System	2,824	1,530	1,294
B. Budiao System	9,695	5,210	4,485
C. Reinforcement/Expansion of Distribution Pipelines	4,633	3,105	1,528
D. Equipment	5,662	4,249	1,413
Sub Total	22,814	14,094	8,720
Detailed Design Cost (10.5%)	2,396	1,480	916
Supervision Cost (3.5 %)	798	493	305
Land Cost	156	-	156
Total	26,164	16,067	10,097
Physical Contingency (10 %)	2,617	1,607	1,010
Total	28,781	17,674	11,107
Price Contingency	21,987	12,273	9,714
Grand Total (Project Cost)	50,768	29,947	20,821
	(Equivalent to US$6.51 M)	(Equivalent to US$3.84 M)	(Equivalent to US$2.67 M)

Table 3.14.3 Disbursement Schedule

NOTE:
- F/C = Foreign Currency Component
- L/C = Local Currency Component
- Unit: One Thousand Pesos = '000 Pesos
- Prices: As of 1st July 1981
- Foreign Exchange Rate: US$1.00 = Pesos 7.80

(Thousand Pesos)

Description	Cost			Yearly Disbursement											
	Total Cost	Breakdown		1983		1984		1985		1986		1987		1988	
		F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
A. Banadero System															
a) Intake Facilities (150 m³ x 1)	700	175	525			175	525								
b) Transmission (ø150 mm x 400 m)	330	221	109			221	109								
c) Pump House (0.7 m³/min x 30m^H x 3)	972	583	389			233	156	350	233						
d) Transmission (ø200 mm x 1,400 m)	822	551	271			220	108	331	163						
B. Budiao System															
a) Transmission (ø350 mm x 1,200 m)	1,423	953	470					953	470						
b) Ground Reservoir (1,600 m³ x 2)	3,060	765	2,295							383	1,148			382	1,147
c) Transmission (ø350 mm x 3,000 m)	3,555	2,382	1,173							2,382	352		821		
(ø200 mm x 500 m)	294	197	97							197					97
d) Distribution (ø350 mm x 1,000 m)	790	529	261							529	100		161		
(ø250 mm x 500 m)	573	384	189							384					189
C. Reinforcement/Expansion of Distribution															
a) ø300 mm x 1,200 m	780	523	257			523	257								
b) ø200 mm x 1,400 m	546	366	180			146	72	220	108						
c) ø150 mm x 2,160 m	594	398	196			100	49	99	49	199	49		49		
d) ø100 mm x 5,300 m	954	639	315			170	63	169	63	300	63		63		63
e) ø 75 mm x 5,300 m	636	426	210			85	42	85	42	256	42		42		42
f) ø 50 mm x 14,040 m	1,123	753	370			151	74	151	74	451	74		74		74

(to be continued)

NOTE:
- F/C = Foreign Currency Component
- F/C = Local Currency Component
- Unit: One Thousand Pesos = '000 Pesos
- Prices: As of 1st July 1981
- Foreign Exchange Rate: US$1.00 = Pesos 7.80

NOTE: Price Escalation Rate (Price Contingency)
Present - 1984: 15% Annual both for F/C and L/C
1985 - 1989: 12% Annual both for F/C and L/C
1990 - : 10% Annual both for F/C and L/C

(Thousand Pesos)

Description	Total Cost	Cost Breakdown		Yearly Disbursement 1983		1984		1985		1986		1987		1988	
		F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
D. Other Equipment															
a) Service Meter (ø13 mm x 7,012)	4,558	3,510	1,048			3,510	210		210		210		209		209
b) Bulk Meter (ø350 mm x 2, ø300 mm x 1) (ø250 mm x 3, ø200mm-100mm x 6)	102	82	20			41	5	41	7						8
c) Valve (52)	312	228	84			57	20	57	20	114			24		20
d) Fire Hydrant (68)	450	297	153			100	50			197	50		23		30
e) Chlorinator (3)	30	27	3					27	2						1
f) Vehicle (3)	210	105	105			70	70	35	35						
Sub-Total	22,814	14,094	8,720			5,902	1,810	2,518	1,476	5,392	2,088		1,466	382	1,880
Detailed Design Cost (10.5%)	2,396	1,480	916	480	916										
Supervision Cost (3.5%)	798	493	305			99	61	99	61	99	61	98	61	98	61
Land Cost	156		156				108		48						
Total	26,164	16,067	10,097	1,480	916	5,901	1,979	2,617	1,585	5,491	2,149	98	1,527	480	1,941
Physical Contingency (10%)	2,617	1,607	1,010	148	92	590	198	262	158	549	215	10	153	48	194
Total	28,781	17,674	11,107	1,628	1,008	6,491	2,177	2,879	1,743	6,040	2,364	108	1,680	528	2,135
Price Contingency	21,987	12,273	9,714	525	325	3,381	1,134	2,025	1,226	5,483	2,146	123	1,909	736	2,974
Grand Total (Project Cost)	50,768	29,947	20,821	2,153	1,333	9,872	3,311	4,904	2,969	11,523	4,510	231	3,589	1,264	5,109

FINANCIAL TABLE 1

DARAGA WATER SUPPLY PROJECT

PORJECT COSTS BY YEAR OF CONSTRUCTION

(P1,000's)

I + II

Project Components By Major Elements	Costs as of 7-1-81 By Construction Year						
	Total	1983	1984	1985	1986	1987	1988
1. Intake Facilities	700	–	700	–	–	–	–
2. Ground Reservoir	3,060	–	–	–	1,531	–	1,529
3. Transmission	6,424	–	658	1,917	2,931	821	97
4. Distribution	5,996	–	1,732	1,060	2,447	389	368
5. Valves	312	–	77	77	114	24	20
6. Fire Hydrant	450	–	150	–	247	23	30
7. Pumps	972	–	389	583	–	-	-
8. Meters	4,660	-	3,766	258	210	209	217
9. Chlorinator	30	–	–	29	–	–	1
10. Vehicle	210	–	140	70	–	–	–
11. Engineering	2,396	2,396	–	–	–	–	–
12. Lands	156	–	108	48	–	–	–
13. Physical Contingency	2,617	240	788	420	764	163	242
14. Supervision	798	–	160	160	160	159	159
15.							
16.							
17.							
18.							
TOTAL, 7-1-81	28,781	2,636	8,668	4,622	8,404	1,788	2,663
ESCALATION FACTORS		1.322500	1.520875	1.703380	1.907785	2.136719	2.393123
ESCALATED COSTS	50,768	3,486	13,183	7,873	16,033	3,820	6,373

I + II

FINANCIAL TABLE 2

DARAGA WATER SUPPLY PROJECT
OPERATION AND MAINTENANCE COSTS
(₱1,000's)

Year	Fixed, 7-1-81 Costs				Escalated Costs	
	Power	Chemicals	Others	Total	Factor 1/	Amount
1981	-	30	174	204	1.000000	204
1982	-	31	174	205	1.150000	236
1983	-	32	174	206	1.322500	272
1984	-	33	183	216	1.520875	329
1985	-	68	210	278	1.703380	474
1986	-	72	229	301	1.907785	574
1987	-	76	274	350	2.136719	748
1988	-	81	319	400	2.393126	957
1989	-	88	374	462	2.680301	1,238
1990	24	94	419	537	2.948331	1,583
1991	52	100	473	625	3.243164	2,027
1992	79	105	473	657	3.567480	2,344
1993	107	111	473	691	3.924228	2,712
1994	107	111	473	691	4.316651	2,983
1995	107	111	473	691	4.748316	3,281
1996	107	111	473	691	5,223148	3,609
1997	107	111	473	691	5.745463	3,970
1998	107	111	473	691	6.320009	4,367

1/ Escalation currently 15 percent per year to 1984 (1981 = 1.00), 12 percent per year between 1985 and 1989 and 10 percent per year in 1990 and afterwards.

FINANCIAL TABLE 3

DARAGA WATER SUPPLY PROJECT
LOAN DISBURSEMENTS AND DEBT SERVICE
(P1,000's)

Year	Disbursement 1/		Loans Outstanding		Interest Payments		Principal Payments 3/	Total Debt Service
	Grant 20%	Loan 80%	Beginning	Ending	First Year 2/	Later Years		
1981								
1982								
1983	697	2,789		2,789	125			125
1984	2,637	10,546	2,789	13,335	474	251		725
1985	1,575	6,298	13,335	19,633	283	1,200		1,483
1986	3,207	12,826	19,633	32,459	577	1,766		2,343
1987	764	3,056	32,459	35,515	137	2,920		3,057
1988	1,275	5,098	35,515	40,613	229	3,195		3,424
1989			40,613	40,497		3,651	116	3,767
1990			40,497	39,943		3,631	554	4,185
1991			39,943	39,127		3,575	816	4,391
1992			39,127	37,777		3,490	1,350	4,840
1993			37,777	36,301		3,367	1,476	4,843
1994			36,301	34,613		3,229	1,688	4,917
1995			34,613	32,925		3,076	1,688	4,764
1996			32,925	31,237		2,925	1,688	4,613
1997			31,237	29,549		2,775	1,688	4,463
1998			29,549	27,861		2,621	1,688	4,309

1/ From Financial Table 1.

2/ Disbursements assumed to be equally spread during year. Charge with 50 per cent of annual interest in first year.

3/ Principal payments according to LWUA year plan.

FINANCIAL TABLE 4

DARAGA WATER SUPPLY PROJECT
CASH REQUIREMENTS PER REVENUE UNIT
(₱1,000's)

Year	Debt Service	O & M	Total Costs	Estimated Reserves 1/	Cost With Reserves	Revenue Units 2/	Cost Per Revenue Unit 3/
1981		204	204		204	739	0.28
1982		236	236		236	770	0.31
1983	125	272	397		397	847	0.47
1984	725	329	1,054		1,054	892	1.18
1985	1,483	474	1,957		1,957	1,729	1.13
1986	2,343	574	2,917		2,917	1,924	1.52
1987	3,057	748	3,805		3,805	2,161	1.76
1988	3,424	957	4,381		4,381	2,387	1.84
1989	3,767	1,238	5,005	250	5,255	2,655	1.98
1990	4,185	1,583	5,768	288	6,056	2,926	2.07
1991	4,391	2,027	6,418	642	7,060	3,228	2.19
1992	4,840	2,344	7,184	718	7,902	3,500	2.26
1993	4,843	2,712	7,555	756	8,311	3,822	2.17
1994	4,917	2,983	7,900	790	8,690	3,822	2.27
1995	4,764	3,281	8,045	805	8,850	3,822	2.32
1996	4,613	3,609	8,222	822	9,044	3,822	2.37
1997	4,463	3,970	8,433	843	9,276	3,822	2.43
1998	4,309	4,367	8,676	868	9,544	3,822	2.50

1/ Reserve estimate equal to 10 per cent of total costs. (5 per cent for the first two years)

2/ Revenue units from Tables 9A, 9B and 9C.

3/ Revenue units divided into costs with reserves.

FINANCIAL TABLE 5 - A

DARAGA WATER SUPPLY PROJECT

ABILITY TO PAY FOR WATER

I + II

1	2	3	4	5	6	7	8
Year	Ave. Monthly Family Income 1/	Available 5%	Average Family Size	Household Water Use		Revenue Units Per Month 2/	Max. Ability Per Rev. Unit
				lpcd	Cubic Meters/ Month		
1981	490.00	24.50	5.62	50	8	25	0.98
1982	563.35	28.18	5.61	50	8	25	1.13
1983	648.03	32.40	5.60	50	8	25	1.30
1984	745.23	37.26	5.59	50	8	25	1.49
1985	834.66	41.73	5.58	62	10	25	1.67
1986	934.82	46.74	5.57	80	13	29	1.61
1987	1,046.99	52.35	5.56	86	14	30	1.75
1988	1,172.63	58.63	5.55	94	16	32	1.89
1989	1,313.35	65.66	5.54	95	16	32	2.12
1990	1,444.69	72.23	5.53	101	17	33	2.19
1991	1,589.15	79.45	5.52	103	17	33	2.41
1992	1,748.07	87.40	5.51	116	19	36	2.43
1993	1,922.88	96.14	5.50	116	19	36	2.67

1/ Average monthly income escalated by 15 per cent per year to 1984, 12 per cent per year between 1985 and 1989, and 10 per cent in 1990 and afterwards.

2/ Assumed 1/2" service.

FINANCIAL TABLE 5 - B

DARAGA WATER SUPPLY PROJECT

ABILITY TO PAY FOR WATER

I + II

Year	Ave. Monthly Family Income 1/	Available 5%	Average Family Size	Household Water Use		Revenue Units Per Month 2/	Max. Ability Per Rev. Unit
				lpcd	Cubic Meters/ Month		
1994	2,115.17	105.76	5.49	116	19	36	2.94
1995	2,326.69	116.33	5.48	116	19	36	3.23
1996	2,559.36	127.97	5.47	116	19	36	3.56
1997	2,815.30	140.77	5.46	116	19	36	3.91
1998	3,096.83	154.84	5.45	116	19	36	4.30

1/ Average monthly income escalated by 15 percent year to 1984, 12 percent per year between 1985 and 1989, and 10 percent in 1990 and afterwards.

2/ Assumed 1/2" service.

FINANCIAL TABLE 6 - A

DARAGA WATER SUPPLY PROJECT
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

I + II

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenue 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1981	739	0.70	517	95	491	204		204	287	287
1982	770	0.70	539	95	512	236		236	276	563
1983	847	1.10	932	96	894	397		397	500	1,063
1984	892	1.10	981	96	942	1,054		1,054	-112	951
1985	1,729	1.60	2,766	96	2,655	1,957		1,957	698	1,649
1986	1,924	1.60	3,078	97	2,986	2,917		2,917	69	1,718
1987	2,161	1.75	3,782	97	3,669	3,805		3,805	-136	1,582
1988	2,387	1.75	4,177	97	4,052	4,381		4,381	-329	1,253
1989	2,655	2.10	5,576	98	5,464	5,005	279	5,284	180	1,433
1990	2,926	2.10	6,145	98	6,022	5,768	307	6,075	-53	1,380
1991	3,228	2.30	7,424	98	7,276	6,418	742	7,160	116	1,496
1992	3,500	2.30	8,050	98	7,889	7,184	805	7,989	-100	1,396
1993	3,822	2.60	9,937	98	9,738	7,555	994	8,549	1,189	2,585

1/ From Tables 9A, 9B and 9C.
2/ Gross revenues from water sales reduced by bad debt allowance.
3/ Total of project debt service, operation and maintenance costs.
4/ Ten percent of gross water sales, after completion of construction. (5 percent for the first two years)
5/ Includes the costs of replacing the first complement of project components with seven years of life expectancy.

FINANCIAL TABLE 6 - B

DARAGA WATER SUPPLY PROJECT
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

I + II

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenues 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1994	3,822	2.60	9,937	98	9,738	7,900	994	8,894	844	3,429
1995	3,822	2.60	9,937	98	9,738	8,045	994	9,039	745	4,174
1996	3,822	2.60	9,937	98	9,738	8,222	994	9,216	522	4,696
1997	3,822	2.60	9,937	98	9,738	8,433	994	9,427	311	5,007
1998	3,822	2.60	9,937	98	9,738	8,676	994	9,670	68	5,075

1/ From Tables 9A, 9B and 9C.

2/ Gross revenues from water sales reduced by bad debt allowance.

3/ Total of project debt service, operation and maintenance costs.

4/ Ten percent of gross water sales, after completion of construction.

5/ Includes costs of replacing the dirst complement of project components with seven years of life expectancy.

FINANCIAL TABLE 7

DARAGA WATER SUPPLY PROJECT

ILLUSTRATIVE RATE SCHEDULE

DOMESTIC AND GOVERNMENTAL SERVICE CONNECTIONS, 1/2"

Year	First 10 m^3 1/	Charge for Each Added m^3 2/			Charge 3/ per Revenue Unit
		11-20	21-45	over 45	
1981	17.50	0.84	0.98	1.19	0.70
1982	17.50	0.84	0.98	1.19	0.70
1983	27.50	1.32	1.54	1.87	1.10
1984	27.50	1.32	1.54	1.87	1.10
1985	40.00	1.92	2.24	2.72	1.60
1986	40.00	1.92	2.24	2.72	1.60
1987	43.75	2.10	2.45	2.98	1.75
1988	43.75	2.10	2.45	2.98	1.75
1989	52.50	2.52	2.94	3.57	2.10
1990	52.50	2.52	2.94	3.57	2.10
1991	57.50	2.76	3.22	3.91	2.30
1992	57.50	2.76	3.22	3.91	2.30
1993	65.00	3.12	3.64	4.42	2.60

Note: 1/ To obtain charge per m^3 for the first 10 m^3 classified by connection size, multiply R.U. charge shown in 3/ above by the following connection size factors.

Domestic : 1.0 for 3/8"; 2.5 for 1/2"; 4.0 for 3/4"; 8 for 1"
Commerical: 5.0 for 1/2"; 8.0 for 3/4"; 16.0 for 1"; 40.0 for 1 1/2"

2/ To obtain charge for each added m^3, multiply R.U. charges shown in 3/ by the following block factors.

Domestic : 1.2 for 11-20 m^3; 1.4 for 21-45 m^3; 1.7 for over 45 m^3
Commercial: 2.4 for 21-45 m^3; 2.8 for 45-100 m^3; 2.4 for over 100 m^3

FINANCIAL TABLE 8

DARAGA WATER SUPPLY PROJECT

GROWTH IN POPULATION, SERVICE CONNECTIONS AND IN DELIVERED AND PROCURED WATER

1	2	3	4	5	6	7	8
Year	Ave. Number Service Connections	Number For Service	Persons Served	Daily Use lpcd 1/	Annual Water Supply (1,000 M^3)		
					Delivered	% Unacct.	Produced
1981	1,223	14.9	18,200	63	418	45	759
1982	1,267	13.6	18,800	63	433	43	759
1983	1,511	13.3	20,100	63	482	40	803
1984	1,677	13.0	21,800	63	502	40	836
1985	1,922	11.6	22,300	126	1,026	40	1,710
1986	2,171	10.5	22,800	136	1,132	37	1,798
1987	2,456	9.5	23,270	148	1,253	34	1,899
1988	2,938	8.8	25,900	146	1,383	32	2,034
1989	3,555	8.1	28,800	146	1,535	30	2,193
1990	4,312	7.3	31,600	146	1,686	28	2,342
1991	5,250	6.5	34,200	148	1,843	26	2,490
1992	6,508	5.7	36,800	147	1,973	25	2,631
1993	8,235	4.8	39,240	145	2,083	25	2,777

1/ Liters per capita per day.

