ing system to counter other problems besetting the groundwater system in MSA. Project cost is P63.11 million. The study on the project was commenced in August 1990 under the grant aid of the Government of Japan through JICA.

(5) Locally Funded Projects (continuing program)

These are projects made as a quick response to public requests for improvement, expansion, replacement, interconnection of small scale watermains extensions and other miscellaneous works that fall outside of ongoing foreign assisted projects. These projects are part of normal work activities of the office and get funding from the annual Engineering budget averaging P100 million per year.

12.3.2 Proposed Projects

Aside from the ongoing projects, the MWSS is planning to implement several projects with the principal objectives of extending the water services to the unserved areas and of augmentation of water production capacity (Table 12.3.4). Outlines of these projects are as follows:

(1) Rizal Province Water Supply Improvement Project (RPWSIP)
1989 - 1998

The project will provide adequate water supply to the 9 municipalities of Rizal covered by Batas Pambansa 799 namely: Angono, Baras, Cardona, Jala-Jala, Morong Pililla, Tanay, Taytay, and Teresa as shown in Figure 12.3.3.(Binangonan was one of the subjects of the project initially. However, it seceded from the project and Taytay was integrated instead).

The project that is being implemented from 1990-1998 extracts groundwater of 11,300 m^3/day for Baras, Cardona, Jala-Jala, Morong, Pililla, Tanay and Teresa while Laguna de Bay will serve Angono and Taytay at a supply volume of 36,800 m^3/day. This will benefit 142,450 customers at a cost of P895 million under the financial assistance by French Government.

This project aims to construct intake structure, water treatment plant, pumping station, reservoir and distribution pipes for Angono and Taytay, and to construct deep wells, elevated tanks and distribution pipes for

other seven towns.

(2) Fringe Area Water Supply Project (FAWSP)
1989 - 1993

Main objective of this project is to improve the water supply in the inadequately served areas shown in Figure 12.3.4. Most of these areas are not connected to the central distribution system of the MWSS and, therefore, the major source of water is groundwater.

The Fringe Area consists of one (1) city and eight (8) municipalities enumerated as follows:

South Sector : Bacoor, Muntinlupa
East Sector : Antipolo, Montalban, San Mateo
West Sector : Cavite City, Kawit, Imus, Rosario

Eight other cities/municipalities in the fringe areas, namely,: Caloocan city B, Marikina, Novaliches in Quezon City, Valenzuela, Las Pinas, Taguig, Cainta, and Taytay will be served with surface water through AWSOP.

The project will construct new deepwells and rehabilitate old ones, pump stations, distribution lines and 40,000 house service connections. At a cost of ₱ 252.4 million, the project is expected to benefit 600,000 customers by 1993.

(3) Metropolitan Manila Water Distribution Project (MMWDP)
1986 - 1991

The project provides the extension of MWSS water supply facilities by maximizing the available capacity of the recently completed Manila Water Supply II Project. The project involves the laying of additional 280 kms of new lines, 26,879 new house service connections including the interconnection of 72 subdivisions, pockets of in-filling developments, urban sites, low income areas and other areas served through groundwater but are showing signs of saline intrusion. The project cost is estimated to be ₱ 1.2 billion including loan amount of 38.0 million from IBRD. This project will benefit 800,000 customers.

As of August 1990, physical accomplishment of MMWDP was reported at 70.62% representing the pipe laying of a total of 384,220 m watermains, installation of 26,182 units of house service connections, interconnection at 567 points, installation of 133 fire hydrants, and 1,894 gate valves.

(4) Umiray-Angat Transbasin Project (UATP)
1991 - 1995

From a diversion dam located in Dingalan, Aurora Province, an estimated 800,000 m^3/day will be diverted from the Umiray River Basin to the Angat River Basin to increase further the capacity of AWSOP. This transbasin project will entail the construction of a diversion dam, tunnels and aqueducts, auxiliary power unit and a treatment plant. The project will cost ₱2.45 billion and will benefit 2.2 million population by year 1995. A loan from ADB with an amount of $1.2 million will be allotted for the feasibility study of the project from the year 1990.

(5) Manila South Water Distribution Project (MSWDP)
1990 - 1995

The project will serve as an alternative source from the existing Angat Water Supply. This project will supply Paranaque, Muntinlupa, Las Pinas, and Bacoor. Project's components include construction of two treated water reservoirs, three booster pumping stations, 52.3 km of primary distribution lines, 220 km of secondary and tertiary distribution networks and 99,100 house service connections. At a cost of ₱1.5 billion, the project will benefit about 1,000,000 population.

(6) Manila Water Supply Project III (MWSP III)
1998 - 2004

The MWSP III project is a multi-purpose development of the Kaliwa River Basin located in Tanay, Rizal that aims to provide long term water supply for Metro Manila and to generate incidental power for the Luzon grid. The project is subdivided into 3 major components, namely: headworks, treatment plant and distribution system capable of conveying a full yield of 1,900,000 m^3/day. Project cost is ₱3 billion.

The MWSP III was started in 1983, and as of 1989, MWSS has already spent ₱426,560,000 for its detailed design, construction of bypass tunnel, relocation and other preparatory works. Based on its approved implementation schedule, MWSS will spend a total of ₱1.15 billion for the next 8 years (1989-1997) for the purpose of transferring the settlers from the watershed.

Considering the huge financing necessary for its completion, the project will be deferred for 12 years. The project cost was found to be more than twice the cost of developing Angat and Umiray Rivers and Laguna de Bay.

(7) Manila North-East Water Supply Project (MNEWSP)
1991 - 1995

The project will revive the utilization of the long abandoned Wawa Dam. It aims to construct potential groundwater sources catering to the water supply requirements of the municipalities of Montalban, San Mateo and a part of Marikina. The project will rehabilitate the intake structure, construct a treatment plant, transmission lines, distribution network and about 43,000 house service connections. With a possible yield of 72,000 m^3/day from Wawa Dam alone, the project is expected to benefit 260,000 customers by 1995 at a cost of ₱580.2 million.

(8) Balara Treatment Plant Rehabilitation Project
1991 - 1994

The rehabilitation project aims to increase operating efficiencies of the Balara Treatment Plant by installing additional equipment, civil structures and telemetering systems. When completed, improvement of water quality and reduction of operating cost are expected. Project cost is placed at ₱ 486.3 million.

12.3.3 Future Water Source and Production Capacity

(1) Water Source

Based on the implementation plans of ongoing projects, only the AWSOP is expected to augment the yield of water sources by an annual average of

1,300 thousands m3/day or 15 m3/sec. Several projects though are lined up by the MWSS to augment the water sources yield: RPWSIP, UATP, MWSP III, MNEWSP (Table 12.3.5). However, these projects are still on the study or on the designing stage and financial sources for them have not been finalized yet. As such, their implementation schedules are only tentative.

(2) Water Production

Since the completion of the La Mesa Treatment Plant in 1985, water production capacity of MWSS has remained at 2,636 thousands m3/day. Among MWSS's ongoing projects only AWSOP is planned for augmenting this capacity through construction of the La Mesa Treatment Plant No. 2 with a capacity of 900 thousands m3/day.

Several courses for increasing supply are being resorted to. One involves the recovery of NRW. Targeted to be discovered by the MWSRP I and II are 765 thousands m3/day of NRW. As more than half of this amount is estimated to be accounted for by leakage from the distribution lines, around 400 thousands m3/day of treated water will be available for consumption, a not so insubstantial amount. Another involves project proposals to augment water production capacity, but these are still on the study or detailed engineering stage.

The highest probability of being implemented among the MWSS proposed projects on increasing production capacity appear to fall on MNEWSP. This project that will use Wawa River as water source is expected to contribute 72 MLD. Other projects propose utilization of Laguna de Bay and groundwater. For reasons of finances and the long construction project could have been the biggest step yet to be taken in augmenting water production capacity.

TABLE 12.1.1 PRESENT WATER SUPPLY COVERAGE: 1987

(million)

Area	Total Population	(%)	Population Served						Underserved/ Unserved Population	(%)
			Total	(%)	Wells/Developed Spring	(%)	Piped System	(%)		
Philippines	57.36	100	36.17	63	17.92	31	18.25	32	21.19	37
Urban	23.53	100	15.39	65	12.52	53	2.87	12	8.14	35
Metro Manila and and its contiguous area*	8.16	100	7.01	86	6.84	84	0.17	2	1.15	14
Others	15.37	100	8.38	55	5.68	37	2.70	18	6.99	45
Rural	33.83	100	20.78	62	5.40	16	15.38	46	13.05	38

* Excluding the 303,433 population of the towns of Rizal province under BP 799.

Source: Department of Public Works and Highways, Water Supply, Sewerage, and Sanitation Master Plan of the Philippines: 1988-2000.

TABLE 12.1.2 NUMBER OF FAMILIES BY MAIN SOURCE OF WATER SUPPLY, BY REGION, URBAN AND RURAL: 1985

Area/Region	Total Number of Families	Faucet inside the house/yard community wtr.system	Faucet, other community water system	Tubed /piped well, own use	Tubed /piped well, others	Dug well	Spring, river, stream, etc.	Rain	Peddler
Philippines	9,847,339	1,853,841	1,723,961	1,678,497	1,631,065	1,702,881	929,892	118,825	208,378
	(100%)	(19)	(13)	(17)	(17)	(17)	(9)	(1)	(2)
Urban	3,726,049	1,462,080	777,429	517,756	478,673	244,330	59,765	14,505	171,511
	(100%)	(39)	(21)	(14)	(13)	(7)	(2)	(0)	(5)
Rural	6,121,290	391,761	946,532	1,160,740	1,152,392	1,458,551	870,126	104,321	36,867
	(100%)	(6)	(15)	(19)	(19)	(24)	(14)	(2)	(1)
Metro Manila Area (NCR)	1,310,549	738,297	292,377	61,783	65,789	32,978	-	-	119,325
	(100%)	(56)	(22)	(5)	(5)	(3)	(-)	(-)	(9)
I. Ilocos	711,232	100,683	90,894	216,201	173,249	94,134	35,529	542	-
II. Cagayan Valley	462,088	18,195	12,915	166,107	127,900	103,281	31,901	1,364	426
III. Central Luzon	956,921	181,438	103,870	380,517	255,389	16,978	14,752	-	3,978
IV. Southern Tagalog	1,303,729	227,001	287,491	256,822	222,193	205,930	100,253	1,294	2,745
	(100%)	(17)	(22)	(20)	(17)	(16)	(8)	(0)	(0)
V. Bicol	668,473	104,311	132,255	88,488	65,793	182,640	86,157	-	8,830
VI. Western Visayas	881,554	70,807	120,490	109,445	119,298	360,119	85,821	9,045	6,530
VII. Central Visayas	783,846	99,975	138,570	60,326	148,001	166,741	116,040	20,760	33,433
VIII. Eastern Visayas	567,496	53,634	157,361	39,594	112,786	137,640	60,793	693	4,996
IX. Western Mindanao	494,818	37,418	72,497	38,272	51,003	174,204	104,750	6,094	10,580
X. Northern Mindanao	565,270	109,462	171,727	23,622	54,236	98,859	99,104	5,778	2,482
XI. Southern Mindanao	705,453	84,995	94,402	160,893	174,835	46,363	64,590	70,553	8,823
XII. Central Mindanao	435,911	27,625	49,111	76,429	60,595	83,015	130,203	2,701	6,231

* Bracketed figures indicate percentages to total number of families.

Source: National Statistics Office, 1985 Family Income and Expenditures Survey.

TABLE 12.1.3 EXISTING WATER SUPPLY FACILITIES: 1987

Area	Type of Facility	Number	Population Served	Total Population	Percent of Population served
Metro Manila and its contiguous areas	Dams	4	7,008,000	8,160,000	86%
	Tunnels	2	-		-
	Aqueducts	7	-		-
	Treatment plants	2	-		-
	Balancing Reservoir	2	-		-
	Pipelines	3,000	-		-
	Pumping stations and reservoir	9	-		-
	Active deepwells	118	-		-
	Fire hydrants	2,350	-		-
	House Service Connection	543,900	-		-
Other urban areas	Waterworks systems (Level III)	214	3,970,000	15,370,000	26%
	Communal faucet systems (Level II)	1,900	1,710,000		11%
	Point sources (Level I)	9,000	2,700,000		18%
Rural areas	Piped systems (Level II & III)	3,232	5,400,000	33,830,000	16%
	Shallow wells	464,678	15,380,000		46%
	Deep wells	193,404			
	Developed springs	9,726			
			36,168,000	57,360,000	63%

Source: Department of Public Works and Highways, Water Supply, Sewerage and Sanitation Master Master Plan of the Philippines: 1988-2000.

TABLE 12.1.4 RESPONSIBILITY OF GOVERNMENTAL AGENCIES

Coverage Area / Responsibility Area / Agency	Metro Manila & its Contiguous Areas			Other Urban and Rural Areas			
	MWSS	DPWH	NWRB	LWUA	DPWH	DLG	NWRB
PLANNING	X (Area Wide)	Sector	C	Other Urban & Rural Areas (Area Wide)	Sector		C
PROGRAMMING	X			L-II/III	L-I Source Dev.	L-I	
FINANCING	X			X	X	X	
INSTITUTIONAL	X			X	Interim	Interim	
ENGINEERING	X			X	X	X	
CONSTRUCTION	X			L-II/III Source Dev.	L-I	L-I	
OPERATION AND MAINTENANCE	X			WD/ RWSA			

X - Directly Responsible
C - Coordination
Source: Department of Public Works and Highways, Water Supply, Sewerage, and Sanitation Master Plan of the Philippines: 1988-2000.

TABLE 12.1.5 PHYSICAL TARGETS, INVESTMENT REQUIREMENTS AND SERVICE COVERAGE, FIRST STAGE (1988-1992)

Particulars	Implementing Agency	Physical Targets	Investment Requirements (million P)	Population Served (million)		% of Population Served	
				Additional	Cumulative	Additional	Cumulative
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WATER SUPPLY			21,691.85				87
I. Metro Manila and its Contiguous Areas			9,568.85	1.440	8.448	4	87
1. Manila Water Supply Rehabilitation Project I	MWSS	- Replacement of 131,000 house con. - Removal 28,000 spaghetti con. - Replacement of 200 km. pipelines - Installation of 600 flow rec. stations - Replacement of 108,000 pcs. water mts. - Repair of 22,500 pcs. water meters - Installation of 12,000 pcs. new water meters - Repair of 300 pcs. valves - Replacement of 2.25 pcs. valve	973.57				
2. Metro Manila Water Distribution Project		- Const. of 28 km. new pipelines - Inst. of 100,000 new house con. - Intercon. 72 sub. to serve 15,600 households - Infilling of 24 areas with secondary and tertiary pipelines - Const. of tertiary pipelines for 160 low-income areas - Drilling and equipping of 5 new deep wells	829.51				
3. Manila Water Supply Project II		- Completion of ongoing works	176.08				
4. Angat Water Supply Optimization Project		- Const. of new 6.4 km. tunnel - Const. of new 16.3 km. aqueduct - Expansion of La Mesa Treatment Plant - Const./Inst. of distribution pipelines pumping stations and reservoir - Inst. of additional house service connections	5,363.10				
5. Manila Water Supply Rehabilitation Project II		- Replacement of 104,000 house con. - - Removal of 13,000 spaghetti con. - Replacement of 50 km. pipelines Inst. of 1,040 flow rec. stations connections - Repair of 7,280 pcs. water meters - Installation of 3,120 water meters - Inst. of 1,560 new valves - Replacement of 11,440 water meters Repair or replacement of 1,560 valves	1,043.40				
6. Fringe Areas Water Supply Project		- Construction of deep wells - Const./Inst. of pipelines - Rehab. of existing facilities Inst. of new house service connection	1,021.55				
7. Water Supply Development in Rizal		- Const. of shallow and deep wells - Const./Inst. of pipelines - Development of springs Installation of house service connection	161.64				
II. Other Urban Areas	LWUA, DLG	- Construction of: 450 Piped Systems 450 Piped Systems (L-II/III) Repair/Rehab. of 250 systems	4,367.00 3,943.00 424.00	4.913 4.913	13.766	22	77
III. Rural Areas	DPWH, DLG, LWUA	- Construction of: 933 Piped Systems 933 Piped Systems (L-II/III) 87.46 Point Sources (L-I) Repair/Rehab. of 21,620 systems	7,756.00 1,668.00 5,990.00 98.00	13.723 0.473 13.25	34.030	30	92

Source: Department of Public Works and Highways, Water Supply, Sewerage and Sanitation Master Plan of the Philippines: 1988-2000.

TABLE 12.1.6 PHYSICAL TARGETS, INVESTMENT REQUIREMENT AND SERVICE COVERAGE, SECOND STAGE (1993-2000)

Particulars	Implementing Agency	Physical Targets	Investment Requirements (million P)	Population Served (million)		% of Population Served	
				Additional	Cumulative	Additional	Cumulative
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WATER SUPPLY							
I. Metro Manila and its Contiguous Areas			22,689.21				94
1. Manila Water Supply Rehabilitation Project III	MWSS	- Const. of 113 meters rockfilled dam - Const. of 2,400 mid treatment plant - Const. of 14 km tunnel - Const. of 23.2 mega watts hydro-electric plant - Const. of pumping stations and reservoirs - Const. of about 500 km. pipelines - Installation of 170,000 new house service connections	129,000.00	2.705	11.153	10	97
II. Other Urban Areas	LWUA	- Construction of: 654 Piped Systems (L-II/III) Repair/Rehab. of 350 systems	6,915.00 6,321.00 594.00	9.025 9.025	23.506	18	95
III. Rural Areas	DPWH, LWUA	- Construction of: 794 Piped Systems (L-II/III) 13,340 Point Sources (L-I) Repair/Rehab. of 21,000 systems Replacement of 9,500 systems	2,874.21 1,929.00 755.46 161.25 28.50	2.715 0.715 2	36.030	1	93

Source: Department of Public Works and Highways, Water Supply, Sewerage and Sanitation Master Plan of the Philippines: 1988-2000.

TABLE 12.1.7 WATER SUPPLY TARGETS: 1988-2000

Category	1988	1989	1990	1991	1992	1993-2000	Total
A. Rural Areas							
1. Point Sources	10,387	16,238	27,119	30,202	24,820	44,340	153,106
Construction	7,823	14,576	20,796	24,433	19,518	13,340	100,486
Shallow well	4,381	7,901	10,831	11,825	9,520	5,070	49,528
Deep well	2,767	5,337	8,357	10,820	8,550	7,200	43,031
Spring developed	405	1,068	1,393	1,788	1,448	1,070	7,177
Others	270	270	215	-	-	-	755
Repair/rehabilitation	2,564	1,662	6,323	5,769	5,320	21,500	43,120
Replacement	-	-	-	-	-	9,500	9,500
2. Piped Systems (Level II/III)	131	204	110	262	226	794	1,727
B. Other Urban Areas							
Piped systems (Level II/III)	84	105	165	184	162	1,004	1,704
Construction	34	55	115	134	112	654	1,104
Repair/rehabilitation	50	50	50	50	50	350	600

Source: Department of Public Works and Highways, Water Supply, Sewerage and Sanitation Master Plan of the Philippines: 1988-2000.

TABLE 12.2.1 MWSS WATER SUPPLY STATISTICS, 1984-1990

Year	1984	1985	1986	1987	1988	1989	1990
1) Pop'n under MWSS (million)	7.480	7.712	7.938	8.167	8.405	8.651	9.133
2) Water Production							
a) Surface Water (million m3)	642.24	757.37	874.07	834.75	849.34	859.10	875.80
b) Groundwater (million m3)	25.56	29.45	30.43	27.87	29.48	28.96	33.33
Total	667.80	786.83	904.51	862.62	878.82	888.06	909.13
Increase	-	119.03	117.68	(41.89)	16.20	9.24	21.07
3) Water Comsumption							
a) Volume Sold (million m3)	289.90	302.85	310.78	336.51	359.45	375.77	384.67
%	43.4%	38.5%	34.4%	39.0%	40.9%	42.3%	42.3%
b) NRW (million m3)	377.90	483.98	593.73	526.11	519.37	512.29	524.46
%	56.6%	61.5%	65.6%	61.0%	59.1%	57.7%	57.7%
Total	667.80	786.83	904.51	862.62	878.82	888.06	909.13
c) House Connection (mil. m3)	168.55	183.55	195.47	218.48	225.85	235.74	244.97
d) P.F. & Other Conn. (mil. m3)	121.35	119.30	115.31	118.03	133.60	140.03	139.70
e) Illegal Use (mil. m3)	151.16	193.59	237.49	210.44	207.75	204.92	209.78
Sub Total	441.06	496.44	548.27	546.95	567.20	580.69	594.45
%	66.0%	63.1%	60.6%	63.4%	64.5%	65.4%	65.4%
f) Leak, Meter Error (mil. m3)	226.74	290.39	356.24	315.67	311.62	307.37	314.68
%	34.0%	36.9%	39.4%	36.6%	35.5%	34.6%	34.6%
Total	667.80	786.83	904.51	862.62	878.82	888.06	909.13
4) Number of Connections							
a) House Connection	321,512	377,538	442,323	490,223	508,545	543,128	599,754
b) Public Faucet	1,020	1,080	1,160	1,230	1,300	1,420	1,490
c) Others	27,039	27,368	26,919	26,703	44,688	43,910	47,343
Total	349,571	405,986	470,402	518,156	554,533	588,458	648,587
Increase	-	56,415	64,416	47,754	36,377	33,925	60,129
5) Estimated Population Served							
a) House Connection (million)	2.604	3.058	3.583	3.971	4.119	4.399	4.858
b) Public Faucet (million)	0.496	0.525	0.564	0.598	0.632	0.690	0.724
Sub Total	3.100	3.583	4.147	4.569	4.751	5.089	5.582
Increase	-	0.483	0.564	0.422	0.182	0.338	0.493
c) Illegal Use (million)	1.358	1.955	2.738	2.483	2.381	2.399	2.649
Total	4.458	5.538	6.884	7.052	7.132	7.489	8.232
Increase	-	1.080	1.347	0.167	0.080	0.357	0.743
6) Per Capita Water Consumption (lpcd)							
a) for distributed water	410	389	360	335	338	325	303
b) for effective water	271	246	218	212	218	212	198
c) for domestic water	177	164	149	151	150	147	138

Note: 5a = 4a x 8.1, 5b = 4b x 486, 5c = (3b x 0.4 x (3c/3a)) / (3c/4a) x 8.1
6a = (3a+3b) / (5a+5b+5c), 6b = (3c+3d+3e) / (5a+5b+5c), 6c = 3c / 5a

Source: Corporate Planning Group

TABLE 12.2.2 WATER DISTRIBUTION AND ITS DISPOSITION

MONTH 1990	DISTRIBUTED WATER	REVENUE WATER	NON-REVENUE WATER	NRW BREAKDOWN (ESTIMATED)		
				ILLEGAL USE	LEAKAGE	METER ERROR
1	75,640,760	32,117,320	43,523,440	1,949,850	36,794,716	4,778,874
2	66,304,860	29,805,980	36,498,880	1,635,150	30,856,153	4,007,577
3	74,098,800	30,426,570	43,672,230	1,956,516	36,920,503	4,795,211
4	70,446,810	31,539,440	38,907,370	1,743,050	32,892,291	4,272,029
5	72,263,882	32,216,412	40,047,470	1,794,127	33,856,131	4,397,212
6	70,541,918	32,359,116	38,182,802	1,710,590	32,279,741	4,192,472
7	77,868,754	32,062,970	45,805,784	2,052,099	38,724,210	5,029,475
8	79,949,295	32,781,163	47,168,132	2,113,132	39,875,939	5,179,061
9	81,132,259	33,427,116	47,705,143	2,137,190	40,329,928	5,238,025
10	82,649,978	33,325,055	49,324,923	2,209,757	41,699,290	5,415,877
11	78,463,710	33,240,963	45,222,747	2,025,979	38,231,310	4,965,458
12	79,567,729	32,223,546	47,344,183	2,121,019	40,024,772	5,198,391
TOTAL	908,928,755	385,525,651	523,403,104	23,448,459	442,484,984	57,469,661
DAILY AVG.	2,490,216	1,056,235	1,433,981	64,242	1,212,288	157,451
% TO DIST.	100.0%	42.4%	57.6%	2.6%	48.7%	6.3%
% TO NRW			100.0%	4.5%	84.5%	11.0%
1989						
TOTAL	888,059,928	376,055,417	512,004,511	84,962,387	367,566,421	59,475,703
DAILY AVG.	2,433,041	1,030,289	1,402,752	232,774	1,007,031	162,947
% TO DIST.	100.0%	42.3%	57.7%	9.6%	41.4%	6.7%
% TO NRW			100.0%	16.6%	71.8%	11.6%

Source: Water Distribution and Its Disposition, Water Distribution & Maintenance Dept., MWSS

