Chapter 2.

Mater Plan

Part II Water Supply

Chapter 2. Master Plan

5. Priority Service Area

In selection of priory areas, the following issues are comprehensively considered as sunumarized in Table 5.1.

5.1 Population Trend

a) Beneficiary population

Through expansion of the water supply systems, beneficiary population should be maxinized and given higher priority in selection of priority areas than the other issues. Most of the NCR comes under this issue.

b) Increase rate

Not only the number of beneficiary population but also those areas of high population increase rate should be considered for high future expandability. Fringe areas of the NCR including Bacoor, Angono, Antipolo and Cainta come under this issue.

5.2 Urban Development Plan

a) Conformity with the existing/planned development plan

Most of the existing development plans are yet on study stage and have no definite implementation plans. However, it is relevant to consider these projects together with water supply expansion schemes.

b) Prioritization of the ongoing projects

Ongoing projects including AWSOP, UATP, RPWSIP etc. should be given high priority to maximize their investment effects.

c) Development potential

Development potential and population increase are closely related each others. Therefore, land use plan should be carefully reviewed and conclude the areawise priority of servicing of water supply.

5.3 Present Water Use (Needs of residents/enterprises)

a) External survey results implemented by the Team

Although it is expected that willingness to connect to the MWSS water supply systems of residents/enterprises is mostly high, there may be differences by area in willingness to connect. The fringe areas of the NCR, where the CDS system is not yet connected and higher willingness to connect is expected, should be prioritized in case expansion scheme will be considered.

b) External survey results implemented by MWSS in 1994

Even in the served areas, water supply services are rated depending upon their geographical situation or distance from the trunk distribution mains as indicated in the survey implemented by MWSS in 1994.

c) Improvement of water supply services

Intermittent water supply, involved with insufficient amount, improper quality, and insufficient pressure, is experienced in high population destiny areas in the central region of the NCR in which beneficiary population is very high. These issues are one of most important to be improved in connection to the mission of the MWSS.

5.4 Groundwater with Saline Intrusion

As stated in the MTPDP, groundwater water with saline intrusion problem shall be minimized through expansion scheme of water supply systems. This problem is occurred along the cities/municipalities, particularly in Las Pinas, Muntinlupa, Cavite city, and Cainta. Likewise, those cities/municipalities of NCR as Manila, Pasay, Caloocan, Las Pinas, Makati, Malabon, Navotas, Paranaque, and Valenzuela and all city/municipalities of Cavite Province are restricted

in groundwater extraction. Therefore, highest priority will be given to every areas with problems on groundwater.

Table 5.1 Priority Area for Water Supply

Province	Priority	Areas	Reason
NCR	High	Manila, Pasay, Quezon, Caloocan, Las Pinas, Makati, Malabon, Muntinlupa, Navotas, Paranaque, Pateros, Taguig, Valenzuela	These municipalities (along with Manila) are utilizing groundwater and suffering from saline intrusion problems. Should be replaced by the CDS system. These are all population increase areas.
	Mid.	Mandaluyong, Marikina, Pasig, San Juan	Most of the NCR is covered by the CDS system. However, the region still experiences insufficient water supply, especially in the amount and pressure, in the central part of the NCR.
Cavite	High	All areas	Saline intrusion problems are evident.
Rizal	High	Cainta	Saline intrusion problems are evident.
	Mid.	Angono, Antipolo, Binangonan, Rodriguez, San Mateo,	These areas are going to be highly urbanized as a eastern fringe of the NCR, just like Cavite Province. The population increase rate is projected to be remarkably higher than the other study areas. Moreover, there is an ongoing project, the Rizal Province Water Implementation Project (RPWSP)
	Low	Baras, Cardona, Jala-jala, Morong, Pililla, Tanay, Teresa	Despite a sharp increase, the population increase is not so high and these areas shall be ranked as low.

Table 5.2 Selection of Priority Areas

City/Municipality	Pop in 1994	Pop in 2015	Pop Inc (2015-1994)	Pop Inc Ratye (2015/1994)	Pop Inc	Pop Inc Rate	Ongoing project	Urban Devlop	Present Water Use	Saline intrusion	Evaluation	
											Total	Priority
NCR	8,680,085	12,435,785	3,755,700	1 43								
Manila	1,632,740	1,719,511	86,771	1 05	3	1	5	1	3	Yes*	13	A
Pasay	394,435	517,753	123,318	1 31	5	1	5	1	3	Yes*	15	A
Quezon	1,827,581	2,748,266	920,755	1 50	5	1	5	5	3		19	A
Caloocan	852,595	1,208,045	355,450	1 42	5	1	5	5	3	Yes*	19	A
Mandaluyong	260,432	299,935	39,503	1 15	1	1	5	1	5		13	B
Las Pinas	360,489	770,817	410,328	2 14	5	5	5	5	3	Yes	23	A
Makati	475,427	560,148	84,721	1 18	3	1	5	1	5	Yes*	15	A
Malabon	297,968	373,140	75,172	1 25	3	1	5	1	3	Yes*	13	A
Marikina	344,589	516,014	171,425	1 50	5	1	5	1	5		12	B
Muntinlupa	336,145	598,897	262,752	1 78	5	3	5	5	3	Yes	21	A
Navotas	206,793	298,533	91,740	1 44	3	1	5	1	3	Yes*	13	A
Paranaque	351,510	602,363	250,853	1 71	5	3	5	5	5	Yes	23	A
Pasig	442,243	691,353	249,110	1 56	5	3	5	1	3		17	B
Pateros	56,177	66,256	10,079	1 18	1	1	5	1	5	Yes	13	A
San Juan	132,979	153,784	20,805	1 16	1	1	5	1	5		13	B
Taguig	315,249	646,634	331,385	2 05	5	5	5	3	5		23	A
Valenzuela	392,803	664,336	271,533	1 69	5	3	5	3	3	Yes*	19	A
CAVITE	513,130	857,774	344,644	1 67								
Cavite	95,990	118,105	22,115	1 23	1	1		1	1	Yes	4	A
Bacoor	186,141	361,544	175,403	1 94	5	3	5	5	1	Yes*	19	A
Imus	105,140	179,375	74,235	1 71	3	3		5	1	Yes*	12	A
Kawit	52,941	83,071	30,130	1 57	1	3		3	1	Yes*	8	A
Noveleta	22,581	35,329	12,748	1 56	1	3		3	1	Yes*	8	A
Rosario	50,337	80,350	30,013	1 60	1	3		3	1	Yes*	8	A
RIZAL	1,156,785	2,435,034	1,278,249	2 11								
Angono	54,175	113,855	59,680	2 10	3	5	5	5	1		19	B
Antipolo	262,776	609,864	347,088	2 32	5	5		5	3		18	B
Baras	19,866	41,448	21,582	2 09	1	5		1	1		8	C
Binangonan	150,126	311,864	161,738	2 08	5	5		3	1		14	B
Cainta	157,435	360,125	202,687	2 29	5	5		3	3	Yes	16	A
Cardona	37,113	72,015	34,902	1 94	1	3		1	1		6	C
Jala-Jala	18,373	35,649	17,276	1 94	1	3		1	1		6	C
Morong	36,216	68,660	32,444	1 90	1	3		1	1		6	C
Pililla	36,898	71,598	34,700	1 94	1	3		1	1		6	C
Rodriguez	75,522	146,684	71,162	1 94	3	3		3	3		12	B
San Mateo	92,712	184,616	91,904	1 99	3	3		5	3		14	B
Tanay	65,766	127,737	61,971	1 94	3	3		1	1		8	C
Taytay	126,559	245,814	119,255	1 94	5	3	5	3	3		19	B
Teresa	23,245	45,105	21,860	1 94	1	3		1	1		6	C
Note					5. 100,000<	5. 2 0<	5. Yes	5. High	5. High	Yes		A. High (20<)
					3. 50,000<	3 1 52<		3. Mid	3. Mid	prioritized		B. Mid (10<)
					1. <50,000	1. <1 52		1. Low	1. low	Yes*		C. Low (<10)
Total	10,350,000	15,728,593	5,378,593	1 52						restricted		

Part II Water Supply

Chapter 2. Master Plan

6. Survey on Needs of Residents/Enterprises

6.1 Objectives

The Team is currently preparing the Metro Manila Water Supply and Sewerage Master Plan. As part of the study, the conduct of socioeconomic survey of households and enterprises is important. Thus, the Team conduced the following survey.

The survey was conducted to analyze:

- how the residents and enterprises evaluate the activities of MWSS;
- what the residents and enterprises would request to MWSS; and
- how the residents and enterprises recognized the importance of the reservation of water environmental conditions.

The main study area covers eight (8) cities and twenty-nine (29) municipalities in Metro Manila (National Capital Region), Cavite Province and Rizal Province under the jurisdiction of the MWSS.

The adjacent municipalities of the Province of Bulacan within the fringes of the MWSS franchise area is also included with this study for the evaluation of probability of future extension to those area.

6.2 Approach and Methodology

6.2.1 Questionnaires

Structured survey questionnaires were administered by locally-hired enumerators. There were three (3) sets of questionnaires as attached whose contents are as follows:

a) Evaluation/needs for the MWSS Project,

b) Consciousness of water environment conservation, and

c) Recognition for public water quality management.

The targeted respondents for questionnaires a) and b) were residents while for questionnaire c) were enterprises.

6.2.2 Sampling

The planned sample size for the survey was as follows:

- 300 samples for residents
- 50 samples for enterprises.

The 300 samples for residents were to be stratified equally for the low income, middle income, and high income. The 50 samples for the enterprises were large-scale users. These were mainly manufactures.

The following table shows the actual sample size undertaken for the survey:

Table 6.1 Actual Sample Size

Respondents	NCR	CAVITE	RIZAL	BULACAN	TOTAL
LARGE-SCALE USERS	27	10	4	3	44
RESIDENTS	178	26	89	18	311
High Income	62	8	25	6	101
Middle Income	54	9	34	6	103
Low Income	62	9	30	6	107
TOTAL	205	36	93	21	355

6.3 Results and Findings

6.3.1 Water Supply

(1) Residents

a) Profile of Residential Respondents

Respondents from the high income class were taken from exclusive subdivisions in the NCR, Rizal, Cavite and Bulacan. Respondents from middle income class were taken from Quezon City, Marikina, Cainta, Pateros, Malabon, and Valenzuela. Respondents from low income class were taken from urban poor, e.g. Tondo.

b) Source of Water

In general, the majority of those surveyed in the residential areas are directly connected to the MWSS system and their responses may therefore be interpreted as indicative of the general perception of those connected to the MWSS system. With regards to area, the respondents in the NCR and Rizal are mostly connected to the MWSS, respondents from Cavite and Bulacan from other water sources.

Most of the low income in the NCR also get water from water vendors and a few from neighbor's connection and public faucet. Aside from connection to the MWSS, the middle and high income in the NCR get their water mostly from private faucets.

In Rizal, the high income are connected to MWSS, while a few in the low and middle income which are not connected to MWSS get from private faucets and neighbor's connection.

Table 6.2 Source of Potable Water Supply

AREA	WATER SOURCE (by income group)		
	Low	Middle	High
NCR	MWSS	MWSS	MWSS
RIZAL	MWSS	MWSS	MWSS
BULACAN/CAVITE	Public./Private faucet		

In Cavite, most of the low income respondents get water from the public faucet, while the middle income respondents source their water from public and private faucets. All of the high income

respondents get their water from private faucets. The private faucet is usually a deep well or shallow well within the yard of a household.

c) Average Monthly Water Consumption

In general, majority of the respondents estimated their consumption to range between 21 m^3 to 50 m^3. Most of the low income consume about 21 m^3 to 40 m^3, while most of the middle and high income group consume 41 m^3 to 50 m^3. Some of the respondents from the middle and high income group also indicated consumption of 51 m^3 and more.

In the area mostly covered by MWSS, the low income group in the NCR consume 21 m^3 to 30 m^3 while the low income group in Rizal consume 31 m^3 to 40 m^3.

The middle income groups in these areas consume from 21 m^3 to 40 m^3 (NCR) and from 41 m^3 to more than 51 m^3 (Rizal).

The high income in the NCR consume more than 51 m^3 and from 21 m^3 to 30 m^3 while in Rizal, 41 m^3 to 50 m^3.

In the periphery of MWSS service areas, the areas of Bulacan and Cavite, respectively, indicated responses of 21 m^3 to 30 m^3 and above 51 m^3 for the low income group and 41 m^3 to 50 m^3 for the high income group.

The middle income group did not give responses. The low percentage of responses for these areas are understandable considering that they source their water mostly from public and private faucets which are not metered.

Table 6.3 Water Consumption

AREA	WATER CONSUMPTION (in m^3 by income group)		
	Low	Middle	High
NCR	21 to 30	21 to 40	51 and more
RIZAL	31 to 40	41 and above	41 to 50
BULACAN	21 to 30	no responses	41 to 50
CAVITE	51 and above	no responses	no response

d) Water Charges

Most of the respondents find present water charges they pay as reasonable. These responses also include those which are not connected to MWSS. Some respondents indicated, however, that the water charges they pay are expensive. But the percentage of these respondents are fewer than those who stated that water charges are reasonable.

In areas covered by MWSS, the low income bracket in the NCR are almost evenly distributed between finding the water charges as reasonable and expensive while in Rizal, the low income group find the water charges as reasonable.

The middle and high income groups in the same area both find the water charges as reasonable. There are, however, some respondents in Rizal for the middle income group that find the water charges as expensive.

In areas not serviced by MWSS, the middle income group find the water charges as reasonable while in the high income group water charges are expensive. The low income group find water charges as expensive also. Only few responded, however, because most of the respondents get water from public and private faucets, in which case, water is not charged the usual fees.

Table 6.4 Water Charge

AREA	WATER CHARGES (by income group)		
	Low	Middle	High
NCR	Reasonable	Reasonable	Reasonable
RIZAL	Reasonable	Reasonable	Reasonable
BULACAN	No responses	Reasonable	Expensive
CAVITE	Expensive	No responses	No responses

e) Average Monthly Household Income

In general, the low income group's average monthly household income fall between P2,501 to P3,500, while the middle income group's average monthly household income fall between P5,001 and P8,000 and the high income group's average monthly household income is P8,001 and above.

In the areas covered by the MWSS, following is the summary of the average monthly income:

Table 6.5 Average Household Income

AREA	AVERAGE MONTHLY HOUSEHOLD INCOME (PESOS)		
	Low	Middle	High
NCR	2,501-3,500	5,001-8,000	> 8,001
RIZAL	2,501-3,500	5,001-8,000	> 8,001
BULACAN	1,001-1,500	5,001-8,000	> 8,001
CAVITE	5 01-1,000	5,001-8,000	> 8,001

f) Customer Service and Water Supply Status

In general, the low income group is evenly divided between those who have no particular complaint and those who observe that customer service response is slow or bad. The middle income group has no particular complaint while the high income group finds the customer service generally good.

Areawise, customer service in the NCR (where most respondents are connected to MWSS) is perceived by the low income group as slow and bad, while the middle and high income groups find no particular complaints for the service. In Rizal, where most respondents are also connected to MWSS, customer service is rated as generally good.

Although customer service is rated as generally satisfactory in areas presently covered by the MWSS, the current status of water supply is not rated similarly. Respondents in the NCR and Rizal that are not satisfied indicated that low pressure and frequent interruption of water supply are the main reasons for their dissatisfaction with the water supply aside from being expensive.

In Rizal, however, the high income group find the water supply satisfactory.

There are minimal responses in Bulacan and Cavite, the trend exhibited finds the water supply as generally good.