I + II

FINANCIAL TABLE 9A

DARAGA WATER SUPPLY PROJECT

I + II

CALCULATION OF REVENUE UNITS

A) AVERAGE NUMBER OF CONCESSIONAIRES

Year	Residential and Government					Commercial and Industrial					Total
	3/8"	1/2"	3/4"	1"	S-Total	1/2"	3/4"	1"	1 1/2"	S-Total	
1981	339	780	10	1	1,130	78	10	3	2	93	1,223
1982	374	860	12	1	1,247	78	10	3	2	93	1,340
1983	386	887	12	1	1,285	80	11	4	2	97	1,382
1984	434	997	12	2	1,445	85	11	4	2	102	1,547
1985	490	1,126	14	2	1,632	143	19	7	3	172	1,804
1986	557	1,280	16	2	1,855	202	27	10	3	242	2,097
1987	640	1,472	19	3	2,134	270	35	12	5	322	2,456
1988	783	1,801	23	3	2,610	275	36	12	5	328	2,938
1989	966	2,222	29	4	3,221	280	36	13	5	334	3,555
1990	1,192	2,741	35	4	3,972	285	36	14	5	340	4,312
1991	1,471	3,384	44	5	4,904	289	38	14	5	346	5,250
1992	1,847	4,248	55	6	6,151	294	39	14	5	352	6,508
1993	2,363	5,436	71	8	7,878	299	39	14	5	357	8,235

B) SERVICE REVENUE UNITS PER CUBIC METER

Year	Residential and Government					Commercial and Industrial					Total
	1.00	2.50	4.0	8.0	S-total	5.0	8.0	16.0	40.0	S-Total	
1981	339	1,950	40	8	2,337	390	80	48	80	598	2,935
1982	374	2,150	48	8	2,580	390	80	48	80	598	3,178
1983	386	2,218	48	8	2,660	400	88	64	80	632	3,292
1984	434	2,493	48	16	2,991	425	88	64	80	657	3,648
1985	490	2,815	56	16	3,377	715	152	112	120	1,099	4,476
1986	557	3,200	64	16	3,837	1,010	216	160	120	1,506	5,343
1987	640	3,680	76	24	4,420	1,350	280	192	200	2,022	6,442
1988	783	4,503	92	24	5,402	1,379	288	192	200	2,022	7,424
1989	966	5,555	116	32	6,669	1,400	288	208	200	2,096	8,765
1990	1,192	6,853	140	32	8,217	1,425	288	224	200	2,137	10,354
1991	1,471	8,460	176	40	10,147	1,445	304	224	200	2,173	12,320
1992	1,847	10,620	220	48	12,735	1,470	312	224	200	2,206	14,941
1993	2,363	13,590	284	64	16,301	1,495	312	224	200	2,231	18,532

FINANCIAL TABLE 9B1

DARAGA WATER SUPPLY PROJECT
CALCULATION OF REVENUE UNITS

I + II

DOMESTIC

Year	Delivered Water (x1000 cum)	Service Connections (x 0.12)	Net	11 - 20 cum		21 - 45 cum		over 45 cum		Total CRU's
				cum	x 1.2	cum	x 1.4	cum	x 1.7	
1981	372	136	236	136	163	100	140	-	-	303
1982	385	150	235	150	180	85	119	-	-	299
1983	429	154	275	154	185	121	169	-	-	354
1984	446	173	273	173	208	100	140	-	-	348
1985	913	196	717	196	235	521	729	-	-	964
1986	1,008	223	785	223	268	562	787	-	-	1,055
1987	1,116	256	860	256	307	604	846	-	-	1,153
1988	1,230	313	917	313	376	604	846	-	-	1,222
1989	1,366	387	979	387	464	592	829	-	-	1,293
1990	1,501	477	1,024	477	572	547	766	-	-	1,338
1991	1,640	588	1,052	588	706	464	650	-	-	1,356
1992	1,756	739	1,017	739	887	278	389	-	-	1,276
1993	1,853	945	908	945	1,134	-	-	-	-	1,134

FINANCIAL TABLE 9B2

DARAGA WATER SUPPLY PROJECT
CALCULATION OF WATER REVENUES UNITS

I + II

COMMERCIAL

Year	Delivered Water (x1000 cum)	Service Connections (x 0.12)	Net	11 - 45 cum		46 - 100 cum		Over 100 cum		Total CRU's
				cum	x 2.4	cum	x 2.8	cum	x 3.4	
1981	46	11	35	35	84	-	-	-	-	84
1982	48	11	37	37	89	-	-	-	-	89
1983	53	12	41	41	98	-	-	-	-	98
1984	56	12	44	43	103	1	3	-	-	106
1985	113	21	92	72	172	20	56	-	-	228
1986	124	29	95	95	228	-	-	-	-	228
1987	137	39	98	98	235	-	-	-	-	235
1988	153	39	114	114	274	-	-	-	-	274
1989	169	40	129	129	310	-	-	-	-	310
1990	185	41	144	143	343	1	3	-	-	346
1991	203	42	161	145	348	16	45	-	-	393
1992	217	42	175	148	355	27	76	-	-	431
1993	230	43	187	150	360	37	104	-	-	464

I + II

FINANCIAL TABLE 9C

SUMMARY OF REVENUE UNITS

Year	Residential and Governmental				Commercial and Industrial				Total All
	Service			Total R & C	Service			Total C & I	
	RU/Serv. Connection	Multiplied by 0.12	Commodity Rev. Units		RU/Serv. Connection	Multiplied by 0.12	Commodity Rev. Units		
1981	2,337	280	303	583	598	72	84	156	739
1982	2,580	310	299	609	598	72	89	161	770
1983	2,660	319	354	673	632	76	98	174	847
1984	2,991	359	348	707	657	79	106	185	892
1985	3,377	405	964	1,369	1,099	132	228	360	1,729
1986	3,837	460	1,055	1,515	1,506	181	228	409	1,924
1987	4,420	530	1,153	1,683	2,022	243	235	478	2,161
1988	5,402	648	1,222	1,870	2,022	243	274	517	2,387
1989	6,669	800	1,293	2,093	2,096	252	310	562	2,655
1990	8,217	986	1,338	2,324	2,137	256	346	602	2,926
1991	10,147	1,218	1,356	2,574	2,173	261	393	654	3,228
1992	12,735	1,528	1,276	2,804	2,206	265	431	696	3,500
1993	16,301	1,956	1,134	3,090	2,231	268	464	732	3,822

ECONOMIC TABLE 1

DARAGA WATER SUPPLY PROJECT

I + II

SUMMARY OF PROJECT COST

Costs as of July 1, 1981 in 1,000 Pesos

Components	Total Cost	Foreign Currency Portion	Local Currency Portion
1. Intake Facilities	700	175	525
2. Ground Reservoir	3,060	765	2,295
3. Transmission	6,424	4,304	2,120
4. Distribution	5,996	4,018	1,978
5. Valves	312	228	84
6. Fire Hydrants	450	297	153
7. Pumps	972	583	389
8. Meters	4,660	3,592	1,068
9. Chlorinators	30	27	3
10. Vehicles	210	105	105
11. Engineering	2,396	1,480	916
12. Lands	156	-	156
13. Supervision	798	493	305
14.			
15.			
16.			
17.			

Source: From Cost Estimates

I + II

ECONOMIC TABLE 2

DARAGA WATER SUPPLY PROJECT

ANNUAL DEMAND AND GROSS PRODUCTION IN 1,000 M^3

1	2	3	4	5	6	7	8	9
Year	Average Connections	Persons Per Service Connection	Population Served	Average Water Use		Net Increase in Delivered Volume	Unacounted Percentage	Annual Production
				Liters/ Capita Per Day	Water Delivered Annually			
1981	1,223	14.9	18,200	64	424		45	770
1982	1,340	13.6	18,200	64	433		45	788
1983	1,382	14.0	19,300	64	448		45	814
1984	1,547	13.0	20,100	64	466	18	45	847
1985	1,804	11.6	21,000	136	1,040	592	40	1,734
1986	2,097	10.5	22,000	143	1,148	700	37	1,823
1987	2,456	9.5	23,270	150	1,271	823	34	1,925
1988	2,938	8.8	25,900	148	1,402	954	32	2,062
1989	3,555	8.1	28,800	148	1,556	1,108	30	2,223
1990	4,312	7.3	31,600	148	1,709	1,261	28	2,374
1991	5,250	6.5	34,200	148	1,868	1,420	26	2,524
1992	6,508	5.7	36,800	149	2,000	1,552	25	2,667
1993	8,235	4.8	39,240	147	2,111	1,663	25	2,815

ECONOMIC TABLE 3-A

DARAGA WATER SUPPLY PROJECT
CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST
Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.25	Labor x 0.5	Residual x 0.95	Total
1. Intake Facilities	175	525	341	184	263	171	175	609
2. Reservoir	765	2,295	1,492	803	1,148	746	763	2,657
3. Transmission	4,304	2,120	574	1,546	6,456	287	1,469	8,212
4. Distribution	4,018	1,978	791	1,187	6,027	396	1,128	7,551
5. Valves	228	84	34	50	342	17	48	407
6. Hydrants	297	153	61	92	446	31	87	564
7. Pumps	583	389	194	195	875	97	185	1,157
8. Meters	3,592	1,068	214	854	5,388	107	811	6,306
9. Chlorinators	27	3	-	3	41	-	3	44
10. Vehicles	105	105	-	105	158	-	100	258
11. Engineering	1,480	916	-	916	2,220	-	870	3,090
12. Lands	-	156	-	156	-	-	148	148
13. Supervision	493	305	-	305	616	-	290	906
14.								
15.								
16.								
17.								

I + II

ECONOMIC TABLE 3-B

DARAGA WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.0	Labor x 0.5	Residual x 0.95	Total
1. Intake Facilities	175	525	341	184	175	171	175	521
2. Reservoirs	765	2,295	1,492	803	765	746	763	2,274
3. Transmission	4,304	2,120	574	1,546	4,304	287	1,469	6,060
4. Distribution	4,018	1,978	791	1,187	4,018	396	1,128	5,542
5. Valves	228	84	34	50	228	17	48	293
6. Hydrants	297	153	61	92	297	31	87	415
7. Pumps	583	389	194	195	583	97	185	865
8. Meters	3,592	1,068	214	854	3,592	107	811	4,510
9. Chlorinators	27	3	-	3	27	-	3	30
10. Vehicles	105	105	-	105	105	-	100	205
11. Engineering	1,480	916	-	916	1,480	-	870	2,350
12. Lands	-	156	-	156	-	-	148	148
13. Supervision	493	305	-	305	493	-	290	783
14.								
15.								
16.								
17.								

ECONOMIC TABLE 3-C

DARAGA WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.25	Labor x 1.0	Residual x 1.0	Total
1. Intake Facilities	175	525	341	184	263	341	184	788
2. Reservoirs	765	2,295	1,492	803	1,148	1,492	803	3,443
3. Transmission	4,304	2,120	574	1,546	6,456	574	1,546	8,576
4. Distribution	4,018	1,978	791	1,187	6,027	791	1,187	8,005
5. Valves	228	84	34	50	342	34	50	426
6. Hydrants	297	153	61	92	446	61	92	599
7. Pumps	583	389	194	195	875	194	195	1,264
8. Meters	3,592	1,068	214	854	5,388	214	854	6,456
9. Chlorinators	27	3	-	3	41	-	3	44
10. Vehicles	105	105	-	105	158	-	105	263
11. Engineering	1,480	916	-	916	3,220	-	916	4,136
12. Lands	-	156	-	156	-	-	156	156
13. Supervision	493	305	-	305	616	-	305	921
14.								
15.								
16.								
17.								

ECONOMIC TABLE 4-0

DARAGA WATER SUPPLY PROJECT

I + II

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

Value without CONVERSION

Components	Total	1983	1984	1985	1986	1987	1988
1. Intake Facilities	700	-	700	-	-	-	-
2. Reservoir	3,060	-	-	-	1,531	-	1,529
3. Transmission	6,424	-	658	1,917	2,931	821	97
4. Distribution	5,996	-	1,732	1,060	2,447	389	368
5. Valves	312	-	77	77	114	24	20
6. Hydrants	450	-	150	-	247	23	30
7. Pumps	972	-	389	583	-	-	-
8. Meters	4,660	-	3,766	258	210	209	217
9. Chlorinators	30	-	-	29	-	-	1
10. Vehicles	210	-	140	70	-	-	-
11. Engineering	2,396	2,396	-	-	-	-	-
12. Lands	156	-	108	48	-	-	-
13. Supervision	798		160	160	160	159	159
14.							
15.							
16.							
17.							
18.							
Total	26,164	2,396	7,880	4,202	7,640	1,625	2,421

ECONOMIC TABLE 4-A

DARAGA WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

I + II

Value with CONVERSION A

Components	Total	1983	1984	1985	1986	1987	1988
1. Intake Facilities	609	-	609	-	-	-	-
2. Reservoirs	2,657	-	-	-	1,328	-	1,329
3. Transmission	8,212	-	821	2,464	3,778	985	164
4. Distribution	7,551	-	2,190	1,359	3,020	453	529
5. Valves	407	-	102	102	147	33	23
6. Hydrants	564	-	186	-	316	28	34
7. Pumps	1,157	-	463	694	-	-	-
8. Meters	6,306	-	5,045	378	315	253	315
9. Chlorinators	44	-	-	43	-	-	1
10. Vehicles	258	-	173	85	-	-	-
11. Engineering	3,090	3,090	-	-	-	-	-
12. Lands	148	-	102	46	-	-	-
13. Supervision	906		182	181	181	181	181
14.							
15.							
16.							
17.							
18.							
Total	31,909	3,090	9,873	5,352	9,085	1,933	2,576

ECONOMIC TABLE 4-B

DARAGA WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

Value with CONVERSION B

Components	Total	1983	1984	1985	1986	1987	1988
1. Intake Facilities	521	-	521	-	-	-	-
2. Reservoirs	2,274	-	-	-	1,137	-	1,137
3. Transmission	6,060	-	606	1,818	2,788	788	60
4. Distribution	5,542	-	1,608	998	2,272	332	332
5. Valves	293	-	74	73	105	23	18
6. Hydrants	415	-	137	-	232	21	25
7. Pumps	865	-	346	519	-	-	-
8. Meters	4,510	-	3,608	271	226	180	225
9. Chlorinators	30	-	-	29	-	-	1
10. Vehicles	205	-	137	68	-	-	-
11. Engineering	2,350	2,350	-	-	-	-	-
12. Lands	148	-	102	46	-	-	-
13. Supervision	783	-	157	157	157	156	156
14.							
15.							
16.							
17.							
18.							
Total	23,996	2,350	7,296	3,979	6,917	1,500	1,954

ECONOMIC TABLE 4-C

DARAGA WATER SUPPLY PROJECT
ECONOMIC COSTS DISTRIBUTED TO YEARS
₱ x 1,000

I + II

Value with CONVERSION C

Components	Total	1983	1984	1985	1986	1987	1988
1. Intake Facilities	788	-	788	-	-	-	-
2. Reservoirs	3,443	-	-	-	1,722	-	1,721
3. Transmission	8,576	-	858	2,573	3,945	1,029	171
4. Distribution	8,005	-	2,321	1,441	3,202	480	561
5. Valves	426	-	107	107	153	34	25
6. Hydrants	599	-	198	-	335	30	36
7. Pumps	1,264	-	506	758	-	-	-
8. Meters	6,456	-	4,713	516	387	388	452
9. Chlorinator	44	-	-	43	-	-	1
10. Vehicles	263	-	176	87	-	-	-
11. Engineering	4,136	4,136	-	-	-	-	-
12. Lands	156	-	108	48	-	-	-
13. Supervision	921	-	185	184	184	184	184
14.							
15.							
16.							
17.							
18.							
Total	35,077	4,136	9,960	5,757	9,928	2,145	3,151

ECONOMIC TABLE 5

I + II

DARAGA WATER SUPPLY PROJECT
OPERATION AND MAINTENANCE EXPENSES
Costs as of July 1, 1981 in 1,000 Pesos

Year	Power	Chemicals	Others	Total	Net Costs
1981	-	30	174	204	
1982	-	31	174	205	
1983	-	32	174	206	1
1984	-	33	183	216	11
1985	-	68	210	278	73
1986	-	72	229	301	96
1987	-	76	274	350	145
1988	-	81	319	400	195
1989	-	88	374	462	257
1990	24	94	419	537	332
1991	52	100	473	625	420
1992	79	105	473	657	452
1993	107	111	473	691	486

Base Year = 1983

ECONOMIC TABLE 6-0

DARAGA WATER SUPPLY PROJECT

LIFE EXPECTANCY AND REPLACEMENT SCHEDULES

I + II

₱ x 1,000

Value without CONVERSION

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Intake Facilities			700		700
2. Reservoirs			3,060		3,060
3. Transmission			6,424		6,424
4. Distribution			5,996		5,996
5. Valves			312		312
6. Hydrants			450		450
7. Pumps		972			972
8. Meters		4,660			4,660
9. Chlorinators	30				30
10. Vehicles	210				210
11. Lands				156	156
12.					

7 Year Items	Years of Installation					Years of Replacement				
1. Chlorinator	1985	1988				1992	1995	1999	2002	2006
2.						2009				
3. Vehicles	1984	1985				1991	1992	1998	1999	2005
4.						2006	2012			

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1984	1985				1999	2000			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003
3.										
4.										

ECONOMIC TABLE 6-A

DARAGA WATER SUPPLY PROJECT

I + II LIFE EXPECTANCY AND REPLACEMENT SCHEDULES

₱ x 1,000

Value with CONVERSION A

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Intake Facilities			609		609
2. Reservoirs			2,657		2,657
3. Transmission			8,212		8,212
4. Distribution			7,551		7,551
5. Valves			407		407
6. Hydrants			564		564
7. Pumps		1,157			1,157
8. Meters		6,306			6,306
9. Chlorinators	44				44
10. Vehicles	258				258
11. Lands				148	148
12.					

7 Year Items	Years of Installation					Years of Replacement					
1. Chlorinator	1985	1988				1992	1995	1999	2002	2005	2009
2. Vehicles	1984	1985				1991	1992	1998	1999	2005	
3.						2006	2012				
4.											

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1984	1985				1999	2000			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003
3.										
4.										

ECONOMIC TABLE 6-B

DARAGA WATER SUPPLY PROJECT

LIFE EXPECTANCY AND REPLACEMENT SCHEDULES

₱ x 1,000

I + II

Value with CONVERSION B

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Intake Facilities			521		521
2. Reservoirs			2,274		2,274
3. Transmission			6,060		6,060
4. Distribution			5,542		5,542
5. Valves			293		293
6. Hydrants			415		415
7. Pumps		865			865
8. Meters		4,510			4,510
9. Chlorinators	30				30
10. Vehicles	205				205
11. Lands				148	148
12.					

7 Year Items	Years of Installation					Years of Replacement					
1. Chlorinator	1985	1988				1992	1995	1999	2002	2006	2009
2. Vehicles	1984	1985				1991	1992	1998	1999	2005	
3.						2006	2012				
4.											

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1984	1985				1999	2000			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003
3.										
4.										

ECONOMIC TABLE 6-C

I + II

DARAGA WATER SUPPLY PROJECT
LIFE EXPECTANCY AND REPLACEMENT SCHEDULES
₱ x 1,000

Value with CONVERSION C

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Intake Facilities			788		788
2. Reservoirs			3,443		3,443
3. Transmission			8,576		8,576
4. Distribution			8,005		8,005
5. Valves			426		426
6. Hydrants			599		599
7. Pumps		1,264			1,264
8. Meters		6,456			6,456
9. Chlorinators	44				44
10. Vehicles	263				263
11. Lands				156	156
12.					

7 Year Items	Years of Installation					Years of Replacement					
1. Chlorinator	1985	1988				1992	1995	1999	2002	2006	2009
2. Vehicles	1984	1985				1991	1992	1998	1999	2005	
3.						2006	2012				
4.											

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1984	1985				1999	2000			
2. Meters	1999	1985	1986	1987	1988	1999	2000	2001	2002	2003
3.										
4.										

ECONOMIC TABLE 7-0

DARAGA WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value without CONVERSION

Components		Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased				
	Land	156	75%	117
50 Year Life, Year Constructed				
1	1984	3,317	42%	1,393
2	1985	3,054	44%	1,344
3	1986	7,270	46%	3,344
4	1987	1,257	48%	603
5	1988	2,044	50%	1,022
15 Year Life, Year of Replacement				
1	1999	4,155	7%	291
2	2000	841	13%	109
3	2001	210	20%	42
4	2002	209	27%	56
5	2003	217	33%	72
7 Year Life, Years of Final Replacement				
1	2006	99	0%	0
2	2009	1	43%	0
3	2012	140	86%	120
Total				8,513

I + II

ECONOMIC TABLE 7-A

DARAGA WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value with CONVERSION A

Components		Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased				
Land		148	75%	111
50 Year Life, Year Constructed				
1	1984	3,908	42%	1,641
2	1985	3,925	44%	1,727
3	1986	8,589	46%	3,951
4	1987	1,499	48%	720
5	1988	2,079	50%	1,040
15 Year Life, Year of Replacement				
1	1999	5,508	7%	386
2	2000	1,072	13%	139
3	2001	315	20%	63
4	2002	253	27%	68
5	2003	315	33%	104
7 Year Life, Years of Final Replacement				
1	2006	128	0%	0
2	2009	1	43%	0
3	2012	173	86%	149
Total				10,099

ECONOMIC TABLE 7-B

DARAGA WATER SUPPLY PROJECT
CALCULATION OF SALVAGE VALUES
₱ x 1,000

Value with CONVERSION B

Components		Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased				
Land		148	75%	111
50 Year Life, Year Constructed				
1	1984	2,946	42%	1,237
2	1985	2,889	44%	1,271
3	1986	6,534	46%	3,006
4	1987	1,164	48%	559
5	1988	1,572	50%	786
15 Year Life, Year of Replacement				
1	1999	3,954	7%	277
2	2000	790	13%	103
3	2001	226	20%	45
4	2002	180	27%	49
5	2003	225	33%	74
7 Year Life, Years of Final Replacement				
1	2006	97	0%	0
2	2009	1	43%	0
3	2012	137	86%	118
Total				7,636

ECONOMIC TABLE 7-C

DARAGA WATER SUPPLY PROJECT
CALCULATION OF SALVAGE VALUES
₱ x 1,000

Value with CONVERSION C

Components		Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased				
Land		156	75%	117
50 Year Life, Year Constructed				
1	1984	4,272	42%	1,794
2	1985	4,121	44%	1,813
3	1986	9,357	46%	4,304
4	1987	1,573	48%	755
5	1988	2,514	50%	1,257
15 Year Life, Year of Replacement				
1	1999	5,219	7%	365
2	2000	1,274	13%	166
3	2001	387	20%	77
4	2002	388	27%	105
5	2003	452	33%	149
7 Year Life, Years of Final Replacement				
1	2006	130	0%	0
2	2009	1	43%	0
3	2012	176	86%	151
Total				11,053

ECONOMIC TABLE 8-0 I + II

DARAGA WATER SUPPLY PROJECT
SUMMARY OF ALL PROJECT COSTS
Costs as of July 1, 1981 in 1,000 Pesos

Value without CONVERSION

Year	Cost of Facilities	Net O & M	Replacement Costs	Total	Salvage	Net Cost
1982						
1983	2,396	1		2,397		
1984	7,880	11		7,891		
1985	4,202	73		4,275		
1986	7,640	96		7,736		
1987	1,625	145		1,770		
1988	2,421	195		2,616		
1989		257		257		
1990		332		332		
1991		420	140	560		
1992		452	99	551		
1993		486	-	486		
1994		486		486		
1995		486	1	487		
1996		486		486		
1997		486		486		
1998		486	140	626		
1999		486	4,254	4,740		
2000		486	841	1,327		
2001		486	210	696		
2002		486	210	696		
2003		486	217	703		
2004		486		486		
2005		486	140	626		
2006		486	99	585		
2007		486		486		
2008		486		486		
2009		486	1	487		
2010		486		486		
2011		486		486		
2012		486	140	626		
Total	26,164	11,702	6,492	44,358	(8,513)	35,845