TABLE 12.2.3 CAPACITY OF WATER SOURCES

Source		Area of Watershed (km^2)	Water Right or Capacity (m^3/day)	Status
Angat Dam (Angat River)		568	1,901,000 1/	Used
Ipo Dam (Angat River, Ipo River)	Old	-	(Submerged by New Dam)	
	New	70	474,000 2/	Used
La Mesa Dam (Novaliches Watershed)		27	100,000 3/	Used
Alat Diversion Dam (Alat River)		14	20,000 4/	Used
Marikina River Pumping Stations 5/	1st	-	189,000	Abandoned
	2nd	-	189,000	Abandoned
Wawa Dam (Wawa River)		280	57,000	Abandoned
Groundwater			82,000 6/	Used
Total			3,012,000 m^3/day	
	Used w/o Groundwater		2,495,000 m^3/day	

1/: Allocated, 22 CMS
2/: AWSOP; derived from catchment area, rainfall, and permeability coefficient
3/: AWSOP; calculated based on water balance
4/: AWSOP; based on measurement
5/: Abandoned due to bad water quality
6/: Annual average pumpage of MWSS-owned deep wells

TABLE 12.2.4 RAW WATER DRAWN FROM SURFACE WATER SOURCES

(thousand m^3)

year	1986	1987	1988	1989	1990
Total	879,956.2	877,733.1	871,413.4	899,157.9	916,875.4
Daily Avg.	2,410.8	2,404.7	2,387.4	2,463.5	2,512.0

Source: MWSS Annual Report 1986, 1987, 1988, 1989, 1990

TABLE 12.2.5 DRAWN RAW WATER BY MONTH: 1990

MONTH 1990	RAW WATER				RECOVERED WASH WATER	TOTAL TREATED WATER
	ANGAT DAM	IPO/ALAT/ LA MESA DAM	MARIKINA PUMP STN.	SUB-TOTAL		
1	65,876,000	8,072,900	0	73,948,900	2,286,000	76,234,900
2	62,673,400	2,017,800	0	64,691,200	2,153,000	66,844,200
3	71,790,700	60,600	0	71,851,300	2,466,800	74,318,100
4	67,951,100	458,900	0	68,410,000	2,299,200	70,709,200
5	71,517,200	(1,688,700)	0	69,828,500	2,794,500	72,623,000
6	51,647,000	17,343,700	0	68,990,700	1,981,500	70,972,200
7	43,104,200	33,127,900	0	76,232,100	2,478,500	78,710,600
8	35,250,800	44,201,900	0	79,452,700	1,405,600	80,858,300
9	74,386,800	5,815,500	0	80,202,300	1,811,700	82,014,000
10	58,703,900	22,451,300	0	81,155,200	2,669,900	83,825,100
11	57,995,300	19,112,600	0	77,107,900	2,398,700	79,506,600
12	67,467,400	10,420,800	0	77,888,200	2,474,400	80,362,600
TOTAL	728,363,800	161,395,200	0	889,759,000	27,219,800	916,978,800
DAILY AVG.	1,995,517	442,179	0	2,437,696	74,575	2,512,271
%	81.9%	18.1%	0	100.0%	-	-
1989						
TOTAL	703,683,900	170,540,000	0	874,223,900	24,961,000	899,184,900
DAILY AVG.	1,927,901	467,233	0	2,395,134	68,386	2,463,520
%	80.5%	19.5%	0	100.0%	-	-

Source: Weekly Status of Water Production and Elevations, Water Sources and Treatment Dept., MWSS

TABLE 12.2.6 MWSS WATER PRODUCTION: 1985-1990

(unit: m^3)

Year	Treated Surface Water			Groundwater from Wells			Total
	Balara T.P.	La Mesa T.P.	Sub Total	Manila & Suburbs	Cavite Waterworks	Sub-Total	
1985	480,875,282	276,501,100	757,376,382	22,934,495	6,519,749	29,454,244	786,830,626
1986	534,394,436	339,681,600	874,076,036	22,840,692	7,590,881	30,431,573	904,507,519
1987	521,429,600	313,332,400	834,762,000	19,816,742	8,055,750	27,872,492	862,634,492
1988	509,568,000	339,772,700	849,340,700	21,418,094	8,059,931	29,478,025	878,818,725
1989	511,068,700	348,015,800	859,084,500	20,989,504	7,977,002	28,966,506	888,051,066
1990	504,033,800	371,767,600	875,801,400	22,553,080	10,773,164	33,326,244	909,127,644
AVG.	510,228,303	331,511,867	841,740,170	21,758,768	8,162,746	29,921,514	871,661,684
Daily.	1,397,886	908,252	2,306,138	59,613	22,364	81,977	2,388,115

Source: Water Sources & Treatment Dept., MWSS

TABLE 12.2.7 WATER PRODUCTION BY MONTH

MONTH 1990	SURFACE WATER				GROUNDWATER			PRODUCED WATER TOTAL
	BALARA NO. 1 TP	BALARA NO. 2 TP	LA MESA TP	SUB-TOTAL	MANILA & SUBURBS	CAVITE WATERWORKS	SUB-TOTAL	
1	12,230,200	29,250,300	31,483,900	72,964,400	1,835,348	841,009	2,676,357	75,640,757
2	10,985,900	25,952,100	27,010,900	63,948,900	1,723,730	832,229	2,555,959	66,504,859
3	12,196,400	28,837,300	30,168,800	71,202,500	1,931,569	964,726	2,896,295	74,098,795
4	11,564,500	27,501,800	28,710,500	67,776,800	1,779,453	890,555	2,670,008	70,446,808
5	11,604,900	27,858,200	30,123,500	69,586,600	1,860,741	813,541	2,674,282	72,260,882
6	11,646,100	27,124,000	29,101,600	67,871,700	1,800,217	870,001	2,670,218	70,541,918
7	12,998,300	29,732,600	32,292,300	75,023,200	1,929,954	915,800	2,845,754	77,868,954
8	14,136,800	30,033,400	32,915,900	77,086,100	1,808,524	994,671	2,803,195	79,889,295
9	14,502,300	30,350,300	33,578,200	78,430,800	1,856,112	845,347	2,701,459	81,132,259
10	14,893,300	31,258,800	33,582,600	79,734,700	1,986,586	928,692	2,915,278	82,649,978
11	14,103,000	30,380,000	31,088,500	75,571,500	1,457,293	935,017	2,392,310	77,963,810
12	14,527,800	30,364,500	31,710,300	76,602,600	2,023,553	941,576	2,965,129	79,567,729
TOTAL	155,389,500	348,643,300	371,767,000	875,799,800	21,993,080	10,773,164	32,766,244	908,566,044
DAILY AVG.	425,725	955,187	1,018,540	2,399,452	60,255	29,516	89,771	2,489,222
%	17.1%	38.4%	40.9%	96.4%	2.4%	1.2%	3.6%	100.0%
1989								
TOTAL	145,611,300	365,457,400	348,015,800	859,084,500	20,989,504	7,977,002	28,966,506	888,051,006
DAILY AVG.	398,935	1,001,253	953,468	2,353,656	57,505	21,855	79,360	2,433,016
%	16.4%	41.2%	39.2%	96.7%	2.4%	0.9%	3.3%	100.0%

Source: Weeekly Status of Water Production and Elevations, Water Sources and Treatment Dept., MWSS

TABLE 12.2.8 OUTLINE OF TREATMENT PLANTS

	Balara Treatment Plant		La Mesa Treatment Plant
	No.1	NO.2	
Year Completed	1935	1958	1985
Location	Balara, Quezon City	same as left	Novaliches, Quezon City
Design Capacity	100 MGD (Normal) = 378,000 m^3/d 125 MGD (Maximum) = 473,000 m^3/d	200 MGD (Normal) = 757,000 m^3/d 300 MGD (Maximum) = 1,136,000 m^3/d	1,500,000 m^3/d
Chemical Mixing	Hydraulic Jump	Rapid Mixing 2 units	Flush Mixer 6 units
Coagulant Used	Alum	Alum	Ferric Chloride/Alum/Polymer
Flocculation Basin	2 units	12 units	72 units
Volume	2,016 m^3	20,300 m^3	20,736 m^3 (8x8x4.5x72)
Detention Time	2,016 / (378,000-132,000) = 11.8 min.	20,300 /757,000 = 38.6 min.	20,736 / 1,500,000 = 19.9 min.
Sedimentation Basin	2 units	12 units	12 units
Volume	4 MG/unit x 2 = 30,000 m^3 (210 x 21 x 3.8 m x 2 units)	106,000 m^3 (73.2 x 18.3 x 6.0 x 6) 73.2 x 18.3 x 7.2 x 6)	83,800 m^3 (16 x 97 x (4.5 + 1.5) x 12)
Detention Time	189 min.	201 min.	80 min.
Accelator	2 units	-	-
Capacity	17.5 MGD/unit (Normal) = 132,000 m^3/d 25.0 MGD/unit (Maximum) = 189,000 m^3/d	-	-
Coagulant Used	Ferric Chloride/Alum/Polymer	-	-
Filter	10 units	20 units	24 units
Type	Dual Media Rapid Sand Filter	same as left	3 layer RSF
Filtration Area	162 m^2/unit	162 m^2/unit	180 m^2/unit
Capacity	12.5 MGD/unit = 47,300 m^3/d/unit	10 MGD/unit = 37,800 m^3/d/unit 15 MGD/unit (Maximum)	62,640 m^3/d/unit
Filt. Velocity	290 m/d	233 m/d	348 m/d

Source: Water Distribution & Maintenance Dept.

TABLE 12.2.9 EXISTING PUMPING STATIONS

NAME	VOLUME OF RESERVOIR ($1000\ m^3$)	PUMPS & MOTOR discharge/head/output/No./type/(*) (MLD) (M) (HP)	COMPLT'N YEAR	PRESENT STATUS
ALGECIRAS	38	22.62 / 46.0/ 225 / 4 / S 34.07 / 30.0/ 200 / 3 / B	1976	operational
BALARA	19	30.30 / 61.0/ 250 / 1 / S 45.51 / 91.5/ 500 / 7 / B /(3)	1972	operational
CALOOCAN	19	22.62 / 46.0/ 225 / 3 / S 34.07 / 30.0/ 200 / 2 / B	1971	inactive
CUBAO	-	24.98 / 33.8/ 200 / 4 / B	1988 renovated	operational
D. TUAZON	19	22.02 / 46.0/ 225 / 4 / S 34.07 / 30.0/ 200 / 3 / B	1972	inactive
ERMITA	19	22.62 / 46.0/ 225 / 3 / S /(1) 34.07 / 30.0/ 200 / 2 / B /(1)	1970	operational
ESPIRITU	19	22.62 / 46.0/ 225 / 3 / S 34.07 / 30.0/ 200 / 3 / B	1976	inactive
FORT BONIFACIO	28	61.20 / 29.0/ 349 / 4 / S /(1)	1986	operational
MAKATI	19	34.07 / 30.0/ 200 / 3 / B 22.62 / 46.0/ 300 / 3 / S	1972	inactive
NOVALICHES	7	3.36 / 23.8/ 20 / 3 / S	1986	operational
NOVELETA	8	23.52 / 30.0/ 45 / 3 / S 31.20 / 30.0/ 149 / 3 / S	1990	operational
PASAY	19	22.62 / 46.0/ 225 / 2 / S 34.07 / 30.0/ 200 / 2 / B	1977	operational
PASIG	80	49.06 / 36.0/ 375 / 5 / S /(1)	1984	operational
SAN JUAN	95 + 57	45.51 / 91.5/ 500 / 6 / B /(2) 30.30 / 61.0/ 250 / 1 / B	1948	operational
TONDO	19	22.62 / 46.0/ 225 / 3 / S 34.07 / 30.0/ 200 / 2 / B	1975	inactive

type: S -- storage pump which boosts water from reservoir to the PDS
B -- in line booster pump which boosts water of PDS.
(*) No. of not-operational pump unit

TABLE 12.2.10 PHYSICAL AND CHEMICAL ANALYSES AT MWSS TREATMENT PLANTS (FROM JANUARY 1 TO DECEMBER 31, 1989)

SAMPLE		pH	Turbidity units	Acidity mg/l	Free CO2 mg/l	Alkalinity mg/l	Bicarbonates mg/l	Hardness mg/l	Chlorides mg/l	Iron mg/l	Residual Chlorine mg/l
Balara Treatment Plant											
Raw Water	Avg.	7.38	19.23	9.10	8.00	54.26	66.20	50.94	7.02	0.15	
	Min.	7.15	6.16	7.15	6.29	51.38	62.68	44.94	5.21	0.09	
	Max.	7.49	49.40	10.33	9.09	58.67	71.58	53.73	8.22	0.25	
Treated	Avg.	7.13	15.38	8.63	7.59	52.06	63.44	50.71	6.93		
	Min.	6.76	5.98	6.80	5.98	48.80	59.53	45.79	5.26		
	Max.	7.36	44.22	10.93	9.61	56.83	69.33	56.50	9.19		
Influent	Avg.	7.10	8.51	8.57	7.54	52.33	63.84	51.00	7.02		
	Min.	6.76	6.07	7.38	6.49	48.26	58.88	45.68	5.68		
	Max.	7.35	15.66	10.48	9.22	57.67	70.36	53.27	9.15		
Filtered Water	Avg.	7.08	3.51	7.91	6.96	51.79	63.18	51.39	7.09		
	Min.	6.86	2.79	7.00	6.16	48.78	59.51	44.78	4.67		
	Max.	7.36	6.39	10.06	8.85	56.33	68.72	56.20	9.41		
Finished Water	Avg.	7.10	3.62	8.13	7.15	51.73	63.11	51.10	7.40	0.07	0.52
	Min.	6.76	2.77	6.76	5.94	49.38	60.24	46.18	5.82	0.05	0.31
	Max.	7.32	6.21	10.23	9.00	57.18	69.76	53.25	11.00	0.08	0.73
La Mesa Treatment Plant											
Raw Water	Avg.	7.22	16.92	11.62	10.23	69.06	84.25	53.08	4.37	0.08	
	Min.	7.16	5.16	10.13	8.91	57.43	70.07	47.94	3.16	0.05	
	Max.	7.30	40.93	13.37	11.76	85.68	104.53	67.00	6.24	0.20	
Treated (Before Settlement)	Avg.	7.06	17.72	11.54	10.18	65.51	79.92	52.80	4.71	0.09	
	Min.	6.97	4.53	10.12	9.08	54.77	66.82	48.97	3.76	0.05	
	Max.	7.19	61.75	13.92	12.55	77.00	93.94	68.25	6.08	0.29	
Influent (Settled)	Avg.	7.05	6.14	11.58	9.25	64.86	79.12	52.71	5.67	0.05	0.96
	Min.	6.96	3.41	10.29	9.06	52.84	64.46	47.71	4.87	0.05	0.90
	Max.	7.15	13.75	13.52	11.37	73.90	90.16	68.00	7.30	0.06	1.07
Filtered Water	Avg.	7.06	1.92	11.21	9.87	63.94	78.00	52.32	5.72	0.05	0.71
	Min.	6.98	1.15	9.26	8.15	53.77	65.60	45.90	4.81	0.05	0.61
	Max.	7.16	3.92	13.15	11.57	72.13	88.00	68.25	7.36	0.05	0.78
Finished Water	Avg.	7.07	2.01	11.07	9.73	64.10	78.44	52.17	5.71	0.05	0.78
	Min.	6.99	1.12	9.59	8.44	53.87	65.72	48.06	4.65	0.05	0.61
	Max.	7.17	4.78	13.17	11.59	71.58	87.33	67.00	7.16	0.05	0.80
Bagbag Reservoir	Avg.	7.09	1.56	11.29	9.94	63.48	78.09	52.48	5.60		0.22
	Min.	7.04	1.09	10.10	8.89	54.00	65.88	47.66	4.85		0.14
	Max.	7.16	2.46	13.03	11.47	71.95	87.78	69.05	6.11		0.32

TABLE 12.2.11 RESULTS OF BACTERIOLOGICAL QUALITY ANALYSIS
(FROM JANUARY 1 TO DECEMBER 31, 1989)

Location	Total No.of	No.of Samples of Samples	Percentage of w/ MPN <2.2	Avg. Residual Satisfaction	Chlorine mg/l
Central Labo. Div.	MWSS Tap Water from Manila City	1,026	1,026	100.0%	0.33 range(0.30-0.43)
	MWSS Tap Water from Other Cities and Municipalities	688	688	100.0%	0.34 (0.20-0.61)
	MWSS Deepwells	735	576	78.4%	0.33 (0.20-0.40)
Process Quality Unit	Manila Tap Water	922	861	93.3%	0.32 (0.13-0.44)
	Suburbs Tap Water	629	445	70.7%	0.19 (0.09-0.85)

TABLE 12.2.12 PHYSICAL AND CHEMICAL ANALYSES OF MWSS TAP WATER (FROM JANUARY 1 TO DECEMBER 31, 1989)

SAMPLE		pH	Color units	Turbidity units	Alkalinity mg/l	Bicarbonate mg/l	Acidity mg/l	Free CO_2 mg/l	Chlorides mg/l	Iron mg/l	Hardness mg/l	Residual Chlorine mg/l	Total Solids mg/l	Silica mg/l	R_2O_3 (Al_2O_3 & Fe_2O_3) mg/l	Aluminum mg/l	Calcium mg/l	Magnesium mg/l	Sulfates mg/l	Fluorides mg/l	Residual Alum mg/l
Philippine Standard		6.5-8.5	5.00	5.00					200.00	1.00			500.00				75.00	50.00	200.00	0.60	
MWSS Tap Water																					
City of Manila	Avg.	7.45	5.00	3.90	50.40	61.50	7.00	6.20	5.20	0.06	60.40	0.35									
(Grab Sample)	Min.	6.40	5.00	1.40	34.40	42.00	2.00	1.80	3.00	0.05	48.00	0.00									
	Max.	8.25	30.00	32.50	72.40	88.30	22.00	19.40	8.00	0.20	90.00	0.60									
City of Manila	Avg.	7.42	5.20	3.50	40.00	48.80	7.40	6.50	4.30	0.06	61.40		138.00	18.80	2.70	1.40	17.80	4.10	36.40	0.04	0.03
(Composite Sample)	Min.	6.90	5.00	2.00	30.00	36.60	3.00	2.60	2.50	0.05	53.00		112.00	8.20	0.40	0.20	6.90	0.30	18.30	0.04	0.02
	Max.	8.05	7.00	7.10	49.20	60.00	18.00	10.60	6.00	0.10	73.00		177.00	26.80	5.20	2.70	25.20	9.40	54.80	0.04	0.04
Other Cities and	Avg.	7.60	5.20	3.50	56.50	65.20	6.20	5.40	5.90	0.06	58.80	0.30									
Municipalities	Min.	6.65	3.00	1.50	33.20	40.50	3.00	2.60	2.00	0.05	10.00	0.00									
(Grab Sample)	Max.	9.30	10.00	10.15	243.20	250.80	26.00	22.90	51.00	0.15	74.00	3.00									
Other Cities and	Avg.	7.71	5.80	3.69	42.10	51.40	6.20	5.40	6.70	0.06	61.10		149.30	20.80	3.30	1.70	18.70	3.60	44.00	0.03	0.03
Municipalities	Min.	7.20	5.00	2.00	26.80	32.70	3.00	2.60	2.00	0.05	52.00		114.00	5.20	0.40	0.20	7.40	nil	19.40	0.04	0.02
(Composite Sample)	Max.	8.20	15.00	10.15	59.00	72.00	20.00	17.60	19.00	0.15	70.00		196.00	29.00	7.70	4.00	26.90	10.10	66.20	0.04	0.04

TABLE 12.3.1 ON-GOING PROJECTS OF MWSS

PROJECT	EXPECTED VOL. TO BE INCREASED /RECOVERED	IMPLEMENTATION SCHEDULE START/ COMPLETE	TOTAL PROJECT COST	SOURCES OF FUND	PROJECT COMPONENTS	REMARKS
Manila Water Supply Rehabilitation Project I (MWSRP I)	NRW Recovery 500 MLD	1983/1991	P 1832.91 M	CC =P 794.00 M ADB =$ 29.16 M	- Replacement of 150 kms. tertiary distribution lines - Installation of 280 public faucets - Construction of 50 kms. new tertiary dist. lines - Construction and replacement of 108,000 house service connections - Relocation of 12,000 water meters	completed in 1991
Manila Water Supply Rehabilitation Project II (MWSRP II)	NRW Recovery 265 MLD	1988/1992	P 1376.52 M	ADB 947=$ 26.40 M DBP =P400.00 M CC =P 89.23 M Equity=P 172.15 M	- Replacement of 1,000 kms. tertiary distribution lines - Installation of 285 public faucets - Construction of tertiary dist. lines - Construction and replacement of 87,121 water meters	
Metropolitan Manila Water Distribution Project (MMWDP)	-	1986/1992	P 1,111.76 M	CC =P509.68 M IBRD 2676=$ 24.53 M	- Construction of 280 kms. dist. lines - Construction of 100,000 house service connections (including interconnection of 72 sub-divisions)	
Angat Water Supply Optimization Project (AWSOP)	Increase 1,300 MLD (Angat Riv.)	1989/1994	P 8,400 M	IBRD 3124=$ 40.00 M ADB 986 =$ 103.70 M OECF =$ 80.00 M Bonds =P1,300.00 M CC =P 27.19 M Equity =P2,121.69 M	- Auxiliary Unit Powerhouse - 6.1 kms. tunnel - 900 MLD Water Treatment Plant - 16 kms. Aqueduct - 4 Treated Water Reservoirs - 11 Pumping Stations upgrading work - 4 Pumping Stations construction work - 137 kms. primary dist. lines - 178 kms. secondary dist. lines - 360,000 house service connections - La Mesa By-ass Aqueduct	
Locally Funded Project			P 100 M (annualy)	Local = P 100 M	- normal act. including improvement, expansion, replacement, interconnection, and other miscellaneous works that fall outside of ongoing foreign assisted projects	

SOURCE: 1) FCBD - PCK used in 1991 Budget
(FCBD -Financial control and Budget Department)
(PCK - Project Cost Estimate)
2) PPD - Engineering Area Project Cost Estimates for Total Project Costs
(PPD - Planning and Programming Department)

TABLE 12.3.2 NRW REDUCTION BY MWSRP I

Group No.	Zone No.	PRE-REHABILITATION DATA					POST-REHABILITATION DATA					Rehab Completion Month
		Month Measured	Total Supply (MLD)	Revenue Water (MLD)	NRW (MLD)	NRW (%)	Month Measured	Total Supply (MLD)	Revenue Water (MLD)	NRW (MLD)	NRW (%)	
IA	53	Sep.'84	42.504	12.734	29.770	70.04	May '90	18.037	12.902	5.135	28.47	Feb. '90
II	15	Feb.'85	4.989	1.976	3.013	60.39	Oct. '89	4.608	3.360	1.248	27.08	Sept. '86
	26	Oct.'85	20.061	7.726	12.335	61.49	Jun. '90	13.075	9.093	3.982	30.46	Feb. '90
	37	Jan.'86	41.820	5.650	36.170	86.49	Mar. '90	12.412	8.807	3.605	29.04	Jan. '90
	68	Oct.'85	10.662	4.781	5.881	55.16	Jul. '89	8.108	6.424	1.684	20.77	June '89
	70	Sep.'85	2.202	0.862	1.340	60.85	Feb. '88	1.955	1.629	0.326	16.68	Dec. '87
VII	90	Oct.'87	18.719	4.320	14.399	76.92	Feb. '90	9.627	7.659	1.968	20.44	Jan. '90
VIII	62	Jan.'88	10.775	3.254	7.521	69.80	Jun. '89	4.748	3.951	0.797	16.78	June '89
IX	59	Jun.'88	0.630	0.359	0.271	43.05	Feb. '90	0.610	0.474	0.137	22.40	Jan. '90
Total			152.362	41.662	110.70	72.66		73.180	54.299	18.882	25.80	

Source: MWSRP I Status Report, July 1990

TABLE 12.3.3 NRW REDUCTION BY MWSRP II

Group No.	Zone No.	PRE-REHABILITATION DATA					POST-REHABILITATION DATA					Rehab Completion Month
		Month Measured (MLD)	Total Supply (MLD)	Revenue Water (MLD)	NRW (MLD)	NRW (%)	Month Measured (MLD)	Total Supply (MLD)	Revenue Water (MLD)	NRW (MLD)	NRW (%)	
I	22	Apr. '88	7.733	4.428	3.305	42.74	Nov. '89	5.994	4.768	1.226	20.45	Dec. '88
	44	Mar. '88	7.355	2.588	4.767	64.81	March '9	5.621	4.258	1.363	24.25	Apr. '89
	66	Sep. '88	3.213	1.870	1.343	41.80	Jan. '90	2.653	2.174	0.479	18.06	Jan. '90
TOTAL			18.301	8.886	9.415	51.45		14.268	11.200	3.068	21.50	

TABLE 12.3.4 PROPOSED PROJECTS OF MWSS

PROJECT	EXPECTED VOL. TO BE INCREASED /RECOVERED	IMPLEMENTATION SCHEDULE START/COMPLETE	TOTAL PROJECT COST (mil. P)	FUND ALLOCATION Activity	L.C. (mil. P)	F.C. (mil. $)	PROJECT COMPONENTS	REMARKS
Rizal Province Water Supply Improvement Project (RPWSIP)	Increase 48 MLD (37-Laguna de Bay 11-Groundwater)	1991/1998	895.1		667.06	7.93	- Intake structure - Water Treatment Plant - Pumping Station - Reservoir - Distribution Pipeline - Deep Wells - Elevated Tanks - Distribution Tanks	On-going detailed engineering construction '92
Fringe Areas Water Supply Project (FAWSP)	Groundwater	1989/1993	252.4	F/S D/S C	38.00 10.00 204.51		- Deepwells (construction and rehabilitation) - Pump Stations - Distribution Network - 40,000 House Service Connections	On-going test wells construction as part of F.S. Construction April '91
Metro Manila Groundwater Dev't. Project (MMGWDP)	-	1990/1992	90	F/S	14.92	2.7	- Execution of study on groundwater development	On-going development study
Umiray-Angat Transbasin Project (UATP)	Increase 800 MLD (Umiray River)	1991/1995	2,454	F/S D/S C	3.50 7.30 800.00	1.27 8.86 44.73	- Diversion Dam - Tunnel/Aqueduct - Watershed Erosion Control	Technical assistance started February 1991 construction June'93
Manila South Water Distribution Project (MSWDP)		1991/1993	1,707		1,311.50	13.42	- Clean Water Reservoirs - Booster Pumping Stations - 52.8 kms. Primary Dist. Network - 220 kms. Secondary and Tertiary Dist. Network - 99,100 House Service Connections	On-going detailed engineering
Manila Water Supply Project III (MWSP III)	Increase 1,900 MLD (Kaliwa River)	1998/2004	12,923				- Laiban Dam - Tunnel - Power Plant - Treatment Plant - Treated Water Reservoir - Distribution System	Detailed engineering for review Construction deferred

TABLE 12.3.4 PROPOSED PROJECTS OF MWSS (cont'd)

PROJECT	EXPECTED VOL. TO BE INCREASED /RECOVERED	IMPLEMENTATION SCHEDULE START/COMPLETE	TOTAL PROJECT COST (mil. P)	FUND ALLOCATION Activity	L.C. (mil. P)	F.C. (mil. $)	PROJECT COMPONENTS	REMARKS
Manila North-East Water Supply Project (MNEWSP)	Increase 72 MLD (Wawa River)	1991/1995	580	F/S	4.58	1.28	- Rehabilitation of Intake Structure	F.S. to start June 1991
				D/S	3.00	0.47		Construction Jan. '94
				C	245.00	9.2	- Water Treatment Plant - Treated Water Reservoirs - Transmission Main/Aqueduct - Distribution System - Wells - 43,000 House Service Connections	
Balara Treatment Plant Rehabilitation Project (BTPRP)	-	1991/1994	486.32	F/S	2.60	0.86	- Rehabilitation of Balara Treatment Plant	Technical assistance to start Aug. 1991 by JICA
				D/S	9.20	1.23		Construction Dec. '93
				C	103.30	10.33		
Cavite Water Supply Project (CWSP)	Increase 300 MLD (Laguna de Bay)	1992/1995	1,489				- Water Treatment Plant - Treated Water Reservoir - Booster Pumping Station - 150 kms Dist. Network - 75,000 House Service Connections	F/S Jan '92-Dec '92 D/S Jan '93-Dec '93 Construction Jan'94 Dec '94

(PPD - Planning and Programming Dept.)

