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 1,980 ha, the population served increases to 49,840 and the total water demand is 9,800 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, 3.14.2 and 3.14.3. The facilities to be constructed are recapitulated in Table 3.14.1. The construction schedule is as Fig 3.14.4 and the project cost and the 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 25 % 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 users 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 49,840 which is a gain of 101 % over the present served population. And the served area will increase from 480 ha to 1,980 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: 18 %
2) Based on Cost Value with Conversion A : 17 %
3) Based on Cost Value with Conversion B : 19 %
4) Based on Cost Value with Conversion C : 16 %

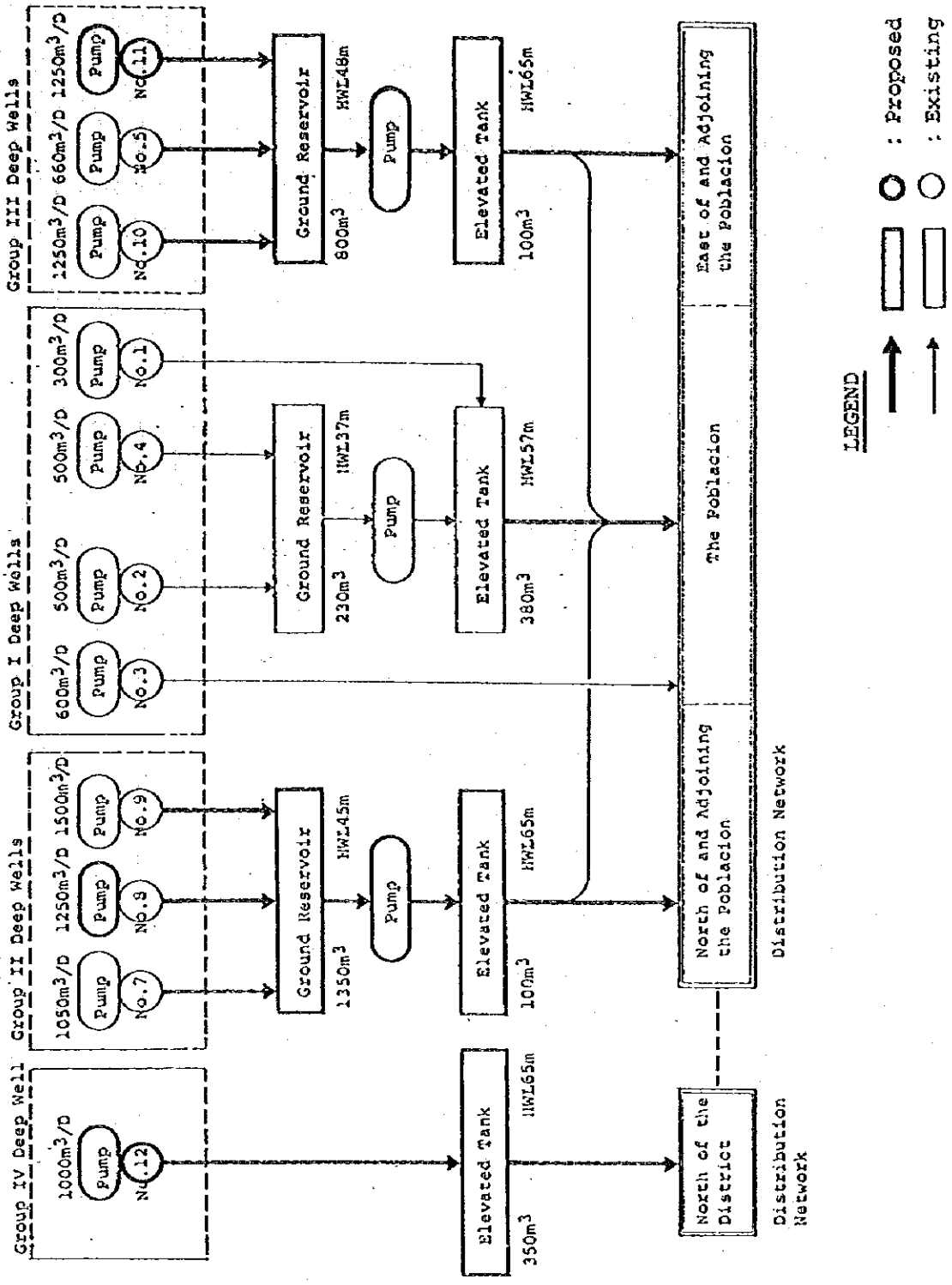


Fig 3.14.1 Schematic Diagram of Proposed Water Supply System

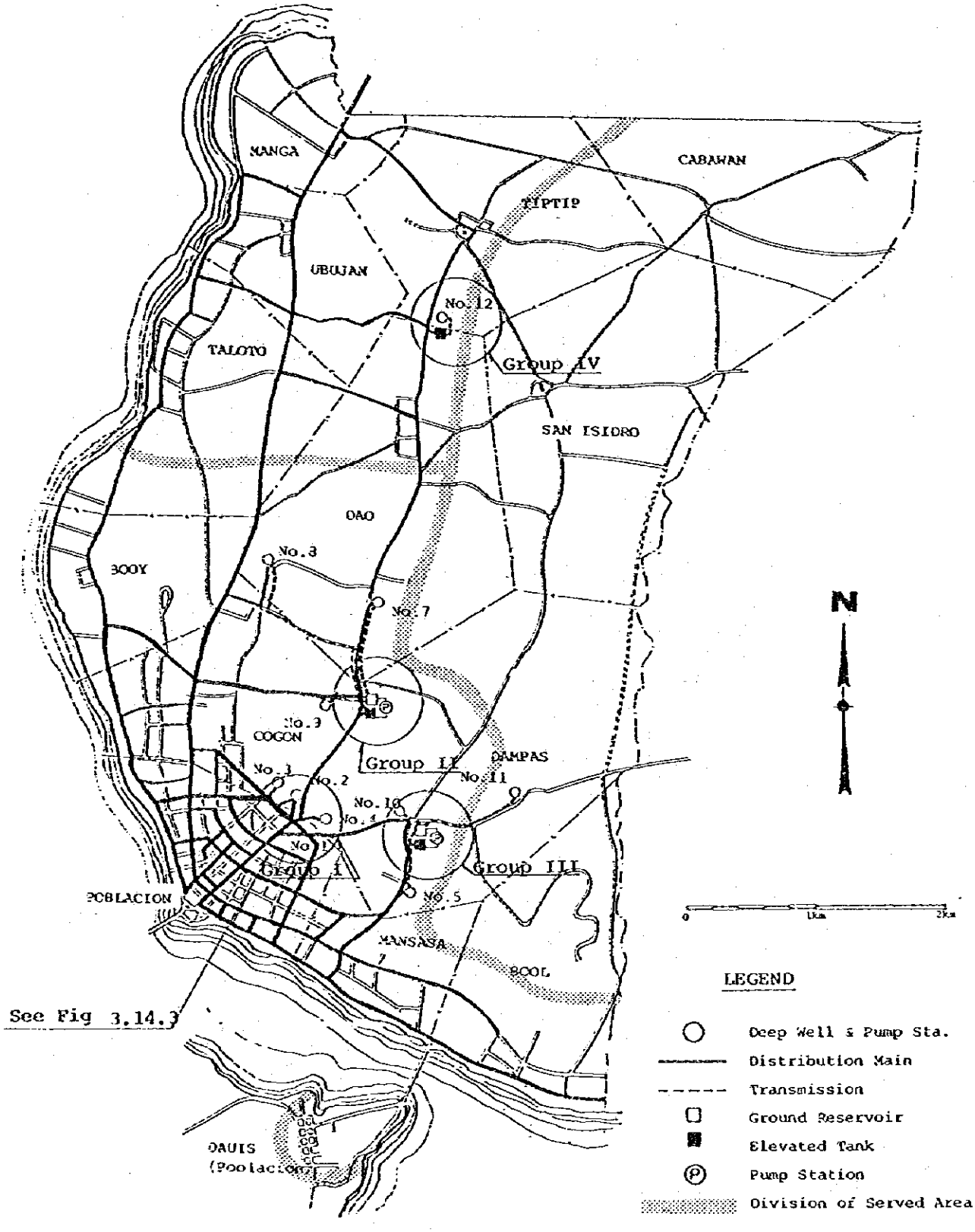


Fig 3.14.2 Proposed Water Supply System for Year 1993

Tagbilaran
(I + II)

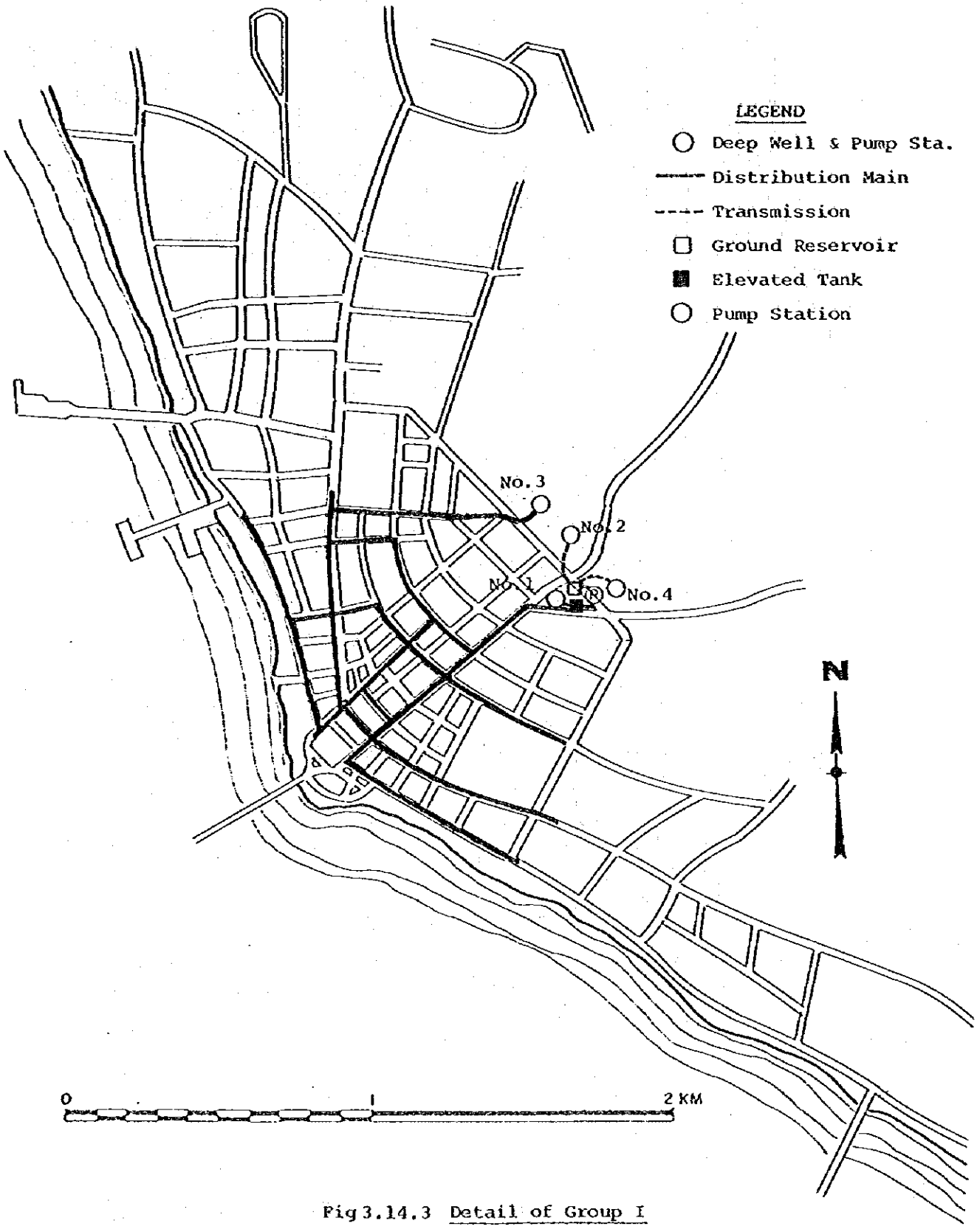


Fig 3.14.3 Detail of Group I

Table 3.14.1 Facilities to be Constructed

Group I Works		
1) Distribution	ø250 mm	L = 1000 m
	ø200 mm	L = 750 m
	ø150 mm	L = 9600 m
	ø100 mm	L = 5300 m
Group II Works		
1) Transmission	ø200 mm	L = 3100 m
2) Ground Reservoir	Reinforced Concrete Made	
	1350 m^3	
	HWL 45 m	
3) Pump Station	62.9 l/s (Capacity)	
	30 m (Total Dynamic Head)	
	Electric Motor Drive	
4) Elevated Tank	Reinforced Concrete Made	
	100 m^3	
	HWL 65 m	
5) Distribution	ø250 mm	L = 2500 m
	14.5 l/s (Capacity)	
	70 m (Total Dynamic Head)	
Group III Works		
1) Deep Well	ø250 mm (Casing Diameter)	
	60 m (Depth)	
2) Deep Well Pump Sta.	14.5 l/s (Capacity)	
	29 KW	
	Electric Motor Drive	
3) Transmission	ø200 mm	L = 1900 m

Tagbilaran
(I + II)

4) Ground Reservoir	Reinforced Concrete Made	
	800 m^3	
	HWL 48 m	
5) Pump Station	39.1 l/s (Capacity)	
	30 m (Total Dynamic Head)	
	Electric Motor Drive	
6) Elevated Tank	Reinforced Concrete Made	
	HWL 65 m, 100 m^3	
7) Distribution	ø200 mm	L = 1750 m

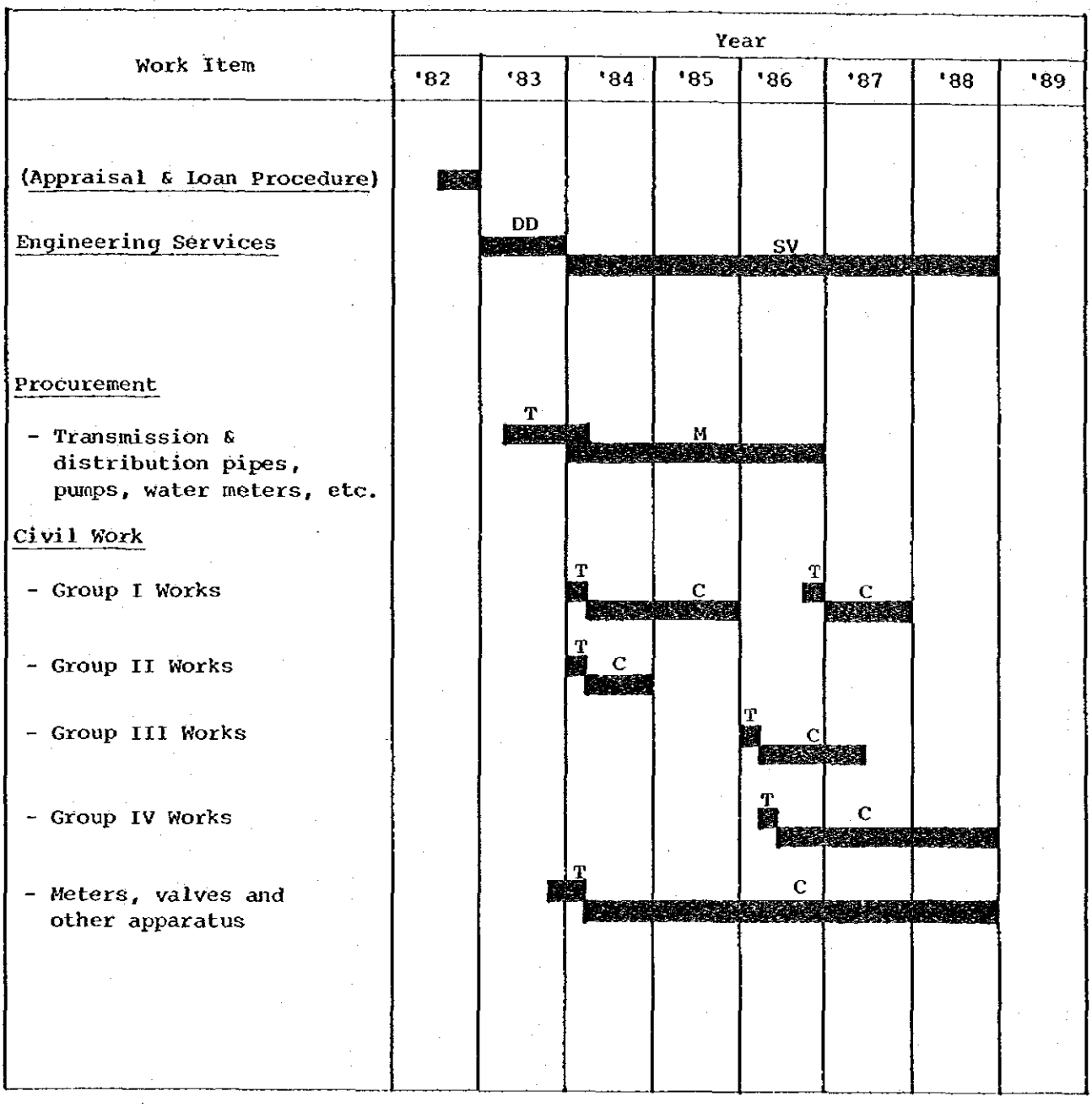
Group IV Works

1) Deep Well	ø250 mm (Casing Diameter)	
	50 m (Depth)	
2) Deep Well Pump Sta.	11.6 l/s (Capacity)	
	29 KW	
	Electric Motor Drive	
3) Distribution	ø100 mm	L = 11500 m

Meters, Valves and Other Appurtenances

1) Water Meter	ø13 mm	1800 pcs.
2) Water Meter & Connection	ø13 mm	5960 pcs.
3) Bulk Meter	ø250 mm	3 pcs.
	ø200 mm	9 pcs.
	ø150 mm	7 pcs.
	ø100 mm	2 pcs.
4) Chlorinator		4 pcs.
5) Fire Hydrant		127 pcs.
6) Valve	ø250 mm	12 pcs.
	ø200 mm	13 pcs.
	ø150 mm	32 pcs.
	ø100 mm	56 pcs.
7) Pressure Gauge		10 pcs.

Fig 3.14.4 Construction Schedule



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

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(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. Group I Works	4,457	2,987	1,470
B. Group II Works	5,425	2,817	2,608
C. Group III Works	4,090	1,968	2,122
D. Group IV Works	2,645	1,645	1,000
E. Meters, Valves and Other Appurtenances	6,370	4,742	1,628
Sub Total	22,987	14,159	8,828
Detailed Design Cost (10.5%)	2,414	1,448	966
Supervision Cost (3.5 %)	805	483	322
Land Cost	71	-	71
Total	26,277	16,090	10,187
Physical Contingency (10 %)	2,628	1,609	1,019
Total	28,905	17,699	11,206
Price Contingency	22,286	13,887	8,399
Grand Total (Project Cost)	51,191 (Equivalent to US$6.56 M)	31,586 (Equivalent to US$4.05M)	19,605 (Equivalent to US$2.51 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. Group I Works															
a) Distribution ø250 mm x 1,000 m	570	382	188			382	188								
b) ø200 mm x 750 m	292	196	96									196	96		
c) ø150 mm x 9,600 m	2,641	1,770	871			1,493	735					277	136		
d) ø100 mm x 5,300 m	954	639	315					398	196			241	119		
B. Group II Works															
a) Transmission (ø200 mm x 3,100 mm)	1,209	810	399			810	399								
b) Ground Reservoir (1,350 m³)	1,372	343	1,029			343	1,029								
c) Pump Station (62.9 ℓ/s)	879	527	352			527	352								
d) Elevated Tank (100 m³)	407	102	305			102	305								
e) Distribution (ø250 mm x 2,500 m)	1,425	955	470			955	470								
f) Pump for No. 8 Well (14.5 ℓ/s)	133	80	53			80	53								
C. Group III Works															
a) Deep Well (ø250 mm x 60 m)	275	80	195							80	195				
b) Deep Well Pump Sta. (14.5 ℓ/s)	340	190	150							190	150				
c) Transmission (ø200 mm x 1,900 m)	741	496	245							496	245				
d) Ground Reservoir (800 m³)	982	246	736							246	736				
e) Pump Station (39.1 ℓ/s)	662	397	265							397	265				
f) Elevated Tank (100 m³)	407	102	305							102	305				
g) Distribution (ø200 mm x 1,750 m)	683	457	226									457	226		

(to be continued)

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
D. Group IV Works															
a) Deep Well (ø250 mm x 50 m)	235	68	167							68	167				
b) Deep Well Pump Sta. (11.6 ℓ/s)	340	190	150							95	75	95	75		
c) Distribution (ø100 mm x 11,500 m)	2,070	1,387	683											1,387	683
E. Meters, Valves and Other Appurtenances															
a) Water Meter (ø13 mm x 1,813 pcs)	272	209	63			209	63								
b) Water Meter & Connection (ø13 mm x 5,957 pcs)	3,872	2,981	891			604	181	425	127	651	194	651	194	650	195
c) Bulk Meter (ø250 mm x 3 pcs)	30	24	6			24	6								
d) Bulk Meter (ø200 mm x 9 pcs)	90	72	18			13	5			59	13				
e) Bulk Meter (ø150 mm, ø100 mm) x 9 pcs	60	48	12			38	9							10	3
f) Chlorinator (4 pcs)	40	36	4			18	2			9	1			9	1
g) Fire Hydrant (127 pcs)	901	594	307			411	212			92	48	91	47		
h) Valve (ø250 mm x 12 pcs)	100	73	27			73	27								
i) Valve (ø200 mm x 13 pcs)	79	58	21			13	5			32	11	13	5		
j) Valve (ø200 mm x 32 pcs)	136	99	37			84	31					15	6		
k) Valve (ø100 mm x 56 pcs)	188	137	51					27	10			17	6	93	35
l) Pressure Gauge (10 pcs)	3	2	1			2	1								