Table 6.6 Customer Service

AREA	CUSTOMER SERVICE (by income group)		
	Low	Middle	High
NCR	Slow or Bad	No complaint	No complaint
RIZAL	Generally good	Generally good	Generally good
BULACAN	No Response	Generally good	Generally good
CAVITE	No complaint	No Response	No Response

Table 6.7 Water Supply Status

AREA	WATER SUPPLY STATUS (by income group)		
	Low	Middle	High
NCR	Low pressure	Satisfactory	Satisfactory
RIZAL	Satisfactory	Expensive	Satisfactory
BULACAN	No Response	Satisfactory	Satisfactory
CAVITE	Satisfactory	No Response	No Response

g) Willingness to Connect to MWSS

Although the overall rating to customer service and water supply status are both satisfactory, willingness to connect among the respondents is high.

In the NCR, where MWSS is required to operate, majority of the respondents are willing to connect. A few qualified that their willingness would depend on the charge.

In Rizal, likewise, the low income is willing to connect although most have indicated that they are willing to connect if charge is not expensive.

In Cavite, the low income groups did not respond, while the medium and high income groups indicated that they are willing to connect without unconditionally.

In Bulacan, most respondents are also willing to connect.

(2) Enterprises

For MWSS user, daily average consumption of the enterprise ranges from 53 to 10,361 m^3 per day. The daily maximum demand range from 5 to 150 m^3 per day and annual consumption ranges from 1,704 to 125,000 m^3.

For non-MWSS, i.e., those with own wells, average daily consumption ranges from 4 to 1,400 m^3 per day only, daily maximum demand is higher with 7 to 730 m^3 per day and the annual consumption again is higher, ranging from 2,496 to 210,000 m^3.

6.3.2 Sewerage and Sanitation

(1) Residents

a) Type of Sanitation Facilities

Majority of respondents have toilet with septic tank as a means of disposing their waste. Some respondents indicated that they are connected to the MWSS sewer system.

b) Willingness to Connect to MWSS Sewer

More respondents would want to be connected but depending on the charge. A greater percentage of the low income group in the NCR, however, would not want to be connected to the MWSS sewer.

(2) Enterprise

The majority of the companies interviewed were not connected to the MWSS sewer system.

6.3.3 Environment

(1) Residents

a) Importance of Water Quality Conservation

A big majority across area and income group think that the water quality should be conserved. Only a very few portion are not sure or have no interest. A big portion of the respondents also believed that effluent aggravates public water bodies.

b) Environmental Charge

Although many responded that they are aware of the importance of conserving the environment, not many except in the high income group, would want to bear the environmental charges. Education of the people regarding promotion and participation in environmental aspects seems to be needed.

(2) Enterprise

Most of the respondents indicated that they are conscious of the importance of water quality conservation. In line with this and in compliance with government requirements, some of the enterprise respondents have installed treatment facilities for their wastewater.

The respondents are also aware of the government rules and regulations. The respondents find the rules appropriate. A certain caution should be effected in utilizing such comment in terms of credibility and lack of bias from the respondents. A high degree of hesitancy was shown by enterprise respondents in submitting their responses due to the nature of the questions. Nevertheless, the trending on their attitude towards government and its rules might be on the conservative side. Hence, allowance to pull downward most of the comments should be exercised.

Most of the respondents are willing to pay necessary costs and said their company spends for water pollution control. Budget allocated for pollution control expenses, however, are minimal. Only about 0.2 to 0.5 million are spent yearly by the respondent companies for pollution control. With the total annual sales ranging from 200 to 800 million pesos per year, the cost to treat water ranges from only 0.1 percent to 0.06 percent of the total annual sales.

Majority of the enterprises think that government should bear some of the cost of pollution control. Some, however, feel that government should subsidize or finance the whole cost. A few think that the private sector should be tapped for this.

7. PARTICULARS OF WATER DEMAND

Summary of Water Demand in case of with CWSP

Average Daily Water Demand	1994	1995	2000	2005	2010	2015
Revenue Water Amount						
Domestic Water	769,467	845,093	1,232,361	1,709,666	2,135,343	2,611,224
Commercial Water	306,000	308,200	349,400	384,900	396,900	409,400
Industrial Water	71,000	75,800	173,300	266,100	272,200	277,500
Sub-total	**1,146,467**	**1,229,093**	**1,755,061**	**2,360,666**	**2,804,443**	**3,298,124**
NRW Amount						
NRW	1,641,597	1,524,909	1,689,293	1,762,934	1,605,143	1,423,587
Public Faucet	22,890	23,610	24,420	24,480	24,510	23,580
Sub-total	**1,664,487**	**1,548,519**	**1,713,713**	**1,787,414**	**1,629,653**	**1,447,167**
Total	**2,810,954**	**2,777,612**	**3,468,774**	**4,148,081**	**4,434,096**	**4,745,291**

Summary of Water Demand in case of without CWSP

Average Daily Water Demand	1994	1995	2000	2005	2010	2015
Revenue Water Amount						
Domestic Water	769,467	839,096	1,176,253	1,560,540	2,065,037	2,611,224
Commercial Water	306,000	308,200	349,400	384,900	396,900	409,400
Industrial Water	71,000	75,800	173,300	266,100	272,200	277,500
Sub-total	**1,146,467**	**1,223,096**	**1,698,953**	**2,211,540**	**2,734,137**	**3,298,124**
NRW Amount (NRW + Public Faucet)						
	1,641,597	1,517,609	1,636,029	1,652,710	1,565,251	1,423,587
	22,890	23,610	24,420	24,480	24,510	23,580
Sub-total	**1,664,487**	**1,541,219**	**1,660,449**	**1,677,190**	**1,589,761**	**1,447,167**
Total	**2,810,954**	**2,764,315**	**3,359,402**	**3,888,730**	**4,323,898**	**4,745,291**

Water Demand by Use (1995-2015) without CWSP

City/Municipality	Domestic					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	166,291	174,938	206,139	236,337	265,388	294,036
Pasay	29,352	31,766	42,496	54,884	68,729	83,876
Quezon	185,734	198,467	254,496	314,016	382,289	457,586
Caloocan	59,197	65,322	94,027	127,648	165,465	206,576
Mandaluyong	27,353	29,013	34,697	40,981	47,394	53,988
Las Pinas	12,526	15,307	31,840	55,902	88,571	131,810
Makati	53,762	56,909	68,089	80,175	92,914	106,428
Malabon	22,679	24,536	32,851	42,249	52,558	63,807
Marikina	38,193	41,072	53,458	67,284	82,072	98,043
Muntinlupa	7,159	9,416	22,986	41,932	66,506	97,021
Navotas	16,428	17,814	24,072	31,283	39,465	48,362
Paranaque	26,314	31,115	57,411	85,833	97,100	108,425
Pasig	39,818	42,971	56,888	73,182	91,784	111,999
Pateros	3,302	3,434	5,034	6,950	9,260	11,926
San Juan	16,444	17,341	20,445	23,412	26,386	29,219
Taguig	6,131	8,376	23,137	45,722	76,465	116,394
Valenzuela	18,713	21,410	35,881	54,952	78,929	107,622
CAVITE						
Cavite City	7,697	8,022	9,913	12,020	14,393	17,007
Bacoor	4,201	5,295	11,810	21,451	34,683	52,062
Imus	962	1,498	4,924	9,946	16,770	25,830
Kawit	3,166	3,467	4,997	6,836	9,172	11,962
Noveleta	524	640	1,323	2,267	3,520	5,087
Rosario	675	930	2,486	4,684	7,642	11,570
RIZAL						
Angono	0	0	7,629	9,970	12,993	16,395
Antipolo	5,978	8,669	20,783	37,190	61,112	93,309
Baras	0	0	0	0	3,453	5,637
Binangonan	0	0	0	0	25,981	42,414
Cainta	4,020	5,627	12,715	22,379	36,345	55,099
Cardona	0	0	0	0	6,147	9,794
Jala-Jala	0	0	0	0	3,043	4,848
Morong	0	0	0	0	5,861	9,338
Pililla	0	0	0	0	6,112	9,737
Rodriguez	2,701	3,475	6,474	10,867	17,175	22,443
San Mateo	5,308	6,211	9,861	14,997	22,156	28,246
Tanay	0	0	0	0	10,904	17,372
Taytay	4,839	6,055	19,389	25,191	32,450	39,822
Teresa	0	0	0	0	3,850	6,134
Total	**769,467**	**839,096**	**1,176,253**	**1,550,540**	**2,065,037**	**2,611,224**

Public Faucet					
22,890	23,610	24,420	24,480	24,510	23,580
NRW of P/F					
32,134	28,740	23,182	18,094	13,907	10,106
Total Use of P/F					
55,024	52,350	47,602	42,574	38,417	33,686

Water Demand by Use (1995-2015) without CWSP (cont.)

City/Municipality	Commercial					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	116,915	117,271	121,127	122,455	123,609	124,645
Pasay	14,706	14,793	19,586	19,977	20,356	20,723
Quezon	76,754	77,159	79,114	95,300	97,389	99,578
Caloocan	10,146	10,336	13,083	14,006	14,908	15,774
Mandaluyong	9,965	10,022	10,271	11,594	11,804	12,000
Las Pinas	552	634	2,907	3,440	4,069	4,809
Makati	42,269	42,373	48,685	49,107	49,502	49,880
Malabon	2,852	2,918	4,223	4,507	4,775	5,030
Marikina	3,450	3,527	3,897	5,002	5,393	5,790
Muntinlupa	69	146	4,658	5,103	5,569	6,059
Navotas	1,809	1,855	2,385	2,608	2,834	3,057
Paranaque	5,964	6,043	8,892	9,326	9,798	10,309
Pasig	8,309	8,407	8,886	12,814	13,350	13,899
Pateros	50	62	113	162	210	258
San Juan	7,291	7,320	7,450	7,617	7,725	7,824
Taguig	321	392	773	3,116	3,642	4,229
Valenzuela	2,029	2,117	4,272	4,761	5,282	5,825
CAVITE						
Cavite City	646	667	2,496	2,583	2,669	2,754
Bacoor	238	280	853	1,110	1,401	1,725
Imus	58	82	521	650	788	943
Kawit	108	120	177	236	300	369
Noveleta	4	9	33	59	86	115
Rosario	32	43	271	328	390	458
RIZAL						
Angono	0	0	78	155	248	356
Antipolo	537	597	954	2,786	3,286	3,871
Baras	0	0	28	56	90	130
Binangonan	0	0	213	424	680	979
Cainta	399	435	2,229	2,473	2,769	3,115
Cardona	0	0	51	100	161	226
Jala-Jala	0	0	25	50	80	112
Morong	0	0	49	98	153	216
Pililla	0	0	50	100	160	225
Rodriguez	37	54	140	675	798	931
San Mateo	165	186	291	616	768	945
Tanay	0	0	90	178	285	401
Taytay	325	352	497	1,266	1,472	1,695
Teresa	0	0	32	62	101	143
Total	306,000	308,200	349,400	384,900	396,900	409,400

Water Demand by Use (1995-2015) without CWSP (cont.)

City/Municipality	Industry					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	13,292	13,292	16,185	16,185	16,185	16,185
Pasay	815	815	2,503	2,503	2,503	2,503
Quezon	16,089	16,086	16,074	31,636	31,628	31,624
Caloocan	8,302	8,302	10,635	10,635	10,635	10,635
Mandaluyong	7,002	7,002	7,002	9,576	9,576	9,576
Las Pinas	106	106	10,582	10,582	10,586	10,586
Makati	4,173	4,173	5,865	5,865	5,865	5,865
Malabon	5,370	5,370	12,653	12,653	12,653	12,653
Marikina	1,264	1,264	1,264	4,549	4,549	4,549
Muntinlupa	5	5	17,138	17,138	17,145	17,145
Navotas	1,815	1,815	2,685	2,685	2,685	2,685
Paranaque	1,506	1,506	10,352	10,352	10,352	10,352
Pasig	7,261	7,261	7,261	36,145	36,145	36,145
Pateros	3	3	881	881	881	881
San Juan	1,078	1,078	1,078	1,106	1,106	1,106
Taguig	8	8	8	19,815	19,815	19,815
Valenzuela	1,044	1,044	14,344	14,344	14,344	14,344
CAVITE						
Cavite City	55	65	83	97	109	120
Bacoor	2	156	447	677	872	1,042
Imus	5	423	1,479	2,106	2,636	3,097
Kawit	30	40	58	72	84	95
Noveleta	1	11	29	43	55	66
Rosario	1	1,331	6,529	8,524	10,213	11,681
RIZAL						
Angono	0	115	334	506	653	780
Antipolo	1,593	2,217	3,400	10,117	10,910	11,599
Baras	0	0	0	0	0	0
Binangonan	0	0	0	0	0	0
Cainta	40	1,082	21,136	22,699	24,022	25,173
Cardona	0	0	0	0	0	0
Jala-Jala	0	0	0	0	0	0
Morong	0	0	0	0	0	0
Pililla	0	0	0	0	0	0
Rodriguez	14	96	250	1,787	1,890	1,981
San Mateo	49	467	1,258	2,175	2,705	3,167
Tanay	0	0	0	0	0	0
Taytay	77	667	1,787	10,647	11,398	12,050
Teresa	0	0	0	0	0	0
Total	**71,000**	**75,800**	**173,300**	**266,100**	**272,200**	**277,500**

Water Demand by Use (1995-2015) without CWSP (cont.)

City/Municipality	Total Water Use (RW)					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	296,498	305,501	343,451	374,977	405,182	434,866
Pasay	44,873	47,374	64,585	77,364	91,588	107,102
Quezon	278,577	291,712	349,684	440,952	511,306	588,788
Caloocan	77,645	83,960	117,745	152,289	191,008	232,985
Mandaluyong	44,320	46,037	51,970	62,151	68,774	75,564
Las Pinas	13,184	16,047	45,329	69,924	103,226	147,205
Makati	100,204	103,455	122,639	135,147	148,281	162,173
Malabon	30,901	32,824	49,727	59,409	69,986	81,490
Marikina	42,907	45,863	58,619	76,835	92,014	108,382
Muntinlupa	7,233	9,567	44,782	64,173	89,220	120,225
Navotas	20,052	21,484	29,142	36,576	44,984	54,104
Paranaque	33,784	38,664	76,655	105,511	117,250	129,086
Pasig	55,388	58,639	73,035	122,141	141,279	162,043
Pateros	3,355	3,499	6,028	7,993	10,351	13,065
San Juan	24,813	25,739	28,973	32,135	35,217	38,149
Taguig	6,460	8,776	23,918	68,653	99,922	140,438
Valenzuela	21,786	24,571	54,497	74,057	98,555	127,791
	0	0	0	0	0	0
CAVITE	0	0	0	0	0	0
Cavite City	8,398	8,754	12,492	14,700	17,171	19,881
Bacoor	4,441	5,731	13,110	23,238	36,956	54,829
Imus	1,025	2,003	6,924	12,702	20,194	29,870
Kawit	3,304	3,627	5,232	7,144	9,556	12,426
Noveleta	529	660	1,385	2,369	3,661	5,268
Rosario	708	2,304	9,288	13,536	18,245	23,709
	0	0	0	0	0	0
RIZAL	0	0	0	0	0	0
Angono	0	115	8,041	10,631	13,894	17,533
Antipolo	8,108	11,483	25,137	50,093	75,308	108,779
Baras	0	0	28	56	3,543	5,767
Binangonan	0	0	213	424	26,661	43,393
Cainta	4,459	7,144	36,080	47,551	63,135	83,387
Cardona	0	0	51	100	6,308	10,020
Jala-Jala	0	0	25	50	3,123	4,960
Morong	0	0	49	98	6,014	9,554
Pililla	0	0	50	100	6,272	9,962
Rodriguez	2,752	3,625	6,864	13,329	19,863	25,355
San Mateo	5,522	6,864	11,410	17,788	25,629	32,358
Tanay	0	0	90	178	11,189	17,773
Taytay	5,241	7,074	21,673	37,104	45,320	53,567
Teresa	0	0	32	62	3,951	6,277
Total	1,169,357	1,246,706	1,723,373	2,236,020	2,758,647	3,321,704

Water Demand by Use (1995-2015) without CWSP (cont.)

