2.3.2 Pollution Control

(1) Water Quality Observation System

Water quality is regularly checked in only Metro Manila Region by DENR and LLDA. Under DENR, its regional offices and LLDA demarcates their jurisdiction as shown in Figure 5.1. From the point of sampling and analysis, LLDA is only in charge of Laguna Lake, and MMR main river and Manila Bay is monitored by DENR-EMB. Above-stated demarcation of region and role sometimes embarrasses people and enterprises, so some kind of merger or definite legislation is recommended in some reports.

During the period of 1972 to 1982 , the former NPCC (now DENR-EMB) established a monitoring program for some rivers and lakes The plan called for yearly and semestrial sampling of major rivers and monthly sampling of Metropolitan Manila river. After the reorganization, constricted budgets have constrained sampling to less frequent intervals on a few selected rivers nationwide. However some water quality management projects have built-in monitoring activities like Pasig River Rehabilitation Project and River Revival Program(Ilog Ko -Irog Ko Project). As to the Laguna Lake sampling has been done twice a month in the main point of the lake .

Manila Bay has been monitored regularly under the Manila Bay Monitoring Program specifically the influence of the MWSS outfalls as well as determining the degree and extent of pollution in the bay.

(2) Water Classification

According to the Revised Water Usage and Classification (DENR Administrative Order.No.34), water bodies are classified into 5 classes (i.e AA, A, B, C and D) for fresh surface water, and 4 classes for marine and estuarine waters (i.e SA, SB, SC and SD). The classes of water bodies with the corresponding beneficial usage is summarized in data report.

In Metro Manila, main rivers are classified as Class C except for that portion of Marikina river upstream of Sto.Rosario bridge which is classified as Class A. Laguna Lake is also classified as Class C

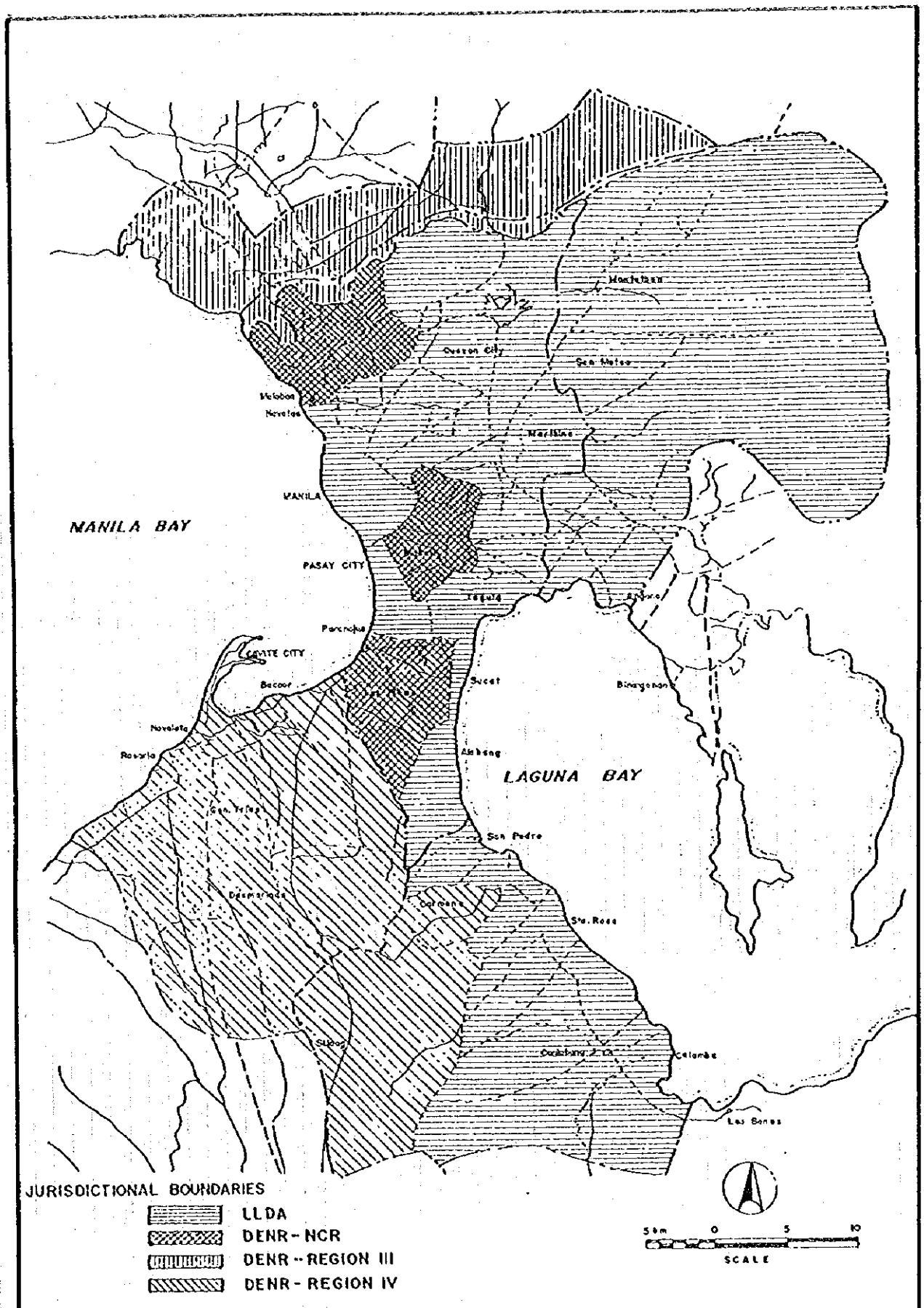


Figure 3.2.6 · Jurisdiction Boundary

(3) Water Quality Criteria

a. Criteria for Surface Water ,Sea Water and Ground Water

Water quality criteria was revised in DENR Administrative Order No.34(1990) as shown in data report.

b. Discharge Water Quality

Discharge water quality was also revised in DENR Administrative Order No.35(1990) as shown in data report. The criteria is adopted to all the industrial and public waste water including sewerage treatment plant discharge water.

c. Clay criteria

As to the water bottom sedimentation , criteria is shown in data report.

(4) Status of Water Quality

Besides Metro Manila ,Metro Cebu and Laguna de Bay coastal area reported to be heavily contaminated due to mainly insufficient sewerage system. Water environment condition in the MMR is as follows

<u>Metro Manila Rivers</u>

As of September 1994 , all of the river systems in Metro Manila are still considered biologically dead except for the upper stream of Marikina River. They are in this condition the whole year round except for the Pasig River which has a natural flushing capacity from the Laguna de Bay during the rainy season. Significantly, the status of these rivers are as follows:

- Pasig-Marikina-San Juan River System

  The main branch has a DO of about zero in the 1980's, which has improved to about 3 mg/l during 1990-1993. The BOD had been about 20 mg/L during 1980-1989 but improved to about 10 mg/L during the last four years. The Marikina branch has a similar trend during the past 14 years i.e., the DO has been about 4 mg/L and BOD approximately 10-15 mg/L. The San Juan river has a DO of below 1 mg/L during 1980-1989 and worsened during the period 1990-1993 to almost nil. The BOD likewise increased from 50 mg/L during the 1980-89 period to about 70 mg/L in 1990-93.

  Water quality data from the Pasig River seems to indicate that 20-30 mg/l BOD in the water column is a critical threshold, above which dissolved oxygen is depleted.

Sedimentation sample taken from various location in the Pasig River indicate minimal metal pollution. The fecal coliform levels are unacceptably high throughout the Pasig River system for contact recreation, especially in the dry season. The Pasig and San Juan Rivers are also public nuisances during the dry season because of their characteristic odor of undiluted sewage.

- Navotas-Malabon-Tullahan-Tenejeros River System

  This river system is one of the most polluted waters in Metro Manila due to indiscriminate dumping of domestic waste. It is heavily silted and is frequently in anaerobic condition, emitting very strong foul odor, especially during the dry season. The DO was between 1 and 2 mg/L during the 1980-1989 period and further dipped to almost nil during the 1990-1993 period. The BOD concentration ranged from 50-100 mg/L during the past 14 years. BOD level were lowest near the river mouth and highest in the middle reaches. The carrying capacity of the main river is so small that essentially raw sewage floods home and commercial areas in the low -lying areas around the river mouth when flooding occurs. The water-borne diseases in the area is reportedly high.

- Paranaque-Zapote River System

  The DO has been 2 mg/L while BOD about 40 mg/L for the period 1980-93. BOD level is high throughout the year and locationally lowest near the river mouth and highest in the upper reaches, and DO is almost absent from most of the river system.

Lakes

The Laguna de Bay's condition has been considered "hypereutrophic"(meaning it has high levels of nutrients that could trigger blooms of harmful algae). The eutrophication is caused as a result of increasing nutrient waste load from domestic households, expanded agricultural and livestock production, intensive fishpen operations, and soil erosion from denuded watersheds. The level of eutrophication is usually measured by the nitrogen and phosphorus level. It is reported that total inflow of nutrients to the lake today should be about 5,500 tons/year nitrogen and 1,200 tons/year phosphorus. The most effective three rivers are San Pedro River, San Cristobal River(West coast) and Morong River (North coast)

The laguna lake has become shallower and is now less than 3.0 m deep on average and consequently more turbid. High turbidity ranging from 58 to 84 mg/l sio_2 is mainly attributed to the strong wind condition and river inflow which stirs up the shallow lake.

During dry month, a flow reversal takes place in the Pasig River, with the result that saline and polluted water from the Manila Bay and enter the lake causing an increase in lake salinity and rendering the lake unsuitable for water supply and irrigation. However this backflow is welcomed by the fishery sector. This conflict is a difficult problem to adjust.