TABLE 12.3.5 PLANNED AUGMENTATION OF WATER SOURCES

YEAR	PROJECT	CAPACITY (m^3/day)
1993	AWSOP	129,600
1995	MNEWSP	72,000
1997	UATP	777,600
2011	MWSP III	1,900,000

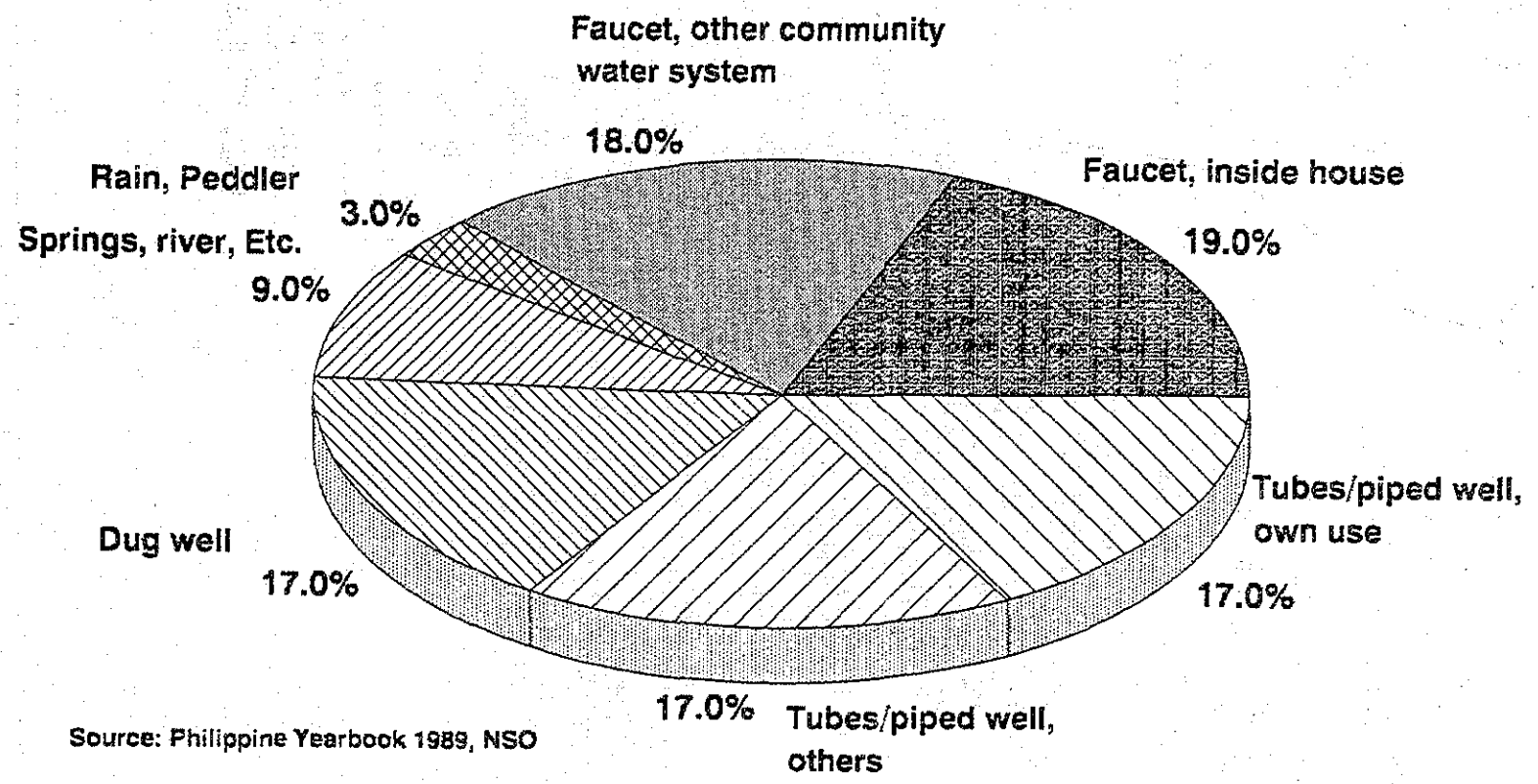
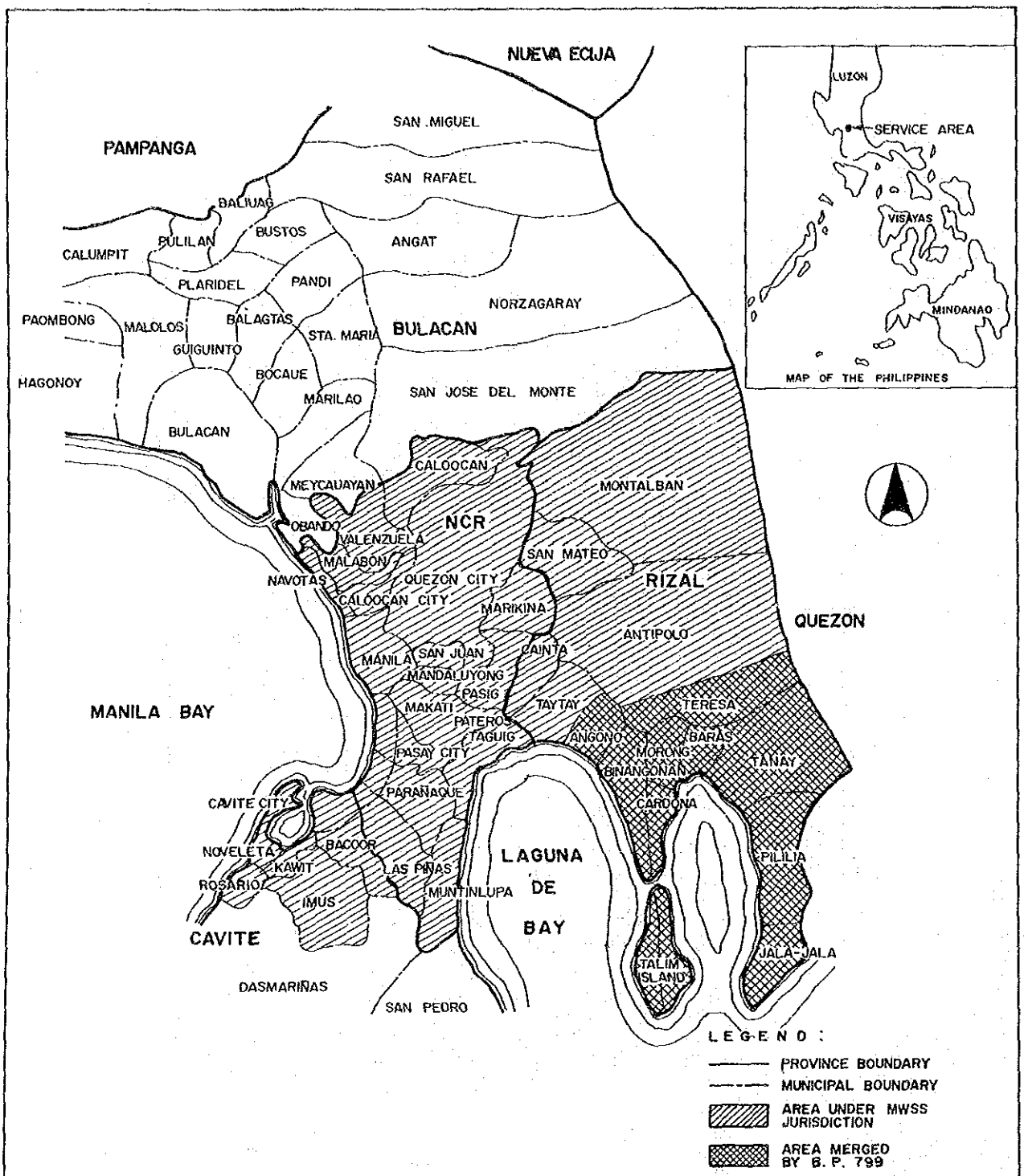
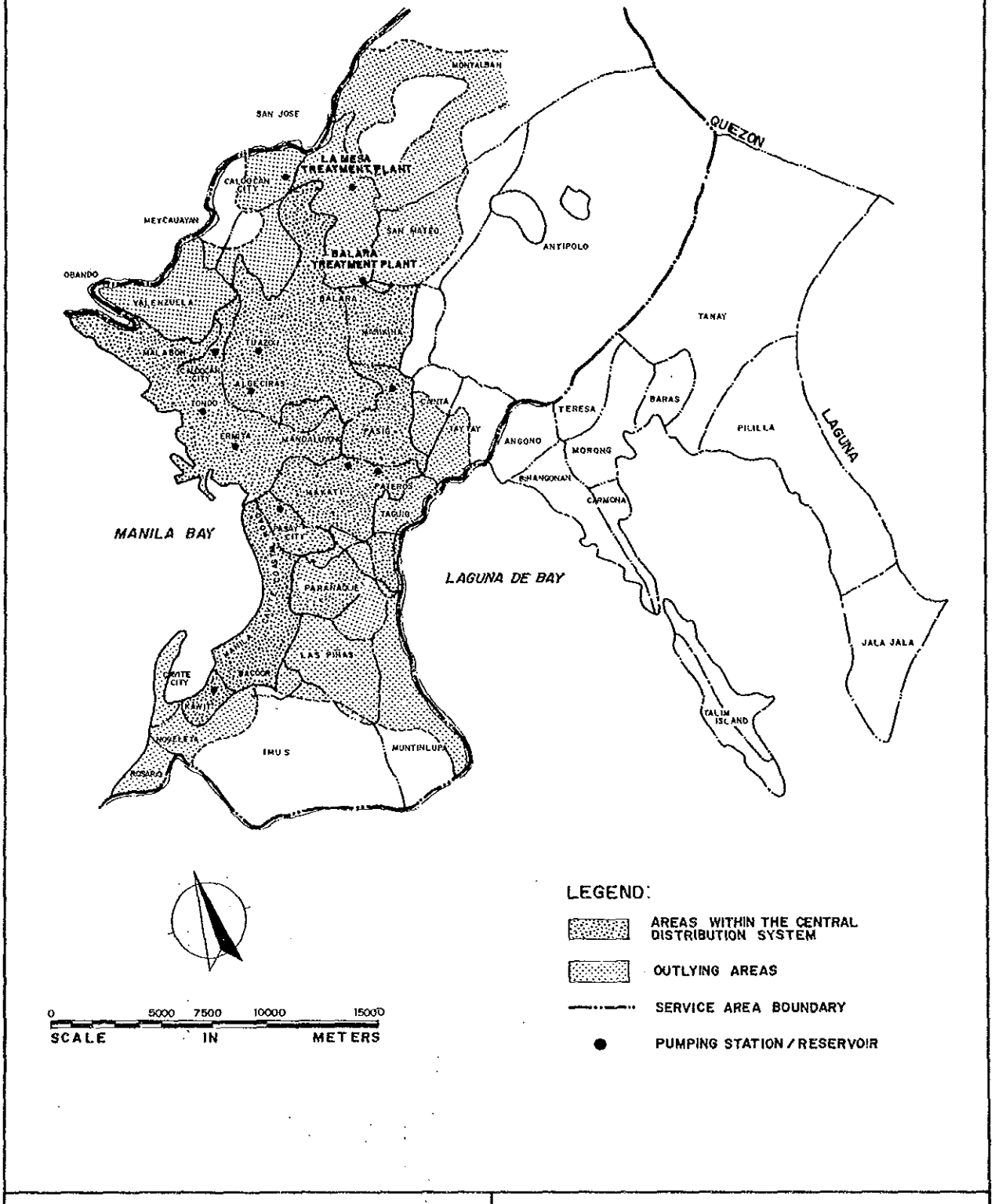


FIGURE 12.1.1 PERCENTAGE OF FAMILIES BY MAIN SOURCE OF WATER SUPPLY, 1985



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.1
JAPAN INTERNATIONAL COOPERATION AGENCY	MWSS SERVICE AREA



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.2 PRESENT WATER SUPPLY SERVICE AREA BY MWSS
JAPAN INTERNATIONAL COOPERATION AGENCY	

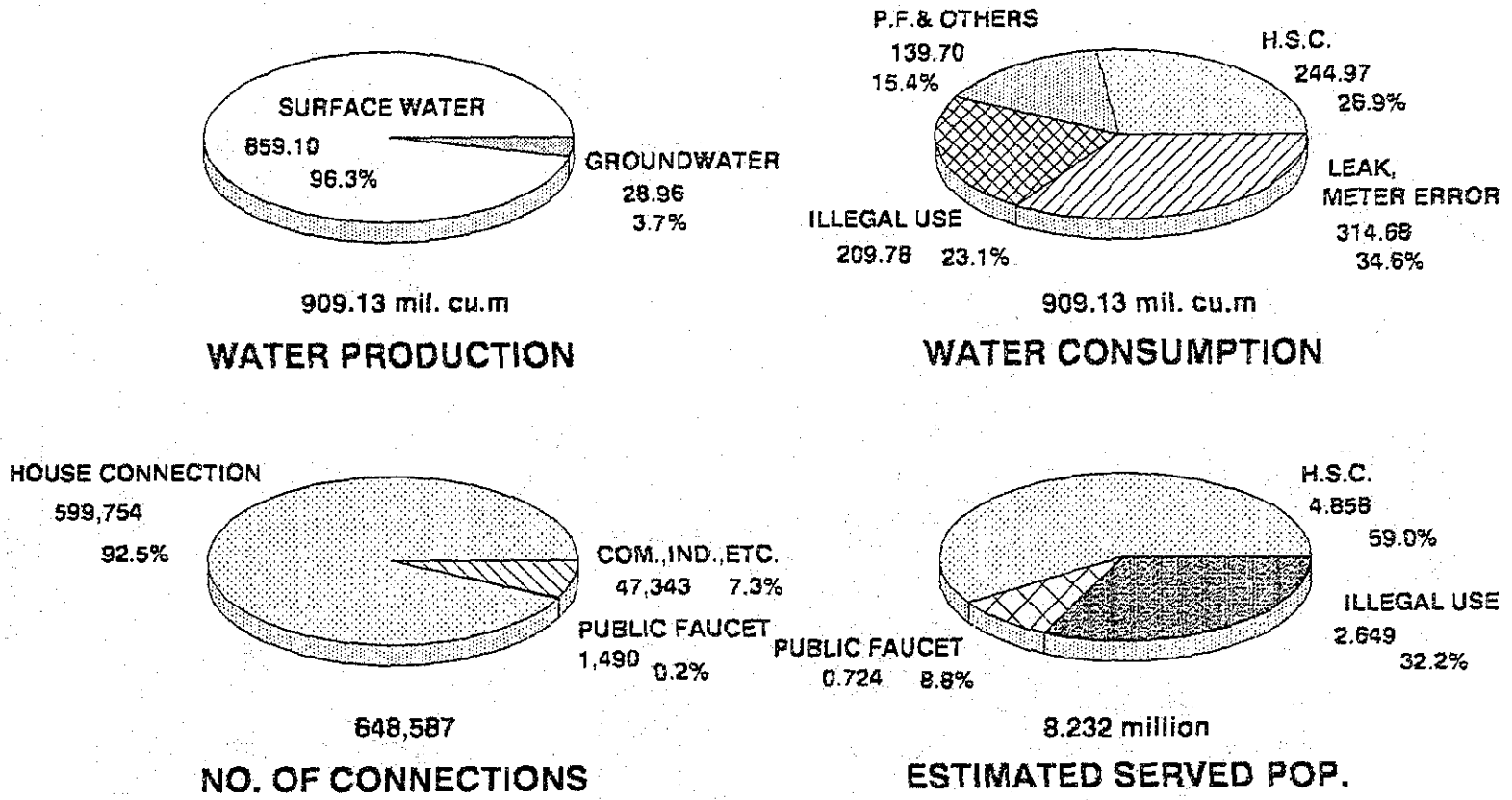
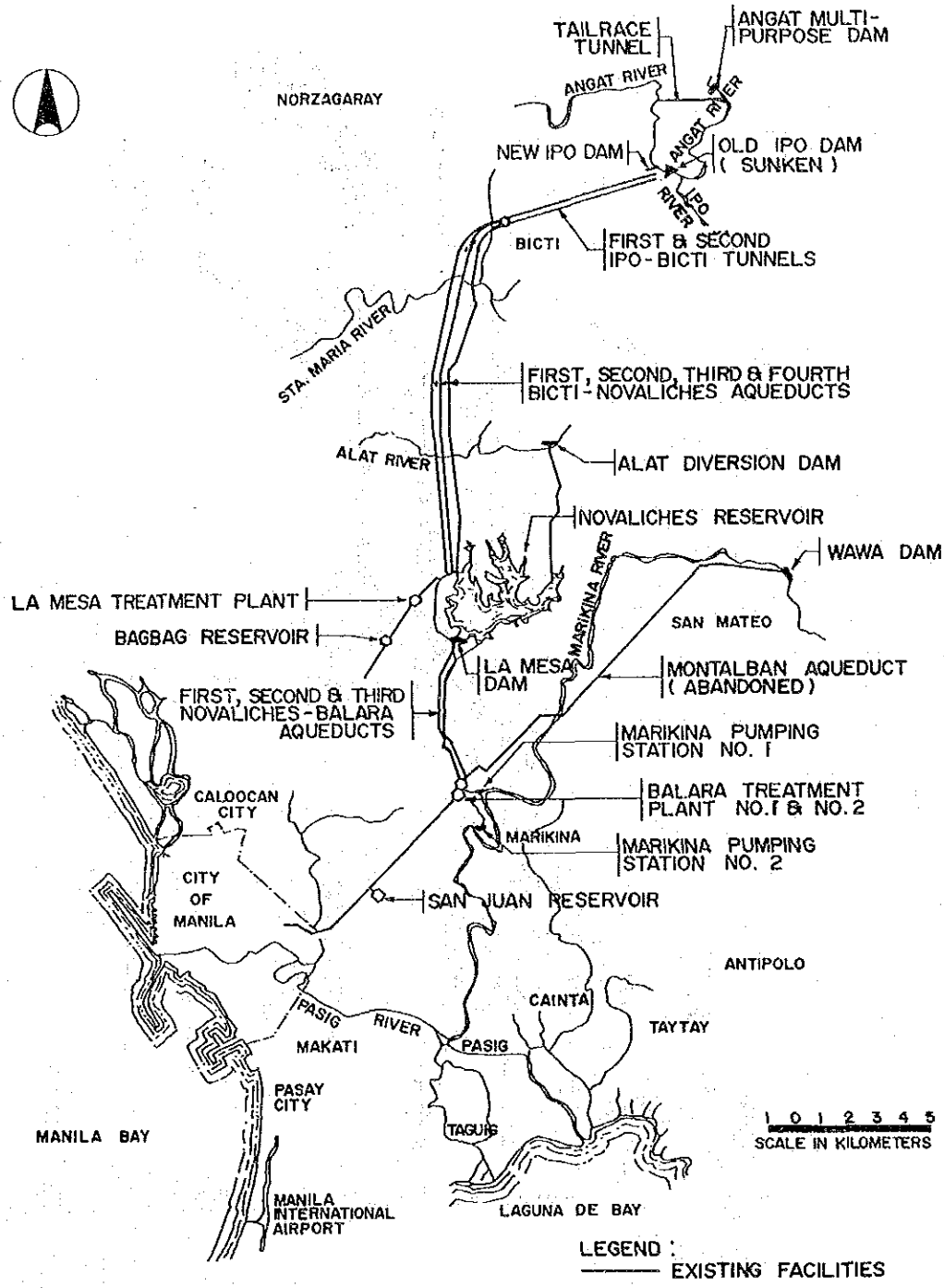
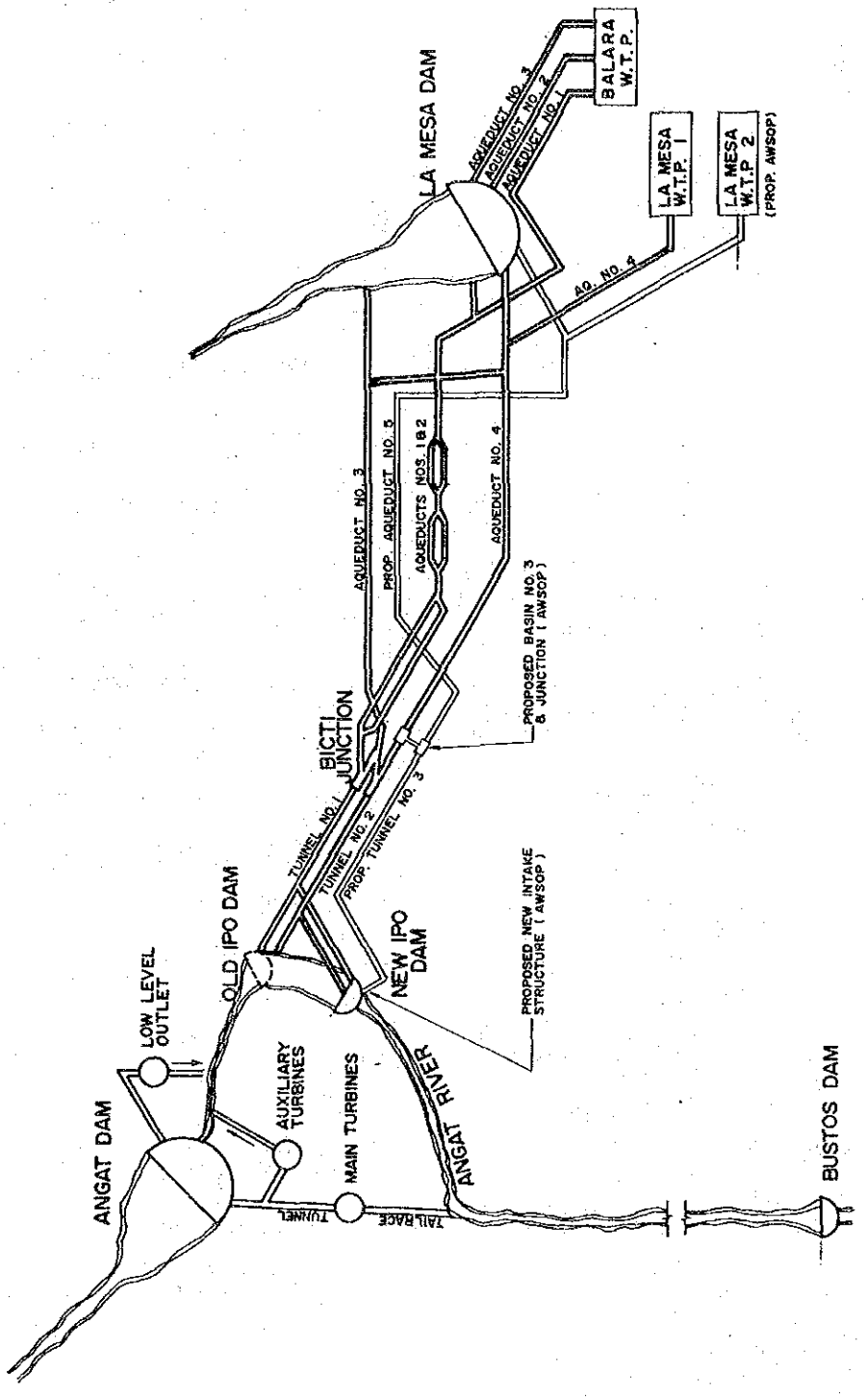