City/Municipality	NRW					
	1994	1995	2000	2005	2010	2015
NCR	58.4	54.9	48.7	42.5	36.2	30
Manila	416,238	371,685	326,044	277,157	229,900	186,371
Pasay	62,995	57,668	61,312	57,182	51,967	45,901
Quezon	391,079	355,100	331,961	325,921	290,114	252,338
Caloocan	109,002	102,204	111,777	112,561	108,378	99,851
Mandaluyong	62,218	56,041	49,336	45,938	39,022	32,385
Las Pinas	18,508	19,534	43,032	51,683	58,570	63,088
Makati	140,671	125,935	116,423	99,891	84,134	69,503
Malabon	43,380	39,956	47,207	43,911	39,710	34,924
Marikina	60,235	55,829	55,648	56,791	52,209	46,449
Muntinlupa	10,154	11,646	42,513	47,433	50,623	51,525
Navotas	28,150	26,152	27,665	27,034	25,524	23,187
Paranaque	47,428	47,065	72,770	77,986	66,527	55,323
Pasig	77,756	71,381	69,333	90,278	80,161	69,447
Pateros	4,710	4,259	5,722	5,908	5,873	5,599
San Juan	34,834	31,332	27,505	23,752	19,982	16,350
Taguig	9,069	10,683	22,706	50,744	56,696	60,188
Valenzuela	30,584	29,910	51,735	54,738	55,920	54,768
	0	0	0	0	0	0
CAVITE	0	0	0	0	0	0
Cavite City	11,790	10,656	11,859	10,665	9,743	8,520
Bacoor	6,234	6,976	12,445	17,176	20,969	23,498
Imus	1,439	2,438	6,573	9,388	11,458	12,801
Kawit	4,638	4,415	4,967	5,280	5,422	5,325
Noveleta	743	803	1,315	1,751	2,077	2,258
Rosario	994	2,805	8,818	10,005	10,352	10,161
	0	0	0	0	0	0
RIZAL	0	0	0	0	0	0
Angono	0	140	7,633	7,858	7,883	7,514
Antipolo	11,382	13,978	23,863	37,025	42,730	46,620
Baras	0	0	27	41	2,010	2,472
Binangonan	0	0	202	313	15,127	18,597
Cainta	6,260	8,696	34,252	35,146	35,823	35,737
Cardona	0	0	48	74	3,579	4,294
Jala-Jala	0	0	24	37	1,772	2,126
Morong	0	0	47	72	3,412	4,095
Pililla	0	0	47	74	3,559	4,269
Rodriguez	3,863	4,413	6,516	9,852	11,270	10,866
San Mateo	7,752	8,356	10,832	13,148	14,542	13,868
Tanay	0	0	85	132	6,349	7,617
Taytay	7,358	8,611	20,574	27,425	25,714	22,957
Teresa	0	0	30	45	2,242	2,690
Total	1,641,597	1,517,609	1,636,029	1,652,710	1,565,251	1,423,587

Water Demand by Use (1995-2015) without CWSP (cont.)

City/Municipality	Total Water Demand					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	712,736	677,386	669,495	652,134	635,082	621,237
Pasay	107,868	105,042	125,897	134,546	143,555	153,003
Quezon	669,656	646,812	681,645	766,873	801,420	841,126
Caloocan	186,647	186,164	229,522	264,850	299,386	332,836
Mandaluyong	106,538	102,078	101,306	108,089	107,796	107,949
Las Pinas	31,692	35,581	68,361	121,607	161,796	210,293
Makati	240,875	229,390	239,062	235,038	232,415	231,676
Malabon	74,281	72,780	96,934	103,320	109,696	116,414
Marikina	103,142	101,692	114,267	133,626	144,223	154,831
Muntinlupa	17,387	21,213	87,295	111,606	139,843	171,750
Navotas	48,202	47,636	56,807	63,610	70,508	77,291
Paranaque	81,212	85,729	149,425	183,497	183,777	184,409
Pasig	133,144	130,020	142,368	212,419	221,440	231,490
Pateros	8,065	7,758	11,750	13,901	16,224	18,664
San Juan	59,647	57,071	56,478	55,887	55,199	54,499
Taguig	15,529	19,459	46,624	119,397	156,618	200,626
Valenzuela	52,370	54,481	106,232	128,795	154,475	182,559
	0	0	0	0	0	0
CAVITE	0	0	0	0	0	0
Cavite City	20,188	19,410	24,350	25,565	26,914	28,401
Bacoor	10,675	12,707	25,555	40,414	57,925	78,327
Imus	2,464	4,441	13,497	22,090	31,652	42,671
Kawit	7,942	8,042	10,198	12,424	14,978	17,751
Noveleta	1,272	1,463	2,699	4,120	5,738	7,526
Rosario	1,702	5,109	18,106	23,541	28,597	33,870
	0	0	0	0	0	0
RIZAL	0	0	0	0	0	0
Angono	0	255	15,674	18,489	21,777	25,047
Antipolo	19,490	25,451	49,060	87,118	118,038	155,399
Baras	0	0	55	97	5,553	8,239
Binangonan	0	0	415	737	41,788	61,990
Cainta	10,719	15,840	70,332	82,697	98,959	119,124
Cardona	0	0	99	174	9,887	14,314
Jala-Jala	0	0	49	87	4,895	7,086
Morong	0	0	96	170	9,426	13,649
Pililla	0	0	97	174	9,831	14,231
Rodriguez	6,615	8,038	13,381	23,181	31,133	36,221
San Mateo	13,274	15,220	22,242	30,936	40,171	46,226
Taney	0	0	175	310	17,538	25,390
Taytay	12,599	15,685	42,247	64,529	71,034	76,524
Teresa	0	0	62	107	6,193	8,967
Total	2,810,954	2,764,315	3,359,402	3,888,730	4,323,898	4,745,291

Domestic Water Demand

City/Municipality	Population Projection					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	1,632,740	1,667,970	1,707,538	1,725,542	1,726,405	1,719,511
Pasay	394,435	407,903	442,902	472,916	497,778	517,753
Quezon	1,827,511	1,900,283	2,140,573	2,340,286	2,548,595	2,748,266
Caloocan	852,595	891,038	999,796	1,068,787	1,157,987	1,208,045
Mandaluyong	260,432	267,980	277,905	287,911	294,888	299,935
Las Pinas	360,489	382,811	470,244	565,280	664,913	770,817
Makati	475,427	489,156	511,060	529,989	546,080	560,148
Malabon	297,968	307,660	330,621	348,865	362,505	373,140
Marikina	344,589	359,638	405,708	447,715	483,982	516,014
Muntinlupa	336,145	362,151	435,341	497,373	550,487	598,897
Navotas	206,793	215,447	240,447	262,494	282,502	298,533
Paranaque	351,510	371,264	430,808	488,481	545,941	602,363
Pasig	442,243	461,691	523,636	583,541	641,439	691,353
Pateros	56,177	54,299	57,352	60,278	63,353	66,256
San Juan	132,979	136,792	143,770	148,283	151,800	153,784
Taguig	315,249	334,190	410,321	493,485	571,252	646,634
Valenzuela	392,803	413,938	483,607	549,831	610,637	664,336
CAVITE						
Cavite City	95,990	96,793	102,235	107,450	112,931	118,105
Bacoor	186,141	198,558	238,872	279,798	320,860	361,544
Imus	105,140	110,611	128,224	145,409	161,723	179,375
Kawit	52,941	55,093	62,333	68,820	75,983	83,071
Noveleta	22,581	23,545	26,509	29,412	32,473	35,329
Rosario	50,337	52,509	59,409	65,915	72,775	80,350
RIZAL						
Angono	54,175	57,369	70,641	83,294	98,212	113,855
Antipolo	262,776	282,346	377,843	445,948	526,074	609,864
Baras	19,866	21,036	25,704	30,322	35,753	41,448
Binangonan	150,126	158,964	193,497	228,154	269,017	311,864
Cainta	157,438	168,940	222,793	263,078	310,647	360,125
Cardona	37,113	38,866	45,627	54,008	63,651	72,015
Jala-Jala	18,373	19,240	22,688	26,738	31,510	35,649
Morong	36,216	37,926	44,719	52,702	60,685	68,660
Pililla	36,898	38,640	45,561	53,695	63,282	71,593
Rodriguez	75,522	79,087	93,252	109,954	129,647	146,684
San Mateo	92,712	97,099	114,545	135,061	159,251	184,616
Tanay	65,766	68,872	81,207	95,751	112,901	127,737
Taytay	126,559	132,535	156,273	184,262	217,264	245,814
Teresa	23,245	24,343	28,702	33,827	39,866	45,105
Total	**10,350,000**	**10,786,583**	**12,152,463**	**13,384,655**	**14,595,049**	**15,728,593**

Domestic Water Demand (cont.)

City/Municipality	Unit Consumption Rate (lpcd)					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	116	119	134	150	165	180
Pasay	121	124	138	152	166	180
Quezon	128	131	144	158	171	185
Caloocan	132	135	149	162	176	190
Mandaluyong	135	138	154	169	185	200
Las Pinas	146	148	159	169	180	190
Makati	141	144	158	172	186	200
Malabon	131	134	148	162	176	190
Marikina	135	138	154	169	185	200
Muntinlupa	121	124	138	152	166	180
Navotas	120	123	137	151	166	180
Paranaque	190	190	193	195	198	200
Pasig	122	125	139	152	166	180
Pateros	143	146	159	173	186	200
San Juan	135	138	154	169	185	200
Taguig	143	146	159	173	186	200
Valenzuela	120	123	137	151	166	180
CAVITE						
Cavite City	104	107	120	133	147	160
Bacoor	104	107	120	133	147	160
Imus	104	107	120	133	147	160
Kawit	104	107	120	133	147	160
Noveleta	104	107	120	133	147	160
Rosario	104	107	120	133	147	160
RIZAL						
Angono	0	107	120	133	147	160
Antipolo	121	124	138	152	166	180
Baras	0	107	120	133	147	160
Binangonan	0	107	120	133	147	160
Cainta	121	124	138	152	166	180
Cardona	0	107	120	133	147	160
Jala-Jala	0	107	120	133	147	160
Morong	0	107	120	133	147	160
Pililla	0	107	120	133	147	160
Rodriguez	136	139	154	170	185	180
San Mateo	136	139	154	170	185	180
Tanay	0	107	120	133	147	160
Taytay	121	124	138	152	166	180
Teresa	0	107	120	133	147	160
Total						

Domestic Water Demand (cont.)

City/Municipality	Domestic Water Demand (mld) w/ CWSP					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	166,291	174,938	206,139	236,337	265,368	294,036
Pasay	29,352	31,766	42,496	54,884	68,729	83,876
Quezon	185,734	198,467	254,496	314,016	382,289	457,586
Caloocan	59,197	65,322	94,027	127,648	165,465	206,576
Mandaluyong	27,353	29,013	34,697	40,981	47,394	53,988
Las Pinas	12,526	16,694	46,679	86,003	107,431	131,810
Makati	53,762	56,909	68,089	80,175	92,914	106,428
Malabon	22,679	24,536	32,851	42,249	52,558	63,807
Marikina	38,193	41,072	53,458	67,284	82,072	98,043
Muntinlupa	7,159	10,851	36,069	67,998	82,219	97,021
Navotas	16,428	17,814	24,072	31,283	39,465	48,362
Paranaque	26,314	31,115	57,411	85,833	97,100	108,425
Pasig	39,818	42,971	56,888	73,182	91,784	111,999
Pateros	3,302	3,434	5,034	6,950	9,260	11,926
San Juan	16,444	17,341	20,445	23,412	26,386	29,219
Taguig	6,131	9,983	38,169	76,772	95,848	116,394
Valenzuela	18,713	21,410	35,881	54,952	78,929	107,622
CAVITE						
Cavite City	7,697	8,053	10,428	12,894	14,907	17,007
Bacoor	4,201	5,930	17,772	33,576	42,354	52,062
Imus	962	1,888	8,617	17,449	21,347	25,830
Kawit	3,166	3,526	5,685	8,258	10,030	11,962
Noveleta	524	703	1,972	3,529	4,286	5,087
Rosario	675	1,120	4,135	7,910	9,606	11,570
RIZAL						
Angono	0	0	7,629	9,970	12,993	16,395
Antipolo	5,978	8,669	20,783	37,190	61,112	93,309
Baras	0	0	0	1,871	3,453	5,637
Binangonan	0	0	0	14,080	25,981	42,414
Cainta	4,020	5,627	12,715	22,379	36,345	55,099
Cardona	0	0	0	3,333	6,147	9,794
Jala-Jala	0	0	0	1,650	3,043	4,648
Morong	0	0	0	3,252	5,861	9,338
Pililla	0	0	0	3,314	6,112	9,737
Rodriguez	2,701	3,475	6,474	10,867	17,175	22,443
San Mateo	5,308	6,211	9,861	14,997	22,156	28,246
Tanay	0	0	0	5,909	10,904	17,372
Taytay	4,839	6,055	19,389	25,191	32,450	39,822
Teresa	0	0	0	2,038	3,850	6,134
Total	**769,467**	**845,093**	**1,232,361**	**1,709,666**	**2,135,343**	**2,611,224**

Domestic Water Demand (cont.)

City/Municipality	Served Population					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	1,434,007	1,469,482	1,535,077	1,580,596	1,610,736	1,633,535
Pasay	242,402	256,571	308,260	361,308	414,151	465,978
Quezon	1,451,802	1,518,326	1,763,832	1,989,243	2,230,021	2,473,439
Caloocan	448,311	484,725	632,871	786,104	939,127	1,087,241
Mandaluyong	202,571	210,096	225,937	242,421	256,847	269,942
Las Pinas	85,879	114,078	294,373	508,752	598,422	693,735
Makati	381,472	395,727	431,335	466,390	499,663	532,141
Malabon	173,061	183,365	222,177	260,951	298,704	335,826
Marikina	282,765	297,421	348,097	398,019	444,779	490,213
Muntinlupa	59,283	87,641	261,640	447,636	495,438	539,007
Navotas	136,897	144,996	175,526	206,583	238,149	268,680
Paranaque	138,587	163,356	297,688	439,633	491,347	542,127
Pasig	326,198	344,421	410,531	480,254	552,279	622,218
Pateros	23,116	23,566	31,601	40,205	49,669	59,630
San Juan	121,831	125,575	133,131	138,496	142,996	146,095
Taguig	42,898	68,509	239,627	444,137	514,127	581,971
Valenzuela	155,910	174,268	261,631	362,888	476,297	597,902
CAVITE						
Cavite City	73,961	75,499	86,900	96,705	101,638	106,295
Bacoor	40,483	55,596	148,101	251,818	288,774	325,390
Imus	9,267	17,698	71,805	130,868	145,551	161,438
Kawit	30,455	33,056	47,373	61,938	68,385	74,764
Noveleta	5,046	6,593	16,436	26,471	29,226	31,796
Rosario	6,490	10,502	34,457	59,324	65,498	72,315
RIZAL						
Angono	0	0	63,577	74,965	88,391	102,470
Antipolo	49,325	70,022	150,759	244,825	368,252	518,384
Baras	0	0	0	14,069	23,490	35,231
Binangonan	0	0	0	105,863	176,744	265,084
Cainta	33,162	45,445	92,236	147,324	219,006	306,106
Cardona	0	0	0	25,060	41,819	61,213
Jala-Jala	0	0	0	12,406	20,702	30,302
Morong	0	0	0	24,454	39,870	58,361
Pililla	0	0	0	24,914	41,576	60,858
Rodriguez	19,849	24,991	41,963	64,103	92,957	124,681
San Mateo	39,032	44,666	63,916	88,465	119,916	156,924
Tanay	0	0	0	44,428	74,176	108,576
Taytay	39,941	48,905	140,646	165,836	195,538	221,233
Teresa	0	0	0	15,696	26,192	38,339
Total	**6,054,001**	**6,495,096**	**8,531,503**	**10,833,148**	**12,480,453**	**14,199,440**

Domestic Water Demand (cont.)