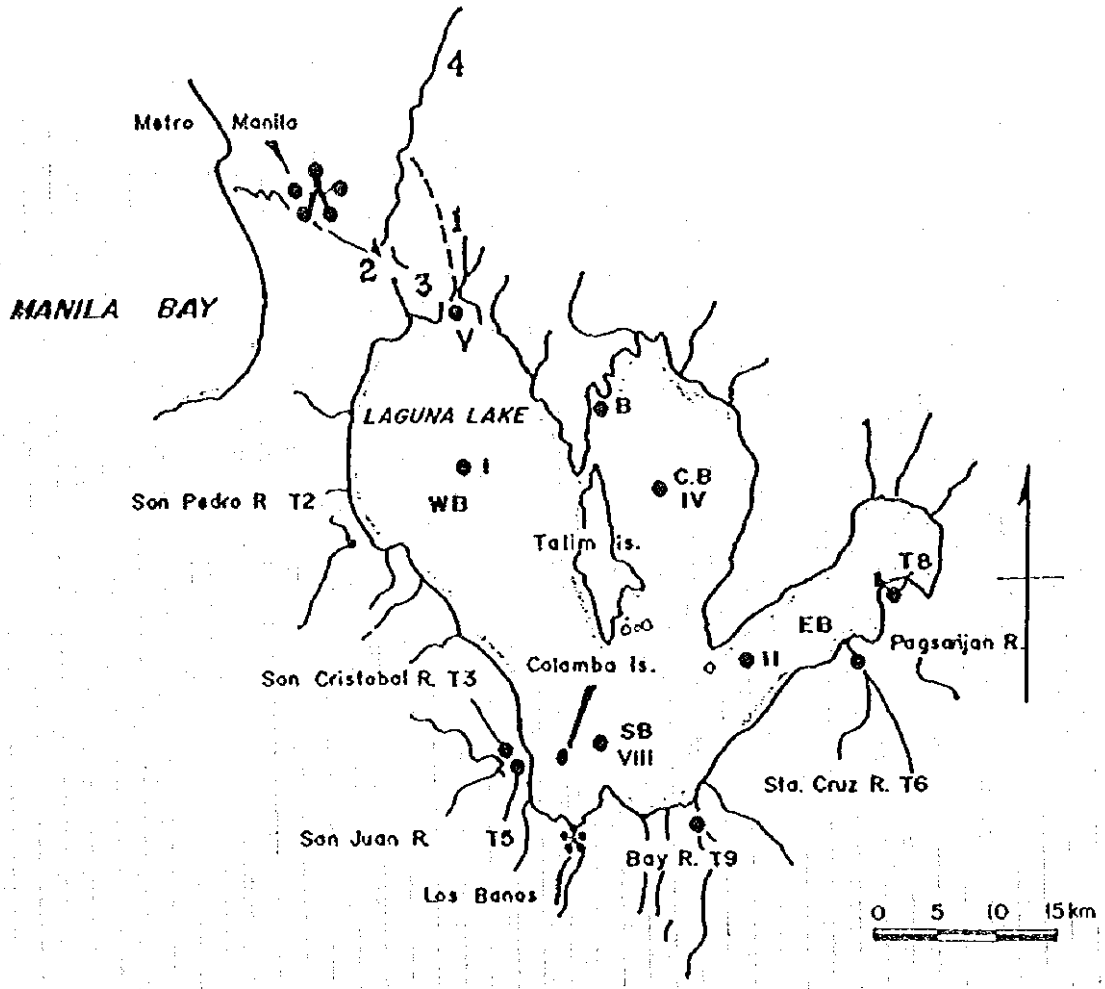
For drinking water, maximum permissible level of total chloride content should not exceed 250 mg / l but 1994 average concentration in all five points is above this threshold limit .

Table 3.2.13 Water quality of Laguna Lake (1994)

Parameters	stations				
	I	II	IV	V	VIII
pH	8.0	7.8	8.4	8.0	8.0
Temperature(c)	29.6	29.5	29.2	29.8	29.6
Nitrate (ug/l)	190	106	201	150	144
Inorganic Phosphate(ug/l)	76	60	90	88	65
Dissolved Oxygen (mg/l)	6.8	6.2	6.7	6.1	6.6
Total Dissolved Solids(mg/l)	790	609	841	796	719
Turbidity(mg/l sio^2)	72	58	56	84	66
Chloride (mg/l)	353	274	384	353	317

source : LLDA , 1994 * see Figure 3.2.7

Toxic and Hazardous substances (THS) means residual substances which can be dangerous to the living organism and human health ; principally heavy metals and agricultural pesticides. Of the THS measured in lake the most abundant THS discharge are Phenol, Methyl-alcohol and 2-4 Dimethyl-Phenol. The result of analysis of lake water in 1988 indicated that arsenic, lead, cadmium, chromium and mercury met the Class C standard. Result for sediment analysis show that only copper failed meeting the Clay standard. Other parameters like Nitrate, DO, pH, TDS is at present below the Class "C" level, while coliform exceeds the standards at the percentage of 6.



WB West Bay
CB Central Bay
EB East Bay
SB South Bay
● Sampling Station

1. Mangahan Floodway
2. Napindan Hydraulic Control Structure
3. Lake Outlet (through Napindan Channel and Pasig River)
4. Marikina River

SAMPLING STATIONS (LLDA) IN LAGUNA LAKE BASIN
(9 tributaries and 4 lake sites)

Figure 3.2.7 Sampling Point in Laguna Lake

Table 3.2.14 Heavy metals on Lake water (1988)

Parameters	stations				
	Class"c"standard	I	II	IV	VIII
Arsenic (As)	50	16	14	12	12
Lead (Pb)	50	8	4	11	7
Cadmium (Cd)	10	1.3	0.67	1.8	1.2
Chromium (Cr)	50	<1.0	2	<1.0	2
Nickel (Ni)		2	5	42	15
Mercury(Hg)	790	609	841	796	719

Source : LLDA

Table 3.2.15 Heavy metals on Lake sediments (1988)

Parameters	stations				
	Clay standard	I	II	IV	VIII
Lead (Pb)	20	15	15	15	15
Cadmium (Cd)		<0.1	<0.1	<0.1	<0.1
Chromium (Cr)	90	9.8	8.2	9.8	8.3
Copper (Cu)	45	120	102	107	110
Nickel (Ni)		14	14	17	12
Mercury (Hg)	0.4	0.089	0.085	0.074	0.082
Zinc (Zn)	95	85	84	86	92

Source : LLDA

Bays

The coastal waters of Manila Bay have some times shown dissolved oxygen(DO) levels below ambient criteria and high bacterial counts exceeding the DENR criteria for the waters used for primary contact recreation.

DO concentration ranging from a low of 1.9 mg/l at the bottom water to a high of 13.4 mg/l. The area immediately west of the Pasig River had DO levels of less than 5 mg/l in bottom water showing deposition of significant amount of oxygen-consuming organic materials.

As to the heavy metal in sediments , concentration of Mercury ranged from 0.19 to 0.87 ppm, Copper from 37 to 101 ppm, Zinc from 151 to 234 ppm, and Cadmium from 0.85 to 2.84 ppm for the period from November 1989 to February 1991. Except for the Zn, other metal concentration fail to pass the soil criteria. High concentration of heavy metal in the shellfish were also investigated in the Manila Bay Monitoring Program (II)

Coliform data collected in 1989-1991 showed further degradation by fecal coliform bacteria especially near the Tondo Pumping Station discharging point and mouth of Pasig River.

Groundwater

Groundwater levels have gone down by more than 100 meters due to over-extraction resulting to salinization of coastal aquifers and sinking of low lying areas(causing flooding). Groundwater potability is threatened by salinity and bacteria contamination from domestic sewage.

In Metro Manila only about half of surface waters met the ambient BOD and DO criteria. In other part of the country, the trend is almost the same expect that there are less rivers which can be considered grossly polluted (based on 1989-1993 data)

(5) Pollution Loading and inventory

For the whole country, about 10,660 tons of BOD are generated daily, 48% coming from industries, 29% from domestic wastewater, 16% from garbage, and, the rest from other sources. In the industrial sector, the livestock and poultry industry is the main generator in terms of BOD which accounts for about 90% and in terms of nitrogen-about 98%. In terms of suspended solids ,the mining industry tops the list of generators with a contribution of 98%. Mining industries both large scale and small scale also discharge toxic elements into the environment.

Regarding to MMR, pollution loading estimated by World Bank consultant showed that about 800 tons of BOD which is a measure of pollutional strength of organic matter are generated every day in Metro Manila in 1992. Of these load, 40% is from domestic wastewater, 38% from industrial source and 22% due to solid wastes, mostly garbage. For industrial sources, the top 3 contributors of organic pollution in Metro Manila accounting for about 90 % of the industrial loading are the food processing, piggery and beverage production industry. Assumption used for the estimation is as follows

- 599 pollutive firms generate 562.7 tons of BOD per day and discharge 303.5 tons with average reduction rate of 46.1 %
- Each person generates 0.55 kg of garbage per day . Collection rate is 75 %, and of the uncollected waste 30 % ends up in the river system. As to the composition of the solid waste, 65 % of the dry weight is organic in nature and 1.6 kg of BOD are generated for each kg of organic solid waste
- Each persons generates 35 kg of BOD per day as wastewater. 1.2 million persons are connected to the central system whose load have no effect on river system. 4.8 million

persons (equivalent to 600,000 septic tanks) have septic tanks which remove only 10 % of BOD due to the bad maintenance. Distribution to each catchment areas are shown in Table 3.2.16.

Table 3.2.16 BOD loads 199s by catchment basin (ton / day)

Catchment Basin	Industrial wastewater	Domestic Wastewater	Solid waste	Total
Meycauayan	104.2	37.5	20.9	162.6
NMTT	22.5	28.8	16	67.3
Pasig	126.9	137.4	76.4	340.7
Paranaque	3.6	23.6	13.1	40.3
Bacoor/Cavite	0	18.7	10.4	29.1
Cainta/Sucat	31.0	53.0	29.5	113.5
Muntinlupa/ San Pedro	15.3	18.7	10.4	44.4
Total	303.5	317.7	176.7	797.9

Source : IECP WB report (1992)

On the other hand, Pasig River Rehabilitation Project report has shown that the source of pollution into the Pasig River were identified as follows using another assumption.

Table 3.2.17 BOD load into Pasig River (1990)

Sources	BOD(tons/day)	Percent
Liquid Domestic Waste	148	45
Solid Domestic Waste	34	11
Industrial Waste	145	44
Total	327	100

Source : PRRP report.

The location of polluting industries is shown in Figure 3.2.8, which indicates high concentration along the NMTT river, Pasig-Marikina River and in the west coast of Laguna Lake. As to the Laguna Lake, it is estimated that domestic source (liquid and solid) account for 30% of the total pollution in the lake while 30 % comes from industrial source. The rest is attributed to the agricultural waste source. In the Lake basin, as of 1994, there are 1,481 industrial establishment mostly concentrated on the western shore. These are dominated by the chemical products, food processing and metal sectors.

About 32% are classified wet (wastewater discharging) industries. Of these wet firms, 69% have waste treatment facilities. According to the 1988 classification, of the 1,165 establishments, 11% were highly pollutive, 59% were pollutive. In the Laguna Lake basin agricultural pollution from fertilizer and pesticides or live stock waste occupies a large portion.

