The present worth benefit of increase in land values from the project implementation is shown in TABLE 10.3.1.

10.3.2 Beneficial Value of Water

It is assumed that all residents of the served area would be willing to obtain water in sufficient quantities at a given price. In general, water prices charged by the Water District are lower than the real value of water. Taking the benefits for "consumer's satisfaction" into consideration, it is assumed that the economic value of water is 20% higher than the de-escalated average rate per cu.m of water used in the Financial Analysis.

The economic value of water is shown in TABLE 10.3.2.

10.4 ECONOMIC COSTS OF THE PROJECT

The direct costs of the project should be transformed into economic costs. For this purpose, the project cost and operating and maintenance costs are considered in the study. These costs will be converted into the economic costs using factors for shadow pricing. The factors for shadow pricing applicable to the study are as follows:

- Foreign exchange component: 1.3
- Unskilled labor premium : 0.5
- Others : 1.0

All taxes should be excluded in the economic study. It is assumed that the cost for the balance of domestic component includes hidden taxes for 5% of the amount.

TABLE 10.3.1 PORTION OF LAND VALUES ATTRIBUTABLE TO PROJECT

Year	Land Use (1,000sq.m)[1/]		Cost of Land (₱1,000)			
	Residential	Commercial/Industrial/Institutional	Residential (₱50/sq.m)	Commercial/Industrial/Institutional (₱120/sq.m)	Total Cost of Land	20 Percent Due to Project[2/]
1988						
1989						
1990						
1991	720	80	36,000	9,600	45,600	9,120
1992	720	80	36,000	9,600	45,600	9,120
1993	810	90	40,500	10,800	51,300	10,260
1994	720	80	36,000	9,600	45,600	9,120
1995	720	80	36,000	9,600	45,600	9,120
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						

1/ The service area of 340 ha from 1988 to 1990 is projected to increase annually by 80 ha in 1991, 1992, 1994 and 1995 and 90 ha in 1993. Land use is assumed to be 90% residential and 10% commercial.

2/ Portion of land values specifically attributable to water supply project is 20%.

TABLE 10.3.2 INCREASE IN CONSUMER STATISFACTION

Year	Incremental Accounted-For Water[3/] (1,000 cu.m/year)	Price Per cu.m[4/]	Economic Value Per cu.m[5/]	Economic Water Revenues (₱1,000)
1988	-83	2.64	3.17	-263
1989	441	2.77	3.32	1,466
1990	972	2.44	2.93	2,846
1991	1,829	3.28	3.94	7,199
1992	2,688	4.40	5.28	14,193
1993	3,544	4.23	5.08	17,989
1994	4,403	4.04	4.85	21,346
1995	5,261	3.61	4.33	22,791
1996	5,261	3.43	4.12	21,654
1997	5,261	3.06	3.67	19,318
1998	5,261	3.23	3.88	20,392
1999	5,261	3.33	4.00	21,023
2000	5,261	3.30	3.96	20,834
2001	5,261	2.95	3.54	18,624
2002	5,261	3.42	4.10	21,591
2003	5,261	3.05	3.66	19,255
2004	5,261	3.15	3.78	19,887
2005	5,261	2.81	3.37	17,740
2006	5,261	2.84	3.41	17,929
2007	5,261	2.99	3.59	18,876

3/ The volume of accounted-for water of 1.13 million cu.m in 1986 is deducted from the projected water consumptions throughout the study period to obtain incremental volume.

4/ The price per cu.m was based on the de-escalated average rate/cu.m in the financial analysis.

5/ The economic value was assumed to be 1.2 times the price per cu.m of water.

10.4.1 Project Cost

By using the shadow pricing factors, the economic project cost is ₱114.17 million which was obtained based on the project cost used in the Financial Feasibility Analysis as shown in TABLE 10.4.1.

10.4.2 Salvage Value

TABLE 10.4.2 presents the salvage value of all the capital equipment in the project in 2007. The percentage of the salvage value was based on the remaining service life of the facilities in 2007.

10.4.3 Operating and Maintenance Costs

In the economic analysis, operating and maintenance costs of personnel, power, chemicals, and maintenance are considered. Likewise, this cost category is converted to economic costs by the shadow pricing factors. TABLE 10.4.3 shows the economic operating and maintenance cost.

10.5 ECONOMIC INTERNAL RATE OF RETURN (EIRR)

EIRR is determined based on economic costs and benefits of the projects. TABLE 10.5.1 shows the computation of the EIRR. The EIRR is 17.6%. Since this rate exceeds the opportunity cost of capital of 12%, and a number of unquantifiable benefits will be also conceived from the implementation of the project, the project is considered economically feasible and an undertaking of the project is suggested itself to proceed positively.

TABLE 10.4.1 ECONOMIC PROJECT COST

(Unit : ₱1,000)

	Financial Project Cost	Foreign Exchange Component	Domestic Component	Unskilled Labor	Balance of Domestic Component	Taxes (5%)	Others (95%)	SHADOW PRICING: Foreign Exchange Component x 1.3	SHADOW PRICING: Unskilled Labor x 0.5	SHADOW PRICING: Others x 1.0	Total Economic Cost
Civil Works											
Deep Well Facilities	6,398	1,579	4,819	585	4,234	212	4,022	2,053	292	4,022	6,367
Transmission Facilities	789	309	480	69	411	20	391	402	35	391	828
Reservoir	3,824	1,093	2,731	294	2,437	122	2,315	1,421	147	2,315	3,883
Disinfection Facilities	306	39	267	24	243	12	231	51	12	231	294
Electric Sub-station	1,033	427	606	55	551	27	524	555	28	524	1,107
Distribution Facilities	14,214	4,457	9,757	1,587	8,170	409	7,762	5,794	793	7,762	14,349
Service Connection	1,896	172	1,724	505	1,219	61	1,158	223	252	1,158	1,633
Land Acquisition	588	0	588	0	588	29	559	0	0	559	559
Admin. Bldg. & Ope. Ctr.	795	143	652	79	573	29	543	186	40	543	769
Vehicle & Stored Material	0	0	0	0	0	0	0	0	0	0	0
Sub-Total of Civil Works	29,843	8,219	21,624	3,198	18,426	921	17,505	10,685	1,599	17,505	29,789
Equipment											
Deep Well Facilities	7,707	5,872	1,835	0	1,835	92	1,743	7,634	0	1,743	9,377
Transmission Facilities	926	532	394	0	394	20	374	692	0	374	1,066
Reservoir	378	210	168	0	168	8	160	273	0	160	433
Disinfection Facilities	479	361	118	0	118	6	112	469	0	112	581
Electric Sub-station	1,624	1,448	276	0	276	14	262	1,882	0	262	2,144
Distribution Facilities	21,421	14,643	6,778	0	6,778	339	6,439	19,036	0	6,439	25,475
Service Connection	15,393	14,713	680	0	680	34	646	19,127	0	646	19,773
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0
Admin. Bldg. & Ope. Ctr.	795	572	223	0	223	11	212	744	0	212	956
Vehicle & Stroed Material	2,757	1,704	1,053	0	1,053	52	1,001	2,215	0	1,001	3,216
Sub-Total of Equipment	51,580	40,055	11,525	0	11,525	576	10,949	52,072	0	10,949	63,021
Total of C.W. & Equipment	81,423	48,274	33,149	3,198	29,951	1,497	28,454	62,757	1,599	28,454	92,810
Physical Contingencies 6/	6,514	3,862	2,652	256	2,396	120	2,276	5,021	128	2,276	7,425
Engineering Services 7/	11,399	6,758	4,641	448	4,193	210	3,983	8,786	224	3,983	12,993
Leakage Detection	990	0	990	0	990	50	940	0	0	940	940
Project Cost	100,326	58,894	41,432	3,902	37,530	1,877	35,653	76,564	1,951	35,653	114,168

6/ 8% of Total Cost of Civil Work & Equipment
7/ 14% of Total Cost of Civil Work & Equipment as Engineering Charge and Construction Supervision

TABLE 10.4.2 SALVAGE VALUE IN YEAR 2007

(Unit : ₱1,000)

Year	Economic Value	Remaining Life in 2007 8/	Salvage Value
1988	13,620	50.0 %	6,810
1989	34,995	52.5	18,372
1990	14,464	55.0	7,955
1991	14,539	57.5	8,360
1992	9,331	60.0	5,599
1993	9,331	62.5	5,832
1994	9,303	65.0	6,047
1995	8,585	67.5	5,795
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			64,770

8/ The average economic life of all items is assumed to be 40 years.

TABLE 10.4.3 INCREMENTAL ECONOMIC OPERATION & MAINTENANCE COST

(Unit : ₱1,000)

Year	Financial O & M Cost	Foreign Exchange Component	Domestic Component	Taxes (5%)	Others (95%)	SHADOW PRICING Foreign Exchange Component x 1.3	SHADOW PRICING Others x 1.0	Economic O & M Cost	Net Economic O & M Cost
1987	1,980	635	1,345	87	1,278	826	1,278	2,104	-
1988	1,900	299	1,601	80	1,521	389	1,521	1,910	-194
1989	2,465	471	1,994	100	1,894	612	1,894	2,506	402
1990	2,989	630	2,359	118	2,241	819	2,241	3,060	956
1991	3,775	854	2,921	146	2,775	1,110	2,775	3,885	1,781
1992	4,559	1,097	3,462	173	3,289	1,426	3,289	4,715	2,611
1993	5,346	1,300	4,046	202	3,844	1,690	3,844	5,534	3,430
1994	6,130	1,523	4,607	230	4,377	1,980	4,377	6,357	4,253
1995	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
1996	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
1997	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
1998	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
1999	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2000	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2001	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2002	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2003	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2004	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2005	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2006	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078
2007	6,916	1,747	5,169	258	4,911	2,271	4,911	7,182	5,078

TABLE 10.5.1 ECONOMIC INTERNAL RATE OF RETURN

(Unit : 1,000 Pesos)

Year	Total Economic Benefits	Total Economic Costs	Net Benefits	Present Value
1988	-263	13,426	-13,689	-13,689.0
1989	1,466	35,397	-33,931	-28,848.0
1990	2,846	15,420	-12,574	-9,088.9
1991	16,319	16,320	-1	-0.6
1992	23,313	11,942	11,371	5,941.2
1993	28,249	12,761	15,488	6,880.1
1994	30,466	13,556	16,910	6,386.5
1995	31,911	13,663	18,248	5,859.4
1996	21,654	5,078	16,576	4,525.2
1997	19,318	5,078	14,240	3,305.1
1998	20,392	5,078	15,314	3,021.9
1999	21,023	5,078	15,945	2,675.1
2000	20,834	5,078	15,756	2,247.4
2001	18,624	5,078	13,546	1,642.7
2002	21,591	5,078	16,513	1,702.5
2003	19,255	5,078	14,177	1,242.7
2004	19,887	5,078	14,809	1,103.7
2005	17,740	5,078	12,662	802.3
2006	17,929	5,078	12,851	692.3
2007	18,876	-59,692	78,568	3,598.5
			EIRR (%)=	17.62

CHAPTER 11
ORGANIZATION AND MANAGEMENT

CHAPTER 11 ORGANIZATION AND MANAGEMENT

11.1 PRESENT ORGANIZATION STRUCTURE

The Angeles City Waterworks System (ACWS) is owned, operated and maintained by the city government of Angeles.

A total of 37 personnel is assigned to the ACWS; 31 for operation and maintenance services under the City Engineer's Office and six for the collection services under the City Treasurer's Office. (See FIGURE 11.1.1 for the present organization structure of the system).

The city mayor is the chief appointing officer. All management and operational policies emanate from the city mayor and the Sangguniang Panlungsod.

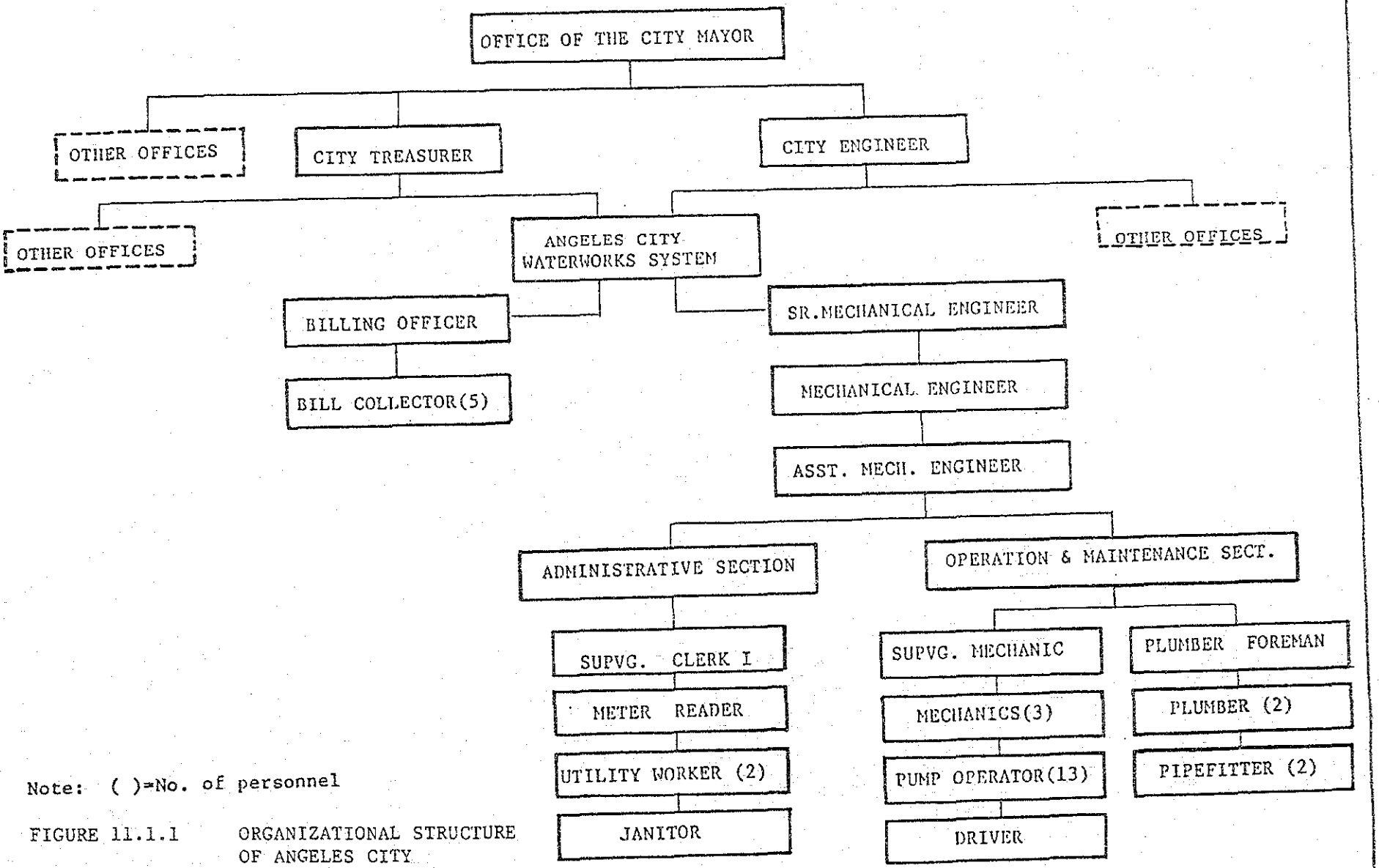
Tax Ordinance No. 8, series 1978 defines the schedule of water rates for the ACWS. It is actually the Sangguniang Panlungsod that decides on the approval of such rates and its date of effectivity.

11.2 PROPOSED ORGANIZATION STRUCTURE

11.2.1 Introduction

The proposed organization structure for the ACWS is the water district structure. The JICA Study Team believes that with the water district organization structure, the water system can look forward to dedicated policy makers providing continuity of policy and its consistent enforcement; to financial independence and business-like management; to capable, qualified and regularly trained personnel; and to freedom from political interference in its operations, particularly on hiring and water rates setting.

The JICA Study Team, however, proposes some changes on both the staffing guidelines as well as the organization chart. The basic water district structure, now existing remains the same.



Note: ( )=No. of personnel

FIGURE 11.1.1 ORGANIZATIONAL STRUCTURE OF ANGELES CITY WATERWORKS SYSTEM

11.2.2 Examination of the LWUA Methodology Manual

The number of water district employees depends primarily on the total number of service connections. Based on this concept, LWUA's Methodology Manual proposes the following staff requirement for a water district.

Personnel	No. of Connections				
	2,000	5,000	10,000	15,000	20,000
General Manager	1	1	1	1	1
Administrative Staff	7	14	20	22	23
Technical Staff	16	35	59	75	92
Commercial Staff	12	25	40	52	64
- meter readers, bill collectors, inspectors	(6)	(14)	(25)	(32)	(42)
- other employees	(6)	(11)	(15)	(20)	(22)
Total Staff	36	75	120	150	180
Staff/1,000 Connections	18	15	12	10	9

Note: The above data do not include personnel for construction of new connections, etc. which are considered to be part of development cost. These development expenses entail additional staff which is assumed to be 15 personnel per 1,000 additional service connection.

Moreover, the above figures are related to a water supply system without treatment plant. If such plant were necessary, additional 10 to 15 employees for each treatment plant with a capacity ranging from 10,000 to 50,000 cu.m/day may be considered.

Above-indicated table shows the staff requirement corresponding up to 20,000 connections. Therefore, we cannot use this table to compute the number of personnel both for Angeles Water District and Dagupan Water District in 1995 and 2010, since they will apparently be beyond the extent of the table.

It is possible, not to mention, that it can be estimate the number of personnel exceeding 20,000, on the basis of some assumption of personnel number per 1,000 connections. but it seems to be slightly forcible.

Therefore, JICA Study Team checked the formula derived from the result of a statistical analysis of the number of personnel in relation to the number of connections for 38 existing water districts for the years 1979, 1980 and 1982.

The guideline proposes two staffing levels. The first level has been proposed for the period 1986-1995; the second for the period 1996-2010.