City/Municipality	House Connection Coverage (%)					
	1994	1995	2000	2005	2010	2015
NCR						
Manila	87.8	88.1	89.9	91.6	93.3	95.0
Pasay	61.5	62.9	69.6	76.4	83.2	90.0
Quezon	79.4	79.9	82.4	85.0	87.5	90.0
Caloocan	52.6	54.4	63.3	72.2	81.1	90.0
Mandaluyong	77.8	78.4	81.3	84.2	87.1	90.0
Las Pinas	23.8	29.8	62.6	90.0	90.0	90.0
Makati	80.2	80.9	84.4	88.0	91.5	95.0
Malabon	58.1	59.6	67.2	74.8	82.4	90.0
Marikina	82.1	82.7	85.8	88.9	91.9	95.0
Muntinlupa	17.6	24.2	60.1	90.0	90.0	90.0
Navotas	66.2	67.3	73.0	78.7	84.3	90.0
Paranaque	39.4	44.0	69.1	90.0	90.0	90.0
Pasig	73.8	74.6	78.4	82.3	86.1	90.0
Pateros	41.1	43.4	55.1	66.7	78.4	90.0
San Juan	91.6	91.8	92.6	93.4	94.2	95.0
Taguig	13.6	20.5	58.4	90.0	90.0	90.0
Valenzuela	39.7	42.1	54.1	66.0	78.0	90.0
CAVITE						
Cavite City	77.1	76.0	85.0	90.0	90.0	90.0
Bacoor	21.7	28.0	62.0	90.0	90.0	90.0
Imus	8.8	16.0	56.0	90.0	90.0	90.0
Kawit	57.5	60.0	76.0	90.0	90.0	90.0
Noveleta	22.3	28.0	62.0	90.0	90.0	90.0
Rosario	12.9	20.0	58.0	90.0	90.0	90.0
RIZAL						
Angono	0.0	0.0	90.0	90.0	90.0	90.0
Antipolo	18.8	24.8	39.9	54.9	70.0	85.0
Baras	0.0	0.0	0.0	46.4	65.7	85.0
Binangonan	0.0	0.0	0.0	46.4	65.7	85.0
Cainta	21.1	26.9	41.4	56.0	70.5	85.0
Cardona	0.0	0.0	0.0	46.4	65.7	85.0
Jala-Jala	0.0	0.0	0.0	46.4	65.7	85.0
Morong	0.0	0.0	0.0	46.4	65.7	85.0
Pililla	0.0	0.0	0.0	46.4	65.7	85.0
Rodriguiez	26.3	31.6	45.0	58.3	71.7	85.0
San Mateo	42.1	46.0	55.8	65.5	75.3	85.0
Tanay	0.0	0.0	0.0	46.4	65.7	85.0
Taytay	31.6	36.9	90.0	90.0	90.0	90.0
Teresa	0.0	0.0	0.0	46.4	65.7	85.0
Total	58	60	70	81	86	90

Industrial Water Demand (m3/d)

City/Municipality	Conditions							Industrial Water Demand (m3/d)					
	1990(MWSS)		1990	Salinity	Conversion	Conversion	Ind. Land Use	1994	1995	2000	2005	2010	2015
	m3/year	m3/d	Private Well (m3/d)	Problems	2000(m3/d)	2005(m3/d)	(%)						
NCR	24,761,109	67,836	260,687										
Manila	4,760,534	13,043	5,786	Yes	2,892		0.0	13,292	13,292	16,185	16,185	16,185	16,185
Pasay	292,065	800	3,375	Yes	1,687		0.0	815	815	2,503	2,503	2,503	2,503
Quezon	5,762,759	15,788	32,368			16,562	0.0	16,089	16,086	16,074	31,636	31,628	31,624
Caloocan	2,973,311	8,146	4,665	Yes	2,332		0.0	8,302	8,302	10,635	10,635	10,635	10,635
Mandaluyong	2,508,080	6,871	5,353			2,574	0.0	7,002	7,002	7,002	9,576	9,576	9,576
Las Pinas	38,095	104	20,959	Yes	10,476		0.0	106	106	10,582	10,582	10,586	10,586
Makati	1,494,580	4,095	3,383	Yes	1,691		0.0	4,173	4,173	5,865	5,865	5,865	5,865
Malabon	1,923,024	5,269	14,565	Yes	7,280		0.0	5,370	5,370	12,653	12,653	12,653	12,653
Marikina	452,522	1,240	6,833			3,285	0.0	1,264	1,264	1,264	4,549	4,549	4,549
Muntinlupa	1,704	5	34,260	Yes	17,133		0.0	5	5	17,138	17,138	17,145	17,145
Navotas	650,139	1,781	1,739	Yes	870		0.0	1,815	1,815	2,685	2,685	2,685	2,685
Paranaque	539,614	1,478	17,691	Yes	8,843		0.0	1,506	1,506	10,352	10,352	10,352	10,352
Pasig	2,600,769	7,125	60,077			28,864	0.0	7,261	7,261	7,261	36,145	36,145	36,145
Pateros	1,135	3	1,756	Yes	878		0.0	3	3	881	881	881	881
San Juan	386,174	1,058	59			28	0.0	1,078	1,078	1,078	1,106	1,106	1,106
Taguig	2,771	8	41,198			19,807	0.0	8	8	8	19,815	19,815	19,815
Valenzuela	373,813	1,024	26,600	Yes	13,295		0.0	1,044	1,044	14,344	14,344	14,344	14,344
CAVITE	33,816	92	5,888										
Cavite City	19,886	54	0	Yes	0		0	55	65	83	97	109	120
Bacoor	585	2	0	Yes	0		3.2	2	156	447	677	872	1,042
Imus	1,779	5	530	Yes	265		8.7	5	423	1,479	2,106	2,636	3,097
Kawit	10,754	29	0	Yes	0		0.2	30	40	58	72	84	95
Noveleta	300	1	0	Yes	0		0.2	1	11	29	43	55	66
Rosario	514	1	5,358	Yes	2,678		27.7	1	1,331	6,529	8,524	10,213	11,681
RIZAL	635,331	1,740	66,329										
Angono	0	0	0				2.4	0	115	334	506	653	780
Antipolo	570,630	1,563	12,025			5,781	13.0	1,593	2,217	3,400	10,117	10,910	11,599
Baras	0	0	0				0.0	0	0	0	0	0	0
Binangonan	0	0	0				0.0	0	0	0	0	0	0
Cainta	14,206	39	36,173	Yes	18,080		21.7	40	1,082	21,136	22,699	24,022	25,173
Cardona	0	0	0				0.0	0	0	0	0	0	0
Jala-Jala	0	0	0				0.0	0	0	0	0	0	0
Morong	0	0	0				0.0	0	0	0	0	0	0
Pililla	0	0	0				0.0	0	0	0	0	0	0
Rodrigues	5,022	14	2,941			1,414	1.7	14	96	250	1,787	1,890	1,981
San Mateo	17,650	48	604			290	8.7	49	467	1,258	2,175	2,705	3,167
Tanay	0	0	0				0.0	0	0	0	0	0	0
Taytay	27,623	76	16,586			7,975	12.3	77	667	1,787	10,647	11,398	12,050
Teresa	0	0	0				0.0	0	0	0	0	0	0
Total	25,430,258	69,670	354,904	N/A	88,400	85,600	100.0	71,000	75,800	173,300	266,100	272,200	277,500

Commercial Water Use

City/Municipality	Population Projection						Condition					Commercial Water Demand (m3/d)					
	1990	1995	2000	2005	2010	2015	1990(MWSS) m3/year	1990(MWSS) m3/d	1990 Private Well(m3/d)	Salinity Problem	Connection 2000 (m3/d)	Connection 2005 (m3/d)	1990	1995	2000	2005	2010	2015
NCR																		
Manila	1,632,740	1,667,970	1,707,536	1,725,542	1,726,405	1,719,511	42,067,707	116,040	4,665	Yes	2,329		116,815	117,271	121,127	122,455	123,809	124,845
Pasay	384,439	407,903	442,802	472,916	497,779	517,753	5,327,980	14,597	8,725	Yes	4,361		14,706	14,793	18,586	19,977	20,358	20,725
Quezon	1,027,511	1,903,283	2,140,573	2,340,266	2,548,585	2,746,296	27,807,499	76,185	27,641			14,192	76,754	77,159	79,114	85,300	97,399	99,578
Caloocan	852,585	891,059	999,798	1,088,767	1,197,987	1,308,045	9,875,980	10,071	3,674	Yes	1,834		10,146	10,336	13,083	14,008	14,808	15,794
Valenzuela	780,477	797,980	877,905	967,911	784,988	799,956	5,610,376	9,891	2,179			1,085	9,955	10,072	10,271	11,284	11,804	12,090
Las Piñas	399,469	382,911	470,244	595,260	664,913	770,817	190,821	547	3,878	Yes	1,836		952	654	2,907	3,440	4,088	4,909
Muntinlupa	475,427	489,156	511,080	529,889	548,080	560,146	15,513,715	41,896	11,721	Yes	5,857		42,289	42,373	46,845	49,107	49,502	49,880
Makati	397,999	507,980	330,821	348,895	362,505	373,140	1,053,252	2,851	2,016	Yes	1,008		2,852	2,918	4,225	4,507	4,775	5,090
Marikina	344,569	359,836	405,708	447,715	485,982	516,014	1,240,818	3,424	1,400			719	3,450	3,527	3,897	5,002	5,365	5,760
Mandaluyong	336,145	362,151	439,941	497,375	550,487	588,897	25,081	69	8,250	Yes	4,109		46	146	4,058	5,125	5,569	6,059
Navotas	209,793	216,447	240,447	262,498	282,502	298,533	665,258	1,796	621	Yes	311		1,809	1,855	2,385	2,806	2,804	3,057
Pateros	351,510	371,284	430,809	486,491	545,941	602,365	2,160,858	5,820	4,914	Yes	2,453		5,984	6,045	8,662	9,328	9,708	10,309
Pasig	442,243	481,861	529,836	583,541	641,439	691,853	3,010,142	8,247	6,858			3,419	8,309	8,407	8,986	12,614	13,350	13,899
Pateros	58,177	64,299	57,362	60,278	63,259	66,256	17,548	48	0	Yes	0		50	62	115	162	210	258
San Juan	112,979	136,782	143,770	148,283	151,800	153,794	2,841,478	7,257	97			50	7,291	7,320	7,450	7,817	7,725	7,824
Taguig	315,240	334,190	410,321	483,485	571,252	646,634	116,282	319	3,665			1,677	921	992	775	3,116	5,842	6,229
Valenzuela	392,803	415,838	483,807	549,831	610,857	664,538	734,929	2,014	3,429	Yes	1,709		2,029	2,117	4,272	4,761	5,262	5,875
CAVITE																		
Cavite City	95,980	98,793	102,295	107,450	112,851	118,105	234,181	642	3,480	Yes	1,737		646	687	2,496	2,585	2,899	2,734
Bacoor	186,161	198,558	236,872	278,798	320,880	361,344	80,403	237	705	Yes	351		256	280	855	1,110	1,401	1,725
Imus	105,140	110,811	126,234	145,409	161,725	179,375	20,695	57	644	Yes	322		58	82	521	650	788	943
Kawit	52,991	56,093	62,333	69,820	75,983	83,071	36,294	100	0	Yes			108	120	177	236	300	369
Noveleta	22,581	23,845	26,509	29,412	32,473	35,529	1,582	4	0	Yes			4	9	33	58	85	115
Rosario	50,337	52,509	58,409	65,915	72,775	80,360	11,744	32	348	Yes	174		32	43	271	328	395	456
RIZAL																		
Angono	54,175	57,369	70,641	83,704	98,212	113,855	0	0	0			1,419	0	0	78	156	246	339
Antipolo	292,778	282,340	377,943	445,048	529,074	609,894	184,564	533	2,783				537	587	954	2,788	3,298	3,871
Baras	19,886	21,088	25,706	30,322	35,753	41,448	0	0	0				0	0	26	58	80	130
Binangonan	180,126	158,894	193,497	228,154	269,017	311,894	0	0	0				0	0	215	424	680	979
Cardo	157,439	166,940	222,795	263,078	310,847	360,375	144,691	399	3,173	Yes	1,586		399	435	2,229	2,475	2,799	3,115
Cainta	37,113	39,996	45,827	54,008	63,691	72,975	0	0	0				0	0	51	100	161	226
Jala-Jala	18,373	19,240	22,889	26,738	31,516	35,849	0	0	0				0	0	25	50	80	112
Morong	35,218	37,926	44,710	52,702	60,995	69,860	0	0	0				0	0	49	98	153	215
Pililla	36,899	38,640	45,561	53,805	63,282	71,589	0	0	0				0	0	50	100	160	226
Rodriguez	75,522	79,067	93,252	109,954	129,647	146,684	13,365	37	944			433	37	54	140	575	708	991
San Mateo	92,712	97,099	114,545	135,061	159,251	184,818	59,772	164	580			200	165	186	291	616	758	995
Taytay	85,760	89,872	81,207	95,751	112,901	127,737	0	0	0				0	0	90	178	295	401
Teytay	129,569	132,535	156,273	184,262	217,264	245,814	117,819	322	1,167			588	325	352	497	1,266	1,672	1,995
Tanay	23,245	24,343	28,702	33,837	39,895	45,105	0	0	0				0	0	32	67	101	143
Total	10,350,000	10,799,583	12,152,463	13,384,655	14,595,048	15,725,583	116,882,091	303,732	108,828		30,000	24,000	368,000	388,200	348,400	384,900	398,900	409,400

Part II Water Supply

Chapter 2. Master Plan

8. Capacity and Hydraulic Calculations

8.1 Planned Water Distribution Quantities

Table 8.1 below presents the planned water distribution quantity for each design year.

Table 8.1 Planned Water Distribution Quantities

Year	Average Daily Water Distribution (mld)
1994	2,811
2000	3,359
2005	3,889
2010	4,324
2015	4,745

Notes: Quantities include NRW
At 2015, coverage = 90% & NRW = 30%

8.2 Maximum and Peak Hour Demand Factors

The maximum day demand factor in the MWSS system is relatively low. The highest computed maximum day demand factor based on the records of the past 8 years is only 123 % (in 1992) and the average figure is 112%. These low demand factors can be mainly attributed to leakage which at present is still very high. These demand factors can be expected to be increased by the implementation of leakage repair and prevention work projects.

It is difficult to accurately forecast the future value of the maximum day demand factor which depends largely on the success of the leak repair projects. In this report, a good performance in the leak reduction effort is assumed and, thus, a higher maximum day demand factor equal to 125%, which is slightly higher than past figures, is adopted. Also used in this report is a peak hour demand factor equal to 175% of the average day demand, the same as in the Angat Water Supply Optimization Project (AWSOP).