(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	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
m) Vehicle (3 cars)	210	105	105			70	70			35	35				
n) Stored Materials	389	304	85			179	50					125	35		
Sub-Total	22,987	14,159	8,828	0	0	6,430	4,193	850	333	2,552	2,440	2,178	945	2,149	917
Detailed Design Cost (10.5%)	2,414	1,448	966	1,448	966										
Supervision Cost (3.5%)	805	483	322			175	116	44	29	88	59	88	59	88	59
Land Cost	71	0	71			0	37			0	24			0	10
Total	26,277	16,090	10,187	1,448	966	6,605	4,346	894	362	2,640	2,523	2,266	1,004	2,237	986
Physical Contingency (10%)	2,628	1,609	1,019	145	97	660	435	89	36	264	252	227	100	224	99
Total	28,905	17,699	11,206	1,593	1,063	7,265	4,781	983	398	2,904	2,775	2,493	1,104	2,461	1,085
Price Contingency	22,286	13,887	8,399	514	343	3,784	2,490	691	280	2,636	2,519	2,834	1,255	3,428	1,512
Grand Total (Project Cost)	51,191	31,586	19,605	2,107	1,406	11,049	7,271	1,674	678	5,540	5,294	5,327	2,359	5,889	2,597

FINANCIAL TABLE 1

TAGBILARAN WATER SUPPLY PROJECT

PORJECT COSTS BY YEAR OF CONSTRUCTION

(₱1,000'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. Vehicles	210	-	140	-	70	-	-
2. Chlorinators	40	-	20	-	10	-	10
3. Wells & Pumps	2,864	-	1,012	-	1,682	170	-
4. Meters & Gauges	4,327	-	1,155	552	917	845	858
5. Distribution System	8,635	-	4,223	594	-	1,748	2,070
6. Transmission System	1,950	-	1,209	-	741	-	-
7. Ground Reservoir	2,354	-	1,372	-	982	-	-
8. Elevated Tank	814	-	407	-	407	-	-
9. Valves	503	-	233	37	43	62	128
10. Fire Hydrants	901	-	623	-	140	138	-
11. Engineering	2,414	2,414	-	-	-	-	-
12. Supervision	805	-	291	73	147	147	147
13. Land	71	-	37	-	24	-	10
14. Stored Materials	389	-	229	-	-	160	-
15. Physical Contingency	2,628	242	1,095	125	516	327	323
16.							
17.							
18.							
TOTAL, 7-1-81	28,905	2,656	12,046	1,381	5,679	3,597	3,546
ESCALATION FACTORS		1.322500	1.520875	1.703380	1.907785	2.136719	2.39312
ESCALATED COSTS	51,191	3,513	18,320	2,352	10,834	7,686	8,486

FINANCIAL TABLE 2

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

I + II

Year	Fixed, 7-1-81 Costs				Escalated Costs	
	Power	Chemicals	Others	Total	Factor 1/	Amount
1981	239	69	354	662	1.000000	662
1982	247	71	352	670	1.150000	771
1983	257	74	344	675	1.322500	893
1984	267	77	336	680	1.520875	1,034
1985	269	77	397	743	1.703380	1,266
1986	283	81	416	780	1.907785	1,488
1987	300	86	439	825	2.136719	1,763
1988	315	91	508	914	2.393126	2,187
1989	332	96	562	990	2.680301	2,653
1990	351	101	606	1,058	2.948331	3,119
1991	370	107	655	1,132	3.243164	3,671
1992	392	113	703	1,208	3.567480	4,310
1993	414	119	752	1,285	3.924228	5,043
1994	414	119	752	1,285	4.316651	5,547
1995	414	119	752	1,285	4,748316	6,102
1996	414	119	752	1,285	5.223148	6,712
1997	414	119	752	1,285	5.745463	7,383
1998	414	119	752	1,285	6.320009	8,121

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

TAGBILARAN WATER SUPPLY PROJECT
LOAN DISBURSEMENTS AND DEBT SERVICE
(₱1,000's)

I + II

Year	Disbursement 1/		Loans Outstanding		Interest Payments		Principal Payments 3/	Total Debt Service
	Grant	Loan	Beginning	Ending	First Year 2/	Later Years		
1981								
1982								
1983	878	2,635		2,635	118			118
1984	4,580	13,740	2,635	16,375	618	237		855
1985	588	1,764	16,375	18,139	79	1,473		1,552
1986	2,708	8,126	18,231	26,265	365	1,631		1,996
1987	1,922	5,764	26,254	32,029	259	2,362		2,621
1988	2,121	6,365	32,018	38,394	286	2,880		3,166
1989			38,394	38,286		3,450	108	3,558
1990			38,286	37,606		3,427	680	4,107
1991			37,606	36,854		3,366	752	4,118
1992			36,854	35,764		3,292	1,090	4,382
1993			35,764	34,434		3,187	1,330	4,517
1994			34,434	32,840		3,062	1,594	4,656
1995			32,840	31,246		2,920	1,594	4,514
1996			31,246	29,652		2,778	1,594	4,372
1997			29,652	28,058		2,633	1,594	4,227
1998			28,058	26,464		2,489	1,594	4,083

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

TAGBILARAN WATER SUPPLY PROJECT

CASH REQUIREMENTS PER REVENUE UNIT

(₱1,000's)

I + II

Year	Debt Service	O & M	Total Costs	Estimated Reserves 1/	Cost With Reserves	Revenue Units 2/	Cost Per Revenue Unit 3/
1981		662	662		662	1,714	0.39
1982		771	771		771	1,832	0.42
1983	118	893	1,011		1,011	1,916	0.53
1984	855	1,034	1,889		1,889	2,130	0.89
1985	1,552	1,266	2,818		2,818	2,235	1.26
1986	1,996	1,488	3,484		3,484	2,386	1.46
1987	2,621	1,763	4,384		4,384	2,560	1.71
1988	3,166	2,187	5,353		5,353	2,776	1.93
1989	3,558	2,653	6,211	311	6,522	3,014	2.16
1990	4,107	3,119	7,226	361	7,587	3,275	2.32
1991	4,118	3,671	7,789	779	8,568	3,557	2.41
1992	4,382	4,310	8,692	869	9,561	3,829	2.50
1993	4,517	5,043	9,560	956	10,516	4,064	2.59
1994	4,656	5,547	10,203	1,020	11,223	4,064	2.76
1995	4,514	6,102	10,616	1,062	11,678	4,064	2.87
1996	4,372	6,712	11,084	1,108	12,192	4,064	3.00
1997	4,227	7,383	11,610	1,161	12,771	4,064	3.14
1998	4,083	8,121	12,204	1,220	13,424	4,064	3.30

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

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

3/ Reserve units divided into costs with reserves.

FINANCIAL TABLE 5 - A

TAGBILARAN WATER SUPPLY PROJECT

ABILITY TO PAY FOR WATER

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	724.56	36.23	5.73	84	14	29	1.25
1982	833.24	41.66	5.72	84	14	29	1.44
1983	958.23	47.91	5.71	83	14	29	1.65
1984	1,101.96	55.10	5.70	82	14	29	1.90
1985	1,234.19	61.71	5.69	85	15	30	2.06
1986	1,382.29	69.11	5.68	89	15	30	2.30
1987	1,548.17	77.41	5.67	93	16	31	2.50
1988	1,733.95	86.70	5.66	94	16	31	2.80
1989	1,942.03	97.10	5.65	97	16	31	3.13
1990	2,136.23	106.81	5.64	98	17	32	3.34
1991	2,349.85	117.49	5.63	101	17	32	3.67
1992	2,584.84	129.24	5.62	102	17	32	4.04
1993	2,843.32	142.17	5.60	102	17	32	4.44

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

TAGBILARAN 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	3,127.67	156.38	5.60	102	17	32	4.89
1995	3,440.42	172.02	5.60	102	17	32	5.38
1996	3,784.46	189.22	5.60	102	17	32	5.91
1997	4,162.90	208.15	5.60	102	17	32	6.50
1998	4,579.20	228.96	5.60	102	17	32	7.15

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

TAGBILARAN WATER SUPPLY PROJECT I + II
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

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	1,714	1.10	1,885	95	1,791	662		662	1,129	1,129
1982	1,832	1.10	2,015	95	1,914	771		771	1,143	2,272
1983	1,916	1.45	2,778	95	2,639	1,011		1,011	1,628	3,900
1984	2,130	1.45	3,089	96	2,965	1,889		1,889	1,076	4,976
1985	2,235	1.45	3,241	96	3,111	2,818		2,818	293	5,269
1986	2,386	1,80	4,295	96	4,123	3,484		3,484	639	5,908
1987	2,560	1.80	4,608	97	4,470	4,384		4,384	86	5,994
1988	2,776	1.80	4,997	97	4,847	5,353		5,353	-506	5,488
1989	3,014	2.20	6,631	97	6,432	6,211	332	6,543	-111	5,377
1990	3,275	2.20	7,205	98	7,061	7,226	360	7,586	-525	4,852
1991	3,557	2.20	7,825	98	7,669	7,789	783	7,572	-903	3,949
1992	3,829	2.50	9,573	98	9,381	7,692	957	9,649	-268	3,681
1993	4,064	2.50	10,160	98	9,957	9,560	1,016	10,576	-619	3,062

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

TAGBILARAN 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	4,064	2.75	11,176	98	10,952	10,203	1,118	11,321	-369	2,693
1995	4,064	2.75	11,176	98	10,952	10,616	1,118	11,734	-782	1,909
1996	4,064	3.00	12,192	98	11,948	11,084	1,219	12,303	-355	1,554
1997	4,064	3.00	12,192	98	11,948	11,610	1,219	12,829	-881	673
1998	4,064	3.25	13,208	98	12,944	12,204	1,321	13,525	-581	92

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

TAGBILARAN 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	27.50	1.32	1.54	1.87	1.10
1982	27.50	1.32	1.54	1.87	1.10
1983	36.25	1.74	2.03	2.47	1.45
1984	36.25	1.74	2.03	2.47	1.45
1985	36.25	1.74	2.03	2.47	1.45
1986	45.00	2.16	2.52	3.06	1.80
1987	45.00	2.16	2.52	3.06	1.80
1988	45.00	2.16	2.52	3.06	1.80
1989	55.00	2.64	3.08	3.74	2.20
1990	55.00	2.64	3.08	3.74	2.20
1991	55.00	2.64	3.08	3.74	2.20
1992	62.50	3.00	3.50	4.25	2.50
1993	62.50	3.00	3.50	4.25	2.50

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

TAGBILARAN 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	2,528	9.7	24,600	105	944	45	1,716
1982	2,818	9.0	25,500	105	1,012	43	1,776
1983	3,255	8.7	28,050	105	1,075	40	1,792
1984	3,783	8.3	30,900	105	1,185	40	1,975
1985	4,129	8.0	32,400	110	1,242	40	2,070
1986	4,337	7.7	33,000	115	1,324	37	2,102
1987	4,585	7.3	33,640	116	1,423	34	2,156
1988	5,030	7.1	35,700	118	1,543	32	2,269
1989	5,525	6.9	38,000	121	1,676	30	2,394
1990	6,160	6.5	40,000	123	1,819	28	2,526
1991	6,865	6.3	42,900	126	1,971	26	2,663
1992	7,640	6.0	45,600	128	2,117	25	2,823
1993	8,485	5.7	48,240	127	2,236	25	2,981

1/ Liters per capita per day.

FINANCIAL TABLE 9A

TAGBILARAN WATER SUPPLY PROJECT

CALCULATION OF REVENUE UNITS

I + II

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	643	1,478	19	2	2,142	330	34	20	2	386	2,528
1982	729	1,676	22	2	2,429	332	35	20	2	389	2,818
1983	855	1,962	24	3	2,844	351	36	22	2	411	3,255
1984	903	2,076	27	3	3,009	337	36	20	2	395	3,404
1985	1,002	2,305	30	3	3,340	340	36	20	2	398	3,738
1986	1,113	2,560	33	4	3,710	342	36	20	3	401	4,111
1987	1,254	2,884	38	4	4,180	346	36	20	3	405	4,585
1988	1,380	3,174	41	5	4,600	367	39	21	3	430	5,030
1989	1,521	3,498	46	5	5,070	389	41	22	3	455	5,525
1990	1,704	3,919	51	6	5,680	410	43	24	3	480	6,160
1991	1,908	4,388	57	7	6,360	431	45	25	4	505	6,865
1992	2,133	4,906	64	7	7,110	453	48	25	4	530	7,640
1993	2,379	5,472	71	8	7,930	474	50	27	4	555	8,485

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	643	3,695	76	16	4,430	1,650	272	320	80	2,322	6,572
1982	729	4,190	88	16	5,023	1,660	280	320	80	2,340	7,363
1983	813	4,673	96	24	5,606	1,675	280	320	80	2,355	7,961
1984	903	5,190	108	24	6,225	1,685	288	320	80	2,373	8,598
1985	1,002	5,763	120	24	6,909	1,700	288	320	80	2,388	9,297
1986	1,113	6,400	132	32	7,677	1,710	288	320	120	2,438	10,115
1987	1,254	7,210	152	32	8,648	1,730	288	320	120	2,458	11,106
1988	1,380	7,935	164	40	9,519	1,835	312	336	120	2,603	12,122
1989	1,521	8,745	184	40	10,490	1,945	328	352	120	2,745	13,235
1990	1,704	9,798	204	48	11,754	2.050	344	384	120	2,898	14,652
1991	1,908	10,970	228	56	13,162	2,155	360	400	160	3,075	16,237
1992	2,133	12,265	256	56	14,710	2,265	384	400	160	3,209	17,919
1993	2,379	13,680	284	64	16,407	2,370	400	432	160	3,362	19,769

FINANCIAL TABLE 9B1

TAGBILARAN 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	840	257	583	257	308	326	456	-	-	764
1982	901	292	609	292	350	317	444	-	-	794
1983	957	341	616	341	409	275	385	-	-	794
1984	1,055	361	694	361	433	333	466	-	-	899
1985	1,105	401	704	401	481	303	424	-	-	905
1986	1,178	445	733	445	534	288	403	-	-	937
1987	1,267	502	765	502	602	263	368	-	-	970
1988	1,373	552	821	552	662	269	377		-	1,039
1989	1,492	608	884	608	730	276	386	-	-	1,116
1990	1,619	682	937	682	818	255	357	-	-	1,175
1991	1,754	763	991	763	916	228	319	-	-	1,235
1992	1,884	853	1,031	853	1,024	178	249	-	-	1,273
1993	1,990	952	1,038	952	1,142	86	120	-	-	1,262

FINANCIAL TABLE 9B2

TAGBILARAN 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	104	46	58	58	139	-	-	-	-	139
1982	111	47	64	64	154	-	-	-	-	154
1983	118	49	69	69	166	-	-	-	-	166
1984	130	47	83	83	199	-	-	-	-	199
1985	137	48	89	89	214	-	-	-	-	214
1986	146	48	98	98	235	-	-	-	-	235
1987	156	49	107	107	257	-	-	-	-	257
1988	170	52	118	118	283	-	-	-	-	283
1989	184	55	129	129	310	-	-	-	-	310
1990	200	58	142	142	341	-	-	-	-	341
1991	217	61	156	156	374	-	-	-	-	374
1992	233	64	169	169	406	-	-	-	-	406
1993	246	67	179	179	430	-	-	-	-	430

FINANCIAL TABLE 9C

SUMMARY OF REVENUE UNITS

I + II

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	4,430	532	764	1,296	2,322	279	139	418	1,714
1982	5,023	603	794	1,397	2,340	281	154	435	1,832
1983	5,606	673	794	1,467	2,355	283	166	449	1,916
1984	6,225	747	899	1,646	2,373	285	199	484	2,130
1985	6,909	829	905	1,734	2,388	287	214	501	2,235
1986	7,677	921	937	1,858	2,438	293	235	528	2,386
1987	8,648	1,038	970	2,008	2,458	295	257	552	2,560
1988	9,519	1,142	1,039	2,181	2,603	312	283	595	2,776
1989	10,490	1,259	1,116	2,375	2,745	329	310	639	3,014
1990	11,754	1,411	1,175	2,586	2,898	348	341	689	3,275
1991	13,162	1,579	1,235	2,814	3,075	369	374	743	3,557
1992	14,710	1,765	1,273	3,038	3,209	385	406	791	3,829
1993	16,407	1,969	1,262	3,231	3,362	403	430	833	4,064

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ECONOMIC TABLE 1

TAGBILARAN WATER SUPPLY PROJECT

SUMMARY OF PROJECT COST

Costs as of July 1, 1981 in 1,000 Pesos I + II

Components	Total Cost	Foreign Currency Portion	Local Currency Portion
1. Vehicles	210	105	105
2. Chlorinators	40	36	4
3. Wells & Pumps	2,864	1,532	1,332
4. Meters & Gauges	4,327	3,337	990
5. Distribution System	8,635	5,786	2,849
6. Transmission System	1,950	1,306	644
7. Ground Reservoir	2,354	589	1,765
8. Elevated Tank	814	204	610
9. Valves	503	367	136
10. Fire Hydrants	901	594	307
11. Engineering	2,414	1,448	966
12. Supervision	805	483	322
13. Land	71	-	71
14. Stored Materials	389	304	85
15.			
16.			
17.			

Source: From Cost Estimates

ECONOMIC TABLE 2

TAGBILARAN WATER SUPPLY PROJECT

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

I + II

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	2,528	9.7	24,600	105	944	-	45	1,716
1982	2,818	9.0	25,500	105	1,012	-	43	1,776
1983	3,255	9.7	28,050	105	1,075	-	40	1,792
1984	3,783	8.3	30,900	105	1,185	110	40	1,975
1985	4,129	8.0	32,400	110	1,242	167	40	2,070
1986	4,337	7.7	33,000	115	1,324	249	37	2,102
1987	4,585	7.3	33,640	116	1,423	348	34	2,156
1988	5,030	7.1	35,700	118	1,543	468	32	2,269
1989	5,525	6.9	38,000	121	1,676	601	30	2,394
1990	6,160	6.5	40,000	123	1,819	744	28	2,526
1991	6,865	6.3	42,900	126	1,917	842	26	2,663
1992	7,640	6.0	45,600	128	2,117	1,042	25	2,823
1993	8,485	5.7	48,240	127	2,236	1,161	25	2,981

ECONOMIC TABLE 3-A

TAGBILARAN WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

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

I + II

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. Vehicles	105	105	-	105	131.3	-	99.8	231.1
2. Chlorinators	36	4	0.4	3.6	45	0.2	3.4	48.6
3. Wells & Pumps	1,532	1,332	661	661	1,915	330.5	627.9	2,873.4
4. Meters & Gauges	3,337	990	198	792	4,171.3	99	752.4	5,022.7
5. Distribution System	5,786	2,849	569.8	2,279.2	7,232.5	284.9	2,165.2	9,682.6
6. Transmission System	1,306	644	161	483	1,632.5	805	458.9	2,171.9
7. Ground Reservoir	589	1,765	1,147.3	617.7	736.3	573.7	586.8	1,897.1
8. Elevated Tank	204	610	396.5	213.5	255	198.25	202.8	665.05
9. Valves	367	136	54.4	81.6	458.8	27.2	77.5	563.5
10. Fire Hydrants	594	307	122.8	184.2	742.5	61.4	175	978.9
11. Engineering	1,448	966	-	966	1,810	-	917.7	2,727.7
12. Supervision	483	322	-	322	603.8	-	305.9	909.7
13. Lands	-	71	-	71	-	-	67.5	67.5
14. Stored Materials	304	85	-	85	380	-	81	461
15.								
16.								
17.								

ECONOMIC TABLE 3-B

TAGBILARAN WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

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

I + II

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. Vehicles	105	105	-	105	105	-	99.8	204.8
2. Chlorinators	36	4	0.4	3.6	36	0.2	3.4	39.6
3. Wells & Pumps	1,532	1,322	661	661	1,532	330.5	627.9	2,490.4
4. Meters & Gauges	3,337	990	198	792	3,337	99	752.4	4,188.4
5. Distribution System	5,786	2,849	569.8	2,279.2	5,786	284.9	2,165.2	8,236.1
6. Transmission System	1,306	644	161	483	1,306	805	458.9	1,845.4
7. Ground Reservoir	589	1,765	1,147.3	617.7	589	573.7	586.8	1,749.5
8. Elevated Tank	204	610	396.5	213.5	204	198.25	202.8	605.1
9. Valves	367	136	54.4	81.6	367	27.2	77.5	471.7
10. Fire Hydrants	594	307	122.8	184.2	594	61.4	175	830.4
11. Engineering	1,448	966	-	966	1,448	-	917.7	2,365.7
12. Supervision	483	322	-	322	483	-	305.9	788.9
13. Lands	-	71	-	71	-	-	67.5	67.5
14. Stored Materials	304	85	-	85	304	-	81	385
15.								
16.								
17.								

ECONOMIC TABLE 3-C

TAGBILARAN WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

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

I + II

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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. Vehicles	105	105	-	105	131.3	-	105	236.3
2. Chlorinators	36	4	0.4	3.6	45	0.4	3.6	49
3. Wells & Pumps	1,532	1,322	661	661	1,915	661	661	3,237
4. Meters & Gauges	3,337	990	198	792	4,171.3	198	792	5,161.3
5. Distribution System	5,786	2,849	569.8	2,279.2	7,232.5	569.8	2,279.2	10,081.5
6. Transmission System	1,306	644	161	483	1,632.5	161	483	2,276.5
7. Ground Reservoir	589	1,765	1,147.3	61.7	736.3	1,147.3	61.7	1,945.3
8. Elevated Tank	204	610	396.5	213.5	255	396.5	213.5	865
9. Valves	367	136	54.4	81.6	458.8	54.4	81.6	594.8
10. Fire Hydrants	594	307	122.8	184.2	742.5	122.8	184.2	1,049.5
11. Engineering	1,448	966	-	966	1,810	-	966	2,776
12. Supervision	483	322	-	322	603.8	-	322	925.8
13. Lands	-	71	-	71	-	-	71	71
14. Stored Materials	304	85	-	85	380	-	85	465
15.								
16.								
17.								