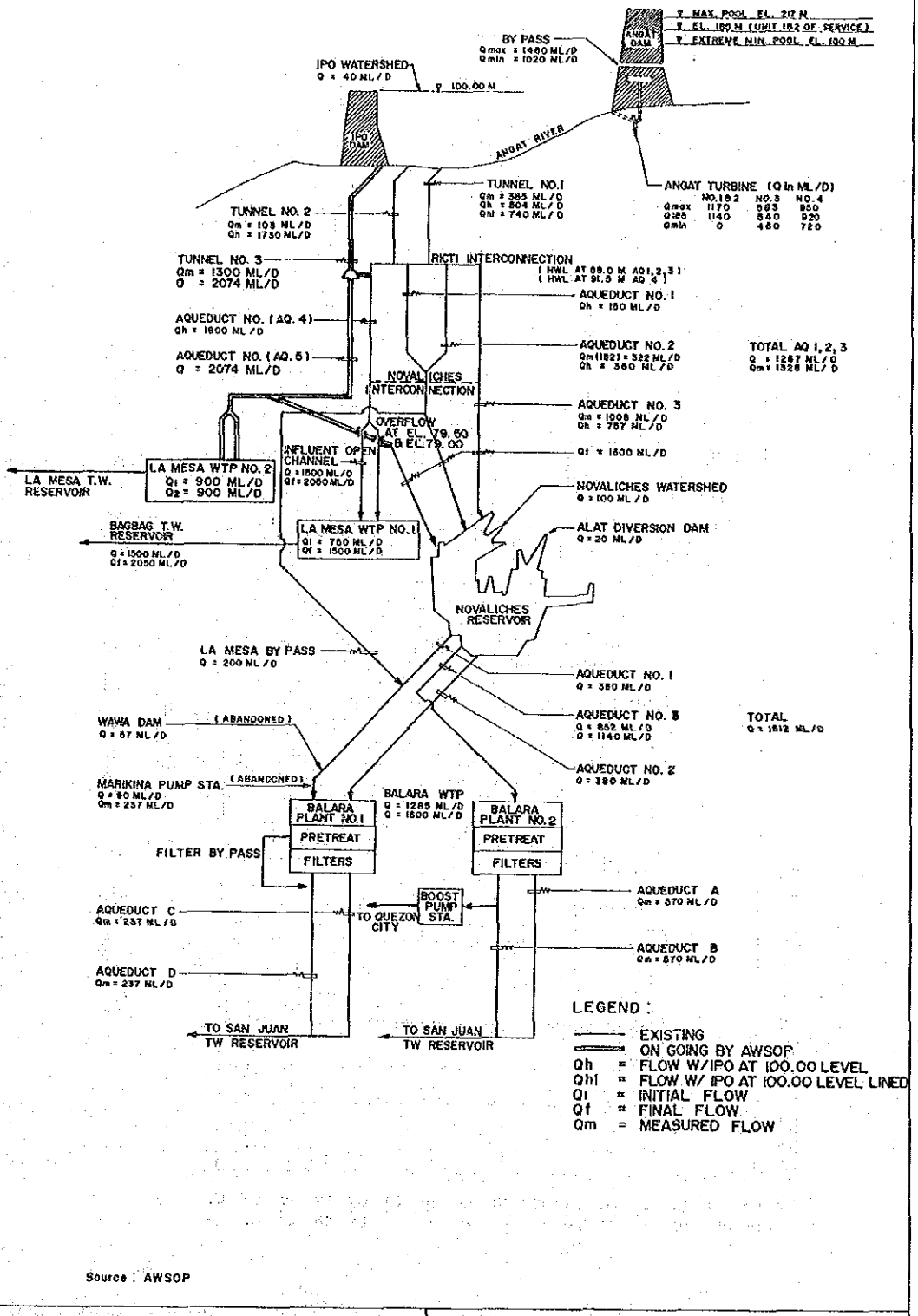
FIGURE 12.2.3 MWSS WATER SUPPLY STATISTICS (1990)



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.4 EXISTING AND MAJOR SUPPLY FACILITIES
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.5 SCHEMATIC DRAWING OF WATER CONVEYANCE SYSTEM
JAPAN INTERNATIONAL COOPERATION AGENCY	



Source : AWSOP

STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.6
JAPAN INTERNATIONAL COOPERATION AGENCY	SURFACE WATER FLOW CHART

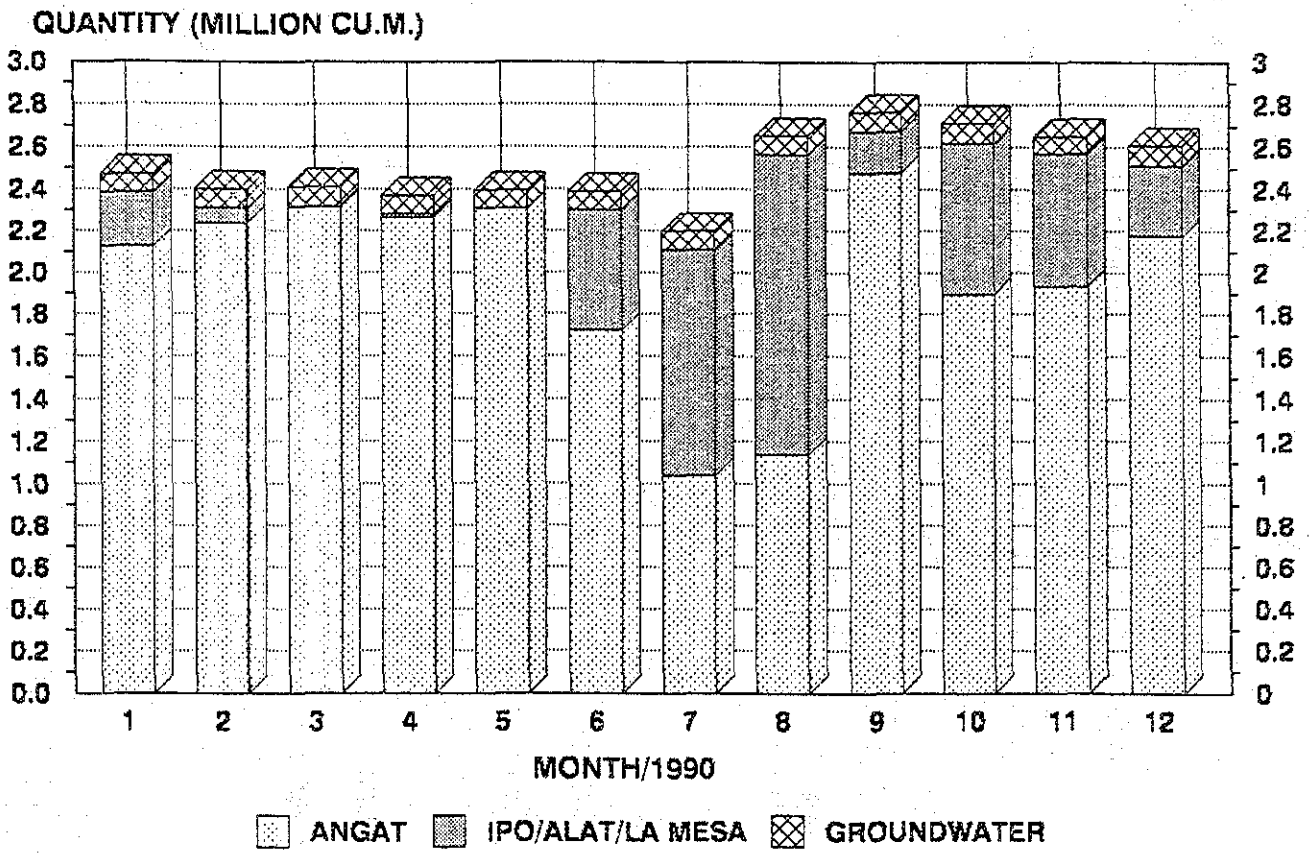
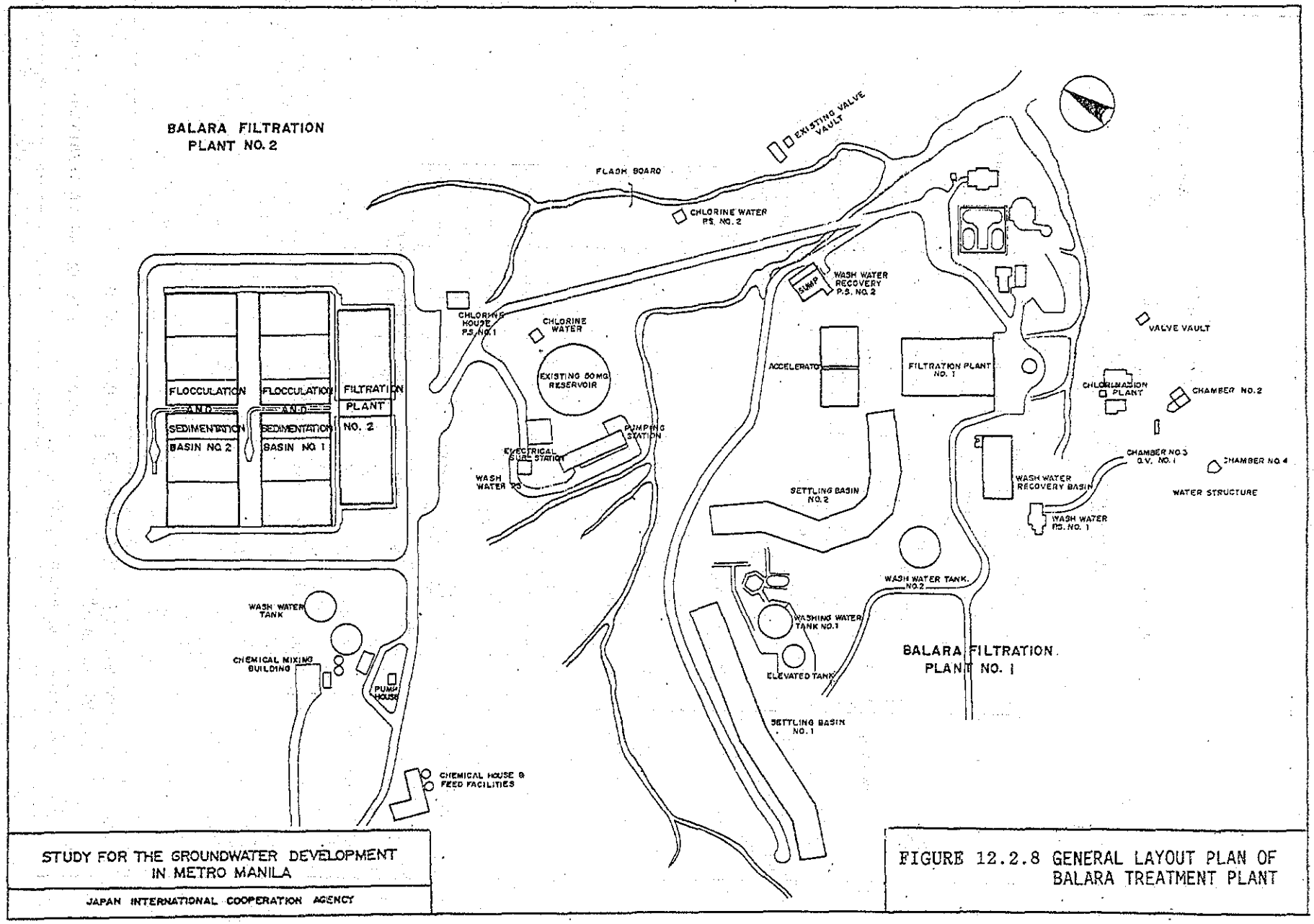


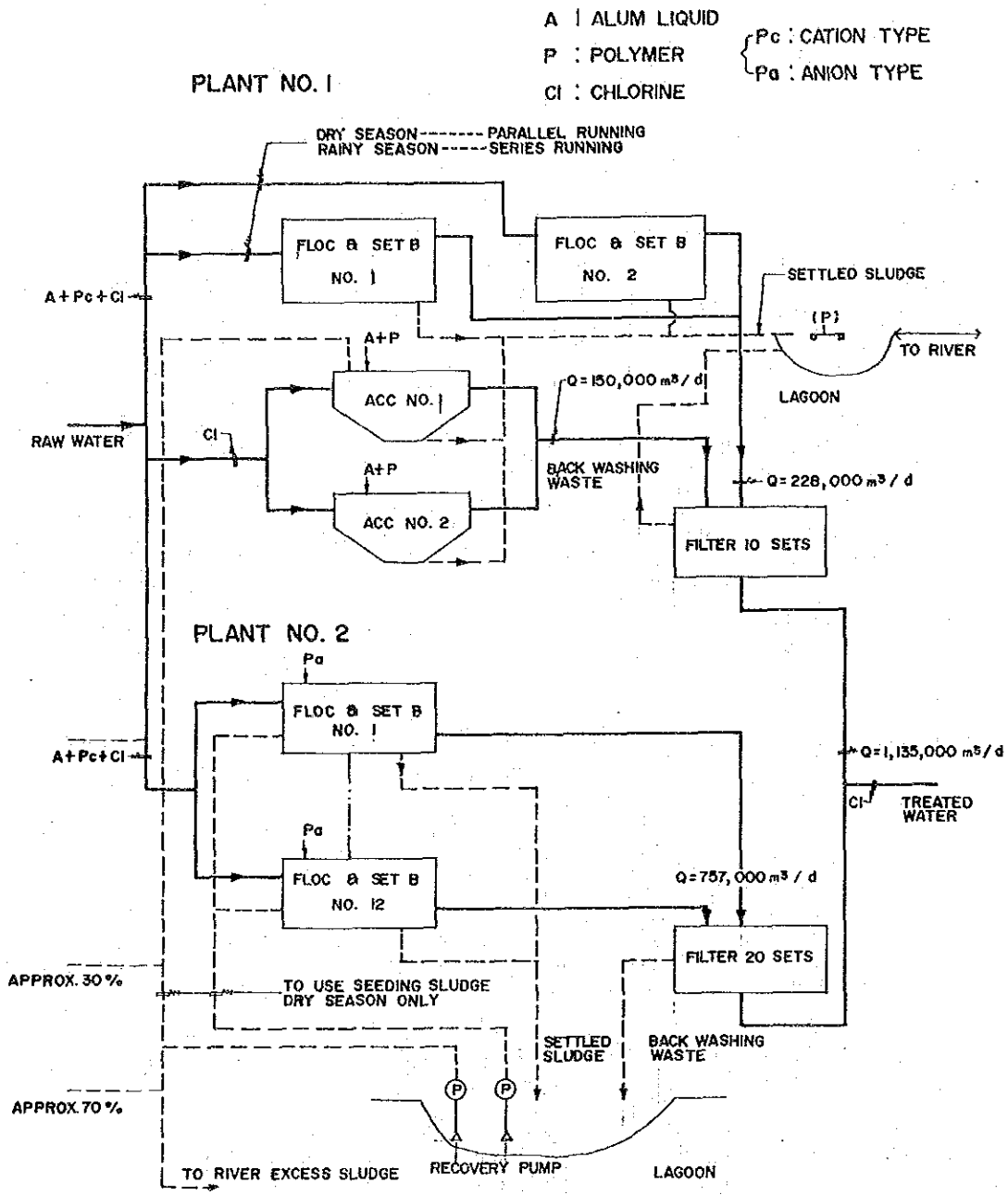
FIGURE 12.2.7 RAW WATER BY SOURCE (MONTHLY DAILY AVERAGE)



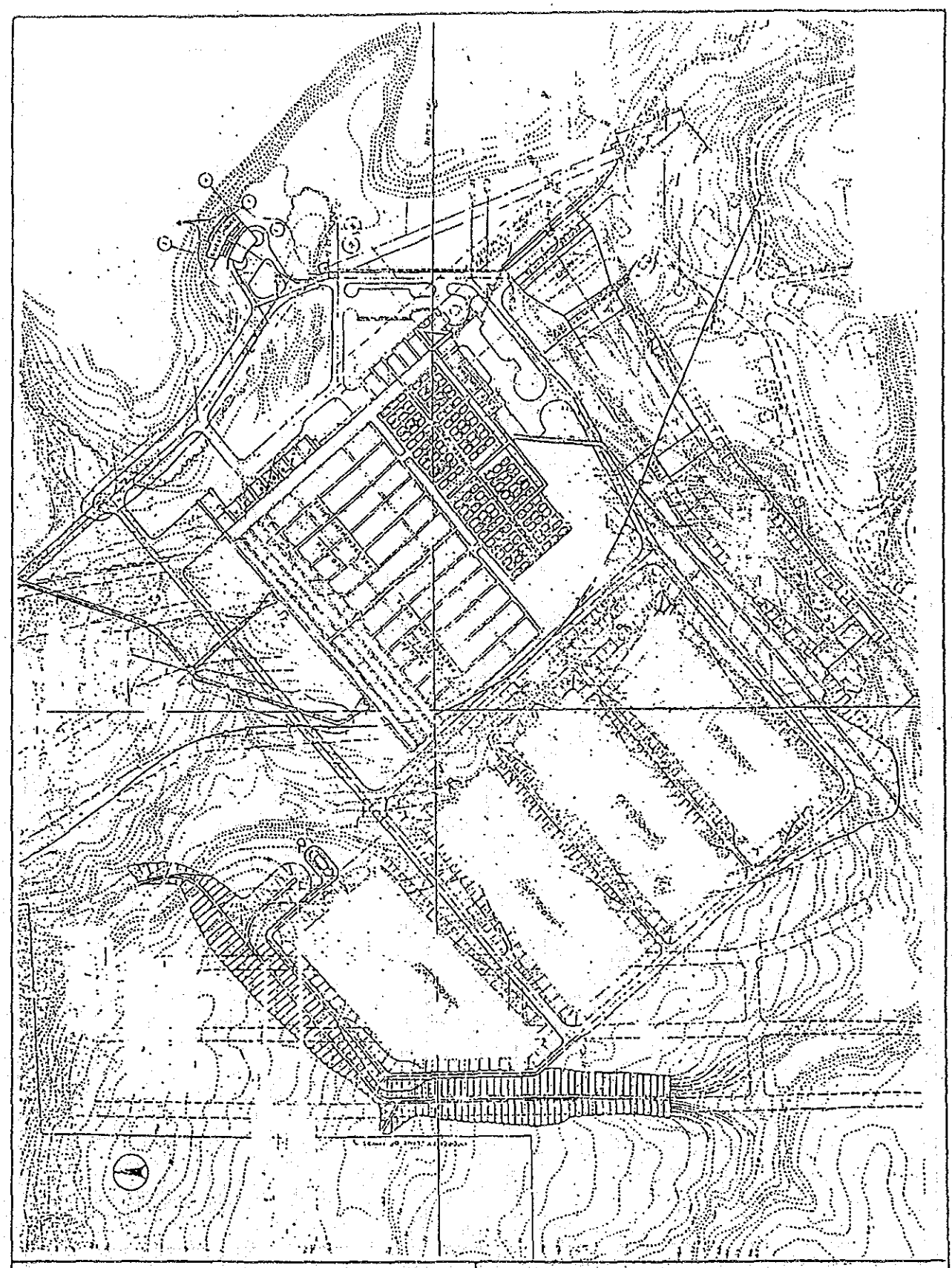
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

FIGURE 12.2.8 GENERAL LAYOUT PLAN OF BALARA TREATMENT PLANT



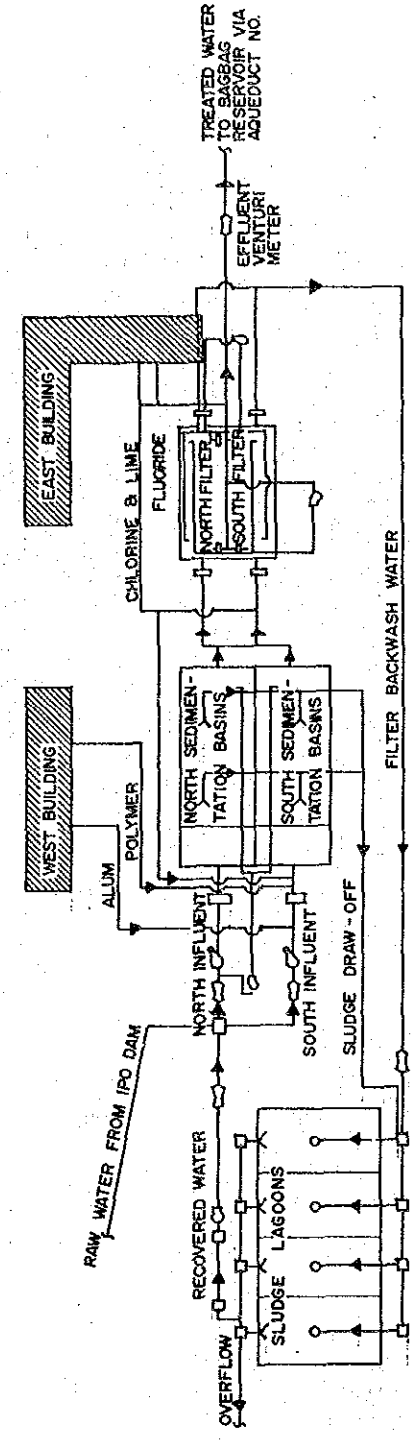
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.9
JAPAN INTERNATIONAL COOPERATION AGENCY	FLOW DIAGRAM OF BALARA TREATMENT PLANT



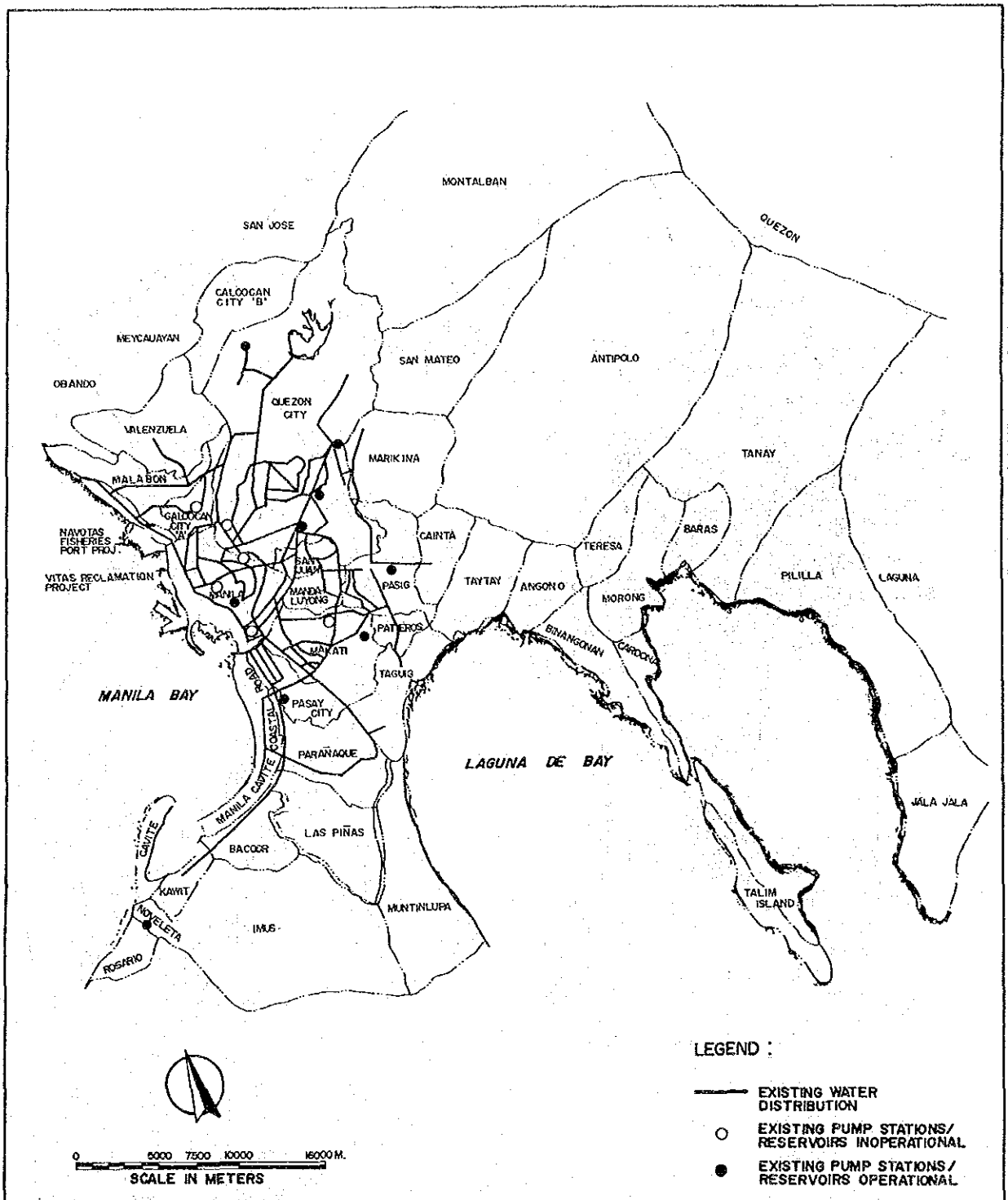
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