Maximum Day Demand : 125% of Average Day Demand
Peak Hour Demand : 175% of Average Day Demand

8.3 Water Supply Distribution Blocks

The service area was subdivided into distribution blocks to facilitate the planning of the future water supply coverage. Considering geography, existing facilities and development projects, seven blocks were established and classified into distribution lineages as presented in Table 8.1.

Table 8.1 Classification of Distribution Blocks

Block No.	Distribution Lineage	Area
1	La Mesa reservoir	part of Quezon, part of Caloocan, Valenzuela
2	Bagbag reservoir	part of Quezon, Malabon, Navotas, part of Caloocan
3	Balara, Cubao, San Juan, Pasig pump stations	part of Quezon, part of San Juan, part of Pasig, part of Mandaluyong
4	Fort Bonifacio, Makati pump stations	part of Makati, part of Taguig
5	Mixing area of Bagbag reservoir and Balara treatment facility	part of Quezon, Manila, part of San Juan, part of Mandaluyong, part of Makati, part of Pasay, part of Paranaque, part of Las Pinas
6	Balara water treatment facility	part of Marikina, part of Pasig
7	Pantay reservoir	part of Marikina, part of Pasig, Pateros, part of Taguig, part of Pasay, part of Paranaque, part of Las Pinas, Muntinlupa, all of Rizal and Cavite.

Note: The Pantay lineage has higher water pressure than others, and hence, water supply coverage is limited only in areas east of Marikina River, the southern part of the NCR, Cavite and Rizal where pipes are or will be relatively new. In the future, after replacement of old pipe lines in the other parts of the system and when all the pipes can already bear high water pressures, reblocking the service area may be considered.

8.4 Cases for Investigation

(1) Block No. 5

Case 1: Existing reservoirs and pumps in this block are used in the future.

Case 2: Existing reservoirs and pumps are abandoned and all supply are by gravity.

(2) Block No. 7

Case 1: Dasmarinas TP is constructed.

Case 2: Dasmarinas TP is not constructed.

8.5 Reservoir Capacity Estimate

The required storage capacities of reservoirs in each distribution block were estimated in accordance with the design criteria adopted by MWSS:

> The reservoir capacity shall be 25% of the daily water demand,
> 20 % (or 80 % of reservoir capacity) is for regulation while
> 5 % (or 20% of reservoir capacity) is for emergency.

8.5.1 Block No. 1 Reservoirs

The projected water demand and the required reservoir capacity for Block No.1 are as follows:

Average Day Demand : 410 mld
Reqd. Storage Capacity : 103 mld

In the on-going AWSOP, however, the design and the site acquisition were already completed for the following Block No.1 reservoirs:

S.Heart	10 ml
Binuksuk	30 ml
La Mesa	50 ml
Total	90 ml

Considering that the total capacity of the above preplanned reservoirs which is almost equal to the required volume (90/103 = 87%), the above AWSOP reservoirs will be adopted in the masterplan without any modification.

8.5.2 Block Nos. 2 - 6 Reservoirs

The projected water demands and the required capacity of reservoirs for Block Nos. 2 through 6 are presented in Table 8.1.

Additional reservoirs are required in Block Nos. 5 and 6 in order to have enough storage capacity. However, due to land developments, there are no suitable sites for the additional reservoirs (particularly at the vicinity of Balara Treatment Plant). So, the plan is to expand Bagbag Reservoir (for the La Mesa Treatment Plant No. 1 lineage) and the construction of La Mesa Reservoir No. 2 in the Novaliches raw water reservoir (for the La Mesa Treatment Plant Nos. 2 & 3 lineage).

Table 8.1 Water Demand Projections and Reservoir Capacities

Block No.	Average Day Demand (mld)	Reqd. Storage Capacity (ml)	Exist. Storage Capacity (ml)		Reqd. Additional Storage Cap.(ml) Case 1	Case 2	Remarks	
2	689	172	219	(200)	-	-	excess 47 ml	(28ml)
3	529	132	249	(249)	-	-		
4	173	43	49	(49)	-	-		
5	1,210	303	133	(0)	170	303		
6	173	43	0	(0)	43	43		
Total					213	346	47 ml	(28ml)

Note: Figures in ( ) are values for Case 2 - Block Nos. 2 &5 reservoirs and pumps are not used.

The required capacities for additional reservoirs for Cases 1 and 2 are as follows:

Case 1 - Existing reservoirs in Block No. 5 to be used.

The required capacity of additional reservoirs for Block Nos. 5 & 6 is 213-47 = 166 ml. This additional capacity will be provided by the expansion of the Bagbag Reservoir and the construction of La Mesa Reservoir No. 2. The reason for the involvement of the two reservoirs is that water to be supplied to Block No. 5 will come not only from La Mesa Treatment Plant No.1, through the Bagbag Reservoir, but also from La Mesa Treatment Plant Nos. 2 & 3, through Balara.

The respective portions of the required additional storage capacity to be provided by the two reservoirs were estimated considering the filtration capacity of La Mesa Treatment Plant No. 1 and the combined capacities of La Mesa Treatment Plant Nos. 2 & 3. The breakdown of the 166 ml additional storage capacity is as follows:

Expansion of Bagbag Reservoir (La Mesa TP No.1 lineage)	36 ml
Construction of La Mesa Reservoir No. 2(La Mesa TP Nos.2 & No.3 lineage)	99 ml
Total	166 ml

Case 2 - Existing reservoirs in Block No. 5 will not be used.

The required additional capacity of reservoirs in Block Nos. 5 & 6 is 346 - 28 = 318 ml. This additional capacity is roughly equal to the required additional volume of reservoirs for the three La Mesa treatment plants as determined below.

For La Mesa TP No.1 (existing)

Max. supply cap.	=	1,500 mld
Ave. supply cap.	=	1,200 mld
Required reservoir cap.	=	300 ml
Existing reservoir cap.	=	200 ml
Reqd. additional res. cap.	=	100 ml

For La Mesa TP No.2 (existing)

Max. supply cap.	=	900 mld
Ave. supply cap. (for Block 1)	=	483 mld
(Required storage for Block 1 to be provided by already planned reservoirs)		
Max. supply cap. (for Blks 5&6)	=	417 mld
Ave supply cap.	=	334 mld
Required reservoir cap.	=	83 ml

For La Mesa TP No.3 (proposed)

Max. supply cap.	=	500 mld (max day)
Ave supply cap.	=	400 mld
Required reservoir capacity	=	100 ml +35 ml

Taking into account the storage requirements of the treatments plants as estimated above, the additional reservoir capacity for Block Nos. 5 & 6 will be provided as follows:

Expansion of Bagbag Reservoir (La Mesa TP No. 1 lineage)	100 ml
Construction of La Mesa Reservoir No. 2 (La Mesa TP Nos. 2 & 3 lineage)	83 + 135 ml
Total	318 ml

8.5.3 Block 7 Reservoirs

The Block 7 distribution lineage is presented as follows.

The Dasmarinas reservoir is planned to be constructed for both Cases 1 and 2 because of the great distance between Cogeo reservoir and Cavite province and because of the large quantity of water involved. The construction of the Dasmarinas Reservoir has the following advantages:

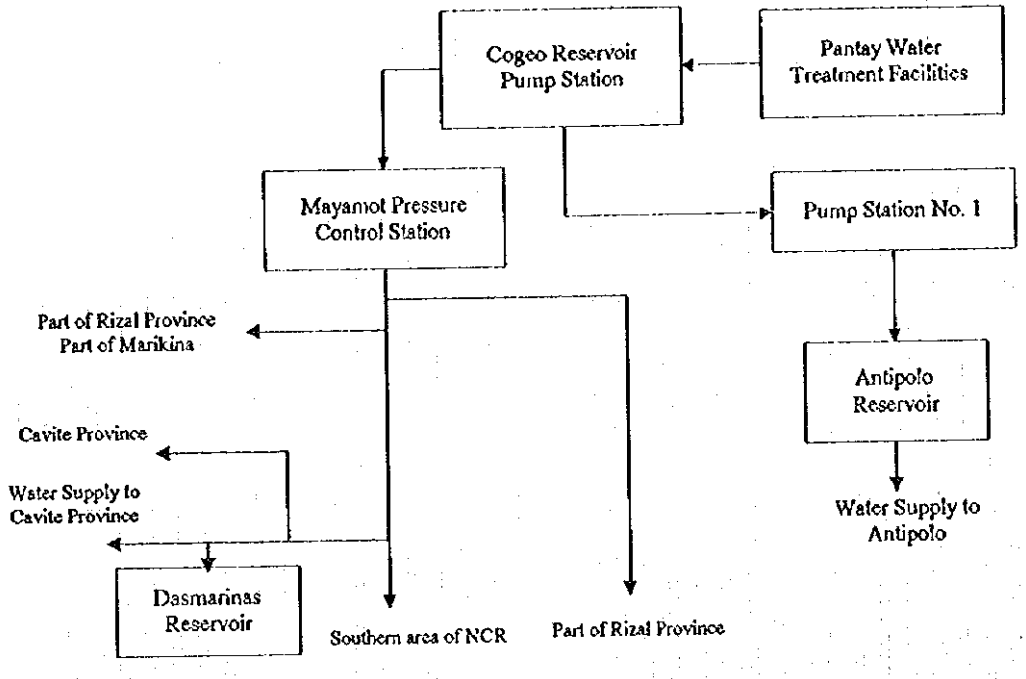


Figure 8.1 Block 7 Distribution Lineage

- Smaller diameter pipes will be required from Cogeo reservoir.
- More stable water supply can be provided with a reservoir placed near the water demand area.

The projected water demand and the required reservoir capacity for Block 7 are as follows:

Average Day Demand	:	1,560 mld
Reqd. Storage Capacity	:	390 ml

The proposed reservoirs for both Case 1 and Case 2 are the same. These reservoirs and their corresponding capacities are as follows:

Cogeo Reservoir	:	232.5 ml	(Case 1 is planned in CWSP water
Antipolo Reservoir	:	37.5 Ml	treatment facility , Case 2 is planned
Dasmarinas Reservoir	:	120 Ml	in the same place but only reservoir)
Total		390 Ml	

In Case 1, the CWSP treatment plant will be constructed and the Dasmarinas Reservoir will be constructed beside it. In Case 2, the CWSP treatment plant will not be constructed and Dasmarinas Reservoir will be located at the same place.

8.6 Antipolo Water Supply

8.6.1 Present Condition

Antipolo is located at the eastern side of the NCR and has an elevation of about 200 m. Because of its high elevation, MWSS is having difficulty in supplying it with water. In 1994, only about 49,000 or 18.8% of the population was served by MWSS from ground water sources.

The population of Antipolo has been increasing in the recent past years and is expected to have the same trend in the future. The population of 263,000 in 1994 is forecasted to increase to 610,000 by the year 2015. With the increasing population and developments, water demand will correspondingly increase. This correlation will be taken into consideration in the planning of the water supply system.

8.6.2 Water Supply System Concept

(1) Source

The economically favorable source of supply will become available after the construction of Pantay Treatment Plant and Cogeo Reservoir. The projected average day demand of 145 mld cannot be met using groundwater sources only. Supplying water from the MWSS central system will also not be feasible because the present central system lacks water and suffers from low pressures.

(2) Coverage

The served area will include Antipolo, part of Angono and part of Taytay.

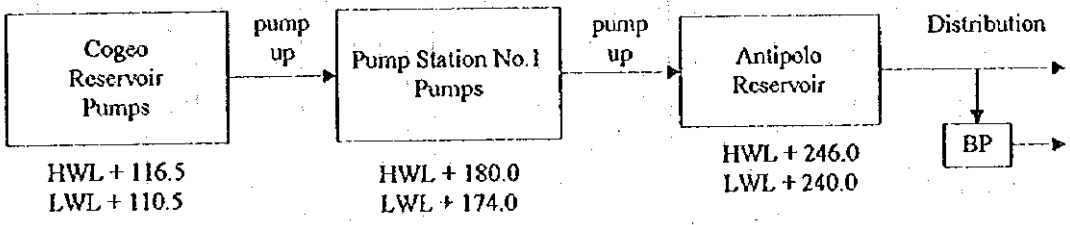
(3) Water Demand

The projected demand for the average day (including NRW) is 150.113 ml broken down as follows:

Antipolo	:	145.113 ml
part of Angono	:	2.500 ml
part of Taytay	:	2.500 ml
Total	:	150.113 ml

8.7 Proposed Facilities

From the proposed system layout presented below, water will be pumped from Cogeo Reservoir to Pump Station No.1 then pumped again to Antipolo Reservoir. From the Antipolo Reservoir, most of the water will be supplied by gravity, and the rest will be distributed using booster pumps.



8.7.1 Transmission Facilities

(1) Cogeo to Pump Station No.1

The quantity of water to be transmitted by pumping = 150,113 x 1.25
= approx. 190 mld
= approx. 132 m^3/min

With the estimated required pumpage, the planned transmission pumps will have the following characteristics:

Pump Type	: Centrifugal
Suction & Discharge Pipe Dia.	: 450 mm x 250 mm
Discharge Capacity	: 33 m^3/min
Delivery Head	: 80 m
Motor Capacity	: 710 kW
No. of Units (including 1 standby)	: 5

The description of the proposed transmission pipe line is as follows:

Length (from Cogeo to PS No.1)	: approximately 3 km
Pipe Diameter	: 1,200 mm
Velocity	: 1.95 m/s
Hydraulic Gradient	: 2.16 %

(2) Pump Station No.1 to Antipolo Reservoir

The required pumpage = 150,113 x 1.25 = approx. 190,000 m^3/day = approximately 132 m^3/min

Providing a capacity equal to one hour of the average day demand, the proposed pump well will have the following capacity and water levels:

Capacity	: 150,113/24 = approx. 6,000 m^3
Water Levels	: HWL+180.0, LWL+174.0

With the estimated required pumpage, the planned transmission pumps will have the following characteristics:

Pump Type	: Centrifugal
Suction & Discharge Pipe Dia.	: 450 mm x 250 mm
Discharge Capacity	: 33 m^3/min
Delivery Head	: 80 m
Motor Capacity	: 710 kW
No. of Units (including 1 standby)	: 5

The description of the proposed transmission pipe line is as follows:

Length (fr.PS No.1 to Antipolo R.)	: approximately 1.2 km
Pipe Diameter	: 1200 mm
Velocity	: 1.95 m/s
Hydraulic Gradient	: 2.16 %

8.7.2 Distribution Facilities

The quantity of water that will be distributed during peak demand hours

= 150,113 x 1.75
= approx. 263 mld
= approx. 183 m^3/min

Part of this distributed water will be supplied from the reservoir which will have a capacity equal to six hours of the average day demand . The reservoir capacity and water levels will be as follows:

Capacity	: 150,113/24 x 6 = approx. 37,500 m^3
Water Levels	: HWL+246.0, LWL+240.0

(1) Distribution (Booster) Pump Stations

There will be two distribution pump stations and their pump characteristics are as follows:

For Nayong Silangan Pump Station	Discharge Capacity:	7 m^3/min
	Delivery Head:	10 m
	Motor Capacity:	15 kW
	No. of Units (including 1 standby):	2
For Robina Farms Pump Station	Discharge Capacity:	11 m^3/min
	Delivery Head:	10 m
	Motor Capacity:	22 kW
	No. of Units (including 1 standby):	2

(2) Distribution Pipe Lines

A complete set of pipe lines will be provided.