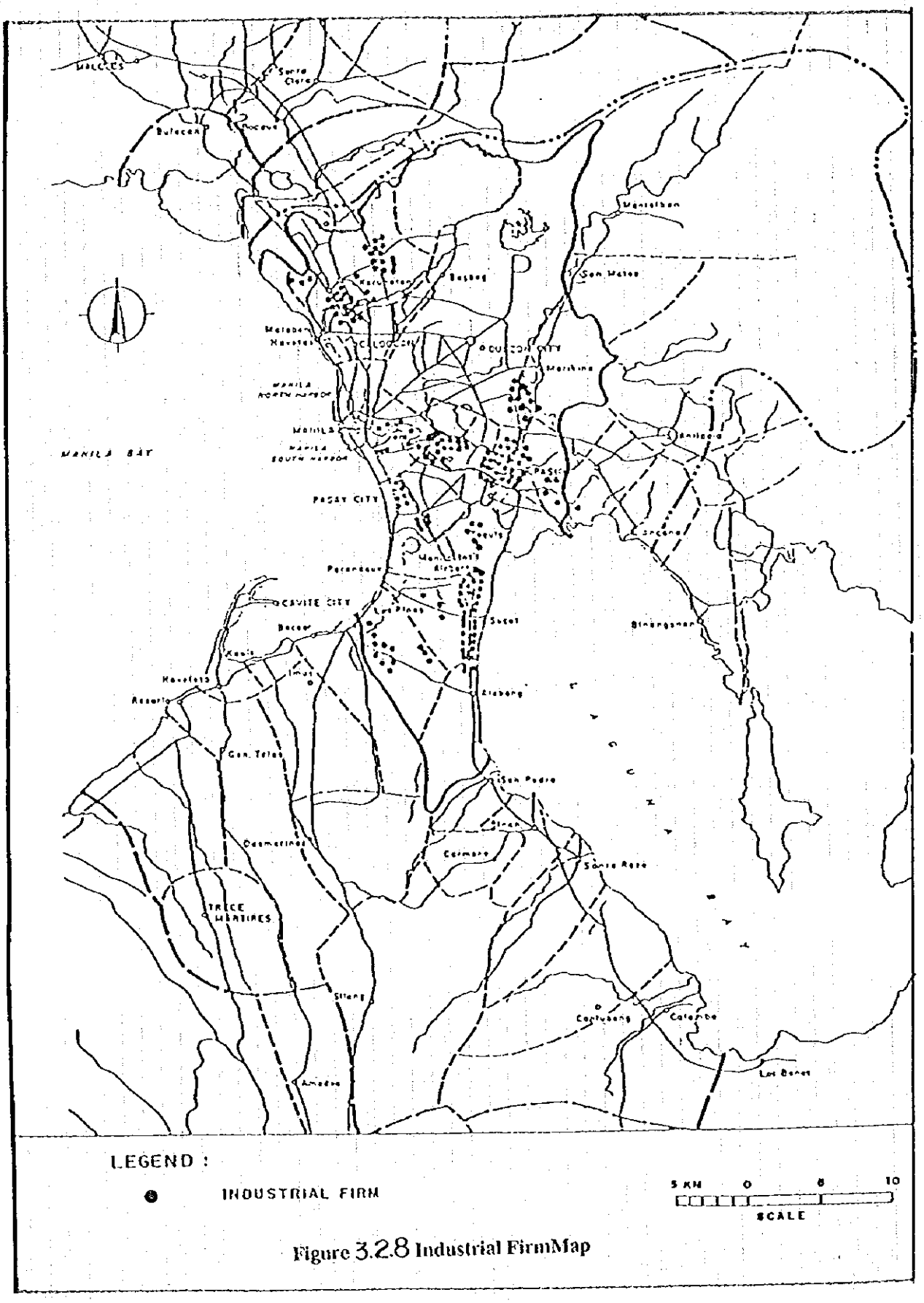


Figure 3.2.8 Industrial FirmMap

Chapter 3.

Mater Plan

Chapter 3. Master Plan

3.1 Basic Policy and conditions for Preparation of Sewerage/Sanitation Master Plan

3.1.1 Basic Frame of the Plan - Industrial Wastewater

Industrial Wastewater Investigation

(1) Effluent Standard

In 1990, the effluent standard for industry was revised by DENR-EMB. After January 1995, following maximum allowable limits in BOD concentration has been adopted by all firms:

Table 3.3.1 Effluent Standard

Industry classification	Inland Water (class C and D)	Coastal Water (class SC and SD)
① Industry producing within 3,000 to 10,000 mg BOD/L	130 or 98% removal	200 or 97% removal
② Industry producing within 10,000 to 30,000 mg BOD/L	200 or 99% removal	600 or 97% removal
③ Industry producing within more than 30,000 mg BOD/L	300 or 99% removal	900 or 97% removal

Source ; DENR-EMB

(2) Wasteeater quality and quantity

Although industrial wastewater is not allowed into sewer pipe in this master plan, its volume and quality is investigated. Industrial wastewater quantity is estimated from water-supply projection considering the IEPC report, while its quality source is mainly from IEPC report.

1) Wastewater quantity

From comprehensive water demand projection, industrial water use through central distribution system in target year 2015 is estimated 191,900 m^3 / day.(see water demand projection) In addition to tap water, private well water volume is calculated based on the data in the "Study for the Groundwater Development in Metro Manila". Industrial water from groundwater is estimated 266,500 m^3/d, so total industrial water is 458,400 m^3/d. Breakdown to each city/municipality is shown in Table 3.1.2. Assuming 70% of water use change into wastewater like other usage, wastewater is calculated in the same table. 320,900 m^3 /d is estimated. According to the IEPC data, industrial wastewater volume discharged from major 596 firms in MWSS jurisdiction amounts to 274,800 m^3 / day as of 1992.(source ; IEPC final report appendices D.8). Considering that 596 firms do not cover whole MWSS jurisdiction area, 320,900 m^3/d is appropriate.

On the other hand, future land use shows that industrial area covers 3,977 ha in 2000 and 5,513 ha in 2015. Overall unit industrial wastewater per hectare is calculated to be 58 m3/d/ha.

Table 3.32 Industrial Wastewater unit ; m3/d

City/Municipality	Central Distribution	Groundwater Source	Industrial Water	Industrial Wastewater
Manila	16,185	2,893	19,078	13,355
Pasay City	2,503	1,688	4,191	2,934
Quezon City	16,089	32,368	48,457	33,920
Calookan City	10,635	2,333	12,968	9,078
Mandaluyong	7,002	5,353	12,355	8,649
Las Pinas	10,586	10,480	21,066	14,746
Makati	5,865	1,692	7,557	5,290
Malabon	12,653	7,283	19,936	13,955
Marikina	1,264	6,833	8,097	5,668
Muntinlupa	17,145	17,140	34,285	24,000
Navotas	2,685	870	3,555	2,489
Paranaque	10,352	8,846	19,198	13,439
Pasig	7,261	60,077	67,338	47,137
Pateros	881	878	1,759	1,231
San Juan	1,078	59	1,137	796
Tagig	8	41,198	41,206	28,844
Valenzuela	14,344	13,300	27,644	19,351
NCR total	136,536	213,291	349,827	244,879
Angono	780	-	780	546
Antipolo	5,818	12,025	17,843	12,490
Baras	-	-	-	-
Binangonan	-	-	-	-
Cainta	25,180	18,087	43,267	30,287
Cardona	-	-	-	-
Jala-jala	-	-	-	-
Morong	-	-	-	-
Pililla	-	-	-	-
Rodorigues	567	2,941	3,508	2,456
San Mateo	2,877	604	3,481	2,437
Tanay	-	-	-	-
Taytay	4,075	16,586	20,661	14,463
Teresa	-	-	-	-
Rizal total	39,297	50,243	89,540	62,678
Cavite City	120	-	120	84
Bacoor	1,042	-	1,042	729
Imus	3,098	265	3,363	2,354
Kawit	95	-	95	67
Noveleta	66	-	66	46
Rosario	11,683	2,679	14,362	10,053
Cavite total	16,104	2,944	19,048	13,334
MWSS total	191,937	266,478	458,415	320,891

EMB classified each industry sector into three category 1) Light industry, 2) Medium industry and 3) Heavy industry and in the former report, the following unit industrial wastewater is shown.

Light industry	30 m3 / ha /day
Medium industry	50 m3 / ha /day
Heavy industry	70 m3 / ha /day

2) Wastewater Quality

Wastewater quality by each industrial sector is assumed to be constant as shown in Table 6.3.

Table 3.3.3 Industrial Wastewater in IEPC

Industry sector	Total BOD generation (kg/day)	Total wastewater (m3/day)	Wastewater Quality (mg/L)
Automotive Industry	1,251	813	1,539
Battery Manufacture	120	50	2,400
Beverage Production	53,249	14,694	3,624
Construction Industry	178	512	346
Commercial Industry	4,781	2,091	2,286
Dyes & Textiles	43,783	46,196	948
Electronic Industry	3,010	10,950	275
Food Processing	145,717	65,633	2,220
Hospital & Clinic	2,543	11,080	230
Leather Tanning	12,997	5,417	2,399
Metal Finishing	8,601	40,531	212
Petro-chemical Industry	22,519	19,858	1,134
Pharmaceuticals	12,079	3,182	3,797
Pulp & Paper	4,071	38,030	107
Paint & Solvent	144	804	179
Piggeries	77,142	10,331	7,467
Total	392,186	270,171	1,452

source: IEPC Report 1992 World Bank

In future, this policy can be reviewed, under following condition.

- Set-up of sewer discharge standard (BOD ,Heavy Metal etc) that each firms should observe. (Toxic hazardous substances should be strictly prohibited)
- Regular submission of record on wastewater volume and quality by each firm
- Legal enforcement on penalty for violation
- Checking system by supervising agency

Discharge wastewater standard in terms of BOD is set-up from the point ;

1. It does not affect so much to the off-site treatment plant
2. Pre-treatment plant for each firms is not a big financial burden considering the waste water tariff collection.

Judging from the existing water quality, BOD 600 mg/L or less concentration seems appropriate criteria for both public sewerage system and on-site pre-treatment by each firm.

3.1.2 Basic Frame of the Plan - Commercial Wastewater

Table 3.3.4 Commercial Wastewater Volume unit ; m3 / d

City/Municipality	Central Distribution	Ground Water Source	Commercial Water	Commercial Wastewater
Manila	124,649	2,333	126,982	88,887
Pasay City	20,730	4,398	25,128	17,590
Quezon City	85,386	27,641	113,027	79,119
Calookan City	15,777	1,837	17,614	12,330
Mandaluyong	10,907	2,128	13,035	9,125
Las Pinas	4,812	1,839	6,651	4,656
Makati	49,889	5,861	55,750	39,025
Malabon	5,032	1,008	6,040	4,228
Marikina	5,071	1,400	6,471	4,530
Muntinlupa	6,065	4,115	10,180	7,126
Navotas	3,058	311	3,369	2,358
Paranaque	10,313	2,457	12,770	8,939
Pasig	10,480	6,658	17,138	11,997
Pateros	258	-	258	181
San Juan	7,774	97	7,871	5,510
Tagig	2,352	3,655	6,007	4,205
Valenzuela	5,828	1,712	7,540	5,278
NCR total	368,381	67,450	435,831	305,082
Angono	358	-	358	251
Antipolo	2,452	2,763	5,215	3,651
Baras	130	-	130	91
Binangonan	979	-	979	685
Cainta	3,117	1,587	4,704	3,293
Cardona	226	-	226	158
Jala-jala	112	-	112	78
Morong	216	-	216	151
Pililla	225	-	225	158
Rodorigues	498	844	1,342	939
San Mateo	745	390	1,135	795
Tanay	401	-	401	281
Taytay	1,097	1,167	2,264	1,585
Teresa	142	-	142	99
Rizal total	10,698	6,751	17,449	12,214
Cavite City	2,757	1,740	4,497	3,148
Bacoor	1,726	352	2,078	1,455
Imus	943	222	1,165	816
Kawit	369	-	369	258
Noveleta	115	-	115	81
Rosario	458	174	632	442
Cavite total	6,368	2,488	8,856	6,199
MWSS total	385,447	76,689	462,136	323,495

3.2 Development Plan on Sewerage

3.2.1 Environmental Assessment of Manila Bay

Importance and necessity of environmental assessment of Manila Bay had been emphasized especially since new outfall system was proposed in 1979 Master Plan and Manila Bay Monitoring Program was conducted from 1982 to 1991 by EMB.