The upper staffing level for the period 1996-2010 was computed from the formula:

$$\log (\text{no. of employees}) = \log (\text{no. of connections}) \times 0.8311 - 1.2113$$

See FIGURE 11.2.1 for the number of personnel needed for the Angeles City Water District, once formed, using the LWUA Methodology Manual.

The lower level, which was assumed for the earlier period from 1986-1995 allows a 30% reduction in staff below the calculated value.

Using the above mentioned formula, the number of personnel for ACWS, if formed into a water district, could be computed as follows:

Design Year	No. of Employees
1995	179
2010	411

It is true that the formula presented by LWUA as a guideline in this study is based on the result of a statistical analysis of the existing water district. But no evaluation has been undertaken whether the figures which were derived from the formula are appropriate or not.

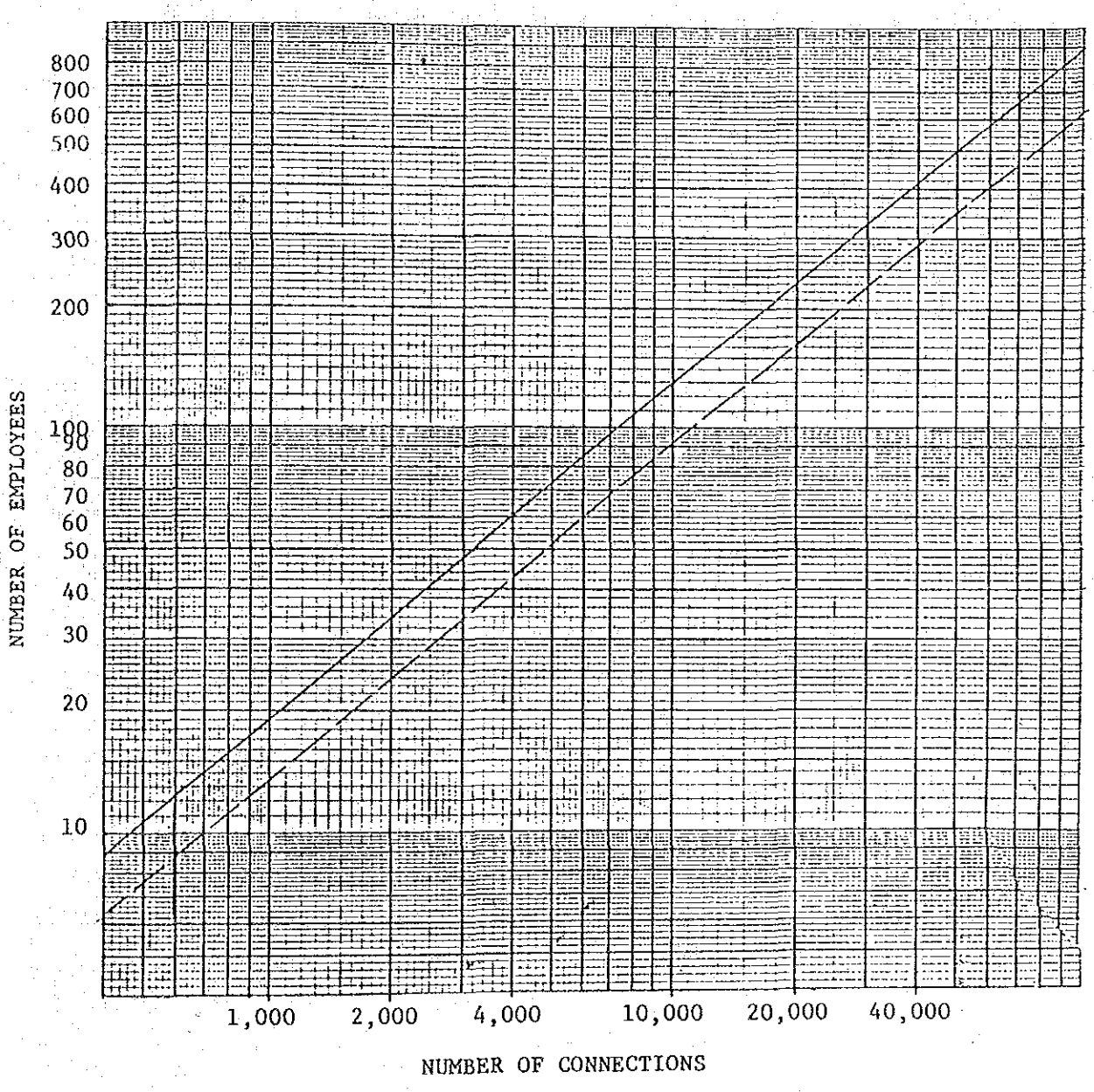


FIGURE 11.2.1 PROPOSED WATER DISTRICT STAFF BY LWUA METHODOLOGY MANUAL

Considering the actual scope and content of operation and management work, the number of personnel computed from the LWUA Methodology Manual, seems to be rather high, particularly for the year 2010.

In this study, therefore, a new proposal regarding the number of personnel based on the appropriate performance of individual work may be recommended.

11.2.3 Proposed Guideline of the JICA Study Team

The task of management is to carry policy into effect with the fullest efficiency withing the limits assigned; that is, to attain maximum performance at minimum cost. It is the duty of management to create conditions which will bring about the optimum use of all resources available to the water district.

Based on this concept, the JICA Study Team examined the present structure of the existing waterworks, not only with regard to the number of personnel; but also with regard as a reference were the statistical data regarding the number of personnel and organization structures of waterworks systems in developed countries.

The procedure which has been adopted in this study is, at first, to divide the organization of a water district into two main branches.

a) The administrative and commercial division, comprising what may be termed the business management (including matters concerning water charges) of the water district.

b) The engineering and technical division, embracing the design and construction of minor extension or improvement works utilizing internal reserve fund; and the operation renewal and maintenance of existing works.

Secondly, the number of personnel has been computed considering the present number of personnel of the ACWS and appropriate performance of individual assignment.

TABLE 11.2.1 shows the JICA Study Team's guideline on the personnel needed to man the proposed water district by scope and content of work.

It was decided by JICA Study Team, to assign no bill collector based on the assumption that the consumers will pay water charges directly to the water district or through their affiliated banks.

TABLE 11.2.2 shows the summary of the present (1986) and the proposed staffing pattern (1995 and 2010) for the ACWS.

11.2.4 Organization Structure

The organization structure proposed for the ACWS is basically the water district structure.

The water system/district will be headed by a five-man Board of Directors, as per PD 198, who will come from the various sectors of the community and will be appointed by the mayor or governor, as the case may be. It is this Board that will set all the policies of the water system/district.

The two broad divisions of the system/district will be:

a) Administrative and Commercial Division
b) Technical Division

Later on, it would be necessary for the ACWS (Water District) to create the position of Assistant General Manager. And as the commercial operations expand, it also might be necessary and advisable to split the Administrative and Commercial Division into two divisions.

TABLE 11.2.1 STAFFING GUIDELINE

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
General Manager	1	Sec.23 of Provincial Water Utilities Act of 1973
ADMINISTRATIVE AND COMMERCIAL		
Asst. General Manager	1	
General Affairs Division Manager Staff	 1 2 (< 20,000 connections) 4 (< 50,000 connections)	°Correspondence °Filing °Agendas °Establishment °Resister of Land, fixed assets °Tenancies °Statistics °General Information and Returns °Board Work, Contracts °Miscellaneous
Account Division Manager Staff	 1 3 (< 10,000 connections) 5 (< 30,000 connections) 7 (< 50,000 connections)	°Cash Receipts and Payments °Revenue Expenditure °Capital Expenditure °Borrowing Powers °Rates and Rating °Wages and Insurance °Recoverable Charges °Procurement of Equipment and Materials °Supplies °Miscellaneous Costs
General Service Division Manager Clerk Mechanics Staff	 1 1 1 4 - 10	°Store-keeping °Transportation °Utilities 4 for less than 10,000 conn., 6 for less than 20,000 conn., 10 for more than 20,001 conn.

TABLE 11.2.1 STAFFING GUIDELINE (continued)

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
Water Charges Division		°Assessments °Resister of Supplies °Guarantees °Meter Charges °Revision of Charges °Statistics °Water Survey °Meter Reading (Consumption, Complaints, Reports) °Collection of Water Charges
Manager	1	
Clerk	2 (<20,000 connections) 3 (<30,000 connections) 5 (<50,000 connections)	
Meter Reader	Proportional to the no.of conn.	° One (1) meter reader per 1,500 connections
TECHNICAL		
Asst. General Manager (Eng'r)	1	
Distribution Division		°Preservation of Water Sources,Prevention of Pollution °Afforestation (in case of spring source) °Operation and Maintenance °Service Reservoirs °Transmission Mains/ Distribution Mains* °Pumping Stations * Hydrants and Valves * Waste Inspection * Extentions, Renewals, Cleaning and Repairs,Street Repairs
Manager (Eng'r)	1	
Mechanics	2	
Electrician	1	
Pump Operators	2 for every 5 stations	
Reservoir Attendants	2	° Two (2) attendants per one reservoir
Pipeline Patrol	Prop'l to the Pipeline length	° One (1) staff per every five (5) kilometer for the first 60 km, then add one per every ten (10) kilometer
General Maintenance	3	° Painters, Blacksmith & c.

TABLE 11.2.1 STAFFING GUIDELINE (continued)

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
Service Works Division		°Meter Fixing and Repairs
Manager	1	°Meter Fixing °Exchanging and Testing °Repairing
		°Plumbing
		°Laying and Maintenance of Service Pipes and Fittings °Plumbing Repairs °Testing of Fittings
Fitters	Proportional to the no.of conn.	° Two(2) fitters for the first 20,000 connections, then add one (1) fitter for every additional 10,000 connections
Meter Repairman	Proportional to the no.of conn.	° Two(2) repairers for the first 10,000 connections, then add one (1) repairer for every additional 10,000 connections
Plumbers	Proportional to the no.of conn.	° Two(2) plumbers for the first 20,000 connections, then add one (1) plumber for every additional 10,000 connections
Laborers	Proportional to the no.of conn.	° Two (2) laborers for the first 20,000 connections, then add one laborer forevery additional 10,000 connections

TABLE 11.2.2 SUMMARY OF PRESENT (1986) AND PROPOSED (1995 and 2010) STAFFING PATTERN (ANGELES CITY)

	1986	1995	2010
Population Served	27,600	101,900	168,200
No. of Connections	4,128	22,500	40,000
Supply Capacity (cu.m/day)	12,000	31,300	59,800
Length of T/D Main (m)	2,000	17,000	36,000
No. of Pump Stations	11	14	24
General Manager	-	1	1
ADMINISTRATIVE AND COMMERCIAL			
Assistant General Manager	-	1	1
General Affairs	1	4	4
Accountancy	-	5	8
General Services	4	13	13
Water Charges			
Manager	-	1	1
Clerk	1	3	5
Meter Reader	1	15	27
Bill Collector	5	-	-
Sub-Total	7	19	33
Total	12	39	59
TECHNICAL			
Assistant General Manager	1	1	1
Distribution			
Manager	-	1	1
Mechanics	6	2	2
Electrician	-	1	1
Pump Operator	13	5	10
Reservoir Attendant	-	2	6
Patrol	-	4	8
General Maintenance	-	3	3
Sub-Total	19	19	32
Service Works			
Manager	-	1	1
Fitter	2	3	5
Meter Repairman	-	3	4
Plumber	3	3	5
Laborer	-	3	5
Sub-Total	5	13	20
Total	25	32	52
GRAND TOTAL	37	72	112

For now, however, the two division structure is recommended and the proposed number of personnel for both divisions is:

Position/Division	1995	2010
General Manager	1	1
Administrative and Commercial	39	59
Technical	32	52
Total	72	112

FIGURE 11.2.2 shows the proposed organization chart for the ACWS Water District.

11.3 MANAGEMENT

11.3.1 Importance of Management

As stated in Section 11.2.3, the task of management is to carry policy into action with the fullest efficiency within the limits assigned; that is, to attain maximum performance at minimum cost. It is the duty of management to create conditions which will bring about the optimum use of all resources available to the water district. Thus the scope of management carries with it a lot of responsibilities.

The continuous and successful operation of a water district depends largely on the patronage of its consumers. The consumers would only patronize a water district if it can provide them safe water in sufficient quantities at all times at a cost within their reach. Patronage of consumers can be achieved through good management.

11.3.2 Functions and Duties of General Manager/Staff

FIGURE 11.2.2. shows the departmental organization in a medium-sized water district whose sources of supply are deep wells. (If its sources are surface water, the treatment plant staff should be added.)

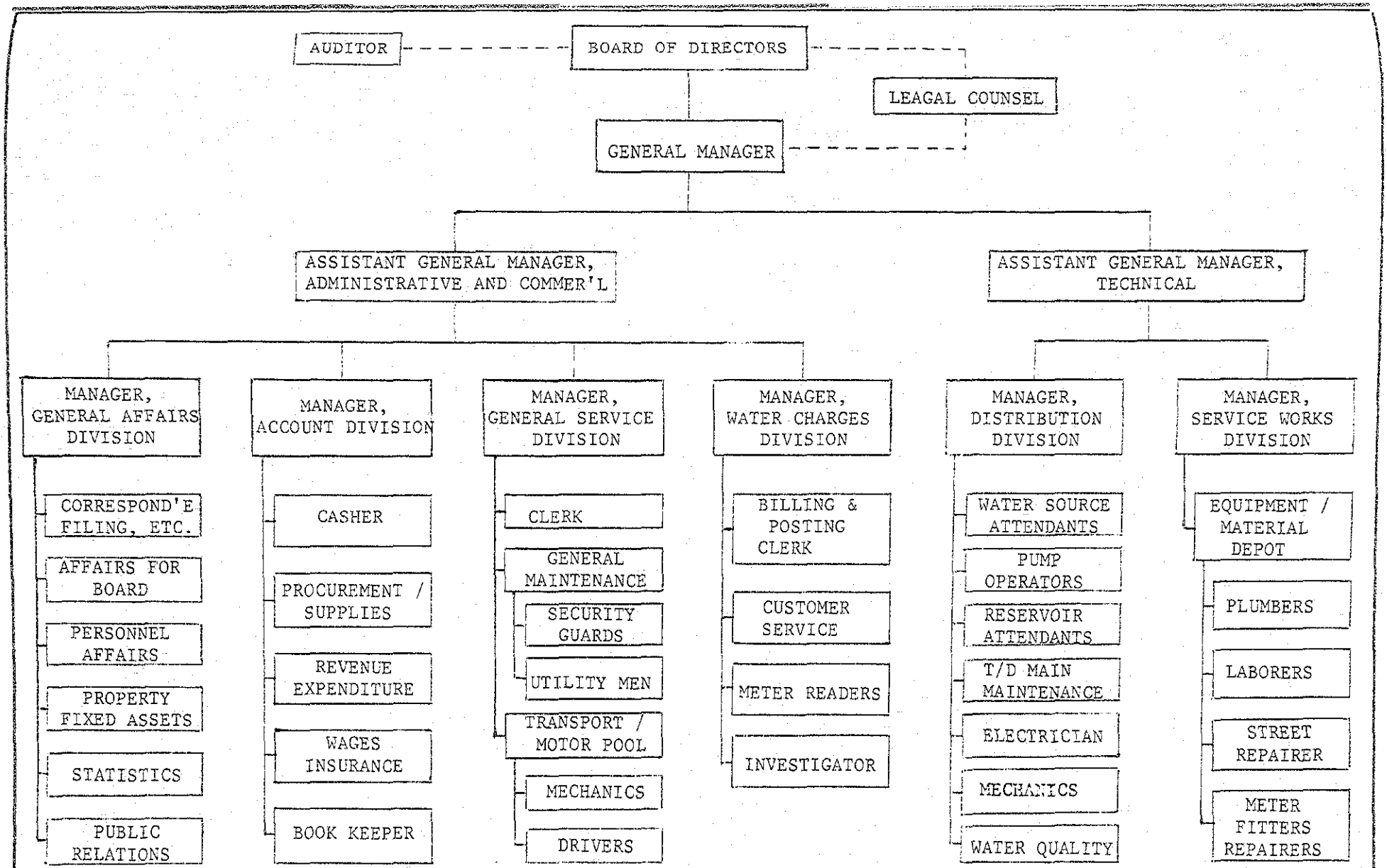


FIGURE 11.2.2 PROPOSED ORGANIZATION STRUCTURE

Many of the functions indicated on the chart are common to the four proposed water districts respectively, although relatively small water districts (e.g., Bayombong-Solano Water District) may find it unnecessary to departmentalize during the early stage.

A carefully planned organization is essential to ensure that the needs of consumers throughout the area can be promptly appreciated and efficiently met. Thus, it is also desirable that every member of the organization not only understand and realize the significance and importance of his or her particular function but also properly discharge that particular function.

(1) The General Manager

Provincial Water Utilities Act of 1973 prescribes the Officers and Employees as follows:

> "SEC. 23. The General Manager. --- At the first meeting of the Board, or as soon as practicable, the Board shall appoint, by a majority vote, a general manager and shall define his duties and fix his compensation. Said officer shall serve at the pleasure of the Board. (As amended by Sec. 9, PD 768)
>
> SEC. 24. Duties. --- The duties of the General Manager and other officers shall be determined and specified from time to time by the Board. The General Manager, who shall not be a director, shall have full supervision and control of the maintenance and operation of water district facilities, with power and authority to appoint all personnel of the district: Provided, that the appointment of personnel in the supervisory level shall be subject to approval by the Board. (As amended by Sec. 10, PD 768)"

Thus, the duties fall, to a large extent, within the sphere of administration. The General Manager should therefore, have managerial ability, and a thorough knowledge of the administrative machine which he controls. Managerial ability implies the ability to select suitably trained or qualified staff, to delegate work and responsibility wisely, and to create and maintain a spirit of co-operative enthusiasm throughout the

entire organization. The General Manager must be able to co-ordinate the efforts of the several different sections, and should keep in close touch with the more important matters being dealt with by each.

Since water industry is mainly concerned with the problems of the collection of water, its storage, treatment (at least chlorination), and distribution, it is most desirable that the General Manager is a chartered civil/sanitary engineer who also has managerial abilities on general, and especially, financial matters.