8.8 Cavite Water Supply System (Provisional Design for reference only)

8.8.1 Source Facilities

The water source is Laguna de Bay and the source facilities will be composed of the existing NIA pump station in Putatan, Muntinlupa and the main irrigation channel leading to the Cavite area. These NIA irrigation facilities are not being used now because the farmers cannot pay the irrigation fee anymore. Part of the irrigation water in the NIA facilities (600,000 m^3/d) will be drawn to be used as water supply for the Cavite water supply system.

8.8.2 Intake Facilities

The intake facilities will be installed at the open channel as near as possible to the tunnel for the following reasons:

- Irrigation water is being polluted by garbage thrown from housing developments alongside the channel.
- Part of water intended for the system may be taken upstream of the intake facilities, for irrigation purposes.

The intake facilities will be set up near the crossing of the irrigation channel with the Molino National Road from where conveyance of water to the treatment plant will be easy.

The intake facilities will include a pump well with a capacity equal to ten minutes of the maximum day demand or 4,200 m^3 and the pumps in it will have the following characteristics:

Pump Type	: Centrifugal
Suction & Discharge Pipe Dia.	: 800 mm x 600 mm
Discharge Capacity	: 85 m^3/min
Delivery Head	: 35 m
Motor Capacity	: 760 kW
No. of Units (including 1 standby)	: 6

8.9 Conveyance Facilities

Raw water from the intake facilities will be pumped and conveyed to the treatment plant through a transmission line described as follows:

Length (from intake to treat. plant):	approximately 3 km
Pipe Diameter:	2,000 mm
Velocity:	2.21 m/s
Hydraulic Gradient:	1.51 %

8.9.1 Treatment Plant

The treatment plant will be set up alongside Molino National Road at a site about 3 km south of the intake facilities. The treatment plant site has an elevation of about 70 m and will be bounded at its north side by San Miguel Subdivision. The treatment plant capacity and type of treatment are as follows:

Treatment (Filtration) Capacity	: 600,000 m^3/day
Type of Treatment	: Chemical Sedimentation + Rapid Filtration

8.9.2 Distribution Facilities

(1) Reservoir

A reservoir with a capacity equal to 25 % of the average day demand will be installed beside the treatment plant. The capacity and water levels of this reservoir are as follows:

Capacity : 600,000/1.25 x 0.25 = 120,000 m^3
Water Levels : HWL+65 m, LWL+60 m

(2) Distribution Pipe Lines

A complete set of pipe lines will be provided.

8.10 Hydraulic Calculation

8.10.1 Evaluation of Existing Pipe Network

The bulk of the present water supply comes from a surface water source in the northern part of the study area, the Angat Dam. Ground water is supplied only in outlying areas of the NCR and parts of Cavite and Rizal provinces. The existing water supply system is shown in Figure 8.2.

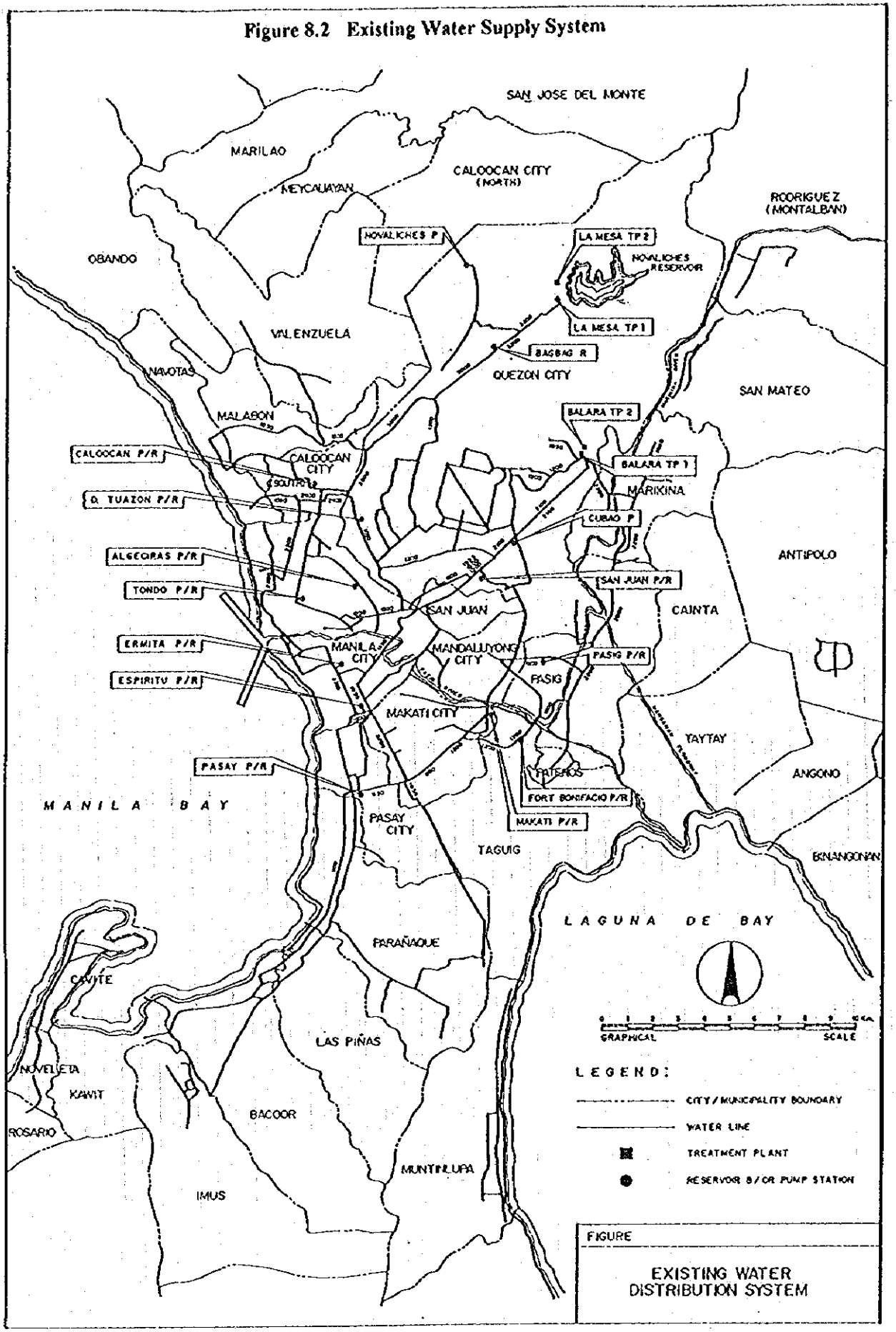
Balara TP Nos. 1 & 2 were the treatment facilities initially constructed. Because of increasing water demand, La Mesa TP No.1 was constructed next, followed by the recently completed La Mesa TP No. 2. Another treatment plant, La Mesa TP No. 3 is being planned.

The distribution system used to operate in such a way that, except in gravity supplied areas, water from the treatment plants are delivered first to the reservoirs then supplied to the service area by pumping.

After La Mesa TP No.1 and Bagbag Reservoir were constructed and put in service, the pressure in the supply area improved. It is because these facilities have higher elevations than the older Balara plants. With the increased system pressure, the operation of some pump stations ceased.

With the exception of Bacoor and Kawit which are connected to the CDS , water in the province of Cavite is inadequately supplied by pumping from groundwater sources. Supply coverage in

Figure 8.2 Existing Water Supply System



Cavite City is considered low at 77%. In the remaining areas, supply coverage is even lower. Kawit, although supplied from the CDS, has only a supply coverage of 58%.

In the province of Rizal, the towns of Rodriguez, San Mateo, Cainta, Taytay and Antipolo are also insufficiently supplied by pumping from ground water sources. Supply coverage rate is also low in all areas.

8.10.2 Evaluation of Existing Pipe Network

The existing pipe network of MWSS was evaluated by simulating its operation using the 1994 water consumption data.

(1) Background

There are 13 main pump stations in the pipe network service area. The operation of 8 of these pump stations are still on-going while the operation of the remaining 5 stations are either suspended or terminated. In the simulation process, the storage pumps of the operating pump stations are assumed to discharge according to their required discharge heads while the booster pumps are assumed to follow their respective Q-H characteristic curves in satisfying the water demand.

The established hydraulic boundaries (LWL) used in the simulation and the resulting HGL's at the pipe network reference points (treatment plants, reservoirs and pump stations) are presented in Table 8.3.

(2) Findings

Based on the results of the pipe network analysis, several areas were found to be suffering from below standard water pressures. Table 8.4 lists nodes representing areas with low water pressures.

Generally, water supply in the La Mesa Treatment Plant side of the system is comparatively good. Treated water from La Mesa is distributed by gravity with high pressure.

Comparatively, the water supply condition in the Balara Treatment `plant side of the system is not good. The service area is composed mostly of high places which are being served by pumps

with inadequate capacity to meet the increasing water demand. The service area also includes places like Manila, Makati and others where the distribution pipes are already very old with greatly reduced carrying capacities.

Table 8.3 Water Levels

Treatment Plants/Reservoirs/ Pump Stations		LWL	DISCHARGE TYPE OF PUMP	HGL	SUPPLY (Mld)
La Mesa Treatment Plant					
Balara Treatment Plant				58.3	
Bagbag Reservoir		65.00		65.0	
Caloocan	R/P	25.40	not in operation		0.0
D.Tuazon	R/P	20.20	not in operation		0.0
Algeciras	R/P	12.80	STORAGE PUMP	25.38	44.0
Tondo	R/P	12.83	not in operation		0.0
Balara	R/P	43.85	BOOSTER PUMP	74.57	171.4
Cubao	P	-	BOOSTER PUMP	68.81	158.8
San Juan	R/P	44.70	STORAGE PUMP	68.71	255.0
Pasig	R/P	40.29	STORAGE PUMP	63.81	147.0
Makati	R/P	23.70	not in operation		0.0
Fort Bonifacio	R/P	39.75	BOOSTER PUMP	43.97	173.9
Ermita	R/P	12.65	STORAGE PUMP	28.16	23.0
Espiritu	R/P	12.78	not in operation		0.0
Pasay	R/P	13.30	STORAGE PUMP	66.96	22.0
			BOOSTER PUMP	66.96	133.2

Table 8.4 Nodes With Insufficient Water Pressures

Node No.	Ground Level	Distribution Lineage	City/Muni -cipality	Remarks
56	12.0	Bagbag	Manila	Lack of pipe capacity, old pipe (Value of coefficient C is small)
176	26.0	Balara PS	Quezon	ditto
179	12.0	Bagbag	Manila	ditto
192	12.0	Bagbag	Manila	ditto
268	19.0	Fort Boni PS	Makati	Lack of pipe capacity, old pipe.
271	18.0	Fort Boni PS	Makati	There are some problem with distribution system. (Water pressure with pump pressurization is not effective)
273	14.0	Fort Boni PS	Makati	
277	13.0	Fort Boni PS	Makati	
278	16.0	Fort Boni PS	Makati	
509	80.0	Balara PS	Quezon	Ground level is higher than pump up capacity (pressure)
510	80.0	Balara PS	Quezon	
511	70.0	Balara PS	Quezon	
512	78.0	Balara PS	Quezon	
518	54.0	Balara PS	Quezon	Lack of pipe capacity
520	54.0	Balara PS	Quezon	ditto
521	52.0	Balara PS	Quezon	ditto
522	48.0	Cubao PS	Quezon	Lack of pipe capacity, old pipe
523	54.0	Balara PS	Quezon	ditto
526	46.0	Balara PS	Quezon	ditto
528	34.0	Balara PS	Quezon	ditto
529	34.0	Balara PS	Quezon	ditto
530	32.0	Balara PS	Quezon	ditto
531	40.0	Balara PS	Quezon	Lack of pipe capacity
532	40.0	Cubao PS	Quezon	Lack of pipe capacity, old pipe
538	67.0	Balara PS	Quezon	There are some problem with distribution system. (Water pressure with pump pressurization is not effective)
541	56.0	Balara PS	Quezon	Lack of pipe capacity
543	43.0	Balara PS	Quezon	ditto
544	48.0	Balara PS	Quezon	ditto
545	56.0	Balara PS	Quezon	ditto
546	60.0	Balara PS	Quezon	Lack of pipe capacity, old pipe

Table 8.4 Nodes With Insufficient Water Pressures (continued)

547	68.0	Balara PS	Quezon	There are some problem with distribution system. (Water pressure with pump pressurization is not effective)
552	50.0	Balara PS	Quezon	Lack of pipe capacity
553	50.0	Balara PS	Quezon	
601	54.0	Cubao PS	Quezon	
602	60.0	Cubao PS	Quezon	There are some problem with distribution system. (Water pressure with pump pressurization is not effective)
642	52.0	Cubao PS	Quezon	Lack of pipe capacity
806	36.0	Fort Boni PS	Makati	Lack of pipe capacity, old pipe
807	18.0	Fort Boni PS	Makati	There are some problem with distribution system. (Water pressure with pump pressurization is not effective)
808	18.0	Fort Boni PS	Makati	
809	22.0	Fort Boni PS	Makati	
811	32.0	Fort Boni PS	Makati	
840	40.0	Fort Boni PS	Taguig	The end of pipe and GL is high
842	40.0	Fort Boni PS	Taguig	

Part II Water Supply

Chapter 2. Master Plan

9. Implementation of Preventive Maintenance

9.1 Investigation of Existing Facilities for Preventive Maintenance

Preparation of preventive maintenance program should be started by investigation of the actual state of the existing facilities.

9.2 Selection of Important Facilities and Equipment for Preventive Maintenance List

The water supply facilities are listed below:

- Raw Water Intake Facilities (Intake tower, screens)
- Raw Water Transmission Facilities (Tunnels)
- Water Treatment Facilities (BTP1, BTP2, LPT1, LPT2)
- Treated Water Transmission Facilities (Primary mains)
- Reservoirs (San Juan, Bagbag)
- Pumping Stations
- Distribution System (Secondary and tertiary mains)

9.3 Implementation of Organization, Institution and Procedure

To proceed with a strict anf effective Preventive Maintenance, it is necessary to study the components of preventive maintenance listed below:

- Engineering
- Management
- Inspection
- Repair Work
- Rehabilitation/Improvement Work
- Design

From among these, the most important items are the inspection and repair work. These two items should be carefully be considered especially in the organization and institution of the preventive maintenance program.

To attain maximum efficiency with the minimum number of staff, the Division in charge of preventive maintenance must be necessarily staffed for the maintenance work.

The preventive maintenance should be carried out as scheduled. Engineers in charge will inspect the important facilities listed in the previous section, following the instructions in the Preventive Manual or Program. They will respond to the needs based on their judgment derived from the inspection.

Every engineer, depending on his expertise, shall submit to the Division Chief the preventive maintenance processing schedule indicating its priorities. The Division Chief will decide on the final schedule considering the budgetary requirements. The Division Chief shall allocate a reserved budget for emergencies and accidents.

9.3.1 Inspection System

Inspection is one of the important components of Preventive Maintenance.

The objectives of inspection are: to find out any defects or deterioration of the equipment/facilities; determine the degree of deterioration of individual portions/parts of the equipment/facilities; and to carry out appropriate and economical repair works.

Repair works should be done according to guidelines or manuals and based on the past repair records and experiences or with reference to similar equipment repair records.

"Inspection" is commonly classified into two categories, namely: parts condition check and functional test as shown in Table 9.1.

Usually, inspection is done by the following methods:

- Visual/Ocular Inspection
- Instrument tests
- Observation of each part of the equipment
- Examination of each equipment efficiency

Table 9.1 Classification of Inspection

Category	Methodology	Period	Type of Inspection
Parts Condition Check	Non-overhaul	Within one month	Daily Inspection
		More than one month	Periodic Inspection
	Overhaul	More than one month	
Functional Test	Non-overhaul	More than one month	Detailed Inspection
	Overhaul		

Inspection is performed according to inspection standards with the results recorded in an inspection list.