It aimed to determine the degree and extent of pollution in Manila Bay and to determine trends in the water quality of the Bay. The important components of the program were the assessment of the effect of the operation of the Tond Outfall and future outfalls on the Bay'water quality and the determination of its assimilative capacity.

Although decisive conclusion on the assimilative capacity was not acquired from the program mainly due to the shortage of accurate data on pollutants entering the Bay and some other constraints, some very vital information was provided including the diffuser model of outfall.

Previous study on environmental assessment is reviewed.

a. Review of previous study

(1)Manila Bay Monitoring Program (1992 April EMB)

1) Feature of Manila Bay

Manila Bay is a marine inlet of the South China Sea. It is also considered an estuary, by definition an arm of the sea which has freshwater introduced at its head. It has a coastline approximately 190 km long and surface area of 1,800 sq km. It is about 54 km long and its width varies from 22 km at its mouth to 60km inside the bay. The bottom topography gradually rises from its mouth at a rate of about 1 m rise for every km of horizontal distance, which means the depth is about 50 m at the mouth.

Manila Bay receives drainage from approximately 17,000 sq km of watershed consisting of 26 catchment area. The Pasig River basin is one of the two major contributory areas consisting of 3,900 sq km of watershed and including Marikina and Laguna de Bay catchment areas. Fig

As to the oceanography, water current is summarized below

- Current is attributed to surface wind stresses, tidal forces and influence of fresh water
- Fresh water from river system varies in season shown in Fig , inducing 0.05 m/s of current velocity. Compensating current from the sea into the Bay is postulated at a depth of 2 to 5 m, working for the renewal of water quality of the Bay

- Wind currently cause 3 types of depth-averaged bay current by seasons
- Tidal current is 0.5 ~ 0.8 m/sec at the mouth of the bay, while in the shallower area, typical speed is about 0.05 m/second

2) Accomplishment and recommendation

Accomplishment is mainly the measurement of water quality and sediment quality of the Bay and biological analysis of shellfish and sessile organisms.
Mathematical modeling and application to the MWSS outfall was also considered.

Regular monitoring of (1) discharges and sediment loading of major rivers, (2) trace metals in sediment inflow,(3) Pesticide inflow and (4) Nutrient inflow are recommended together with continuation of physico-chemical and biological monitoring.

(2). Second Manila Sewerage Project (1991 November ADB)

With regard to Manila Bay, ADB consultant recommended upgrading of water quality laboratories of EMB and Assessment of absorption capacity of Manila Bay both proposed in Pasig River Rehabilitation Project. And also (1) a year long pre-discharge analysis and on-going post-discharge monitoring of physico-chemical and biological factors and (2) continuation of Manila Bay Monitoring Program were recommended

(3). Environmental Management Strategy (1992 November World Bank/United Nations Development Program)

Construction of Water quality models are recommended . these are (1) hydrodynamic modeling to simulate Bay circulation for different season ,(2) transport dispersion modeling to simulate fate and transport of oil pollutant and (3) an outfall diffuser model to describe near field dilution in the vicinity of outfalls.

b. Recommendation

Under the existing condition that degradation of bay water is proceeding, wastewater should be treated inland as far as budget permits. And even in case outfall system is adopted, it should be tentative intermediate countermeasures.

3.2.2 Design Criteria

(1) Hydraulic criteria

a. Flow calculation equation

Manning formula is used for sewer pipe for its simplicity.

$$V=(1/n)\ R^{2/3}\ I^{1/2}$$

where, V: velocity of flow (m/s)
n : roughness coefficient (-)
R: hydraulic radius (m)
I : inclination (decimal)

Standard roughness coefficient of the pipe is as follows

Pipe	Roughness Coefficiency
Asbestos Cement Pipes	0.013
Vitrified Clay Pipe	0.013
PVC / Plastic pipe	0.010
Concrete pipe /conduit	0.013
Steel Pipe (coated)	0.012

b) In-pipe velocity

Minimum Velocity

The minimum velocity in-pipe is determined as follows to avoid the deposit of organic materials and reduce clearing occasion of pipe.

Sanitary sewer	; 60 cm/sec
Storm and combined sewer	; 80 cm/sec

With regard to sullage and effluent of septic tank, it is possible to lower to 45cm/sec because these water does not include solid .

Maximum Velocity

Maximum velocity shall not exceed 3.0 m/sec in any type of sewer to protect erosion.

(2) Structural Design of facility

a) interceptor

Starting point; downstream of drainage area with more than 20 ha

Minimum diameter; 300 mm

Earth cover; 1.0 ~ 5.0 m

b) Manhole

According to present standard of MWSS, minimum size of manhole is 900 in diameter and maximum spacing is given below

- 120 m for pipe 400 mm ϕ and smaller

- 150 m for pipe 450 to 1000 mm ϕ
- 250 m for pipe 1100 mm ϕ and larger

Pipe cleaning by mechanical method with either bucket type or high water pressure equipment and vacuums car requires that manhole spacing is between 90 m and 140 m, so following revise is recommended.

- 50 m for pipe 400 mm ϕ and smaller
- 80 m for pipe 450 to 1000 mm ϕ
- 120 m for pipe 1100 mm ϕ and larger - 50 m

c) Pump station

Pump station shall be installed in case that earth cover of the pipe is more than 5~6 m in view of construction practice and operation and maintenance of pipe lines.

Two types of pump station shall be decided depending on the flow rate.

One is manhole type with submersible pump which can be installed under the road for the requirement of 5 m^3/ in, and the other is common pump station ensuring land area for operation and maintenance with more than 5 m^3/d of flow rate

Pump station capacity is decided by hourly peak flow.

d) Treatment plant

Following four(4) treatment method are considered; stabilization pond, Aerated Lagoon, Oxidation ditch and Activated sludge. Except for activated sludge, daily average flow is the standard flow for the calculation. Daily maximum flow is adopted for activated sludge method.

1) Stabilization pond

Stabilization pond system consists of anaerobic pond, facultative pond and maturation pond series. Design criteria of each pond are shown below

a) Anaerobic pond

BOD volumetric loading	< 300 g/m^3/d (200 g/m^3/d)
Detention time	1 ~ 5 day
Pond depth	2.5 ~ 5 m (4.5 m including 0.5 m sludge layer)

b) Facultative pond

BOD surface loading: $1 / f \times 60.3 \times 1.0993^{Ta}$ (kg BOD/ha/d)

Ta =average temperature of lowest month; 25deg

f = safety factor 1.5

$1/1.5 \times 60.3 \times 1.0993^{25} = 428$

Pond depth: 1.5 ~ 2 m (2.0 m)

c) Maturation pond

Pond depth: 1.0 ~ 1.5 (1.5 m)

Pond volume is determined to satisfy the following equation, assuming effluent coliform number.

$N_R / N_o = 1 / (K'R_1+1)(K'R_2+1) \ldots.(K'R_n+1)$

where, No=Colifor number of inflow
NR=Coliform number R days later
K' = constant $K'_{t=20} = 2.0 / d$, $K'_t = K'_{t=20} \times 1.07^{(t-20)}$
R1, R2.....Rn = detention time of each line-up pond (3 ~10 days of detention time each)

2) Aerator lagoon

Aerated lagoon system consists of aerated lagoon, facultative aerated lagoon and polishing pond in series.

a) Aerated lagoon
Detention time 3 days
Pond depth 4.5 m including 0.5 m sludge layer
Required power for complete mixing
5 watt / m^3

b) Facultative Aerated lagoon
Detention time 3 days
Pond depth 4.5 m including 0.5 m sludge layer
Required power for complete mixing
5 watt / m^3 for top 1m surface

c) Polishing pond
Detention time 1 days
Pond depth 1.5 m with sludge layer of 0.5 m

d) Disinfection chlorine dosing contact time over 15 min

3) Oxidation ditch

a) Oxidation ditch
Detention time 10~16 hr(15 hr)
BOD-SS loading 0.1 kg-BOD/ kg-SS / d
MLSS 3000 mg/ l
Return sludge rate 80 ~ 150 %

b) Final sedimentation tank
Surface loading 15 $m^3 / m^2 / d$
Detention time 3 hr
Pond depth 2.5 ~3.5 m
Effluent weir loading < 120 m^3 / m/d

c) Disinfection chlorine dosing contact time over 15 min

4) Activated sludge

a) Primary sedimentation tank

Detention time	2.0 hr
surface loading	30 m^3 / m^2 / d
Effluent weir loading	200m^3 / m/d
Pond depth	2.5 ~ 3.0 m

b) Aeration tank

Detention time	6 to 8 hr (7 hr)
BOD-SS loading	0.5 kg-BOD / SS-kg
MLSS	1,500 ~2,000 mg/l
Return sludge rate	25 %

c) Secondary sedimentation tank

Detention time	3.0 hr
surface loading	30 m^3 / m^2 / d
Effluent weir loading	150m^3 / m/d
Pond depth	2.5 ~ 3.0 m

d) Disinfection — chlorine dosing contact time over 15 min

5) Sludge Drying Bed — required area 0.025 m^2/ person.
Drying time 15 days

6) Gravity thickener

Sludge loading	60 ~ 90 kg-DS/m^2/d
Retention time	12 hr
tank depth	4 m
thickened sludge moisture content	97%