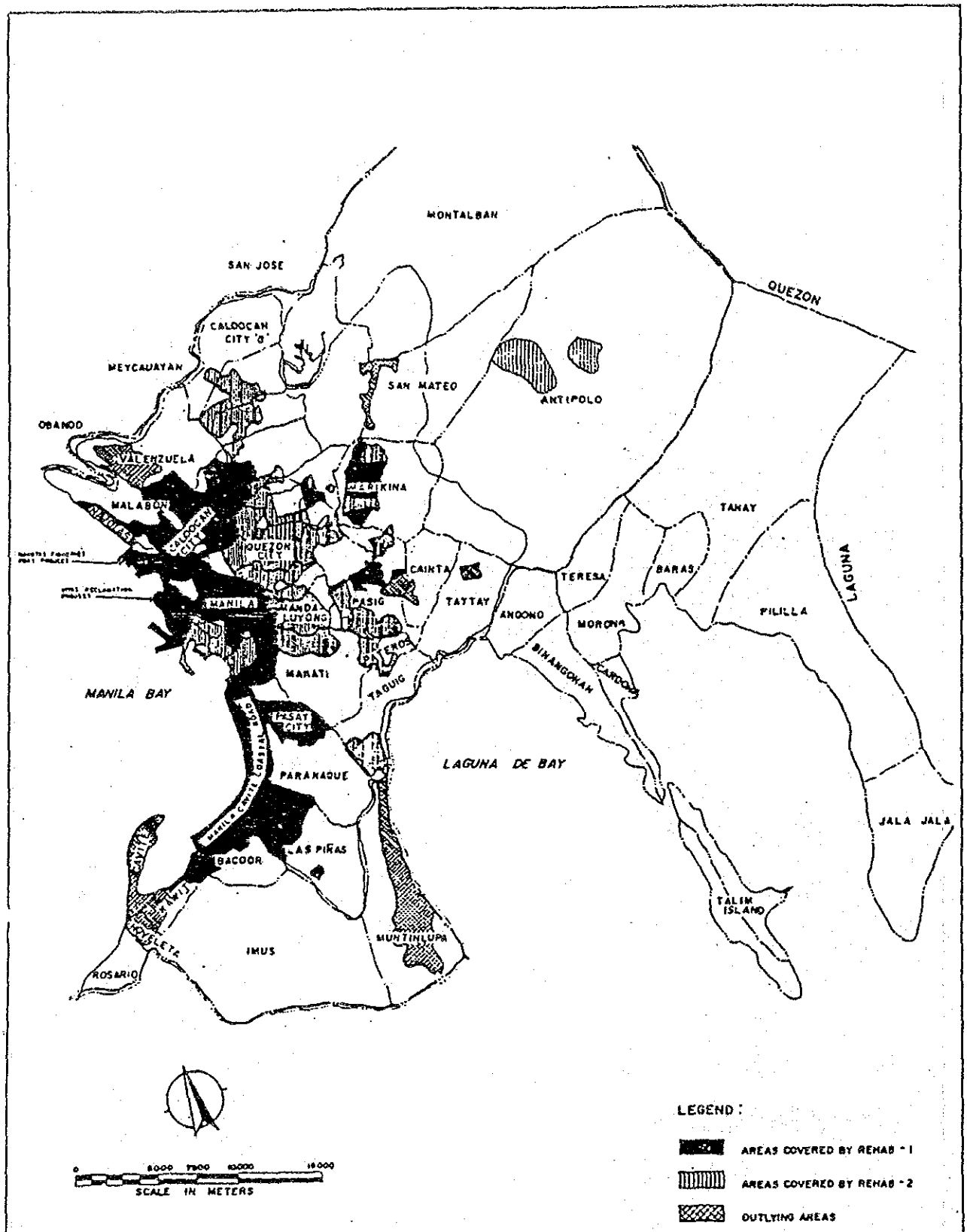
FIGURE 12.2.10 GENERAL LAYOUT PLAN OF LA MESA TREATMENT PLANT



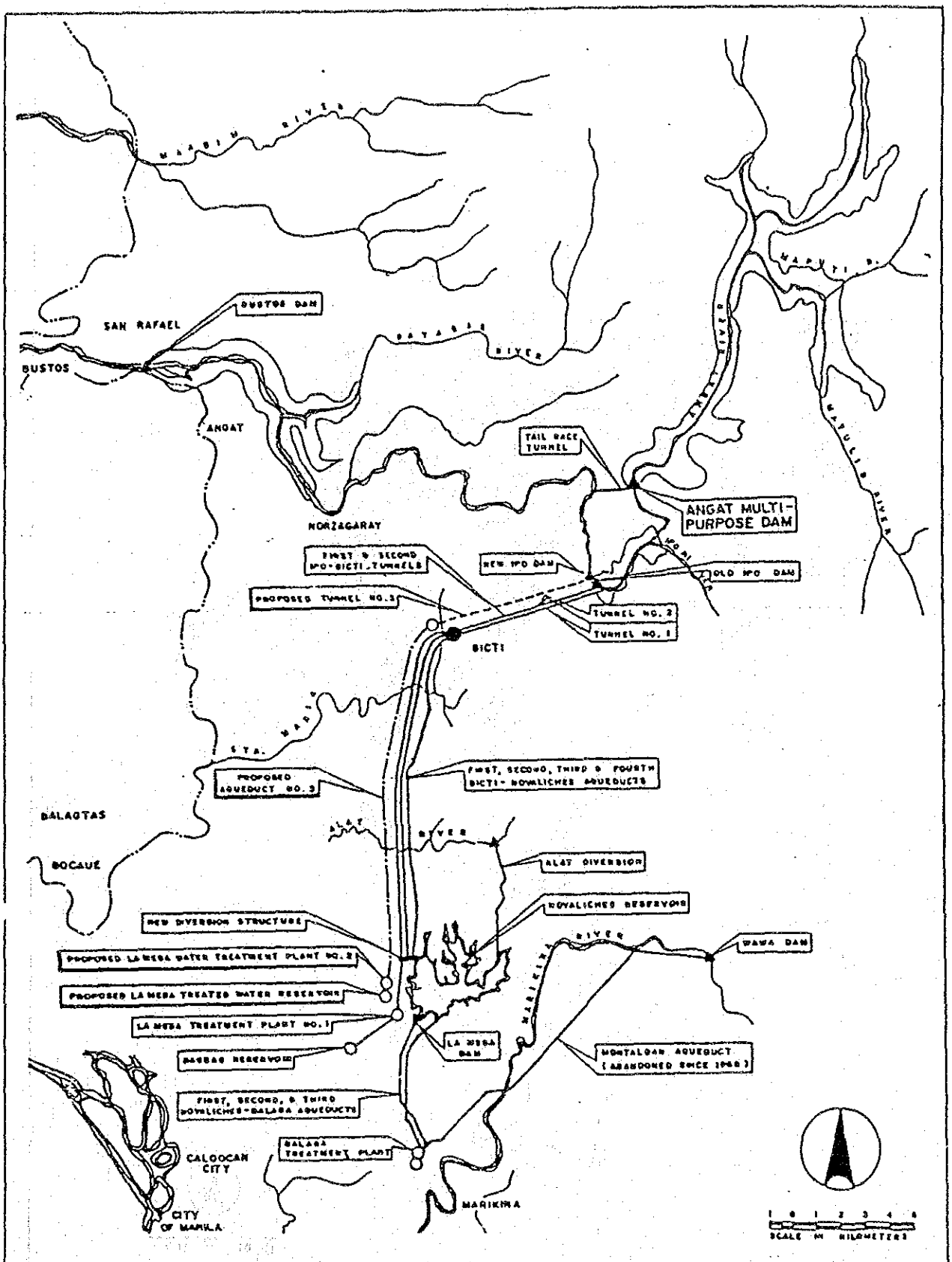
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.11
JAPAN INTERNATIONAL COOPERATION AGENCY	FLOW DIAGRAM OF LA MESA TREATMENT PLANT



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.2.12 EXISTING PRIMARY DISTRIBUTION SYSTEM
JAPAN INTERNATIONAL COOPERATION AGENCY	



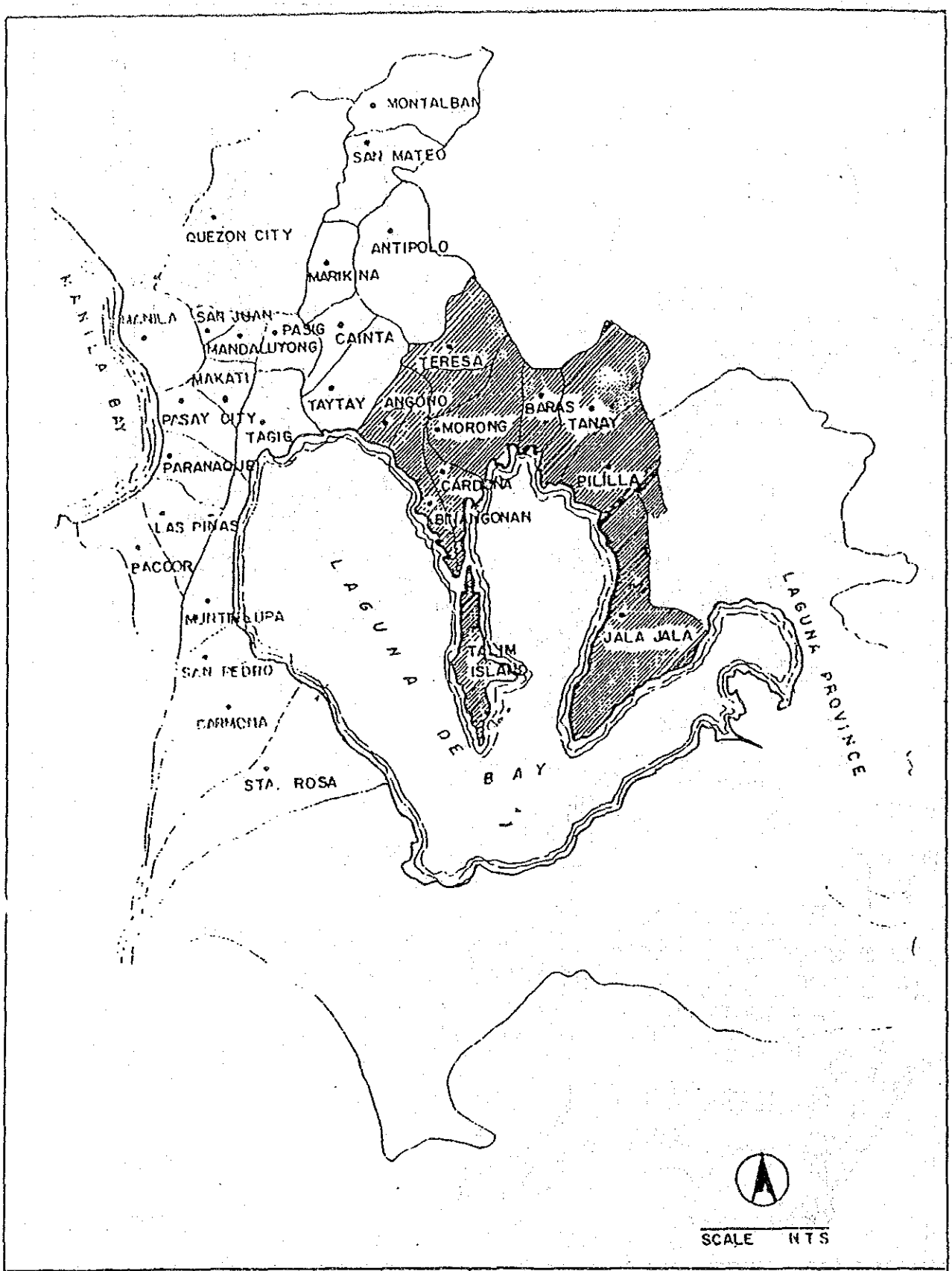
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.3.1 AREAS COVERED BY REHABILITATION PROJECTS
JAPAN INTERNATIONAL COOPERATION AGENCY	



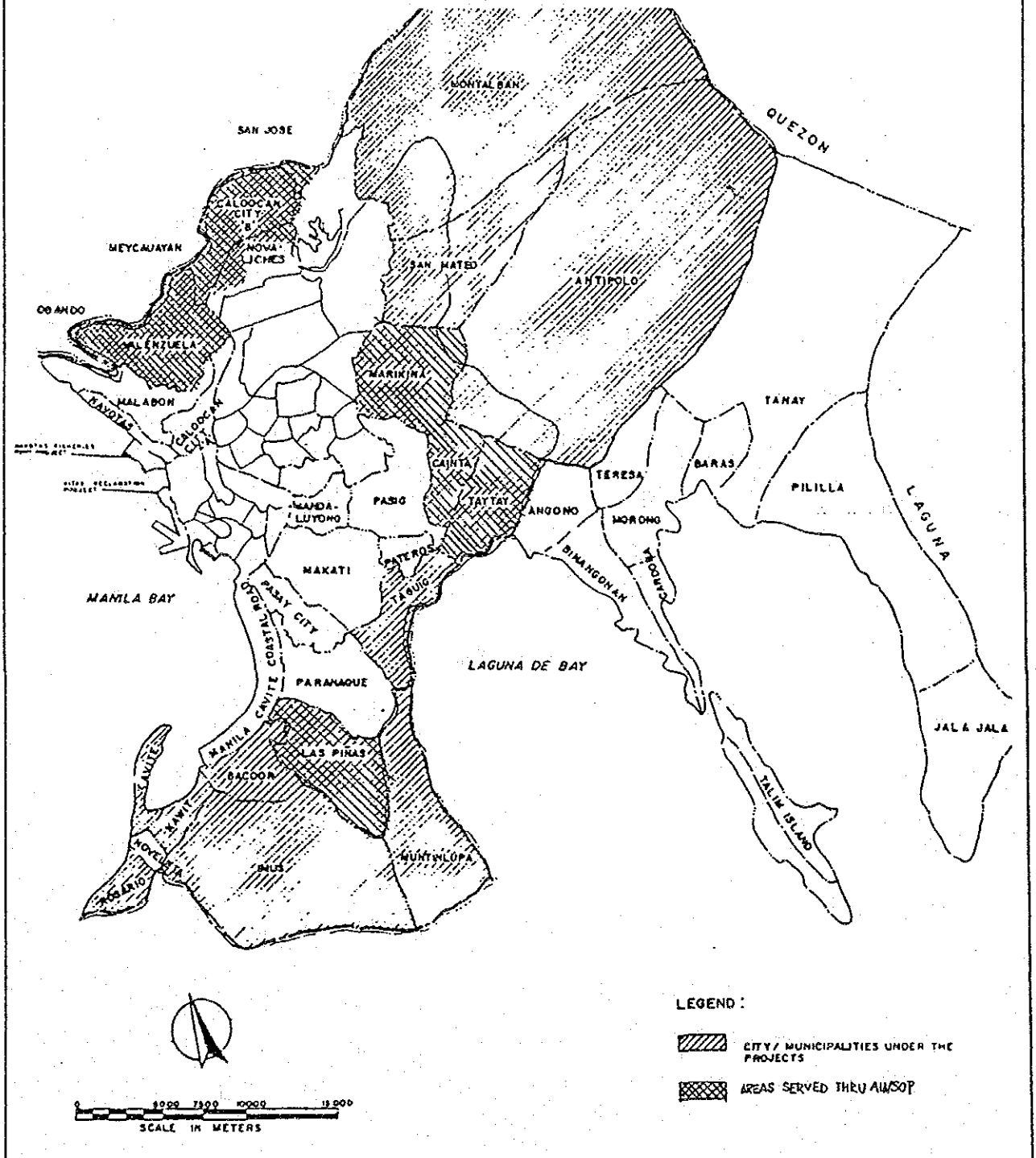
STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

FIGURE 12.3.2
DEVELOPMENT PLAN OF AWSOP



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.3.3 STUDY AREA OF RPWSIP
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY FOR THE GROUNDWATER DEVELOPMENT IN METRO MANILA	FIGURE 12.3.4 FRINGE AREAS WATER SUPPLY PROJECT STUDY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	

CHAPTER 13

WATER DEMAND PROJECTION

CHAPTER 13 WATER DEMAND PROJECTIONS

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CHAPTER 13 WATER DEMAND PROJECTIONS

13.1 SCOPE

The water demand projection for the water supply system of MWSS was done to determine the domestic, commercial, and industrial water demand in the MSA, from the city/municipal level down to the barangay level, and especially for the specified Antipolo Study Area; and also, to update the projection that was made through the previous projects conducted by the MWSS. The present projection was arrived at through calculations using updated data on present water consumption, population, income growth, change of water tariff, economic growth, etc.

From the menu of available projection methods, such as time-series trend analysis, regression analysis, factorial analysis, piling up of detailed water use, etc., this study opted for a kind of multiple regression analysis, which type the Manila Water Supply Project III (MWSP III) and the Angat Water Supply Optimization Project (AWSOP) also used.

So that planning for the respective areas may be unified, a general adoption of the methods and data used in the Fringe Area Water Supply Project (FAWSP) and the Rizal Province Water Supply Improvement Project (RPWSIP, now RPWSP) was made, to the extent warranted in the areas covered by both projects.

13.2 WATER DEMAND PROJECTION

13.2.1 Present Condition

(1) Domestic Water Consumption

The derivation of the figure for the equivalent served population rests on these assumptions: for house service connections, the average number of users per connection is 8.1 (MWSS Consumer Survey, 1981); and for public faucets, the average number of users is 486 (60 times of H.S.C.), the same figure being used for projection by the Corporate Planning Group of MWSS (CORPLAN). A different assumption, however, was applied

to some areas under FAWSP, e.g., Imus, Antipolo, Montalban and San Mateo -- an assumption resulting from the detailed investigation of each area by FAWSP.

The data on billed water consumption and number of house service connections are shown in Table 13.2.1. These were prepared by the Computer Service Center of the MWSS.

Of the billed domestic water, metering losses accounted for about 9.57 percent. This ratio was estimated from the results of a field survey conducted under the Manila Water Supply Rehabilitation Project II (MWSRP II, Table 13.2.2).

Calculations on present per capita water consumption were made based on recorded water consumption and the estimated served population (Table 13.2.3). For house service connections, the average per capita water consumption is 170 liters per capita per day (lpcd). This consumption type recorded a low of 51 lpcd in Las Piñas and a high of 324 lpcd in Parañaque.

Average per capita water consumption from public faucets is 19 lpcd, ranging from 9 lpcd in Makati to 79 lpcd in Antipolo. For purposes of statistical analysis, however, using these figures raises questions as they are much influenced by the accuracy of assumptions. The number of public faucets is very limited for making a statistical analysis. The estimated per capita consumption from public faucets is thus not suitable for the projection of future water consumption.

Municipalities with low per capita consumption are generally found in areas experiencing water supply constraints, e.g., Caloocan City, Las Piñas, Malabon, Muntinlupa, Navotas, Pateros, Taguig, Valenzuela, and some municipalities in the provinces of Cavite and Rizal. Because of insufficient water supply, water consumption in these areas is suppressed. Considering their potential demand to be higher, a rapid increase in water consumption will be seen after improvement of the water supply situation is effected by MWSS through several ongoing projects such as AWSOP, Manila South Water Distribution Project (MSWDP), and FAWSP. This improvement is factored into the demand projection for these areas.

For the BP799 area in Rizal Province, no useful data on water consumption was obtained. The data prepared by RPWSIP were utilized for the projection of future water consumption.

(2) Commercial Water Consumption

The total billed commercial consumption in 1990 averaged 303,732 m^3/day as shown in Table 13.2.4. The larger part of this consumption was taken up by the NCR, amounting to 99.2% of the total. In particular, Manila, Quezon City and Makati combined to share of 97.1% of the total. The commercial sector of Cavite and Rizal consumed only 0.4% and 0.5%, respectively, of the total commercial consumption.

After adjustment for meter error, the average consumption per meter connection was placed at 8.119 m^3/day, ranging from 0.734 m^3/day in Muntinlupa to 14.910 m^3/day in Makati. The correction factor used for the adjustment of consumption was based on the survey result conducted by the Manila Water Supply Rehabilitation Project I (MWSRP I) and is calculated as follows:

Ratio of large meter to be rehabilitated	53.52%
Increase of consumption after rehabilitated	24.9%

Estimated over-all meter error:

53.52% x 24.9% = 13.33% increase

(Source: 4th Quarter Report 1987, MWSRP I)

Thus, the recorded billed consumption of large meters such as commercial and industrial sector was increased by 13.33% for data processing.

For the BP799 area, no useful data on water consumption of commercial sector were available.

(3) Industrial Water Consumption

The total billed industrial consumption in 1990 averaged 74,552 m^3/day as shown in Table 13.2.5. Most of this was also consumed in the NCR, amounting to 96.3% of the total, almost the same figure for its commercial consumption. Of this percentage, more than half was also accounted for by Manila, Quezon City and Makati which combined to a total share of

54.8% of total consumption. In the case of Mandaluyong and Pasig, the parity between commercial and industrial consumption breaks as the figure for industrial consumption share is higher, i.e., 3.3% for commercial and 9.2% for industrial in Mandaluyong, and 2.7% and 9.6% in Pasig. The industrial sector of Cavite and Rizal consumed only 1.4% and 2.3% respectively, of the total industrial consumption. After making the same adjustment for meter error as that done for the commercial sector, the average consumption per meter connection became 10.788 m^3/day, ranging from 0.756 m^3/day in Muntinlupa to 29.897 m^3/day in Mandaluyong. For the BP799 area, no useful data was available on the water consumption of the industrial sector

(4) Groundwater Consumption

As discussed in Subsection 2.2.3, MWSS has been pumping up a yearly average of about 29,922,000 m^3 of groundwater for the last 6 years. This volume is equivalent to about 82,000 m^3/day or 3.4% of all MWSS water production for the same period.

In addition to the pumpage by MWSS, groundwater pumpage of the private sector in 1990 amounted to a daily average of about 840,700 m^3. Around 45% or about 379,000 m^3 of pumpage by the private sector was used for domestic use. This volume is equivalent to 44% of served water by MWSS. The population with private water supply systems was estimated to be about 38% of the population with MWSS water supply system, in consideration of said per capita water consumption and private pumpage for domestic use (Table 13.2.3). Thus, about 31% of the water demand for domestic use was supplied from private groundwater pumpage.

As shown in Table 13.2.4, it is estimated that about 106,800 m^3/day or 24% of total water demand for commercial use was supplied by the private sector.

In contrast to the commercial water consumption, about 81% of the total water demand for industrial use, or around 354,900 m^3/day, was supplied by the private sector (Table 13.2.5).

13.2.2 Water Consumption Projection

(1) Domestic Water Consumption

Projections of domestic consumption were computed separately for general and blighted populations. Population and per capita water consumption were determined for each group.

a) Per Capita Water Consumption

Domestic water consumption is affected by income growth and water tariff change with some extent of elasticity for both factors. The projection for a given year is done by first determining the per capita domestic water consumption in that year. This may be given by the following formula:

$$PCC(I) = PCC(I-1) \times [1+(PCIG(I-1)+(TI(I-1) \times PED)]$$

where:

I	=	year
PCC(I)	=	per capita consumption for year I
PCIG(I)	=	per capita income growth in real terms in year I
IED	=	income elasticity consumption
TI(I)	=	tariff increase in real terms in year I
PED	=	price elasticity of consumption

Data on per capita income growth, water tariff increases, income elasticity, and price elasticity are assumed by CORPLAN as shown in Table 13.2.6. For the general population, CORPLAN assumed a continuous decrease of per capita income up to the year 2010. Tariff was assumed to increase continuously starting year 1993, by 1.38% annually. Income elasticity and price elasticity computed by CORPLAN are 0.30 and -0.20 respectively. Per capita consumption in the year 2010, therefore, was computed to decrease to about 87% of that in 1990.

Projected per capita consumption of the blighted population in the year 2010 was also computed to decrease slightly due to tariff increase, even with the assumption of stability in their per capita income. Table 13.2.6 also shows the computation results for both groups.