I + II

ECONOMIC TABLE 8-A

DARAGA WATER SUPPLY PROJECT

SUMMARY OF ALL PROJECT COSTS

Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION A

Year	Cost of Facilities	Net O & M	Replacement Costs	Total	Salvage	Net Cost
1982						
1983	3,090	1		3,091		
1984	9,873	11		9,884		
1985	5,352	73		5,425		
1986	9,085	96		9,181		
1987	1,933	145		2,078		
1988	2,576	195		2,771		
1989		257		257		
1990		332		332		
1991		420	173	593		
1992		452	128	580		
1993		486		486		
1994		486		486		
1995		486	1	487		
1996		486		486		
1997		486		486		
1998		486	173	659		
1999		486	5,636	6,122		
2000		486	1,072	1,558		
2001		486	315	801		
2002		486	254	740		
2003		486	315	801		
2004		486		486		
2005		486	173	659		
2006		486	128	614		
2007		486		486		
2008		486		486		
2009		486	1	487		
2010		486		486		
2011		486		486		
2012		486	173	659		
Total	31,909	11,702	8,542	52,153	(10,099)	42,054

ECONOMIC TABLE 8-B

I + II

DARAGA WATER SUPPLY PROJECT
SUMMARY OF ALL PROJECT COSTS
Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION B

Year	Cost of Facilities	Net O & M	Replacement Costs	Total	Salvage	Net Cost
1982						
1983	2,350	1		2,351		
1984	7,296	11		7,307		
1985	3,979	73		4,052		
1986	6,917	96		7,013		
1987	1,500	145		1,645		
1988	1,954	195		2,149		
1989		257		257		
1990		332		332		
1991		420	137	557		
1992		452	97	549		
1993		486		486		
1994		486		486		
1995		486	1	487		
1996		486		486		
1997		486		486		
1998		486	137	623		
1999		486	4,051	4,537		
2000		486	790	1,276		
2001		486	226	712		
2002		486	181	667		
2003		486	225	711		
2004		486		486		
2005		486	137	623		
2006		486	97	583		
2007		486		486		
2008		486		486		
2009		486	1	487		
2010		486		486		
2011		486		486		
2012		486	137	623		
Total	23,996	11,702	6,217	41,915	(7,636)	34,279

I + II

ECONOMIC TABLE 8-C

DARAGA WATER SUPPLY PROJECT
SUMMARY OF ALL PROJECT COSTS
Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION C

Year	Cost of Facilities	Net O & M	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	4,136	1		4,137		
1984	9,960	11		9,971		
1985	5,757	73		5,830		
1986	9,928	96		10,024		
1987	2,145	145		2,290		
1988	3,151	195		3,346		
1989		257		257		
1990		332		332		
1991		420	176	596		
1992		452	130	582		
1993		486		486		
1994		486		486		
1995		486	1	487		
1996		486		486		
1997		486		486		
1998		486	176	662		
1999		486	5,349	5,835		
2000		486	1,274	1,760		
2001		486	387	873		
2002		486	389	875		
2003		486	452	938		
2004		486		486		
2005		486	176	662		
2006		486	130	616		
2007		486		486		
2008		486		486		
2009		486	1	487		
2010		486		486		
2011		486		486		
2012		486	176	662		
Total	35,077	11,702	8,817	55,596	(11,053)	44,543

ECONOMIC TABLE 9

DARAGA WATER SUPPLY PROJECT

I + II

BENEFITS AT 1981 PRICES

(₱ x 1,000)

Year	Volume	Qualitative	Fire Loss Reduction	Total	National Interest Adjustment
1982					
1983					
1984	67	166	70	303	333
1985	2,190	332	81	2,603	2,863
1986	2,590	497	94	3,181	3,499
1987	3,045	497	111	3,653	4,018
1988	3,530	497	135	4,162	4,578
1989	4,100	497	160	4,757	5,233
1990	4,666	497	195	5,358	5,894
1991	5,254	497	283	6,034	6,637
1992	5,742	497	294	6,533	7,186
1993	6,153	497	327	6,977	7,675
1994	6,153	497	327	6,977	7,675
1995	6,153	497	327	6,977	7,675
1996	6,153	497	327	6,977	7,675
1997	6,153	497	327	6,977	7,675
1998	6,153	497	327	6,977	7,675
1999	6,153	497	327	6,977	7,675
2000	6,153	497	327	6,977	7,675
2001	6,153	497	327	6,977	7,675
2002	6,153	497	327	6,977	7,675
2003	6,153	497	327	6,977	7,675
2004	6,153	497	327	6,977	7,675
2005	6,153	497	327	6,977	7,675
2006	6,153	497	327	6,977	7,675
2007	6,153	497	327	6,977	7,675
2008	6,153	497	327	6,977	7,675
2009	6,153	497	327	6,977	7,675
2010	6,153	497	327	6,977	7,675
2011	6,153	497	327	6,977	7,675
2012	6,153	497	327	6,977	7,675
Total	154,244	13,917	7,963	176,124	193,741

I + II

ECONOMIC TABLE 10-0

DARAGA WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

Cost Value without CONVERSION

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	2,397	-	-2,397	-2,397
1984	7,891	333	-7,558	-6,180
1985	4,275	2,863	-1,412	-944
1986	7,236	3,499	-4,237	-2,316
1987	1,770	4,018	2,248	1,005
1988	2,616	4,578	1,962	717
1989	257	5,233	4,976	1,487
1990	332	5,894	5,562	1,359
1991	560	6,637	6,077	1,214
1992	551	7,186	6,635	1,083
1993	486	7,675	7,189	960
1994	486	7,675	7,189	785
1995	487	7,675	7,188	642
1996	486	7,675	7,189	525
1997	486	7,675	7,189	429
1998	626	7,675	7,049	344
1999	4,740	7,675	2,935	117
2000	1,327	7,675	6,348	207
2001	696	7,675	6,979	186
2002	696	7,675	6,979	152
2003	703	7,675	6,972	124
2004	486	7,675	7,189	105
2005	626	7,675	7,049	84
2006	585	7,675	7,090	69
2007	486	7,675	7,189	57
2008	486	7,675	7,189	47
2009	487	7,675	7,188	38
2010	486	7,675	7,189	31
2011	486	7,675	7,189	26
2012	626	7,675	15,562*	45
Salvage(-)	8,513			
Total	35,845	193,741	157,896	1

* Values include salvage.

Rate of Return = 0.22

ECONOMIC TABLE 10-A

DARAGA WATER SUPPLY PROJECT
INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION A

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	3,091	-	-3,091	-3,091
1984	9,884	333	-9,551	-8,082
1985	5,425	2,863	-2,562	-1,835
1986	9,181	3,499	-5,682	-3,443
1987	2,078	4,018	1,940	995
1988	2,771	4,578	1,807	784
1989	257	5,233	4,976	1,827
1990	332	5,894	5,562	1,728
1991	593	6,637	6,044	1,589
1992	580	7,186	6,606	1,470
1993	486	7,675	7,189	1,354
1994	486	7,675	7,189	1,145
1995	487	7,675	7,188	969
1996	486	7,675	7,189	820
1997	486	7,675	7,189	694
1998	659	7,675	7,016	573
1999	6,122	7,675	1,553	107
2000	1,558	7,675	6,117	358
2001	801	7,675	6,874	340
2002	740	7,675	6,935	291
2003	801	7,675	6,874	244
2004	486	7,675	7,189	216
2005	659	7,675	7,016	178
2006	614	7,675	7,061	152
2007	486	7,675	7,189	131
2008	486	7,675	7,189	111
2009	487	7,675	7,188	94
2010	486	7,675	7,189	79
2011	486	7,675	7,189	67
2012	659	7,675	17,115*	135*
Salvage(-)	10,099			
Total	42,054	193,741	151,687	0

* Values include salvage.

Rate of Return = 0.18

I + II

ECONOMIC TABLE 10-B

DARAGA WATER SUPPLY PROJECT
INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION B

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	2,351	-	-2,351	-2,351
1984	7,307	333	-6,974	-5,624
1985	4,052	2,863	-1,189	-773
1986	7,013	3,499	-3,514	-1,843
1987	1,645	4,018	2,373	1,004
1988	2,149	4,578	2,429	829
1989	257	5,233	4,976	1,369
1990	332	5,894	5,562	1,234
1991	557	6,637	6,080	1,088
1992	549	7,186	6,637	958
1993	486	7,675	7,189	837
1994	486	7,675	7,189	675
1995	487	7,675	7,188	544
1996	486	7,675	7,189	439
1997	486	7,675	7,189	354
1998	623	7,675	7,052	280
1999	4,537	7,675	3,138	101
2000	1,276	7,675	6,399	165
2001	712	7,675	6,963	145
2002	667	7,675	7,008	118
2003	711	7,675	6,964	94
2004	486	7,675	7,189	79
2005	623	7,675	7,052	62
2006	583	7,675	7,092	50
2007	486	7,675	7,189	41
2008	486	7,675	7,189	33
2009	487	7,675	7,188	27
2010	486	7,675	7,189	22
2011	486	7,675	7,189	17
2012	623	7,675	13,990 *	27*
Salvage(-)	7,636			
Total	34,279	193,741	159,462	1

* Values include salvage.

Rate of Return = 0.24

ECONOMIC TABLE 10-C

DARAGA WATER SUPPLY PROJECT
INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION C

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	4,137	-	-4,137	-4,137
1984	9,971	333	-9,638	-8,268
1985	5,830	2,863	-2,967	-2,183
1986	10,024	3,499	-6,525	-4,119
1987	2,290	4,018	1,728	936
1988	3,346	4,578	1,232	572
1989	257	5,233	4,976	1,983
1990	332	5,894	5,562	1,901
1991	596	6,637	6,041	1,771
1992	582	7,186	6,604	1,661
1993	486	7,675	7,189	1,551
1994	486	7,675	7,189	1,331
1995	487	7,675	7,188	1,141
1996	486	7,675	7,189	979
1997	486	7,675	7,189	840
1998	662	7,675	7,013	703
1999	5,835	7,675	1,840	158
2000	1,760	7,675	5,915	436
2001	873	7,675	6,802	430
2002	875	7,675	6,800	369
2003	938	7,675	6,737	314
2004	486	7,675	7,189	287
2005	662	7,675	7,013	240
2006	616	7,675	7,059	207
2007	486	7,675	7,189	181
2008	486	7,675	7,189	155
2009	487	7,675	7,188	133
2010	486	7,675	7,189	114
2011	486	7,675	7,189	98
2012	662	7,675	18,066*	212*
Salvage(-)	11,053			
Total	44,543	193,741	149,198	-4

* Values include salvage.

Rate of Return = 0.17

APPENDIXES

Appendix 1 Water Quality of Water Sources

Water quality of the existing water sources and potential ones in the study area was analyzed in the present study. Results of the analyses are presented in Table 1 together with the water quality standard of the Philippines in Table 2 Major characteristics of the water quality are as follows:

1) Spring Water

a. Water of most springs has good water quality, not requiring any water treatment except for disinfection.
b. Generally the water is soft and not corrosive, and concentrations of dissolved matters, hardness and chloride, are comparatively low.
c. The Bañadero spring water has a rather high concentration of sulfate, such as 600 mg/l. It is recommendable to mix the water with other source water having low sulfate concentrations for health and pipe protection.

2) Deep Well Water

a. Water of deep wells in the poblacion has high values of color and odor.
b. Value of dissolved matters is high, which is undesirable for domestic use.
c. The water is free from contamination by domestic waste water.

3) Riverbed Water

Some shallow wells dug on the riverbed and outcrops of riverbed water which are being used by inhabitants nearby have good water quality, not requiring treatment for domestic use.

Table 1 Water Quality of Existing Water Soueces in Legaspi City and Daraga

Items / Source	Budiao Spring No. 1	Budiao Spring No. 2	Banadero Spring	Daraga Spring	Camp Ibalon Deep Well	Bogtong Spring	Salbacion Spring	Tinapian Spring	Lacag Spring	Buyoan Spring	Tinago Deep Well	Malabog Spring	Bicol Deep Well	Bitano Deep Well
Sampling date	10 Aug	10 Aug	10 Aug	11 Aug	11 Aug	11 Aug	19 Aug	14 Aug	17 Aug	11 Aug	11 Aug	11 Aug	11 Aug	11 Aug
Weather	fine	fine	fine	Clouded	Clouded	Clouded	fine	fine	fine	Clouded	Clouded	Clouded	Clouded	Clouded
Atom. Temperature (°C)	27	27	27	25	25	25	28	27	26	25	25	25	25	25
Water Temperature (°C)	25	25	26	26	27	26	26	23	24	24.5	29	26	36	27
Turbidity (mg/l)	0	0	0	0	0	0	0	0	8	0	5	0	0	20
Color (mg/l)	0	0	0	10	15	0	0	0	0	0	20	0	8	40
Conductivity (µS/cm)	350	380	1060	650	1000	1050		230		340	2600	320	1690	
Hardness (mg/l)	60	85	310	775	100	190	67.5	35	25	95	325	50	30	300
Calcium (mg/l)	12	16	96	20	32	64	13	8	6	22	90	12	8	64
Magnesium (mg/l)	7.3	8.5	17	6.7	4.9	7.3	9	3.6	2.4	9.7	24	5	2.4	34
Chloride (mg/l)	12	18	76	36	70	40	50	12	35	12	340	10	230	290
pH	7.2	7.1	7.2	6.9	6.8	7.4	7.0	6.6	6.9	6.8	7.6	6.6	6.5	7.6
Alkalinity (mg/l)	70	50	80	60	160	100	80	40	50	70	240	80	200	210
Sulfate (mg/l)	2	1	600	20	15	140	2.5	0	1	0	215	0	41	275
Ammonia-N (mg/l)	<0.3	<0.3	<0.3	0.3	2.5	<0.3	<0.3	<0.3	0.4	<0.3	1.0	<0.3	1.5	2.0
Iron (mg/l)	0.001	0.01	0.015	0.01	0.01	0.01	0.01	0.015	0.045	0.005	0.025	0.01	0.015	0.04
Manganese (mg/l)	0.05	nil	0.05	0.15	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.02	0.10	0.35
Odor 1/	0	0	1	1	3	1	0	0	0	0	4	2	4	5
Total Bacteria (/ml)	negative	100	100	90	negative	20	50	50	more than 3000	negative	negative	negative	negative	negative
Coliform groups (/ml)	negative	negative	negative	50	negative	20	15	20	more than 1000	negative	negative	negative	negative	negative

Table 2 Water Quality Standard
Key Parameters of the Philippines
Standard for Drinking Water

Parameters[1/]	Permissible Level[2/]	Maximum Permissible[2/]
Coliform groups	No detecting in 100 ml	-
Total Bacteria	10/ml	-
Odor	Unobjectionable	-
Taste	Unobjectionable	-
Color	5 units	50 units
Turbidity	5 units	25 units
Total solids	500	1,500
pH	7.0 - 8.5	6.5 - 9.2
Total hardness	100	500
Calcium, as Ca	75	200
Magnesium, as Mg	50	150
Chloride, as Cl	200	600
Sulfate, as SO_4	200	400
Nitrate, as NO_3	-	30
Iron, as Fe	0.3	1.0
Manganese, as Mn	0.1	0.5

1/ The above table shows only main parameters of the Standard, which are considered essential for judging characteristics of drinking water quality.

2/ All units are in mg/l, unless otherwise stated.

Water quality of the currently-used water sources in the study area was investigated during the field survey from 9th to 21st August 1981. Remarkable characteristics of water quality except only some springs are that water of some sources has odor of hydrogen sulfide, and some others have color in addition to the odor. Findings on these two matters are briefly described below.

1) Odor of Hydrogen Sulfide

As shown in Table 1.3.1, water of deep wells in the area has strong odor of hydrogen sulfide, which is a phenomenon often seen in the volcanic area. Hydrogen sulfide (H_2S) may most probably have been caused by reduction of sulfuric acid (H_2SO_4), which is generally found in the volcanic formations. Meanwhile, water of the river, shallow wells and some springs has no or little order.

Regarding removal of the odor, a test by aeration was carried out in the field. As shown in Fig 1, aeration is very effective in reducing the odor within a short time.

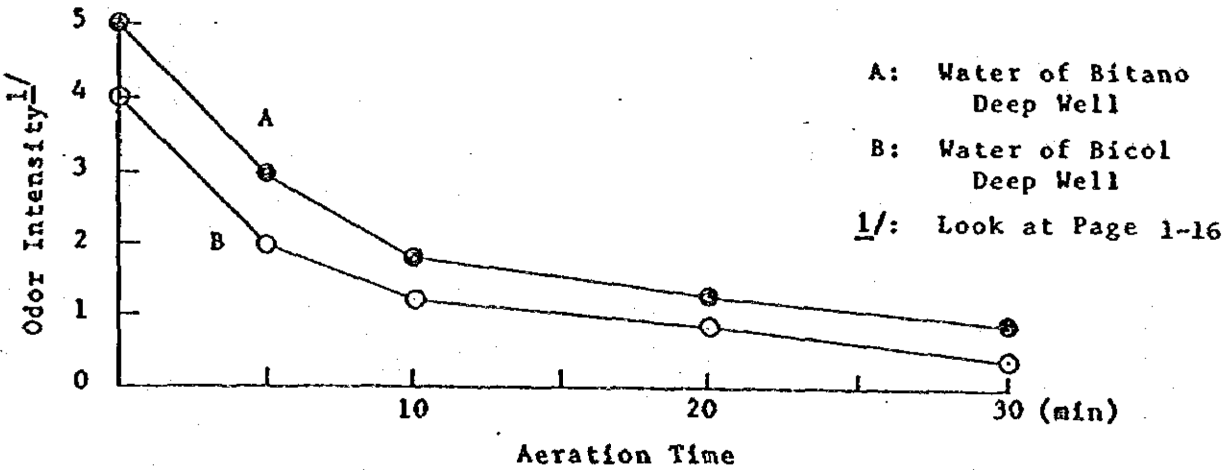


Fig 1 Test Result of Odor Removed by Aeration

2) Color

Water of deep wells and a spring surveyed in the area has high value of yellow color, exceeding the permissible value specified by the drinking water standard, as shown in the above-mentioned table. As the cause of the color was considered to be by dissolved matters, correlation between color and dissolved matters was investigated.

It was found that manganese, among others had a high correlation coefficient 0.94 with color, which is presented in Fig 2.

3) Summary

Findings and considerations on water quality are summarized as below:

a. Odor can be easily removed by aeration.
b. Color cannot be removed by aeration.
c. To oxidize and make manganese insoluble, over 10 mg/l chlorine is required.
d. To treat the water with color, a complete series of treatment processes will be needed.

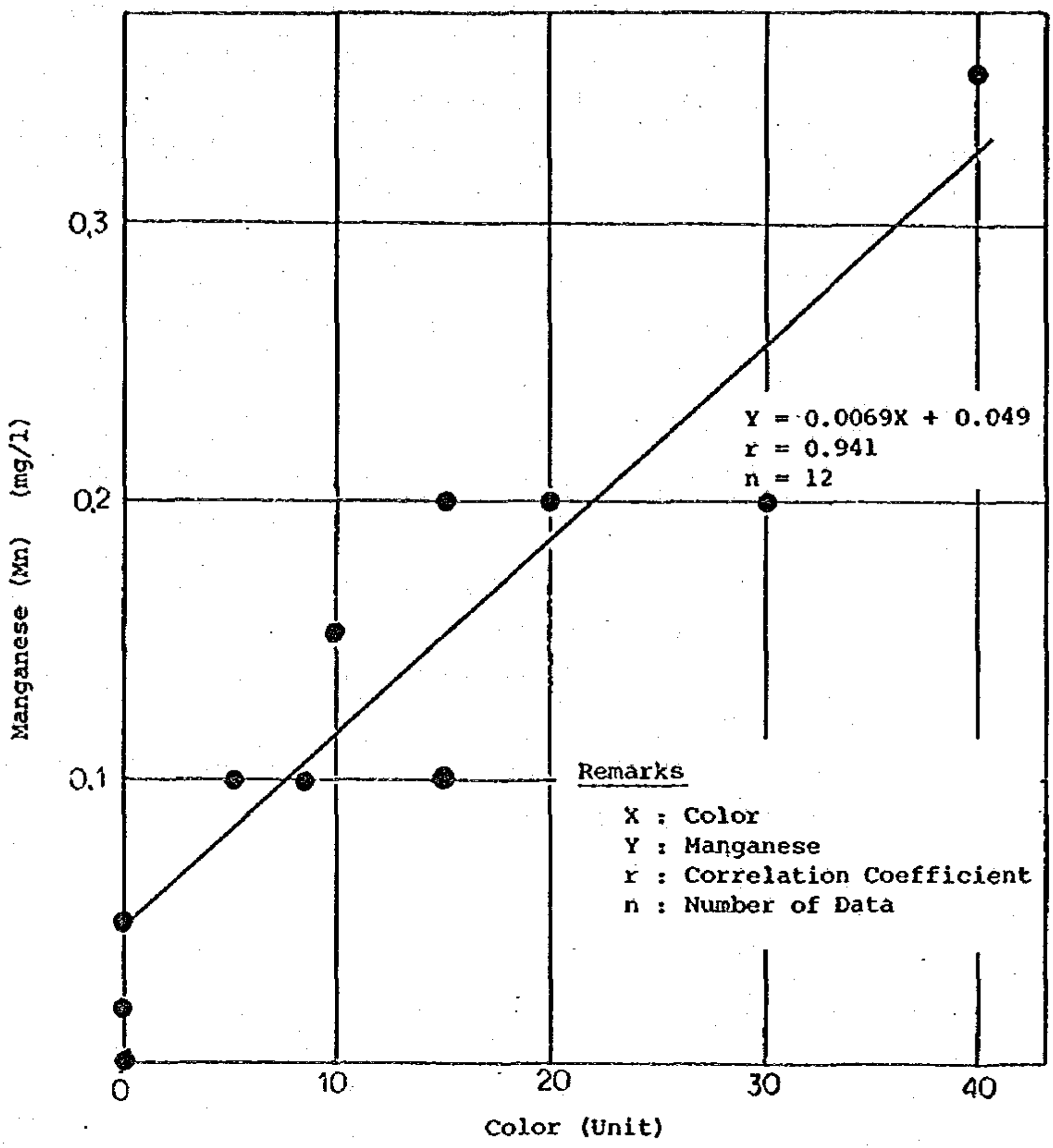


Fig 2 Correlation of Color and Manganese Concentration

Appendix 2 Findings on Transmission Pipeline

The transmission pipelines of the Albay Provincial Waterworks suffered heavy damages from the flood that occurred in June 1981. As the pipelines are located on the deposits of the volcano traversing the skirts of Mt. Mayon, they are extremely vulnerable to the mountain mud flow which contains cobbles, gravel and sand. The present field survey, therefore, was carried out to ascertain the present conditions of damaged pipelines and to find out means to be taken in rehabilitation of the pipelines and remedy of the shortcomings thereof in connection with the project planning for the water district. The survey was conducted in August 1981, about two months after the disaster. Major findings are as follows.