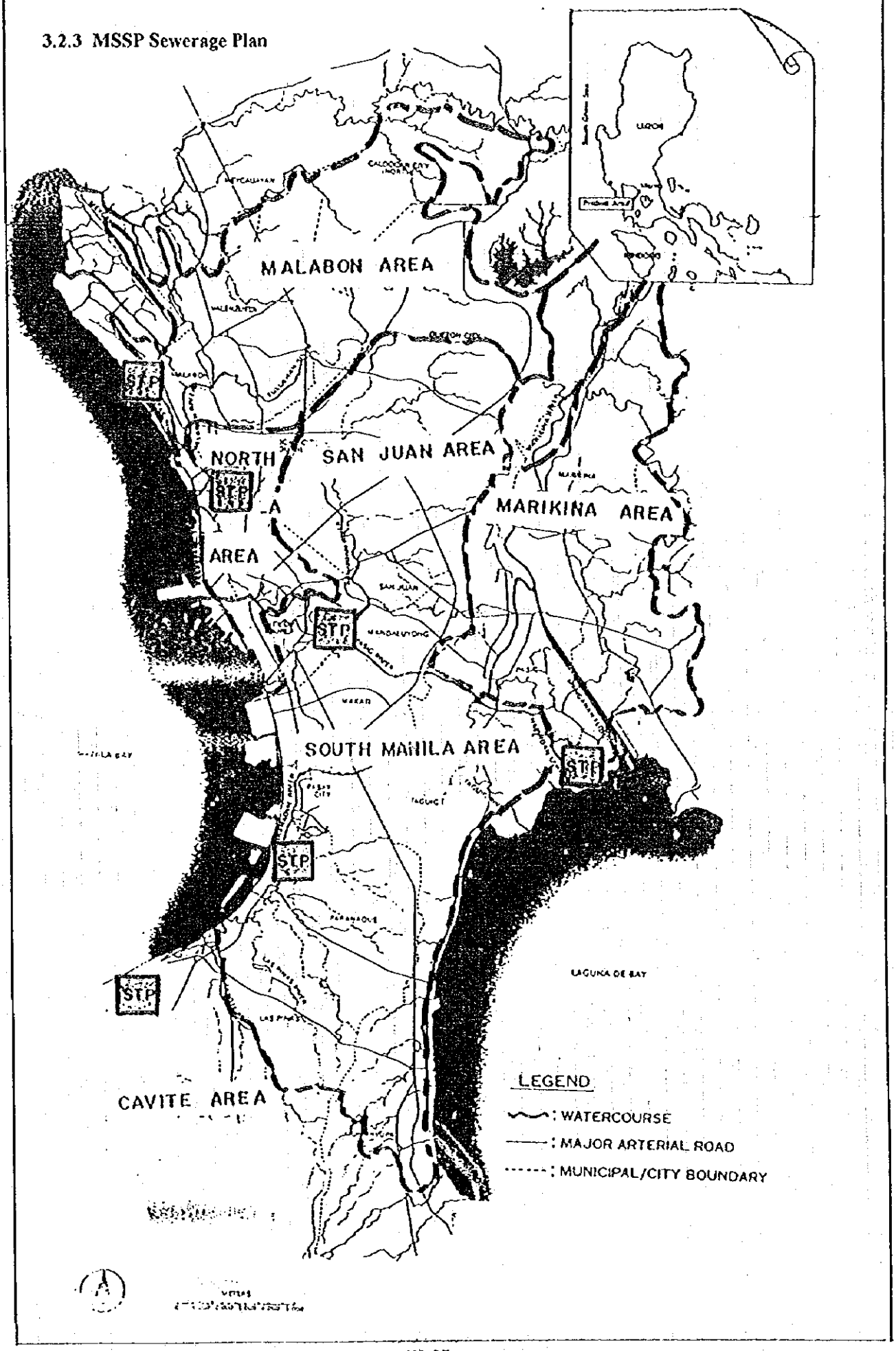
7) Digestion tank

Retention time	20 days for primary digestion tank and 10 days for secondary digestion tank
Digestion rate	50 %
Digested sludge moisture content	96 to 97.5 %

8) Mechanical dewatering

Type	Centrifugal
operation time	6 hour x 6 days per week
Moisture content	75 to 80%

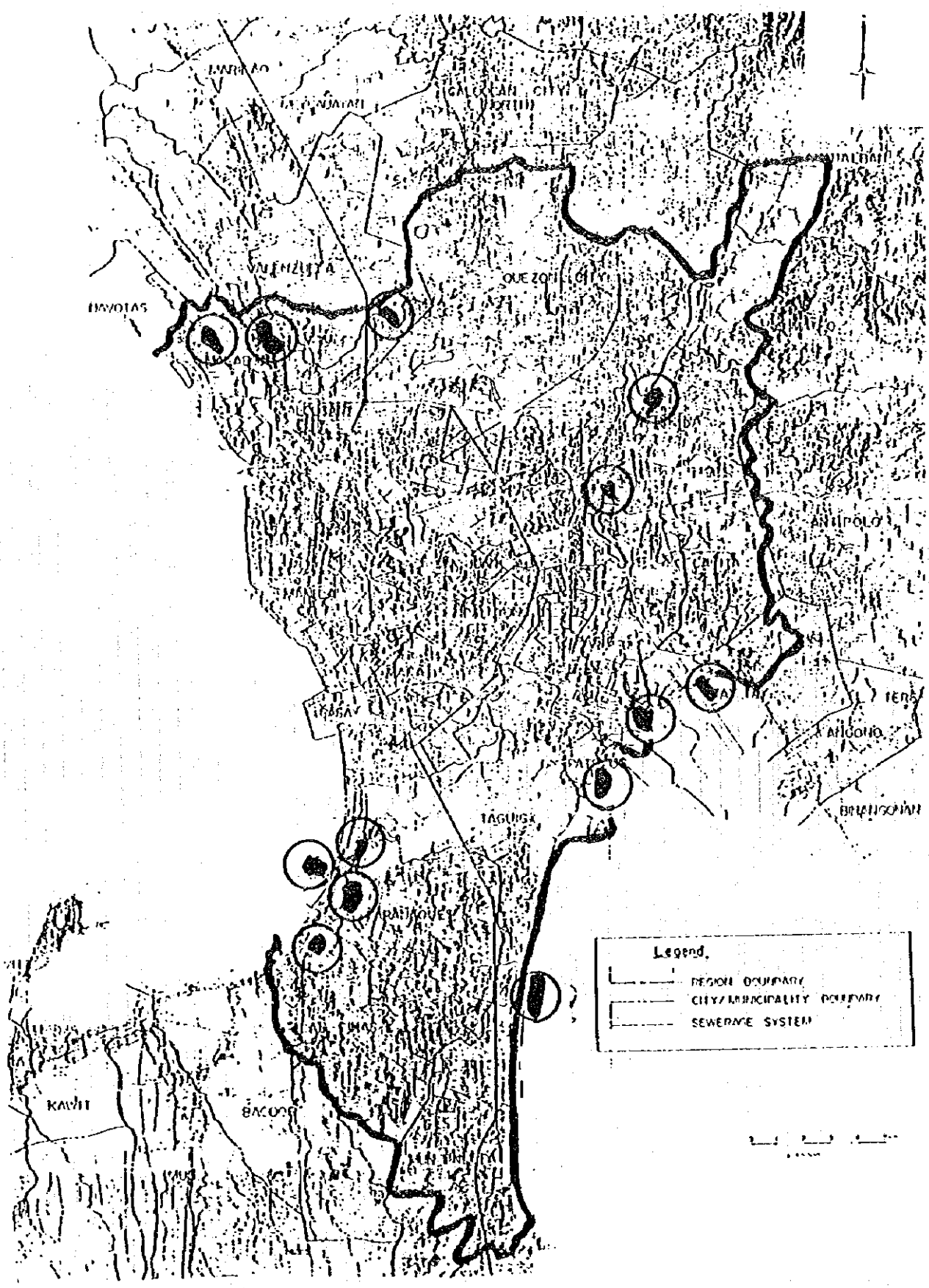
3.2.3 MSSP Sewerage Plan



3.2.4 Comparison with Former System and New Zone

System	Area(ha)	zone	Area(ha)	Remark
Central - North	888.2			already sewered area
Tondo	288.2			ditto
Dagupan	287.7	(10) Central-North	1,739	ditto
Bacood	132.6			future expansion is easy
Central - South	911.7	(11) Central-South	818	already sewered area
Pandacan	376.2	(9) Pandacan	540	already sewered area
Balut	215.4	(17) Balut	138	Future re-development
Caloocan	739.0	(16) Caloocan	628	
Sampaloc	570.7	(12) Sampaloc	511	
South manila	1,910.5	(24) South Manila	1,779	
Makati	239.0			
Bonifacio	761.1	(22) Bonifacio	1,080	Including Golf course
Ayala	649.3	(23) Ayala	900	already sewered area
Dagat-Dagatan	755.7	(18) Dagat-Dagatan	676	already sewered area
Navotas	2,648.1	(21) Navotas	1,253	
Malabon	3,927.1	(19) Tuliahan	3,462	Upper stream of NMTT
		(20) Malabon	1,136	Middle stream of NMTT
Paranaque	3,506.0	(25) Paranaque	3,684	
		(27) NAIA	941	including part of Pasay and Paranaque
Las Pinas	4,632.2			
		(26)Las Pinas	2,873	
Bacoor	1,366.3			future reclamation is neglected
New Manila	4,297.8	(7) Mandaluyong	460	Pasig river basin
		(15) San Juan	2,244	lower stream of SJ river
Quezon	5,174.0	(14) Cubao	3,120	middle stream of SJ river
		(13) North Quezon	3,466	Upper stream of SJ river
Gadalupe	680.0	(8)Gadalupe	588	
Taguig	1,937.6	(3) Taguig	2,256	
Bagumbayan	1,524.4	(4) Muntinlupa	3,786	Expansion of planning area
Ortigas	8,245.2	(1) Baho-Buli	5,251	Baho-Buli river basin
		(2) West Mangahan	1,261	Separation by Mangahan FW
		(6) Ortigas	1,594	
San Mateo	5,045.0	(5)San Mateo	4,508	
Total	51,709.0		50,692	