Computation results show rather low per capita consumption relative to those in foreign countries. In previous studies, i.e., FAWSP and RPWSIP, increasing per capita consumption were assumed in projecting future water consumption.

This Study, therefore, set the per capita consumption of the general population at 180 lpcd for the year 1995 and 200 lpcd for 2010. Said settings are in harmony with the per capita consumption in typical developed areas such as Manila and Quezon City. For the years between 1995 and 2010, per capita consumptions were interpolated. For some municipalities with present high per capita consumption, that is, those with more than 200 lpcd, namely, Makati, Parañaque, and San Juan -- per capita consumption in the year 2010 was set in consideration of present consumption.

The per capita consumption in some areas which presently lack water, but which are expected to benefit from AWSOP and MSWDP, was assumed to substantially increase by the year 1995. The per capita consumption in those areas was also set at 180 lpcd, considering the present water consumption amount and the distance from the central distribution system.

For municipalities located in the outlying areas but which are covered by the ongoing projects, i.e., FAWSP and RPWSP, the per capita consumption applied in each project was also adopted in this Study for consistency. For areas in Cavite, however, the same per capita consumption as the one for NCR was adopted. Table 13.2.7 presents the adopted per capita consumption of each city/municipality for selected years.

Per capita consumption of the blighted population is limited by the water supply capacity of faucets. Their consumption was calculated to be 30 lpcd, on the assumption that they get their water from public faucets having a 24-hour flow rate of 10 liter/min. and a service rate of 486 persons per faucet. In projecting their consumption, setting the per capita consumption at 35 lpcd seems to be appropriate, considering the estimated present per capita consumption from public faucets was that presented in Table 13.2.3. This per capita consumption is held to be constant up to the year 2010.

b) Projected Population

The population of each city/municipality in the future that was projected in Section 6.1 contains general and blighted population categories. The projected population under such categories were adopted for the projection of water consumption.

For some areas, the estimated year-1990 general population is smaller than the estimated equivalent number of population for house service connections shown in Table 13.2.8. This means that a part of the blighted population have house service connections instead of public faucets. For those areas, therefore, corrections were made on the ratio of blighted population to total population, on the assumption that the estimated equivalent number of population for house service connections is equal to the general population of the area as shown in Table 13.2.8.

Moreover, since beneficiaries of private sector supply systems may also be categorized under general population, around 80% of the NCR population was estimated to fall under this category as shown in Table 13.2.3. Therefore, the ratio of the total blighted population was adjusted at 20% of total population in accordance with the respective shares of the estimated blighted population in each municipality in year-1990 as shown in Table 13.2.9.

Assuming these blighted population ratios will remain constant in the future, the future populations were projected for both groups.

The ratio of population served by MWSS was determined for each projection year, by city/municipality, with due consideration to present served population by MWSS and private water supply systems presented in Table 13.2.2.

For the areas covered by FAWSP and RPWSP, the respective served population projected in the reports of these projects were adopted, that is, after the projected population of each area was adjusted.

C) Domestic Consumption

Total domestic consumption is obtained by multiplying per capita consumption and population over all cities and municipalities for each

projection year. Computation results at 5-year intervals for years 1995-2010 are presented in Tables 13.2.10 to 13.2.13.

(2) Commercial Water Consumption

Commercial water consumption is similarly influenced by economic growth and tariff changes in real terms, with some extent of elasticity on both factors.

The annual commercial consumption in a given year may be given by the following formula:

$$CD(I) = CD(I-1) \times [1+(CG(I-1) \times COED)+(CTI(I-1) \times CPED)]$$

where:

- I = Year
- CD(I) = Total commercial consumption in year I
- CG(I) = GDP growth rate in service sector in year I
- COED = output elasticity of consumption in service sector
- CTI(I)= tariff increase in real terms in year I
- CPED = price elasticity of consumption

Data on GDP growth in the service sector discussed in Section 6.1 were applied for this projection. Data on tariff increases, output elasticity, and price elasticity were assumed by CORPLAN as shown in Table 13.2.4. As computed, commercial consumption in the year 2010 in the MSA, excluding the BP799 area, will be more than double the estimated present demand.

The share of MWSS water supply to the total commercial consumption was calculated at 76.3% based on the actual billed water consumption and the estimated total commercial consumption (Table 13.2.4). The amount of privately supplied water for commercial consumption was about 106,800 m^3/day based on the groundwater use survey. Assuming that the share of private supply and the share of the consumption of each city/municipality will be stable in the future, the commercial consumption in the future was projected as shown in Table 13.2.15. For the areas under BP799, commercial consumption was computed using the methods adopted in RPWSP as presented in Appendices D and E.

It is estimated that MWSS shall supply 801,100 m3/day for commercial consumption in the year 2010. This amount is equivalent to 2.3 times of the presently supplied amount for commercial use.

(3) Industrial Water Consumption

Industrial water consumption in the future is projected in the same way as commercial water consumption.

The projected growth of the GDP for the industrial sector as discussed in Chapter 11 was applied in the projection of industrial consumption. Data on tariff increases, output elasticity, and price elasticity that were assumed by CORPLAN were also adopted for the Study and are shown in Table 13.2.16.

Industrial consumption in the year 2010 is estimated to be about 1.8 times of estimated present demand.

The share of MWSS water supply to the total industrial consumption is calculated at 19.2%, based on the actual billed water consumption and the results of the groundwater use survey (Table 13.2.5). The private supply for industrial consumption in 1990 was about 354,900 m3/day. Assuming that the share of the private supply and the share of the consumption by each city/municipality will be stable in the future, the industrial consumption in the future was projected as shown in Table 13.2.17. For the areas covered by RPWSP, industrial consumptions were computed using the respective methods adopted in RPWSP.

It is estimated that MWSS shall supply 223,700 m3/day for industrial consumption in the year 2010. This amount is equivalent to 2.6 times of present MWSS industrial consumption.

13.2.3 Total Water Demand

The total water demand is obtained by summing up the domestic, commercial, and industrial consumption that are projected for each year. Also added to this demand are the water losses during distribution.

Present Non-Revenue Water of MWSS exceeds 50% of total distributed

amount, and it includes various components e.g., meter error, illegal connections, leakage, and so on. The projected future consumption, however, excludes leakage. The MWSS water demand thus involves adding the amount of leakage.

The size of projected water demand, given the currently high NRW ratios, (see Table 13.2.18) will be affected substantially by the leakage ratios that are adopted. MWSS aims to reduce the NRW ratio to 25% in its reduction program under MWSRP I and II, which are currently being implementation.

Reducing the NRW ratios to such levels may, however, be difficult to achieve as present ratios are still high. Even AWSOP already adopted higher NRW ratios in its feasibility stage. But even these higher ratios were revised for much higher ones at AWSOP's detailed design stage.

For reasons of comparison, three cases were presented for the above said ratios, from which cases the leakage ratios that were used by this study in projecting the water demand were determined.

The first case (Case 1) is based on the projection of CORPLAN: Leakage amount will be reduced to 25.2% of total demand in year 1995, and to 21% in years 2000, 2005, and 2010 as shown in Table 13.2 18. These ratios are considered as direct results of NRW reduction programs. MWSS areas in Cavite and Rizal are assigned leakage ratios that are adopted in FAWSP's and RPWSP's respective areas.

The second case (Case 2) is based on the ratios used in AWSOP's feasibility study stage. These NRW ratios--30% in year 1995 and 25% in years 2000, 2005 and 2010--are higher than those of CORPLAN.

In the ongoing detailed design stage of AWSOP, leakage ratios higher than those in Case 2 were adopted: 35% for year 1996. The third case (Case 3) had this considered such that the ratio for 1995 is 35%, that for 2000 is 30%, and 25% for years 2005 and 2010.

All three cases are tabulated below. The ratios applied in Case 3 are the ones adopted by this Study for the projection of water demand.

ADOPTED LOSS RATIO (% to Total Supply)

	1995	2000	2005	2010
CASE 1	25.2	21.0	21.0	21.0
CASE 2	30.0	25.0	25.0	25.0
CASE 3	35.0	30.0	25.0	25.0

The computation results for years 1995, 2000, 2005, and 2010 are summarized in Tables 13.2.19 to 13.2.31 and Figures 13.2.1 to 13.2.3.

13.3 Supply Capacity Against Demand

A yearly water demand and supply analysis for the period 1995 to 2000 and for years 2005 and 2010 was made considering the projected water demand and the planned water supply capacity.

The projected water demand was allocated by expected water source, assuming the ratio of supplied water by source as shown in Tables 13.3.1 to 13.3.4. The location of respective areas, the present coverage of the Central Distribution System (CDS), and existing groundwater pumping capacity were considered for this assumption. In this assumption, Bacoor and Kawit in Cavite will be served through CDS. Areas in Rizal, however, are generally supplied with groundwater, except some areas that are close to the existing CDS.

On the assumption that the planned and ongoing projects to augment the water source and treatment capacity will be implemented on schedule, a comparison of surface water supply capacity and water demand (Summarized in Tables 13.2.29 to 13.2.31) for each particular year was done and is presented in Table 13.3.5 and Figure 13.3.1. From this comparison, the following were noted:

a. AWSOP is indispensable to meet demand.

b. The surface water supply capacity will not be critical to meet demand until 2010 even if produced water is supplied to NCR and a part of Cavite and Rizal, and the augmentation of water source is conducted on schedule.

c. If the implementation of UATP and MNEWSP is delayed, water supply situation will be critical by the year 2005.

d. Required groundwater pumpage will increase to about 1,278,000 m^3/day in 2010 including discharge by private sector.

e. The share of groundwater in total water supply will decrease to about 24.6% in 2010.

f. If the Bulacan Bulk Water Supply Project is implemented, implementation of MWSP III should be advanced as early as possible. Otherwise, the supply situation will be critical soon after year 2005. Though water amount to be allotted for the Bulacan project shall be decided based on the probable implementation schedule of MNEWSP, UATP, and MWSP III, the proposed amount for its Phase I (1996; 100,200 m^3/day, 2000; 131,100 m^3/day) can be secured if UATP is executed on schedule. However, supply of all proposed amount for Phase II (2010; 398,400 m^3/day) before completion of MWSP III will make MWSS water supply situation critical.

13.4 Groundwater Discharge Projection

13.4.1 Outlines of Scenarios

For preparation of data to be used in the simulation of future groundwater level in Metro Manila, projection of groundwater discharge was done using the projected groundwater demand in the study area. For that purpose, four scenarios were prepared considering the assumptions stated in each case.

Basic Assumptions:

a. AWSOP will be completed in 1996.

b. UATP will be completed in 1998.

c. MNEWSP will be completed in 1997. Water source for the whole

area of Montalban, San Mateo, and a part of Marikina will be converted to the Wawa Dam the next year. Groundwater utilization facilities to be constructed to meet demand by that year will be operated continuously from that year onward.

d. MSWDP will be completed in 1995.

Scenario 1 (Basic Scenario):

The increase of commercial and industrial water demand will be in proportion to the estimated present share of the MWSS and the Private sector, except in some areas within CDS such as Manila, Pasay, Quezon, Caloocan, Makati, Malabon, Mandaluyong, Navotas, and San Juan. In these areas, said increase will be covered by MWSS only. In Cavite area, only Bacoor and Kawit will be supplied by CDS.

The calculations done in Subsections 13.2 and 13.3 were based on this scenario.

Scenario 2 (Optimistic Scenario):

The same assumption on commercial and industrial water demand as in Scenario 1. However,commercial and industrial water demand increase in private sector from year 2001 is converted to MWSS (Tables 13.4.1 and 13.4.2). Municipalities in the Cavite area will be supplied by CDS.

Scenario 3 (Most Optimistic Scenario):

The same assumption on commercial and industrial water demand as in Scenario 1. However, commercial and industrial water demand increase in the private sector from year 1996 is converted to MWSS. Municipalities in the Cavite area will be supplied by CDS.

Scenario 4 (Pessimistic Scenario):

The same assumption on commercial and industrial water demand as in Scenario 1. However, implementation of projects mentioned in Basic Assumptions is delayed for 2 years. In the Cavite area, only Bacoor and Kawit will be supplied by CDS.

Difference between assumptions in each scenario can be summarized briefly as follows:

Scenario No.	MWSS Surface Water Supply Projects	Future Pumpage of Commercial & Industrial Private Wells	CDS Connection in Cavite MSA
1	On-schedule completion of ongoing projects	Increasing[1]	Bacoor 100% covered, Kawit 50%, others 0%
2	Same as Scenario 1	Increasing[2] up to year-2000, thereafter pumpage is constant	All municipalities covered
3	Same as Scenario 1	Increasing[2] up to year-1995, thereafter pumpage is constant	All municipalities covered
4	Two years delay of completion of ongoing projects	Same as Scenario 1	Same as Scenario 1

1 With respect to future demand increases but maintaining year-1990 percentage shares
2 With respect to future demand increases and up to the year indicated

13.4.2 Projected Groundwater Discharge

In accordance with the above-mentioned scenarios, groundwater demand in the future was projected. Tables 13.4.9 to 13.4.12 summarize the demand projection in Scenario 2 for selected years, while Tables 13.4.13 to 13.4.16 present an allocation of the projected water demand by source of the same scenario. Tables 13.4.17 to 13.4.24 and Tables 13.4.25 to 13.4.32 were similarly prepared for Scenarios 3 and 4.

Using the results of above projection, distribution of groundwater discharge was projected for each scenario (Tables 13.4.33 to 13.4.36). To increase the probability of the projection, adjustment including interpolation was done on the projected discharge between the years 1991 to 1999 for several areas in Cavite and Rizal so as to moderate the rate of increase of discharge. Projections for each scenario are summarized in Tables 13.4.37 to 13.4.40.

In Scenario 1, groundwater discharge of the MWSS and the private sector

will respectively increase to 280,000 m^3/day, and 998,000 m^3/day. This total increase of 1,278,000 m^3/day is equivalent to 1.37 times of estimated present discharge.

In Scenario 2, total discharge will increase to 1,139,000 m^3/day or 1.22 times of present level. It is 1,064,000 m^3/day or 1.14 times of the present level in Scenario 3.

In Scenario 4, which is pessimistic but has a high probability, total discharge will be 1,295,000 m^3/day or 1.39 times of present discharge.

For all scenarios, areas in Cavite and Rizal require much increase of groundwater discharge.

13.5 Water Demand Projection in Antipolo Basin

13.5.1. Present Situation

a) Existing System

The Poblacion area of Antipolo which occupies the center of the Antipolo Basin was initially served by the water supply system constructed by the then Bureau of Public Works. This system includes 6 deepwells and about 20 km of distribution pipelines. When Antipolo became a part of the MWSS service area in 1976, the system was turned over to MWSS. Immediately thereafter, a full scale rehabilitation of said system was undertaken by MWSS, especially the source facilities.

The rapid urbanization and the development of new subdivisions in the early 1980s significantly raised the need for water sources. To meet this demand, MWSS constructed an additional 4 deepwells for the system: 2 wells in 1981; 1 well in 1982; and 1 well in 1983. A total of 10 deepwells have therefore been operational since those times. All of these wells are currently operated on 24-hour basis. Their various capacities range from 210 liter/min. to 1,400 liter/min. Due to limited water source and rugged terrain of the area, rationing is done in the system via control of valves.

At present, the system in Antipolo has about 33.59 km of distribution pipelines as a result of some expansions which mostly consist of interconnections requested by newly developed subdivisions.. A distribution reservoir is not provided in the system so that the pumped groundwater is directly injected into the distribution pipes after some extent of chlorination.

b) Water Consumption

As shown in Table 13.5.1, the Computer Service Center of MWSS summarized the existing number of connections and water consumption in 1990 of the MWSS water supply system in the Antipolo Basin.

Observations regarding this table are summarized below:

a. Total water consumption in the basin is rather small in comparison with the share of no. of connections due to small water consumption in industrial sector.

b. The share of domestic consumption is in accord with the share of no. of connections.

c. The character of the area in the basin may be categorized as a residential area with small scale commercial enterprises.

d. Per capita domestic consumption may be estimated as follows:
2,962 m^3/day / (3,535 conn. x 8.1 person/conn.)
= 103.4 lpcd

According to the groundwater use survey conducted in this study, 26 deepwells are operated in the basin in addition to the 10 deepwells of MWSS. The discharge and water consumption by use obtained by the survey is summarized in Table 13.5.2.

Thus, the MWSS system discharged about half of the total groundwater discharge in the basin. Only 33.5% of MWSS discharge was billed as revenue water in 1990. Though a part of NRW seems to be consumed by illegal connections, most of it is considered to be leakage in view of the rather low per capita consumption estimated for the area. Survey on

this matter was conducted by FAWSP in 1989. As a result of that survey, ratios for leakage and unbilled consumption during that time were estimated at 68.2% and 0.2% of production amount, respectively.

Using the present population in the basin -- the 84,823 estimated in Chapter 2 -- and the data presented in Table 13.5.2, the average per capita domestic consumption may be estimated as follows:

Assumption: Ratio of illegal consumption = 0.2%
Water consumption for domestic use in the basin is,
3.4475 + (3.5803 x 0.002)
= 3.4547 MCM = 9,465 m^3/day
therefore, average per capita consumption is,
9,465 m^3/day /84,823 = 112 lpcd

13.5.2 Water Demand Projection

(1) Domestic Water Consumption

The population projected in Chapter 11 was adopted for the projection of water demand in the Antipolo basin. MWSS service ratio was determined in accordance with the planned service coverage of the MWSS system and the extent of urbanization. MWSS service coverage was determined under the following assumptions:

a. The service area within the basin boundary will be limited by the year 2000, except for the present service area that is out of the basin.

b. The service area will continuously expand outward from the central area (poblacion).

c. The priority of service will be laid on the present developed area, and it will be covered by the year 2000.

d. Present developed area closely located outside the basin will be covered after the year 2001.

e. The basin will be fully covered by the system by the year

2010.

Figures 13.5.1 and 13.5.2 present the service coverage in selected years. Population in the service area may be estimated by multiplying the population of the Antipolo study area and the service ratio. In 1995, it will be about 71,000, including those in the present service area outside of the basin, and which is about 67% of the population in the basin. It will increase to about 195,000 or about 110% of basin population in the year 2010. Since the estimated present served population is about 29,000 (3,535 conn. x 8.1), the served population in 2010 will be about 6.8 times of present served population (Table 13.5.3).

The domestic water demand in the MWSS's system in the basin were computed as shown in Table 13.5.4, adopting the same per capita consumption as those applied in the previous projection in FAWSP.

(2) Commercial Water Consumption

The water consumption of the commercial sector computed in Subsection 13.2 was adopted in projecting the commercial water consumption in the Antipolo Basin.

Based on the data presented in Table 13.5.1, 51% of the MWSS commercial consumption projected for the Antipolo municipality is considered to be consumed in the basin.

Allocation to each barangay was done in accordance with the domestic consumption share of each barangay. The computation results for the entire basin and the MWSS system are presented in Tables 13.5.5 and 13.5.6.

(3) Industrial Water Consumption

The water consumption in industrial sector computed in Section 13.2 is adopted in the projection of industrial water consumption.

Based on the data presented in Table 13.5.1, 3% of the MWSS industrial consumption projected for Antipolo municipality is considered to be consumed in the basin. The present private industrial consumption, in

addition to the MWSS industrial consumption, was added to the total demand, considering that the bulk of it was consumed by a few poultry farms.

Allocation to each barangay was done in accordance with the share of the domestic consumption. The computation results for the entire basin and the MWSS system are presented in Tables 13.5.5 6and 13.5.6 for the entire basin and the MWSS system.

(4) Distribution Loss

Losses during water distribution are mainly caused by leakage. Though the present leakage ratio is considerably high, probably amounting to more than 50%, a ratio of 30% was applied for the projection up to the year 2000, and 25% after that, in anticipation of the benefits of the NRW reduction program and of new projects to be implemented in the basin, including the high rate replacement of old distribution pipes.

(5) Total Demand

Total water demand in the basin and in the MWSS service area are summarized in Tables 13.5.5 and 13.5.6.

13.5.3 Analysis on Supply Capacity and Projected Demand

Projected water demand for the Antipolo basin is summarized as shown in Table 13.5.5. Because of the limited yield of the groundwater resource in the basin, additional water sources in the future shall be mainly obtained from surface water resources. Based on the computer simulation of the groundwater condition in the basin, a groundwater discharge of about 27,800 m^3/day is considered to be the maximum limit of discharge in the basin. Augmentation of water source, as implied in the table, is a course that should be immediately pursued.

Due to the pumpage of existing groundwater pumping facilities, the water source augmentation by groundwater resource has a maximum limit of 8,344 m^3/day. Of this figure, 2,070 m^3/day will be obtained through rehabilitation of existing MWSS's deepwells. Therefore, the total additional pumpage resulting from the development of new wells must not exceed

6,274 m^3/day.

After augmentation of the groundwater resource, supply capacity will be able to meet the demand until the year 1998, on a daily average basis. On a daily maximum basis, however, supply capacity will not be able to satisfy the demand from 1995.

Further augmentation is thus required, and at an average of about 1,800 m^3/day in the year 2000 and about 18,100 m^3/day in the year 2010, assuming maximum groundwater production capacity is about 27,400 m^3/day (Table 13.5.8 and Figure 13.5.3). On a daily maximum basis, amount of augmentation is 15,500 m^3/day in 2000 and 40,900m^3/day in 2010.

TABLE13.2.1 NUMBER OF CONNECTIONS AND BILLED CONSUMPTION IN 1990

CITY /MUNICIPALITY	NUMBER OF SERVICE CONNECTIONS					WATER CONSUMPTION IN 1990 (CUBIC METER)						% TO TOTAL
	DOM	P.P.	COM.	IND.	OTHERS	DOM	P.P.	COM.	IND.	OTHERS	TOTAL	
I. NCR	587,778	462	41,010	5,763	528	275,826,999	1,430,279	105,937,991	24,761,109	1,442,796	413,399,174	97.4
CITY OF MANILA	155,052	86	14,452	707	88	75,898,348	354,831	42,357,707	4,760,534	913,457	124,284,877	29.3
PASAY CITY	25,087	33	1,907	161	8	10,198,494	62,164	5,327,980	292,085	3,565	15,884,288	3.7
QUEZON CITY	147,326	167	10,695	1,712	276	73,012,881	498,558	27,807,459	5,762,759	466,346	107,548,003	25.3
CALOOCAN CITY	44,673	41	2,535	718	5	16,102,242	118,420	3,675,980	2,973,311	8,600	22,878,553	5.4
LAS PIMAS	7,939	8	315	32	19	1,082,472	13,573	199,821	38,095	12,195	1,346,156	0.3
MAKATI	40,210	5	3,189	294	8	22,351,210	7,495	15,313,713	1,494,580	5,532	39,172,530	9.2
MALABON	18,012	19	989	368	1	6,240,013	58,209	1,033,252	1,923,024	360	9,254,858	2.2
MANDALUYONG	21,345	19	1,125	257	4	9,453,861	51,806	3,610,376	2,508,080	3,570	15,626,893	3.7
MARIKINA	28,315	23	1,288	503	3	13,818,472	95,034	1,249,818	452,522	356	15,616,202	3.7
MUNTINLUPA	5,505	0	106	11	95	1,315,447	0	25,061	1,704	24,090	1,366,302	0.3
NAVOTAS	13,795	6	471	128	3	3,214,442	19,807	655,258	650,139	1,343	4,540,989	1.1
PARANAQUE	13,552	17	1,045	168	3	11,830,787	42,757	2,160,859	539,614	1,254	14,575,271	3.4
PASIG	32,630	21	1,105	266	11	15,810,304	45,118	3,010,142	2,600,769	1,083	21,467,421	5.1
PATEROS	2,349	0	34	3	0	628,561	0	17,946	1,135	0	647,642	0.2
SAN JUAN	12,851	8	920	146	1	8,633,477	45,615	2,641,428	386,174	205	11,706,899	2.8
TAGUIG	4,060	3	61	8	1	1,188,990	7,620	116,282	2,771	270	1,315,913	0.3
VALENZUELA	15,077	6	775	282	2	5,046,998	10,072	734,929	373,813	565	6,166,377	1.5
II. CAVITE	16,879	17	731	53	1,293	4,304,555	43,328	394,069	33,818	336,131	5,111,901	1.2
BACOOR	3,881	5	132	3	58	941,683	19,813	86,403	585	21,983	1,070,467	0.3
CAVITE CITY	7,807	8	398	32	218	1,982,973	17,099	234,181	19,886	56,740	2,310,879	0.5
IMUS	978	0	54	6	1	284,472	0	20,855	1,779	536	307,642	0.1
KAWIT	3,055	4	119	9	663	825,494	6,416	39,294	10,754	174,127	1,056,085	0.2
NOVELETA	507	0	5	1	104	117,848	0	1,592	300	28,112	147,852	0.0
ROSARIO	651	0	23	2	249	152,085	0	11,744	514	54,633	218,976	0.1
III. RIZAL	17,116	9	654	180	15	4,892,593	27,582	530,031	635,331	2,307	6,087,844	1.4
ANGONO	-	-	-	-	-	-	-	-	-	-	-	-
ANTIPOLO	4,445	1	223	41	3	1,316,107	1,416	194,554	570,630	481	2,083,188	0.5
BARAS	-	-	-	-	-	-	-	-	-	-	-	-
BINANGONAN	-	-	-	-	-	-	-	-	-	-	-	-
CAINTA	3,003	2	134	26	8	995,747	4,142	144,691	14,206	1,275	1,160,061	0.3
CARDONA	-	-	-	-	-	-	-	-	-	-	-	-
JARA-JARA	-	-	-	-	-	-	-	-	-	-	-	-
MONTALBAN	2,039	0	36	10	3	546,674	0	13,395	5,022	440	565,531	0.1
MORONG	-	-	-	-	-	-	-	-	-	-	-	-
PILILLA	-	-	-	-	-	-	-	-	-	-	-	-
SAN MATEO	3,678	4	107	47	0	841,283	12,224	59,772	17,650	0	930,929	0.2
TANAY	-	-	-	-	-	-	-	-	-	-	-	-
TAYTAY	3,951	2	154	56	1	1,192,782	9,800	117,619	27,823	111	1,348,135	0.3
TERESA	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	621,773	488	42,395	5,996	1,836	285,024,147	1,501,189	110,862,091	25,430,258	1,781,234	424,598,919	100.0