ECONOMIC TABLE 4-0

TAGBILARAN WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

I + II

Value without CONVERSION

Components	Total	1983	1984	1985	1986	1987	1988
1. Vehicles	210	-	140	-	70	-	-
2. Chlorinators	40	-	20	-	10	-	10
3. Wells & Pumps	2,864	-	1,012	-	1,682	170	-
4. Meters & Gauges	4,327	-	1,155	552	917	845	858
5. Distribution System	8,635	-	4,223	594	-	1,748	2,070
6. Transmission System	1,950	-	1,209	-	741	-	-
7. Ground Reservoir	2,354	-	1,372	-	982	-	-
8. Elevated Tank	814	-	407	-	407	-	-
9. Valves	503	-	233	37	43	62	128
10. Fire Hydrants	901	-	623	-	140	138	-
11. Engineering	2,414	2,414	-	-	-	-	-
12. Supervision	805	-	291	73	147	147	147
13. Land	71	-	37	-	24	-	10
14. Stored Materials	389	-	229	-	-	160	-
15.							
16.							
17.							
18.							
Total	26,277	2,414	10,951	1,256	5,163	3,270	3,223

ECONOMIC TABLE 4-A

TAGBILARAN 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. Vehicles	231	-	155	-	76	-	-
2. Chlorinators	49	-	25	-	12	-	12
3. Wells & Pumps	2,873	-	1,006	-	1,695	172	-
4. Meters & Gauges	5,023	-	1,341	641	1,064	981	996
5. Distribution System	9,683	-	4,744	678	-	1,937	2,324
6. Transmission System	2,172	-	1,347	-	825	-	-
7. Ground Reservoir	1,897	-	1,100	-	797	-	-
8. Elevated Tank	656	-	328	-	328	-	-
9. Valves	564	-	259	39	51	68	147
10. Fire Hydrants	979	-	675	-	157	147	-
11. Engineering	2,728	2,728	-	-	-	-	-
12. Supervision	910	-	328	90	164	164	164
13. Land	68	-	35	-	23	-	10
14. Stored Materials	461	-	271	-	-	190	-
15.							
16.							
17.							
18.							
Total	28,294	2,728	11,614	1,448	5,192	3,659	3,653

ECONOMIC TABLE 4-B

TAGBILARAN WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000 I + II

Value with CONVERSION B

Components	Total	1983	1984	1985	1986	1987	1988
1. Vehicles	205	–	137	–	68	–	–
2. Chlorinators	40	–	20	–	10	–	10
3. Wells & Pumps	2,490	–	872	–	1,469	149	–
4. Meters & Gauges	4,188	–	1,118	534	888	818	830
5. Distribution System	8,236	–	4,036	577	–	1,647	1,976
6. Transmission System	1,845	–	1,144	–	701	–	–
7. Ground Reservoir	1,750	–	1,015	–	735	–	–
8. Elevated Tank	605	–	303	–	302	–	–
9. Valves	472	–	217	33	42	57	123
10. Fire Hydrants	830	–	573	–	133	124	–
11. Engineering	2,366	2,366	–	–	–	–	–
12. Supervision	789	–	284	79	142	142	142
13. Lands	68	–	35	–	23		10
14. Stored Materials	385		227			158	
15.							
16.							
17.							
18.							
Total	24,269	2,366	9,981	1,223	4,513	3,095	3,091

ECONOMIC TABLE 4-C

TAGBILARAN 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. Vehicles	236	-	158	-	78	-	-
2. Chlorinators	49	-	25	-	12	-	12
3. Wells & Pumps	3,237	-	1,133	-	1,910	194	-
4. Meters & Gauges	5,161	-	1,378	658	1,094	1,008	1,023
5. Distribution System	10,082	-	4,940	706	-	2,016	2,420
6. Transmission System	2,277	-	1,412	-	865	-	-
7. Ground Reservoir	1,945	-	1,128	-	817	-	-
8. Elevated Tank	865	-	433	-	432	-	-
9. Valves	595	-	274	42	54	71	154
10. Fire Hydrants	1,050	-	725	-	168	157	-
11. Engineering	2,776	2,776	-	-	-	-	-
12. Supervision	926	-	333	92	167	167	167
13. Lands	71	-	37	-	24	-	10
14. Stored Materials	465	-	274	-	-	191	-
15.							
16.							
17.							
18.							
Total	29,735	2,776	12,250	1,498	5,621	3,804	3,786

ECONOMIC TABLE 5

TAGBILARAN WATER SUPPLY PROJECT

OPERATION AND MAINTENANCE EXPENSES

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

I + II

Year	Power	Chemicals	Others	Total	Net Costs
1981	239	69	354	662	
1982	247	71	352	670	
1983	257	74	344	675	5
1984	267	77	336	680	10
1985	269	77	397	743	73
1986	283	81	416	780	110
1987	300	86	439	825	155
1988	315	91	508	914	244
1989	332	96	562	990	320
1990	351	101	606	1,058	388
1991	370	107	655	1,132	462
1992	392	113	703	1,208	538
1993	414	119	752	1,285	615

Base Year = 1983

ECONOMIC TABLE 6-0

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

Value without CONVERSION

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Vehicles	210				210
2. Chlorinators	40				40
3. Wells & Pumps		2,864			2,864
4. Meters & Gauges		4,327			4,327
5. Distribution System			8,635		8,635
6. Transmission System			1,950		1,950
7. Ground Reservoir			2,354		2,354
8. Elevated Tank			814		814
9. Valves			503		503
10. Fire Hydrants			901		901
11. Land				71	71
12. Stored Materials	389				389

7 Year Items	Years of Installation					Years of Replacement					
1. Vehicles	1984	1986				1991	1993	1998	2000	2005	200 201
2. Chlorinators	1984	1986	1988			1991	1993	1995	1998	2000	200 200 201
3. Stored Materials	1984	1987				1991	1994	1998	2001	2005	
						2008	2012				

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

ECONOMIC TABLE 6-A

TAGBILARAN WATER SUPPLY PROJECT
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. Vehicles	231				231
2. Chlorinators	49				49
3. Wells & Pumps		2,873			2,873
4. Meters & Gauges		5,023			5,023
5. Distribution System			9,683		9,683
6. Transmission System			2,172		2,172
7. Ground Reservoir			1,897		1,897
8. Elevated Tank			656		656
9. Valves			564		564
10. Fire Hydrants			979		979
11. Land				68	68
12. Stored Materials	461				461

7 Year Items	Years of Installation					Years of Replacement					
1. Vehicles	1984	1986				1991	1993	1998	2000	2005	2007 2012
2. Chlorinators	1984	1986	1988			1991	1993	1995	1998	2000	2002 2004
3. Stored Materials	1984	1987				1991	1994	1998	2001	2005	2012
						2008	2012				

15 Year Items	Years of Installation					Years of Replacement				
1. Wells & Pumps	1984	1986	1987			1999	2001	2002		
2. Meters & Gauges	1984	1985	1986	1987	1988	1999	2000	2001	2002	

Tagbilaran

I + II

ECONOMIC TABLE 6-B

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

Value with CONVERSION B

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Vehicles	205				205
2. Chlorinators	40				40
3. Wells & Pumps		2,490			2,490
4. Meters & Gauges		4,188			4,188
5. Distribution System			8,236		8,236
6. Transmission System			1,845		1,845
7. Ground Reservoir			1,750		1,750
8. Elevated Tank			605		605
9. Valves			472		472
10. Fire Hydrants			830		830
11. Lands				68	68
12. Stored Materials	385				385

7 Year Items	Years of Installation					Years of Replacement					
1. Vehicles	1984	1986				1991	1993	1998	2000	2005	200 201
2. Chlorinators	1984	1986	1988			1991	1993	1995	1998	2000	
						2002	2005	2007	2009	2012	
3. Stored Materials	1984	1987				1991	1994	1998	2001	2005	200 201

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

ECONOMIC TABLE 6-C

I + II

TAGBILARAN 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. Vehicles	236				236
2. Chlorinators	49				49
3. Wells & Pumps		3,237			3,237
4. Meters & Gauges		5,161			5,161
5. Distribution System			10,082		10,082
6. Transmission System			2,277		2,277
7. Ground Reservoir			1,945		1,945
8. Elevated Tank			865		865
9. Valves			595		595
10. Fire Hydrants			1,050		1,050
11. Lands				71	71
12. Stored Materials	465				465

7 Year Items	Years of Installation					Years of Replacement					
1. Vehicles	1984	1986				1991	1993	1998	2000	2005	2007 2012
2. Chlorinators	1984	1986	1988			1991	1993	1995	1998	2000	
						2002	2005	2007	2009	2012	
3. Stored Materials	1984	1987				1991	1994	1998	2001	2005	2008 2012

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

I + II

ECONOMIC TABLE 7-0

TAGBILARAN 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			
1984	37		
1986	24 71	75%	53
1988	10		
50 Year Life, Year Constructed			
1 1984	8,067	42%	3,388
2 1985	631	44%	278
3 1986	2,313	46%	1,064
4 1987	1,948	48%	935
5 1988	2,198	50%	1,099
15 Year Life, Year of Replacement			
1 1999	2,167	7%	152
2 2000	552	13%	72
3 2001	2,599	20%	520
4 2002	1,015	27%	274
5 2003	858	33%	283
7 Year Life, Years of Final Replacement			
1 2007	80	14%	11
2 2008	160	29%	46
3 2009	10	43%	4
4 2012	389	86%	335
Total			8,514

ECONOMIC TABLE 7-A

I + II

TAGBILARAN 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			
1984	35		
1986	23 68	75%	51
1988	10		
50 Year Life, Year Constructed			
1 1984	8,453	42%	3,550
2 1985	717	44%	315
3 1986	2,158	46%	993
4 1987	2,152	48%	1,033
5 1988	2,471	50%	1,236
15 Year Life, Year of Replacement			
1 1999	2,347	7%	164
2 2000	641	13%	83
3 2001	2,759	20%	552
4 2002	1,153	27%	311
5 2003	996	33%	329
7 Year Life, Years of Final Replacement			
1 1907	88	14%	12
2 1908	190	29%	55
3 1909	12	43%	5
4 1912	451	86%	388
Total			9,077

I + II

ECONOMIC TABLE 7-B

TAGBILARAN 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			
1984	35		
1986	23 68	75%	51
1988	10		
50 Year Life, Year Constructed			
1 1984	7,288	42%	3,061
2 1985	610	44%	268
3 1986	1,913	46%	880
4 1987	1,828	48%	877
5 1988	2,099	50%	1,050
15 Year Life, Year of Replacement			
1 1999	1,990	7%	139
2 2000	534	13%	69
3 2001	2,357	20%	471
4 2002	967	27%	261
5 2003	830	33%	274
7 Year Life, Years of Final Replacement			
1 1907	78	14%	11
2 1908	158	29%	46
3 1909	10	43%	4
4 1912	384	86%	330
Total			7,792

ECONOMIC TABLE 7-C

TAGBILARAN WATER SUPPLY PROJECT

I + II

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			
1984	37		
1986	24 71	75%	53
1988	10		
50 Year Life, Year Constructed			
1 1984	8,912	42%	3,743
2 1985	748	44%	329
3 1986	2,336	46%	1,075
4 1987	2,244	48%	1,077
5 1988	2,574	50%	1,287
15 Year Life, Year of Replacement			
1 1999	2,511	7%	176
2 2000	658	13%	86
3 2001	3,004	20%	601
4 2002	1,202	27%	325
5 2003	1,023	33%	338
7 Year Life, Years of Final Replacement			
1 1907	90	14%	13
2 1908	191	29%	55
3 1909	12	43%	5
4 1912	457	86%	393
Total			9,556

Tagbilaran

I + II

ECONOMIC TABLE 8-0

TAGBILARAN 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	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	2,414	5		2,419		
1984	10,951	10		10,961		
1985	1,328	73		1,401		
1986	5,091	110		5,201		
1987	3,270	155		3,425		
1988	3,223	244		3,467		
1989		320		320		
1990		388		388		
1991		462	389	851		
1992		538		538		
1993		615	80	695		
1994		615	160	775		
1995		615	10	625		
1996		615		615		
1997		615		615		
1998		615	389	1,004		
1999		615	2,167	2,782		
2000		615	632	1,247		
2001		615	2,759	3,374		
2002		615	1,025	1,640		
2003		615	858	1,473		
2004		615		615		
2005		615	389	1,004		
2006		615		615		
2007		615	80	695		
2008		615	160	775		
2009		615	10	625		
2010		615		615		
2011		615		615		
2012		615	389	1,004		
Total	26,277	14,605	9,497	50,379	(8,514)	41,865

ECONOMIC TABLE 8-A

I + II

TAGBILARAN 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	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	2,728	5		2,733		
1984	11,629	10		11,639		
1985	1,510	73		1,583		
1986	5,082	110		5,192		
1987	3,683	155		3,838		
1988	3,662	244		3,906		
1989		320		320		
1990		388		388		
1991		462	451	913		
1992		538		538		
1993		615	88	703		
1994		615	190	805		
1995		615	12	627		
1996		615		615		
1997		615		615		
1998		615	451	1,066		
1999		615	2,347	2,962		
2000		615	729	1,344		
2001		615	2,949	3,564		
2002		615	1,165	1,780		
2003		615	996	1,611		
2004		615		615		
2005		615	451	1,066		
2006		615		615		
2007		615	88	703		
2008		615	190	805		
2009		615	12	627		
2010		615		615		
2011		615		615		
2012		615	451	1,066		
Total	28,294	14,605	10,570	53,469	(9,077)	44,392

ECONOMIC TABLE 8-B

I + II

TAGBILARAN 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	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	2,366	5		2,371		
1984	9,994	10		10,004		
1985	1,275	73		1,348		
1986	4,421	110		4,531		
1987	3,115	155		3,270		
1988	3,098	244		3,342		
1989		320		320		
1990		388		388		
1991		462	384	846		
1992		538		538		
1993		615	78	693		
1994		615	158	773		
1995		615	10	625		
1996		615		615		
1997		615		615		
1998		615	384	999		
1999		615	1,990	2,605		
2000		615	612	1,227		
2001		615	2,515	3,130		
2002		615	977	1,592		
2003		615	830	1,445		
2004		615		615		
2005		615	384	999		
2006		615		615		
2007		615	78	693		
2008		615	158	773		
2009		615	10	625		
2010		615		615		
2011		615		615		
2012		615	384	999		
Total	24,269	14,605	8,952	47,826	(7,792)	40,034

ECONOMIC TABLE 8-C

I + II

TAGBILARAN 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	2,776	5		2,781		
1984	12,265	10		12,275		
1985	1,563	73		1,636		
1986	5,508	110		5,618		
1987	3,828	155		3,983		
1988	3,795	244		4,039		
1989		320		320		
1990		388		388		
1991		462	457	919		
1992		538		538		
1993		615	90	705		
1994		615	191	806		
1995		615	12	627		
1996		615		615		
1997		615		615		
1998		615	457	1,072		
1999		615	2,511	3,126		
2000		615	748	1,363		
2001		615	3,195	3,810		
2002		615	1,214	1,829		
2003		615	1,023	1,638		
2004		615		615		
2005		615	457	1,072		
2006		615		615		
2007		615	90	705		
2008		615	191	806		
2009		615	12	627		
2010		615		615		
2011		615		615		
2012		615	457	1,072		
Total	29,735	14,605	11,105	55,445	(9,556)	45,889

ECONOMIC TABLE 9

I + II

TAGBILARAN WATER SUPPLY PROJECT
BENEFITS AT 1981 PRICES
(₱ x 1,000)

Year	Volume	Qualitative	Fire Loss Reduction	Total	National Interest Adjustment
1982					
1983					
1984	407	398	206	1,011	1,112
1985	618	795	227	1,640	1,804
1986	921	1,193	250	2,364	2,600
1987	1,288	1,193	280	2,761	3,037
1988	1,732	1,193	308	3,233	3,556
1989	2,224	1,193	339	3,756	4,132
1990	2,753	1,193	379	4,325	4,758
1991	3,115	1,193	424	4,732	5,205
1992	3,855	1,193	472	5,520	6,072
1993	4,296	1,193	526	6,015	6,617
1994	4,296	1,193	526	6,015	6,617
1995	4,296	1,193	526	6,015	6,617
1996	4,296	1,193	526	6,015	6,617
1997	4,296	1,193	526	6,015	6,617
1998	4,296	1,193	526	6,015	6,617
1999	4,296	1,193	526	6,015	6,617
2000	4,296	1,193	526	6,015	6,617
2001	4,296	1,193	526	6,015	6,617
2002	4,296	1,193	526	6,015	6,617
2003	4,296	1,193	526	6,015	6,617
2004	4,296	1,193	526	6,015	6,617
2005	4,296	1,193	526	6,015	6,617
2006	4,296	1,193	526	6,015	6,617
2007	4,296	1,193	526	6,015	6,617
2008	4,296	1,193	526	6,015	6,617
2009	4,296	1,193	526	6,015	6,617
2010	4,296	1,193	526	6,015	6,617
2011	4,296	1,193	526	6,015	6,617
2012	4,296	1,193	526	6,015	6,617
Total	102,833	33,404	13,405	149,642	164,616

ECONOMIC TABLE 10-0

TAGBILARAN WATER SUPPLY PROJECT I + II

INTERNAL RATE OF RETURN COMPUTATION

Cost Value without CONVERSION

Year	Total Cost	Total Benefit	Net Benefit	Present Net Benefit
1982				
1983	2,419	-	-2,419	-2,419
1984	10,961	1,112	-9,849	-8,361
1985	1,401	1,804	403	290
1986	5,201	2,600	-2,601	-1,591
1987	3,425	3,037	-388	-201
1988	3,467	3,556	89	39
1989	320	4,132	3,812	1,427
1990	388	4,758	4,370	1,388
1991	851	5,205	4,354	1,174
1992	538	6,072	5,534	1,267
1993	695	6,617	5,922	1,151
1994	775	6,617	5,842	964
1995	625	6,617	5,992	839
1996	615	6,617	6,002	714
1997	615	6,617	6,002	606
1998	1,004	6,617	5,613	481
1999	2,782	6,617	3,835	279
2000	1,247	6,617	5,370	332
2001	3,374	6,617	3,243	170
2002	1,640	6,617	4,977	221
2003	1,473	6,617	5,144	194
2004	615	6,617	6,002	192
2005	1,004	6,617	5,613	153
2006	615	6,617	6,002	139
2007	695	6,617	5,922	116
2008	775	6,617	5,842	97
2009	625	6,617	5,992	85
2010	615	6,617	6,002	72
2011	615	6,617	6,002	61
2012	1,004	6,617	14,127*	122*
Salvage(-)	8,514			
Total	41,865	164,616	122,751	1

Rate of Return = 0.18

Tagbilaran

ECONOMIC TABLE 10-A

I + II

TAGBILARAN WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION A

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	2,733	-	-2,733	-2,733
1984	11,639	1,112	-10,527	-9,034
1985	1,583	1,804	221	163
1986	5,192	2,600	-2,592	-1,638
1987	3,838	3,037	-801	-434
1988	3,906	3,556	-350	-163
1989	320	4,132	3,812	1,523
1990	388	4,758	4,370	1,498
1991	913	5,205	4,292	1,263
1992	538	6,072	5,534	1,397
1993	703	6,617	5,914	1,281
1994	805	6,617	5,812	1,080
1995	627	6,617	5,990	956
1996	615	6,617	6,002	822
1997	615	6,617	6,002	705
1998	1,066	6,617	5,551	560
1999	2,962	6,617	3,655	316
2000	1,344	6,617	5,273	392
2001	3,564	6,617	3,053	195
2002	1,780	6,617	4,837	265
2003	1,611	6,617	5,006	235
2004	615	6,617	6,002	242
2005	1,066	6,617	5,551	192
2006	615	6,617	6,002	178
2007	703	6,617	5,914	151
2008	805	6,617	5,812	127
2009	627	6,617	5,990	112
2010	615	6,617	6,002	97
2011	615	6,617	6,002	83
2012	1,066	6,617	14,628*	173*
Salvage(-)	9,077			
Total	44,392	164,616	120,224	4

* Values include salvage.

Rate of Return = 0.17

ECONOMIC TABLE 10-B

I + II

TAGBILARAN WATER SUPPLY PROJECT
INTERNAL RATE OF RETURN COMPUTATION

Cost Value, with CONVERSION B

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	2,371	-	-2,371	-2,371
1984	10,004	1,112	-8,892	-7,457
1985	1,348	1,804	456	321
1986	4,531	2,600	-1,931	-1,139
1987	3,270	3,037	-233	-115
1988	3,342	3,556	214	89
1989	320	4,132	3,812	1,326
1990	388	4,758	4,370	1,275
1991	846	5,205	4,359	1,067
1992	538	6,072	5,534	1,136
1993	693	6,617	5,924	1,020
1994	773	6,617	5,844	844
1995	625	6,617	5,992	726
1996	615	6,617	6,002	610
1997	615	6,617	6,002	511
1998	999	6,617	5,618	401
1999	2,605	6,617	4,012	240
2000	1,227	6,617	5,390	271
2001	3,130	6,617	3,487	147
2002	1,592	6,617	5,025	178
2003	1,445	6,617	5,172	153
2004	615	6,617	6,002	149
2005	999	6,617	5,618	117
2006	615	6,617	6,002	105
2007	693	6,617	5,924	87
2008	773	6,617	5,844	72
2009	625	6,617	5,992	62
2010	615	6,617	6,002	52
2011	615	6,617	6,002	44
2012	999	6,617	13,410*	82*
Salvage(-)	7,792			
Total	40,034	164,616	124,582	3

* Values include salvage.