1. Budiao Spring System

a. The pipeline had many breakages between A and B in the attached figure. All visible breakages were temporarily repaired and presently the pipeline is in service.
b. At B, the flow in the pipe was free, not filling the pipe.
c. At the downstream of B, consumers are taking water from the pipe by hand pump.
d. At about the middle of B and C, an air pipe was blowing out air.
e. At C, water pressure was about 0.5 kg/sq cm.
f. Measured yield at A was about 7,600 cu m/day, and past records say the minimum yield is 6,540 cu m/day.
g. The carrying capacity of the pipeline is calculated as 3,900 cu m/day, assuming C = 90.

From the above observation and calculation, it is concluded that 1) there are still pipe breakage unrepaired between A and B, 2) the present actual flow may be far less than the calculated value, and 3) the spring has a big potential even when the repair is completely made.

2. Bañadero Spring System

This spring system had not been repaired at the time of the field survey. As the intake facilities were also damaged, the actual yield of the spring was not ascertained.

From the pipe size and length, the carrying capacity of the pipeline is calculated as 2,200 cu m/day assuming C = 90, against the recorded yield 2,940 cu m/day.

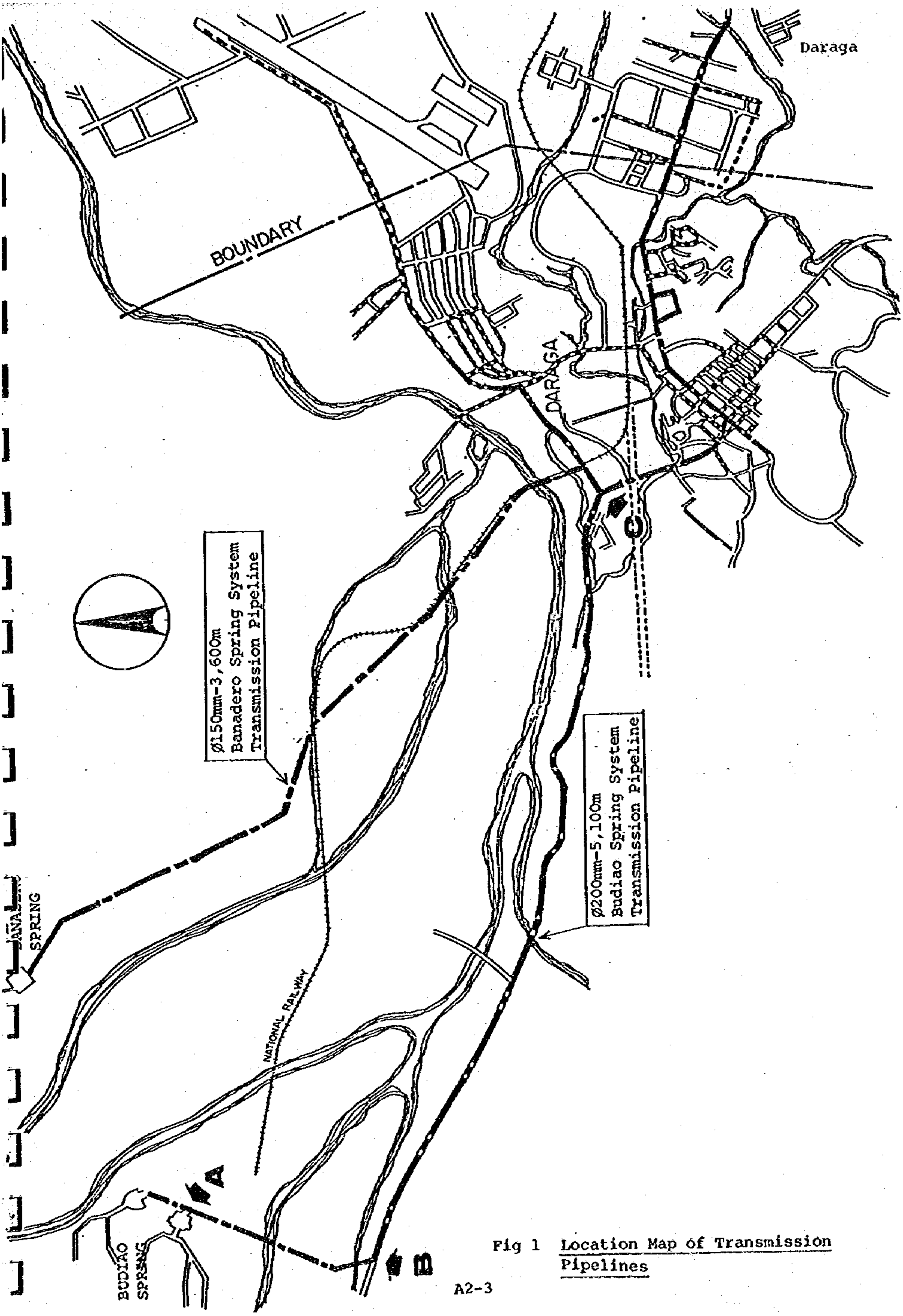


Fig 1 Location Map of Transmission Pipelines

Appendix 3 Water Pressure in Daraga

To investigate water pressure and its variation during 24 hours in the Daraga area, pressure recording was made at four strategic points on the distribution mains, as shown in Figs 1 and 2 , in August 1981.

Point R-1 on the transmission line just before forking into two distribution mains. Points R-2 and R-3 are each on the two distribution mains just after the above bifurcation. Point R-4 is at the farther end of Daraga poblacion where water supply conditions were extremely poor. The recorder for this point was placed on a service connection which is about four meters below the main.

As is clear in the figure, all pressures of the four recorded points were very low all through the day, with even the highest pressure less than 1 kg/ sq cm. Especially in the daytime from 6 A.M. to 8 P.M., the pressure was as low as 0.2 kg/sq cm.

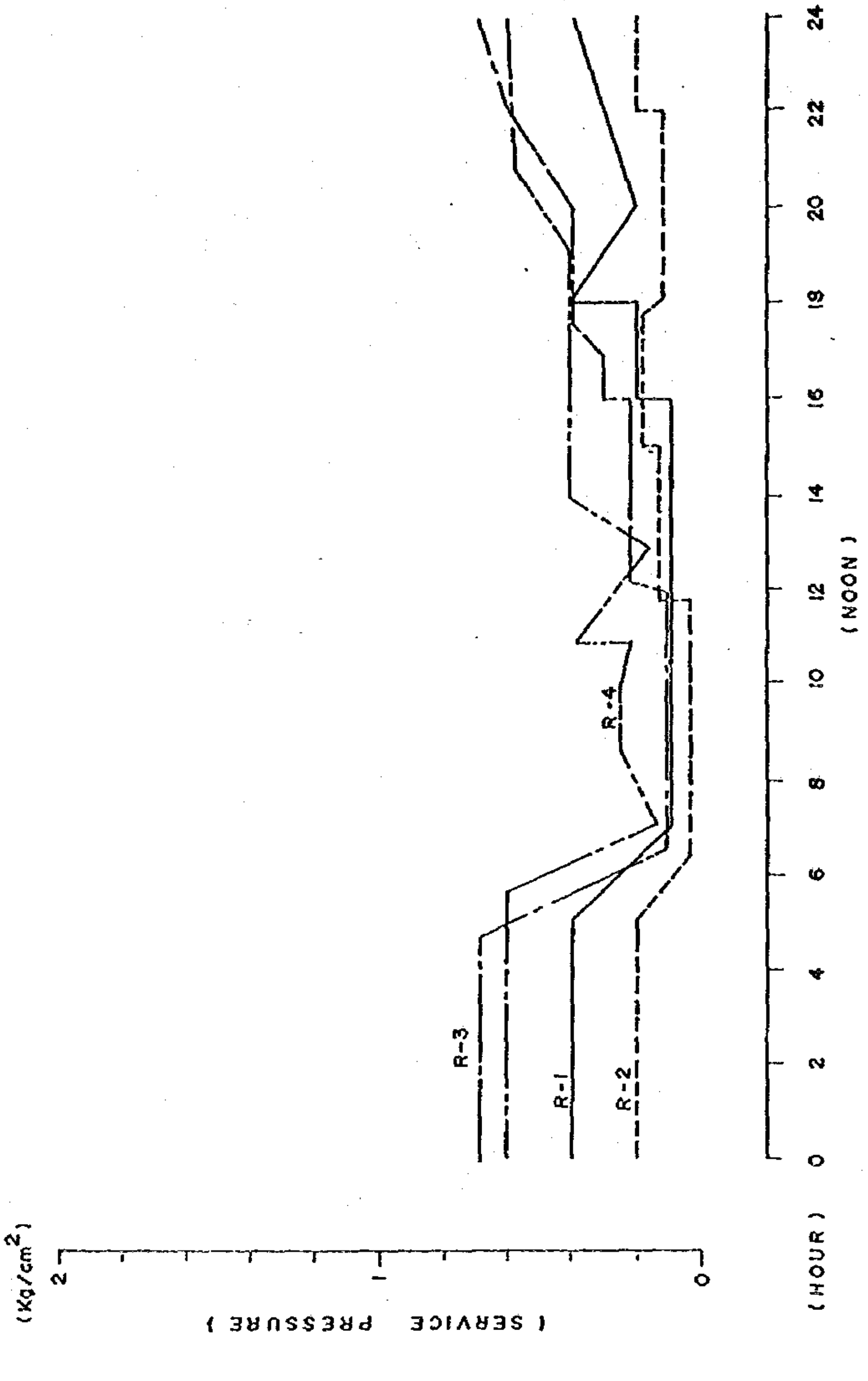


Fig 1 Variation of Water Pressure in Daraga
(Aug. 1981)

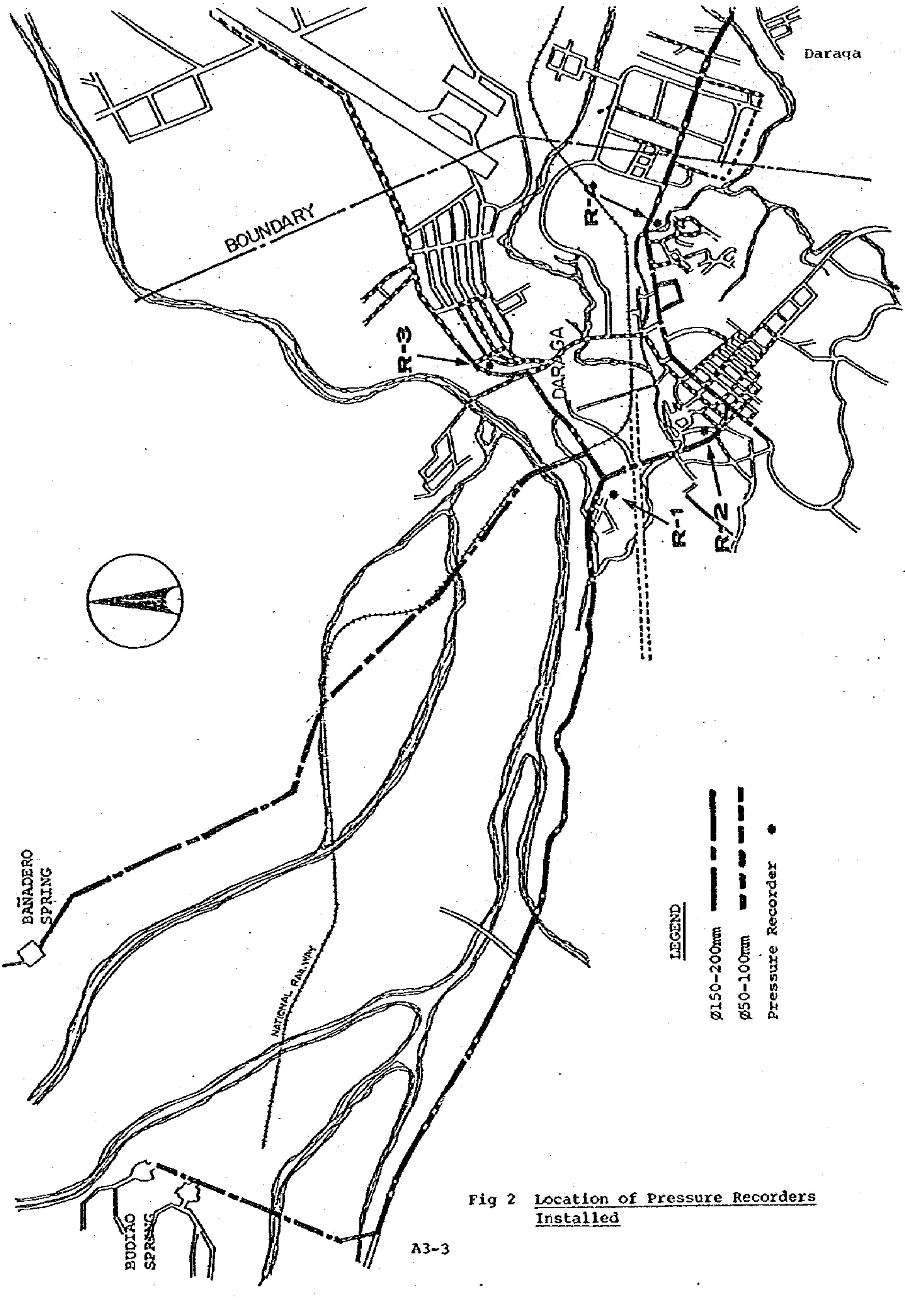


Fig 2 Location of Pressure Recorders Installed

Appendix 4. Study on Water Sources

1. General

Study Area: the city of Legaspi and the municipality of Daraga including the periphery thereof.

Purpose of Study: to examine possible sources of surface water and groundwater for the use of Legaspi and Daraga Water Districts.

Method of Study: reconnaissance in the field, flow measurement, analysis of existing data and electric resistivity survey.

Period of Field Investigation: August 10 to 20, 1981.

2. Topography

The region which includes the study area is characterized by volcanoes. Mt. Mayon is situated in the north of Daraga and Legaspi and rises to an elevation of 2,462 m with a perfect conical shape. Its volcanic activities are vigorous. As the volcano has repeatedly erupted, it has formed vast skirts, which extend as far as the sea-shore 10 km away from the crater in the north east of Daraga and Legaspi. The volcano has two types of topography: its upper portion, about 120 m and above, with steep slopes; its lower portion, less than that, with gentle and smooth slope. The former portion is dominated by the pyroclastic rocks; the latter portion by the mudflows. Many small streams have developed in the radial directions from the center of the volcano. Some of the streams drain directly into the sea, and some others are collected by the Yawa River, which borders the southern skirt of the volcano.

The Yawa River flows west to east, gathering tributaries from both Mt. Mayon and the lower Catabrean mountains in the south of Daraga and Legaspi, and empties into the sea.

There is a small hill, Mt. Linguion with an elevation of 156 m, located on the south of the Yawa River. Its slope is rather steep. The hill is assumed to be an old volcano.

The Yawa River has developed a small alluvial plain between the River and the above-mentioned lower mountains.

The lower mountains have an elevation of about 100 m above sea level, stretch to south with many undulations, and have a steep slope on the north end. The mountains originated from an old volcano, which has come to have many valleys and summits due to erosion.

Contour lines and classifications of the topography are shown in the map of Fig 1, and the cross section thereof in Fig 2.

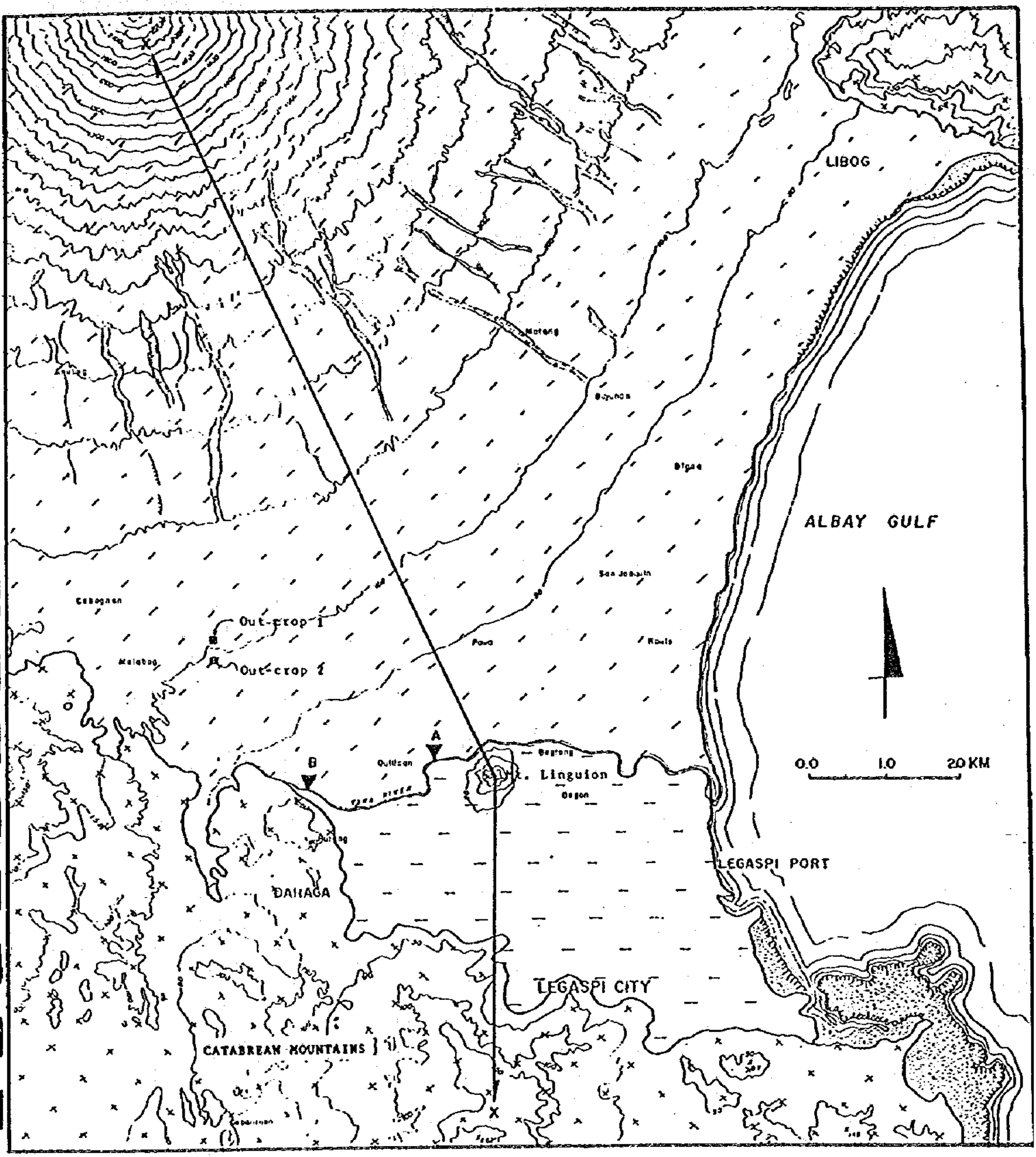


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Fig. 1 Classification Map of Topography
(Out-crops 1 and 2 are shown in Figs. 4 and 5)

(legend symbol)	Mayon Volcano
(legend symbol)	Plain
(legend symbol)	The Lower Mountains
A, B:	The locations of river flow measurement

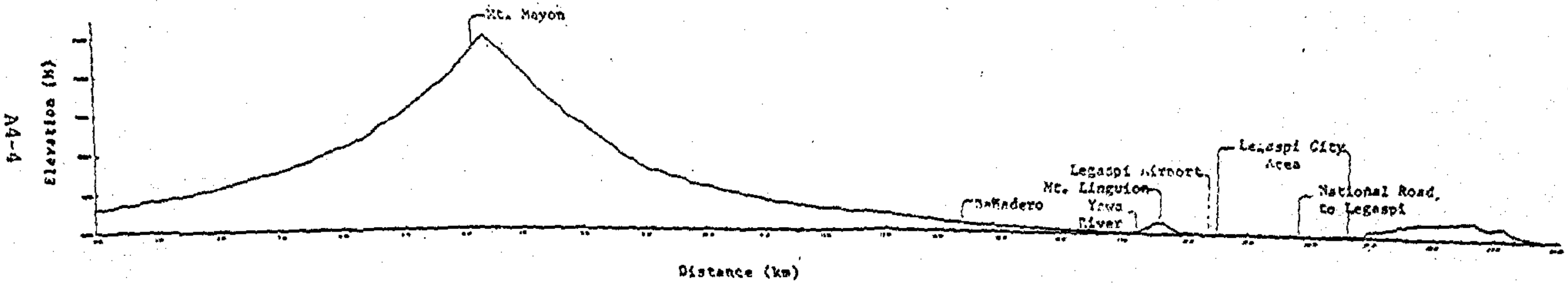

Fig 2 Topographic Profile of Section Line X-X'

3. Geology

The lower Catabrean mountains are made up of lava flows, agglomerates, volcanic breccia, tuff with interbeds of conglomerate, sandstone and shale according to the Groundwater Geology of Bicol Peninsula (1973)1/. The geological age is lower Miocene and the formation is called Daraga formation. Fig 3 shows the geological map in the study area.