Presently, however, the four study areas are not yet managed as a water district, for these systems to start out rightly, it must be able to have a man of managerial competence and experience appointed as a General Manager.

Therefore, the first priority should rather be given to managerial ability rather than to be an engineer. In case any other non-technical person is appointed as the General Manager, the General Manager should be assisted by a chief engineer.

Although the General Manager is responsible for the day-to-day conduct of affairs of the water district, he should not become too immersed in details. He should exercise over-all supervision and control, thereby giving himself ample time to plan the improvement/development of the Water District carefully in anticipation of the consumer's needs, and to deal promptly with unforeseen situations of major importance as they arise.

(2) The Administrative Machine

As indicated in the FIGURE 11.2.2, the proposed organization of the water district can be divided into two main branches:--- (1) the Administrative, and (2) the Technical.

These two branches are in contact at many points, and are so interdependent that a high degree of co-operation is essential to ensure coordination of effort, economy in working, and proper balance between income and expenditure. Each of these two main branches is, in turn, divided into a number of subsections.

As efficient administration cannot be achieved by staff in water-tight compartments, officers in charge of departments should not only possess a detailed knowledge of every aspect of the work of their respective departments, but should also take an interest in, and have a general knowledge of, the work of other departments.

In the organization depicted in functional form in FIGURE 11.2.2, it seems not necessary to mention the scope of the individual works one by one basis. Keynotes or recommendations are as follow:---

11.3.3 Problems Arising from the Transition of Administrations

Transition from the existing water supply organizations to the respective water districts will inevitably take time. Each water authority then should make necessary preparations for setting up respective water districts in various aspects --- legislative, budgetary, personnel and technical.

(1) Personnel

a) Appointment of qualified personnel to the key positions is indispensable for good management of a water district. Generally, it might be somewhat difficult to get well educated or qualified personnel in local cities and municipalities, especially in areas far from Metro Manila. However, there are other aspects that may make up for apparent lack of education or qualification. These are experience, the right attitude and the potential or capacity of a person to learn.

b) If the employees who belong to the existing water supply authorities will transfer to the proposed water districts there will be no displacement, since the number of employees of the existing water supply authorities are less than the proposed number of personnel required for water districts in the target years 1990 and 2010.

However, there may be problems on absorbing dead wood or unwanted employees. It may be best to terminate such employees services

at the start of the water district operations so as not to complicate matters further.

c) It is recommended that the experience of the personnel who have worked for a long time for the relevant water authority and are well acquainted with that water supply system, managerially or technically, be made good use of.

d) In the procedures for recruitment, if necessary, any newly formed water district may fully utilize LWUA's assistance to obtain desirable personnel, especially for managerial positions. It is expected, therefore, LWUA can use its testing system to recommend the most appropriate candidate as required water district.

e) Attention should be given to procedures for the recruitment, proper use and retention of technical personnel including the establishment of career structures.

f) Training of personnel on all levels and categories is a vital aspect in relation to work performance, morale and retention of staff. It was disclosed through the study, that most of the staff of all the four water supply systems have not enjoyed the benefits of any kind of training at all. Before and after the formation of these systems into water districts, LWUA should train the personnel from the board of directors and General Manager down to the plumber.

g) An information dissemination and public relations programs should be developed. The water districts serves the people and needs the support of the people, especially on payment of water bills or when the water rates are increased. It should therefore regularly inform and educate its public on the plans and programs of the water district and on the correct usage of water.

(2) Change of Charging System

a) At present, in the waterworks of Angeles City, Dagupan City and Cabuyao-Sta. Rosa-Biñan, the combined use of flat rate system and

metered system is adopted, while in Bayombong-Solano only a flat rate system is adopted because all the faucets are unmetered.

In principle, the proposed four water districts should be operated and managed on the basis of 100% metering, in accordance with the Letter of Instruction No. 700, June 1, 1978, to insure correct charging of water actually consumed and discourage its wasteful use. One hundred percent (100%) metering is the basis of the water tariff structure and, in effect, is the basis for financial viability.

b) To install water meters (including replacement of the nonfunctioning/malfunctioning meters) to all the consumers takes time. Therefore, it is necessary to stipulate a provisional rate regulation of combined use of flat rate and metered system, fixing the target date by which 100% metering should be realized.

c) Since the life of water meters is about 8 years, the water district should have a plan to replace water meters installed at every customer once in 8 years basis and to guarantee the budget and manpower necessary for its execution.

11.3.4 Problems Arising from Rapid Expansion of the Systems

(1) Coordination During Construction Period

According to the demand projection in the target year for the Short Term Development, the size of the water supply systems will more than double compared to its present size.

Considering the rapid expansion of the water supply systems, there may be much inconvenience caused by the construction work. For instance, to minimize water interruption and traffic congestion caused by pipe laying work, it is necessary to develop close coordination and cooperation between the respective water district and LWUA (Engineering Services) together with the local transportation authorities and inform the people to be affected by the expansion project.

(2) Office Accommodation for Increasing Personnel

Increase of personnel requires a larger office space. In this regard, the newly established water districts may talk with the related cities/municipalities respectively of utilization of the former office space of the respective water supply authorities until the water district could afford to move to a new office.

11.4 OTHER RECOMMENDATIONS

11.4.1 LWUA Assistance

Immediately upon their formation into water districts, it is recommended that the LWUA install an appropriate commercial practice system (CPS) to back up the said water districts. Also, an effective acquisition and sustained training programs for both water district officials and personnel should be formulated and implemented as soon as possible. A rational public information and education program should also be undertaken by the new water districts.

The JICA Team also reminds that the LWUA maximizes its assistance to the proposed water district upon its formation. It is expected that partially the proposed water district will need LWUA's assistance in all aspects of its operation and financial, technical and institutional. It is believed that this package of assistance will greatly enhance the water system's capability to provide an adequate and efficient water service to its consuming public.

11.4.2 Formation of Water Districts

Basically, LWUA provides every necessary assistance once a waterworks system is formed into a water district. Yet, under the decree that created both LWUA and the water district (PD 198, as amended), the formation of a water district is at the option of the local governments concerned.

There is actually a very positive trend towards the formation of water districts in the above-mentioned four study areas. Members of the Sangguniang Panlalawigan/Panlungsod have been taking an increasing interest in the importance of an improved water supply system.

The JICA Team believes LWUA can facilitate things by having a more aggressive program or campaign in water district formation itself; but should include effective information measures to promote formation through grass-roots and media based campaigns.

APPENDICES

APPENDIX 3.2.1 LIST OF SUBDIVISIONS (March 1983)

NAME OF SUBDIVISION	OWNER/OPERATOR	L O C A T I O N	AREA (In Sq. M.)
1. Abacan Subdivision	Nicolas Tinio	Balibago	51,180.00
2. Abad Santos Subdivision			
3. Angelina Subdivision	Rafael Lazatin	San Jose	55,553.00
4. Bagong Bayan Subdivision	Don Pepe Henson	Cutcut	460,017.00
5. Bagong Silang Subdivision	Don Pepe Henson	Cutcut	19,882.00
6. Balibago Subdivision	Isabelo Concepcion	Balibago	190,960.00
7. Beatriz Pangilinan	Beatriz Pangilinan	Balibago	7,433.00
8. Belen Homesite Subdivision	Atty. R. Morales	Sto. Cristo	237,609.00
9. Carmenville Subdivision	Renato Tayag	Cutcut	126,605.00
10. Checkpoint Subdivision	Anacleto Muñoz	Balibago	138,444.00
11. Clarkview Subdivision	Felipe Juico	Balibago	572,300.00
12. Clemente Dayrit	Clemente Dayrit, Jr.	Lourdes Sur East	473,905.70
13. Don Pepe Subdivision	Don Pepe Henson	Balibago	50,000.00
14. Don Bonifacio Subdivision	Timoteo Cruz	Pulung Maragul	720,000.00
15. Doña Agripina Subdivision	Ernesto Lopez, Jr.	Pandan	154,320.00
16. El Cano Subdivision	Dante Timbol	Pulung Bulu	193,800.00
17. El Cano Subdivision	Dante Timbol	Pulung Bulu	227,000.00
18. Escel Park	Jesus Lazatin	Sto. Domingo	49,840.00
19. Felisa Subdivision	Jose Galura	Balibago	94,448.00
20. Lenifel Subdivision	Enrique Baluyut	Balibago	27,177.00
21. Henson Low Cost Housing	Don Pepe Henson	Balibago	76,815.00
22. Hensonville Subdivision	Don Pepe Henson	Malabañas	529,689.00
23. Holy Cross Subdivision	Carmela Narciso	Sapangbato	184,758.00

(List of Subdivisions cont'd.)

NAME OF SUBDIVISION	OWNER/OPERATOR	L O C A T I O N	AREA (In Sq. M.)
24. Josefa Subdivision	Jose Narciso	Balibago	118,351.00
25. Josefaville - I	Jose Narciso	Malabañas-Amsik	50,144.00
26. Josefaville - II	Jose Narciso	Malabañas	65,267.00
27. Kalayaan Subdivision	Don Pepe Henson	Lourdes Northwest	14,321.00
28. Mountain View Subdivision	Oscar Santos	Balibago	195,462.00
29. Leoncia Subdivision	Rafael Lazatin	Sto. Domingo	231,053.00
30. L & S Subdivision		Sto. Domingo	
31. Marisol Subdivision	Eusebio Lopez, Jr.	Pandan	634,206.00
32. Nepomuceno I	Francisco G. Nepomuceno	Cutcut	116,142.50
33. Nepomuceno II	Francisco G. Nepomuceno	Cutcut	323,462.00
34. Nepomuceno III	Francisco G. Npeomuceno	Cutcut	870,480.00
35. Nepomuceno IV	Francisco G. Nepomuceno	Cutcut	365,436.00
36. New Valley	Bonifacio Eusebio	Balibago	88,836.00
37. Ophebia	Abelardo Tinio	Balibago	17.520.00
38. Plaridel I	Anacleto Muñoz	Malabañas	479,929.00
39. Plaridel II	Anacleto Muñoz	Anunas-Amsik	352,444.00
40. Priscilla Subdivision	Priscilla Santos	Balibago	5,529.00
41. Raymond Subdivision	Angel Reyes	Balibago	22,480.00
42. Roque Henson	Roque Henson	Balibago	27,177.00
43. Rovimar Subdivision	Vicente Henson	Balibago	27,185.00
44. Riverside Subdivision	Trinidad Lazatin	Anunas	337,871.00
45. Sor Maria Luisa	Renato Tayag	Balibago	27,177.00
46. Sta. Maria I	Priscilla J. Tinio	Balibago	36,612.00

(List of Subdivision cont'd.)

NAME OF SUBDIVISION	OWNER/OPERATOR	L O C A T O R	AREA (In Sq. M)
47. Sta. Maria II	Priscilla J. Tinio	Balibago	187,360.00
48. San Angelo Subdivision	Anacleto Muñoz	Sto. Domingo	494,300.00
49. Springside Subdivision	Carlos Sandico	Pandan	34,772.00
50. Sabina Tablante	Sabina Gomez	Balibago	37,493.00
51. San Antonio	Renato Tayag	Pulung Maragul	201,658.00
52. Sandico I	Carlos Sandico	Pulung Maragul	119,259.00
53. Sandico II	Carlos Sandico	Pandan	88,614.00
54. San Ignacio	Jose P. Dizon	Pandan	146,570.00
55. San Jose I	Jose Reynoso	Pulung Bulu	62,327.00
56. San Jose II	Jose Reynoso	Pulung Bulu	50,000.00
57. San Jose III	Jose Reynoso	Pulung Bulu	108,546.00
58. Severina Diamond	Severina Lim	Balibago	578,853.00
59. Timog-Silangan Park	Abelardo Tinio	Cutcut	1,090,830.00
60. T. Silangan (Resettlement)	Abelardo Tinio	Cutcut	625,572.00
61. La Buena-Tanhueco	Ben Tanhueco	Balibago	9,920.00
62. Vicente Henson	Vicente Henson	Balibago	27,177.00
63. Villa Amanda	Amanda Henson	Balibago	27,176.00
64. Villa Angela	Jesus Lazatin	Sto. Domingo	447,357.00
65. Villa Dolores	Pablo Panlilio	Sto. Domingo	220,382.00
66. Villa Esperanza	Purification Flores	Malabañas	31,881.00
67. Villa Gloria	Abelardo Tinio	San Jose	153,025.00
68. Villa Henson	Don Pepe Henson	Lourdes Northwest	11,859.00
69. Villa Sol	Sabiano Sagulo	Malabañas	528,000.00

(List of Subdivision cont'd.)

NAME OF SUBDIVISION	OWNER/OPERATOR	L O C A T I O N	AREA (In Sq. M)
70. Villa Teresa	Peter Nepomuceno	Cutcut	650,000.00
71. Abad Santos Compound		Pulung Maragul	
72. Embassy Court		Balibago	
73. Clarkville		Balibago	
74. East West Subdivision		Lourdes Sur East	
75. Villa Angelina	Rafael Lazatin	San Jose	
76. Pacimar Estate	Vladimir Panlilio	Pulung Bulu	26,673.00
77. Pineda Compound			
78. Essel Subdivision			

APPENDIX 3.4.1 Power Rate of Angeles Electric Corporation

Residential

First	15 kwh	₱ 0.40 per kwh
Next	35 kwh	0.38 per kwh
Next	51 kwh	0.35 per kwh
Next	100 kwh	0.33 per kwh
Excess	kwh	0.32 per kwh

Minimum Charge : ₱4.80 for the first 12 kwh

Small General Service

Classification	Conn. Load in Watts	₱0.50/kwh	₱0.40/kwh	₱0.35/kwh
GS-1	2,500 or less	First 50 kwh	Next 150 kwh	Next 300 kwh
GS-2	2,501 to 5,000	90	260	550
GS-3	5,001 to 10,000	160	440	1,200
GS-4	10,001 up	350	900	3,250

Monthly Excess : ₱0.33 per kwh

Minimum Charge : ₱7.20 for the first 12 kwh

Large General Service (GS-5)

Demand Charge		₱10.00 per kw
Plus Energy Charge	First 100 hrs.	₱ 0.35 per kwh
	Next 100 hrs.	0.32 per kwh
	Next 100 hrs.	0.30 per kwh
	Over 300 hrs.	0.28 per kwh

Minimum Charge : ₱300.00

APPENDIX 4.1.1.A Water Supply of the Subdivisions Visited by JICA Study Team

ITEM		Name of Subdivision					
		Carmen-ville	Essel	Sunset	Timog Park	Villa Angela	Villa Teresa
Background Information	Year Established	1968	1969	1985	1981	-	1969
	Number of Households	550	222	70	281	300	500
	Land area (ha.)	47	-	-	32	-	63
Water Supply Status	Ownership of the system	Ass'n.	Ass'n	Ass'n	Ass'n	Ass'n	Ass'n
	Commencement of Op'n	1968	1976	1965	1982	-	1968
	Water source	10 well	1 well	2 well	6 well	4 well	2 well
	Dist. Tank capacity (GAL)	50,000	11,000	100,000	100,000	-	100,000
	Number of Connections	550	222	70	174	300	350
	Served percentage	100	100	100	62	100	70

Note: - No data provided

APPENDIX 4.1.1.B Water Charges for the Subdivisions Visited by JICA Study Team

Villa Teresa WW:

Water Consumption	Residential	Commercial
0 - 10 cu.m	₱14.50 cu.m/minimum	₱17.00 cu.m/minimum
11 - 20	1.50	1.80
21 - 30	1.55	1.90
31 - 40	1.60	2.00
41 - 50	1.65	2.10
51 - 60	1.70	2.20
61 - 70	1.75	2.30
71 - 100	1.90	2.50
over 100	2.00	2.70

Villa Teresa WW:

Water Consumption	Residential
0 - 10 cu.m	₱22.00 cu.m/minimum
11 - 20	2.25
21 - 30	2.30
31 - 40	2.35
41 - 50	2.40
51 - 60	2.45
61 - 70	2.50
71 - 100	2.60
over 100	2.75

Essel WW:

First 10 cu.m (min) is ₱28.00 plus ₱2.00 per cu.m in excess of 10 m^3 Carmenville, Sunset and Timog Park WW - charge is flat rate at ₱160.00 per month.