When an inspection of more than a month interval is to be carried out, the schedule should be prepared and made known to the inspector in advance. To carry out the inspection smoothly, the use of an inspection check card is recommended. It should be noted that unnecessary repetition of inspection results to a higher maintenance (inspection) cost and therefore should be avoided.

Whenever necessary, the inspection period should be revised to suit actual results.

9.3.2 Record Report System

(1) Various Records of Preventive Maintenance

Proper execution of preventive maintenance will require the following various records to be prepared and filed:

- Check list
- Inspection report card
- Preventive maintenance card

(2) Check List

A check list is to be used for daily and weekly check-up by operators to record operational conditions of equipment and facilities. Engineers in charge of preventive maintenance will refer to this on their monthly or yearly inspection.

(3) Inspection Record Card

An inspection record card will be filled up by the engineers in charge of preventive maintenance to serve as a basis for repair, replacement, and arrangement of instruments, equipment and buildings.

(4) Preventive Maintenance Card

On the Preventive Maintenance Card, columns should be provided to fill up the necessary information categorized as follows:

Function of value management items

- Asset number
- Date of procurement
- Procurement cost
- Installation cost
- Alteration cost
- Renovation cost

Function of technical management item

- Name of manufacturer
- Design specification
- Nominal capacity
- Drawing number
- Reference description
- Alternative specification

Function of repair cost management item

- Date of repair
- Repair chit number (small scale repair)
- Name of the work (large scale rehabilitation/improvement)
- Repair cost

(5) Reports on Preventive Maintenance

The report is important in confirming the achievement and effectiveness of the preventive maintenance. Such report will be useful in revising the preventive maintenance manual, evaluation on skills of each operator, and improving manpower training program and personnel administration.

The reports on preventive maintenance can be categorized as follows:

Report on Performance

- Monthly repair cost report
- Daily or weekly inspection report
- Important repair/improvement report

Report on Improvement

To prepare reports for improvement, it requires the reporter to collect detailed field reports which require considerable time and manpower. In this regard, these reports shall exclusively be prepared for the most important point of improvement and shall not be obliged to be prepared like a monthly report.

Chapter 2. Master Plan

10. Water Quality Control in Qualitative Abnormalities and Countermeasures

The results of water quality test are particularly important because water quality directly affects the health of the people in the community. This appendix is concerned with testing done on a daily basis, with emphasis placed on the countermeasures to be taken when water quality testing indicates abnormal system operation, and in particular to the countermeasures to be followed when there is an abnormal propagation of plankton. This problem may occur at either the new or existing treatment plant.

(1) Water Temperature

The temperature of raw water changes with the seasons and with the ambient air temperature. Compared to the raw water temperature, the temperature of water from the service taps fluctuates much less. Should water from the service taps show an abnormal fluctuation of temperature, the cause should be determined taking into account meteorological conditions. If necessary, effective measures must be taken with necessary installation provided to prevent such troubles.

(2) Color

The color of water is often confused with the color of suspended foreign substances causing turbidity. Supply water may have a reddish yellow color because of rust formation in water distribution and service piping or because of scales produced by iron-bacteria. Raw water may have a yellowish brown color that can be attributed to the decay products of organic compounds. Water is sometimes colored when mixed with industrial effluent, such as an accidental release from a pigment production plant or fabric dying plant. Should the supply water be colored, the cause could be found and an effort made to eliminate the source of pollution.

(3) Odor

Before distribution, supply water is disinfected by chlorination, with a residual level of chlorine remaining. It is therefore inevitable that supply water often smells, though slightly. The smell of residual chlorine is not regarded to be abnormal. Other odors are often ascribed to the foreign substances suspended or dissolved in raw water. The sources of other odors should be determined and countermeasures taken.

(4) Turbidity

Turbidity of treated water stems from various factors such as failure of water treatment facilities, failure to flush thoroughly distribution and service piping, corrosion of piping and other water supply facilities, and abnormal growth of bacteria and plankton. Should treated water be turbid, the causes should be determined. When the water treatment process is at fault, the facilities thereof must be improved as required, sometimes by changing the dosing rate of coagulant or the procedure of filtration operation. In case the turbidity is confirmed to have come from rust caused by corrosion of steel and galvanized steel pipe, the piping must be modified.

(5) pH

Generally, the pH of treated water does not fluctuate considerably. Abnormal change in the pH is often ascribable to accidental industrial releases into raw water, thick algae growths, inadequate dosing rates of various chemicals including chlorine, loss in normal serviceability of distribution and service piping. When treated water has an abnormally high pH, the cause should be determined and effective countermeasures taken to regulate the pH.

(6) Alkalinity

Normally, the alkalinity of water declines gradually during the rainy season and ascends gradually during the drought season. Therefore, should the alkalinity go up abruptly, there must be an underlying cause or abnormality which should be uncovered. Water treated by rapid sand filtration with the use of aluminum sulfate for coagulation shows a decrease of alkalinity proportional to the quantity of aluminum sulfate applied. Water from a service tap sometimes exhibits increased alkalinity when the distribution system is built with asbestos-cement pipes. Excluding the case with asbestos-cement piping, the alkalinity of tap water is approximately the

same as the water which has just been treated. Accordingly, should there be a remarkable change of alkalinity, there must be some trouble with the distribution or service piping. The cause should be isolated and a check made to see if supply water is being accidentally mixed with other water.

(7) Residual Chlorine

Chlorine dosing rate is variable, depending on the chlorine demand of the raw water. The quality standard of supply water prescribes that tap water have more than 0.1 ppm of free residual chlorine. It is therefore necessary to check from time to time whether the dosing rate satisfies the standard. Measuring the residual chlorine level is easy and it is therefore desirable to examine samples from as many service taps as practicable. If tap water does not contain the specified level of residual chlorine, the chlorine dosing rate may be inadequate, the flow of water at or near the chlorine dosing point may be irregular, or the service piping may have some trouble, or there may be some other abnormality which should be identified.

(8) Plankton

Algae and plankton growth may be abundant during warm seasons, sometimes giving rise to the trouble of clogging of sand filters. To prevent such trouble, it is necessary to perform daily checking of signs of excessive growths of algae or plankton. Should such a sign be detected, effective measures should be taken without delay to prevent an abnormal growth. Otherwise, large manpower and expenses may be required, and sometimes, normal water supply service may be interrupted. An abnormal growth of algae and plankton may sometimes subject even rapid sand filters to clogging, thereby decreasing the length of filtration and sometimes allowing fragments of the algae mass to flow through the filter and discolor the supply water.

Two methods have been proven to be effective with rapid sand filtration to prevent abnormal algae and plankton growth. They are proper maintenance of coagulation, flocculation, and sedimentation systems and frequent, direct removal of mass growths in the sedimentation basin. Sometimes insect larvae may pass through a rapid sand filter. Two remedies are available: one is pre-chlorination to kill the insects, and the other is increasing the frequency of cleaning the rapid sand filter to limit the propagation of insects in the filter.

11. IMPLEMENTATION SCHEDULE

1. Water Treatment Plant, Pipelines (La Mesa-Balara)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
La Mesa TP 1 Rehabilitation	1,320,000																					
Dist. Pipelines (La Mesa-Balara)	994,400																					

2. Block No. 1

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reservoir																						
S. Heart	34,824																					
Binuksuk	86,288																					
La Mesa	143,813																					
Pump Station																						
La Mesa P.S.	466,470																					
Sacred Heart Area Pump																						
Binuksuk Area Pump																						
Capitol Area Pump																						
Fairview Booster P.S.	50,723																					
Pipe																						
1,800 -300 mm L= 72,716 m	1,143,080																					

3. Block No. 2 and No. 5 (Case 1)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reservoir																						
Bag Bag (36 ML)	103,545																					
2nd La Mesa (130 ML)	328,556																					
Rehab of Existing P.S.																						
Algeciras R/P	35,161																					
Pasay R/P	18,179																					
Caloocan	14,013																					
D. Tuazon	8,415																					
Tondo	9,150																					
Espiritu	30,242																					
Ermita	2,187																					
Pipe																						
1,200-400 mm, L=20,540 m	321,047																					

4. Block No. 2 and No. 5 (Case 2)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reservoir																						
Bag Bag (100 ML)	287,625																					
2nd La Mesa (218 ML)	607,331																					
Pipe																						
2,200-400 mm, L=33,919 m	886,280																					

5. Block No. 3 (Common)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rehab of Pump Facilities																						
Balara R/P	56,236																					
San Juan R/P	183,525																					
Pasig R/P	157,751																					
Cubao P	197,072																					

6. Block No. 3 (Case 1)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pipe																						
1,200-300 mm, L=12,402 m	158,337																					

7. Block No. 3 (Case 2)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pipe																						
1,300-300 mm, L=16,033 m	251,839																					

8. Block No. 4

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rehab of Pump Facilities																						
Makati R/P	103,166																					
Fort Benefacio R/P	38,686																					
Pipe																						
1,350-300 mm, L=6,442 m	78,068																					

9. Block No. 7 (Common)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Kaliwa River																						
Land Acquisition	2,486,000																					
Laiban Dam	4,569,600																					
Raw Water Outlet Works	3,293,900																					
Headrace Hydropower (30 MW)	1,819,200																					
Treated Waterways	1,562,300																					
Power Lines	122,000																					
Treatment Plant Q=195 MLD	3,008,200																					
Pipeline	410,860																					
Pipeline	133,530																					
Cogeo Reservoir	372,000																					
Mayamot	513,200																					
Antipolo																						
Transmission Facilities																						
Cogeo P.S.	358,342																					
1st Lifting P.S.	392,192																					
Reservoir																						
Antipolo	159,540																					
Pump Station, Booster																						
Nayong Silangan P.S.	11,064																					
Robina Farm P.S.	11,253																					
Pipe																						
1,500-300 mm, L=18,950 m	212,088																					
Tanay Intake, Water Treatment Facilities, Transmission & Distribution Facilities	57,365																					

10. Block No. 7 (Case 1)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CWSP																						
Intake Facilities																						
Intake Q=60 MLD	542,796																					
Water Treatment Facilities																						
Dasmarinas TP Q=60 MLD	1,860,000																					
Reservoir																						
Dasamarinas	373,200																					
Pipe																						
2,400-300 mm, L=70,900 m	1,235,384																					

11. Block No. 7 (Case 1): Phese 2

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pipe																						
3,500-300 mm, L=171,0045 m	6,831,435																					

12. Block No. 7 (Case 2)

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reservoir																						
Dasmarinas	373,200																					
Pipe																						
3,500-300 mm, L=208,035 m	7,704,042																					

13. Common Items for All Blocks

Description	Construction Cost (Pesos)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<Small Pipe Installation>																						
50-250 mm, L=4.913 km	8,052,407																					
<Replacement of Dist. Pipelines>																						
L=2.054 km	6,223,620																					

12. COST ESTIMATES

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
1. Water Treatment Plant and Distribution Pipe from La Mesa to Balara								
1.1	Water Treatment Facilities							
	La Mesa No. 1 Plant	500 mld	L.S.			1,320,000		including resettlement, overhead
	Sub-total						1,320,000	Rehabilitation
1.2	Distribution Pipe	2800 mm	8,800	m	113,000	994,400		a portion of AWSOP
	Sub-total						994,400	including excavation, backfilling, reconstruction of pavement, and overhead
	Total for Item 1						2,314,400	
2. Block No. 1								
2.1	S. Heart Reservoir							
	Land acquisition							Already completed
	Construction works	RC	10,000	m3	2,143	21,430		including excavation and backfilling works
	Ancillary works		L.S.			6,429		30% of above cost including piping, fence, access road, etc.
	Overhead		L.S.			6,965		including access road
	Sub-total						34,824	
2.2	Binukusuk Reservoir							
	Land acquisition							Already completed
	Construction works	RC	30,000	m3	1,770	53,100		including excavation and backfilling works
	Ancillary works		L.S.			15,930		30% of above cost including piping, fence, access road, etc.
	Overhead		L.S.			17,258		including access road
	Sub-total						86,288	
2.3	La Mesa Reservoir							
	Land acquisition							Already completed
	Construction works	RC	50,000	m3	1,770	88,500		including excavation and backfilling works
	Ancillary works		L.S.			26,550		30% of direct cost including piping, fence, access road, etc.
	Overhead		L.S.			28,763		including access road
	Sub-total						143,813	
2.4	Distribution Pump Station							
	Land acquisition							Already completed

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	P.S. Construction works	RC	1,700	m2	38,700	65,790		including excavation and backfilling works
	Pump facilities							
	Sacred heart area	25mld, 71m, 315kw	5	units	1,805,000	9,025		with motors
	Binukusuk area	60mld, 29m, 315kw	8	units	8,110,000	64,880		ditto
	Capitol area	50mld,30m,275kw	3	units	7,236,000	21,708		ditto
	Ancillary works for pumps		L.S.			28,684		30% of pump facilities, including piping, valves, etc.
	Electrical works		L.S.			149,604		including receiving facility
	Test run		L.S.			13,695		5% of pump and electrical facilities
	Ancillary works		L.S.			35,339		10% of the above except for land acquisition expenses
	Overhead		L.S.			77,745		
	Sub-total						466,470	
2.5	Fairview Booster Pump Station							
	Land acquisition							Already completed
	P.S. Construction works	RC	220	m2	8,200	1,804		including excavation and backfilling works
	Pump facilities	13 mld x 30m x 75 kW	3	units	723,000	2,169		with motors
	Ancillary works for pumps		L.S.			651		30% of pump facilities, including piping, valves, etc.
	Electrical works		L.S.			32,058		including receiving facility
	Test run		L.S.			1,744		5% of pump and electrical facilities
	Ancillary works		L.S.			3,843		10% of the above except for land acquisition expenses
	Overhead		L.S.			8,454		
	Sub-total						50,723	
2.6	Piping Work							
	Distribution Pipes	1800 mm	11,143	m	29,858	332,708		including excavation, backfilling, reconstruction of
		1500 mm	2,200	m	25,751	56,652		pavement, and overhead
		1350 mm	5,068	m	23,176	117,456		
		1200 mm	2,880	m	20,974	60,405		
		900 mm	14,211	m	16,642	236,499		
		750 mm	5,989	m	12,642	75,713		
		600 mm	20,272	m	9,442	191,408		
		500 mm	2,149	m	8,157	17,529		
		450 mm	1,059	m	7,341	7,774		
		400 mm	3,998	m	6,677	26,695		

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
		300 mm	3,747	m	5,402	20,241		
	Sub-total		72,716	m			1,143,081	
	Total for item 2						1,925,199	
3. Block No. 2 and No. 5 (Case 1)								
3.1	Bag bag Reservoir							
	Land acquisition							Already completed
	Construction works	RC	36,000	m3	1,770	63,720		including excavation and backfilling works
	Ancillary works		L.S.			19,116		30% of direct cost including piping, fence, access road, etc.
	Overhead		L.S.			20,709		including access road
	Sub-total						103,545	
3.2	La Mesa Reservoir							
	Land acquisition							Already completed
	Construction works	RC	130,000	m3	1,770	230,100		including excavation and backfilling works
	Ancillary works		L.S.			87,615		30% of direct cost including piping, fence, access road, etc.
	Overhead		L.S.			65,711		including access road
	Sub-total						383,426	
3.3	Algeciras R/P							
	Rehabilitation works		L.S.			35,161		all including (see details)
	Sub-total						35,161	
3.4	Pasay R/P							
	Rehabilitation works		L.S.			18,179		all including (see details)
	Sub-total						18,179	
3.5	Caloocan R/P							
	Rehabilitation works		L.S.			14,013		all including (see details)
	Sub-total						14,013	
3.6	D. Tuazon R/P							
	Rehabilitation works		L.S.			8,415		all including (see details)