3.2.5 Potential WWTP site



3.2.6 Cost comparison of Each System

Table Cost comparison among alternative systems — cost : million pesos

		Outline				Construction Cost						Operation& Maintenance Cost(per year)					
	System No	Area (km2)	Population (persons)	WWTP(or Outfall (Daily Max.;m3/D)	Transfer Pump Station (Daily Max.;m3/D)	Collection Syste	WWTP	ransfer Pump Statio	rechergePump Statio	Outfall	Total	Collection Syste	WWT	Pump Statio	Outfall	Total	Remark
SSITS	1	4,506	808,650	282,002		570	540		-		1,110	3	7			10	zone(5)
	2	5,251	1,035,060	243,484		659	606		-		1,265	3	8			11	zone(1)
	3	2,855	616,437	146,737		372	442		-		814	2	5			7	zone(2),(6)
	4	2,256	446,113	107,540		300	364		-		664	1	4			6	zone(3)
	5	3,786	665,929	162,347		483	471		-		954	2	6			8	zone(4)
	6	3,664	612,255	161,232		471	469		-		940	2	6			8	zone(25)
	7	2,873	711,020	156,061		374	459		-		833	2	6			8	zone(26)
	8	941	228,036	55,637		142	241		-		383	1	3			3	zone(27)
	9	1,080	192,918	46,275		159	221		-		379	1	2			3	zone(22)
	10	900	275,985	65,024		137	310		-		447	1	4			4	zone(23)
	11	5,611	1,606,133	415,947		702	847		-		1,549	4	12			15	zone(15),(7),(8),(9),(24)
	12	2,557	1,142,023	282,462		336	665		-		1,001	2	9			11	zone(10),(11)
	13	5,075	1,595,952	359,640		636	774		-		1,411	3	11			14	zone(12),(14),(16),(17),(18)
	14	3,482	776,252	190,185		444	520		-		964	2	7			9	zone(19)
	15	4,602	1,037,401	249,905		581	616		-		1,197	3	8			11	zone(13),(20)
	16	1,253	399,155	82,236		179	308		-		487	1	4			4	zone(21)
	Total	50,692	12,147,319	2,946,732		6,545	7,854		-	-	14,399	33	101	-	-	134	
MSIT	1	9,759	1,843,710	445,486	(5) 202,002	1,200	884	70			2,154	6	13	4		22	zone(1),(5)
	2	5,111	1,062,550	254,277	(3) 107,540	642	623	47			1,312	3	8	2		14	zone(2),(3),(6)
	3	3,786	665,929	162,347		483	471				954	2	6			8	zone(4)
	4	6,557	1,323,275	317,313		816	715				1,531	4	10			14	zone(25),(26)
	5	5,676	1,658,901	437,303		728	874				1,602	4	12			16	zone(8),(9),(22),(23),(24),(27)
	6	2,557	1,142,023	282,462		336	665				1,001	2	9			11	zone(10),(11)
	7	11,243	2,970,222	709,972	(7)+(14)+(15)383,720	1,378	1,182	107			2,667	7	18	7		32	zone(7),(12),(13),(14),(15),(16),(17),(18)
	8	5,851	1,480,709	337,492		731	743				1,474	4	10			14	zone(19),(20),(21)
	Total	50,692	12,147,319	2,946,732		6,314	6,156	224	-	-	12,697	32	86	13	-	130	
LSITS	1	31,501	6,677,553	1,647,726	(5)202,002, (5)+(1)445,486	1,809	2,000	186	-		5,996	19	34	26		79	zone(1),(2),(3),(4),(5),(6),(7),(8),(9)
					(5)+(1)+(6)+(2)+(3) 699,763,(4)162,347	-	-	218	-				-				zone(22),(23),(24),(25),(26),(27)
	2	2,557	1,142,023	282,462		336	665		-		1,001	2	9			11	zone(10),(11)
	3	10,783	2,847,034	679,050	(14)+(15) 299427	1,323	1,150	91	-		2,564	7	17	5		29	zone(12),(13),(14),(15),(16),(17),(18)
	4	5,851	1,480,709	337,492		731	743		-		1,474	4	10			14	zone(19),(20),(21)
	Total	50,692	12,147,319	2,946,732		6,199	4,558	497	-	-	11,254	31	70	32	-	133	
OOS	1	31,501	6,677,553	1,647,726	(5)202,002, (5)+(1)445,486	3,809	-	186	274	4,536	8,807	19		52	23	94	zone(1),(2),(3),(4),(5),(6),(7),(e),(9)
					(5)+(1)+(6)+(2)+(3) 699,763,(4)162,347			218							-		zone(22),(23),(24),(25),(26),(27)
	2	2,557	1,142,023	282,462		336	-		87	-	423	2		5	-	7	zone(10),(11)
	3	10,783	2,847,034	679,050	(14)+(15) 299427	1,323	-	91	154	2,268	3,836	7		17	11	35	zone(12),(13),(14),(15),(16),(17),(18)
	4	5,851	1,480,709	337,492		731	-		98	1,134	1,963	4		6	6	15	zone(19),(20),(21)
	Total	50,692	12,147,319	2,946,732		6,199	-	497	614	7,938	15,247	31	-	81	40	151	
KOOS	1	31,501	6,677,553	1,647,728	(5)202,002, (5)+(1)445,486	3,809	1,664	186	274	4,536	10,470	19	17	52	23	111	zone(1),(2),(3),(4),(5),(6),(7),(8),(9)
					(5)+(1)+(6)+(2)+(3) 699,763,(4)162,347			218							-		zone(22),(23),(24),(25),(26),(27)
	2	2,557	1,142,023	282,462		336	462		87	-	886	2	4	5	-	11	zone(10),(11)
	3	10,783	2,847,034	679,050	(14)+(15) 299427	1,323	874	91	154	2,268	4,710	7	8	17	11	43	zone(12),(13),(14),(15),(16),(17),(18)
	4	5,851	1,480,709	337,492		731	526		98	1,134	2,489	4	4	6	6	20	zone(19),(20),(21)
	Total	50,692	12,147,319	2,946,732		6,199	3,526	497	614	7,938	18,773	31	33	81	40	185	

3.2.7 Comparison of Optimization Plan

m.p = million pesos

	Case 1	Case 2	case 3
Construction cost WWTP	$T_1=0.2\times514{,}000^{0.723}$ (AS) =2692 m.p $T_2=0.2\times387{,}000^{0.723}$ =2192 m.p	$T_1=0.146\times514{,}000^{0.699}$ (OD) =1372 m.p $T_2=0.2\times387{,}000^{0.723}$ =2192 m.p	$T_1=0.2\times514{,}000^{0.723}$ =2692 m.p $T_2=0.2\times387{,}000^{0.723}$ =2192 m.p
Pumping Station	-	$P_1=0.026\times216{,}000^{0.647}$ =74 m.p $P_2=0.026\times666{,}000^{0.647}$ =152 m.p	$P_1=0.026\times216{,}000^{0.647}$ =74 m.p $P_2=0.026\times666{,}000^{0.647}$ =152 m.p
Main sewer	Force ϕ1200 x 2 x 3.9km 3900x2x18,000 = 140m.p Trunk main ϕ2000x 5km 5000x 30,000 =150mp	Force ϕ1200 x 2 x 3.9km 3900x2x18,000 = 140m.p Force main ϕ1500x 2x12km ϕ 800x 2x4km 12000x25,000x2+4000x12000x2 =696mp	Force main ϕ1500x 2x4km ϕ 800x 2x4km 4000x25,000x2+4000x12000x2 =296mp
Total	5174mp	4626mp	5406 mp

3.2.8 Cost Estimate of Framework Plan Area

						(million pesos)	
System	Area(ha)	Volume(m3/d)	Item		Calculation	Cost	Remark
Marikina	5814	274,000	Pipe Cost	Trunk Main	14.5x58.14+35	878	
				Sewer Network	5814x120x5000/1000000	3488	120m/ha,5000p/m
			WWTP		0.177x274,000^0.699	1119	OD
			Total			5486	
East Mangahan	3945	171,000	Pipe Cost	Trunk Main	14.5x39.45+35	607	
				Sewer Network	3945x120x5000/1000000	2367	
			WWTP		0.319x171,000^0.624	588	AL
			Total			3562	
West Mangahan	5111	254,000	Pipe Cost	Trunk Main	14.5x51.11+35	776	
				Sewer Network	5111x120x5000/1000000	3067	
			WWTP		0.319x274,000^0.624	752	AL
			Total			4595	
Muntinlupa	3786	162,000	Pipe Cost	Trunk Main	14.5x37.86+35	584	
				Sewer Network	3786x120x5000/1000000	2272	
			WWTP		0.242x162,000^0.723	1413	AS
			Total			4269	
Paranaque	6557	317,000	Pipe Cost	Trunk Main	14.5x65.57+35	986	
				Sewer Network	6557x120x5000/1000000	3934	
			WWTP		0.319x317000^0.624	864	AL
			Total			5784	
South Manila	4666	396,000	Pipe Cost	Trunk Main	14.5x33.08+35	515	1,358ha is existing
				Sewer Network	3308x120x5000/1000000	1985	
			WWTP		0.319x396,000^0.624	993	AL
			Total			3492	
Ayala	900	83,000	Pipe Cost	Trunk Main	14.5x3+35	79	600ha is existing
				Sewer Network	300x120x5000/1000000	180	
			WWTP		0.242x35,000^0.723	467	AS
			Total			725	
Bonifacio	1080	48,000	Pipe Cost	Trunk Main	14.5x10.80+35	192	
				Sewer Network	1080x120x5000/1000000	648	
			WWTP		0.177x48,000^0.699	331	OD
			Total			1171	
Central Manila	3692	387,000	Pipe Cost	Trunk Main	14.5x20.97+35	339	1595ha is existing
				Sewer Network	2097x120x5000/1000000	1258	
			WWTP		0.242x387,000^0.723	2653	AS
			Total			4250	
North Manila	5851	337,000	Pipe Cost	Trunk Main	14.5x58.51+35	883	
(MNTT basin)				Sewer Network	5851x120x5000/1000000	3511	
			WWTP		0.319x337,000^0.624	897	AL
			Total			5291	
North Manila	9290	515,000	Pipe Cost	Trunk Main	14.5x82.90+35	1237	1000ha is existing
(San Juan basin)				Sewer Network	8290x120x5000/1000000	4974	
			WWTP		0.319x515,000^0.624	1169	AL
			Total			7380	
Total						46006	

3.2.9 Required WWTP Site Area Calculation

West Mangahan Treatment Plant Area Comparison					
AL 72,000m3/d		72,000	OD 72,000m3/d		72000
Aerated Lagoon	Detention time	3 days	Oxidation Ditch	Detention time	15h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	54000		Area(m2)	15000
Facultative	Detention time	3 days	Sedimentation	Final Sedimentation	3h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	54000		Area(m2)	3000
Polishing Pond	Detention time	1 days	Drying Bed	area per capita	0.025m2/capita
	Pond Depth	1.5m(effective)		Area(m2)	8675
	Area(m2)	48000			
Drying Bed	area per capita	0.025m2/capita			
	Area(m2)	8675			
Total	Area(m2)	164675	Total	Area(m2)	26675
Site area	total x 2	329350	Site area	total x 3	80025
m2/m3		4.57			1.11

South Manila Treatment Plant Area Comparison					
AL 207,000m3/d		207,000	OD 207,000m3/d		207000
Aerated Lagoon	Detention time	3 days	Oxidation Ditch	Detention time	15h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	155250		Area(m2)	43125
Facultative	Detention time	3 days	Sedimentation	Final Sedimentation	3h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	155250		Area(m2)	8625
Polishing Pond	Detention time	1 days	Drying Bed	area per capita	0.025m2/capita
	Pond Depth	1.5m(effective)		Area(m2)	23775
	Area(m2)	138000			
Drying Bed	area per capita	0.025m2/capita			
	Area(m2)	23775			
Total	Area(m2)	472275	Total	Area(m2)	75525
Site area	total x 2	944550	Site area	total x 3	226575
m2/m3		4.56			1.09