APPENDIX 4.1.2 POPULATION AND NUMBER OF HOUSEHOLDS SERVED BY TYPE OF WATER SOURCE (1980)

Area		Barangay	No. of HH Population	Waterworks			Private and point source		
				City	Others	Total	Private pipes with pump	Point source with pitcherpump	Total
Urban	1	A. del Rosario	4,508	182	616	798	1,254	2,456	3,740
			791	32	108	140	220	431	651
	2	Amsik	1,111					1,111	1,111
			195					195	195
	3	Anunas	9,477		3,328	3,328	2,308	3,841	6,149
			1,663		584	584	405	674	1,079
	4	Balibago	31,606		21,449	21,449	4,115	6,042	10,157
			5,545		3,763	3,763	722	1,060	1,782
	5	Capaya	2,536					2,536	2,536
			445					445	445
	6	Claro M. Recto	7,695	1,533	519	2,052	1,254	4,389	5,643
			1,350	269	91	360	220	770	990
	7	Cutcut	14,004	194	1,704	1,898	1,601	10,505	12,106
			2,457	34	299	333	281	1,843	2,124
	8	Lourdes North-west	9,501	2,929		2,929		6,772	6,772
			1,667	479		479		1,188	1,188
	9	Lourdes Sur	3,760	2,012		2,012	461	1,287	1,748
			660	353		353	81	226	307
	10	Lourdes Sur East	4,940	1,043		1,043	1,151	2,746	3,897
			867	183		183	202	482	704
	11	Malabañas	13,690	382	6,657	7,039	1,835	4,816	6,651
			2,402	67	1,168	1,235	322	845	1,167
	12	Margot	1,368					1,368	1,368
			240					240	240
	13	Pampang	2,879	450		450	513	1,916	2,429
			505	79		79	90	336	426
	14	Pandan	12,517	3,939		3,939	4,229	4,349	8,578
			2,196	691		691	742	763	1,505

APPENDIX 4.1.2 (cont'd)

Area	Barangay	No. of HH Population	Waterworks			Private and point source		
			City	Others	Total	Private pipes with pump	Point source with pitcherpump	Total
Rural	29 Cuayan	433 76					433 76	433 76
	30 Cutud	672 118					672 118	672 118
	31 Mining	570 100					570 100	570 100
	32 Tabun	684 120					684 120	684 120
	Sub-Total	2,359 414					2,359 414	2,359 414
TOTAL		188,912 33,148	23,681 4,120	42,178 7,400	65,859 11,520	27,872 4,891	95,181 16,737	123,053 21,628

Note: Above: Population
Below: No. of HH

Source: Planning and Development Sec. of Angeles City
City Engineer's Office

APPENDIX 4.1.3 LEVEL I WATER SUPPLY SYSTEMS
(AS OF DEC. 1984)

Barangay	No. of Wells	Number of HH	Estimated Pop. Served	Population (1986)	Served Percentage	Remarks
1. A. del Rosario	3	31	186	5,069	3.7	
2. Anunas	1	12	72	575	12.5	
3. Capaya	3	32	192	3,763	5.1	
4. Cutcut	11	110	660	16,227	4.1	
5. Cutud	1	10	60	943	6.4	
6. Lourdes N.W.	9	90	540	11,201	4.8	
7. Lourdes S.E.	4	40	240	7,504	3.2	
8. Pampang	1	10	60	2,347	2.6	
9. Pulungbulu	7	63	378	7,837	4.8	
10. Pulung Cacutud	3	30	180	1,151	15.6	
11. Pulung Maragul	2	20	120	4,760	2.5	
12. Salapungan	2	22	132	7,615	1.7	
13. San Jose	7	64	384	7,394	5.2	
14. San Nicolas	1	10	60	4,184	1.4	
15. Sapalibutad	2	18	108	2,214	4.9	
16. Sta. Teresita	3	30	180	11,866	1.5	
17. Sto. Cristo	2	20	120	2,811	4.3	
18. Sto. Domingo	1	9	54	14,566	0.4	
19. Tabun	3	30	180	747	24.1	
20. Virgen delos Remedios	1	10	60	1,940	3.1	
Total	67	661	3,966	114,714	3.5%	

Note: Estimated population: 6 persons/HH

APPENDIX 4.1.4 LEVEL II WATER SUPPLY SYSTEMS
(AS OF 1985)

Barangay	No. of HH Served	Estimated Population Served	Population (1986)	Served Percentage	Remarks
1. Anunas	60	360	575	62.6	Ave. persons per HH is 6
2. Cuayan	60	360	342	100	
3. Cutud	40	240	943	25.5	
4. Capaya	120	720	3,763	19.1	
5. Pulung Cacutud	125	750	1,151	65.2	
6. Pandan	198	1,188	15,075	7.9	
Total	603	3,618	21,849	16.6%	

APPENDIX 4.2.1 LEVEL I WATER SUPPLY SYSTEM

As of Dec. 31, 1985

Location	Well No.	No. of Household Per System	Well Casing		Constructed By	Date Constructed	Condition of System	Remarks
			Dia. (inch)	Depth (feet)				
Bgy. Cutud	1	10	2"	140'	MPW	1982	Satisfactory	
Bgy. Pampang	2	10	1-1/2"	80'	MPW	1982	Satisfactory	
Bgy. Lourdes North West	3	10	1-1/2"	100'	MPW	1982	Satisfactory	
Bgy. San Jose	4	10	1-1/2"	140'	MPW	1982	Satisfactory	
Bgy. San Nicolas	5	10	1-1/2"	100'	MPW	1982	Satisfactory	
Bgy. Cutcut	6	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Tabun	7	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. San Jose	8	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Pulung Maragal	9	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Pulung Cacutud	10	10	2"	140'	MPW	1982	Satisfactory	
Bgy. Pulung Cacutud	11	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Cutcut	12	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Tabun	13	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Sapalibutad	14	10	1-1/2"	120;	MPW	1982	Satisfactory	
Bgy. Pulung Maragul	15	10	1-1/2"	120'	MPW	1982	Satisfactory	
Bgy. Tabun	16	10	5"	110'	MPW	1982	Satisfactory	
Bgy. Pulung Cacutud	17	10	5"	140'	MPW	1982	Unsatisfactory	Musky taste
Bgy. Capaya I	18	10	5"	120'	MPW	1982	Unsatisfactory	High iron concentration
Bgy. Cutcut	19	10	5"	130'	MPW	1982	Unsatisfactory	High iron concentration

APPENDIX 4.2.1 (Cont'd) As of Dec. 31, 1985

Location	Well No.	No. of Household Per System	Well Casing		Constructed By	Date Constructed	Condition of System	Remarks
			Dia. (inch)	Depth (feet)				
Sitio Maligaya	44	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Sitio Maligaya	45	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Bgy. Lourdes North West	46	10	1-1/2"	60'	RWDC	1982	Satisfactory	
Bgy. Cutcut	47	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Sitio Maligaya	48	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Sitio Maligaya	49	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Bgy. Lourdes North West	50	10	1-1/2"	100'	RWDC	1982	Satisfactory	
Bgy. Lourdes North West	51	10	1-1/2"	80'	RWDC	1982	Satisfactory	
Bgy. Lourdes Sur East	52	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Lourdes Sur East	53	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Lourdes Sur East	54	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Agapito del Rosario	55	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Pulungbulu	56	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Cutcut	57	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Virgen de los Remedios	59	10	1-1/2"	60'	RWDC	1983	Satisfactory	
Bgy. Lourdes North West	60	10	1-1/2"	80'	RWDC	1983	Satisfactory	
Bgy. Sto. Cristo	61	10	1-1/2"	40'	RWDC	1983	Satisfactory	
Bgy. Cutcut	62	10	1-1/2"	80'	RWDC	1983	Satisfactory	
Bgy. Sto. Cristo	63	10	1-1/2"	40'	RWDC	1983	Satisfactory	
Bgy. Lourdes Sur East	64	10	1-1/2"	60'	RWDC	1983	Satisfactory	

APPENDIX 4.2.2 LEVEL II WATER SUPPLY SYSTEM

As of Dec. 31, 1985

Location	No. of Household Served	No. of Connection	Source	System	Pump	Tank	Pipe			Conducted by	Date Constructed	Remarks
							Size (mm)	Length (m)	Type			
Bgy. Anuas	60	7	Deepwell	Pumped	Centrifugal	Steel	50	541	PE	MPWH	1981	
Bgy. Cauayan	60	5	Deepwell	Pumped	Centrifugal	Steel	50	498	PE	MPWH	1981	
Bgy. Cutud	40	3	Deepwell	Pumped	Centrifugal	Steel	63-75	207	PE	MPWH	1981	
Bgy. Capaya	120	11	Deepwell	Pumped	Centrifugal	Steel $V=6.4m^3$	25-63	872	PVC	MPWH	1984	
Bgy. Pulung Cacutud	125	-	Deepwell	Pumped	Centrifugal	Steel	-	-	PVC	MPWH	1984	
Bgy. Pandan (land tenure)	198	21	Deepwell	Pumped	Centrifugal	Steel $V=6.4m^3$	38-100	1,440	PVC	BWP/MLG	1985	

Source: City Engineer's Office

APPENDIX 4.2.3 Pump Efficiency Test at No. 1 Pumping Station

The pump discharge rate, water pressure, and voltage and electric current were measured using different opening ratios of the gate valve. The following is a rough percentage of the opening ratio of the gate valve for the four examination steps. Approximately 50 to 60% of the ratio seemed to be allowable during the examination as a response of the pump and motor to the valve operation.

Valve Operation:

Case	Handle Ope.	Estimated Opening ratio
1	17.5	50 - 60%
2	11.5	40 - 50
3	6.5	30
4	4.5	20

Note: Number of turning for opening the valve completely; 23.5

The following Table shows the results of measurement.

TABLE 4.2.3.1 DATA ON PUMP TEST

Case	Discharge Rate (l/s)	TDH (m)	Ia (Amp)	Va (Volts)	Op (KW)	IPM (KW)	λo (%)	OPM (KW)	p (%)
1	43.3	27.9	93.3	240.0	11.8	33.0	35.8	28.1	42.0
2	43.2	29.9	92.3	246.6	12.7	33.5	37.9	28.5	44.6
3	43.1	32.9	93.0	250.0	13.9	34.2	40.6	29.1	47.8
4	42.2	34.9	94.7	250.0	14.4	34.9	41.3	29.7	48.4

Note: TDH = (measured water pressure) + (distance between pump operation water level and level of pressure gauge: 18.3)

Abbreviations and adopted formulas in the Table are given below.

Q : Pump Discharge Rate (l/s)

TDH : Total Dinamic Head (m)

I_a : Current (Amp)

V_a : Voltage (Volt)

O_p : Pump Output (kw)

$$O_p = \frac{Q \times TDH}{102}$$

IPM : Input Power to Motor (Kw)

$$IPM = \frac{Ia \times Va \times PF \times 3}{1000}$$

PF : Power Factor (0.85)

λo : Overall Efficiency of Pump and Motor (%)

$$\lambda o = \frac{OP}{IPM} \times 100$$

OPM : Motor Output (Kw)

$$OPM = IPM \times m$$

λm : Motor Efficiency (0.85)

λp : Pump Efficiency (%)

$$\lambda p = \frac{OP}{OPM} \times 100$$

FIGURE 4.2.3.1 shows the pump performance curb.

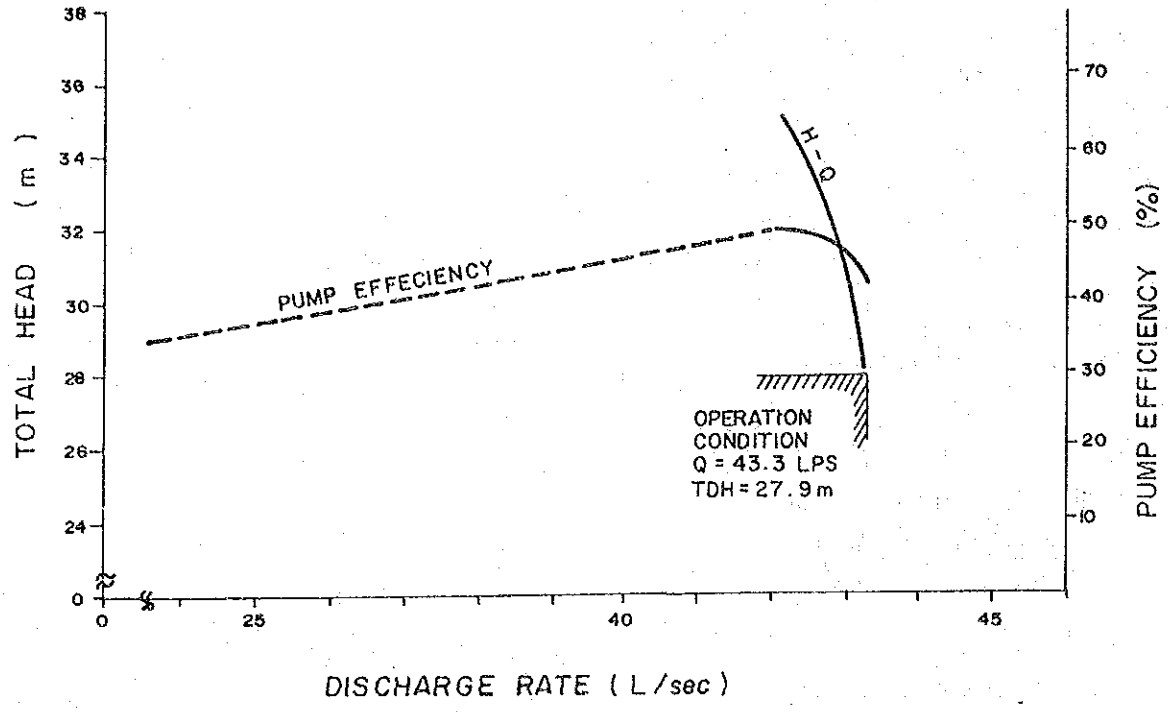
There is no data available on the conditions in selecting an appropriate pump and pump performance curb for the test pumping station. As such, a comparative study of the pump efficiency between those initially planned and operated at present cannot be made except from a general view point.

The coefficient assumed in estimating the efficiency of the pump, the pump and motor, are general figures based on field experience as follows:

PF = 0.85

λm = 0.85 - 0.90 under the conditions of 60 Hz, 2-6p and 30-37 Kw

The distance between water level during pump operation and the elevation of the water pressure gauge in order to estimate dynamic head is also assumed to be 18.3 m using the data on the pumping test conducted about 16 years ago. There is a possibility that the water level during pump operation at present might be about three meters below the assumed water level. This calculation is based on the information on the declining of water level at No. 9 pumping station (0.2m/year).



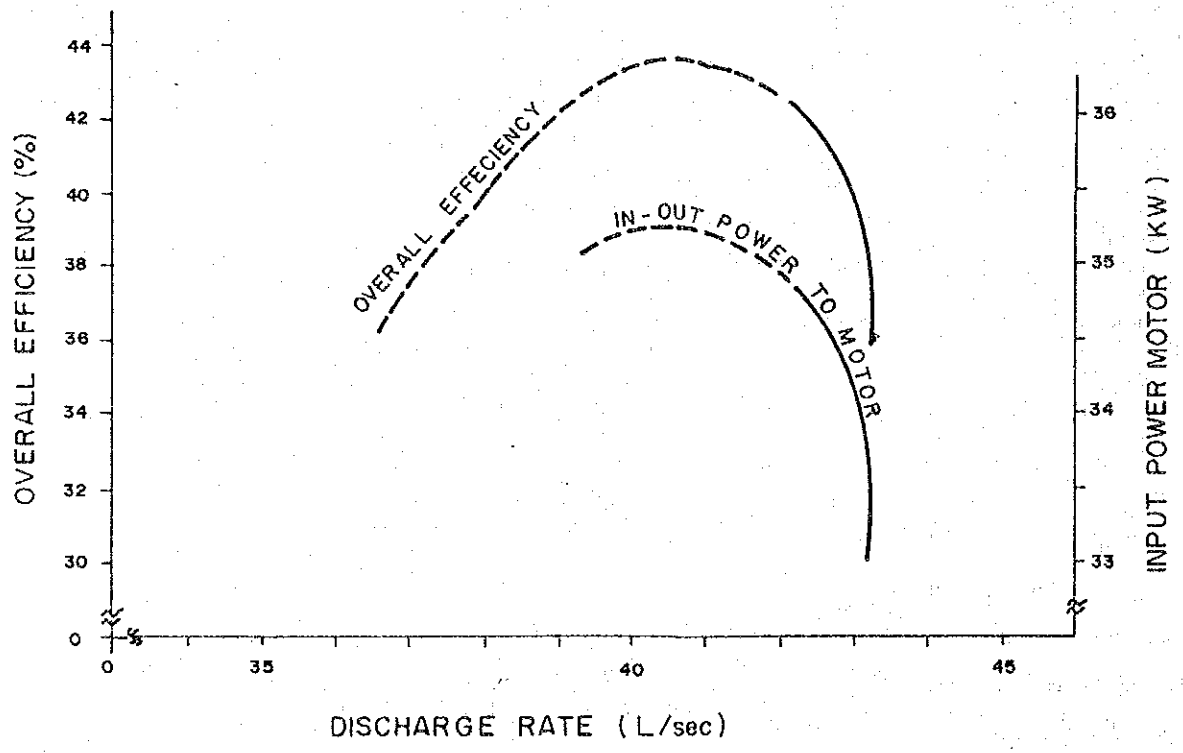


FIGURE 4.2.3.1

PUMP PERFORMANCE CURVE
(NUMBER I PUMPING STATION)

The result of measurements revealed that the pump discharge rate is around 42 to 43 l/s with a dynamic water head between 28 to 35 m. The input Power to motor and motor output, gradually increased in accordance with reduction of valve open ratio. The figures of OPM varied from 28 to 30 KW.

The motor output (60 Hz) for the vertical type multi-stage turbine pump is as follows:

OPM = 30 KW
Pump discharge rate : 42 l/s
Dynamic water head : 35 m

The above figures are almost the same as those measured at the pumping station. Because of the lowering of the water table, the present pump operation conditions may be concluded as:

a) Pump discharge rate : 42 - 43 l/s
b) Total dinamic water head : 31 - 38 M
c) Input power to motor : 33 - 35 KW
d) Motor output : 28 - 30 KW

APPENDIX 4.2.4 Water pressure in the Service Area

Twenty-five points were pinpointed to measure water pressure as shown in TABLE 4.2.4.1 and FIGURE 4.2.4.1. Sixteen points were service connections, while nine were pumping stations. A topographic survey was likewise conducted at 60 points.

TABLE 4.2.4.1 MEASURING POINTS

ITEM	No.	Location/address of the Points	Consumer type	Dia. of Connect.
Pump Station	1	A. Mabini St.	Domestic	1/2"
	2	San Nicolas St.	"	"
	3	Rizal Extension	"	"
	4	Kuliat St	"	"
	5	Sta. Teresita	"	"
	6	Bo. Pandan Marison	"	"
	7	San Angelo	"	"
	8	Pampang Rd	"	"
	9	Division Rd. Mc Arthur Highway	"	"
Service Area	1	224, Astoria cor. Vgutls	Domestic	1/2"
	2	308, 8th St. Marison	"	"
	3	San Jose St.	"	"
	4	1524, Jeus St.	"	"
	5	427, Aran Malavak	"	"
	6	23, Magkalinis St.	"	"
	7	628, M.L. Quezon St.	"	"
	8	593, Rizal St.	Commercial	"
	9	819, Henson St.	Domestic	"
	10	3 Ar 17 Rizal St.	"	"
	11	235, Harvard cor. Astoria	"	"
	12	1042, Henson St.	Commercial	"
	13	J. Surla St.	Domestic	"
	14	1948, Jesus Ext.	"	"
	15	319, St. Rosario St.	"	"
	16	San Joaquin St.	"	"

The results of the measurements are given in TABLE 4.2.4.3. The contour line of the total water head and water pressure at 12:00 and 24:00 are depicted in FIGURE 4.2.4.2 A & B and 4.2.4.3 A & B. These may represent distribution of water pressure for day time and night time, respectively. The ground elevation at each point is given in TABLE 4.2.4.2, which is used in estimating the total water head.