Field evidence shows that volcanic rocks are massive and agglomeratic, and the rocks are pyroclastic rocks, tuff, volcanic rocks, and volcanic breccia, which derive from the old volcano.

Mt. Mayon is an active volcano of Konide type. The eruption debris are composed of andesitic pyroclastic rocks, scoria, volcanic ash and mudflows. Large andesites, with a longitudinal axis about 1.5 m, scatter in the volcanic ash and small scoria in the upper portion about 120 m in altitude, of the mountain. Pyroclastic rocks also exist in this portion. Fig 4 shows the outcrop of pyroclastic rocks in Budiao, Daraga.

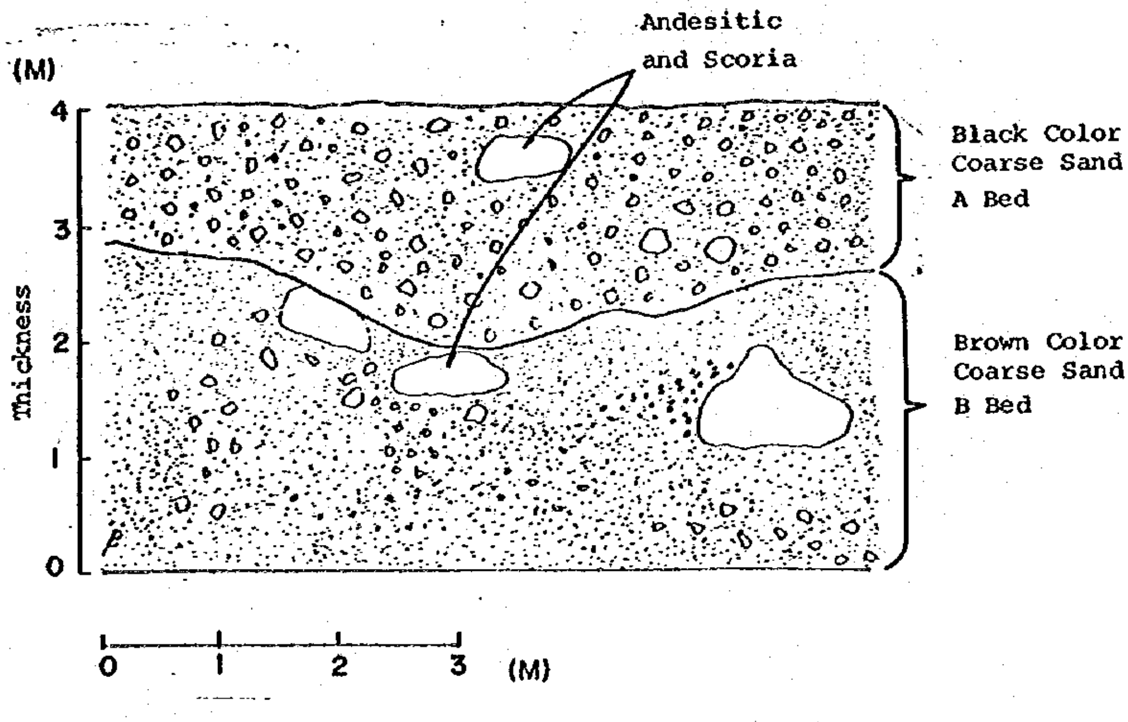

Fig 4 Outcrop of Pyroclastic Rocks
(The location is shown in the Outcrop 1 of Fig 1)

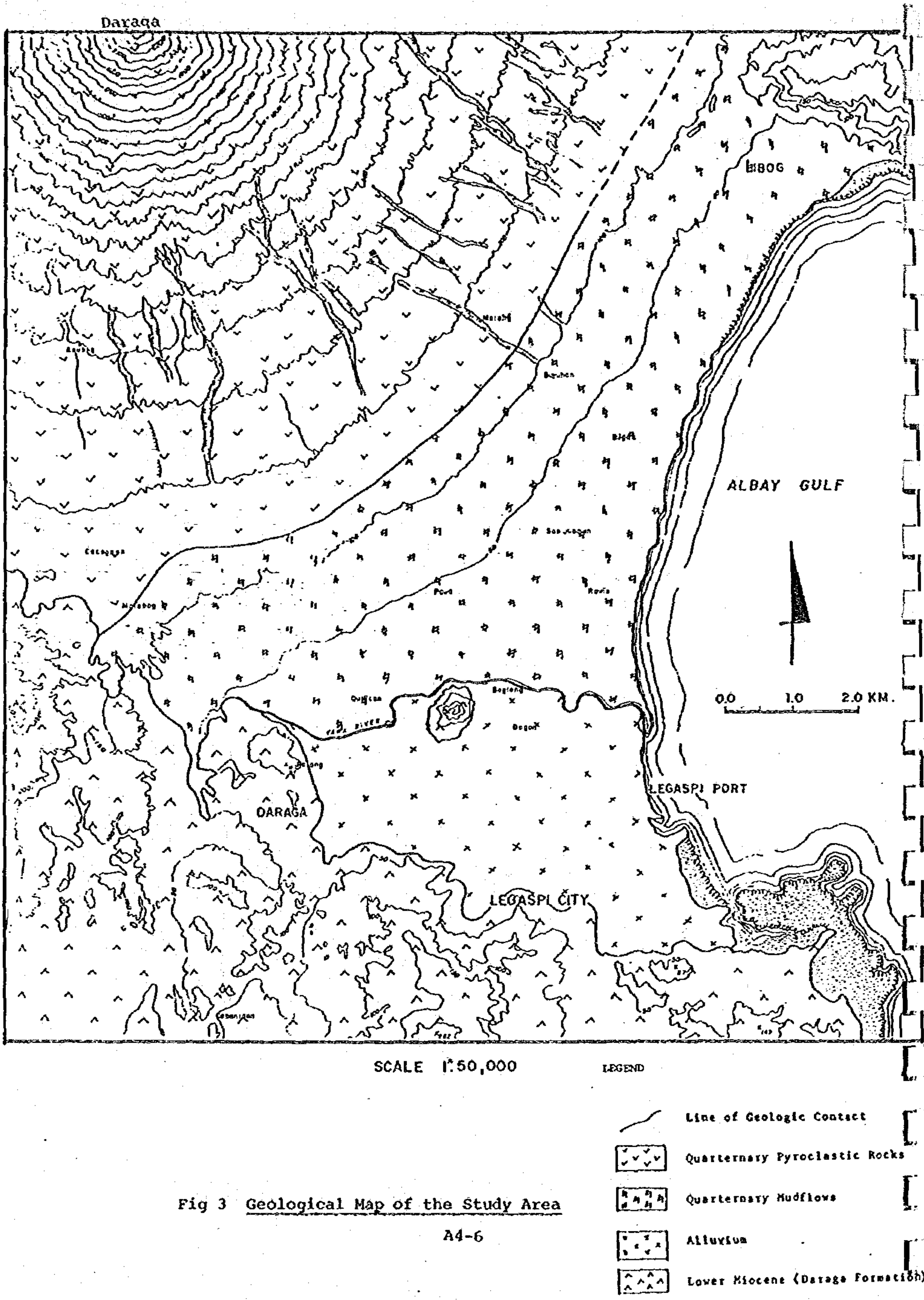

Fig 3 Geological Map of the Study Area

Mudflows, about one meter thick, cover the pyroclastic rocks and make the gentle and smooth slope of the lower portion of the mountain. Large andesites ejected from the volcano are sometimes found in the mudflow area. Fig 5 indicates the outcrop of the mudflow observed at Budiao, Daraga.

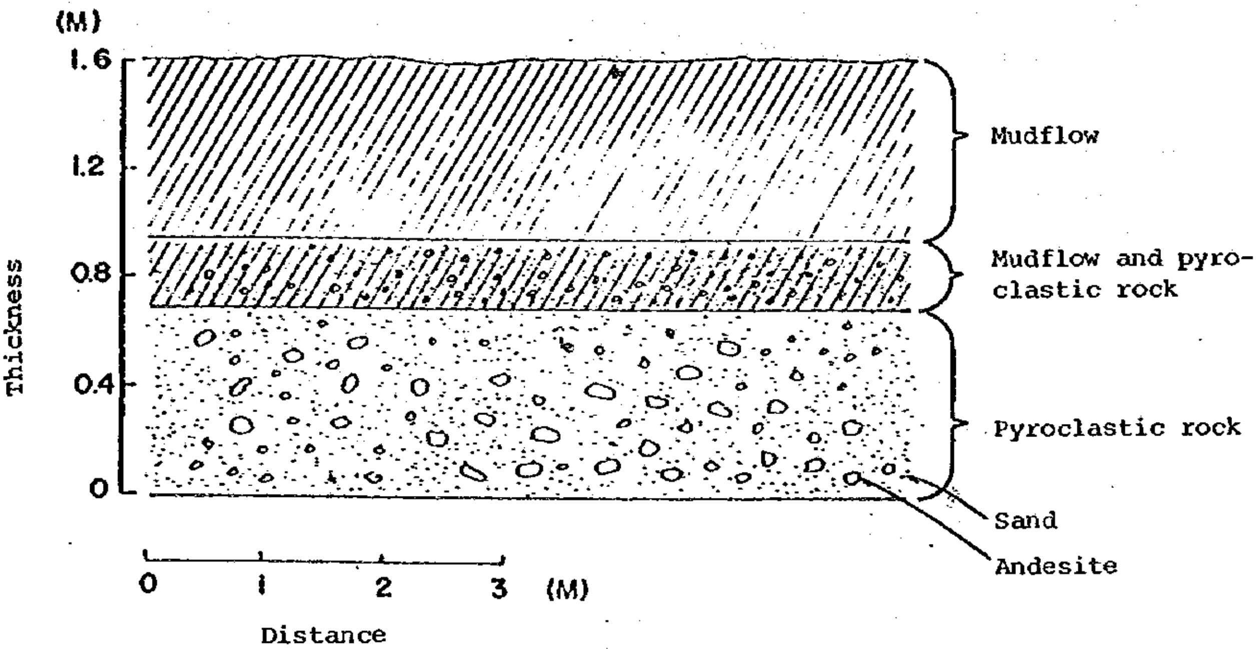

Fig 5 Outcrop of Mudflows
(The lcoation is shown in the Outcrop 2 of Fig 1)

The following Table 1 explains the stratifications of the formations in the study area.

Table 1 Geological Stratigraphy of Daraga and Legaspi Area

Sediments	Geological Period	Lithology
Alluvium	Recent	Lapilli, volcanic sand, volcanic ash, clay
Eruptions debris of Mt. Mayon	Quarternary	Andesitic pyroclastic rocks and scoria, volcanic ash, mudflows
Daraga formation	Lower Miocene	Lava flow, pyroclastic rocks, tuff, volcanic breccia

The alluvium is formed of lapilli, volcanic sand, volcanic ash and clay. These sediments derive from the eruption debris of Mt. Mayon and the formations of the lower mountains. The alluvium, it is considered, is formed of erosional material transported by the Yawa River.

Mt. Linguion consists mainly of lapilli, 3 cm to 2 mm in size, and loam. The geology explains that this mountain is an old volcano, the eruptions of which took place in the Tertiary.

4. Hydrology

4.1 Rainfall

The study area has no definite dry season with pronounced maximum rainfalls from November through January. Legaspi has an annual average rainfall 3256 mm (normal 1957-70)[2] with a maximum monthly average 415 mm in the period from November to January and a high monthly average 223 mm from February to October. The annual rainfall of this area is fairly high composed with the average in the whole Philippines, 2500 mm.

The region is frequently hit by the typhoons during the period from October to December.

4.2 River

The Yawa River is a stream running from west to east with a drainage area about 78.3 sq km. In the present field survey, the river discharge was measured at the two points shown in Fig 1, on August 17, 1981. The instruments used for the survey were a Price current meter for flow velosity and a tape for the cross section of the stream. The weather of the day was fine. The measured discharge was Q = 3.1 cu m/sec = 267,840 cu m/d at the A point of the main stream, and Q = 1.8 cu m/sec = 155,520 cu m/d at the B point of the tributary.

The streamflow increases very rapidly when the basin has a rainfall, and the discharge is not large in the period of no rain. When the discharge is high, a great amount of volcanic ash and small breccia are carried downstream.

4.3 Groundwater

The study area has many springs scattered in the mountainous area and many wells of several types in the alluvial area. Fig 6 shows the locations of springs and wells. Table 2 indicates details of water sources.

Mt. Mayon has a number of springs at its foot, lower than 130 m in altitude, but almost no springs above that. The distribution of springs explains that the groundwater is recharged in the upper portion and flows out in the lower portion of the mountainside. These springs have generally large quantities of discharge. There are some springs along tributaries of the Yawa River, but their discharges are very small.

Rain water infiltrates in the recharge area, as mentioned above, and a part of the recharged water outflows as springs. The remaining part becomes groundwater, which is withdrawn by many wells in the alluvial area. The water withdrawn by these wells have peculiar offensive odour of hydrogen sulfide, which is derived, it is considered; from the characteristics of the volcanic sediments and the reduction of sulfides. Exceptionally there are some small areas where better quality water is found, such as Legaspi Port and Bogtong. Flowing wells are distributed in Legaspi Port, Gogon and the east portion of Old Albay. The wells scatter, with a well depth of 60 m to 80 m, in Legaspi City.

Dug wells are distributed, with a well depth of a few meters, in the study area, withdraw the unconfined water. Water level of such wells fluctuates with the intensity of rainfall.

The lower mountains also have many springs. Their discharges are very small, for example, Delapaz with Q = 0.113 l/sec = 9.8 cu m/day in contrast with the discharge of Budiao springs (No. 2) of Mt. Mayon Q = 88 l/sec = 7603.2 cu m/day. Mt. Liguion has a few springs with a small discharges. One of them has good quality without odour, and another one has an objectionable odour of hydrogen sulfide.

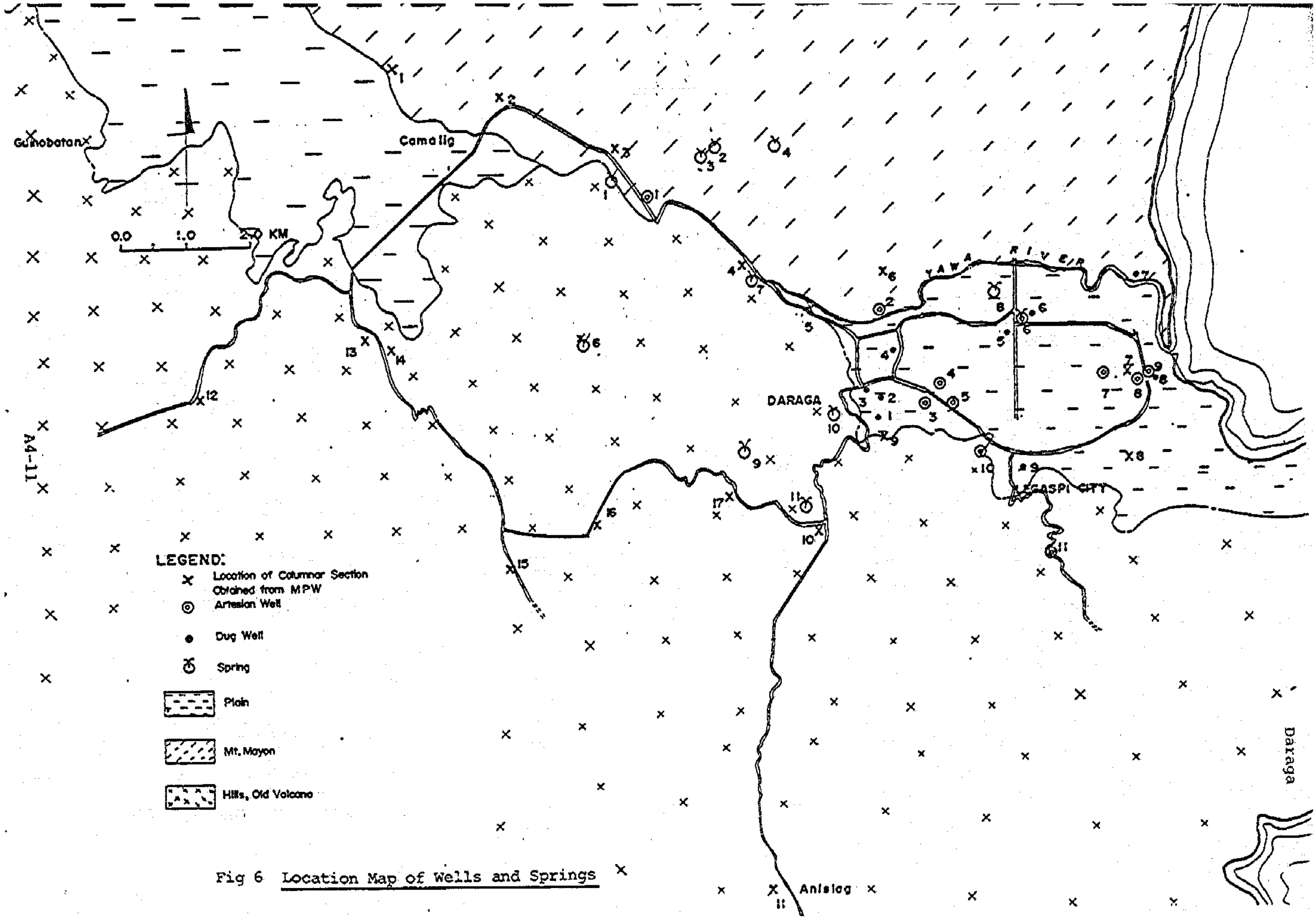

Fig 6 Location Map of Wells and Springs

Number of Springs	Surveyed Date	Locations	Elevation (m)	Discharge (lps)
1	August 11	Salvacion	140	1.6
2	August 10	Budiao I	130	88
3	August 10	Budiao II	130	
4	August 10	Banadero	120	
5	August 11	Buyoan	95	83.6
6	August 17	Lacag	160	
7	August 17	Busay	60	
8	August 11	Bogtong	30	9.8
9	August 13	Dela Paz	80	0.1
10	August 17	Daraga	80	
11	August 13	Penafrancia	90	

No. of Shallow Wells	Surveyed Date	Locations	Casing Diameter (mm)	Well Depth (m)	Static Water-Level (m)	Elevation (m)	Discharge (lps)	Remarks
1	August 13	Daraga	150	4.38	3.10	5-20		
2	August 11	Pro. Waterworks Pump Station	5.05m x 8.08m concrete box					
3	August 13	Daraga		4.20		5-20	3.81	Odor of H_2S
4	August 13	Bactol		6.10		5-20		
5	August 12	Curuzada	600	5.49		5-20		
6	August 12	Airport		3.53	1.75	5-20		Odor of H_2S
7	August 18	MPW Office		2.12	1.05	5-20		Odor of H_2S
8	August 18	Piea Sice		2.69	1.81	5-10		
9	August 12	Legaspi		3.00	1.96	5-10		
				1.30	0.63	5-20		

Deep Wells

No.	Surveyed Date	Locations	Casing Diameter (mm)	Well Depth (m)	Static Water-Level (m)	Elevation (m)	Discharge (lps)	Remarks
1	August 14	Malabog Elem.						
2	August 13	Quilicao Elem.				129		
3	August 11	Bicol Univ. Campus		15.24		20		Turbidity, Odor of H_2S
4	August 11	Bagong Ibalon	200	62.0	6.36	5-20		1,690 /cm
5	August 13	Old Albay	200	61.0	4.27	5-20	3.8	
6	August 12	Curizada	100	74.0		5-20		
			100	63.0		5-20	0.017	High iron contents, Odor of H_2S
7	August 11	Bitano	100	64.6	-3.35	5-20		Flowing well, Odor of H_2S
8	August 18	Housing Project Well						
9	August 11	Tinago	200	13.5	0.61	5-20		Odor of H_2S
10	August 12	Banadero	100	16.8	-2.44	5-20	0.38	Flowing well, Odor of H_2S
11	August 12	Tognao Taysan	200	61.0	4.8	5-20		Odor of H_2S
			40	18.3	1.83	70		

Table 2 Water Source Data

5. Hydrogeology

As already stated, the lower mountains belong to Lower Miocene in geological age, which is considered to have a poor groundwater. Springs found in the mountains have small yields.