Rate of Return = 0.19

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I + II

ECONOMIC TABLE 10-C

TAGBILARAN WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION C

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	2,781	-	-2,781	-2,781
1984	12,275	1,112	-11,163	-9,646
1985	1,636	1,804	168	125
1986	5,618	2,600	3,018	-1,947
1987	3,983	3,037	-946	-528
1988	4,039	3,556	-483	-233
1989	320	4,132	3,812	1,587
1990	388	4,758	4,370	1,572
1991	919	5,205	4,286	1,333
1992	538	6,072	5,534	1,487
1993	705	6,617	5,912	1,373
1994	806	6,617	5,811	1,166
1995	627	6,617	5,990	1,039
1996	615	6,617	6,002	899
1997	615	6,617	6,002	777
1998	1,072	6,617	5,545	620
1999	3,126	6,617	3,491	338
2000	1,363	6,617	5,254	439
2001	3,810	6,617	2,807	203
2002	1,829	6,617	4,788	299
2003	1,638	6,617	4,979	268
2004	615	6,617	6,002	280
2005	1,072	6,617	5,545	223
2006	615	6,617	6,002	209
2007	705	6,617	5,912	178
2008	806	6,617	5,811	151
2009	627	6,617	5,990	134
2010	615	6,617	6,002	116
2011	615	6,617	6,002	101
2012	1,072	6,617	15,101*	219*
Salvage(-)	9,556			
Total	45,889	164,616	118,727	1

* Values include salvage.

Rate of Return = 0.16

APPENDIXES

1. Water Quality Analysis
2. Tap Water Pressure Examination
3. Study on Water Sources
4. Basic Cost Data
5. Socio-Economic Study
6. Design Criteria for Planning
7. Procedure of Projection of Population and Water Demand

Appendix 1. Water Quality Analysis

Results of water quality analyses of the existing and potential water sources and the Water Quality Standard for Drinking Water of the Philippines are shown in Tables 1, 2 and 3. Remarkable characteristics of the analytical results are summarized below.

1) Existing Deep Wells

a. All the deep well water does not contain turbidity.
b. Hardness is higher than the permissible level of the Standard.
c. No.6 well has a remarkably high concentration of chloride. Nos.1, 2 and 3 wells have higher concentrations of chloride than the permissible level of the Standard.
d. Bacteria and coliform groups are not contained in the water.

2) Other Potential Sources

a. The surface water of the Loboc and the Abatan Rivers has high value of turbidity and numberless bacteria and coliform groups.
b. Water of the Bilibili spring is potable.
c. The private well water contains high hardness and low turbidity.

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Table 1 Water Quality of Existing Wells

Deep Well / Items	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6 2/	No. 7	No. 8	No. 9
Sampling Date	8 July	8 July	7 July	8 July	8 July	7 July	20 Oct	7 July	11 July
Weather	Cloudy	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Cloudy
Atmoshperic Temperature (°C)	27.0	31.0	29.0	31.0	31.0	30.0	-	30.0	30.0
Water Temperature (°C)	27.5	27.5	27.5	27.5	27.5	27.0	28.0	27.5	28.0
Turbidity	0	0	0	0	0	0	0	0	0
Conductivity(μU/cm)	1300	1700	1500	700	550	2600	600	500	500
Hardness (mg/l) (as $CaCO_3$)	500	600	540	370	350	680	340	210	360
Calcium (mg/l)	192	212	160	126	114	240	104	104	112
Magnesium (mg/l)	22	7.3	7.3	6.1	6.1	21.9	20	4.9	7.3
PH	7.3	7.4	7.2	7.3	7.3	7.4	7.8	7.2	7.0
Alkalinity (mg/l)	140	180	140	130	140	80	190	100	150
Chloride (mg/l)	470	370	300	110	25	740	30	30	70
Sulfate (mg/l)	54	15	33	3	2	64	4	7.5	7.5
Ammonia-N (mg/l) 1/	less than 0.3	less than 0.3	less than 0.3	less than 0.3	less than 0.3	less than 0.3	less than 0.3	less than 0.3	less than 0.3
Nitrate-N (mg/l)	15.8	23	14	16.7	17.6	18	23.3	13.6	20.2
Iron (mg/l)	0.02	0.01	0.01	0.02	0.01	0.0	0.02	0.01	0.01
Manganese (mg/l)	0.08	0.20	0.13	0.18	0.10	0.0	0.2	0.0	0.3
Bacteria(/ml)	negative	negative	negative	negative	10	600	30	20	280
Coliform Group (/100 ml)	negative	negative	negative	negative	negative	32	10	7	150
Dissolved Oxygen (mg/l)	6.09	5.62	4.53	5.31	6.25	5.97	4.23	4.37	5.19
Dissolved Oxygen (%)	78	72	58	68	80	76	70	56	67

1/ A reading of less than 0.3 is not calibrated in the equipment.

2/ The well was abandoned July 1981 because of the salinization of water.

Table 2 Water Quality of Potential Water Sources

Sampling Point / Items	The Loboc River	The Abatan River	Bilibili Spring	Cabawan Spring	Manga Private Well	Tiptip Private Well	Taloto Private Well	Cogon Private Well(1)	Cogon Private Well(2)
Sampling Date	11 July	11 July	11 July	9 July	9 July	10 July	9 July	10 July	10 July
Weather	cloudy	cloudy	cloudy	fine	fine	fine	fine	fine	fine
Atmoshperic Temperature (°C)	31.5	31.0	32.0	32.0	30.0	31.0	31.0	32.0	32.0
Water Temperature (°C)	26.5	28.0	27.0	26.5	28.0	28.5	28.0	27.5	28.5
Turbidity	50	10	0	0	0	0	20	0	15
Conductivity(μU/cm	375	2,800	550	520	1,900	500	800	600	550
Hardness (mg/l) (as $CaCO_3$)	240	-	320	-	-	300	-	390	360
Calcium (mg/l)	64	-	122	-	-	-	-	-	-
Magnesium (mg/l)	6.1	-	6.1	-	-	-	-	-	-
PH	7.0	7.7	7.2	7.8	7.6	7.4	7.4	7.8	7.8
Alkalinity (mg/l)	100	-	180	-	-	180	-	160	170
Chloride (mg/l)	18	800	32	-	-	30	-	18	55
Sulfate (mg/l)	4	-	2	-	-	-	-	-	-
Ammonia-N (mg/l)1/	0.8	-	0.3	0.4	-	less than 0.3	-	0.5	less than 0.3
Nitrate-N (mg/l)	18.9	-	15	-	-	-	-	-	-
Iron (mg/l)	0.13	-	0.03	-	-	-	-	-	-
Manganese (mg/l)	0.18	-	0.0	-	-	-	-	-	-
Bacteria(/ml)	2,000	1,000	35	1,000	-	30	-	more than 3,000	-
Colliform Group (/100 ml)	1,000	350	negative	480	-	15	-	more than 1,000	-
Dissolved Oxygen (mg/l)	7.29	5.97	5.66	5.54	5.97	6.46	5.89	6.72	6.24
Dissolved Oxygen (%)	92	77	72	70	77	84	76	86	82

1/ A reading of less than 0.3 is not calibrated in the equipment.

Table 3 Water Quality Standard
Key Parameters of 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	1500
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
Sulfates, 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.

Appendix 2. Tap Water Pressure Examination

In order to investigate tap water pressure and its variation during 24 hours in Tagbilaran City, the pressure recordings were carried out at six strategic points in the distribution network, as shown in Fig 1 and Fig 2, July in 1981.

R-1 is located nearby the distribution main from the No.8 well water source and had rather high pressure compared with others.

R-2 had pressure of around 1.0 Kg/cm^2 during 24 hours although it is located inside the poblacion.

R-3 and R-4 had low pressure of less than 0.4 Kg/cm^2 and almost no water for a few hours a day.

R-5 and R-6 had almost no water all day long.

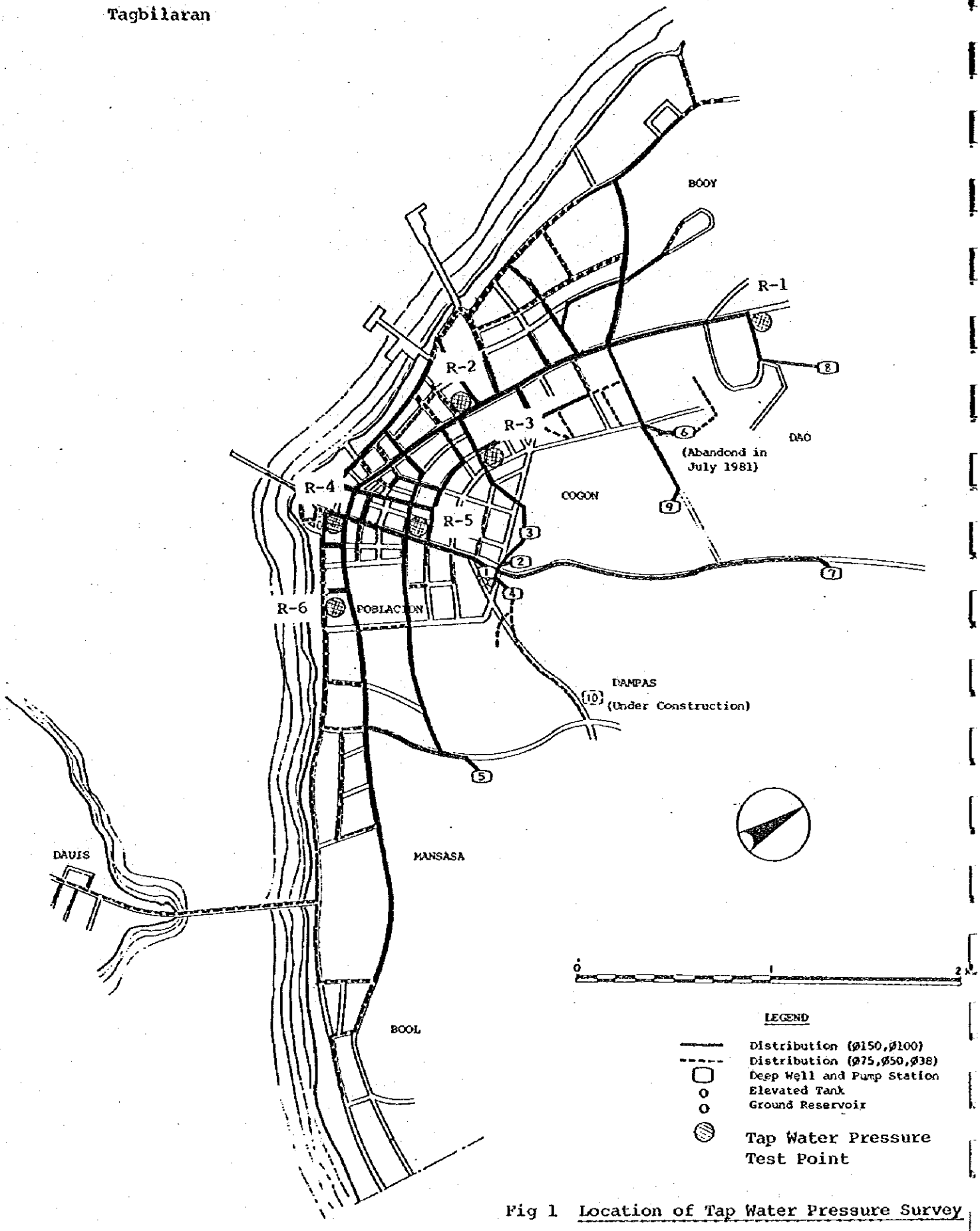

Fig 1 Location of Tap Water Pressure Survey

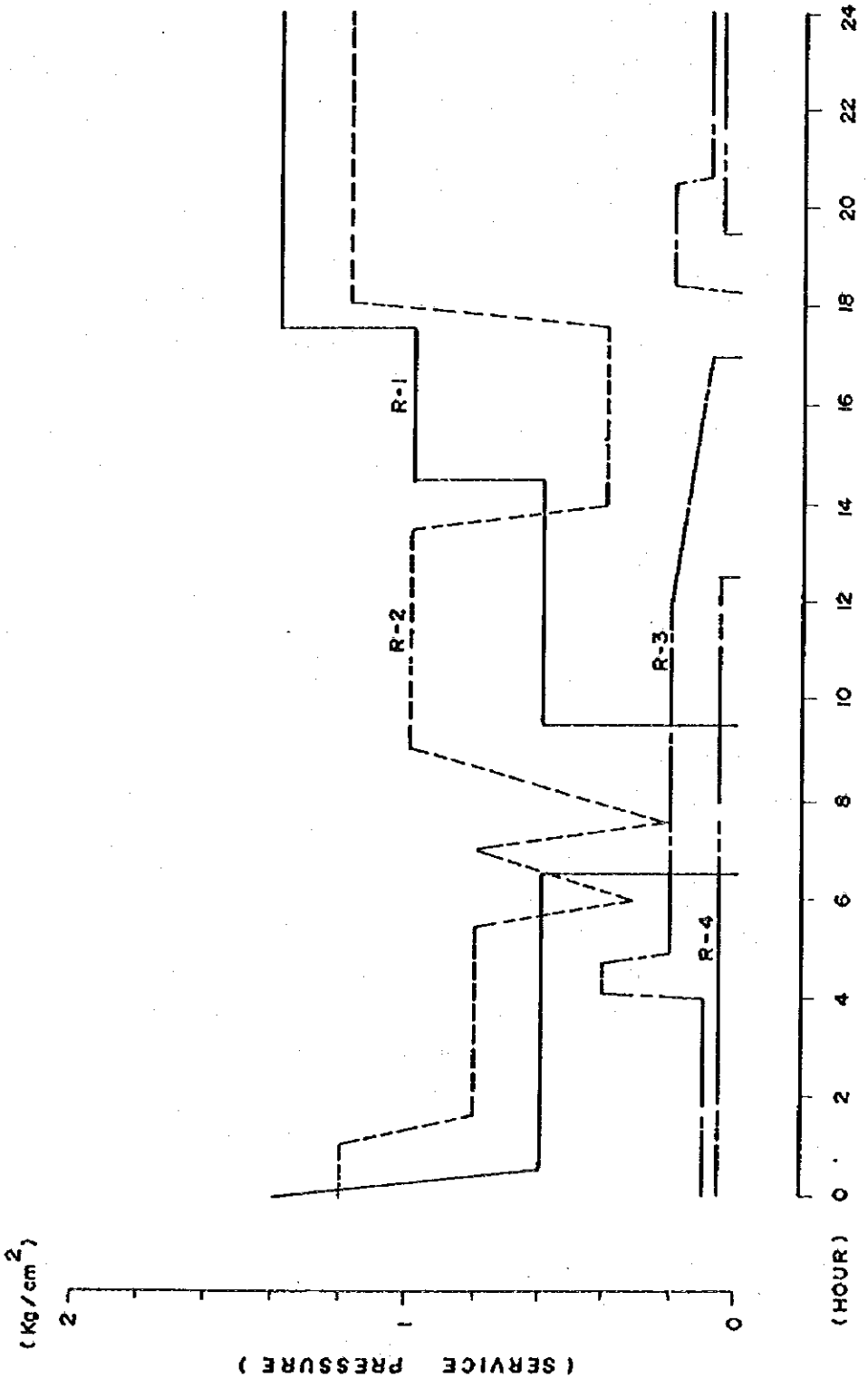

Fig 2 Variation of Water Pressure in Tagbilaran City

Appendix 3 Study on Water Sources

1. General

Study Area: the city area of Tagbilaran including its periphery, the Loboc River and its basin, 17.5 km east of the city, and the Abatan River and its basin, 8.5 km north of the city.

Purpose of Study: to explore possible water sources; surface and ground, for the use of the Tagbilaran Water District.

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

Period of Field Investigations: July 6, to July 13, 1981

2. Topography

The coastline of Tagbilaran City generally has steep cliffs 7 to 8 m high. The ground surface rises up to about 20 m at a distance of 200 m from the coast. The land undulates with a range of 5 m, gradually rising up to an elevation of 45 m at a point 5 km away from the coast. Beyond this point the elevation of the ground is generally 45 to 50 m.

As can be seen in Figs 1 and 2, the contour lines depict clearly the undulating topography with numerous circular or oval depressions, the diameter of which ranges from 50 m to 800 m. The depressions have rather steep slopes and their bottoms are fairly flat.

In the study area, there are two conspicuous hills with an elevation of 100 m or higher, one in the northwest and the other in the southeast of the city, which are topographically the characteristic features of the area.

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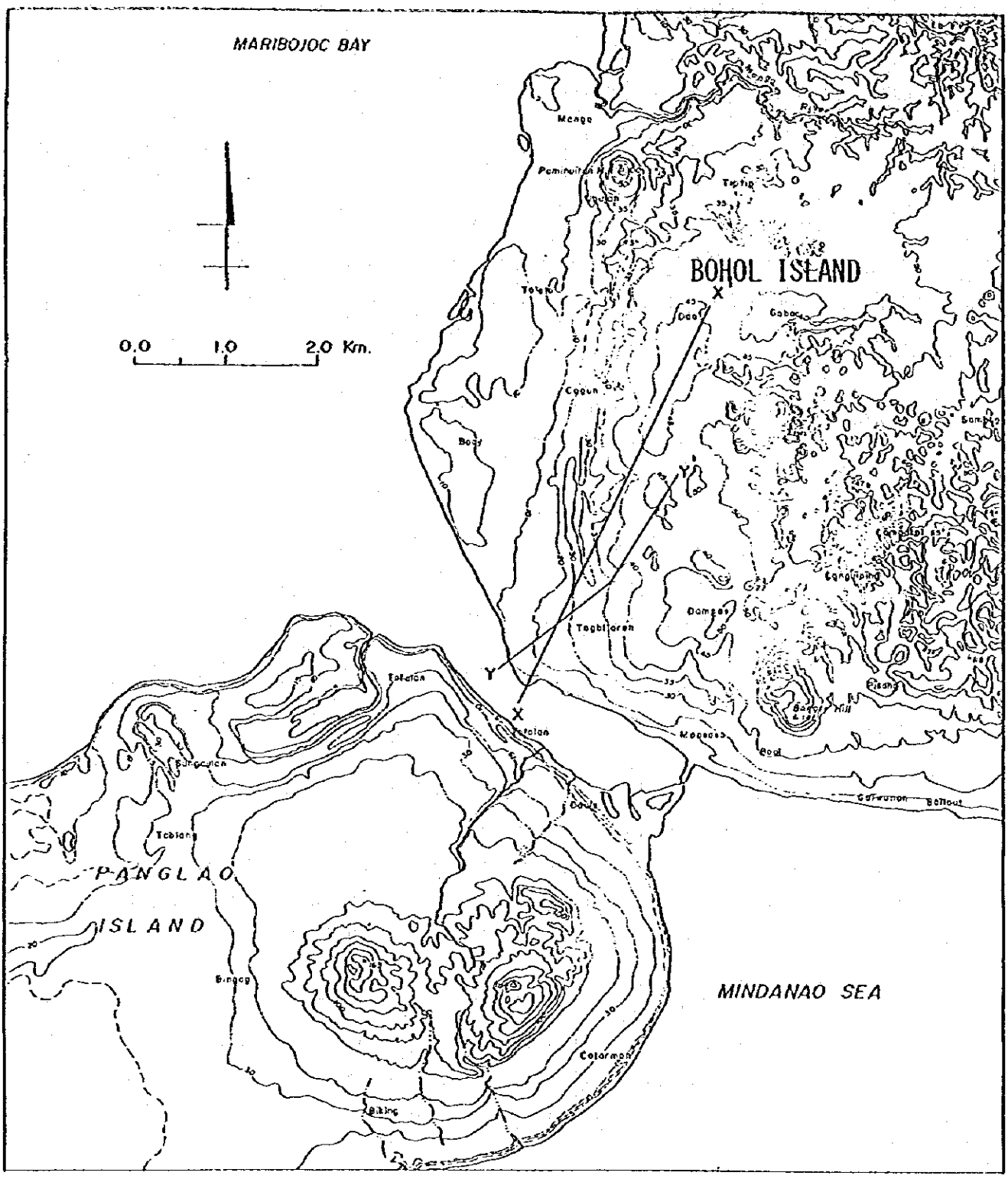


Fig 1 Topographic Contour Lines

LEGEND

X-X' Topographic Section Line

Y-Y' do

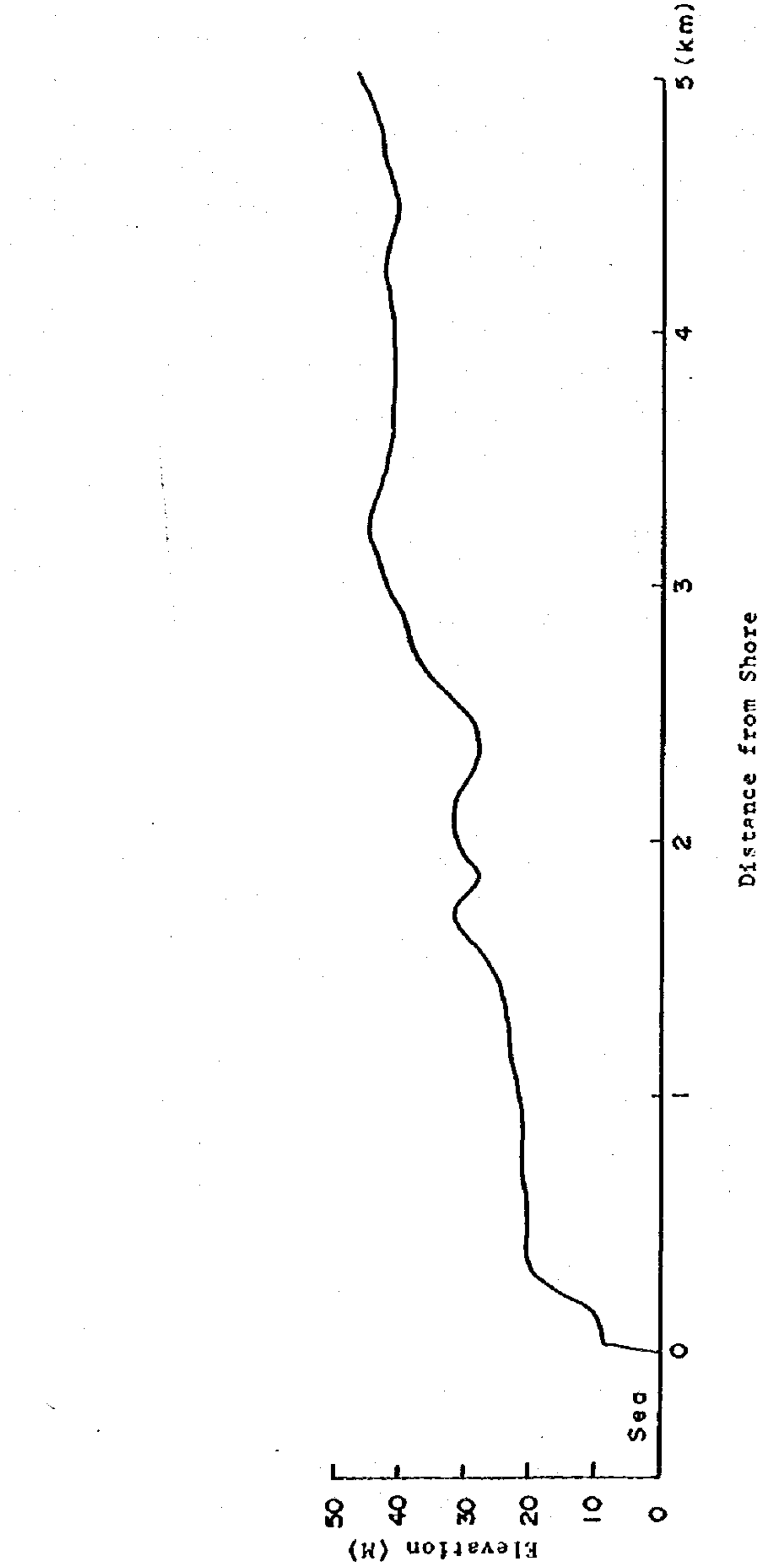


Fig 2 Topographic Profile (Along the line X-X' in Fig 1)

The above-mentioned depressions have been formed due to erosion by the rain water. This phenomenon is characteristic of the land composed of limestone. The rain water infiltrates into the ground dissolving the limestone, resulting in development of depressions and few rivers.