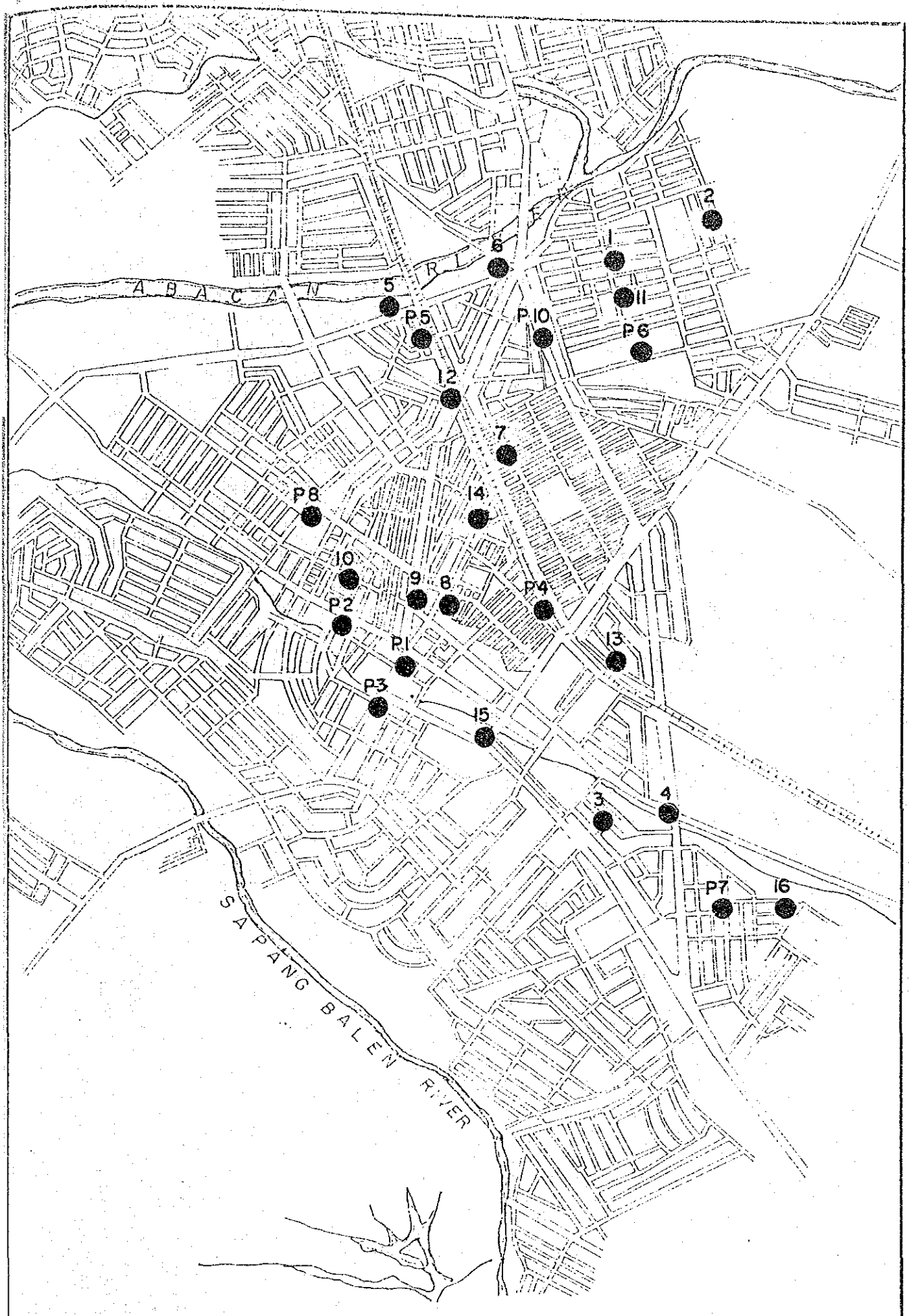


FIGURE 4.2.4.1

LOCATION OF MEASURING POINTS

TABLE 4.2.4.3 RESULT OF WATER PRESSURE TEST

Unit : kg/cm^2

	No. \ hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Service Area	1	0.3	0.3	0.3	0.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.3	0.3
	2	1.1	1.2	1.1	1.0	0.9	0.9	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.8	0.9	1.1	1.1
	3	<0.1	<0.1	<0.1	0.25	0.25	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1
	4	0.5	0.5	0.5	0.5	0.5	0.25	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.2	0.25	0.25	0.25	0.5	0.5	0.1	0.25	0.5	0.5	0.5
	5	0.2	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0	0	0.1	0.1	0.1	0.1	0.1	0.3	0.3
	6	0.4	0.5	0.5	0.6	0.4	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.3	0.2	0.3	0.25	0.4
	7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<0.1	<0.1
	10	0.35	0.35	0.25	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.15	0.2	0.25	0.3
	11	0.6	0.6	0.5	0.3	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.5	0.5	0.5	0.6
	12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1
	13	0.5	0.6	0.6	0.6	0.6	0.5	0.3	<0.1	<0.1	<0.1	<0.1	0.1	0.25	0.3	0.5	0.7	0.25	0.5	0.3	0.3	0.5	0.5	0.5	0.5
	14	<0.1	0.1	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<0.1
	15	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
	16	0.5	0.5	0.4	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.4
P.S	1	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8
	2	0	0	0	0	0	0	0.1	0.1	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.8	0.9	0.9	0	0
	3	0.4	0.4	0.4	0.4	0.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.25	0.25	0.25	0.25	0.2	0.4
	4	0.2	1.3	1.1	0.3	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2
	5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.4
	6	0.6	0.75	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.4	1.2	1.1	1.0	1.0	1.0	0.75	0.75	0.75	0.6
	7	1.25	1.25	1.25	1.25	1.0	1.0	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.25	1.25
	8	1.0	1.0	0.8	0.8	0.8	1.0	0.8	0.7	0.7	0.7	0.6	0.6	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.8	1.0	1.0	1.0
	10	1.7	1.7	1.7	1.7	1.5	1.4	1.3	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.7