SOURCE : COMPUTER SERVICE CENTER, MWSS

TABLE 13.2.2 RESULTS OF FIELD MEASUREMENT ON NON-REVENUE WATER

No. of Zones Measured	38
Surveyed Area	6,308 ha.
No. of Surveyed Households	237,072
Date Measured	Mar. 1988 - Nov. 1990
Supplied Water	625.037 MLD (100%)
Revenue Water	234.867 MLD (37.58%)
Non-Revenue Water (NRW)	390.170 MLD (62.42%)
NRW Breakdown:	
Unbilled WSC	21.145 MLD (3.38%)
Poor Metering	22.474 MLD (3.60%)
Illegal Use	51.830 MLD (8.29%)
Probable Leakage	294.751 MLD (47.16%)
% to Revenue Water:	
Unbilled WSC	8.99%
Poor Metering	9.57%
Illegal Use	22.07%
Probable Leakage	125.50%

Source: 1st Q'tr Report 1991, MWSRP II

TABLE 13.2.3 STATUS OF DOMESTIC WATER SUPPLY BY MWSS AND PRIVATE SYSTEMS

CITY/MUNICIPALITY	1990 CENSUS POPULATION (1)	MWSS HOUSE SERVICE CONNECTION: AVG. DAILY CONSUMPTION AMOUNT (M3/D) (2)	% TO TOTAL (3)	CONNECTIONS: NUMBER (4)	EQUIVALENT NO. OF POPULATION (5)	% TO TOTAL POP. (6)	AVERAGE PER CAPITA CONS. (LPCD) (7)	CORR'D PER CAPITA CONS. (LPCD) (8)	MWSS PUBLIC FAUCETS: AVERAGE DAILY CONSUMP. (M3/D) (9)	PUBLIC FAUCETS: NUMBER (10)	EQUIV. NO. OF POP. (11)	% TO TOTAL POP. (12)	AVERAGE PER CAPITA CONS. (LPCD) (13)	CORR'D PER CAPITA CONS. (LPCD) (14)	EQUIVALENT NO. OF POPULATION SERVED BY MWSS: TOTAL (HSC+PF) (15)	% TO TOTAL POP. (16)	PRIVATE WELL: DOMESTIC SUPPLY AMOUNT (M3/D) (17)	ESTIMATED SERVED POPULATION (18)	SHARE IN SUPPLY: AMOUNT (%) (19)	EQUIVALENT NO. OF POPULATION SERVED BY MWSS & PRIVATE SYSTEM: TOTAL (20)	% TO TOTAL (21)
I. NCR	7,928,867	755,690	96.8	587,778	4,761,002	60.0	158.7	174	5,919	462	224,532	2.8	17.5	19	4,985,534	62.9	266,935	1,355,526	24.3	6,341,059	80.0
1. Manila	1,598,918	207,941	26.6	155,052	1,255,921	78.5	165.6	181	972	86	41,796	2.6	23.3	25	1,297,717	81.2	2,214	12,204	1.0	1,309,921	81.9
2. Pasay City	366,823	27,941	3.6	25,087	203,205	55.4	137.5	151	170	33	16,038	4.4	10.6	12	219,243	59.8	5,827	32,372 *	15.9	251,615	68.6
3. Quezon City	1,665,766	200,035	25.6	147,326	1,193,341	71.6	167.6	184	1,356	167	81,162	4.9	16.8	18	1,274,503	76.5	31,316	170,505	12.4	1,445,006	86.7
4. Caloocan City	761,011	44,116	5.6	44,673	361,851	47.5	121.9	134	324	41	19,926	2.6	16.3	18	381,777	50.2	19,137	106,317 *	23.2	488,094	64.1
5. Las Pinas	296,851	2,566	0.4	1,939	64,306	21.7	46.1	51	37	8	3,888	1.3	9.6	10	68,194	23.0	57,141	317,450 *	94.6	385,644	129.9
6. Makati	452,734	61,236	7.8	40,210	325,701	71.9	188.0	206	21	5	2,430	0.5	9.5	9	328,131	72.5	10,075	48,906	13.1	377,037	83.3
7. Malabon	278,380	17,096	2.2	18,012	145,897	52.4	117.2	128	159	19	9,234	3.3	17.3	19	155,131	55.7	1,892	10,511 *	5.1	165,642	59.5
8. Mandaluyong	244,538	25,901	3.3	21,345	172,895	70.7	149.8	164	140	19	9,234	3.8	15.1	17	182,129	74.5	1,495	9,108	5.0	191,236	78.2
9. Marikina	310,010	37,855	4.8	28,315	229,352	74.0	165.1	181	260	13	11,178	3.6	23.3	26	240,530	77.6	5,340	29,525	11.3	270,054	87.1
10. Muntinlupa	276,912	3,604	0.5	5,505	44,591	16.1	80.8	89	-	-	0	-	-	-	44,591	16.1	49,108	272,822 *	92.6	317,413	114.6
11. Navotas	186,739	8,867	1.1	12,795	111,740	59.8	78.8	86	54	6	2,916	1.6	18.6	20	114,656	61.4	1,691	9,394 *	14.8	124,050	66.4
12. Paranaque	307,717	32,413	4.2	13,552	109,771	35.7	295.3	324	117	17	8,262	2.7	14.2	16	118,033	38.4	47,553	146,979	59.2	265,012	86.1
13. Pasig	397,309	43,316	5.5	32,630	264,303	66.5	163.9	180	124	21	10,206	2.6	12.1	13	274,509	69.1	9,223	51,361	16.2	325,870	82.0
14. Pateros	51,401	1,722	0.2	2,349	19,027	37.0	90.5	99	-	-	0	-	-	-	19,027	37.0	0	0 *	0.0	19,027	37.0
15. San Juan	126,708	23,653	3.0	12,851	104,093	82.2	227.2	249	125	8	3,888	3.1	32.1	35	107,981	85.2	252	1,012	1.0	108,993	86.0
16. Taguig	266,680	3,258	0.4	4,060	32,886	12.4	99.1	109	21	3	1,458	0.5	14.3	16	34,344	12.9	21,514	119,522 *	85.7	153,866	57.8
17. Valenzuela	340,050	13,827	1.8	15,077	122,124	35.9	113.2	124	23	6	2,916	0.9	9.5	10	125,040	36.8	3,157	17,539 *	17.2	142,579	41.9
II. CAVITE	457,020	11,795	1.5	16,819	136,133	29.8	86.6	95	119	17	8,262	1.8	14.4	16	144,395	31.6	46,864	260,354	78.2	404,749	88.6
1. Bacoor	159,685	2,580	0.3	3,881	31,436	19.7	82.1	90	54	6	2,430	1.5	22.3	24	33,866	21.2	31,507	175,039 *	91.6	208,905	130.8
2. Cavite City	91,641	5,411	0.7	7,801	63,231	69.0	85.9	94	47	8	3,888	4.2	12.0	13	67,125	73.2	849	4,717 *	12.4	71,841	78.4
3. Imus	92,125	779	0.1	974	7,335	8.0	106.3	116	-	0	0	0.0	-	-	7,335	8.0	3,268	18,156 *	79.3	25,491	27.7
4. Kawit	47,755	2,262	0.3	3,055	24,746	51.8	91.4	100	18	4	1,944	4.1	9.0	10	26,690	55.9	2,832	15,722 *	59.1	42,412	88.8
5. Noveleta	20,409	323	0.0	507	4,107	20.1	78.6	86	-	0	0	0.0	-	-	4,107	20.1	5,659	31,439 *	94.1	35,546	174.2
6. Rosario	45,405	417	0.1	651	5,273	11.6	79.0	87	-	0	0	0.0	-	-	5,273	11.6	2,751	15,282 *	85.8	20,555	45.3
III. RIZAL	980,194	13,404	1.7	17,116	138,499	14.2	96.1	105	56	5	3,215	0.3	23.5	26	142,715	14.6	65,171	362,061	81.5	504,776	51.5
1. Angono	46,014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Antipolo	207,842	3,606	0.5	4,445	36,005	17.3	100.1	110	4	1	54	0.0	71.8	79	36,059	17.3	29,367	163,150 *	89.1	199,209	95.8
3. Baras	18,388	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Binangonan	127,561	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Cainta	126,939	2,728	0.3	3,003	24,324	19.2	112.2	123	11	2	972	0.8	11.7	13	25,296	19.9	9,273	51,517 *	75.5	76,813	60.6
6. Cardona	32,962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. Jala-Jala	16,318	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8. Montalban	67,074	1,498	0.2	2,039	15,804	23.7	94.2	103	0	0	0	0.0	-	-	15,964	23.7	4,144	23,578 *	72.1	39,482	58.9
9. Morong	32,165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Pililla	32,771	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. San Mateo	82,310	2,305	0.3	3,678	31,263	38.0	73.7	81	33	4	1,218	1.5	27.5	30	32,481	39.5	2,647	14,706 *	50.8	47,187	57.3
12. Tanay	58,418	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. Taytay	112,603	3,268	0.4	3,451	32,003	28.5	102.1	112	27	2	972	0.9	27.6	30	32,975	29.3	19,640	109,111 *	96.5	142,086	126.4
14. Teresa	20,645	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	9,366,081	780,888	100.0	621,773	5,036,634	53.8	155.0	170	6,113	488	236,010	2.5	17.4	19	5,272,644	56.3	378,970	1,977,941	30.6	7,250,585	77.4

(5)=(4)x8.1 (7)=(2)/(5)x1000 (8)=(7)x1.0957 (11)=(10)x488 (13)=(9)/(11)x1000 (14)=(13)x1.0957 (15)=(5)+(11) (16)=(15)/(1)x100 (17)=(17)/(((2)+(9))*1.0957+(17))*100 (20)=(15)+(18)

* Assumed per capita consumption of 180 lpcd was used instead of estimated per capita consumption considering suppressed water supply condition.

TABLE 13.2.4 STATUS OF COMMERCIAL CONSUMPTION IN 1990

CITY/MUNICIPALITY	AVG. DAILY BILLED MWSS COMMERCIAL CONSUM.			NUMBER OF MWSS METER CONNECTION	CONSUMPTION PER METER CONNECTION		PRIVATE WELL COMM'L PUMPAGE (M3/DAY)	ESTIMATED TOTAL COMM'L CONSUM. (M3/DAY)	% TO TOTAL (%)	SHARE OF PRIVATE WELL (%)
	AMOUNT (M3/DAY)	CORRECTED (M3/DAY)	% TO TOTAL		BILLED (M3/DAY)	CORRECTED (M3/DAY)				
I. NCR	301,200	341,350	99.2	41,010	7.345	8.324	93,315	434,665	96.4	21.5
1. Manila	116,049	131,518	38.2	14,452	8.030	9.100	4,665	136,183	30.2	3.4
2. Pasay City	14,597	16,543	4.8	1,907	7.655	8.675	8,795	25,338	5.6	34.7
3. Quezon City	76,185	86,340	25.1	10,695	7.123	8.073	27,641	113,981	25.3	24.3
4. Caloocan City	10,071	11,414	3.3	2,535	3.973	4.502	3,674	15,088	3.3	24.4
5. Las Pinas	547	620	0.2	315	1.738	1.970	3,678	4,299	1.0	85.6
6. Makati	41,955	47,548	13.8	3,189	13.156	14.910	11,721	59,269	13.1	19.8
7. Malabon	2,831	3,208	0.9	989	2.862	3.244	2,016	5,224	1.2	38.6
8. Mandaluyong	9,891	11,210	3.3	1,123	8.808	9.982	2,128	13,338	3.0	16.0
9. Marikina	3,424	3,881	1.1	1,288	2.659	3.013	1,400	5,280	1.2	26.5
10. Muntinlupa	69	78	0.0	106	0.648	0.734	8,230	8,308	1.8	99.1
11. Navotas	1,795	2,035	0.6	471	3.812	4.320	621	2,655	0.6	23.4
12. Paranaque	5,920	6,709	1.9	1,045	5.665	6.420	4,914	11,624	2.6	42.3
13. Pasig	8,247	9,346	2.7	1,105	7.463	8.458	6,658	16,004	3.5	41.6
14. Pateros	49	56	0.0	34	1.446	1.639	0	56	0.0	0.0
15. San Juan	7,237	8,201	2.4	920	7.866	8.915	97	8,299	1.8	1.2
16. Taguig	319	361	0.1	61	5.222	5.918	3,655	4,016	0.9	91.0
17. Valenzuela	2,014	2,282	0.7	775	2.598	2.944	3,423	5,705	1.3	60.0
II. CAVITE	1,080	1,224	0.4	731	1.477	1.674	5,175	6,399	1.4	80.9
1. Bacoor	237	268	0.1	132	1.793	2.032	703	971	0.2	72.4
2. Cavite City	642	727	0.2	398	1.612	1.827	3,480	4,207	0.9	82.7
3. Imus	57	65	0.0	54	1.058	1.199	644	709	0.2	90.9
4. Kawit	108	122	0.0	119	0.905	1.025	0	122	0.0	0.0
5. Noveleta	4	5	0.0	5	0.872	0.989	0	5	0.0	0.0
6. Rosario	32	36	0.0	23	1.399	1.585	348	385	0.1	90.5
III. RIZAL	1,452	1,646	0.5	654	2.220	2.516	8,338	9,983	2.2	83.5
1. Angono	-	-	-	-	-	-	-	-	-	-
2. Antipolo	533	604	0.2	223	2.390	2.709	2,763	3,367	0.7	82.1
3. Baras	-	-	-	-	-	-	-	-	-	-
4. Binangonan	-	-	-	-	-	-	-	-	-	-
5. Cainta	396	449	0.1	134	2.958	3.353	3,173	3,622	0.8	87.6
6. Cardona	-	-	-	-	-	-	-	-	-	-
7. Jala-Jala	-	-	-	-	-	-	-	-	-	-
8. Montalban	37	42	0.0	36	1.019	1.155	844	886	0.2	95.3
9. Morong	-	-	-	-	-	-	-	-	-	-
10. Pililla	-	-	-	-	-	-	-	-	-	-
11. San Mateo	164	186	0.1	107	1.530	1.734	390	576	0.1	67.8
12. Tanay	-	-	-	-	-	-	-	-	-	-
13. Taytay	322	365	0.1	154	2.092	2.371	1,167	1,532	0.3	76.2
14. Teresa	-	-	-	-	-	-	-	-	-	-
TOTAL	303,732	344,219	100.0	42,395	7.164	8.119	106,828	451,047	100.0	23.7

TABLE 13.2.5 STATUS OF INDUSTRIAL CONSUMPTION IN 1990

CITY/MUNICIPALITY	AVG. DAILY BILLED MWSS INDUSTRIAL CONSUM.			NUMBER OF MWSS METER CONNECTION	CONSUMPTION PER METER CONNECTION		PRIVATE WELL IND'L PUMPAGE (M3/DAY)	ESTIMATED TOTAL IND'L CONS. (M3/DAY)	% TO TOTAL	SHARE OF PRIVATE WELL (%)
	BILLED (M3/DAY)	CORRECTED (M3/DAY)	% TO TOTAL		BILLED (M3/DAY)	CORRECTED (M3/DAY)				
I. NCR	71,792	81,361	96.3	6,291	11.412	12.933	280,687	362,048	82.4	77.5
1. Manila	15,545	17,617	20.9	795	19.554	22.160	5,786	23,403	5.3	24.7
2. Pasay City	810	918	1.1	169	4.793	5.432	3,375	4,293	1.0	78.6
3. Quezon City	17,066	19,341	22.9	1,988	8.585	9.729	32,368	51,708	11.8	62.6
4. Calookan City	8,170	9,259	11.0	723	11.300	12.806	4,665	13,923	3.2	33.5
5. Las Pinas	138	156	0.2	51	2.702	3.062	20,959	21,115	4.8	99.3
6. Makati	4,110	4,658	5.5	302	13.609	15.423	3,383	8,041	1.8	42.1
7. Malabon	5,270	5,972	7.1	369	14.281	16.184	14,565	20,537	4.7	70.9
8. Mandaluyong	6,881	7,799	9.2	261	26.365	29.879	5,353	13,151	3.0	40.7
9. Marikina	1,241	1,406	1.7	506	2.452	2.779	6,833	8,239	1.9	82.9
10. Muntinlupa	71	80	0.1	106	0.667	0.756	34,280	34,360	7.8	99.8
11. Navotas	1,785	2,023	2.4	129	13.836	15.681	1,739	3,762	0.9	46.2
12. Paranaque	1,482	1,679	2.0	171	8.666	9.821	17,691	19,370	4.4	91.3
13. Pasig	7,128	8,079	9.6	277	25.734	29.165	60,077	68,156	15.5	88.1
14. Pateros	3	4	0.0	3	1.037	1.175	1,756	1,760	0.4	99.8
15. San Juan	1,059	1,200	1.4	147	7.201	8.161	59	1,259	0.3	4.7
16. Taguig	8	9	0.0	9	0.926	1.049	41,198	41,208	9.4	100.0
17. Valenzuela	1,026	1,162	1.4	285	3.599	4.079	26,600	27,763	6.3	95.8
II. CAVITE	1,014	1,149	1.4	1,346	0.753	0.853	5,889	7,037	1.6	83.7
1. Bacoor	62	70	0.1	61	1.014	1.149	0	70	0.0	0.0
2. Cavite City	210	238	0.3	250	0.840	0.952	0	238	0.1	0.0
3. Imus	6	7	0.0	7	0.906	1.027	530	538	0.1	98.7
4. Kawit	507	574	0.7	672	0.754	0.854	0	574	0.1	0.0
5. Noveleta	78	88	0.1	105	0.741	0.840	0	88	0.0	0.0
6. Rosario	151	171	0.2	251	0.602	0.682	5,358	5,530	1.3	96.9
III. RIZAL	1,747	1,980	2.3	195	8.959	10.153	68,328	70,308	16.0	97.2
1. Angono	-	-	-	-	-	-	-	-	-	-
2. Antipolo	1,565	1,773	2.1	44	35.561	40.301	12,025	13,798	3.1	87.1
3. Baras	-	-	-	-	-	-	-	-	-	-
4. Binangonan	-	-	-	-	-	-	-	-	-	-
5. Cainta	42	48	0.1	34	1.247	1.414	36,173	36,221	8.2	99.9
6. Cardona	-	-	-	-	-	-	-	-	-	-
7. Jala-Jala	-	-	-	-	-	-	-	-	-	-
8. Montalban	15	17	0.0	13	1.151	1.305	2,941	2,958	0.7	99.4
9. Morong	-	-	-	-	-	-	-	-	-	-
10. Pililla	-	-	-	-	-	-	-	-	-	-
11. San Mateo	48	55	0.1	47	1.029	1.166	604	658	0.1	91.7
12. Tanay	-	-	-	-	-	-	-	-	-	-
13. Taytay	77	87	0.1	57	1.343	1.522	16,586	16,672	3.8	99.5
14. Teresa	-	-	-	-	-	-	-	-	-	-
TOTAL	74,552	84,490	100.0	7,832	9.519	10.788	354,904	439,394	100.0	80.8

Billed Water Consumption categorized in Others are included in Industrial Consumption

TABLE 13.2.6 PER CAPITA DOMESTIC WATER DEMAND GROWTH

FOR GENERAL POPULATION

YEAR	PCIG(I) (1)	IED (2)	IR1(I) (3)	TI(I) (4)	PED (5)	IR2(I) (6)	IR(I) (7)	II(I) (8)
1990	-9.17	0.30	-2.75	-0.77	-0.20	0.15	-2.60	1.0000
1991	14.72	0.30	4.42	-2.53	-0.20	0.51	4.92	1.0492
1992	-17.64	0.30	-5.29	-0.31	-0.20	0.06	-5.23	0.9943
1993	-1.22	0.30	-0.37	1.38	-0.20	-0.28	-0.64	0.9880
1994	-1.43	0.30	-0.43	1.38	-0.20	-0.28	-0.71	0.9810
1995	1.49	0.30	0.45	1.38	-0.20	-0.28	0.17	0.9827
1996	3.11	0.30	0.93	1.38	-0.20	-0.28	0.66	0.9891
1997	-3.01	0.30	-0.90	1.38	-0.20	-0.28	-1.18	0.9775
1998	-2.92	0.30	-0.88	1.38	-0.20	-0.28	-1.15	0.9662
1999	-3.00	0.30	-0.90	1.38	-0.20	-0.28	-1.18	0.9548
2000	-12.31	0.30	-3.69	1.38	-0.20	-0.28	-3.97	0.9169
2001	-1.28	0.30	-0.38	1.38	-0.20	-0.28	-0.66	0.9109
2002	-1.18	0.30	-0.35	1.38	-0.20	-0.28	-0.63	0.9052
2003	-1.08	0.30	-0.32	1.38	-0.20	-0.28	-0.60	0.8997
2004	-1.00	0.30	-0.30	1.38	-0.20	-0.28	-0.58	0.8945
2005	-0.91	0.30	-0.27	1.38	-0.20	-0.28	-0.55	0.8896
2006	-0.84	0.30	-0.25	1.38	-0.20	-0.28	-0.53	0.8849
2007	-0.77	0.30	-0.23	1.38	-0.20	-0.28	-0.51	0.8804
2008	-0.70	0.30	-0.21	1.38	-0.20	-0.28	-0.49	0.8762
2009	-0.63	0.30	-0.19	1.38	-0.20	-0.28	-0.46	0.8721
2010	-0.56	0.30	-0.17	1.38	-0.20	-0.28	-0.44	0.8682

FOR BLIGHTED POPULATION

YEAR	PCIG(I) (1)	IED (2)	IR1(I) (3)	TI(I) (4)	PED (5)	IR2(I) (6)	IR(I) (7)	II(I) (8)
1990	0.00	0.11	0.00	-0.77	-0.06	0.05	0.05	1.0000
1991	0.00	0.11	0.00	-2.53	-0.06	0.15	0.15	1.0015
1992	0.00	0.11	0.00	-0.31	-0.06	0.02	0.02	1.0017
1993	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	1.0009
1994	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	1.0000
1995	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9992
1996	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9984
1997	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9976
1998	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9967
1999	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9959
2000	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9951
2001	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9943
2002	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9934
2003	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9926
2004	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9918
2005	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9910
2006	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9902
2007	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9893
2008	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9885
2009	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9877
2010	0.00	0.11	0.00	1.38	-0.06	-0.08	-0.08	0.9869

SOURCE: CORPLAN

(1) Per capita income growth in real terms in year I (%)
(2) Income elasticity of consumption
(3) Increase rate by income growth in year I (1) * (2) (%)
(4) Tariff increase in real terms in year I (%)
(5) Price elasticity of consumption
(6) Increase rate by tariff increase in year I (4) * (5) (%)
(7) Increase rate in year I (%)
(8) Increase index in year I, 1.0000 in base year 1990

TABLE 13.2.7 PER CAPITA DOMESTIC CONSUMPTION PROJECTION

CITY/MUNICIPALITY	1990	1995	2000	2005	2010
I. NCR	174				
CITY OF MANILA	181	186	191	195	200
PASAY CITY *a	151	180	187	193	200
QUEZON CITY	184	188	192	196	200
CALOOCAN CITY *a	134	180	187	193	200
LAS PINAS *s	51	180	187	193	200
MAKATI	206	210	213	217	220
MALABON *a	128	180	187	193	200
MANDALUYONG	164	180	187	193	200
MARIKINA	181	186	190	195	200
MUNTINLUPA *s	89	180	187	193	200
NAVOTAS *a	86	180	187	193	200
PARANAQUE	324	305	287	268	250
PASIG	180	185	190	195	200
PATEROS *a	99	180	187	193	200
SAN JUAN	249	249	249	250	250
TAGUIG *a	109	180	187	193	200
VALENZUELA *a	124	180	187	193	200
II. CAVITE	95				
BACOOR *s, f	90	180	187	193	200
CAVITE CITY *f	94	180	187	193	200
IMUS *f	116	180	187	193	200
KAWIT *f	100	180	187	193	200
NOVELETA **	86	180	187	193	200
ROSARIO *f	87	180	187	193	200
III. RIZAL	105				
ANGONO *r	-	141	160	181	205
ANTIPOLO *f	110	138	149	155	162
BARAS *r	-	141	160	181	205
BINANGONAN *r	-	141	160	181	205
CAINTA *a	123	180	187	193	200
CARDONA *r	-	141	160	181	205
JARA-JARA *r	-	141	160	181	205
MONTALBAN *f	103	111	118	124	129
MORONG *r	-	141	160	181	205
PILILLA *r	-	141	160	181	205
SAN MATEO *f	81	178	190	204	219
TANAY *r	-	141	160	181	205
TAYTAY *a	112	180	187	193	200
TERESA *r	-	141	160	181	205