Due to the characteristic-formation of the land consisting of limestone, there are not many alluvial formation in the area, with a very narrow belt in the coastal areas. Sediments to be flushed away by the river flow are scarce because they are soluble.

The Loboc and the Abatan Rivers have alluvial plains at their river-mouths, but the plains are usually small. Of the two plains, that of the Loboc River is a little wider, as its basin has some clayey and silt formation.

3. Geology

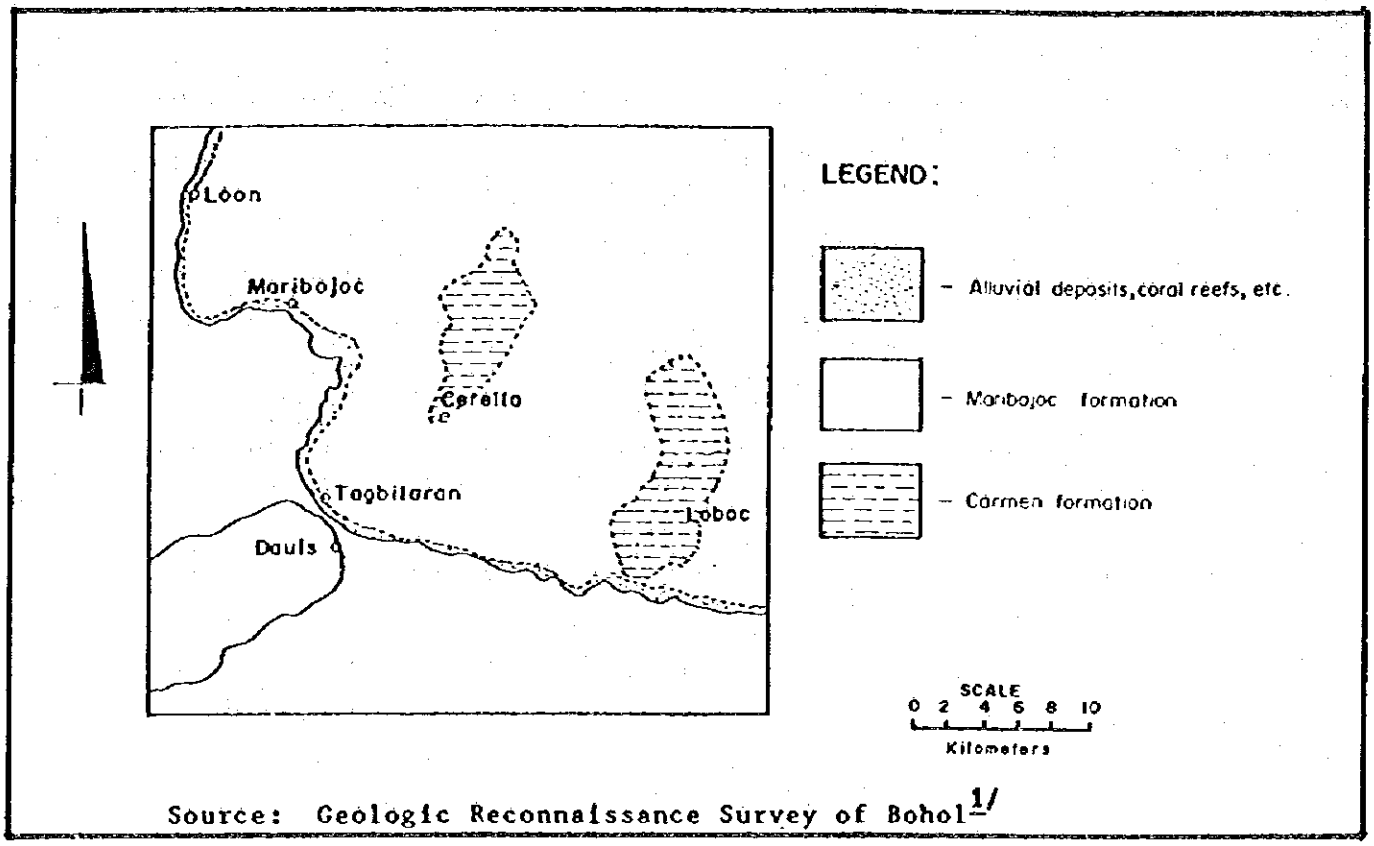
Table 1 shows the geological stratigraphy of formations in the areas of Tagbilaran City, the Loboc River and the Abatan River.

Table 1 Geological Stratigraphy around Tagbilaran City

Formation	Geological Period
Alluvium, coral reef	Quarternary
Maribojoc formation	Tertiary
Carmen formation	Tertiary

In the above table the formations are older in the order from top to bottom.

Distribution of the formations is shown in Fig. 3. The study area is predominantly composed of Maribojoc formation. Carmen formation is distributed in only the Loboc basin and the northeast of the city. Alluvium is found along the seacoast forming a very narrow belt.



Source: Geologic Reconnaissance Survey of Bohol[1/]

Fig 3 Distribution of Formations

The characteristics of the formations are shown in Table 2 below.

Table 2 Characteristics of the Formations

Formations	Characteristics
Alluvium	Found along the seacoast; distribution limited.
Maribojoc formation	Consists of limestone; disintegrated by rain into black soil; formed symmetrical conical hills, the cause for which is unknown.
Carmen formation	Consists mainly of Ilihan shale, Carmen sandstone and shale, Tubigon conglomerate, Sevilla marl, and highly tuffaceous rock. In the south of the city, some menbers of the above are overlain unconformably by Maribojoc limestone.

The Maribojoc formation may possibly be classified into two parts, one the symmetrical conical hills with high elevations of 100 to 140 m and the other the lower land with an elevation of 50 m or less. However, as both are composed of limestone and not much different in the age of formation, they are usually treated as same Tertiary formation.

The Carmen formation was observed at and around the Loboc dam in the Loboc basin, to include calcareous clay, siltstone, calcareous sandstone, mudstone, etc. In the Loboc basin, there are formations with higher run-off characteristics than the Maribojoc formation. The Loboc basin has rather many valleys and tributary streams and developed alluvial plains, while the area of the Maribojoc formation has no rivers except the Abatan River and the Manga River and has many depressions.

To understand formations and stratifications in the study area, Fig 4, Locations of Columnar Sections and Fig 5, Columnar Sections are presented. The well logs show that most of the formations in the area consist of limestone with clay and sand partially included. Limestone can be sorted out into two kinds, i.e., hard and soft, but they can be treated as same one from the geological standpoint.

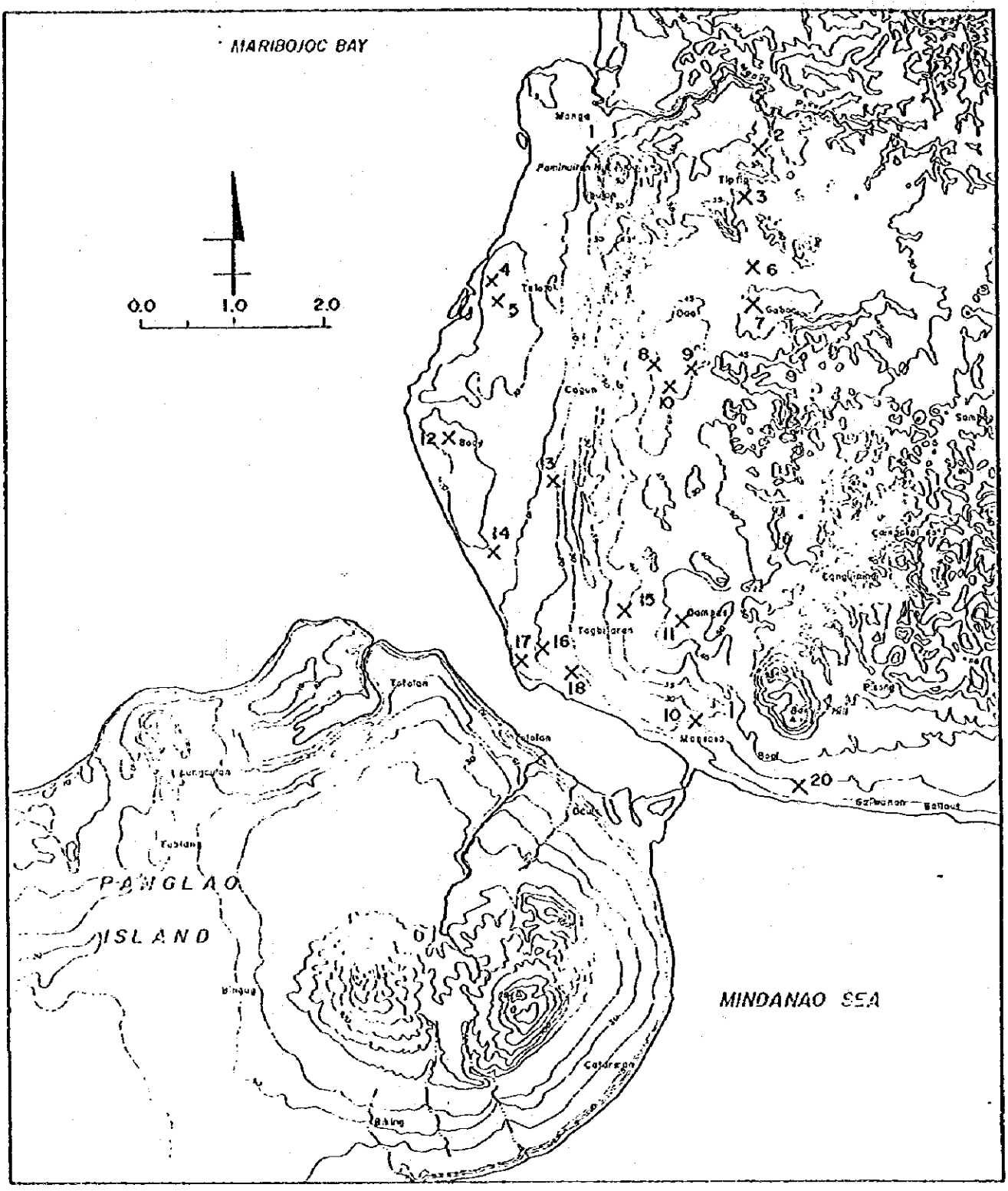


Fig 4 Location Map of Columnar Sections in Fig 5

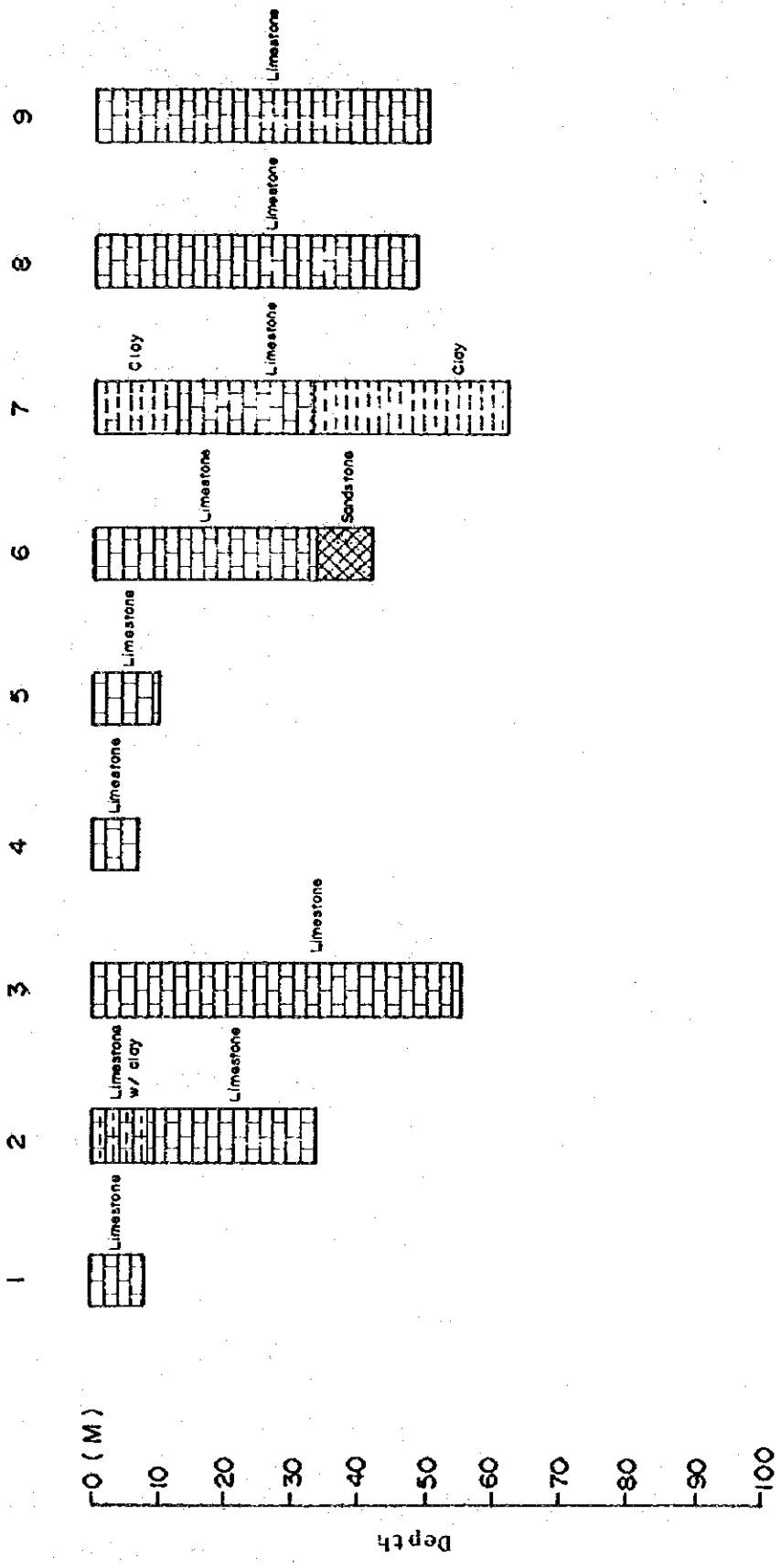


Fig 5-1 Columnar Sections

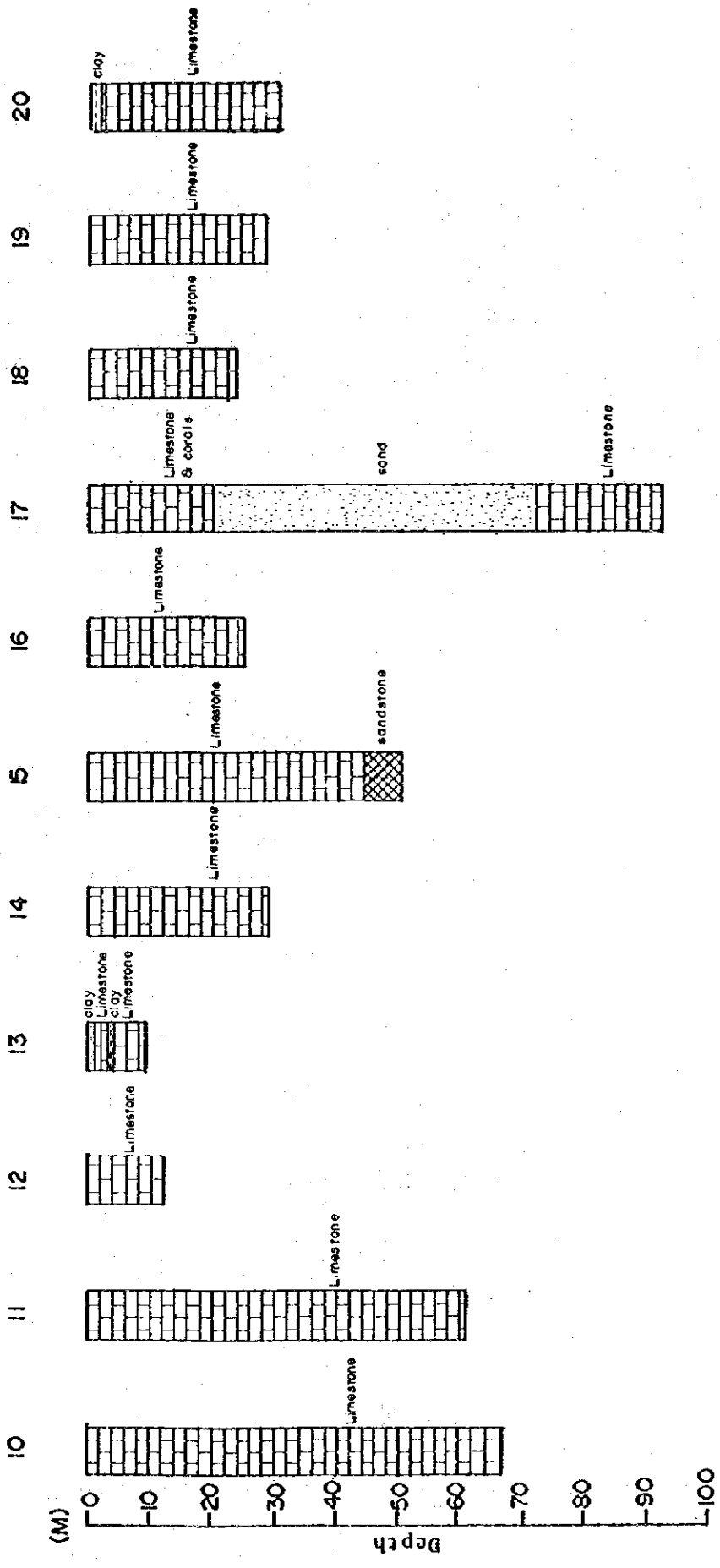


Fig 5-2 Columnar Sections

4. Hydrology

4.1 Rainfall

The study area has no definite dry season and no pronounced rainy period[2/]. Tagbilaran City has an average precipitation of 1393 mm per year (normal 1951-70)[3/], with a low average 85 mm per month from January to May and a high average 141 mm June to December. The annual precipitation of this area is fairly low compared with that of all the Philippines, 2500 mm. The area is very rarely hit by the typhoons, which generally bring rainfall.

4.2 River Flow

The discharge of the Loboc River was measured at the point shown in Fig 6 on July 11, 1981. The weather of the day was fine. The measured discharge was Q= 22.0 cu m/sec = 1,900,800 cu m/d. The Loboc River has an abundant flow, while there are no rivers in the Tagbilaran City area. Surface Water Supply of the Philippines (1966-1969)[4/] has the following Table.

Table 3 Daily Average, Daily Maximum and Minimum Discharges of the Loboc River (cu m/sec)

Year	Daily Average	Daily Maximum	Daily Minimum
1966	19.7	98	6.0
67	20.6	169	5.8
68	12.3	90	7.4
69	12.5	49	8.5
Average	16.3	101	6.9

Both daily averages and daily minimums fluctuate in only small ranges for each year, but daily maximums show remarkable variations.