The surface sediments of Mayon Volcano consist of pyroclastic rocks in higher portion than 120 m and mudflows in lower portion. Groundwater flows out from the interface between the pyroclastic rocks and the mudflows, and from river bank of tributaries of the Yawa River. Mudflows are underlain by another formations of pyroclastic rocks, which it is considered, also include groundwater flowing from the volcano.

In this connection, detailed characteristics of geology are shown in the columnar sections of Fig 7 and are explained as follows.

(1) The eruptions of the volcano are composed of clay (mudflow and/or loam), volcanic sand, lapilli and volcanic breccia as shown in No. 1 to No. 4 and No. 6 columnar sections.
(2) The lower mountains consist of clay, tuff, sand and gravel which derived from old volcano, and limestone as indicated in No. 8 to No. 17 columnar sections.
(3) Alluvium is made up of clay, sand, and gravel as shown in the No. 5 and No. 7 columnar sections.

In order to examine the geological structure of alluvial area, the geoelectric resistivity survey was carried out. Measured points are shown in Fig 8, the analytical results in Fig 9. In A-A' cross section line along the Yawa River, geological structures are composed of three formations:

(1) Old volcanic rocks are the oldest of three formations and base rocks in the study area, which are overlain by both the younger and the older eruptions of the volcano. The volcanic rocks are more than 60 m in depth under land surface.

Daraga

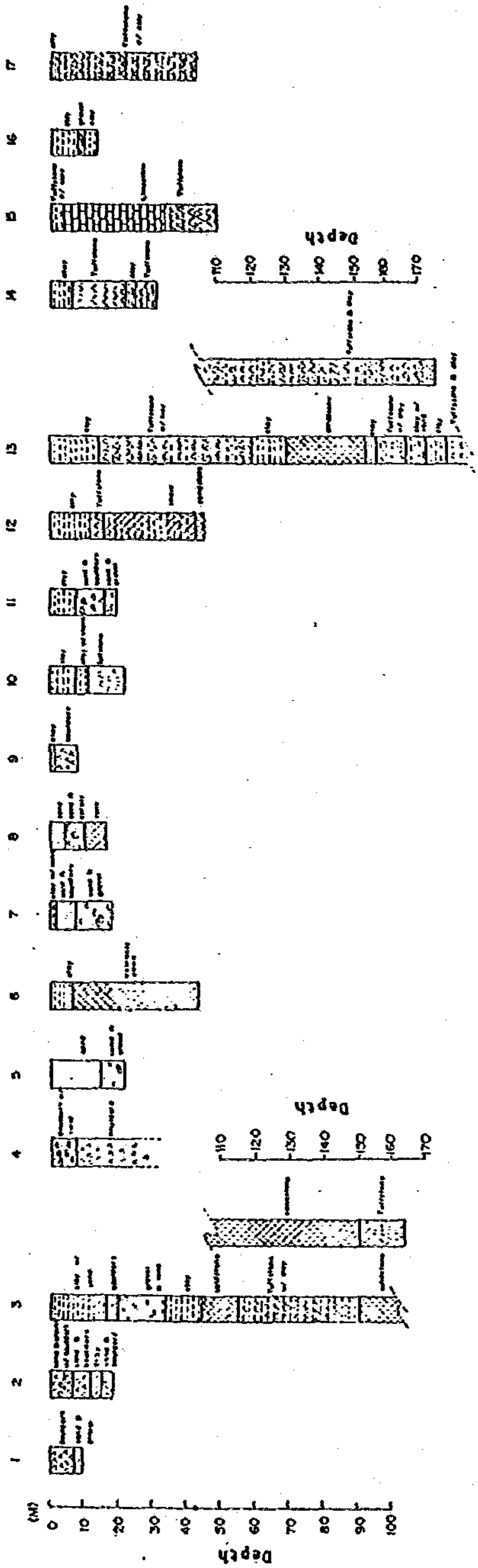

Fig 7 Columnar Sections Shown in Fig 6

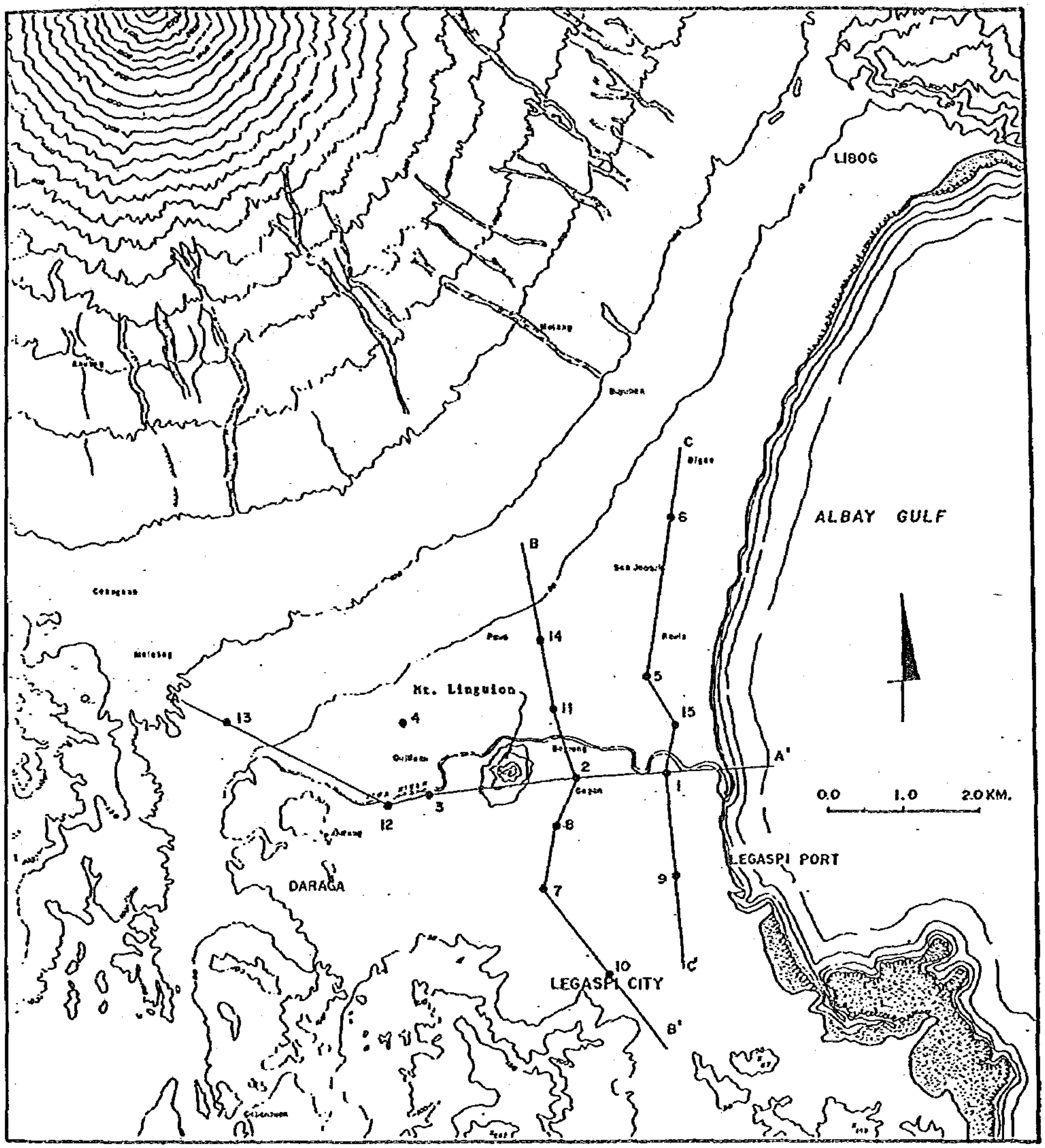

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Fig 8 Geoelectric Resistivity Survey Points

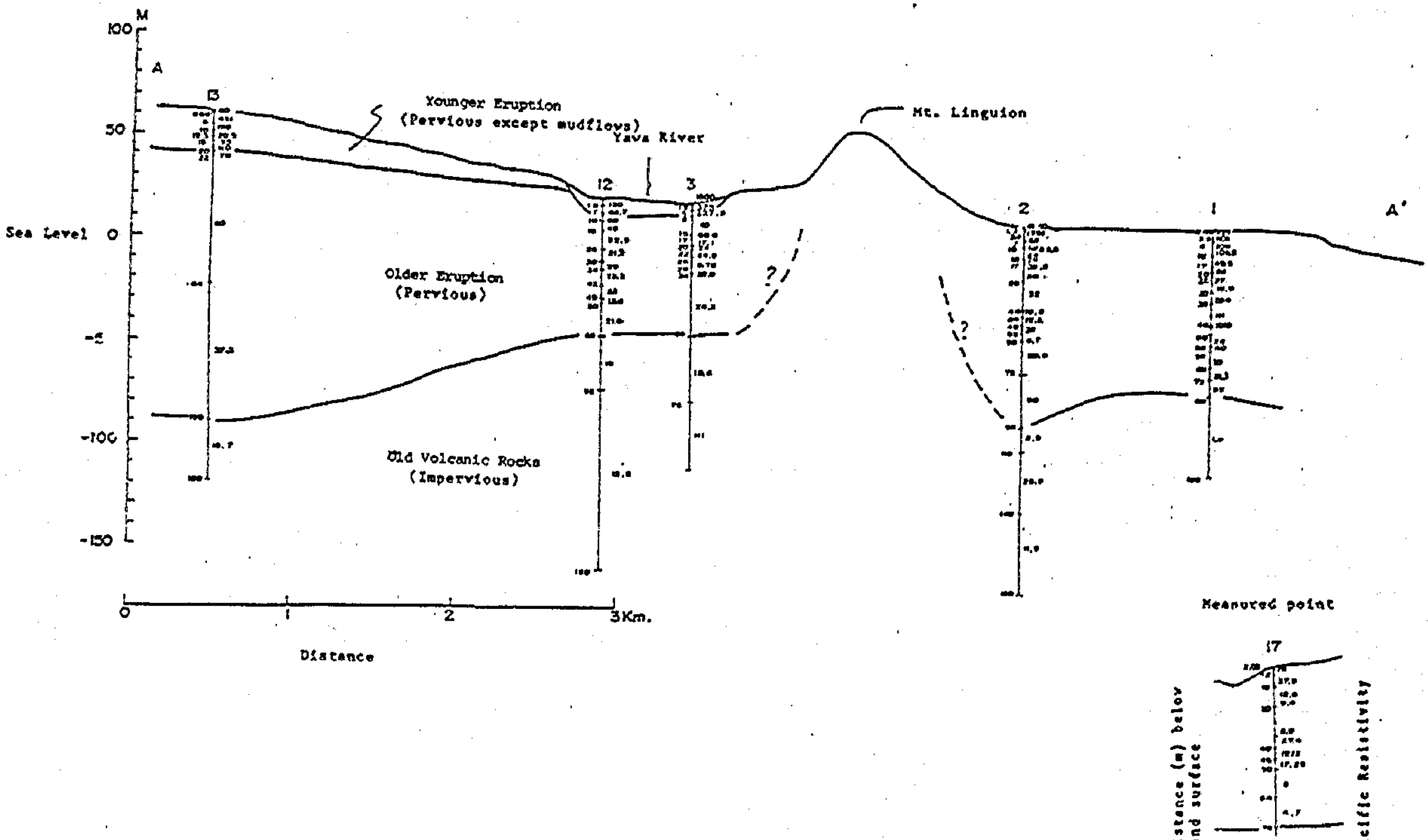

Fig 9-1 Analytical Results of Geoelectric Resistivity Survey

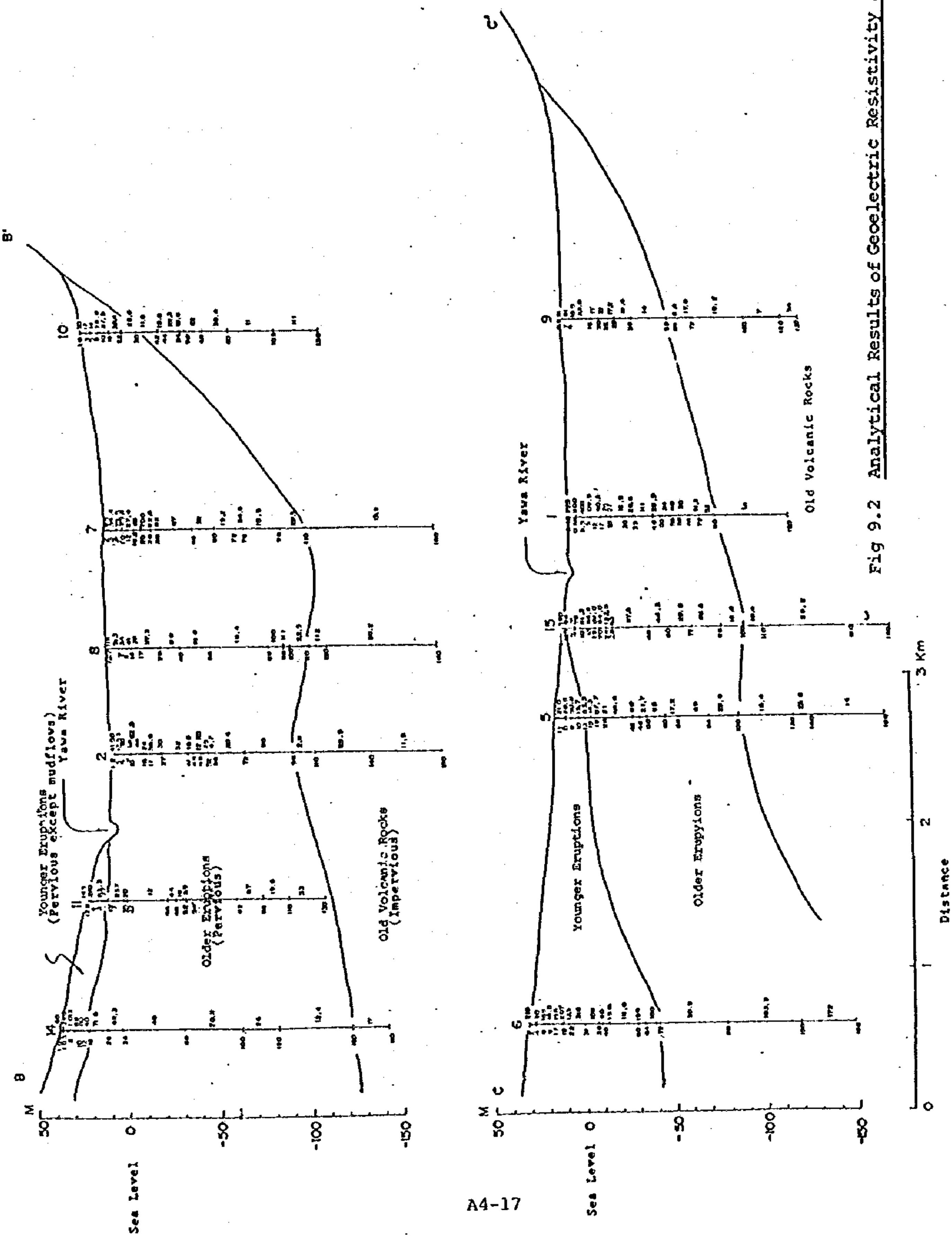

Fig 9.2 Analytical Results of Geoelectric Resistivity Survey

The volcanic rocks are estimated to be same as the geology of Mt. Linguion.

(2) The older eruptions of the volcano have a thickness over 60 m and are in the alluvium area. The older eruptions are covered by the younger eruptions in the skirts area of the volcano in the north of the river. The alluvium is formed in the surface of the old eruptions by the river in the area shown in Fig 1. The river always transports the volcanic ash and sand to the sea, and deposits sand in the river bed.

(3) The younger eruptions of the volcano are the same as observed in the field survey. The eruptions consist of pyroclastic rocks, scoria, volcanic ash and mudflow as discussed in 4.3 Geology.

In both B-B' and C-C' cross sections, old volcanic rosks rise up with a fairly steep slope to the south and reach the land surface and become the same formation as the lower mountains. Therefore, old volcanic rocks are Lower Miocene in geological age and include no good aquifer as mentioned before and are impervious.

The older and the younger eruptions (Except mudflows) have good aquifers, and especially the groundwater in the older eruptions is withdrawn by the shallow wells and flowing wells in the alluvial area. The groundwater is considered to be recharged by rainfall in the mountain.

6. Evaluation of Water Resources

6.1 River

The characteristics of the Yawa River are summarized from the description of previous sections as follows.

1) The river flows west to east, gathering tributaries from both Mt. Mayon and the lower mountains.
2) The river has a drainage area about 78.3 sq km.
3) The river always deposits the volcanic sand on the river bed.
4) The measured discharge was Q = 267,840 cu m/day at the main river.

With regard to utilization of the river surface water, its possibility is rather small. While the river has perennial flow owing to the abundant rainfall in the region, no suitable sites needed for construction of intake facilities are found along the river in the study area.

Regarding the riverbed water of the river, however, there is a rather high possibility, considering that the river has a riverbed consisting of sand together with not-scarce perennial flow. To tap the riverbed water, it is advisable to carry out further investigations to ascertain available quantity and others, necessary for detail design.

6.2 Spring

Springs in Mt. Mayon have generally large discharges and good water quality as shown in Appendix 1. Their discharges are fairly constant through the year. They are appropriate for utilization for water supply.

6.3.1 Alluvial Area

Groundwater conditions in the alluvial area are recapitulated from previous sections.

1) Geological Structures

(1) Geological structures are composed of three formations: base formation of the old volcanic rocks, lower formation of the older eruptions of Mt. Mayon, upper formation of the alluvium.
(2) The old volcanic rocks include no good aquifers.
(3) The older eruptions have a thickness over 60 m.
(4) Alluvium

a. Alluvium spreads on the surface of the older eruptions
b. Alluvium is undistinguishable from the older eruptions for its consists of same volcanic sediments.

2) Groundwater

(1) Groundwater is withdrawn by many wells in various depths in alluvium area.
(2) Groundwater is found in the older eruptions which have good aquifers.
(3) Groundwater is considered to be recharged by rainfall in the mountain.
(4) Groundwater withdrawn by wells has mostly peculiar offensive odor of hydrogen sulfide.

On the basis of above facts, the groundwater conditions are schematically shown in Fig 10.

As rainfall amount is large through all year, and moreover, most of it infiltrates into the pervious pyroclastic rocks and becomes groundwater; recharge of the groundwater is estimated to be great. For utilization of the groundwater, it will be needed to remove the odor thereof.

6.3.2 Mountain Foot of Mt. Mayon

Except springs with fairly large yields in the mountain foot area, there are the following water sources:

1) Seepage of groundwater, as described in the foregoing subsection 4.3 and section 5, which is presently used for the paddy field.
2) Fissure water flowing in lavas
3) Groundwater in water bearing layers existing in fairly deep portions, such as the older eruptions.

If such groundwater is trapped and collected in an efficient manner without impairing the existing large springs, that will be a desirable water source for water supply. Possibility of utilization of such groundwater is examined as follows:

(1) Seepage Water

1) Since groundwater seepage takes place spreading over a wide area, and such groundwater is flowing in very little depth on the impervious layer, a well, sunk vertically, cannot collect water in sufficient quantity necessary for water supply.
2) If a horizontal well is to be employed to collect such groundwater, its length will be unpractically long.

(2) Fissure Water

1) Detection of flowing paths of fissure water is very difficult, whatever survey method may be used.
2) Flowing paths often change with eruptions of the volcano.

(3) Deep Groundwater

1) Investigations required to ascertain the location, quantity and the like of such groundwater are usually very time-consuming and costly, though possible.
2) The groundwater is considered to have objectionable odor.

From the above discreet examination, seepage water and fissure water are not recommendable to develop, and development of deep groundwater is not considered advantageous at the stage of the present study.