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	Sub-total						8,415	
3.7	Tondo R/P							
	Rehabilitation works		L.S.			9,150		all including (see details)
	Sub-total						9,150	
3.8	Espiritu R/P							
	Rehabilitation works		L.S.			30,242		all including (see details)
	Sub-total						30,242	
3.9	Ermita R/P							
	Rehabilitation works		L.S.			2,187		all including (see details)
	Sub-total						2,187	
3.10	Piping works							
	Distribution pipe for block No. 2	1200 mm	576	m	20,974	12,081		
		750 mm	950	m	12,642	12,010		
	Sub-total		1,526	m			24,091	
	Distribution pipe for block No. 5	1200 mm	9,751	m	20,974	204,517		including excavation, backfilling, reconstruction of
		900 mm	176	m	16,642	2,929		pavement, and overhead
		750 mm	1,937	m	12,642	24,488		
		600 mm	6,250	m	9,442	59,013		
		400 mm	900	m	6,677	6,009		
	Sub-total		19,014	m			296,956	
	Total for Item 3						925,365	
4. Block No. 2 and No. 5 (Case 2)								
4.1	Bag bag Reservoir							
	Land acquisition							Already completed
	Construction works	RC	100,000	m3	1,770	177,000		including excavation and backfilling works
	Ancillary works		L.S.			53,100		30% of direct cost including piping, fence, access road, etc.
	Overhead		L.S.			57,525		including access road

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	Sub-total						287,625	
4.2	La Mesa Reservoir							
	Land acquisition							Already completed
	Construction works	RC	218,000	m3	1,770	385,860		including excavation and backfilling works
	Ancillary works		L.S.			161,955		30% of direct cost including piping, fence, access road, etc.
	Overhead		L.S.			121,466		including access road
	Sub-total						669,281	
4.3	Piping works							
	Distribution pipe for block No. 2	2000 mm	9390	m	33,176	311,523		including excavation, backfilling, reconstruction of
		1200 mm	576	m	20,974	12,081		pavement, and overhead
		1000 mm	1,200	m	18,048	21,658		
		750 mm	950	m	12,642	12,010		
	Sub-total		12,116	m			357,271	
	Distribution pipe for block No. 5	2200 mm	9,060	m	38770	351,256		including excavation, backfilling, reconstruction of
		1500 mm	2,580	m	25751	66,438		pavement, and overhead
		1200 mm	900	m	20,974	18,877		
		900 mm	176	m	16,642	2,929		
		750 mm	1,937	m	12,642	24,488		
		600 mm	6,250	m	9,442	59,013		
		400 mm	900	m	6,677	6,009		
	Sub-total		21,803	m			529,009	
	Total for Item 4						1,843,186	
5. Block No.3 (Common)								
5.1	Balara R/P							
	Rehabilitation works		L.S.			56,236		all including (see details)
	Sub-total						56,236	
5.2	San Juan R/P							
	Rehabilitation works		L.S.			183,525		all including (see details)

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	Sub-total						183,525	
5.3	Pasig R/P							
	Rehabilitation works		L.S.			157,751		all including (see details)
	Sub-total						157,751	
5.4	Cubao R/P							
	Rehabilitation works		L.S.			197,072		all including (see details)
	Sub-total						197,072	
	Total for Item 5						354,584	
6. Block No. 3 (Case 1)								
6.1	Piping works							
	Distribution pipe	1200 mm	2,627	m	20,974	55,099		including excavation, backfilling, reconstruction of
		900 mm	2,600	m	16,642	43,269		pavement, and overhead
		750 mm	890	m	12,642	11,251		
		600 mm	3,655	m	9,442	34,511		
		300 mm	2,630	m	5,402	14,207		
	Sub-total		12,402	m			158,337	
	Total for Item 6						158,337	
7. Block No. 3 (Case 2)								
7.1	Piping works							
	Distribution pipe	1500 mm	3,631	m	25,751	93,502		including excavation, backfilling, reconstruction of
		1200 mm	2,627	m	20,974	55,099		pavement, and overhead
		900 mm	2,600	m	16,642	43,269		
		750 mm	890	m	12,642	11,251		
		600 mm	3,655	m	9,442	34,511		
		300 mm	2,630	m	5,402	14,207		
	Sub-total		16,033				251,839	
	Total for Item 7						251,839	

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
8. Block No. 4								
8.1	Makati R/P							
	Rehabilitation works		L.S.			103,166		all including (see details)
	Sub-total						103,166	
8.2	Fort Bonifacio R/P							
	Rehabilitation works		L.S.			38,686		all including (see details)
	Sub-total						38,686	
8.3	Piping works							
	Distribution pipe for block No. 2	1350 mm	1,400	m	23,176	32,446		including excavation, backfilling, reconstruction of
		900 mm	29	m	16,642	483		pavement, and overhead
		750 mm	1,650	m	12,642	20,859		
		600 mm	1,513	m	9,442	14,286		
		300 mm	1,850	m	5,402	9,994		
	Sub-total		6,442	m			78,068	
	Total for Item 8						219,920	
9. Block No. 7 (Common)								
9.1	Headworks/Treatment Plant							Update the MWSP III data
	Land acquisition		L.S.			2,486,000		including resettlement
	Liban Dam	113 m height, rock fill	L.S.			4,569,600		
	Raw Water Outlet Works	Multi level intake	L.S.			3,293,900		including Tunnel No. 1
	Headrace, hydropower gen.	Max. 30 MW	L.S.			1,819,200		including Tunnel No. 2 and power generators
	Treated Waterways	Dia. 3.2 m, Length 6.9	L.S.			1,562,300		including Tunnel No. 3
	Power Lines	115 kv	L.S.			122,000		
	Treatment Plant	650 mld x 3 lines =1,950 mld	L.S.			3,008,200		
	Pipe Lines	Intake Dia. 3.2 m	4,000	m	102,715	410,860		
		Trans. Dia. 3.2 m	1,300	m	102,715	133,530		
	Cogeo Reservoir		232,500	m3	1,600	372,000		
	Sub-total						17,777,590	

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
9.2	Mayamoto Pressure Reduction Facilities							
	Land acquisition		15,000	m2	3,100	46,500		
	Pressure red. facilities	2,100 mld	L.S.			466,700		
	Sub-total						513,200	
9.3	For Antipolo Water Supply Fac. (Cogeo Pump Station)							
	Land acquisition							included with the Cogeo distribution tank
	P.S. Construction works	RC	1,000	m2	38,700	38,700		including excavation and backfilling works
	Pump facilities	45 mld x 80m x 710 K	5	units	11,398,000	56,990		with motors
	Ancillary works for pumps		L.S.			17,097		30% of pump facilities, including piping, valves, etc.
	Electrical works		L.S.			102,202		including receiving facility
	Test run		L.S.			8,814		5% of pump and electrical facilities
	Ancillary works		L.S.			22,380		10% of the above except for land acquisition expenses
	Overhead		L.S.			49,237		
	Transmission pipe	1200 mm	3,000	m	20,974	62,922		
	Sub-total						358,342	
9.4	For Antipolo Water Supply Fac. (1st booster P.S.)							
	Land acquisition		8,000	m2	2,200	17,600		
	P.S. Construction works	RC	6,000	m3	2,143	12,858		including excavation and backfilling works
	P.S. Building works	RC	1,000	m2	38,700	38,700		
	Pump facilities	47.5 mld x 80m x 710	5	units	11,398,000	56,990		with motors
	Ancillary works for pumps		L.S.			17,097		30% of the above item, including piping, fence, etc.
	Electrical works		L.S.			102,202		including receiving facility
	Test run		L.S.			8,814		5% of pump and electrical facilities
	Ancillary works		L.S.			35,238		10% of the above except for land acquisition expenses
	Overhead		L.S.			77,524		
	Transmission pipe	1200 mm	1,200	m	20,974	25,169		
	Sub-total						392,192	

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
9.5	For Antipolo Water Supply Fac. (Antipolo Reservoir)							
	Land acquisition		13,600	m2	3,800	51,680		
	Res. construction works	RC	37,500	m3	1,770	66,375		including excavation and backfilling works
	Ancillary works		L.S.			19,913		30% of the above item, including piping, fence, etc.
	Overhead		L.S.			21,572		including access road
	Sub-total						159,540	
9.6	For Antipolo Water Supply Fac. (Nayong Silangan P.S.)							
	Land acquisition		500	m2	3,800	1,900		
	P.S. Construction works	RC	170	m2	8,200	1,394		including excavation and backfilling works
	Pump facilities	10 mld x 10m x 15 KW	2	units	452,000	904		with motors
	Ancillary works for pumps		L.S.			271		30% of the pump facilities, including piping, fence, etc.
	Electrical works		L.S.			4,110		including receiving facility
	Test run		L.S.			264		5% of pump and electrical facilities
	Ancillary works		L.S.			694		10% of the above except for land acquisition expenses
	Overhead		L.S.			1,527		
	Sub-total						11,064	
9.7	For Antipolo Water Supply Fac. (Robina Farm Booster P.S.)							
	Land acquisition		500	m2	3,800	1,900		
	P.S. Construction works	RC	170	m2	8,200	1,394		including excavation and backfilling works
	Pump facilities	16 mld x 10m x 22 KW	2	units	504,000	1,008		with motors
	Ancillary works for pumps		L.S.			302		30% of the pump facilities, including piping, fence, etc.
	Electrical works		L.S.			4,110		including receiving facility
	Test run		L.S.			271		5% of pump and electrical facilities
	Ancillary works		L.S.			709		10% of the above except for land acquisition expenses
	Overhead		L.S.			1,559		
	Sub-total						11,253	
9.8	For Antipolo Water Supply Fac. (piping works)							

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	Distribution pipes	1500 mm	1,700	m	25,751	43,777		including excavation, backfilling, reconstruction of
		1000 mm	2,700	m	18,048	48,730		pavement, and overhead
		750 mm	2,950	m	12,642	37,294		
		600 mm	850	m	9,442	8,026		
		450 mm	8,350	m	7,341	61,297		
		300 mm	2,400	m	5,402	12,965		
	Sub-total		18,950	m			212,088	
9.9	For Tanay (mountainous areas)							
	Intake and treatment facilities		L.S.			57,365		
	Transmission and distribution facilities							
	Sub-total						57,365	
	Total for item 9						15,492,633	
10. Block No. 7 (Case 1) : Phase 1								
	CWSP portion							
10.1	Intake Facilities							
	Land acquisition		7,800	m2	1,800	14,040		
	P.S. Construction works	RC	4,200	m3	2,143	9,001		including excavation and backfilling works
	P.S. Building works	RC	1,300	m2	38,700	50,310		
	Pump facilities	122.4 mld x 35m x 760 kW	6	units	15,837,000	95,022		with motors
	Ancillary works for pumps		L.S.			28,507		30% of the above item, including piping, fence, etc.
	Electrical works		L.S.			110,970		including receiving facility
	Test run		L.S.			11,725		5% of pump and electrical facilities
	Ancillary works		L.S.			38,654		10% of the above except for land acquisition expenses
	Overhead		L.S.			85,039		
	Transmission pipe	2000 mm	3,000	m	33,176	99,528		
	Sub-total						542,796	
10.2	Water Treatment Facilities							

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
	Land acquisition		200,000	m2	1,800	360,000		
	Dasmarinas TP	600 mld	L.S.			1,500,000		all including
	Sub-total						1,860,000	
10.3	Dasmarinas Reservoir							
	Land acquisition		34,000	m2	1,800	61,200		
	Res. construction works	RC	120,000	m3	1,600	192,000		including excavation and backfilling works
	Ancillary works		L.S.			57,600		30% of the above item, including piping, fence, etc.
	Overhead		L.S.			62,400		including access road
	Sub-total						373,200	
10.4	Piping Works							
	Distribution pipes	2400 mm	4,000	m	40,045	160,180		
		2000 mm	5,800	m	33,176	192,421		
		1800 mm	2,500	m	29,858	74,645		
		1650 mm	3,400	m	27,370	93,058		
		1500 mm	4,660	m	25,751	120,000		
		1350 mm	3,400	m	23,176	78,798		
		1200 mm	1,250	m	20,974	26,218		
		1050 mm	7,650	m	18,752	143,453		
		900 mm	4,450	m	16,642	74,057		
		750 mm	2,680	m	12,642	33,881		
		600 mm	7,300	m	9,442	68,927		
		450 mm	21,210	m	7,341	155,703		
		300 mm	2,600	m	5,402	14,045		
	Sub-total		70,900	m			1,235,384	
	Total for Item 10						3,468,584	
11. Block No. 7 (Case 1) : Phase 2								
	Piping works							
	Distribution pipings	3500 mm	7,700	m	112,344	865,049		including excavation, backfilling, reconstruction of
		3000 mm	30,165	m	96,295	2,904,739		pavement, and overhead
		2800 mm	4,660	m	89,875	418,818		

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
		2600 mm	5,800	m	83,456	484,045		
		2200 mm	4,000	m	38,770	155,080		
		2000 mm	9,200	m	33,176	305,219		
		1800 mm	6,500	m	29,858	194,077		
		1500 mm	5,000	m	25,751	128,755		
		1200 mm	10,000	m	20,974	209,740		
		1050 mm	970	m	18,752	18,189		
		1000 mm	18,800	m	18,048	339,302		
		900 mm	14,190	m	16,642	236,150		
		750 mm	25,410	m	12,642	321,233		
		600 mm	19,950	m	9,442	188,368		
		450 mm	6,900	m	7,341	50,653		
		400 mm	1,800	m	6,677	12,019		
	Sub-total		171,045				6,831,435	
	Total for Item 11						6,831,435	
12. Block No. 7 (Case 2)								
12.1	Dasmarinas Reservoir							
	Land acquisition		34,000	m2	1,800	61,200		
	Res. construction works	RC	120,000	m3	1,600	192,000		including excavation and backfilling works
	Ancillary works		L.S.			57,600		30% of the above item, including piping, fence, etc.
	Overhead		L.S.			62,400		including access road
	Sub-total						373,200	
12.2	Piping Works							
	Distribution Pipes	3500 mm	7,700	m	112,344	865,049		including excavation, backfilling, reconstruction of
		3000 mm	44,625	m	96,295	4,297,164		pavement, and overhead
		2000 mm	9,200	m	33,176	305,219		
		1800 mm	9,000	m	29,858	268,722		
		1650 mm	3,400	m	27,370	93,058		
		1500 mm	5,000	m	25,751	128,755		
		1350 mm	3,400	m	23,176	78,798		
		1200 mm	11,250	m	20,974	235,958		

Item No.	Descriptions	Specifications	Q'ty	Unit	Unit Cost	Cost	Sub-total	Remarks
		1050 mm	8,620	m	18,752	161,642		
		1000 mm	21,260	m	18,048	383,700		
		900 mm	18,640	m	16,642	310,207		
		750 mm	7,260	m	12,642	91,781		
		600 mm	27,250	m	9,442	257,295		
		450 mm	27,330	m	7,341	200,630		
		400 mm	1,800	m	6,677	12,019		
		300 mm	2,600	m	5,402	14,045		
	Sub-total		208,335				7,704,042	
	Total for Item 12						8,077,242	
13. Common Items for All Blocks								
	Small Pipe Installation	less than 250 mm	4,913,000	m	1,639	8,052,407		
	Replacement of Pipes		2,054,000	m	3,030	6,223,620		
	Sub-total		6,967,000	m			14,276,027	
	Total for Item 13						14,276,027	