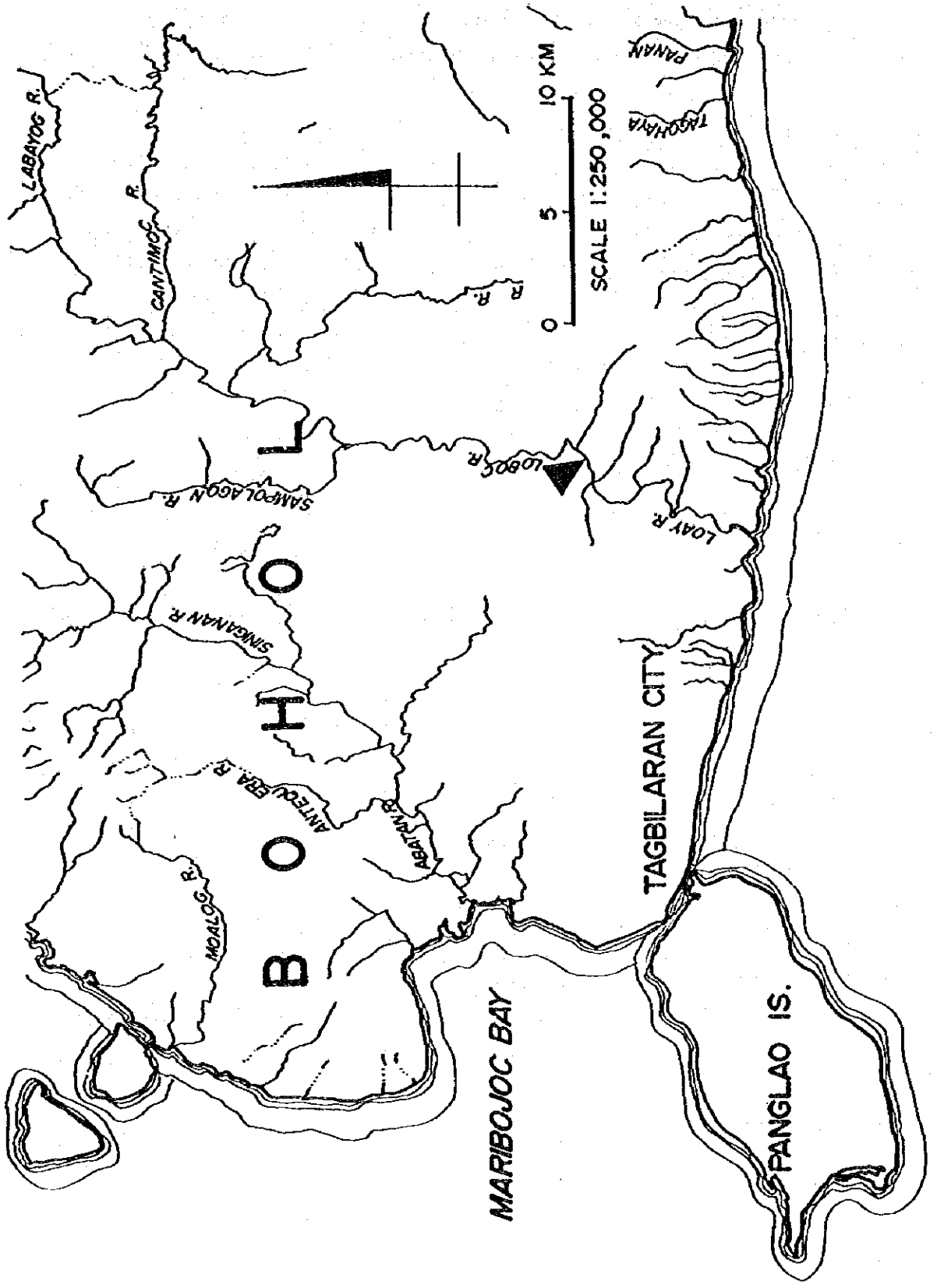


Fig 6 Point of River Discharge Measurement

The average minimum flow is 6.9 cu m/sec = 596,000 cu m/d, a sizable discharge, and the river is a potential as a water source for the water supply.

The Abatan and the Manga Rivers in the Maribojoc formation area have no or extremely small flows except during rains, causing sea water to flow upstream fairly far inland. This was verified by the fact that the river water has a conductivity of 2800 μ℧/cm at the Bili-Bili spring location on the day of the field investigation. When there is a heavy rain upstream of the river, the discharge increases very rapidly. These river are not suitable for utilization as water source.

4.3 Groundwater

The study area has no good aquifer, namely, extremely low groundwater table. Sea water tends to intrude inland and groundwater withdrawn by deep wells contains, generally, salinity.

The area has many wells and some springs. The locations of dug wells, drilled wells and springs, and groundwater table are shown in Fig 7, and the detail of water sources in Table 4, and a diagram showing the relation between the topographic crosssection and groundwater tabel in Fig 8. As will be known in the above figures, the contour line of the groundwater table is roughly parallel with the coast line. The gradient of the groundwater table rises very gently toward inland, whereas the land surface has steeoer gradient. According to the topographical crosssection the land elevation of a point 2.4 km away from the sea coast is 42 m, but the elevation of the groundwater table at the same point is 6.59 m above sea level, that is, the groundwater table has a gradient of 1/364. This low groundwater table is explained as follows: The Maribojoc formations consisting of limestone are porous, and its pores are fairly large. Therefore, aquifers have poor capacity for storing groundwater, resulting in low groundwater table.

Groundwater, withdrawn by shallow and deep wells a few kilometers away from the sea coast, contain generally salinity. Sea water in the study area is observed to intrude fairly far into the inland.

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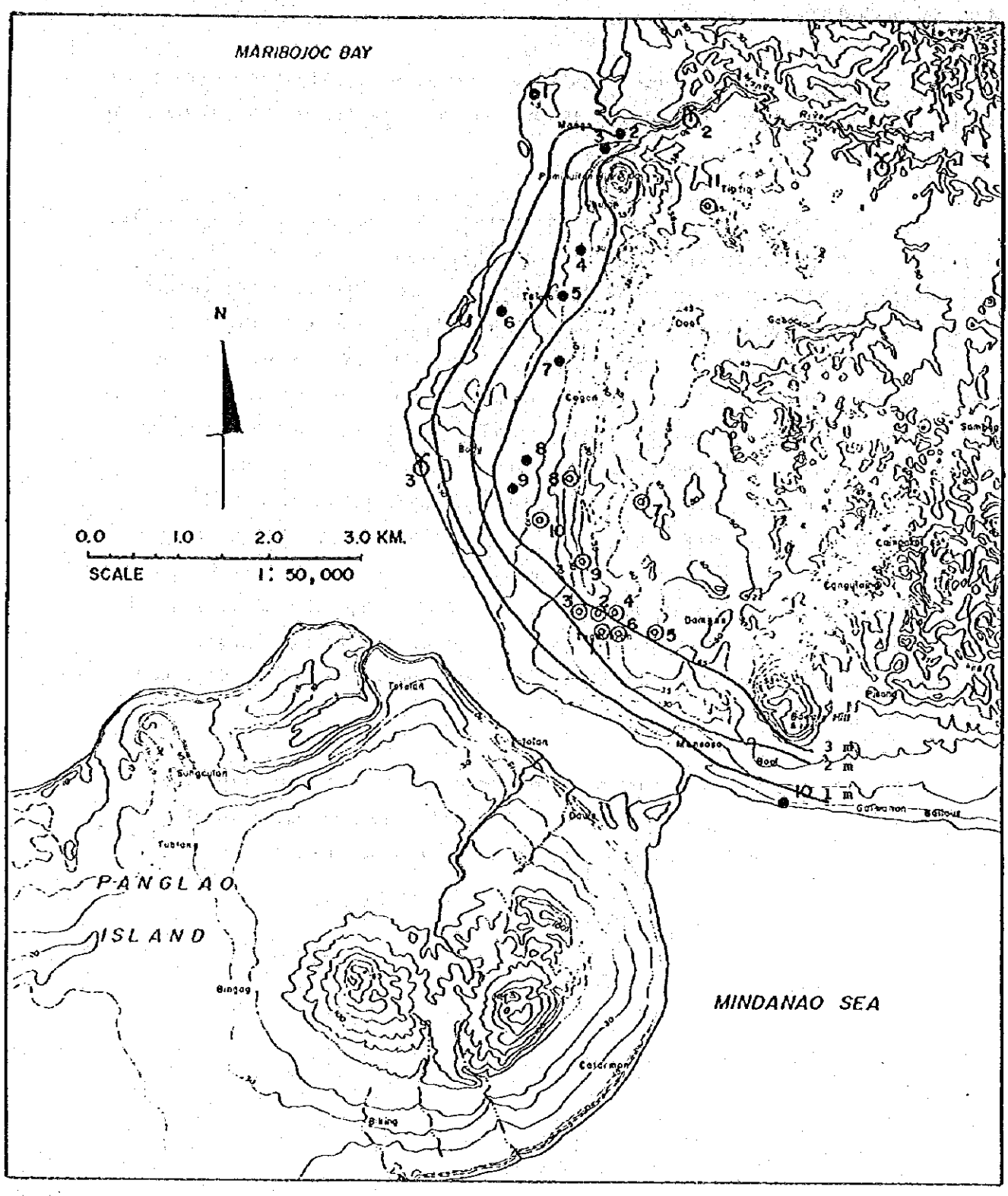


Fig 7 Location Map of Deep Wells, Dug Wells and Springs

LEGEND:

- Dug Well
- Deep Well
- Spring
- Groundwater Table

Table 4 Details of Wells and Other Sources

Source Number	Observed Date	Casing Diameter (mm)	Well Depth (m)	Ground Elevation	SWL (m)	PWL (m)	Discharge (lps)	Conductivity (μS/cm)	pH	Cl^{-1} (ppm)
	DEEPWELL									
1	7-7-81	150	25				3.5	1300	7.3	470
2	7-7-81	350	34			37.14	5.8	1700	7.4	370
3	7-7-81	200	35				6.9	1500	7.2	300
4	7-7-81	150	43				5.8	700	7.3	110
5	7-7-81	200	43				7.6	550	7.3	25
6	7-7-81	250	20				—	2600	7.4	740
7	7-7-81	150	—		18.71		6.9	690	7.8	35
8	7-7-81	200	27				5.8	500	7.2	30
9	7-7-81	250	53		35.13		22.2	500	7.2	70
10	7-9-81		18.3				(3.8)	600	7.8	
11	7-13-81	100	48.0		16.67			500	7.4	30
	SHALLOW (DUG) WELLS									
1	7-10-81			5.5	4.81			4900	7.3	
2	7-9-81			10.0	8.17			1900	7.6	
3	7-10-81			9.0	5.61			1900	7.1	
4	7-13-81			9.5	8.18			750		
5	7-13-81			10.5	6.04			760		
6	7-9-81			11.0	7.92			800	7.4	
7	7-9-81			9.5	4.85			650	7.6	
8	7-13-81				2.83			750		
9	7-9-81			7.0	2.67					
10	7-13-81			3.1	2.71			7900		
	SPRINGS & SURFACE WATERS									
1	7-9-81							520	7.8	
2										
3										
	LOBOC RIVER 7-11-81							375	7.0	18
	ABATAN RIVER 7-12-81							2800	7.7	
	BILI-BILI SPRING 7-11-81			2.0			10	550	7.2	32
	TIPTIP SPRING 7-9-81							5000	7.8	

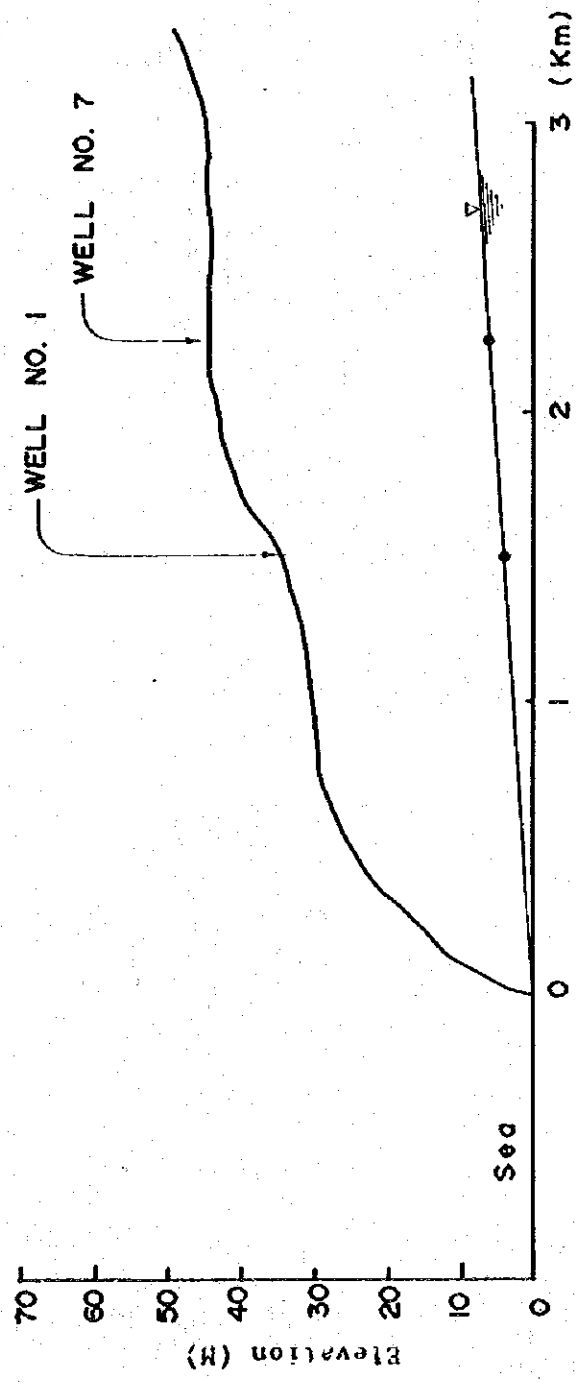


Fig 8 Ground Elevation and GRoundwater Table

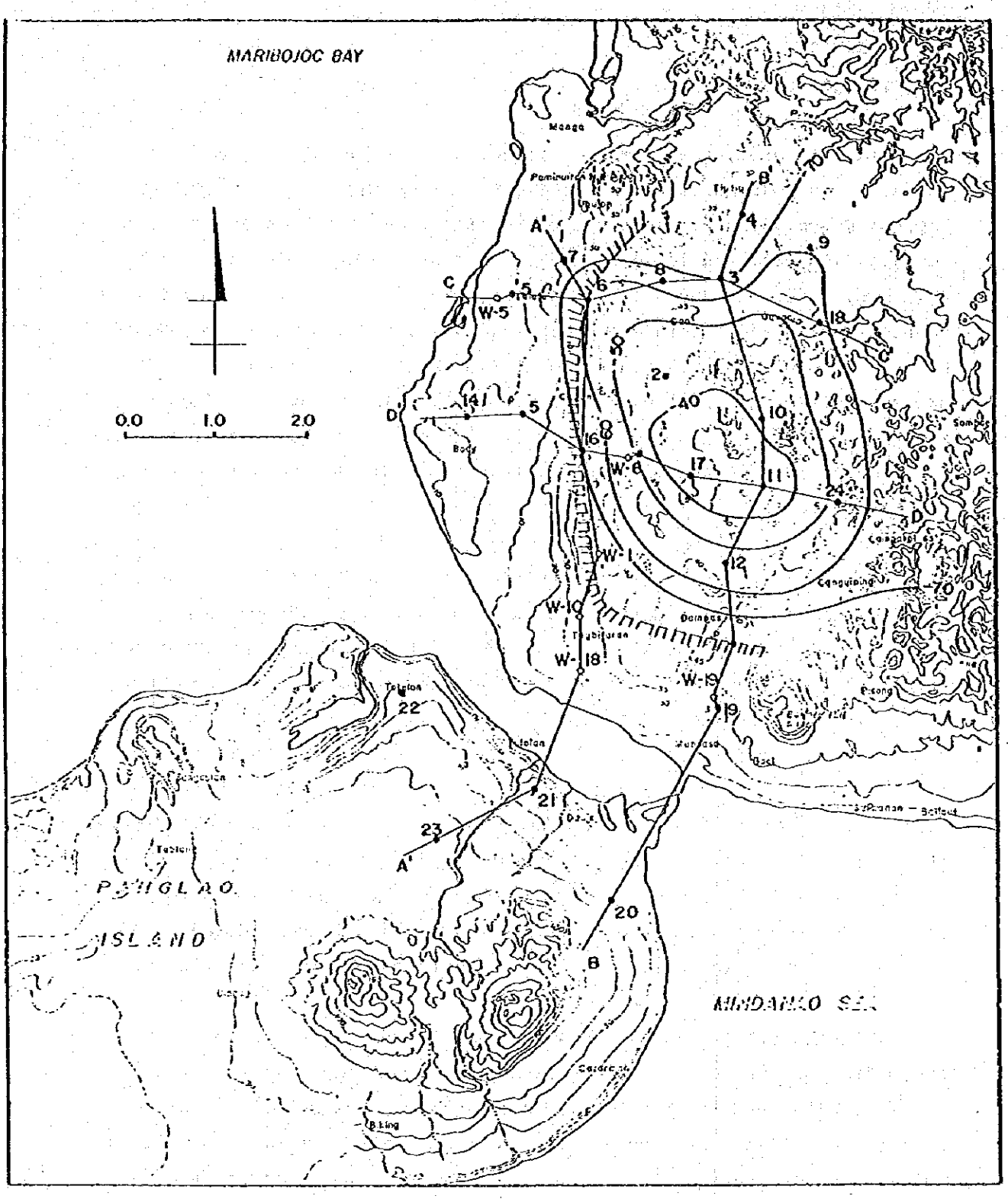
5. Hydrogeology

In this area, the formation is composed mainly of limestones as shown in the columnar sections of Fig 5. According to the present geological survey, the limestones compose of alternating beds of hard and compact, and soft and loose rocks. Hard and compact limestones sometimes have many fissures, and soft and loose rocks are porous including fairly younger sediments of corals and other fossils, through which groundwater can easily pass. As was stated in section of the 4.3 Groundwater, the groundwater level is extremely low even in the inland distant from the seashore. The formation is poor in storing groundwater, because the size of porosity in limestones is larger than that in alluvium. This is why the study area has poor aquifers.

In order to get detail information of the geological structure, a geoelectric resistivity survey was carried out. Fig 9 shows points of survey, contour limes of the base of the Maribojoc formations obtained and the boundary line of salty and fresh water obtained. The base of the Maribojoc formation is highest in the northeast portion of the Tagbilaran City and goes down in all directions. The boundary line of fresh water is 1.3 km to 1.9 km inland in parallel with the shoreline. Geological cross sections and the boundaries of fresh water are indicated in Fig 10. The Maribojoc formation has a thickness from 120 m to 80 m and is underlain by Carmen formation, which is estimated to be composed of silt and/or clay and is impervious. The formation is considered to be Carmen Formation from observation of outcrops and geological structures.

All the cross sections show that the boundary lines have a rather steep dip and the sea water intrusion is wedge-shaped. In the cross section, W-10 well is situated 500 m away from the seashore and 250 m from the sea-fresh water boundary. The water withdrawn by this well has chloride concentration of 370 ppm. In C and D cross sections, the sea water intrusion is more intense and the boundary line is less steep, approaching close to the sea level. In this area, therefore, fresh water cannot be easily obtained by wells.

Tagbilaran



LEGEND

Fig 9 Geoelectric Resistivity Survey Point

● Geoelectric Resistivity measuring point

Limits of Salt Water Intrusion

Contour Line of the Base of the Maribojoc Formation (Meters below mean sea level)

O Drilled Well

Section Line

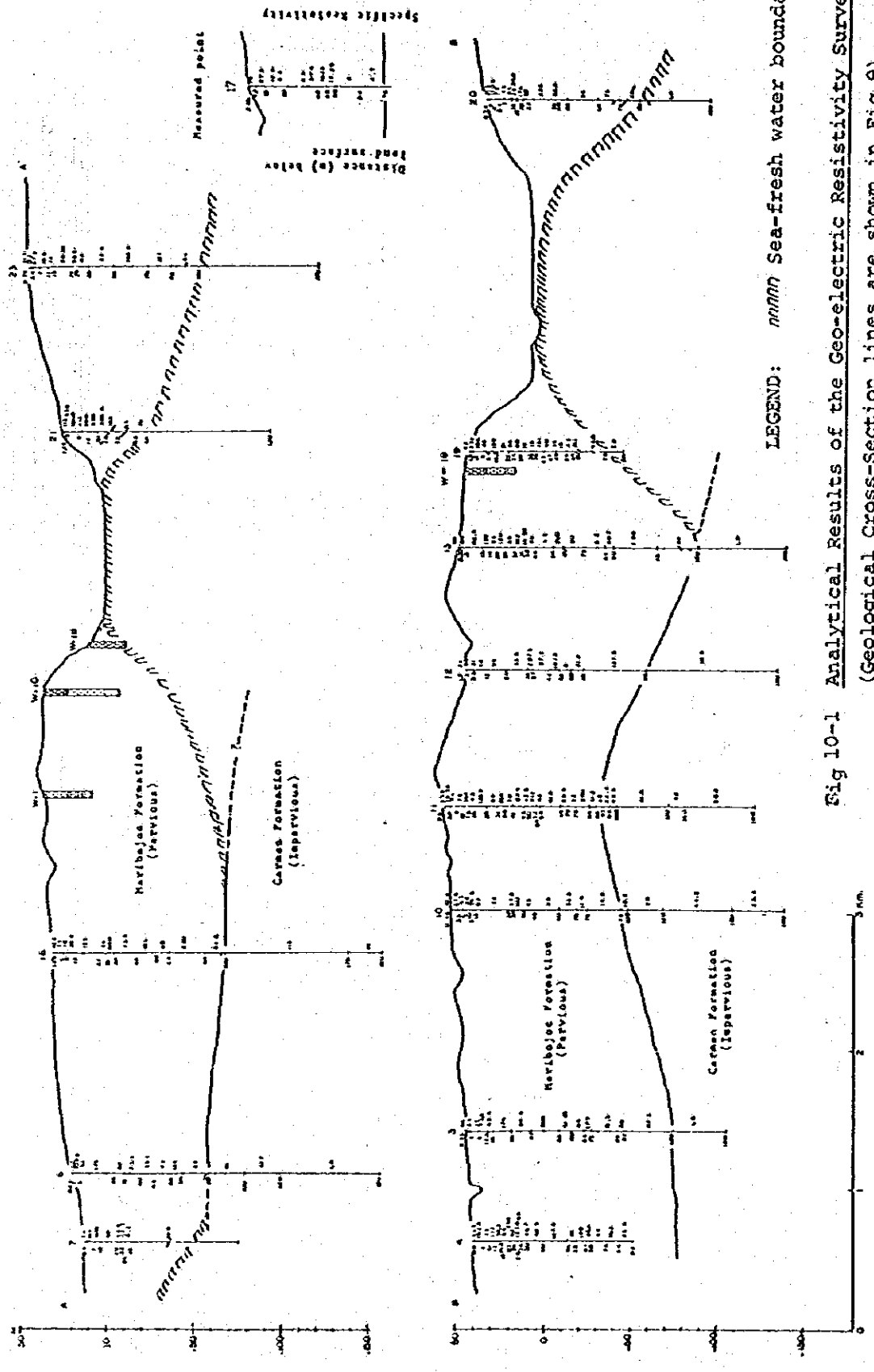


Fig 10-1 Analytical Results of the Geo-electric Resistivity Survey
(Geological Cross-Section lines are shown in Fig 9)