1. Areas with <*a> have suppressed demand due to low water pressure, and be expected to be improved by AWSOP.
2. Areas with <*s> also have suppressed demand due to low water pressure, and be expected to be improved by MSWDP.
3. Areas with <*f> have suppressed demand due to limited water sources, and be expected to be improved by FAWSP.
4. Areas with <*r> are merged area under BP799, and be expected to be improved by RPWSIP.
5. Per capita water demand in Noveleta was assumed to be same as the one in Kawit

TABLE 13.2.8 ESTIMATED SERVED POPULATION IN THE NCR IN 1990, BY CITY/MUNICIPALITY

CITY/MUNICIPALITY	TOTAL POPULATION (1990)			ESTIMATED SERVED POPULATION			SERVED % TO TOTAL			CORRECTED POPULATION			SERVED % TO CORRECTED POP.	
	TOTAL (CENSUS)	GENERAL (ESTIMATED)	BLIGHTED (ESTIMATED)	TOTAL	H.S.C. (ESTIMATED)	PUBLIC FAUCETS (ESTIMATED)	TOTAL	H.S.C.	P.F.	GENERAL	WATER BLIGHTED	BL'D % TO TOTAL	GENERAL	WATER BL'D
							TOTAL	GENERAL	BL'D					
NCR	7,928,867	5,123,288	2,805,579	4,985,534	4,761,002	224,532	62.9	92.9	8.0	5,701,383	2,227,484	28.1	83.5	10.1
CITY OF MANILA	1,598,918	1,173,606	425,312	1,297,717	1,255,921	41,796	81.2	107.0	9.8	1,255,921	342,997	21.5	100.0	12.2
PASAY CITY *a	366,623	46,928	319,695	219,243	203,205	16,038	59.8	433.0	5.0	203,205	163,418	44.6	100.0	9.8
QUEZON CITY	1,666,766	911,721	755,045	1,274,503	1,193,341	81,162	76.5	130.9	10.7	1,193,341	473,425	28.4	100.0	17.1
CALOOCAN CITY *a	761,011	456,607	304,404	381,777	361,851	19,926	50.2	79.2	6.5	456,607	304,404	40.0	79.2	6.5
LAS PINAS *s	296,851	243,418	53,433	68,194	64,306	3,888	23.0	26.4	7.3	243,418	53,433	18.0	26.4	7.3
MAKATI	452,734	369,884	82,850	328,131	325,701	2,430	72.5	88.1	2.9	369,884	82,850	18.3	88.1	2.9
MALABON *a	278,380	198,763	79,617	155,131	145,897	9,234	55.7	73.4	11.6	198,763	79,617	28.6	73.4	11.6
MANDALUYONG	244,538	157,727	86,811	182,129	172,895	9,234	74.5	109.6	10.6	172,895	71,644	29.3	100.0	12.9
MARIKINA	310,010	204,975	105,035	240,530	229,352	11,178	77.6	111.9	10.6	229,352	80,659	26.0	100.0	13.9
MUNTINLUPA *s	276,972	197,481	79,491	44,591	44,591	0	16.1	22.6	0.0	197,481	79,491	28.7	22.6	0.0
NAVOTAS *a	186,799	93,400	93,399	114,656	111,740	2,916	61.4	119.6	3.1	111,740	75,060	40.2	100.0	3.9
PARANAQUE	307,717	275,407	32,310	118,033	109,771	8,262	38.4	39.9	25.6	275,407	32,310	10.5	39.9	25.6
PASIG	397,309	284,473	112,836	274,509	264,303	10,206	69.1	92.9	9.0	284,473	112,836	28.4	92.9	9.0
PATEROS *a	51,401	42,920	8,481	19,027	19,027	0	37.0	44.3	0.0	42,920	8,481	16.5	44.3	0.0
SAN JUAN	126,708	113,404	13,304	107,981	104,093	3,888	85.2	91.8	29.2	113,404	13,304	10.5	91.8	29.2
TAGUIG *a	266,080	199,551	66,529	34,344	32,886	1,458	12.9	16.5	2.2	199,551	66,529	25.0	16.5	2.2
VALENZUELA *a	340,050	153,023	187,027	125,040	122,124	2,916	36.8	79.8	1.6	153,023	187,027	55.0	79.8	1.6

NOTE: 1. Areas with (*a) have suppressed demand due to low water pressure, and be expected to be improved by AWSOP.
2. Areas with (*s) also have suppressed demand due to low water pressure, and be expected to be improved by MSWDP.

TABLE 13.2.9 MODIFIED WATER-BLIGHTED POPULATION IN NCR, BY CITY/MUNICIPALITY

CITY/ MUNICIPALITY	1990			1995		2000		2005		2010	
	TOTAL POPULATION	BLIGHTED POPULATION	%	TOTAL POPULATION	WATER BLIGHTED POPULATION	TOTAL POPULATION	WATER BLIGHTED POPULATION	TOTAL POPULATION	WATER BLIGHTED POPULATION	TOTAL POPULATION	WATER BLIGHTED POPULATION
1. Manila City	1,598,918	244,184	15.3	1,666,014	253,102	1,705,567	257,958	1,723,126	259,690	1,723,147	258,959
2. Pasay City	366,623	116,339	31.7	402,932	127,193	433,048	136,092	457,147	143,156	475,225	148,397
3. Quezon City	1,666,766	337,037	20.2	1,870,519	376,263	2,049,017	410,335	2,200,635	439,136	2,323,154	462,274
4. Caloocan City	761,011	216,709	28.5	872,801	247,245	979,527	276,244	1,076,883	302,624	1,164,630	326,356
5. Las Pinas	296,851	38,040	12.8	413,469	52,707	551,808	70,029	708,704	89,621	878,109	110,730
6. Makati	452,734	58,982	13.0	489,333	63,417	517,961	66,829	539,315	69,337	553,794	70,997
7. Malabon	278,380	56,680	20.4	305,870	61,952	328,653	66,271	346,868	69,696	360,515	72,233
8. Mandaluyong	244,538	51,004	20.9	265,870	55,164	282,944	58,445	296,044	60,935	305,315	62,665
9. Marikina	310,010	57,422	18.5	359,368	66,217	405,480	74,381	447,289	81,760	483,621	88,151
10. Muntinlupa	276,972	56,591	20.4	346,829	70,494	419,918	84,969	493,739	99,553	565,215	113,642
11. Navotas	186,799	53,436	28.6	207,567	59,067	225,328	63,836	240,031	67,760	251,550	70,811
12. Paranaque	307,717	23,002	7.5	369,370	27,466	430,253	31,851	488,493	36,035	541,964	39,866
13. Pasig	397,309	80,329	20.2	466,552	93,837	532,663	106,657	593,888	118,495	648,283	128,982
14. Pateros	51,401	6,038	11.7	58,438	6,828	64,776	7,535	70,318	8,151	74,945	8,663
15. San Juan	126,708	9,471	7.5	133,478	9,925	137,583	10,185	140,304	10,350	141,007	10,372
16. Taguig	266,080	47,363	17.8	311,031	55,075	353,627	62,339	392,792	68,998	427,323	74,851
17. Valenzuela	340,050	133,147	39.2	432,359	168,407	530,824	205,839	632,076	244,234	731,811	281,971
T O T A L	7,928,867	1,585,773	20.0	8,971,800	1,794,360	9,948,977	1,989,795	10,847,652	2,169,530	11,649,608	2,329,922

TABLE 13.2.10 PROJECTED DOMESTIC WATER CONSUMPTION IN 1995, BY CITY/MUNICIPALITY

CITY/MUNICIPALITY	TOTAL POPULATION (1995)			PER CAPITA CONSUMPTION		DOMESTIC CONSUMPTION (1995)			MWSS CONNECTED %			MWSS CONNECTED POPULATION			MWSS DOMESTIC CONSUMPTION			PRIVATE DOM. CONSUMPTION		
	TOTAL	GENERAL	WATER BLIGHTED	GEN'L (LPCD)	BL'D (LPCD)	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)	GEN'L POP.	WATER BL'D POP.	MWSS TOTAL POP.	GENERAL POP.	WATER BLIGHTED POP.	TOTAL POP.	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)
I. NCR	8,971,800	7,177,440	1,794,360	192	35	1,379,394	62,803	1,442,197	80	30	70	5,777,280	542,543	6,319,823	1,107,101	18,929	1,126,290	272,094	43,814	315,907
CITY OF MANILA	1,666,014	1,412,912	253,102	186	35	262,886	8,859	271,745	95	30	85	1,342,266	75,931	1,418,197	249,742	2,658	252,399	12,144	6,201	19,345
PASAY CITY *a	402,932	275,739	127,193	180	35	49,633	4,452	54,085	85	30	68	234,378	38,158	272,536	42,188	1,336	43,524	7,445	3,116	10,561
QUEZON CITY	1,870,519	1,494,256	376,263	188	35	280,548	13,169	293,717	95	30	82	1,419,543	112,979	1,532,522	268,521	3,951	270,472	14,027	9,218	23,246
CALOOCAN CITY *a	872,801	625,556	247,245	180	35	112,600	8,654	121,254	70	30	59	437,889	74,174	512,063	78,820	2,596	81,416	23,780	6,058	29,838
LAS PINAS *s	413,469	360,762	52,707	180	35	64,937	1,845	66,782	45	30	43	162,343	15,812	178,155	29,222	553	29,775	35,715	1,231	37,307
MAKATI	489,333	425,916	63,417	210	35	89,231	2,220	91,451	90	30	82	383,324	19,025	402,349	80,308	666	80,974	8,923	1,554	10,477
MALABON *a	305,870	243,918	61,952	180	35	43,905	2,158	46,074	70	30	62	170,742	18,586	189,328	30,734	650	31,384	13,172	1,518	14,689
MANDALUYONG	265,870	210,706	55,164	180	35	37,927	1,931	39,858	95	30	82	200,171	16,549	216,720	36,031	579	36,610	1,896	1,352	3,248
MARIKINA	359,368	293,151	66,217	186	35	54,423	2,318	56,741	95	30	83	278,493	19,865	298,358	51,782	695	52,397	2,721	1,622	4,342
MUNTINLUPA *s	348,829	276,335	70,494	180	35	49,740	2,467	52,208	40	30	35	110,534	21,148	131,682	19,896	740	20,636	29,844	1,727	31,571
NAVOTAS *a	207,567	148,500	59,067	180	35	26,730	2,067	28,797	90	30	73	133,650	17,720	151,370	24,057	620	24,677	2,673	1,447	4,120
PARANAQUE *s	369,370	341,904	27,466	305	35	104,333	961	105,294	60	40	59	205,142	10,987	216,129	62,600	385	62,984	41,733	577	42,310
PASIG	466,552	372,715	93,837	185	35	68,833	3,284	72,117	90	30	78	335,444	28,151	363,595	61,949	985	62,935	5,883	2,295	8,182
PATEROS *a	58,438	51,610	6,828	180	35	9,290	239	9,529	45	30	43	23,224	2,049	25,273	4,180	72	4,252	5,109	167	5,277
SAN JUAN	133,478	123,553	9,925	249	35	30,794	347	31,141	95	45	91	117,375	4,466	121,841	29,254	156	29,410	1,540	191	1,731
TAGUIG *a	311,031	255,956	55,075	180	35	46,072	1,928	48,000	20	30	22	51,191	16,523	67,714	9,214	578	9,793	36,858	1,349	38,207
VALENZUELA *a	432,359	283,952	148,407	180	35	43,511	5,894	53,406	65	30	51	171,569	50,522	222,091	30,882	1,768	32,651	16,629	4,126	20,755
II. CAVITE	534,043	515,406	18,637	180	35	92,773	652	93,425	48	30	47	245,186	5,667	250,853	44,133	198	44,332	48,640	454	49,094
BACOOR *f,s	196,636	189,282	7,374	180	35	34,067	258	34,325	45	30	44	85,168	2,212	87,380	15,330	77	15,408	18,737	181	18,918
CAVITE CITY *f	98,576	96,654	1,922	180	35	17,398	67	17,465	63	54	63	60,654	1,035	61,689	10,918	36	10,954	6,480	31	6,511
IMUS *f	107,162	103,813	3,349	180	35	18,686	117	18,804	41	28	41	43,045	937	43,982	7,748	33	7,781	10,938	84	11,023
KAWIT *f	55,217	54,555	662	180	35	9,820	23	9,843	69	67	69	37,702	442	38,144	6,786	15	6,802	3,034	8	3,041
NOVELETA	23,325	22,511	814	180	35	4,052	28	4,080	25	30	25	5,628	244	5,872	1,013	9	1,022	3,039	20	3,059
ROSARIO *f	53,127	48,511	4,616	180	35	8,750	158	8,908	27	18	26	12,589	797	13,386	2,338	28	2,366	6,412	130	6,542
III. RIZAL	1,149,930	660,355	489,575	154	34	101,805	16,835	118,640	47	10	31	308,031	46,718	354,749	45,785	1,752	47,536	56,021	15,083	71,104
ANGONO *r	55,062	22,025	33,037	141	35	3,115	1,156	4,271	100	0	40	22,025	0	22,025	3,115	0	3,115	0	1,156	1,156
ANTIPOLO *f	261,738	208,674	53,064	138	39	28,796	2,068	30,864	37	23	34	76,871	12,370	89,241	10,608	482	11,090	18,188	1,586	19,774
BARAS *r	19,051	898	18,153	141	31	127	558	685	100	0	5	898	0	898	127	0	127	0	558	558
BINANGONAN *r	140,791	49,553	91,238	141	34	7,008	3,109	10,117	100	0	35	49,553	0	49,553	7,008	0	7,008	0	3,109	3,109
CAINTA *a	154,650	131,720	22,930	180	35	23,710	1,153	24,862	25	20	26	32,930	9,879	42,809	5,927	346	6,273	17,782	807	18,589
CARDONA *r	35,194	3,465	31,729	141	30	490	966	1,456	100	0	10	3,465	0	3,465	490	0	490	0	966	966
JALA-JALA *r	17,814	517	17,297	141	31	73	542	615	100	0	3	517	0	517	73	0	73	0	542	542
MONTALBAN *f	75,766	58,944	16,822	111	39	6,538	657	7,195	56	41	52	32,779	6,841	39,620	3,636	267	3,903	2,902	390	3,292
MORONG *r	34,528	6,750	27,778	141	31	955	861	1,816	100	0	20	6,750	0	6,750	955	0	955	0	861	861
PILILLA *r	36,137	4,968	31,169	141	32	703	993	1,696	100	0	14	4,968	0	4,968	703	0	703	0	993	993
SAN MATEO *f	92,401	50,515	41,886	178	39	8,995	1,636	10,630	44	34	35	22,179	9,859	32,138	3,987	385	4,352	5,008	1,251	6,278
TANAY *r	65,810	15,347	50,463	141	33	2,170	1,656	3,826	100	0	23	15,347	0	15,347	2,170	0	2,170	0	1,656	1,656
TAYTAY *a	129,481	103,585	25,896	180	35	18,645	906	19,552	35	30	34	36,255	7,769	44,024	6,526	272	6,798	12,119	634	12,754
TERESA *r	21,507	3,394	18,113	141	32	480	575	1,055	100	0	16	3,394	0	3,394	480	0	480	0	575	575
TOTAL	10,655,773	8,353,201	2,302,572	166	35	1,573,973	80,290	1,654,262	76	26	65	6,330,496	594,929	6,925,425	1,197,219	20,939	1,218,158	376,754	59,351	436,105

NOTE: 1. Areas with (*a) have suppressed demand due to low water pressure, and be expected to be improved by ANSDP.
2. Areas with (*s) also have suppressed demand due to low water pressure, and be expected to be improved by KSWDP.
3. Areas with (*f) have suppressed demand due to limited water sources, and be expected to be improved by PAWSP.
4. Areas with (*r) are merged area under BP799, and be expected to be improved by RPWSIP.

TABLE 13.2.11 PROJECTED DOMESTIC WATER CONSUMPTION IN 2000, BY CITY/MUNICIPALITY

CITY/MUNICIPALITY	TOTAL POPULATION (2000)			PER CAPITA CONSUMPTION		DOMESTIC CONSUMPTION (2000)			MWSS CONNECTED %			MWSS CONNECTED POPULATION			MWSS DOMESTIC CONSUMPTION			PRIVATE DOMESTIC CONSUMPTION		
	TOTAL	GENERAL	WATER BLIGHTED	GEN'L (LPCD)	BL'D (LPCD)	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)	GEN'L POP.	WATER BL'D POP.	MWSS TOTAL POP.	GENERAL POP.	WATER BLIGHTED POP.	TOTAL POP.	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)	GENERAL (M3/D)	WATER BLIGHTED (M3/D)	TOTAL (M3/D)
I. NCR	9,948,977	7,959,182	1,989,795	196	35	1,562,371	69,643	1,632,014	88	60	83	7,026,290	1,193,877	8,220,167	1,378,416	41,786	1,420,202	183,955	27,857	211,812
CITY OF MANILA	1,705,567	1,447,609	257,958	191	35	276,069	9,029	285,097	95	60	90	1,375,228	154,775	1,530,003	262,265	5,417	267,682	13,803	3,611	17,415
PASAY CITY *a	433,048	296,956	136,092	187	35	55,432	4,763	60,195	90	60	81	267,260	81,655	348,916	49,889	2,858	52,747	5,543	1,905	7,448
QUEZON CITY	2,049,017	1,638,682	410,335	192	35	314,355	14,362	328,717	95	60	88	1,556,748	246,201	1,802,949	298,637	8,617	307,254	15,718	5,745	21,462
CALOOCAN CITY *a	979,527	703,283	276,244	187	35	131,280	9,669	140,948	80	60	74	562,627	165,746	728,373	105,024	5,801	110,825	26,256	3,867	30,123
LAS PINAS *a	551,808	481,779	70,029	187	35	89,932	2,451	92,383	75	60	73	361,335	42,017	403,352	67,443	1,471	68,920	22,483	980	23,463
MAKATI	517,961	451,132	66,829	213	35	96,093	2,339	98,432	95	60	90	428,576	40,097	468,673	91,288	1,403	92,691	4,805	936	5,740
MALABON *a	328,653	262,382	66,271	187	35	48,978	2,319	51,297	80	60	76	209,906	39,762	249,668	39,182	1,392	40,574	9,796	928	10,723
MANDALUYONG	282,944	224,499	58,445	187	35	41,906	2,046	43,952	95	60	88	213,274	35,067	248,341	39,811	1,227	41,038	2,095	818	2,914
MARIKINA	405,680	331,099	74,581	190	35	63,052	2,603	65,656	95	60	89	314,544	44,629	359,173	59,800	1,562	61,462	3,153	1,041	4,194
MUNTINLUPA *a	419,918	334,949	84,969	187	35	62,524	2,974	65,498	75	60	72	251,211	50,982	302,193	46,893	1,784	48,677	15,631	1,190	16,821
NAVOTAS *a	225,328	161,492	63,836	187	35	30,145	2,234	32,379	95	60	85	153,417	38,302	191,719	28,638	1,341	29,978	1,507	894	2,401
PARANAQUE *a	430,253	398,402	31,851	287	35	114,249	1,115	115,364	80	60	79	318,721	19,111	337,832	91,399	669	92,068	22,850	446	23,296
PASIG	532,663	426,006	106,657	190	35	80,850	3,733	84,583	95	60	88	404,706	63,994	468,700	76,807	2,240	79,047	4,042	1,493	5,536
PATEROS *a	64,776	57,241	7,535	187	35	10,685	264	10,949	70	60	69	40,068	4,521	44,590	7,479	158	7,638	3,205	105	3,311
SAN JUAN	137,583	127,398	10,185	249	35	31,784	356	32,141	95	60	92	121,028	6,111	127,139	30,195	214	30,409	1,589	143	1,732
TAGUIG *a	353,627	291,288	62,339	187	35	54,374	2,182	56,556	70	60	68	203,902	37,403	241,305	38,082	1,309	39,371	16,312	873	17,185
VALENZUELA *a	530,824	324,985	205,839	187	35	60,664	7,204	67,868	75	60	69	243,738	123,504	367,242	45,498	4,323	49,820	15,166	2,882	18,048
II. CAVITE	611,062	593,551	17,511	187	35	110,796	613	111,409	71	46	70	420,474	7,397	428,471	78,488	280	78,768	32,308	333	32,641
BACOOR *f,s	235,538	228,354	7,184	187	35	42,626	251	42,878	80	60	79	182,683	4,310	186,994	34,101	151	34,252	8,525	101	8,626
CAVITE CITY *f	104,379	102,876	1,503	187	35	19,204	53	19,256	78	58	78	80,121	877	80,998	14,956	31	14,987	4,248	22	4,270
IMUS *f	121,860	118,797	3,063	187	35	22,175	107	22,283	57	39	57	67,721	1,207	68,928	12,641	42	12,683	9,534	65	9,599
KAWIT *f	62,446	61,928	518	187	35	11,560	18	11,578	84	76	84	52,015	393	52,408	9,709	14	9,723	1,850	4	1,855
NOVELETA	25,102	25,354	748	187	35	4,733	26	4,759	64	48	64	16,311	360	16,671	3,045	13	3,057	1,688	14	1,702
ROSARIO *f	60,737	56,242	4,495	187	35	10,499	157	10,656	38	19	37	21,623	850	22,473	4,036	30	4,066	6,462	128	6,590
III. RIZAL	1,325,412	863,057	462,355	165	35	142,705	16,187	158,891	66	11	47	569,460	52,168	621,628	94,949	2,042	96,991	47,755	14,145	61,900
ANGONO *r	64,219	32,110	32,109	160	35	5,138	1,124	6,262	100	0	50	32,110	0	32,110	5,138	0	5,138	0	1,124	1,124
ANTIPOLO *f	319,849	263,155	56,694	149	42	39,186	2,381	41,567	44	24	40	116,023	13,380	128,403	17,128	562	17,690	22,058	1,819	23,877
BARAS *r	21,063	1,183	19,880	160	31	189	610	799	100	0	6	1,183	0	1,183	189	0	189	0	610	610
BINANGONAN *r	152,533	68,131	84,402	160	34	10,902	2,873	13,775	100	0	45	68,131	0	68,131	10,902	0	10,902	0	2,873	2,873
CAINTA *a	206,850	186,174	20,686	187	35	34,752	724	35,476	70	60	69	130,322	12,412	142,733	24,327	434	24,761	10,426	290	10,715
CARDONA *r	36,995	3,945	33,050	160	30	631	1,005	1,636	100	0	11	3,945	0	3,945	631	0	631	0	1,005	1,005
JALA-JALA *r	19,109	1,681	17,428	160	31	269	542	811	100	0	9	1,681	0	1,681	269	0	269	0	542	542
MONTALBAN *f	83,837	68,024	15,813	118	42	8,050	664	8,714	67	44	62	45,243	6,902	52,145	5,354	290	5,644	2,696	374	3,070
MORONG *r	36,957	7,832	29,125	160	31	1,253	900	2,153	100	0	21	7,832	0	7,832	1,253	0	1,253	0	900	900
PILILLA *r	39,119	7,254	31,865	160	32	1,161	1,010	2,171	100	0	19	7,254	0	7,254	1,161	0	1,161	0	1,010	1,010
SAN MATEO *f	101,679	60,602	41,077	190	42	11,539	1,725	13,264	56	26	44	33,817	10,575	44,392	6,439	444	6,883	5,100	1,281	6,381
TANAY *r	72,764	24,525	48,239	160	33	3,924	1,570	5,494	100	0	34	24,525	0	24,525	3,924	0	3,924	0	1,570	1,570
TAYTAY *a	148,322	133,490	14,832	187	35	24,918	519	25,437	70	60	69	93,443	8,899	102,342	17,443	311	17,754	7,475	208	7,683
TERESA *r	22,106	4,951	17,155	160	31	792	539	1,331	100	0	22	4,951	0	4,951	792	0	792	0	539	539
TOTAL	11,885,451	9,415,790	2,469,661	193	35	1,815,872	86,442	1,902,314	85	51	78	8,016,224	1,254,042	9,270,266	1,551,854	44,107	1,595,962	264,018	42,335	306,353

NOTE: 1. Areas with (*a) have suppressed demand due to low water pressure, and be expected to be improved by AWSOP.
2. Areas with (*s) also have suppressed demand due to low water pressure, and be expected to be improved by MSMDP.
3. Areas with (*f) have suppressed demand due to limited water sources, and be expected to be improved by FAWSP.
4. Areas with (*r) are merged area under BP759, and be expected to be improved by RPWSIP.