Note: <0.1 ; less than 0.1 kg/cm^2

Operation of No. 2 P.S; 6:00 AM - 10: PM

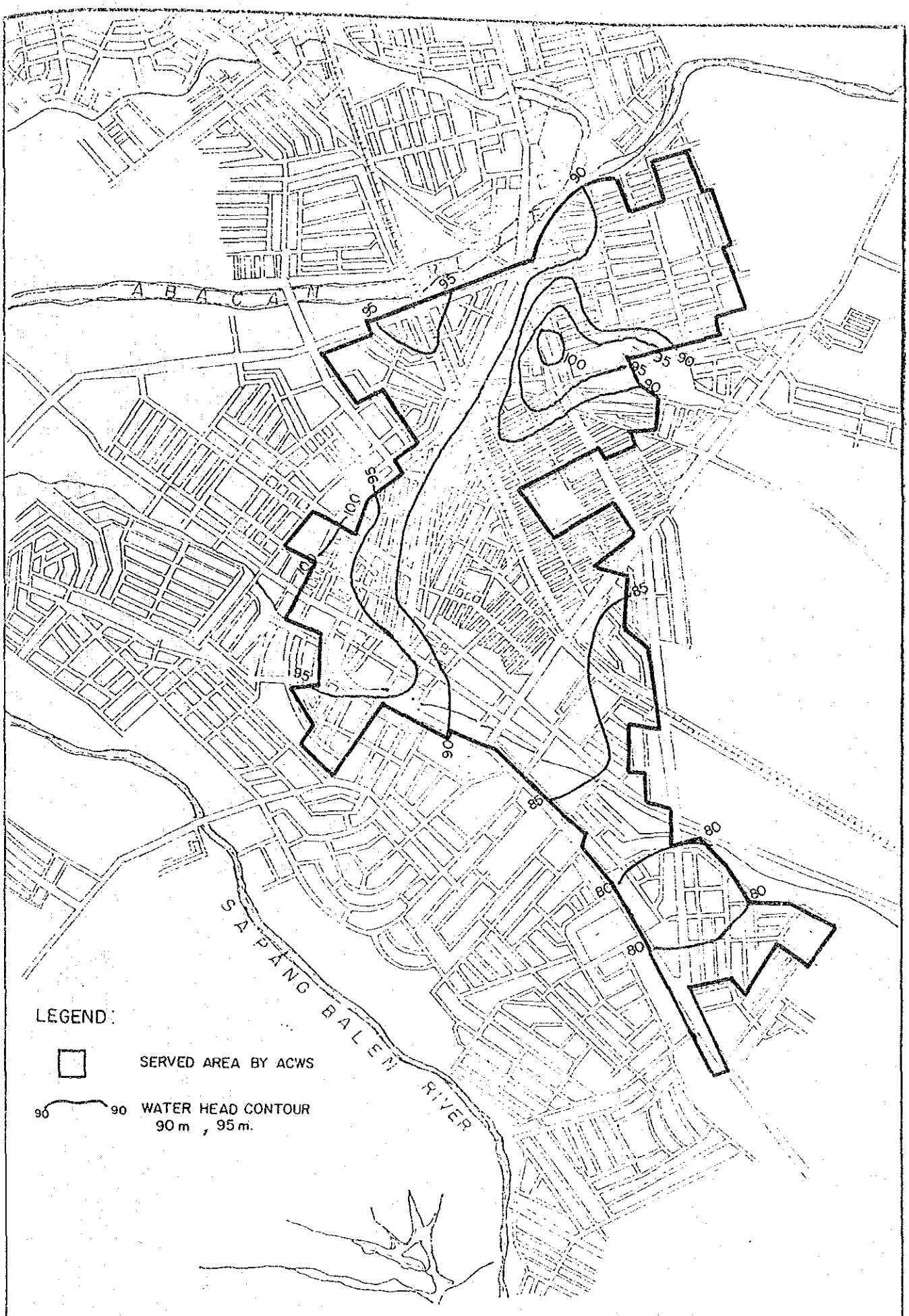


FIGURE 4.2.4.2.A

CONTOUR LINE OF TOTAL WATER HEAD AT 12:00

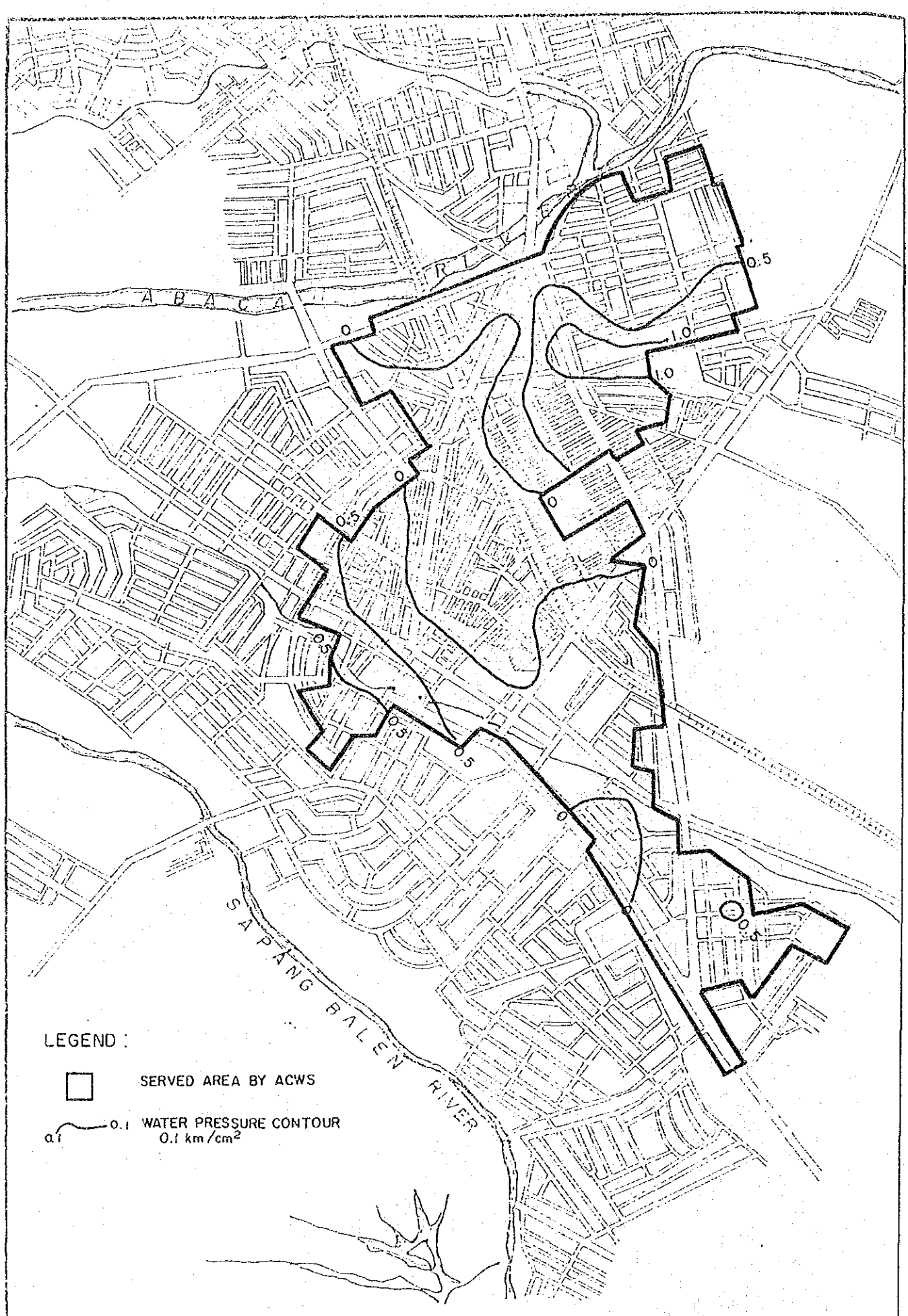


FIGURE 4.2.4.2.B

CONTOUR LINE OF WATER PRESSURE AT 12:00

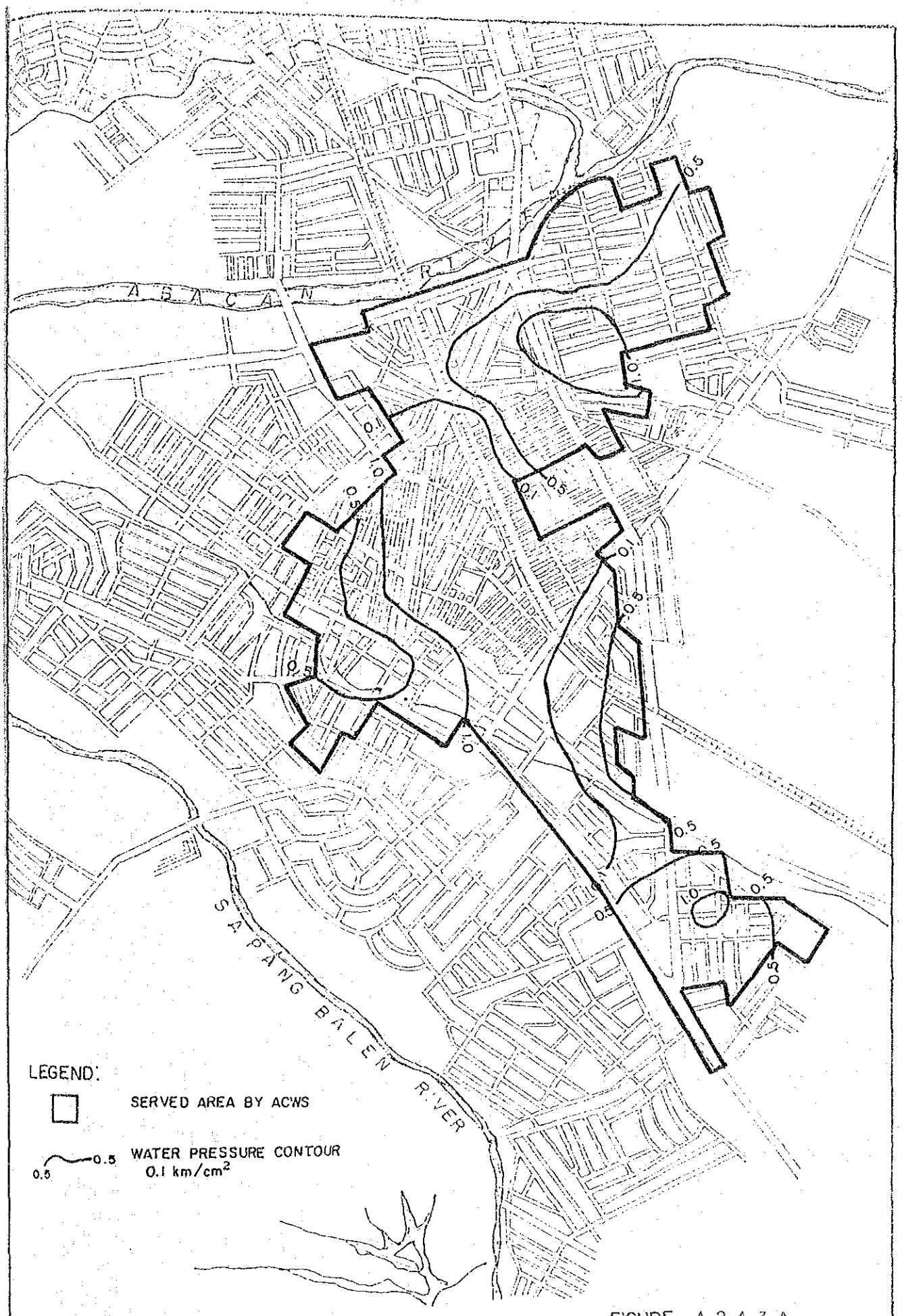


FIGURE 4.2.4.3.A

CONTOUR LINE OF WATER PRESSURE AT 24:00

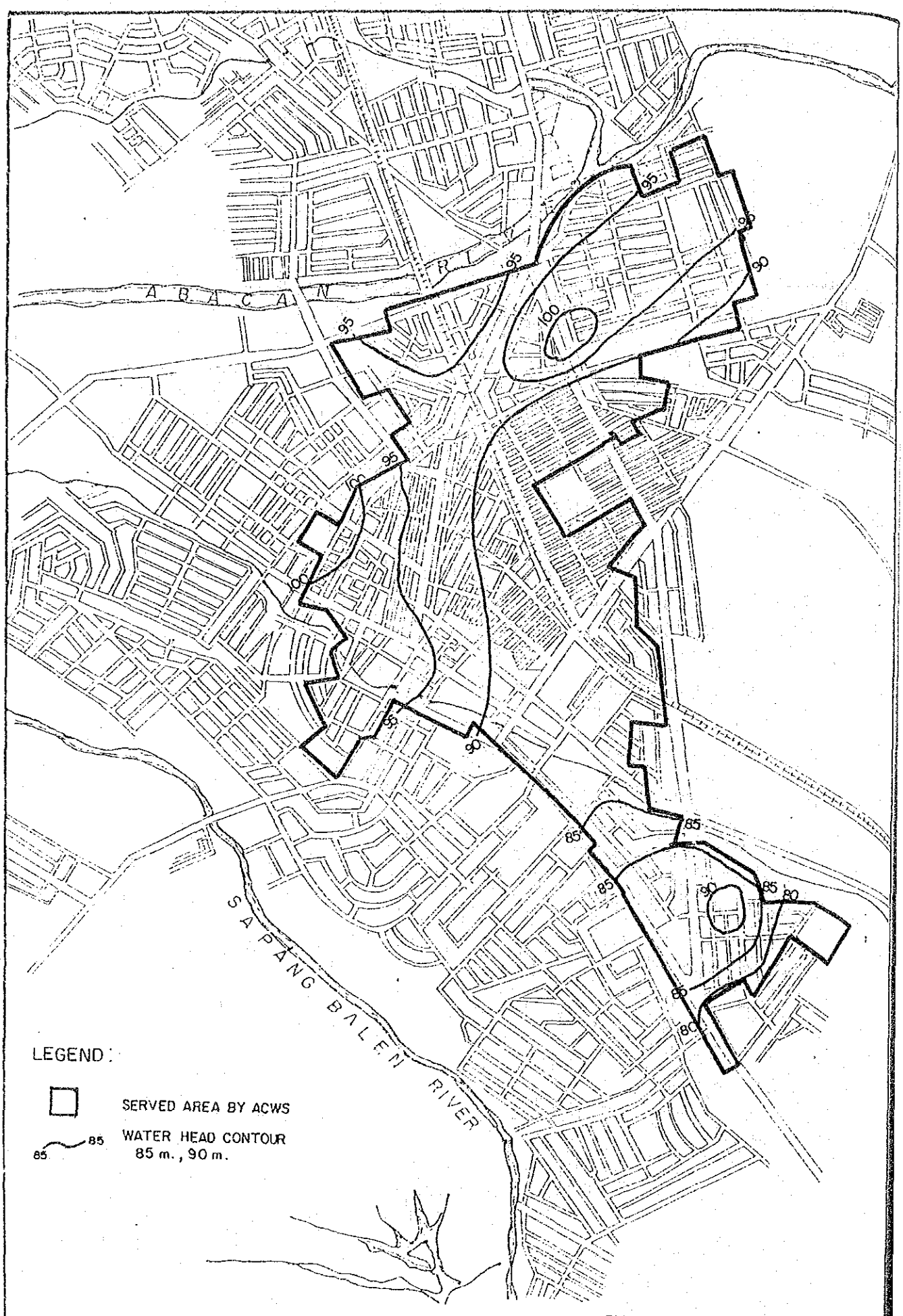


FIGURE 4.2.4.3.B

CONTOUR LINE OF TOTAL WATER HEAD AT 24:00

TABLE 4.2.4.2

GROUND ELEVATION AT SELECTED MEASURING POINTS

Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Service Area G.L. (m)	86	84	82	81	95	91	89	90	90	95	86	92	83	90	89	72

Point	1	2	3	4	5	6	7	8	9	10
Pumping Station G.L. (m)	91	93	91	86	94	84	79	97	-	88

Source: Topographic survey (JICA) and data from City Engineers Office

The service area has a gentle slope of one to two percent form northeast to southeast. The maximum difference of ground level in the area is approximately 20 meters.

The location of the existing 11 pumping stations in ground level terms is delineated below.

a) Northern portion of the area with a higher elevation; 8 P.S.
b) Western portion of the area with a higher elevation ; 2 P.S.
c) Southern portion of the area with a lower elevation : 1 P.S.

The ground level of the pumping stations affects the distribution status of total water head and the area covered by each pumping station, as shown in FIGURE 4.2.4.2.A and 4.2.4.3.A. In addition to the influence made by topographic conditions, water pressure in the area is directly affected by the pumping stations. The figures at the pumping stations vary from 0.2 - 0.4 kg/cm^2 at No. 5 P.S. to 1.2 - 1.7 kg/cm^2 at No. 10 P.S. The results of measurements made at the pumping stations revealed a dominant tendency in the daytime and nighttime; the highest water pressure during the hours from 8:00 A.M. to 5:00 P.M.; and the lowest from 6;00 A.M. to 7:00 P.M. This corresponds to general water use patterns during the day.

With regard to the distribution of water pressure in the area and the hourly variation, Figures 4.2.4.2.B and 4.2.4.3.B show the following:

a) The water pressure changes through the day

b) The figure during daytime (6:00 A.M. to 7:00 P.M.) is quite low (less than 0.1 kg/cm^2) in most of the area except for the limited area in the vicinity of the pumping stations. Furthermore, there is no water supply to the central portion of the service are in the daytime (about 1/3 of service area).

c) Water pressure throughout the service are in the nighttime (8:00 P.M. to 5:00 A.M.)shows a little better figure than that in daytime. However the pressure in the central portion (1/3 of service area) is still quite low with a figure of less than 0.1 kg/cm^2.

APPENDIX 4.2.5 NUMBER OF CONNECTION BY METERED AND UNMETERED

Consumer Type			Zone No. / Hills	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
				351	670	241	270	442	212	349	413	574	696	184	751	342	630	527	581	715	475	442	158	172	276	9471
Metered	Domestic	1/2	No. of Connect.	89	173	12	90	105	20	57	12	12	23	-	15	-	33	27	19	27	64	165	16	9	2	970
			m^3/month	2754	5687	276	2516	4519	378	1395	877	332	799	-	251	-	1386	1011	433	792	1900	7072	552	195	65	33690
		3/4	No. of Connect.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
			m^3/month	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
		1	No. of Connect.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			m^3/month	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Commercial	1/2	No. of Connect.	1	3	-	-	1	22	2	134	17	11	1	2	-	1	-	-	1	-	7	-	5	55	263
			m^3/month	20	350	-	-	30	582	64	1395	430	513	68	13	-	50	-	-	15	-	275	-	107	1114	7026
		3/4	No. of Connect.	1	-	-	-	2	1	-	7	1	3	-	-	-	-	-	-	-	-	-	-	-	-	15
			m^3/month	14	-	-	-	28	15	-	553	294	152	-	-	-	-	-	-	-	-	-	-	-	-	1057
		1	No. of Connect.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			m^3/month	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Institutional		No. of Connect.	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
			m^3/day	-	-	-	-	414	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	414
Unmetered	Domestic	1/2	No. of Connect.	92	136	44	72	73	24	147	21	155	186	6	342	23	113	134	210	148	218	227	45	63	74	2553
		3/4	No. of Connect.	-	-	1	1	1	2	1	5	-	1	-	-	-	-	-	2	-	-	-	-	1	-	15
		1	No. of Connect.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Commercial	1/2	No. of Connect.	5	6	3	2	2	37	10	63	11	32	8	-	1	5	10	5	-	-	3	3	5	87	298
		3/4	No. of Connect.	-	-	1	-	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5
		1	No. of Connect.	-	1	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-	5
	Institutional	1/2	No. of Connect.	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Note: Data in May 1986

APPENDIX 4.4.1 NUMBER OF CONNECTIONS, CONSUMPTION AND WATER CHARGES

DOMESTIC:

Zone Number	Metered			Unmetered		Total	
	Number of Connections	Consumption (m^3/month)	Charges (₱)	Number of Connections	Charges (₱)	Number of Connections	Charges (₱)
1	89	2,754	3,016.18	92	1,681.66	181	4,697.84
2	173	5,687	5,863.40	136	2,858.25	309	8,721.65
3	13	286	292.00	45	1,017.75	58	1,309.75
4	90	2,516	2,624.00	73	1,813.40	163	4,437.40
5	105	4,419	4,270.00	74	1,772.95	179	6,042.95
6	20	878	846.40	26	530.00	46	1,376.40
7	57	1,395	1,583.80	148	3,232.60	205	4,816.40
8	12	877	854.00	26	833.00	38	1,687.00
9	12	332	394.00	155	3,404.00	167	3,798.00
10	23	799	887.80	187	4,139.13	210	5,026.93
11	-	-	-	6	122.00	6	122.00
12	15	251	321.20	342	7,523.60	357	7,844.80
13	-	-	-	23	458.00	23	458.00
14	33	1,386	1,430.40	113	2,497.20	146	3,927.60
15	27	1,011	1,019.20	134	2,878.00	161	3,897.20
16	19	433	490.00	212	4,592.60	231	5,082.60
17	27	792	816.00	148	3,277.40	175	4,093.40
18	64	1,900	2,140.40	218	5,012.21	282	7,152.61
19	165	7,092	6,659.00	227	5,453.95	392	12,112.95
20	16	552	550.80	45	1,030.00	61	1,580.80
21	9	195	168.40	64	1,374.00	73	1,542.40
22	2	65	64.00	74	1,611.20	76	1,675.20
Sub-Total	971	33,700	34,290.98	2,568	57,112.90	3,539	91,403.88

COMMERCIAL & INSTITUTIONAL

Zone Number	Metered			Unmetered		Total	
	Number of Connections	Consumption (m^3/month)	Charges (₱)	Number of Connections	Charges (₱)	Number of Connections	Charges (₱)
1	2	34	126.40	5	409.00	7	535.40
2	3	350	641.60	7	795.00	10	1,436.60
3	–	–	–	4	475.00	4	475.00
4	–	–	–	2	120.00	2	120.00
5	3	59	219.60	2	134.80	5	354.40
6	23	597	1,563.20	37	3,230.00	60	4,793.20
7	2	64	152.80	10	900.00	12	1,052.80
8	141	3,948	10,078.00	68	6,471.35	209	16,549.35
9	18	724	1,636.80	11	978.90	29	2,615.70
10	14	665	1,502.70	34	3,348.00	48	4,850.70
11	1	68	132.80	8	999.60	9	1,132.40
12	2	13	81.60	–	–	2	81.60
13	–	–	–	1	64.00	1	64.00
14	1	50	104.00	5	450.00	6	554.00
15	–	–	–	10	886.00	10	886.00
16	–	–	–	5	350.00	5	350.00
17	1	15	48.00	–	–	1	48.00
18	–	–	–	–	–	–	–
19	7	275	608.00	3	270.00	10	878.00
20	–	–	–	4	525.00	4	525.00
21	5	107	291.20	5	450.00	10	741.20
22	55	1,114	3,494.60	87	7,277.35	142	10,771.95
Sub-Total	278	8,083	20,681.30	308	28,134.00	586	48,815.30

APPENDIX 4.4.1 (cont'd)

INSTITUTIONAL:

Zone Number	Metered			Unmetered		Total	
	Number of Connections	Consumption (m^3/month)	Charges (₱)	Number of Connections	Charges (₱)	Number of Connections	Charges (₱)
1	-	-	-	2	181.20	2	181.20
5	1	414	710.00	-	-	1	710.00
Sub-Total	1	414	710.00	2	181.20	3	891.20
TOTAL	1,250	42,197	55,682.28	2,878	85,428.10	4,128	141,110.38

APPENDIX 4.4.2 COMPOSITION OF EACH BARANGAY IN TERMS OF WATER ZONE

Barangay	Composition (Zone Number)	Percentage of the Zone	Remarks
A. del Rosario	11	75	
	13	100	
Claro M. Recto	15	20	
	16	90	
Cutcut	21	50	
Lourdes Northwest	12	100	
	22	50	
Lourdes Sur	7	75	
	9	100	
Lourdes Sur East	16	10	
	17	90	
Malabanas	15	50	
	18	5	
Pampang	22	45	
Pandan	18	95	
	19	100	
Pulung Bulu	3	25	
	4	100	
	5	60	
Salapungan	20	100	
San Jose	1	5	
	2	50	
	3	30	
San Nicolas	8	70	
	10	60	
	11	25	
Sta. Teresita	14	100	
	22	5	
Sta. Trinidad	10	40	
Sto. Cristo	3	15	
	5	40	
	6	50	
	7	25	
	17	10	
Sto. Domingo	1	95	
	2	50	
Sta. Rosario	3	30	
	6	50	
	8	30	
	21	50	
Virgen de los Remedios	15	30	

Note: The percentage is calculated using household number distributed in related barangays.

APPENDIX 4.4.3 WATER CONSUMPTION

4.4.3.A UNIT COMMERCIAL WATER CONSUMPTION (METERED)

Zone	Water Consumption(m3) Monthly	Daily	No. of Connection	Per Connection Per Day(m3)	Remarks
6	630	21	63	0.333	
8	4173	139	159	0.874	
9	1228	41	35	1.171	
10	1113	37	39	0.949	
11	82	3	1	3.000	
12	1297	43	18	2.389	
13	0	0	0	-	
21	432	14	14	1.000	
22	570	19	57	0.333	
Total	9525	317	386	0.821	

4.4.3.B ESTIMATION OF TOTAL WATER CONSUMPTION

No. of Connections			Unit Consumption	Daily Consumption	Remarks
Domestic	Sub-Total	3,567	1.567 m^3/d	5,589 m^3/d	
Commer-cial	Metered	298	0.821	245	
	Unmetered	255	2.18*	556	
	Sub-Total	553		801	
	Total	4,120		6,390	

Note: * Average Consumption in Balibago Waterworks System

APPENDIX 4.5.1 Unaccounted-for Water/Not Utilized Water

The Zone No. 1, southern tip of the existing service area was selected as a model area in accordance with the following criteria.

a) Easy measurements of flow rate into or out of the area ensuring served population of about 10% of the city total population served.
b) The total maximum number of flow meter required should be less than three.
c) The area should be predominantly residential.
d) Easy data collection

FIGURE 4.5.1.1 shows the flow chart to analyze unaccounted for water/not utilized water.

(1) Background information and existing water supply in Zone No. 1

1) Description of the model study area

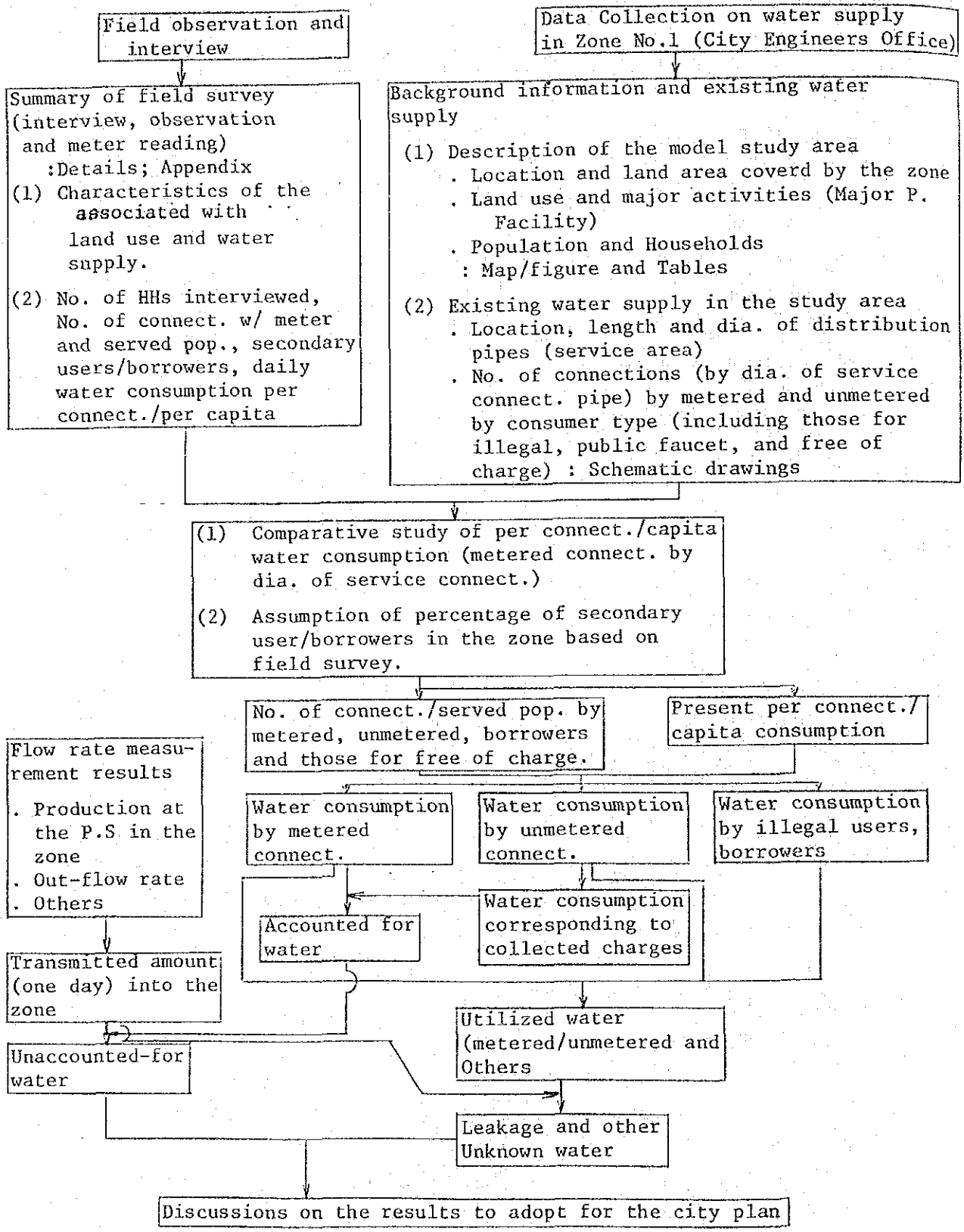
The model study area, Zone No. 1 (see FIGURE 4.5.1.2) is located in the southern tip of the existing service area with an approximate area of 60 ha and population of 2,112 (352 households).