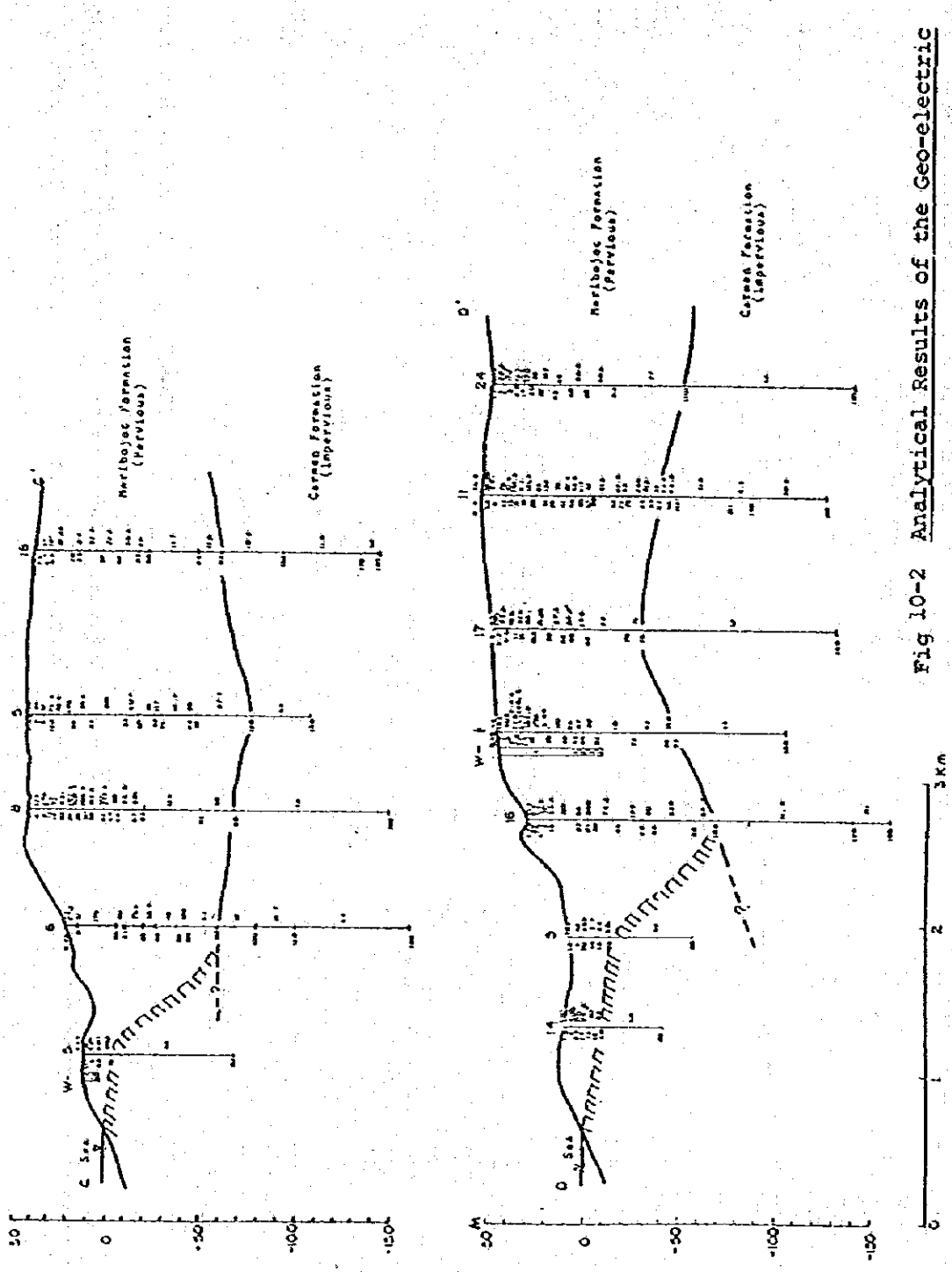


Fig 10-2 Analytical Results of the Geo-electric Resistivity Survey (Geological Cross-Section Lines are shown in Fig 9)

6. Evaluation of Water Sources

6.1 Rivers

Major features of the rivers investigated are reiterated below from descriptions in the previous sections.

(a) The Loboc River

1) The river has a large discharge of 596,000 cu m/day on the average minimum flow.
2) The flow of the river is rather constantly large, as the river is situated in the Carmen formation.
3) The water quality of the river, as presented in Appendix 1, is suitable for drinking, when properly treated.

(b) The Abatan and the Manga Rivers

4) Ordinary flows of the two rivers are very small, and the river water, even considerably upstream, contains salinity due to sea water intrusion.

From the standpoint of quantity and quality, the Loboc River is recommended for water supply as a water source. The Abatan and the Manga Rivers are not suited for water source for a water supply system.

6.2 Springs

1) The Bili-Bili spring has an yield of about 1,000 cu m/day, and the water quality is suitable for drinking, as shown in the same Appendix as above.
2) Other springs are very poor in yield.

From the above, the Bili-Bili spring is a potential water source for water supply in both quantity and quality.

6.3 Groundwater

To evaluate the availability of groundwater, major results of hydrogeological survey are summed up below.

1) The study area is predominantly composed of the Maribojoc formation consisting of alternating beds of hard and compact, and soft and loose limestones.
2) The Maribojoc formation has a thickness, 120 to 80 m, and is underlain by another formation which is estimated to be made up of silt and/or clay.
3) Groundwater in aquifers is not confined due to the characteristics of the limestone formation.
4) Groundwater table is extremely low.
5) Sea water tends to intrude inland.

Based on the above facts, Fig 11 is prepared. It shows schematically hydrogeological conditions.

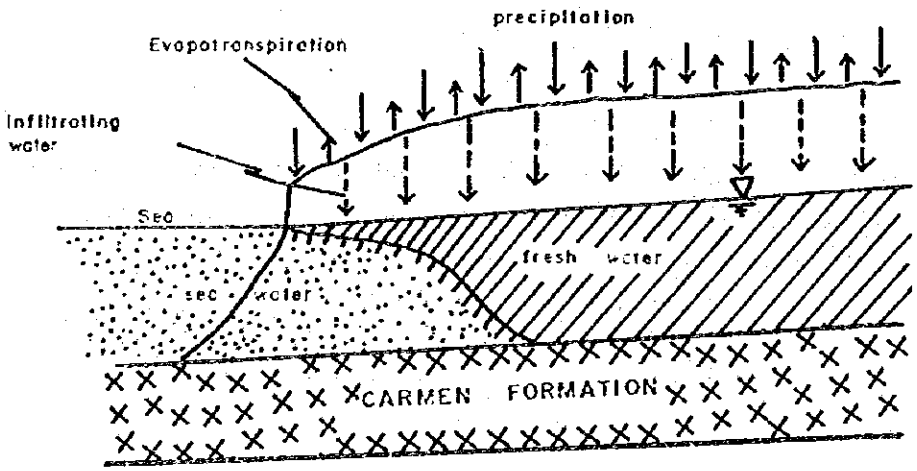


Fig 11 Schematic Diagram of Hydrogeological Conditions

In Fig. 11 the hatched portion shows fresh groundwater which is being used. To check further availability of the groundwater, recharge to this groundwater is estimated as follows.

Precipitation data (normal, 1951-70) are obtained from PAGASA. Evaporation (1979) of the only data available is obtained from NIA. By multiplying the evaporation data by reasonal coefficient, taking into consideration that evapotranspiration in the area with a little rainfall has a tendency to be large, the evapotranspiration is computed. Recharge cal-

The drainage area to recharge this groundwater is shown in Fig. 12. The border lines A and B are taken from the topographical map. (And the extremity of the border lines A and B is limited by the outcrop in the Carmen formation). Further, the border line C is the line on or near which the present deep wells are located. Therefore, the drainage area which contributes to the recharge of groundwater is M area as shown in the same Figure.

Using the above three factors: the precipitation, the evapotranspiration, and the recharge area, the recharge is calculated as 8.6 million cu m/day.

Against the above recharge, the existing deepwells are currently withdrawing about 3.2 million cu m/day. Its trap ratio is about 37 per cent, and the present withdrawal is considered to be near the limit, taking it into consideration that all groundwater cannot be caught by the wells.

---

(1) $R = (P-E_2) \times Am$

R : Recharge of the M area (cu m)	8,600,000
P : Precipitation (m)	1.394
E_2: Evapotranspiration (m)	1.010
Am: Drainage area (m^2)	22,340,000

Tagbilaran

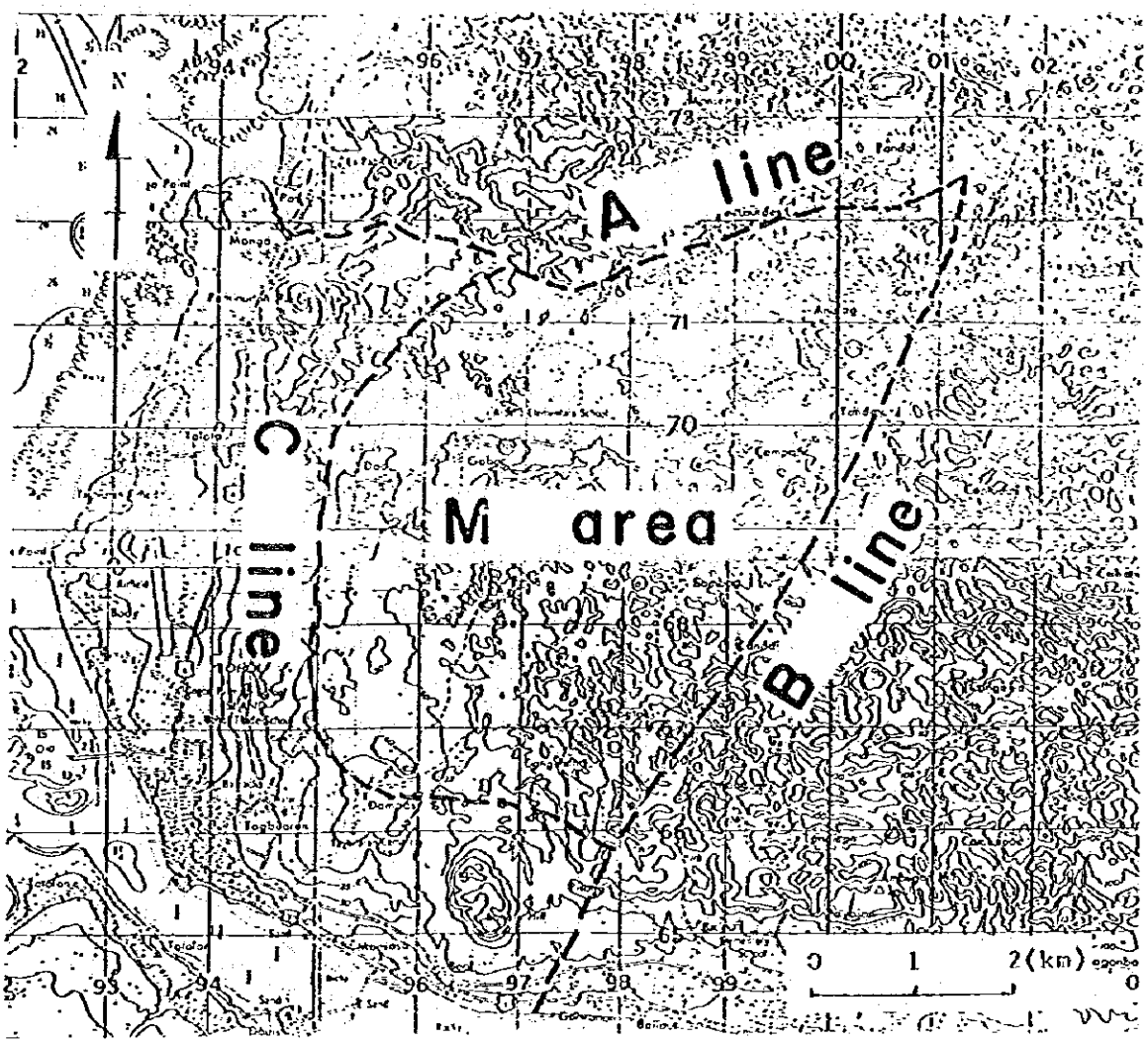


Fig 12 Drainage Area (M) used in Calculation of Groundwater Recharge

As some wells located near the seashore are suffering from increasing salinity by sea water intrusion, they are desirable to be relocated according to the following consideration, keeping the total production below the present level.

(1) Wells should be located within the recomended line (C-line) shown in Fig 12.
(2) The standard spacing of wells should be 1 (one) km.
(3) Well bottom should be located above sea level.
(4) The standard production of a well should be 1,000 cu m/day.
(5) No more wells should be sunk in the present wellfield.

Tagbilaran

7. Groundwater in the Vicinity of Study Area

7.1 General

The study is carried out to investigate groundwater in the outer area of Tagbilaran City, namely, the whole area between the Abatan River, north of the city, and the Loboc River, east of the city.

7.2 Natural Conditions

Fig 13 shows the above mentioned study area. Geological formations and hydrogeological features in the study area are quite similar to that in the city area as shown in Fig 3. Locations of existing wells and water quality thereof are shown in Fig 13 and Table 5, respectively.

7.3 Evaluation of Groundwater Source

The area between the Abatan and the Manga Rivers is small and recharge in this area is quite limited, and besides the surface water of the two rivers and groundwater along them are contaminated with sea water. Therefore, this area is not fit for groundwater development.

Regarding the area east of the city, recharge is estimated as follows. In Fig 14, the drainage area is delineated with border lines. The border lines, A' and D' are determined by the presence of the impermeable layer of the Carmen formation. The border line B' and C' are determined from topography. Further, the border line E' is assumed as a line outside of which no wells are to be sunk to avoid sea water intrusion, as in the city area. The recharge of groundwater in the above drainage area is estimated using precipitation and evapotranspiration data[3]. The recharge is calculated as 24 million cu m/day, an enormous amount.

From the above, it is concluded that groundwater is available in the study area, and to take the groundwater, same conditions as described in the previous study should be observed.

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[3] The data used are the same as that of the previous section.

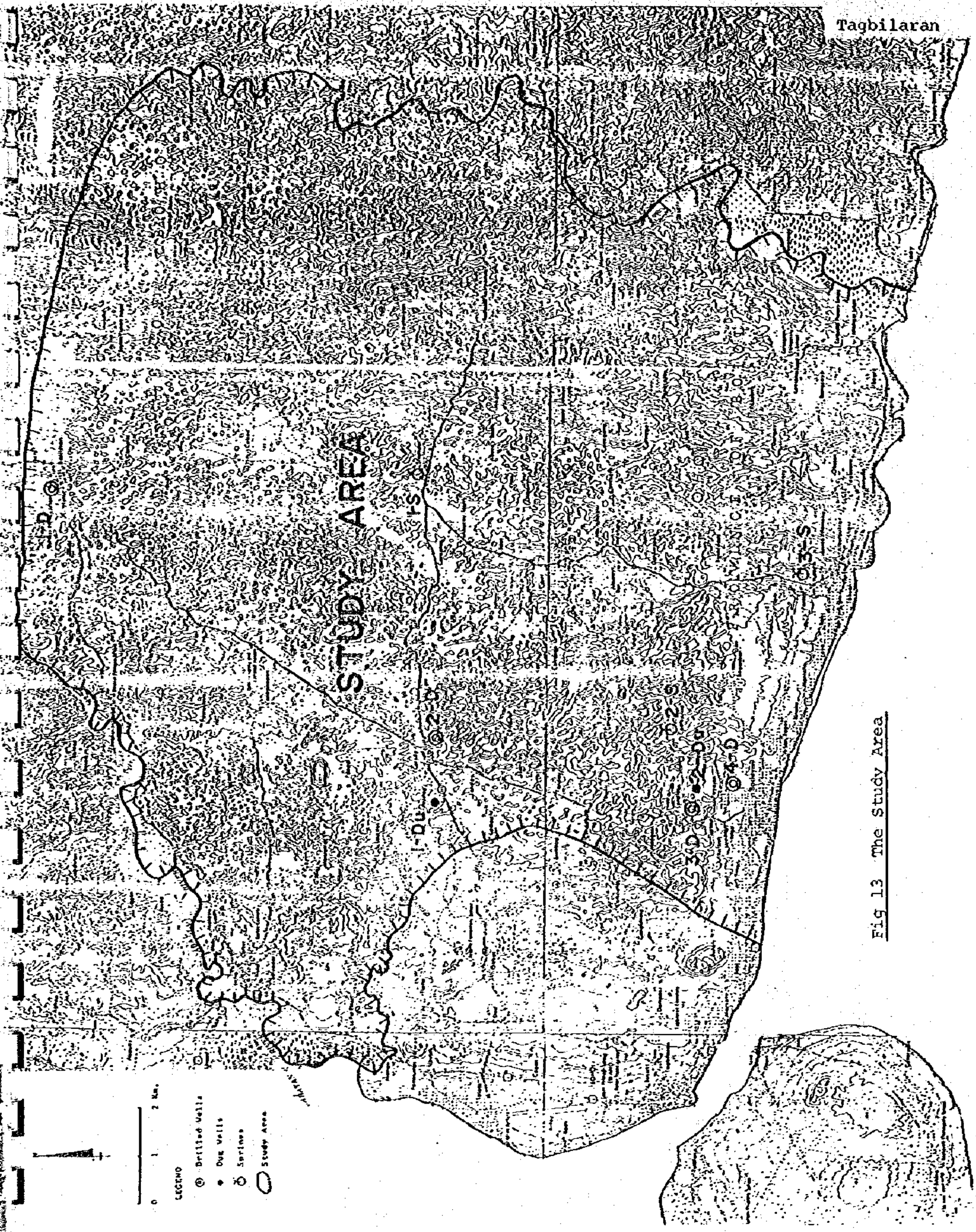

Fig 13 The Study Area

Table 5 Wells and Springs Data

Number	Location	Sampling Date	Casing Diameter	Depth	Static* Water Level	Pumping* Water Level	Discharge	Conductivity	Cl^{-1}	pH
Drilled Wells										
1-D	Balilihan	10-21-81	250 mm	44.2M	M			625 /cm	13.4 ppm	7.55
2-D	Anislag, Corella	10-21-81						590		7.4
3-D	San Isidro, Baclayon	10-21-81	150 mm					1200		7.8
4-D	Baclayon	10-21-81						2050		7.4
Dug Wells										
1-Du	Anislag, Corella	10-21-81		5.44	1.41			690	15.7	7.45
2-Du	Landican, Baclayon	10-21-81			25.0			1400	170.0	7.5
Springs										
1-S	Sikatuna	10-21-81						790	13.4	7.5
2-S	Cambanao, Baclayon	10-21-81						500		7.4
3-S	Alburquerque	10-21-81						700	13.4	7.55

*Static Water Level (G.L. Minus)

Pumping Water Level (G.L. Minus)

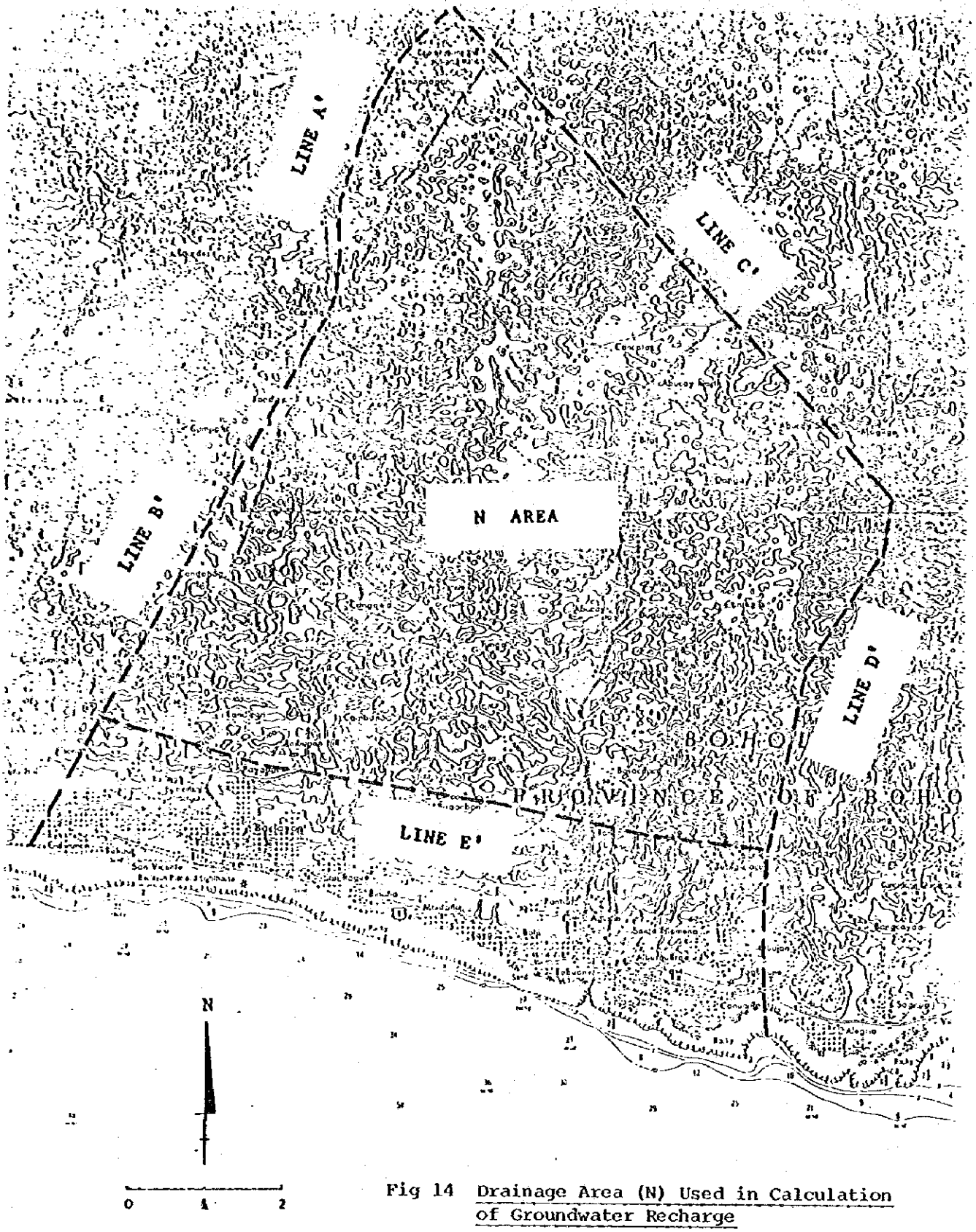

Fig 14 Drainage Area (N) Used in Calculation of Groundwater Recharge

REFERENCE

1/ Amalile Cruz (1959); Geologic Reconnaissance Survey of Bohol

2/ BCGS (1972); National Economic Atlas

3/ PAGASA (1974); Annual Climatological Review

4/ DPWTC (1966-69); Surface Water Supply of the Philippines

Appendix 4. Basic Cost Data

This appendix 4 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

Appendix 5. Socio-Economic Study

1. The Economy of the Study Area

1.1 Commerce and Services

Tagbilaran is primarily identified as a commercial and trading center. Although considered also as the educational center of the province, its economy is anchored basically in the influx of students and government workers, whose needs cater to the proliferation and growth of business and commerce. Agriculture takes a backseat as far as economic activity is concerned. Manufacturing industries are few except for some unorganized cottage industries incapable of supporting the economy.