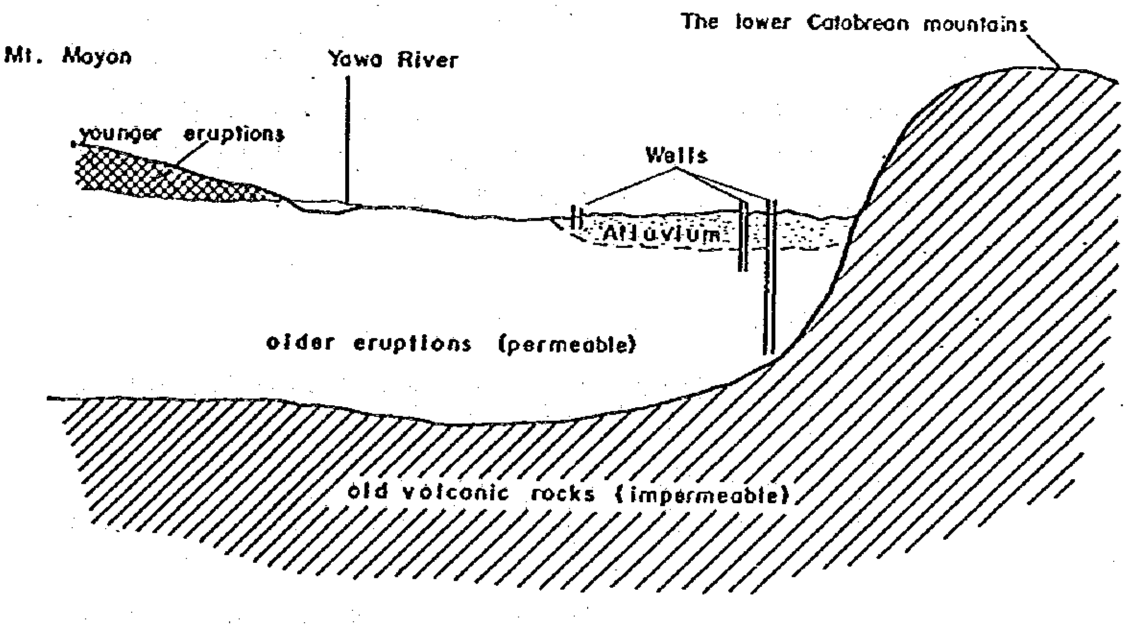

Fig. 10 Schematic Diagram of Groundwater Condition

REFERENCE

1/ Policarpio T. Dumapit (1973); Ground Water Geology of Bicol Peninsula

2/ PAGASA (1974); Annual Climatological Review

Appendix 5 Socio-Economic Study

1. Economy of the Study Area

1.1 Primary Industries

The study area, although becoming urbanized, basically depends upon primary industries such as agriculture, forestry, fishery and livestock raising. (See Table 1 and 2)

Of the total land uses in Legaspi City, 48.6% is classified as croplands, 20.5% as pasture lands and 17.5% as forest lands. Nearby 27% of the labor force is engaged in agriculture, forestry and fisheries. The leading crops of Legaspi City are rice, coconut, corn, camote and cassava. Located in the seashore, fishing is also an industry in which a small portion of the Legaspi labor force is engaged. Annual catch is around 4,000 mt. In Daraga, 58.9% of the total land area is built-up area and 41.1% is croplands. The percentage of workers engaged in agriculture, forestry and fishing is 35.0. Daraga's leading crops are rice, coconut, corn and vegetables. Livestock and poultry follow rice and other agricultural products in value and quantity. They are lucrative and are contributing to augmentation of farm income in Daraga. (See Tables 1, 3, 4, 5 and 6)

1.2 Manufacturing

The percentage of the labor force engaged in manufacturing is 20.2 for Legaspi City and 28.6 for Daraga. The manufacturing establishments in the study area is mostly small-scaled, with the exception only of the Legaspi Oil Company and the Isarog Pulp and Paper Mill. There are 32 NACIDA* registered cottage industries in the study area with a total capitalization of P46,722,601. Two thirds (22) of them are located in Daraga and one third (10) in Legaspi City. The leading types of manufacturing are handicraft and furniture. (See Table 7)

Note: *National Cottage Industries Development Authority

1.3 Commerce and Services

The percentage of the total labor force engaged in trade and commerce, transportation and service amounts to 44.0 for Legaspi City and 27.7 for Daraga. Legaspi City and Daraga are becoming the hub of trade and commerce in the Bicol Region. Legaspi City and Daraga are complementing each other in trade and commerce as they serve their combine population as well as residents of surrounding areas. The leading types of the business establishments in the study area are sari-sari stores, dry goods stores, fresh fish dealers and general merchandise. (See Table 8)

1.4 Income Distribution

The surveys conducted by Legaspi lity (in 1979) and Daraga (in 1976) show that more than half of the total households earn less than P400 monthly in Legaspi City and less than P300 monthly in Daraga. The percentage of the total households earning more than P1,000 amount to 11.9 in Legaspi City and 7.0 in Daraga. It is to be noted in this connection that food is identified as the leading area of expense by household in the study area and 80% of the urban household and 75% of the rural households produce nearly one-fourth of the food that they consume. (See Table 8)

1.5 Employment

Of the population 10 years and over in 1975, those in the labor force, as revealed by the 1978 Updated Settlement Profile, amounted to 51.9% in Legaspi City and 58.7% in Daraga. The unemployment rate was 5.9% in Legaspi City and 4.1% in Daraga. (See Table 9)

Table 1 Existing Land Uses
(Source of Data: Settlement Profile, 1978)

Uses	LEGASPI CITY Has.	LEGASPI CITY % of Total	DARAGA Has.	DARAGA % of Total
1) Built-up Area:	2,194.0	6.2	7,079.5	58.9
Poblacion	569.3	1.6	2,500.0	20.8
Barangays	1,624.7	4.6	4,570.5	38.1
2) Croplands:	17,254.6	48.6	4,929.5	41.1
Permanent Crops	9,343.1	26.3	3,121.6	26.0
Annual Crops	4,658.0	13.1	1,807.9	15.1
3) Pasture Lands:	7,265.5	20.5	None	0.0
4) Forest Lands:	6,229.2	17.5	None	0.0
5) Inland Fisheries and Other Uses:	896.0	2.5		
Total Land Area	35,526.1	100.0	12,000	100.0

Table 2 Total Employment Size, Albay Province
(Source of Data: 1975 Population Census)

Type of Industry	Percentage
1) Agriculture, Forestry and Fisheries	54.5%
2) Mining and Quarrying	0.2
3) Manufacturing	18.7
4) Electricity, Gas and Water	0.2
5) Construction	3.1
6) Commerce	6.1
7) Transportation, Communication and Storage	3.2
8) Services	14.0
Total	100.0%

Table 3 Percent of Workers by Major Industry
(Source of Data: City Planning & Development Staff of Legaspi, and Municipal Planning & Development Staff of Daraga)

	Legaspi City (1979)	Daraga (1980)
1) Agriculture, Forestry and Fishing	26.7%	35.01%
2) Mining and Quarrying	0.10	0.55
3) Manufacturing	20.24	28.57
4) Construction	6.25	4.54
5) Trade and Commerce	13.14	7.53
6) Transportation	6.23	3.05
7) Services	24.62	17.08
8) Electricity	0.49	-
9) Others	2.24	3.67

Table 4 Leading Crops
(Source of Data: Settlement Profile, 1978)

	LEGASPI CITY		DARAGA	
Name of Crop	Area (Has.)	Annual Production (m.t.)	Area (Has.)	Annual Production (m.t.)
1) Rice	1,367.3	5,370.0	2,415.8	6,700.0
2) Corn	250.0	237.5	234.5	303.0
3) Camote	190.2	634.4	-	-
4) Coconut	3,047.0	3,205.6	20,026.1	14,443.7
5) Cassava	117.9	347.4	-	-
6) Vegetable & Rootcrops	-	-	1,270.6	1,897.7
7) Abaca	74.7	17.1	7	

Table 5 Livestock and Poultry (Heads and Birds)
(Source of Data: City Planning and Development Staff, Legaspi, and Municipal Planning and Development Staff, Daraga)

	Legaspi City (1971)	Daraga (1976)
1) Pig	842	7,414
2) Goat	-	256
3) Rabbit	-	824
4) Chicken	120	32,157
5) Cattle	50	1,622

Table 6 Fishing (1976)
(Source of Data: Project Compassion Baseline Survey, 1977)

	Legaspi City	Daraga
1) Fishpond/Fishpen Operation		
a. Total area (has.)	8.1	0.1
b. Annual production	4.0	0.1
2) Offshore/Coastal Fishing		
a. Total tonnage (fishing vessel)	46.2	-
b. Annual fish catch	4,178.8	-
3) Inland Fishing		
a. Total number (fishing boats)	-	-
b. Annual fish catch (m.t.)	-	-

Table 7 Manufacturing
- Cottage Industries Registered with NACIDA as of 1980 -
(Source of Data: NACIDA, Legaspi)

	Legaspi City	Daraga
No. of Operators classified by type of industry:		
a. Handicraft	7	21
b. Furniture	2	
c. Ceramics Ind.	1	
d. Metal craft		1
Total No.	10	22
Employment (No. of Workers)	375	1,589
Capitalization	₱2,237.262	₱4,487.339

Table 8 Household Income Distribution
(Source of Data: City Planning & Development Staff of Legaspi and Municipal Planning & Development Staff of Daraga)

	Legaspi (1979) %	Daraga (1976) %
Below ₱200	15.17	48.14
₱200 - 299	17.43	21.89
₱300	18.89	10.48
₱400	12.88	4.08
₱500	8.43	3.62
₱600	5.54	2.32
₱700	3.86	0.65
₱800	3.28	1.21
₱900 - 999	2.63	0.65
₱1,000 - 1,499	6.96	2.88
₱1,500 and over	4.93	4.08

Table 9 Labor Force and Employment (%)
(Source of Data: Settlement Profile, 1978)

	Legaspi City		Daraga	
1) Population 10 years old and over	100.0		100.0	
2) In the Labor Force:	51.9[a/]	100.0	58.7[a/]	100.0
Employed	48.8	94.1[b/]	56.4	95.9[b/]
Unemployed	3.1	5.9[c/]	2.3	4.1[c/]
3) Not in the Labor Force:	48.0		41.3	

Note: a/ - Labor force ratio
b/ - Employment ratio
c/ - Unemployment ratio

2. Social Background

2.1 Ethnical and Cultural Characteristics

The original inhabitants of the study area were predominantly Malays. As shown in Table 10, Bicol is spoken by 97.4% of Legaspi residents and 98.1% of Daraga residents. (See Table 10) People in the study area are predominantly Roman Catholic. The Population Census conducted in 1970 shows that 96.5% of the population in Legaspi City and 99.3% of that in Daraga are Roman Catholic. (See Table 11)

2.2 Population Structure

As shown in Table 12, Legaspi City has slightly more males than females and Daraga slightly more females than males. More than half of the population in the study area are under 20 years old. (See Tables 12 and 13)

2.3 Educational Attainment Level

The educational attainment level of Legaspi City and Daraga is among the highest not only in the Province of Albay but also compared with surrounding Provinces. This reflects that these areas form a center of education, having Bicol University, Divine World College and other high level schools. Academic degree holders total 3,175 in Legaspi City and 1,712 in Daraga. (See Table 14)

2.4 Dwelling

Table 15 shows that the household-dwelling unit ratio is 1.0 to 1.1 in Legaspi City and 0.99 to 1.00 in Daraga. As the percentage distribution of Dwelling Units by type of dwelling shows, single dwelling units prevail both in Legaspi City and Daraga. Classified by roofing materials, nipa prevails in a high percentage. (76.4% in Legaspi City and 72.4% in Daraga). Aluminum follows with a percentage of about 20% (19.7% in Legaspi City and 21.6% in Daraga).

Table 10 Population by Mother Tongue Ethnic Origin, 1975
(Source of Data: 1975 Population Census)

	Classification	Legaspi City	Daraga
1)	Bicol	86,064	62,078
2)	Tagalog	1,348	873
3)	Hiligaynon, Ilongo	180	76
4)	Cebuano	177	59
5)	Chinese, Mandarin	130	-
6)	Others	659	179
	Total	88,379	63,265

Table 11 Population Classified by Religion, 1970
(Source of Data: 1970 Census of Population and Housing)

	Classification	Legaspi City	Daraga
1)	Roman Catholic	81,982	57,904
2)	Protestant	692	277
3)	Iglesia ni Cristo	723	-
4)	Aglipayan	-	-
5)	Islam	-	-
6)	Buddhism	-	27
7)	Others	621	127
8)	None	72	-
	Total	84,090	58,335

Table 12 Population By Sex, 1980
(Source of Data: 1980 Population Census)

	Legaspi City	Daraga
Both Sexes	98,683	73,224
Male	49,367	36,247
Female	48,685	36,966

Table 13 Population by Age Group, 1975
(Source of Data: 1975 Population Census)

	Legaspi City			Daraga		
	Both Sexes	Male	Female	Both Sexes	Male	Female
All Ages	88,378	44,435	43,539	63,265	31,573	31,692
Under 1	2,356	1,245	1,111	1,502	762	740
1 - 4	10,789	5,520	5,268	7,746	3,974	3,772
5 - 9	13,789	6,915	6,406	9,740	4,992	4,748
10 - 14	12,271	6,331	5,940	8,631	4,426	4,205
15 - 20	10,636	5,221	5,415	7,708	7,747	3,961
21 - 24	7,701	3,736	3,965	5,599	2,593	3,006
25 - 29	6,026	2,965	3,057	4,443	2,161	2,282
30 - 34	4,856	2,320	2,436	3,368	1,672	1,696
35 - 39	4,625	1,812	2,305	3,083	1,551	1,532
40 - 44	3,668	1,617	1,856	2,553	1,261	1,292
45 - 49	3,342	1,686	1,656	2,365	1,158	1,207
50 - 54	2,435	1,175	1,260	1,824	889	935
55 - 59	2,019	988	1,031	1,505	783	722
60 - 64	1,678	845	837	1,235	628	607
65 - 69	1,045	531	514	791	412	379
70 - 74	825	408	417	588	284	304
75 - 79	296	145	157	241	111	130
80 - 84	163	66	97	143	73	70
85 and Over	231	102	129	200	96	104

Table 14 Population 6 Years Old and Over by Highest Grade Complete, 1975
(Source of Data: 1975 Population Census)

	Legaspi City	Daraga
Total	72,565	51,960
No Grade Completed	8,086	6,090
Elementary		
1st - 3rd Grade	13,234	8,467
4th Grade	7,594	6,513
5th Grade	6,131	4,694
6th Grade	15,775	11,885
High School		
1st - 3rd Year	8,535	5,810
4th Year	4,636	2,896
College (No Degree)		
1st - 3rd Year	3,711	2,281
4th or Higher	581	803
Academic Degree Holder	3,175	1,712
Not Stated	1,107	605

Table 15 Dwelling Conditions
(Source of Data: 1980 Population Census)

	Legaspi City	Daraga
1) Number of Households (1980)	17,329	12,961
2) Household-to-Dwelling Unit Ratio	1.10 to 1	0.99 to 1
3) Percentage Distribution of Dwelling Units by Type of Dwelling		
a. Single	92.2	93.5
b. Duplex	2.7	2.7
c. Barong-Barong	2.5	2.0
d. Other Types	2.6	1.8
Total	100.0	100.0
4) Percentage Distribution of Dwelling Units by Type of Roofing Materials		
a. Aluminum	19.7	21.6
b. Asbestos	0.1	0.2
c. Tile/Concrete	0.5	0.4
d. Cogon	1.5	4.3
e. Nipa	76.4	72.4
f. Others	1.9	1.1
Total	100.0	100.0

3. Infrastructures

3.1 Land Transportation

The transportation system for the study area, the City of Legaspi and the Municipality of Daraga, includes one airport, one seaport and one railway line. The airport connects the city and the municipality with Manila by a daily flight, with Cebu by three flights a week and with Virac by two flights a week. More than 30 buses run to Manila. Inter-province bus service is available with at least one hour interval. In the City and the Municipality, spot-to-spot transportation is available by jeeps/jeepneys and motor-tricycles, which number more than 1,000 (see Table 16).

3.2 Roads

The road network of the study area, i.e., Legaspi and Daraga, totals 345 kilometers of which about 40% is paved either with concrete or asphalt. This pavement ratio is considerably high compared with other municipalities. (See Table 17)

3.3 Irrigation Systems

There is no irrigation systems maintained by the National Irrigation Administration. As shown in Table 18, there have been proposed 18 communal irrigation systems, but so far only one project is on-going.

3.4 Waterworks and sewerage System

The study area is being served by a provincial water supply systems, though its service is not so satisfactory, as delineated in PART ONE. The area has no sewerage system.

3.5 Power

The study area is presently served with electric power by the Albay Electric Cooperative, a semi-government entity, which buys its electric power from National Power Corporation (NAPOCOR). As shown in Table 19, the residential consumers in the study as of May 1981 total 11,546, 38.12% of the total households there. Monthly residential consumption in the area amount to 726,152 KWH while commercial one records 785,478 KWH.

Table 16 Transportation Resources in the Study Area, 1980
(Source of Data: Bureau of Land Transportation)

Kind of Motor Vehicles	Number
1) Cars	1,021
2) Jeeps/jeepneys	1,635
3) Trucks	541
4) Buses	99
5) Trailers	87
6) Motor-cycles	626
7) Motor-tricycles	639
Total	4,598

Table 17 Road Length and Surface Conditions (Km)
(Source of Data: Office of the City Engineers, Legaspi
Office of the Highway District Engineer, Albay)

		Surface Conditions		
Legaspi	Total Length km	Gravel & Other	Asphalt	Concrete
1) National Road	56.803	26.19	13.835	16.778
2) Provincial Road	5.1	2.3	21.0	27.8
3) City Road	29.67	11.34	15.86	2.47
4) Barangay Road	80.33	80.33	-	-
Total	217.903	120.16	50.695	47.048
Daraga				
1) National Road	22.629	-	-	22.629
2) Provincial Road	28.57	22.95	5.02	0.6
3) Municipal Road	11.7	1.6	9.4	0.7
4) Barangay Road	64.1	64.1	-	-
Total	126.999	88.65	14.42	23.929
Grand Total	344.902	272.91	65.115	70.977

Table 18 List of Communal Irrigation Projects/Systems at Legaspi City and Daraga
(Source of Data: National Irrigation Administration, Albay Office)

Name of Project	Location	Area (Has.)	Status of Proj.	Source	Status of Water Right Permits
1) Arimbay CIP	Legaspi City	150	Deferred	Buyuan River	Temporary water permit from NWRC
2) Pawa Rawis CIP	Legaspi City	122	Deferred	Pawa River	None
3) Maslog CIS	Legaspi City	18	Proposed	Maslog Creek	None
4) Taysan CIS	Legaspi City	25	Proposed	Taysan Creek	None
5) Bagacay CIS	Legaspi City	13	Proposed	Bagacay Creek	None
6) Cullat CIS	Daraga, Albay	86	On-going	Yawa River	Under Preparation by NIA
7) De la Paz CIS	Daraga, Albay	11	Proposed	Dinoronan Creek	None
8) Malabog CIS	Daraga, Albay	180	Proposed	Malabog Creek	None
9) Maroroy-Bagtang CIS	Daraga, Albay	18	Proposed	Maroroy-Bagtang Creek	None
10) Pandan CIS	Daraga, Albay	50	Proposed	Pandan Creek	None
11) Budiao-Quilicao CIS	Daraga, Albay	200	Proposed	Quilicao River	None
12) Bongalon CIS	Daraga, Albay	60	Proposed	Bongalon River	None
13) Anislag CIS	Daraga, Albay	20	Proposed	Anislag Creek	None
14) Bascaran CIS	Daraga, Albay	50	Proposed	Bascaran Creek	None
15) Inarado CIS	Daraga, Albay	150	Proposed	Dinoronan Creek	None
16) Mayon CIS	Daraga, Albay	25	Proposed	Mayon Creek	None
17) Namantao CIS	Daraga, Albay	15	Proposed	Namantao Creek	None
18) Tabon-Tabon CIS	Daraga, Albay	150	Proposed	Tabon-Tabon Creek	None

Table 19 Electricity Consumers and Consumption
(Source of Data: Albay Electric Cooperative, Inc.)

	Legaspi City (Incl. Albay)	Daraga
1) No. of Residential Consumers	7,721	3,825
2) No. of Minimum Consumers (Res.)	2,755	652
3) No. of Commercial Consumers	1,040	494
4) No. of Minimum Consumers	293	26
5) Kilowatthour Consumption		
a. Residential	505,565	220,587
b. Commercial	680,530	104,948

Rate Schedule as of May 1981

Type of Consumer		Rate
Residential/Public Building	Minimum Bill	₱ 6.95
	Excess	.58/kwh
Commercial	Minimum	12.00
	Excess	.60/kwh

4. Public Health

4.1 Causes of Morbidity and Mortality

The health picture of the Albay Province in the past five years, 1976 to 1980, showed that Gastro-Enteritis, water-borne disease, was top in the causes of morbidity and was the fifth among the leading causes of mortality.

In Legaspi City, Gastro-Enteritis ranked 7th in the causes of morbidity and mortality. In Daraga, it ranked also 7th in the causes of mortality but 10th in the causes of morbidity. The environmental and sanitary conditions in Legaspi and Daraga which are considered comparatively better than other municipalities but are yet to be improved further. Both of them have in common a public water supply system whose service area is however limited. (See Tables 21 and 22)

4.2 Health Facilities

The City of Legaspi and the Municipality of Daraga can be considered as one district, viewed from the availability of hospital services. Eleven hospitals out of the total 12 in the study area are private hospitals. The total bed capacity of these 12 hospitals amounts to 861. Other health facilities in Legaspi and Daraga, as listed in Table 23, number 36.