Central Manila Treatment Plant Area Comparison					
AL 162,000m3/d		162,000	OD 162,000m3/d		162000
Aerated Lagoon	Detention time	3 days	Oxidation Ditch	Detention time	15h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	121500		Area(m2)	33750
Facultative	Detention time	3 days	Sedimentation	Final Sedimentation	3h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	121500		Area(m2)	6750
Polishing Pond	Detention time	1 days	Drying Bed	area per capita	0.025m2/capita
	Pond Depth	1.5m(effective)		Area(m2)	23675
	Area(m2)	108000			
Drying Bed	area per capita	0.025m2/capita			
	Area(m2)	23675			
Total	Area(m2)	374675	Total	Area(m2)	64175
Site area	total x 2	749350	Site area	total x 3	192525
m2/m3		4.63			1.19

North Manila Treatment Plant Area Comparison					
AL 282,000m3/d		282,000	OD 282,000m3/d		282000
Aerated Lagoon	Detention time	3 days	Oxidation Ditch	Detention time	15h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	211500		Area(m2)	58750
Facultative	Detention time	3 days	Sedimentation	Final Sedimentation	3h
	Pond Depth	4.0m(effective)		Pond Depth	3.0m(effective)
	Area(m2)	211500		Area(m2)	11750
Polishing Pond	Detention time	1 days	Drying Bed	area per capita	0.025m2/capita
	Pond Depth	1.5m(effective)		Area(m2)	33325
	Area(m2)	188000			
Drying Bed	area per capita	0.025m2/capita			
	Area(m2)	33325			
Total	Area(m2)	644325	Total	Area(m2)	103825
Site area	total x 2	1288650	Site area	total x 3	311475
m2/m3		4.57			1.10

3.2.10 Sampling Schedule and Test Program

Treating Facility / Test Items	Septic Tank			Septage Treatment Plant [Experimental Plant (Lagoon)]					Activated Sludge Treatment (Ayala STP)				Anaerobic Digestion Tank (Ayala STP)			
	Sludge	Effluent	Septage	Raw Septage / Supernatant	Lagoon	Effluent	Excess Sludge	Dewatered Sludge	Inflow / Effluent	Aeration Tank	Excess Sludge	Effluent	Thickend Sludge	Digested Sludge	Super-natant	Dewatered Sludge
Routine Test																
Temperature	■	■	■	●	●	●			●	●		●	▲		▲	
Color/Odor				●		●			●			●				
Transparancy	■	■	■	●	●	●	●		●	●		●	▲	▲	▲	
pH					●					●						
DO					●					●	●					
SV																
Periodical Test																
COD	□	□	□	○	○	○			○						△	
BOD	□	□	□	○	○	○			○	○			△	△	△	
SS	□	□	□	○			○				○					
VSS				○			○				○					
TS	□	□	□	○		○		○				○	△	△		△
TVS				○		○	○	○			○	○	△	△		△
TDS						○	○									
SM						○	○					○				
Periodical Test																
Oil-Grease	□	□	□	△		△			△		△	△	△	△	△	
Alkalinity	□	□	□	△		△	△		△		△	△			△	
K-N	□	□	□	△		△	△		△		△	△			△	
NH_4-N				△		△			△			△				
NO_3-N						△						△				
T-P	□	□	□	△		△	△		△		△	△			△	
PO_4-P				△		△			△			△			△	
Residual Chlorine						▲						▲				
Detergent						△						△				
Phenol						△						△				
Heavy Metals Items	□‡	□‡		△‡		△‡	△‡	△‡	△	△‡		△‡				△‡
Total Coliforms	□	□		△		△						△			△	
Biota					△					△						
Note :														Gas		

Note : Sampling Frequency ● ▲ ■ : Routine Test ○ : Once/Week~Twice/month △ : Once/month □ : Twice/year

‡ : Items that can reduce the number of test at the stages of operating and observing.

3.3 Development Plan on Sanitation

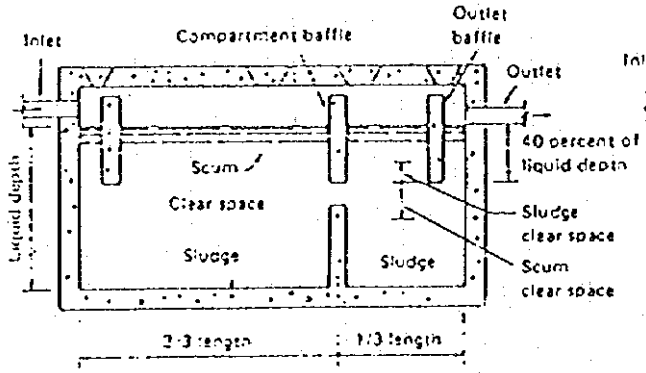
3.3.1 Leaching Area of Septic Tank

Type of Soil	Required Leaching Area	
	Sq.feet per100 gallons septic tank capacity	Sq.meters/per 1000 liters septic tank capacity
Coarse sand or Gravel	55	13.5
Loamy sand	85	20.9
Sandy loam or sandy clay	100	24.5
Silty or clayey loams	140	34.4
Clay loams and clay	Perk Test (1) required	Perk Test required

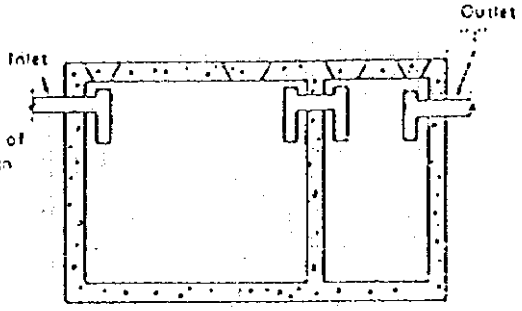
3.3.2 Small bore System design criteria

Parameter	Basis
Design flow	Based on per capita sewage production with a small peak factor due to the buffering effect of septic tank. Infiltration allowance is not considered
Design flow depth of pipe	Full depth
Minimum pipe diameter	100 mm
Pipe roughness coefficiency	Manning n=0.010 to 0.013
Minimum velocity	0.3 m/sec
Minimum slope	100 mm = 0.0024 150 mm = 0.0012 200 mm = 0.0010 250 mm = 0.0008
Alignment	curved alignment is allowed between manholes
Manhole	250 mm interval on minimum grade

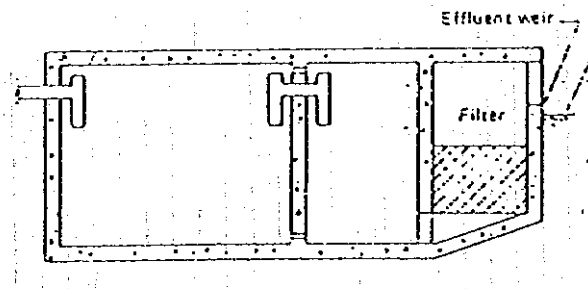
3.3.3 Septic Tank Upgrading



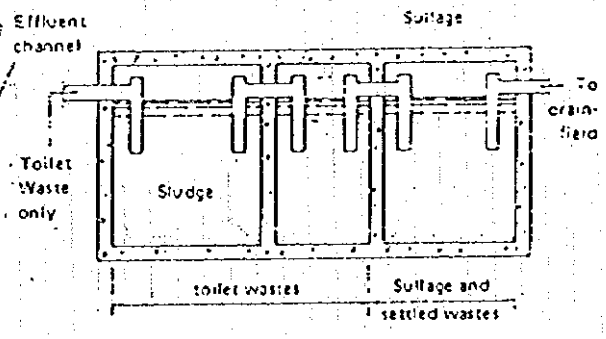
Conventional two-compartment septic tank with baffle walls



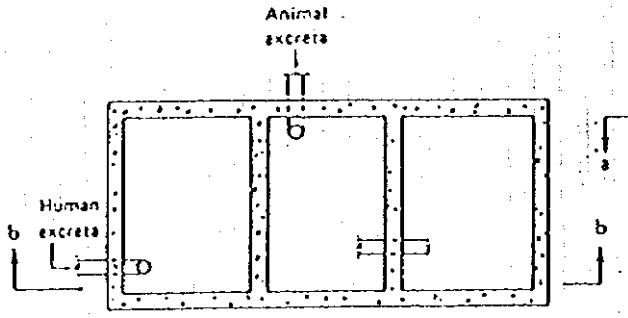
Conventional two-compartment septic tank with inlet connector and outlet "t"



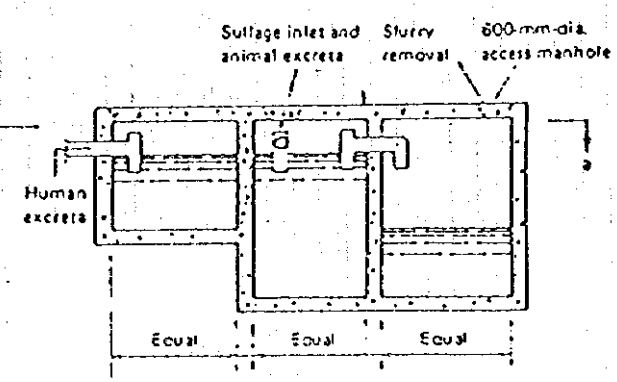
Two-compartment septic tank with upflow filter