As Table 1 indicates, 72.8% of the total households in Tagbilaran depend upon salaries and wages. These salaried and waged workers are considered to be employed by various types of establishments as listed in Table 4. Of the total 1,326 establishments, 773 or 58.3% are engaged in wholesale and retail trade. Next come those engaged in community, social and personal services, numbering 347 or 26.2%.

Most of the 927 households, 30.8% of the total household in Dauis who are depending salaries and wages for their income are reportedly employed by businesses in Tagbilaran and can be regarded as part of the Tagbilaran economy as far as their productive activities are concerned. The majority of them are living in Poblacion and Totelan where the Bohol Provincial Waterworks is supplying piped water.

1.2 Primary Industries

As shown in Table 1, those engaged in primary industries such as farming, livestock/poultry and fishing share 51.3% of the total own-operated income earners.

1.2.1 Farming

The soil of Tagbilaran lacks natural fertility to produce crops abundantly. As shown in Table 7, farm production in Tagbilaran is poor. Tagbilaran has around 1,000 part-time farmers usually cultivating less than a hectare per farmer. There is no real farmer in the city in the sense that nobody earn a living wholly dependent on the produce of soil. (See Tables 2 and 4)

1.2.2 Livestock and Poultry

In Tagbilaran City, there are three major swine producers and four commercial poultry farms. There are also found numerous households tending these animals as backyard raising producers. As shown in Table 5, the largest meat product is pork. Next comes beef and followed by chicken meat.

1.2.3 Fishing

As shown in Table 6, fishing in Tagbilaran is small-scaled with the total tonnage of vessels weighing only 100 MT, and with annual production amounting to less than 500 MT. The city is at times dependent on the fish coming from nearby market.

1.3 Manufacturing

There are around 150 manufacturing establishments in Tagbilaran but they are all small-scaled cottage type industries engaged in food-processing, furniture, handicraft, etc. (See Table 8)

1.4 Income Distribution

The survey conducted by the Tagbilaran City Planning and Development Staff in 1975 revealed that the average monthly households income in the City of Tagbilaran amounted to ₱563.86 (See Table 9). A review of households income distribution by income bracket shows that 67.4% of the total households in the city center in the bracket below ₱399. According to the Municipal Planning and Development staff of Dauis, more than 60% of households in Dauis earn less than ₱400 monthly.

1.5 Employment

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

Table 1 Number of Households by Income Source
(Source of Data: 1975 Population Census)

Classification	Tagbilaran	Dauis
a. Own-Operated Income	171	695
1) Farming	171	695
2) Livestock/Poultry	252	687
3) Fishing	220	448
4) Manufacturing	100	39
5) Retail Trade	271	76
6) Other Economic Activity	240	130
b. Salaries and Wages	4,234	927
c. Pension and Others	356	20
Total Households	5,814	3,012

Table 2 Land Use, 1980 (Areas in Hectares)
(Source of Data: City Development Officer, Tagbilaran; Municipal Development Officer, Dauis)

Classification	Tagbilaran	Dauis
1) Residential	250	133
2) Commercial	42	5.3
3) Industrial	10	0.5
4) Institutional	5	0.2
5) Agricultural	542	1,038
6) Others (inclusive of unused land)	2,406	3,348
Total Area	3,207	4,524

Table 3 Employment Size, Bohol Province
(Source of Data: 1975 Population Census)

1)	Agriculture, Forestry and Fisheries	66.1%
2)	Mining and Quarrying	0.1%
3)	Manufacturing	12.5%
4)	Electricity, Gas and Water	0.1%
5)	Construction	1.6%
6)	Commerce	6.4%
7)	Transportation, Communication and Storage	2.0%
8)	Services	11.2%
	Total	100.0%

Table 4 Number of Establishments by Major Division, 1978
(Source of Data: Census Office, Tagbilaran)

	Classification	Tagbilaran	Dauis
1)	Agriculture, Fishery and Forestry	1	-
2)	Mining and Quarrying	-	-
3)	Manufacturing	144	1
4)	Electricity, Gas and Water	2	-
5)	Construction	3	-
6)	Wholesale & Retail Trade	773	98
7)	Transport, Storage and Communication	11	1
8)	Financing, Insurance, Real Estate, Business Services	45	1
9)	Community, Social and Personal Services	347	20
	Total	1,326	121

Table 5 Livestock and Poultry Animal Population, 1980
(Source of Data: City Development Officer, Tagbilaran; Municipal Development Officer, Dauis)

No. of Animals	Tagbilaran	Dauis
1) Carabao	729	200
2) Cattle	1,960	1,166
3) Swine	7,590	5,612
4) Poultry	23,048	13,229
5) Goat	587	207
6) Horse	151	13

Table 6 Fishing
(Source of Data: City Development Officer, Tagbilaran; Municipal Development Officer, Dauis)

	Tagbilaran	Dauis
1) No. of Fisherman		
a. Sustenance fisherman	no data	1,200
b. Commercial fisherman	no data	204
2) No. of vessels		
a. Motorized vessels	no data	204
b. Non-motorized vessels	no data	919
3) Total Tonnage of Vessels	100.0 MT	450 MT
4) Annual Fish Production	489 MT	1,360 MT

Table 7 Leading Crops, 1978
(Source of Data: Socio-Economic Profile, 1980, prepared by Provincial Development Staff)

	Tagbilaran	Dauis
1) Rice		
In Cavans	280	1,176
Value	₱13,860	₱55,242
2) Corn		
In Cavans	1,672	3,520
Value	₱70,224	₱147,840
3) Coconut		
In Cavans	846,625	1,009,000
Value	₱634,959	₱756,750

Table 8 Number of Manufacturing Establishments By Type, 1978
(Source of Data: City Development Staff)

1)	Tinsmith	11	-
2)	Bakery	10	-
3)	Rice Milling	9	-
4)	Ceramics/Hollow Blocks	8	-
5)	Food Products	4	1
6)	Home Industries	4	-
7)	Furniture	3	-
8)	Wreath Shop with Flowermaking	3	-
9)	Others		-
	Total	144	1

Table 9 Average Monthly Household Income In Tagbilaran, By Income Bracket
(Source of Data: City Planning and Census Development Staff 1975 Census)

Classification	1975 No. of Households	Percentage
Below P100	816	14.4%
P100 - 199	1,271	21.8
P200 - 299	1,051	18.1
P300 - 399	765	13.1
P400 - 499	431	7.4
P500 - 599	338	5.8
P600 - 699	263	4.5
P700 - 799	161	2.7
P800 - 899	161	2.7
P900 - 999	99	1.7
P1000 and above	453	7.8
TOTAL	5,808	100.0

Table 10 Labor Force and Employment
(Source of Data: 1975 Population Census)

	Tagbilalan		Davis	
1) Population 10 years old and over	32,183		12,688	
2) In the labor force	51.9%[a/]	(100%)	58.7%[a/]	(100%)
- 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	48.1%		41.3%	

NOTE: a/ Labor participation rate
b/ Employment rate
c/ Unemployment rate

2. Social Background

2.1 Ethnical and Cultural Characteristics

The city of Tagbilaran is predominantly inhabited by people with parentage originally from Tagbilaran and from various places of the province of Bohol. Following them in number are Cebuanos who have already taken roots in the city because of their professions and business interests. This explains why the city's population is basically Cebuano or Boholano speaking people. This phenomenon is same with the Dauisanos. As shown in Table 11, Cebuano is spoken by 98.7% of the population in Tagbilaran and by 99.5% of Dauis' population.

As demonstrated by a number of religious denominations and organizations existing in the city, its people are very religious. As Table 12 shows, 97.7% of Tagbilaran's population and 100.0% of Dauisans are Roman Catholic.

2.2 Population Structure

As shown in Table 13, the study area has slightly more females than males (48.76% vs. 51% in Tagbilaran and 49.7% vs. 50.27% in Dauis). More than half of the population in the area are under 20 years old (See Table 14).

2.3 Educational Attainment Level

The educational attainment level of the city of Tagbilaran is among the highest not only in the Province of Bohol but also nationwide. This reflects that Tagbilaran is the educational center of Bohol. It has a total of 10 major educational institutions offering courses ranging from nursery classes to vocational, engineering and medical courses.

In a survey conducted by the City Planning and Development Staff of Tagbilaran in 1975, it was found out that students came from as far as Davao and Jolo, Butuan and Surigao, and students and pupils enrolled in different grade schools totalled 24,074 (See Table 15).

2.4 Dwellings

As shown in Table 16, the Households-to-Dwelling Units ratio is 1.129:1 in Tagbilaran where in-migrants outnumber out-migrants, while it represents 0.974:1 where out-migrants are over in-migrants (See Tables 16 and 17).

As shown in Table 16, single units prevail both in Tagbilaran and Dauis. There are some duplex units in Dauis. From the viewpoint of roofing materials, nearly half of houses in Tagbilaran and Dauis use aluminum and galvanized iron but light materials such as nipa also prevails in a high percentage.

Table 11 Population By Mother Tongue (Ethnic Origin)
(Source of Data: 1975 Population Census)

Classification	Bohol Province	Tagbilaran City	Dauis
Cebuano	752,564	36,834	17,869
Apayao or Isneg	1,843	-	-
Tagalog	1,535	120	20
Bicol	916	-	-
Aklanon	518	84	-
Bontoc	462	-	8
Hiligaynon, Ilongo	367	49	-
Maguindanao	188	-	-
Maranag	148	51	-
Aguyatano	120	-	-
Samal	-	-	26
All other dialects	709	197	32
Total	759,370	37,335	17,955

Table 12 Population Classified By Religion, 1970
(Source of Data: 1970 Population Census)

Classification	Tagbilaran	Dauis
Roman Catholic	32,231	15,812
Protestant	496	-
Iglesia and Cristo	44	-
Aglipayan	-	-
Islam	1	-
Buddhism	-	-
Other	210	-
None	23	-
Total	33,005	15,812

Table 14 Population by Age Group
(Source of Data: 1975 Population Census)

	TAGBILARAN			DAUIS		
	Both Sexes	Male	Female	Both Sexes	Male	Female
ALL AGES	37,335	18,428	18,907	17,955	9,004	8,951
Under 1	945	500	445	540	286	254
1 - 4	4,082	2,128	1,954	2,099	1,105	994
5 - 9	5,172	2,630	2,542	2,628	1,378	1,250
10 - 14	4,743	2,433	2,310	2,516	1,290	1,226
15 - 19	4,592	2,137	2,455	1,617	899	718
20 - 24	3,518	1,642	1,876	1,146	574	572
25 - 29	2,479	1,178	1,301	1,017	481	536
30 - 34	2,203	1,043	1,160	1,009	494	515
35 - 39	2,060	1,015	1,045	841	411	430
40 - 44	1,754	869	885	884	423	461
45 - 49	1,347	665	682	726	349	377
50 - 54	1,104	554	550	680	303	377
55 - 59	909	453	456	602	265	337
60 - 64	877	436	441	526	240	286
65 - 69	586	292	294	397	195	202
70 - 74	510	245	265	383	173	210
75 - 79	207	111	96	128	50	78
80 - 84	143	59	84	94	38	56
85 and Over	104	38	66	122	50	72

Table 13 Total, Urban and Rural Population by Sex, 1980
(Source of Data: 1980 Population Census)

Item	Tagbilaran	Dauis
1) Total Population		
Both Sexes	42,275	18,254
Male	20,614	9,076
Female	21,661	9,178
2) Urban Population		
Both Sexes	42,275	18,254
Male	20,614	9,076
Female	21,661	9,178
3) Rural Population		
Both Sexes	-	-
Male	-	-
Female	-	-

Table 15 Population 6 Years Old and Over by Highest Grade Completed, 1975
(Source of Data: 1975 Population Census)

Classification	Tagbilaran	Dauis
1) No grade completed	2,493	1,828
2) Elementary		
1st - 3rd grade	4,585	3,129
4th grade	3,001	3,129
5th grade	2,122	2,590
6th & 7th grade	4,706	3,034
3) High School		
1st - 3rd year	4,636	1,217
4th year	2,304	457
4) College (No Degree)		
1st - 3rd year	2,902	365
4th or higher	585	56
5) Academic Degree Holder	3,490	295
6) Not Stated	409	296
Total	31,233	14,730

Table 16 Dwelling Conditions (1980)
(Source of Data: 1980 Population Census and Settlement Profile)

		Tagbilaran	Dauis
1)	Number of Households	7,373	3,253
2)	Number of Dwelling Units	6,537	3,341
3)	Households-to-Dwelling Units Ratio	1,129:1	0.974:1
4)	Percentage Distribution of Dwelling Units by Type of Dwelling		
	a. Single	82.3	95.0
	b. Duplex	9.0	0.8
	c. Barong-Barong	2.2	3.9
	d. Other types	6.6	3.9
	Total	100.0	100.0
5)	Percentage Distribution of Dwelling Units by Type of Roofing Materials		
	a. Aluminum/Galvanized iron	49.8	42.8
	b. Asbestos	less than 0.1	less than 0.1
	c. Tile/Concrete	0.2	0.1
	d. Cogon	0.2	0.1
	e. Nipa	49.7	56.9
	f. Others	0.2	0.1
	Total	100.0	100.0

Table 17 Number of Dwelling Units Occupied and Vacant
(Source of Data: Census Office, Tagbilaran)

	Tagbilalan	Dauis
Total	6,636	3,341
Occupied	6,368	3,250
Vacant	268	91

3. Infrastructures

3.1 Land Transportation

The transportation system for Tagbilaran comprises of one airport, one seaport and various land roads. The airport connects the city with Cebu City by four flights a week.

The port of Tagbilaran, a tertiary port, is the major link of the province with various parts of the Region and the rest of the country via waterborne transportation.

The mode of transportation in the city depends largely on that of buses, motorcycles, tricycles, and jeepneys which totals around 2,200 in number, as listed in Table 18.

3.2 Roads

The road network of Tagbilaran City totals 119.487 kilometers, of which 53.23% is asphalted. No roads in the city is paved with concrete. The surface conditions of the roads in the city are generally poor, with 36.90% of the total length left unpaved (See Table 19).

3.3 Irrigation Systems

There is no irrigation systems either maintained by the National Irrigation Administration or by private associations.

3.4 Waterworks and Sewerage Systems

The study area is being served by a provincial water supply system, though its service is not satisfactory, as described in PART ONE.

The area has no sewerage system.

3.5 Power

The study area is presently served with electric power by the Bohol Provincial Electric System, a provincial government entity which purchases power from the Loboc Hydro Electric Plant through the National Power Corporation. As shown in Table 20, the residential consumers in the study area as of December 1980 total 3,493, or 47.38% of the total households.

Table 18 Transportation Resources in the Study Area (July, 1981)
(Source of Data: Bureau of Land Transportation)

1)	Cars	326
2)	Jeeps/Jeepneys	687
3)	Trucks	324
4)	Buses	112
5)	Trailers	6
6)	Motor-cycles	1,790
7)	Motor-tricycles	825

Table 19 Road Length and Surface Conditions

		Total Length	Surface Conditions		
			Earth	Gravel	Asphalt
1)	National Road	18,582 m	-	-	18,582 m
2)	City Road	68,667	7,738	17,301	43,628
3)	Barangay Road	32,238	4,065	26,783	1,390
	Total	119,487 m	11,803	44,084	63,600 m

Table 20 Number of Electric Consumers in Tagbilaran
(Source of Data:

	As of Dec. 1979	As of Dec. 1980
1) Residential	3,110	3,493
2) Commercial	736	770
3) Government Offices		
a. Special Rate	20	20
b. Provincial	42	44
c. Municipal	10	14
d. National	35	42
Total	3,953	4,383

Ref:

No. of Total Households (1980) : 3,493

No. of Residential Households (1980) : 7,373

Rate of Energization : 47.38%

4. Public Health

4.1 Causes of Morbidity and Mortality

A review of the leading causes of morbidity and mortality in Tagbilaran and Dauis since 1975 (shown in Table 21) shows that Gastro-Enteritis ranks 2nd highest, dysentery 8th and cholera 9th in the city of Tagbilaran, while dyspepsia and scabbies are found in the five leading causes of morbidity in Dauis (See Table 22).

As the Provincial and City Health Centers point out, these diseases are communicable and considered due to unsatisfactory sanitary environments. Particularly, inadequate clean and potable water supply and poor garbage disposal remain as contributing factors thereto.

4.2 Health Facilities

The City of Tagbilaran has a comparatively large number of health facilities, i.e., 5 hospitals including a medical college hospital and 110 other facilities. The Municipality of Dauis on the other hand, has only one facility, the municipal health center, and greatly depends upon those health facilities located in the neighboring city, Tagbilaran (See Table 23).

4.3 Sanitary Toilets

In the City of Tagbilaran, nearly 60% of the total households have flush type and water-scaled type toilets, but the rest are without sanitary ones. The statistics for the Municipality of Dauis shows that 86% of the households have toilets, though the sanitary conditions of those toilets are not described. The sanitization of toilets in both the City of Tagbilaran and the Municipality of Dauis is largely hindered by inadequate water supply.

Table 21 1975 to 1980 Leading Causes, or Morbidity and Mortality In the City of Tagbilaran
(Source of Data: City Health Center of Tagbilaran, Bohol)

	Causes of Morbidity	5-Year Average June 1975-June 1979 Rate per 100,000 pop.	Half-Year Records July-December 1980 Rate per 100,000 pop.
1)	Influenza	185.23	1.64
2)	Pneumonia	53.49	1.27
3)	Bronchitis	102.81	0.74
4)	Gastro-Enteritis	138.54	0.34
5)	Mumps	0.00	0.11
6)	Measles	38.10	0.06
7)	Dysentery all forms	8.29	0.06
8)	Cholera	0.00	0.06
9)	Tuberculosis all forms	0.00	0.02
10)	Chicken Pox	0.00	0.02
	Causes of Mortality		
1)	Arteriosclerosis H. Disease	23.52	9.7
2)	Septicemia	7.02	8.94
3)	Pneumonia	18.76	8.13
4)	Cerebro-Vescular Accident	18.42	7.31
5)	P.T.B. all forms	31.23	5.69
6)	Congestive Heart Failure	15.12	4.87
7)	Stillbirth	11.05	4.06
8)	Prematurity	0.00	3.25
9)	Gastro-Enteritis	0.00	2.43

Table 22 1976 to 1980 Leading Causes of Morbidity and Mortality in the Municipality of Dauis 5-Year Average

	Causes of Morbidity	Rate per 100,000 Population
1)	C. Cold	210
2)	Dyspepsia	200
3)	Urti	183
4)	Wound (infected)	163
5)	Scables	135
6)	Bronchitis	105
7)	Fever	84
8)	Parasitism	50
9)	Hypertension	45
10)	Hyperacidity	20

	Causes of Mortality	Rate per 100,000 Population
1)	CHF	165
2)	Broncho-P	135
3)	Koch- P	120
4)	CVA	73
5)	Malignancy	58
6)	Prematurity	57
7)	Cirrhosis Liver	42
8)	Cardio-Resp. Failure	34
9)	Cong. Anomalies	20
10)	Nephroses	15

Table 23 Health Facilities (In Number)
(Source of Data: City Health Center of Tagbilaran and Municipal Health Center of Dauis)

	The City of Tagbilaran	Number
1)	Hospital	5
2)	Health Units, Clinics, and other facilities	110

	The Municipality of Dauis	
1)	Hospital	-
2)	Health Units, Clinics, and other facilities	1

Table 24 Number of Households and Percent of Households with Sanitary Toilets
(Source of Data: City Health Center of Tagbilaran and Municipal Health Center of Dauis)

Tagbilaran

Total Households (In Number) 7,373

1)	Household with flush & water-sealed type toilets	58.55%
2)	Households with open pit toilets	5.80%
3)	Others	35.65%

Dauis

Total Households (In Number) 3,253

1)	Households with toilets	86.10%
2)	Households without toilets	13.90%

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 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.