4.3 Sanitary Toilets

The ratio of the households with flush-type and water-sealed type toilets amounts to 50.18% in the City of Legaspi and 40.95% in the Municipality of Daraga. Inadequate water supply is considered a major cause hindering the further sanitization of toilets in these districts. (See Table 24)

Table 20 1976 to 1980 Ten Leading Causes of Morbidity and Mortality, (5-Year Average)
(Source of Data: The Provincial Health Center of Albay)

ALBAY PROVINCE

	Causes of Morbidity	Rate (Per 10,000 Population)
1)	Gastro-Enteritis	198.54
2)	Pneumonia	196.17
3)	Pulmonary T.B.	187.16
4)	Influenza	114.63
5)	Bronchitis	113.01
6)	Heart Disease	75.63
7)	Prematurity	24.37
8)	Hypertension	22.16
9)	Malnutrition	18.02
10)	Accident	17.28

	Causes of Mortality	Rate (Per 10,000 Population)
1)	Pneumonia	142.25
2)	Pulmonary T.B.	84.79
3)	Heart Disease	75.63
4)	Bronchitis	56.73
5)	Gastro-Enteritis	38.85
6)	Prematurity	24.16
7)	Hypertension	22.16
8)	Malnutrition	18.02
9)	Accident	17.28
10)	Malignancy	11.23

Table 21 1976 to 1980 Ten Leading Causes of Morbidity and Mortality, (5-Year Average)
(Source of Data: The City Health Department of Legaspi)

LEGASPI CITY

	Causes of Morbidity	Rate (Per 100,000 Population)
1)	Bronchitis	3,558.36
2)	Upper Respiratory Tract Infection	2,485.66
3)	Intestinal Parasitism	1,275.16
4)	Anemia	1,149.02
5)	Influenza	1,080.12
6)	Malnutrition	1,039.84
7)	Gastro-Enteritis	941.26
8)	Skin Disease	642.35
9)	Infected Wound	374.17
10)	P.T.B.	374.17

	Causes of Mortality	Rate (Per 100,000 Population)
11)	Bronchopneumonia	221.53
2)	CVA	133.55
3)	PTB	83.73
4)	Bronchitis	79.49
5)	Malignancy	19.07
6)	Myocardial Infraction	24.37
7)	Gastro-Enteritis	24.37
8)	Coronary Thrombosis	23.31
9)	Prematurity	18.01
10)	Malnutrition	14.83

Table 22 1976 to 1980 Ten Leading Causes of Morbidity and Mortality, (5-Year Average)
(Source of Data: The Municipal Health Center of Daraga)

DARAGA

	Causes of Morbidity	Rate (Per 1,000 Population)
1)	Upper Respiratory Tract Infection	5.4
2)	Viral Infection	2.1
3)	Infection Wound	1.4
4)	Anemia	1.3
5)	Hypertension	1.2
6)	Bronchitis	1
7)	Parasitism	.93
8)	Urinary Tract Infection	.68
9)	Non-Infectious Diarrhea	.63
10)	Acute Gastro-Enteritis	.61

	Causes of Mortality	Rate (Per 1,000 Population)
1)	Carde-Respiratory Failure	1.8
2)	Bronchopneumonia	1.3
3)	Cerebro-Vascular Accident	.72
4)	Kech's Pubmenary	.57
5)	Stillbirth	.43
6)	Coronary Thrombosis	.32
7)	Gastro-Enteritis	.29
8)	Bronchitis	.29
9)	Congestive Heart Failure	.26
10)	Malnutrition	.16

Table 23 Health Facilities
(Source of Data: The City Health Department of Legaspi and the Provincial Health Center of Albay)

The City of Legaspi	Number
1) Hospital	9
2) Other	21
The Municipality of Daraga	
1) Hospital	3
2) Other	15

Table 24 Number of Households and Percent of Households with Sanitary Toilets
(Source of Data: The City Health Department of Legaspi and the Provincial Health Center of Albay)

The City of Legaspi	Number	Percent
Total Households	17,329	
1) Households with flush & water-sealed type toilets		50.81
2) Households with open pit toilets		42.25
3) Others		6.94
The Municipality of Daraga		
Total Households	12,961	
1) Households with flush & water-sealed type toilets		40.95
2) Households with open pit toilets		44.18
3) Others		14.87

Appendix 6 Design Criteria for Planning

To prepare the master plan and the preliminary design of feasibility study on a standardized basis, the following design criteria are worked out. In preparing these criteria, due consideration has been given to the design criteria that were made by LWUA and compiled in the Technical Standard Manual. And to make the present criteria more realistic and workable, the local conditions including that of the existing water supply facilities, in particular are taken into account.

1. (Per capita Consumption) For planning of the district water supply system, average daily per capita consumptions for each study area are projected based on records of different WDs. In this study the values tabulated in Table A.7.4 and Table A.7.5 shall be used as a basis for unit consumption figures.

2. (Peak Factor) Since no data on maximum day and peak hour demands in each study area are available the following demand factors shall be used.

Average day demand	1.00
Maximum day demand	1.20 x average day demand
Peak hour demand	1.50 x average day demand

3. (Capacity of the Facilities) The capacity of the water source and transmission facilities shall be determined based on Maximum day demand.

   The distribution facilities shall be designed based on Peak hour demand.

4. (Water Pressure) Maximum static pressure on a pipeline shall not exceed 7 kg/sq cm. In case unavoidable, special device shall be installed to keep the water pressure within the said limit.

Minimum water pressure at pipe ends of the distribution system shall not be less than 7 m in head, as far as practicable.

5. (C Value) C value to be used for hydraulic calculation of new pipe shall be:

Pipe Size (mm)	C Value
600 and over	130
500 - 250	120
200 - 100	110
75	100
All sizes of PVC	140

C value for old pipe shall be determined according to the conditions of pipe.

6. (Pipe Material) Pipe materials shall be selected from the following: ACP, CIP, DCIP, Steel Pipe, PVC.

In selecting pipe materials, the following shall be taken into consideration:

1) Maximum static pressure and water hammer impact which the pipeline is to be subjected to.
2) Conditions of the road under which the pipeline is to be laid.
3) Corrosiveness of the soil in which the pipeline is to be burried.

7. (Fire Hydrants) Standard spacing of fire hydrants shall be 150 m. Size of pipe on which the fire hydrant to be installed shall be 150 mm and above. In case of fire hydrant is considered indispensable due to the conditions of the locality, 100 mm pipe may be utilized for installation of the fire hydrant.

8. (Valves, Air Valves, and Drain Pipe) Valves shall be installed at the following points:

Transmission pipelines:	strategic operating points at about 2 km intervals.
Distribution mains :	all main crosses and branches and at about 300 m intervals.

Air valves shall be installed at the top of vertical curves of pipelines.

Drain pipes shall be installed at the bottom of vertical curves of pipelines, where draining from the pipeline is possible.

9. (Storage Capacity) The capacity of a distribution reservoir shall be equivalent to 8 hours quantity of maximum day demand including water for fire fighting and water for emergency.

The said capacity can be split into plural numbers of reservoir in accordance with the needs of the locality.

10. (Meters) All production of the water source facilities and distribution shall be metered. For this purpose, bulk meters shall be provided at appropriate and convenient places to measure.

House meters shall be installed at all service connections.

Appendix 7 Procedure of Projections of Population and Water Demand [1/]

A. Population Projection

General

To estimate the study area population which is one of the basic factors of water requirement, the past census made by the National Census and Statistics Office (NCSO) is used as the most reliable demographic data.

The total study area population is projected on the basis of separate projections for the city core or poblacion and for the rural barangays within the study area. The method of past trend extrapolation is applied for population projection of such "micro-economic" areas of barangays in this study.

To determine future growth rates for each barangay the following factors are considered:

1. Existing and proposed land use plans.(residential, commercial, industrial, institutional and agricultural zones)
2. Physical limits (barriers) to the geographical development of the area.
3. Population density. (persons per ha)
4. Housing patterns.
5. Existing and proposed transportation and communication facilities. (road network, etc)
6. Possible migrations within the municipality and the region
7. Family planning program of the Government.

Remarks: 1/ In the course of the work of preparing the master plan for water supply of the four WDs in the three provincial areas (Ilocos Norte WD in Ilocos Norte Province, Legaspi City WD and Daraga WD in Albay Province, and Tagbilaran WD in Bohol Province), this procedure of projections of population and water demand is established as a general concept to be applied to the four WDs.

Total Municipal Population

In projecting the municipal population, the following steps are observed:

1. Using available past census data, a trend analysis on past growth rates and the factors which might have influenced them is performed. Past population trend of the municipality is shown in Table 1.2.2 thru Table 1.2.6. (See 2.2 Population, Part One: General)
2. Future growth rates up to the design year are projected based on the field conditions and future development as well as data obtained in step 1 above.
3. The population for each design year is obtained using the projected average annual growth rates in step 2 above. The population in each design year is tabulated as shown in Table 2.3.1 The past and future trends are graphically shown in Fig. 2.3.1. (See 3.1 Population Projection, Part Two: Master Plan)

Barangay Population

1. Using the same method outlined for municipal population projections, the population for each barangay covered by the municipality is projected.
2. Since the total annual population of all the barangays should equal to the total annual municipal population, barangay population is revised where applicable and necessary. Population projection for each barangay is shown in Table 2.3.2 thru Table 2.3.6. (See 3.1 Population Projection, Part Two: Master Plan)
3. Population density of each barangay is checked.

As an example of the high growth of population in the study area, the high series of NEDA-POPCOM projection is introduced herein, which is considered to be a useful data for a sensitivity analysis of the population projection. While the low growth of population in the study area is projected with an assumption that the average growth rates from one design year to another design year may differ by 10 to 20 per cent from the medium growth of projection made in this study. The high and low growth of populations are shown in Table 2.3.7 and Table 2.3.8. (See 3.1 Population Projection, Part Two: Master Plan)

Served Population

At present, the served area of the city/municipality is mostly concentrated on the poblacion or the central urban area, where the middle-high income groups are usually found.

A percentage of population served is estimated in each design year based on the present population served, data gathered in the field, cost and availability of the water from sources. The served population as well as the served area 1/ for Phase I (1987) is decided based on a concept that the purpose of this Phase project is to satisfy the present water requirement which has not been met in recent years due to deterioration of the water supply facilities, by rehabilitation, improvement and some additional works, within as short a period as possible. It is the goal of this study, however, to be able to extend improved water services (Level III system services to no less than 70 percent and 80 percent of the population in the served area by Phase II (1993) and the master plan period (2010) respecitvely.

Remarks: 1/ Served area for this study is discussed in 2.2 Served Area, Part Two: Master Plan.

B. Water Demand Projection

General

Future water demand is projected by category of water use and area of water demand. The categories adopted are 1) domestic, 2) commercial and industrial and 3) institutional water demands. Unaccounted-for-water is also estimated and totalled to the above demands. The water demand areas adopted for projection are poblacion or urban area and rural barangays. The urban area includes the neighboring barangays of the poblacion where applicable.

Historical consumption data are not available because the current supply does not cover all the consumers with service connections and no records of meter reading are obtained. Therefore, potential/theoretical demand for the study area is considered as for the present consumption.

The potential demand as an average per capita demand for the study area is estimated based on the similar WDs records 1/ of consumption and the classification of WDs stipulated in the Design Manual of LWUA. The result of classification of WDs for the present study is shown in Table A.7.3. The average per capita water demands for the urban and rural areas are estimated respectively and shown in Table A.7.4 and Table A.7.5.

Domestic Demand

The projected demands for domestic water are based on the average per capita consumption and the projected served population in the study area. As mentioned in the preceding paragraph, data on present average domestic unit consumption for the study area are not available, then the consumption records of different WDs are referred

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Remarks: 1/ Ref. Table A.7.1 Per Capita Consumption in Existing Water District (1978) and Table A.7.2 Average Unit Consumption by WD classification in 1978.

so that present unit consumption in the similar city/municipality is to be applied for the potential unit consumption for the study area. The future unit consumption which will represent an average consumption in the urban area are projected based on the said potential consumption as shown below:

City/Municipality	1978 (lpcd)	1987 (lpcd)	1993 (lpcd)	2010 (lpcd)
Ilocos Norte				
Laoag	128	128	135	155
Pasuquin	100	105	115	140
Bacarra	100	105	115	140
Vintar	100	105	115	140
Paoay	100	105	115	140
Legaspi	135	135	148	175
Daraga	135	135	148	175
Tagbilaran	128	128	135	155

Domestic consumption projections for the rural area are projected using the same method for the urban area projections, however, only a single series unit domestic consumption is estimated to adopt for all the study areas. The domestic unit consumptions are projected as follows:

	1980 (lpcd)	1987 (lpcd)	1993 (lpcd)	2010 (lpcd)
All rural area	60	69	78	100

The potential unit consumption in 1980 is estimated based on the experiences in the rural water supply programs in the Southeast Asian countries. Future unit consumptions are projected on the basis that the unit consumptions will increase at a growth rate of 2.0% per annum in the period 1980-1993 and 1.5% per annum in the period 1993 -2010, respectively.

Commercial and Industrial Demand

Reliable data on present commercial and industrial water consumption of the study area are not available. Therefore, the following assumptions are employed for the future demand projections. According to the experience in the Philippines, there is a relation between the level of commercial and industrial activities and the service area population. These ratios vary from a minimum level of 0.3 commercial and industrial connections per 100 inhabitants to a maximum level of 1.2 connections per 100 inhabitants.

To estimate future commercial and industrial demands in the study area the following connection densities and unit consumptions are assumed:

Connection Density Ratio

	Group II	Group III	Group IV
(a) 1980 Density Ratio	-	-	-
(b) Density Increase Coefficient for year			
1987	1.4	1.2	1.0
1993	1.6	1.4	1.0
2010	2.5	2.0	1.2

Group II : Legaspi and Daraga

Group III : Laoag and Tagbilaran

Group IV : Bacarra, Pasuquin, Vintar and Paoay

Unit Consumption per Connection

Years	Unit Water Consumption (m^3/day)
1987	1.2
1993	1.5
2010	2.0

Based on the above assumptions, unit commercial and industrial consumptions as per capita consumptions for the future design years are obtained and shown below:

Commercial and Industrial Consumptions (lpcd)

Years	Group II	Group III	Group IV
1987	17 (13)	14 (11)	12 (11)
1993	24 (16)	21 (16)	14 (12)
2010	50 (29)	41 (26)	24 (17)

( ) Percentage to the per capita domestic consumption

Institutional Water Demand

Institutional water consumers include schools, churches, public administration buildings and hospitals. It can be assumed that all institutional establishments within the future service area will be connected. Based on this consideration and referring to the socio-economic data, one institutional connection per 2000 inhabitants is employed to be served in the study area. Unit consumption for the institutional connection will be as follows:

Year	1987	1993	2010
Unit Institutional consumption (m^3/day)	4.0	6.0	8.0
Coverted. to per capita consumption (lpcd)	2.0	3.0	4.0

Unaccounted-for-Water

Unaccounted-for-water including wastage, leakage and water losses are estimated as follows. During the field investigation the unaccounted-for-water measurement in the study area was not able to undertake because the supply capacity had not fully met with the requirement and no water condition in the distribution network was chronically observed.

Based on the experience, the following values for unaccounted-for-water (percentage of the total water production) may be assumed for the future design years:

Year	1987	1993	2010
System with old and new pipelines in 1987	34	25	20
System with new pipelines in 1987	22	20	20

Total Water Demand

The projected unit consumption figures for domestic, commercial and industrial, institutional, and unaccounted-for-water have been presented in the preceding sections. The compiled projected unit consumption and supply requirements are listed in Table A.7.4 and Table A.7.5.

The average day demand and supply requirements for the study area are projected based on the above unit consumption and supply requirements and the projected served population. The consolidated projection of average day water demands for the study area are shown in 3.2 Water Demand, Part Two: Master Plan.

Table A.7.1 Per Capita Consumption in Existing Water District (1978)

	Water District	Total Population (1978)	Served Population (1978)	Number of Service Connection	Average Consumer per Connection	Average Metered Use per Connection (m^3/month)	Per Capita Consumption (lpcd)	Water District Group
1.	Bacolod	222,740	47,410	4,375	10.8	46.8	144	I
2.	Bayao	482,230	33,672	5,466	6.2	37.6	202	I
3.	Zamboanga	261,980	37,846	9,818	3.9	50.0	427	II
4.	Cebu	625,350	85,358	12,496	6.8	42.9	210	I
5.	Lipa	105,940	9,066	1,273	7.1	30.1	141	II
6.	Tarlac	158,340	5,615	942	6.0	26.7	148	II
7.	Cabanatuan	113,810	21,327	2,848	7.5	42.2	188	II
8.	Gapan	53,840	4,750	589	8.0	13.5	56	IV
9.	Bislig	56,840	4,284	865	5.0	23.3	155	III
10.	Urdaneta	64,880	3,203	441	7.3	25.1	115	III
11.	Silay	104,550	6,142	984	6.2	39.8	214	III
12.	Calamba	96,310	6,174	1,135	5.4	26.3	162	II
13.	Cotabato	66,756	14,586	1,900	7.7	28.4	123	III
14.	Roxas	71,049	8,240	1,028	8.0	32.8	134	III
15.	Baybay	66,596	5,138	1,153	4.5	16.2	120	III
16.	San Fernando	97,800	10,632	1,445	7.4	26.4	119	II
17.	Olongapo	143,279	43,806	6,375	6.9	42.2	204	I
	Average				6.7	32.4	168.4	

Daraga

Table A.7.2 Average Unit Consumption by WD Classification in 1978

WD Group[1/]	Accounted-for-water[2/] (lpcd)	Unaccounted-for-water[3/] (lpcd)	Total (lpcd)
I	190	127	317
II	152	101	253
III	144	96	240
IV	112[4/]	75	187

1/ Refer to Design Manual of LWUA

2/ Based on records of different WDs

3/ 40% of the total is applied

4/ No data but estimated

Table A.7.3 Classification of Water Districts According to Future Requirements

City/Municipality	1975 Urban Income	Urban Households with Refri-gerators	Urban Households with Flush Toilets	1975 Business Index	1980 Cost of Water Source of Supply	1980 Served Population	Total Points	Group
Ilocos Norte								
Laoag	10	8	6	11	14	8	57	III
Pasuquin	6	7	6	4	20	5	48	IV
Bacarra	8	7	6	4	17	5	47	IV
Vintar	6	6	5	4	14	5	40	IV
Paoay	6	6	5	2	11	5	35	V
Legaspi	10	8	6	16	20	9	69	II
Darage	6	8	6	16	20	8	64	II
Tagbilaran	10	8	6	16	11	8	59	III

Note: The grouping of WDs, based on the range of total points under the 5 criteria, is a follows:

Group	Total Points
I	70 and above
II	60 - 69
III	50 - 59
IV	40 - 49
V	39 and below

Daraga

Table A.7.4 Legazpi, Daraga (Group II)
Average Unit Consumption and Supply Requirements

Category/Year	1978	1987	1993	2010
Domestic, lpcs	135	135	148	175
Commercial/Industrial, lpcd	15	17	24	50
(% of domestic)	(11)	(13)	(16)	(29)
Institutional, lpcd	2	2	3	4
Accounted-for-water, lpcd	152[1/]	154	175	229
Unaccounted-for-water, lpcd	101	79	58	57
(% of production)	(40)	(34)	(25)	(20)
Total unit demand requirement, lpcd	253[2/]	233	233	286

1/ Based on records of different WDs.

2/ Estimated as potential/theoretical requirement.

Table A.7.5 Rural Barangays

Average Unit Consumption and Supply Requirement

Category/Year	1980	1987	1993	2010
Domestic, lpcd	60 1/	69	78	100
Institutional, lpcd	2	2	3	4
Accounted-for-water, lpcd	62	71	81	104
Unaccounted-for-water, lpcd	21	20	20	26
% of Production	(25)	(22)	(20)	(20)
Total unit demand requirment, lpcd	83	91	101	130

1/ Potential/theoretical requirement

Appendix 8 Basic Cost Data

This appendix A presents basic cost data which are applied to costs estimates of the present feasibility study. Basically the unit costs are taken from the Methodology Manual of LWUA, as far as applicable. However, unit costs not included in the Manual are taken from prevailing prices in the Philippines as of July 1981. Further, some of breakdown ratios presented in the Manual have been modified so as to fit the present case.

Table 1 shows the prevailing land prices in each location of the present projects. Table 2 Labor Costs and Table 3 Unit Prices for Civil Works are quoted from the Manual for reference. Table 4 shows percentages of Foreign and Local components of various work items which are used in the present feasibility study. These percentages are obtained adjusting the percentages of corresponding work items in the Manual.

Table 1 Land Prices of Study Area

Location	Prices (pesos/sq m)
Mountainous area	20
Unirrigated rice field	25 - 30
Irrigated rice field	35
Poblacion	100 - 200

Table 2 Labor Costs

Items	Unit	Rates (Pesos)
Unskilled*	per day	20 - 25
Skilled **	do	40 - 45

* Mason, Pipe fitter, Pipe layer, Excavator, etc.

** Carpenter, Tinsmith, Supervisor of labors, etc.

Table 3 Unit Prices for Civil Works

Items	Unit	Rate (Pesos)
Earth Work		
Common excavation	cu m	40
Hardpan excavation	do	65
Trench excavation	do	55
Rock excavation	do	95
Backfill dumpted	do	15
Backfill compacted	do	70
Disposal material	do	12
Gravel blanket	do	80
Concrete Work		
Concrete 4,000 psi	cu m	880
Concrete 3,000 psi	do	740
Formwork vertical	sq m	60
Formwork horizontal	do	100
Reinforcement bars	kg	10

Table 4 Components of Breakdown Used in Cost Estimates

Item	F/C	L/C
Deep well	29%	71%
Deep well pumping station	56	44
Transmission/distribution pumping station	60	40
Transmission/distribution pipeline	67	33
Valve	73	27
Service connection	77	23
Fire hydrant	66	34
Reservoir, chamber, etc.	25	75
Bulk meter	80	20
Chlorinator	90	10
Vehicle	50	50

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