The area is predominantly residential with small commercial establishments along the Mc Arthur Highway. The major public facilities within the zone are St. Domingo Elementary School and Camp Tomas Pepito. The following is information obtained through the field survey.

- o St. Domingo Elementary School : 1,300 pupils and 33 teaching staff members
- o Camp Tomas Pepito : 155 personnel and 150 detainees

The location of households, commercial establishments and public facilities as well as road networks in the zone is given in FIGURE 4.5.1.3.

FIGURE 4.5.1.1 FLOW CHART FOR ESTIMATION OF UNACCOUNTED-FOR-WATER/ AND SOME FUNDAMENTALS



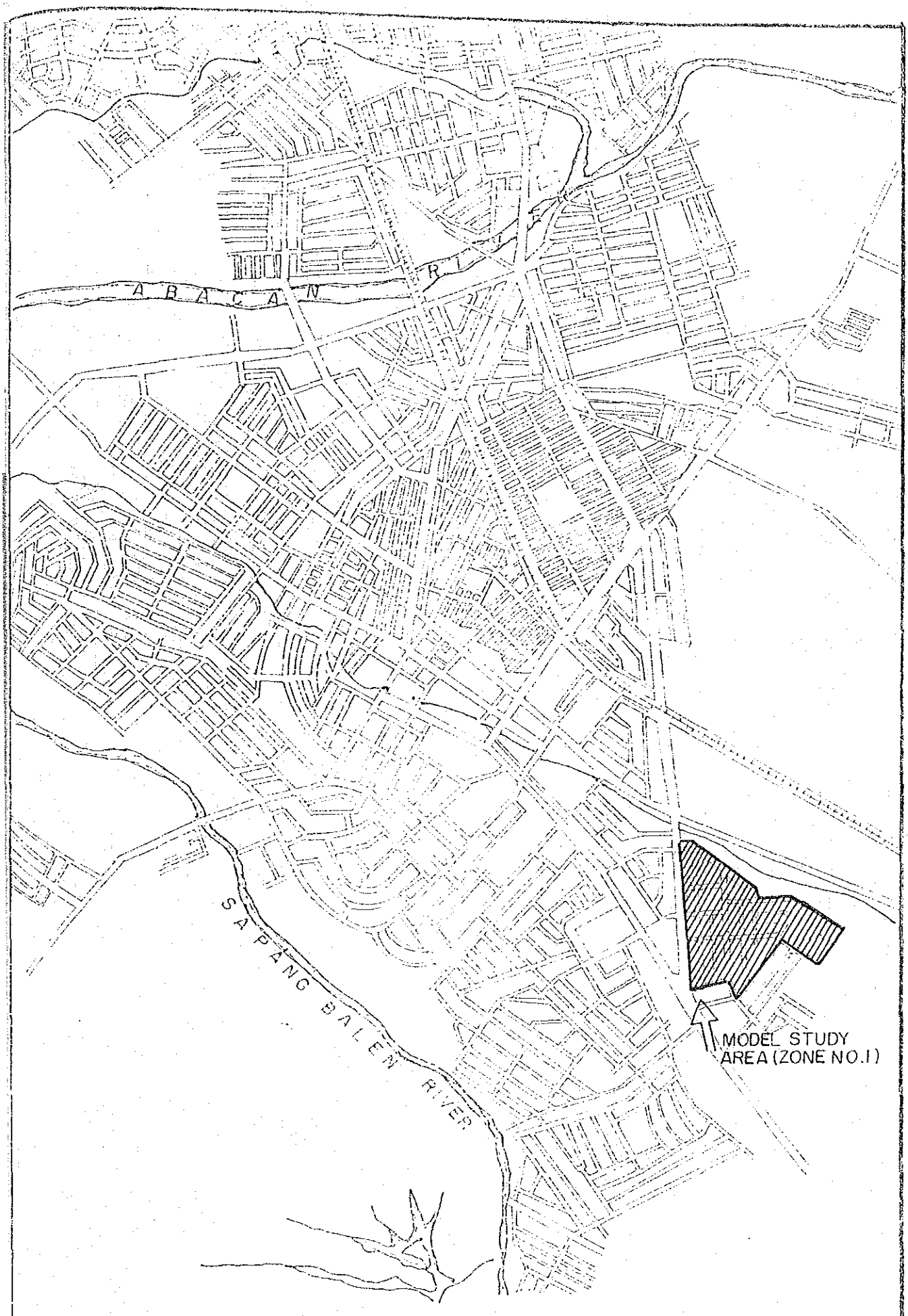


FIGURE 4.5.1.2

LOCATION MAP
OF STUDY AREA

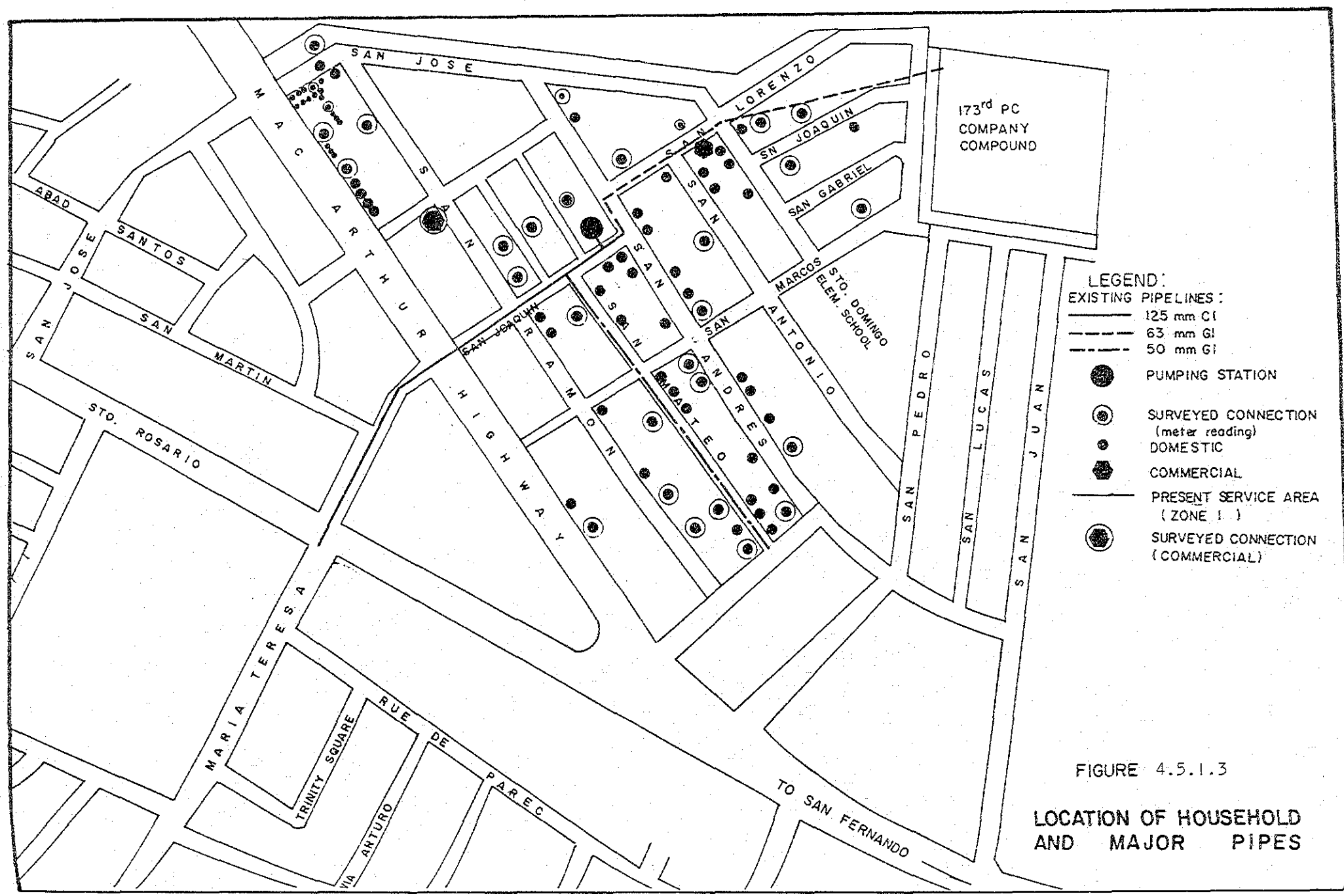


FIGURE 4.5.1.3

LOCATION OF HOUSEHOLD AND MAJOR PIPES

2) Existing water supply in the zone

The water sources for the zone is a deep well with a pumping station (No. 7). The water produced at the pumping station is used not only for the zone including the Camp area but also for Zone No. 2. However the water pressure during daytime in the area far from the pump station in Zone No. 1 is quite low. There is no water supply to the elementary school during daytime. The diameter of distribution pipes ranges from 50 to 125 mm with a total length of 620 m. (Refer to FIGURE 4.5.1.3 on the location of distribution pipes).

a) Served population in the Zone

The served population comprises primary users and secondary users/borrowers, which were identified through the field interview. The following is the outline of the findings.

Field interview results

Investigations on the 36 domestic connections, which account for 40% of total metered connections, revealed the following composition of users.

Type	No. of HHs	Served Pop.
Primary users	36	228
Secondary users/ borrowers	21	85
T o t a l	57	313

The percentage of secondary users/borrowers to the primary users is calculated at 37%. The figure seems to reflect the fact that the zone is predominantly composed of apartment houses.

Estimating the population in the zone and the number of concessionaires

The study zone consists of 15 sub-areas. Population by sub-area was estimated knowing the number of households and

using six persons as the average number of persons per HH. Number of primary users was also estimated in the same manner.

The population served is the total of primary users and secondary users/borrowers. The percentage of secondary users/borrowers to the primary users was assumed to be 35, based on the field investigation, although this figure should be further studied before an average figure for the city is made (See TABLE 4.5.1.1).

TABLE 4.5.1.1 POPULATION IN THE ZONE AND CONCESSIONAIRES

Sub-Area	Zone Population	Served Population				
		Primary	Secondary/ borrowers	Total	Served Percent	R. M.
1	180	24	8	32	17.8	
2	54	12	4	16	29.6	
3&4	186	84	29	113	60.8	
5	138	42	15	57	41.3	
6	102	66	23	89	87.3	
7	60	60	-	60	100.0	All primary user
8	114	108	6	114	100.0	Most of population is primary user
9	312	210	74	284	91.0	
10	-	-	-	-	-	No connection
11	108	78	27	105	97.2	
12	96	66	23	89	92.7	
14	300	84	29	113	37.7	
15	378	222	78	300	79.4	
Total	2,112	1,098	331	1,429	67.7	

Note : a) Secondary users/borrowers is 35% of primary users; average number of HH : 6 persons
b) Population/pupils at the camp and elementary school is not included in the Table.

The estimated total population served is 1,098 out of the Zone population of 2,112. The percentage of primary users to the zone population is approximately 52%, while total population served is 68%.

b) Water supply status in the Zone.

Number of connections by type of consumer as of May 1986 is summarized in TABLE 4.5.1.2. Public faucets installed in the premise of elementary school and those for the Camp were excluded. The total number of connections is 190 of which 91 (48%) is metered.

TABLE 4.5.1.2 NUMBER OF CONNECTIONS BY CONSUMER TYPE

Sub-Area	Domestic				Commercial			Institutional			Total		
	No. of HHs	Metered	Unmetered	Total	Metered	Unmetered	Total	Metered	Unmetered	Total	Metered	Unmetered	Total
1	30	2	2	4	-	1	1	-	-	-	2	3	5
2	9	-	1	1	-	-	-	-	1	1	-	2	2
3&4	31	11	3	14	1	-	1	-	-	-	12	3	15
5	23	1	6	7	1	3	4	-	-	-	2	9	11
6	17	8	3	11	-	-	-	-	-	-	8	3	11
7	10	4	6	10	-	-	-	-	-	-	4	6	10
8	19	15	3	18	-	-	-	-	-	-	15	3	18
9	52	4	31	35	-	-	-	-	-	-	4	31	35
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	18	10	3	13	-	-	-	-	-	-	10	3	13
12	16	7	4	11	-	-	-	-	-	-	7	4	11
13	14	4	3	7	-	-	-	-	-	-	4	3	7
14	50	9	5	14	-	-	-	-	-	-	9	5	14
15	63	14	22	36	-	1	1	-	1	1	14	24	38
Total	352	89	92	181	2	5	7	-	2	2	91	99	190

Note: Diameter of service connections by consumer type
Domestic: metered and unmetered; 1/2 inches
Commercial: metered, one 1/2 inch and another 3/4 inch;
unmetered, 1/2 inch
institutional: unmetered, 1/2 inch

TABLE 4.5.1.3 SUMMARY OF WATER CONSUMPTION AND CHARGES

Consumer Type	Metered			Unmetered		Total	
	No. of Connect.	m^3/month	Charge (₱)	No. of Connect.	Charge (₱)	No. of Connect.	Charge (₱)
Domestic	89	2,754	2,802	92	2,077.04	181	4,879.04
Commercial	2	34	126.4	5	409	7	535.40
Institutional	-	-	-	2	181	2	181
Total	91	2,788	2,928.4	99	2,618.04	190	5,546.44

Data Source : City Engineers Office

The following is a summary of connections.

Type of Consumer	Metered	Unmetered	Total	Unmetered Additional Faucet
Domestic	89 (1/2")	92 (1/2")	181	182
Commercial	2 (1/2" & 3/4")	5 (1/2")	7	
Institutional	-	2 (1/2")	2	
Total	91	99	190	182

Water consumption and collected charges by consumer type

Water consumption and collected charges from metered/unmetered connections by consumer type for the month of May, 1986 are summarized in TABLE 4.5.1.3. (Details are given in TABLE 4.5.1.4.A to 4.5.1.4.C)

c) Per capita water consumption and domestic daily water consumption.

Per capita water consumption was studied by metered and unmetered connection due to the following:

i) Insufficiency of water supply because of limited water sources and pump capacity, especially in the remote areas where water pressure is less than 0.1 kg/cm^2 through the day.

ii) Some areas are provided with water supply only during daytime or nighttime by means of valve operation of the distribution pipes.

iii) Most of the metered connections are installed along the main distribution pipeline, where comparatively good service is provided. On the other

TABLE 4.5.1.4.A WATER CONSUMPTION AND CHARGES (DOMESTIC CONNECTION)

Sub-area	Metered No. of Connect.	Metered m^3/month	Metered Charge (₱)	Unmetered No. of Connect	Unmetered Charge (₱)	Total No. of Connect	Total Charge(₱)	R.M.
1	2	28	35.20	2	42	4	77.2	
2	-	-	-	1	20	1	20.	
3 & 4	11	318	337.20	3	68	14	405.2	
5	1	35	34.	6	120	7	154	
6	8	266	260.80	3	74	11	334.8	
7	4	99	103.20	6	156	10	259.2	
8	15	328	370.	3	69.45	18	439.45	
9	4	111	114.4	31	668.06	35	782.46	
11	10	269	276.8	3	62.	13	338.80	
12	7	232	251.6	4	90	11	341.60	
13	4	162	153.6	3	66.	7	219.60	
14	9	405	378.	5	114	14	492.	
15	14	501	487.2	22	527.53	37	1,014.73	
Total	89	2,754	2,802.	92	2,077.04	182	4,879.24	

TABLE 4.5.1.4.B WATER CONSUMPTION AND CHARGES (COMMERCIAL CONNECTION)

Sub-area	Metered No. of Connect.	Metered m^3/month	Metered Charge(₱)	Unmetered No. of Connect.	Unmetered Charge(₱)	Total No. of Connect.	Total Charge(₱)	R.M.
1	-	-	-	1	90.	1	90.0	
3 & 4	1	14	70.40	-	-	1	70.40	
5	1	20	56.	3	270	4	326.	
15				1	49	1	49	w/meter but not working
Total	2	34	126.40	5	409	7	535.40	

TABLE 4.5.1.4.C WATER CONSUMPTION AND CHARGES (INSTITUTIONAL CONNECTION)

Sub-area	Metered No. of Connect.	Metered m^3/month	Metered Charge(₱)	Unmetered No. of Connect.	Unmetered Charge(₱)	Total No. of Connect.	Total Charge(₱)	R.M.
2	-	-	-	1	125.	1	125.	
15	-	-	-	1	56.	1	56.	
Total	-	-	-	2	181.	2	181.	

hand, the remaining areas experience shortage of water.

Water consumption and per capita daily consumption (metered)

Daily water consumption (metered)was reported for the month of May at 91.8 cu.m/day for the 89 connections. Total population served for the metered connections is about 700 calculated by estimating the zone total population served (1,429 persons) in Table 2.3.1 and the percentage of metered connections to the total number of connections(89/181 = 49%).

Daily per capita water consumption was calculated to be 131 l/cap.day.

The calculated figure using the meter reading results from concessionaires selected at random during field survey is 183 l/cap.day.

The summary of findings is shown in TABLE 4.5.1.5 in addition to the water consumption for the month of May. The average per capita consumption for the month of May for the 36 concessionaires is calculated at 157 l/cap.day. The figures calculated using data collected through field survey are 20 to 40% bigger than the estimated zone average for the month of May. This result may be attributed to the difference of service level in the zone due to insufficiency in water supply and the daily fluctuation in consumption. The average figure of 131 l/cap.day, can be the daily zone average considering the constraints of the present water supply.

Water consumption and per capita daily consumption for unmetered connections

Collections from unmetered connections for May was ₱2,077.04. These come from the flat rate connections as well as metered connections whose meters are under repair. For the latter, water charge is an average of previous month's consumption. It is difficult to assess the number of faucets per household using collection as a basis. Estimates were made, therefore, using the following:

Water consumption per connection for the flat rate (₱18/month, 1/2" service connection) is 15 cu.m/month ((₱18-₱14) ÷ ₱0.8/cu.m + 10 cu.m = 15 cu.m). On the other hand, the consumption range for the metered connection (See TABLE 4.5.1.6) gives an idea of the average figure for majority of the concessionaires.

The Table reveals that approximately 90% of metered connections belongs to the consumption range of 0-60 cu.m/month. The average consumption within the range was calculated at 24.2 cu.m/month.

TABLE 4.5.1.5

No.	Address	Field Survey				Data	R. M.
		Daily Consump.	Primary User	Secondary User	Pop. Served		
1	1-1-8	0.7	5	12	17	0.6	
2	1-3-13A	0.8	3		3	0.8	
3	1-3-13E	0.7	7		7	0.7	
4	1-8-12M	0.5	4		4	0.8	
5	1-8-12G	1.6	5		5	2.7	
6	1-5-5	2.1	5		5	1.1	
7	1-3-2	1.7	12		12	1.8	
	1-3-19A	0.5	3		3	0.5	Commercial connection (excluded from the Total)
8	1-9-17A	1.0	6		6	1.4	
9	1-9-25	1.0	5		5	0.8	
10	1-14-8	2.3	10		10	2.1	
11	1-15-50B	2.2	15		15	0.7	
12	1-14-20A	6.6	5	26	31	4.3	
13	1-15-51	1.0	10		10	1.1	
14	1-14-29	1.0	8		8	(1.0)	
15	1-15-50E	1.8	4	2	6	1.5	
16	1-15-50F	2.3	8	5	13	1.3	
17	1-15-61	1.0	3		3	0.5	
18	1-15-17	0.9	5		5	0.2	
19	1-15-30	2.0	5	10	15	1.7	
20	1-15-37	2.2	6	4	10	2.5	
21	1-11-23	0.8	7		7	0.3	
22	1-13-9	1.7	6		6	(1.7)	
23	1-12-8A	1.4	5		5	0.9	
24	1-11-12	2.0	5	2	7	1.9	
25	1-14-28	1.9	8		8	1.3	
26	1-12-2	0.6	3		3	0.4	
27	1-9-46	0.3	3		3	1.1	

TABLE 4.5.1.5(cont'd)

No.	Address	Field Survey				Data	R. M.
		Daily Consump.	Primary User	Secondary User	Pop. Served		
28	1-7-2	1.4	5		5	(1.4)	
29	1-12-3A	1.9	4	10	14	2.1	
30	1-11-7A	2.4	5		5	2.3	
31	1-6-8	0.6	3		3	0.7	
32	1-6-4	1.4	6		6	0.5	
33	1-6-1A	3.0	10	8	18	2.1	
34	1-6-19	0.9	6	5	11	1.5	
35	1-6-17	1.4	10		10	1.3	
36	1-6-14B	2.5	11	3	14	(2.5)	
Total (Domestic)		57.6	228	87	315	49.6	

Note : Daily consumption obtained by meter reading (Field survey)

( ) : used same figures of measured

TABLE 4.5.1.6

RANGE OF WATER CONSUMPTION (METERED) AND MAJORITY AVERAGE CONSUMPTION

Consumption. Range (cu.m/mon.)	No. of Connect.	Percen-tage	Summation of percent.	Calculation of majority average				
				Ave. cu.m	cu.m/ mon.	Total	Ave. cu.m /mon.	l/cap. day
0 - 10	15	16.9	16.9	5	84.5			
11 - 20	22	24.7	41.6	15	370.5			
21 - 30	16	18.0	59.6	25	450			
31 - 40	13	14.6	74.2	35	511			
41 - 50	6	6.7	80.9	45	301.5			
51 - 60	7	7.9	88.8	55	434.5	2,152	24.2	102
61 - 70	4	4.5	93.3	65	292.5			
71 - 80	3	3.4	96.7	75	255			
81 - 90	1	1/1	97.8	85	93.5			
91 - 100	0	0.0	97.8	95				
101 - 110	1	1.1	98.9	105	115.5			
111 -	1	1.1	100.0	120	132	3,040.5	30.4	128
Total	89	100.0						

Note : Overall average; 128 which corresponds to that estimated using data of May (131)

Per capita daily consumption for the unmetered connections was estimated using estimated served population and number of connections as follows:

i) Figure corresponding to the flat charge:

15 cu.m/month x 92 connect ÷ 30 day÷(1429 - 700)

= 0.063 cu.m/cap.day

ii) The average consumption of majority of metered connections 24.2 cu.m/month x 92 connect.÷ 30 ÷ 729

= 0.102 cu.m/cap.day

Per average per capita consumption for the unmetered connections seems to be between 63 to 131 l/cap.day. Being within the consumption range, 102 l/cap.day may be used for the purpose of this study.

Daily water consumption for the unmetered concessionaires is accordingly estimated at 74.2 cu.m/day (24.2 cu.m/month ÷ 30 days x 92 connection).

The water consumption of the domestic origin is, therefore, 166 cu.m/day as a total of metered (91.8 cu.m/day) and unmetered (74.2 cu.m/d).

d) Unit water consumption and total consumption for commercial use: Water consumption by the existing metered connections for the month of May was recorded at 34 cu.m/month. Daily per connection consumption is calculated at 0.57 cu.m/day. A figure of 0.5 cu.m/day was meter-read in one of the two connections during the field survey. Inferred consumption for the unaccounted connections was estimated using charge composition as follows:

(₱90 - ₱40) ÷ ₱1.6/cu.m + 10 cu.m = 41.25 cu.m/month
41.25 ÷ 30 = 1.375 cu.m/day

The figure of 1.375 cu.m/day may be used for the unmetered connections since it corresponds to the charges paid by them on a same basis of the metered connection.

Water consumption for commercial use is 8.01 cu.m/day as shown below.

metered	:	1.13 cu.m/day (2 connections)
unmetered	:	1.375 cu.m/day x 5 = 6.88 cu.m/day (5 connections)
Total	:	8.01 cu.m/day

e) Unit water consumption and total consumption for the institutional use: The existing two connections; the camp and

elementary school are unmetered. Unit water consumption based on the charges is same as that for the commercial unmetered connections. However, it was confirmed in the field that there is no water supply to the elementary school during daytime. Therefore water consumption for the institutional use in the zone may be accounted to be 1.38 cu.m/day (one governmental office).

(4) Water consumption in the zone (Utilized water in Zone No. 1)

The total water consumption including domestic/commercial and institutional uses is estimated at 175.39 cu.m/day.

Estimate of the water transmitted/distributed to Zone No. 1 from No. 7 pumping station

Preliminary survey revealed that part of water produced at no. 7 pumping station is distributed to the Zone No. 2 and is also provided to the Camp without charge (unmetered).

Under these conditions, flow rate measurement was conducted through the day at the two points as shown in FIGURE 4.5.1.4 (the point connected to the Zone No. 2 and that before the Camp compound.) The measurement records are given in TABLE 4.5.1.7.

The water balance between production and distribution/consumption is given below.

$$Q = (q_1 + q_2) = q_3 + q_4$$

where, Q : production (cu.m/day)

q_1 : supply to the Camp (cu.m/day)

q_2 : supply to the No. 2 zone

q_3 : Consumption in the No. 1 zone

q_4 : water not utilized in zone No. 1 (leakage and unknown water)

The results of flow rate measurement are summarized as follows:

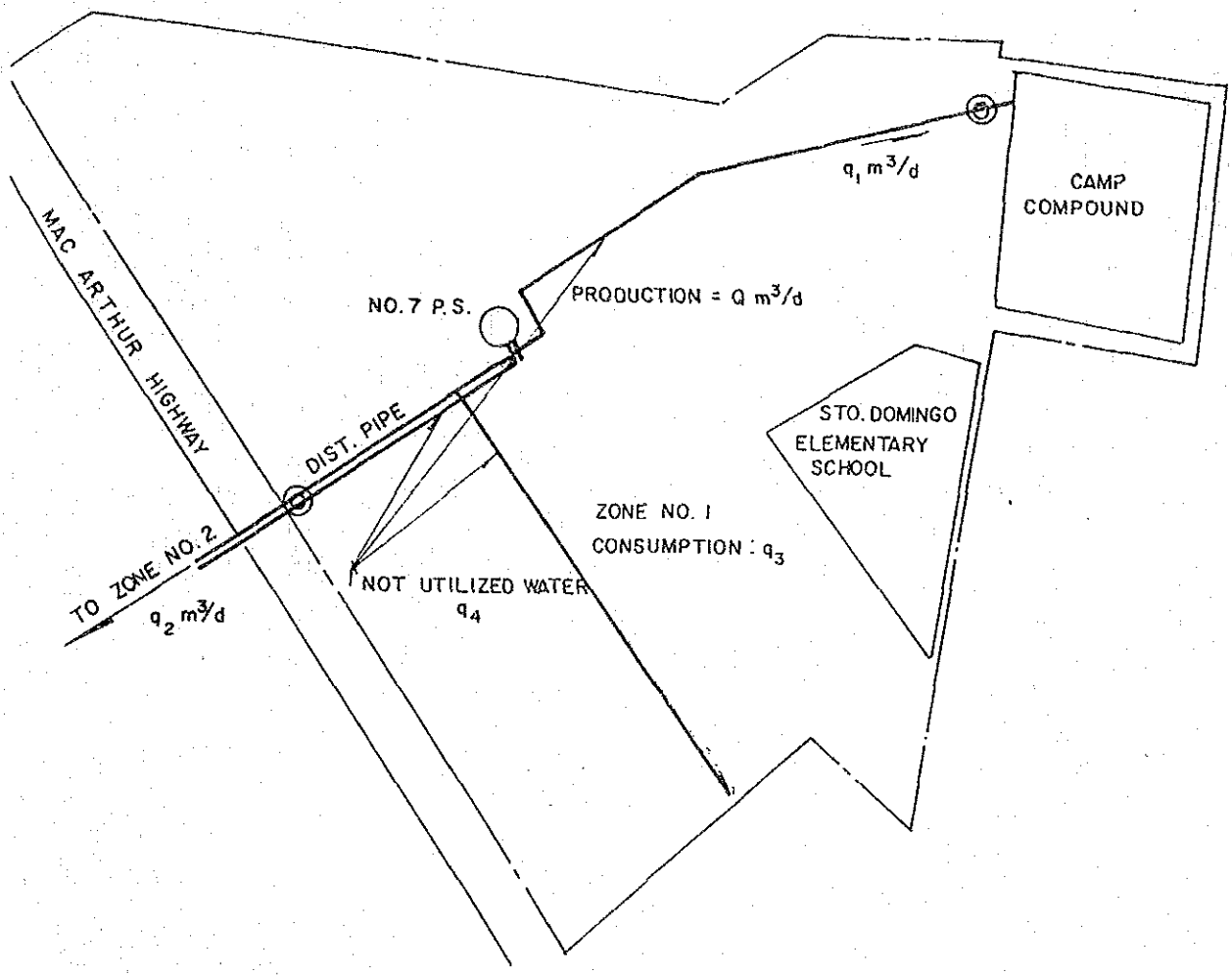
Q = 812,8 cu.m/day

$q_1 = 114.5$

$q_2 = 495.0$

$q_3 + q_4 = Q - (q_1 + q_2)$:water distributed to Zone No. 1

$= 203.3$ cu.m/day



BALANCE BETWEEN PRODUCTION AND DISTRIBUTION

$Q = (q_1 + q_2) + q_3 + q_4$

LEGEND :

◎ FLOW RATE MEASURING POINT

FIGURE 4.5.1.4

FLOW RATE MEASURING POINTS

TABLE 4.5.1.7 FLOW RATE MEASUREMENT RESULTS

Unit: cu.m/hour

Time	Production (No. 7 P.S.)	Flow rate		Distributed into Zone No. 1	R. M.
		Connection (Zone 1 & 2)	Near Capamp		
0 - 1	32.9	26.5	6.4	0.0	
1 - 2	32.9	26.6	6.3	0.0	
2 - 3	32.9	26.9	6.0	0.0	
3 - 4	32.9	26.8	6.1	0.0	
4 - 5	33.0	26.4	6.4	0.2	
5 - 6	33.9	22.1	4.9	6.9	
6 - 17	34.7	17.1	3.4	14.2	
7 - 8	34.6	15.6	3.6	15.4	
8 - 9	34.5	16.0	3.5	15.0	
9 - 10	33.9	16.1	3.5	14.3	
10 - 11	34.0	16.8	3.6	13.6	
11 - 12	34.3	17.6	3.8	12.9	
12 - 13	34.4	17.1	3.8	13.5	
13 - 14	34.2	19.0	4.2	11.0	
14 - 15	34.2	20.3	4.8	9.1	
15 - 16	34.2	19.6	4.5	10.1	
16 - 17	34.4	17.2	3.6	13.6	
17 - 18	34.5	18.3	3.6	12.6	
18 - 19	34.2	18.8	4.1	11.3	
19 - 20	34.1	17.9	4.2	12.0	
20 - 21	33.9	19.8	4.7	9.4	
21 - 22	33.8	21.9	5.7	6.2	
22 - 23	33.4	24.6	6.8	2.0	
23 - 0	33.0	26.0	7.0	0.0	
Hourly Ave.	33.9	20.6	4.8	8.5	
Daily Total	812.8	495.0	114.5	203.3	

Utilized water in the zone and unaccounted-for water

Based on the above water consumption and production/distribution from the water source, water utilized in Zone No. 1 is calculated at approximately 85% of distributed amount from No. 7 pumping station (See FIGURE 4.5.1.5).

This FIGURE is comparatively high attributed seemingly to the low water pressure and water use through the day.

Utilized water (percentage)

a) Distributed: 203.3, 100%

b) Consumption: 175.39, 85%

c) Leakage & Unknown: 27.9, 15%

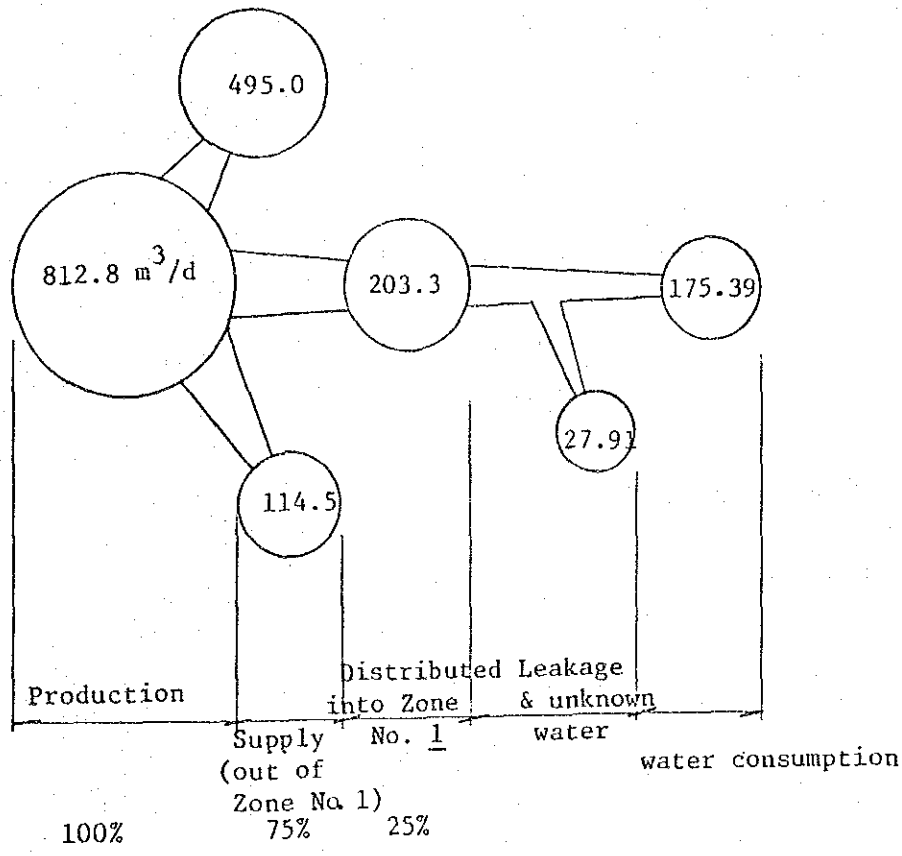


FIGURE 4.5.1.5 RELATIONSHIP AMONG PRODUCTION, DISTRIBUTION, LEAKAGE & UNKNOWN WATER AND CONSUMPTION

Of the water distributed into the Zone (203.3 cu.m/day), approximately 15% (27.9/cu.m/day) is lost to leakage and other reasons. Accounted-for water was estimated according to the following procedure.

Domestic consumption

a) metered = 91.8 cu.m/day (89 connections)

b) unmetered :

87 connections (₱18 - ₱14) ÷ 0.8 + 10 cu.m
= 15 cu.m/connect.month(0.5 cu.m/connect.day)
0.5 x 87 = 43.5 cu.m/day

182 additional faucet ₱2 ÷ 0.8
= 2.5 cu.m/faucet.month (0.083 cu.m/faucet.day)
0.083 x 182 = 151 cu.m/day

5 metered (but not functioning)
1.03 cu.m/connect.day (metered average) x 5
= 5.2 cu.m/day

Sub-total 63.8 cu.m/day
(92 connections & 182 additional faucets)

Total 155.6 cu.m/day
(181 connections & 182 additional faucets)

Commercial consumption

a) metered : 1.1 cu.m/day (2 connections)

b) unmetered : (₱90 - ₱40) ÷ ₱1.6 cu.m + 10 cu.m
= 41.3 cu.m/connect.month (1.375 cu.m/-conn.day) 1.375 x 5 = 6.9 cu.m/day

Total : 8 cu.m/day (7 connections)

Institutional consumption

a) unmetered: 1.4 cu.m/day (1 connection)

Total accounted-for water is accordingly 165 cu.m/day. The percentage of accounted-for water distributed form the source is approximately 80, which seems to be above the city's average.