Three-compartment septic tank



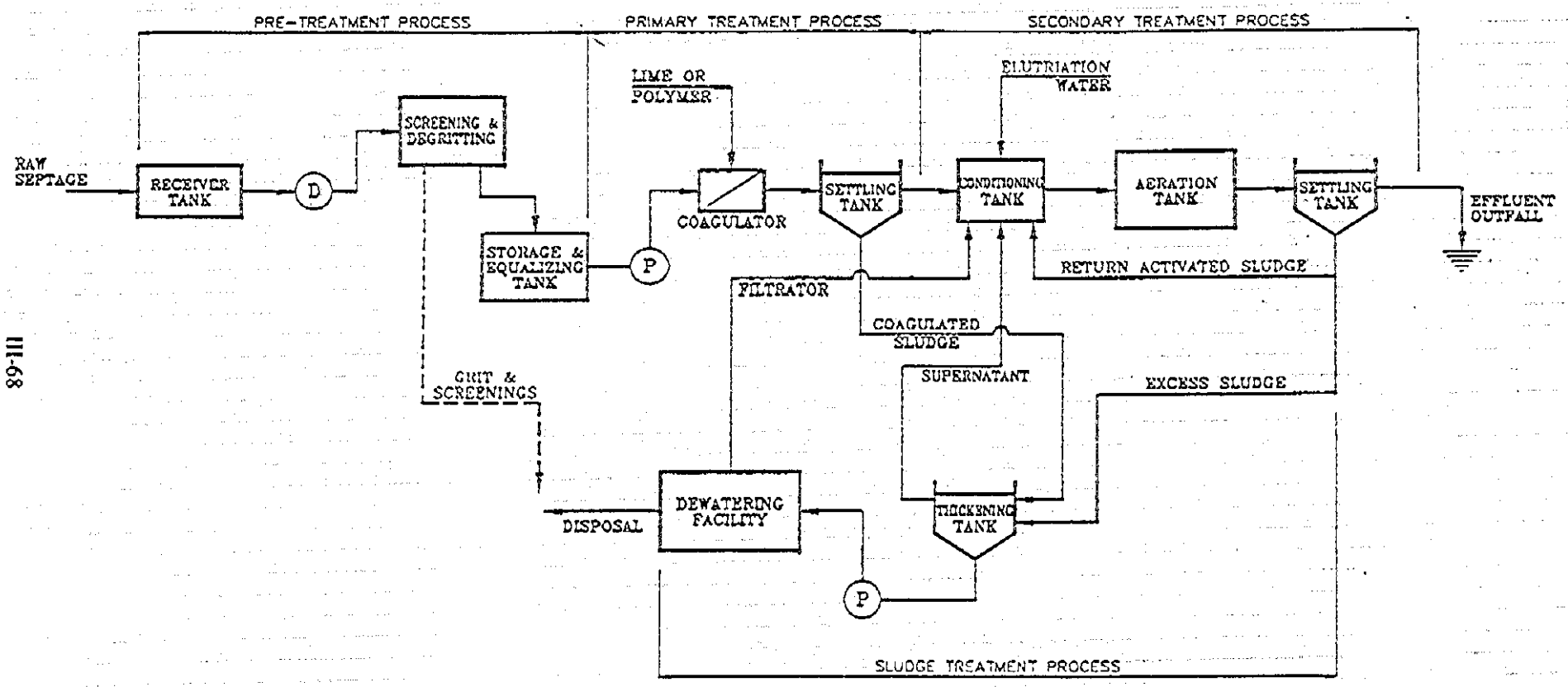
Section a-a



Section b-b

Three-compartment septic tank for resource recovery

3.3.4 Septage Treatment Plant Flow



SCHEMATIC FLOW DIAGRAM FOR COAGULATION METHOD

Chapter 4.

Proposed Projects

Chapter 4. Proposed Projects

4.2 Project Cost

4.2.1 Project Cost Calculation

1. Sewerage Construction Cost (million Pesos)					
1-A. Ayala Sewage Treatment Plant Rehabilitation (Phase 1)					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		55.94	41.51	97.45	1994-1995 escalation rate 1.035
1-B. Ayala Sewerage System Rehabilitation					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		-	144.53	144.53	1994-1995 escalation rate 1.035
1-C. Manila Central Sewerage System Rehabilitation					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		69.50	135.51	205.01	1994-1995 escalation rate 1.035
1-D. South Manila System					
Cost Item	content	Foreign	Local	Total	Remark
(1) Direct Cost					
1) Interceptor	27.97km2		441.00	441.00	14.5x27.97+35 all local
2) Force Main	neglect				
3) Pump Station	neglect		-		
4) WWTP	daily average 207,000m3/d	264.80	397.20	662.00	0.319x207000^.624 Local 60%
Total of Direct Cost		264.80	838.20	1,103.00	
(2) Engineering fee	(1)x0.07	18.54	58.67	77.21	
(3) Land Acquisition	940,000 m2		56.40	56.40	60 peso/m2
(4) Contingency	{(1)+(2)+(3)}x0.1	28.33	95.33	123.66	
Total Cost		311.67	1,048.60	1,360.27	
1-E. Central Manila System					
Cost Item	content	Foreign	Local	Total	Remark
(1) Direct Cost					
1) Interceptor	16.20km2		270.00	270.00	14.5x16.20+35 all local
2) Force Main	700mm x 3,000m		30.00	30.00	10,000 x 3,000 peso all local
3) Pump Station	hourly max 58,000m3/d	14.80	22.20	37.00	0.031x58000^.647 Local 60%
4) WWTP	daily average 162,000m3/d	310.00	465.00	775.00	0.177x162000^.699 Local 60%
Total of Direct Cost		324.80	787.20	1,112.00	
(2) Engineering fee	(1)x0.07	22.74	55.10	77.84	
(3) Land Acquisition	neglect		-	-	
(4) Contingency	{(1)+(2)+(3)}x0.1	34.75	84.23	118.98	
Total Cost		382.29	926.53	1,308.82	
1-F. North Manila System					
Cost Item	content	Foreign	Local	Total	Remark
(1) Direct Cost					
1) Interceptor	50.24km2		763.00	763.00	14.5x50.24+35 all local
2) Force Main	800mmx2x4km,1200mmx2x10km		504.00	504.00	13x2x4+20x2x10 all local
3) Pump Station	(1)215,000m3/d,(2)428,000m3/d	80.80	121.20	202.00	0.031x215000^.647+0.031x428000^.647
4) WWTP	daily average 282,000m3/d	321.20	481.80	803.00	0.319x282000^.624 Local 60%
Total of Direct Cost		402.00	1,870.00	2,272.00	
(2) Engineering fee	(1)x0.07	28.14	130.90	159.04	
(3) Land Acquisition	1,290,000 m2		77.40	77.40	60 peso/m2
(4) Contingency	{(1)+(2)+(3)}x0.1	43.01	207.83	250.84	
Total Cost		473.15	2,286.13	2,759.28	
1-G. Ortigas System					
Cost Item	content	Foreign	Local	Total	Remark
(1) Direct Cost					
1) Interceptor	15.94km2		266.00	266.00	14.5x15.94+35 all local
2) Force Main	900mmx4km		60.00	60.00	15,000x4,000
3) Pump Station	hourly max 108000m3/d	22.40	33.60	56.00	0.031x108000^.647
4) WWTP	daily average 72,000m3/d	137.20	205.80	343.00	0.319x72000^.624 Local 60%
Total of Direct Cost		159.60	565.40	725.00	
(2) Engineering fee	(1)x0.07	11.17	39.58	50.75	
(3) Land Acquisition	330,000 m2		19.80	19.80	60 peso/m2
(4) Contingency	{(1)+(2)+(3)}x0.1	17.08	62.48	79.56	
Total Cost		187.85	687.25	875.11	
1-H. Ayala STP Rihabilitation Phase 2					
Cost Item	content	Foreign	Local	Total	Remark
(1) Direct Cost		228.00	342.00	570.00	Local 60%
(2) Engineering fee	(1)x0.07	15.96	23.94	39.90	
(3) Land Acquisition			-	-	
(4) Contingency	{(1)+(2)+(3)}x0.1	24.40	36.59	60.99	
Total Cost		268.36	402.53	670.89	
Sewerage Project Total		Foreign	Local	Total	
		1,748.76	5,672.61	7,421.36	

Sewerage O&M Cost				
South Manila System		Cost/Capacity	O&M cost(millionPesos/year)	Remark
	Pipe System	441	2.21	0.5% of Construction Cost
	Pump Station	0		
	WWTP	207,000m3/d	8.60	0.908*207000^0.748/1000
	Total		10.81	
Central Manila System		Cost/Capacity	O&M cost(millionPesos/year)	Remark
	Pipe System	300	1.50	0.5% of Construction Cost
	Pump Station	h.m 40m3/min	1.47	49.2*40^0.92
	WWTP	162,000m3/d	118.57	0.657*162000^1.009/1000
	Total		121.53	
North Manila System		Cost/Capacity	O&M cost(millionPesos/year)	Remark
	Pipe System	1267	6.34	0.5% of Construction Cost
	Pump Station	h.m149&297m3/min	14.18	49.2*149^0.92+49.2*297^0.92
	WWTP	282,000m3/d	10.64	0.908*282000^0.748/1000
	Total		31.35	
West Mangajhan System		Cost/Capacity	O&M cost(millionPesos/year)	Remark
	Pipe System	326	1.63	0.5% of Construction Cost
	Pump Station	h.m 75m3/min	2.61	49.2*75^0.92
	WWTP	72,000m3/d	3.9	0.908*72000^0.748/1000
	Total		8.14	

Ayala Rehabilitation Phase 2 Breakdown(in x1,000 $)		
Aeration Tank	1,340	
Air Blower	2,620	
Second Sedimentation	2,860	
Deodorizer	2,500	
Thickener	670	
Sludge Dewater	9,360	
Generator	680	
Chroline Contact	380	
Total	20,410	
Peso equivalent(million Pesos)	551	
x 1.035	570	

2. Sanitation Facility Construction Cost (million Pesos)					
2-A. Septage Collection and Hauling					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		-	260.02	260.02	1994-1995 escalation rate 1.035
2-B. Barging of Septage for Sea Dumping					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		-	160.76	160.76	1994-1995 escalation rate 1.035
2-C. Barge Loading Station Construction					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		-	22.19	22.19	1994-1995 escalation rate 1.035
2-C'. Barge Loading Station Construction phase 2					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		-	11.10	11.10	1994-1995 escalation rate 1.035
2-D. Dagat-Dagatan Septage Treatment Plant Construction					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		130.81	192.98	323.79	1994-1995 escalation rate 1.035
2-E. Supply of Laboratory Equipment, Vacuum Cars/Accessories and Other Vehicles					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		141.93	35.48	177.41	1994-1995 escalation rate 1.035
2-F. Dagat-Dagatan STP 2nd Stage					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		215.97	234.90	450.87	1994-1995 escalation rate 1.035
2-G. Dagat-Dagatan STP 3rd Stage					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		254.49	375.45	629.94	1994-1995 escalation rate 1.035
2-H. Quezon City STP 1st Stage					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		622.00	917.60	1,539.60	1994-1995 escalation rate 1.035
2-I. Quezon City STP 2nd Stage					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		469.04	691.96	1,161.00	1994-1995 escalation rate 1.035
2-J. Paranaque STP					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		622.00	917.60	1,539.60	1994-1995 escalation rate 1.035
2-K. Taguig STP					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		622.00	917.60	1,539.60	1994-1995 escalation rate 1.035
2-L. Quezon City STP Another Expansion					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		117.26	172.99	290.25	one quarter of 2-I project

2-M. Paranaque STP Expansion					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		234.52	345.98	580.50	half cost of 2-I project
2-N. Binangonan STP					
Cost Item	content	Foreign	Local	Total	Remark
Total Cost		622.00	917.60	1,539.60	same as J / K Project
Sanitation ProjectTotal		Foreign	Local	Total	
		4,052.02	6,174.21	10,226.23	

Sanitation Facility O&M Cost(million Pesos/year)				
(1) Collection and Treatment'				
	Period	Capacity(m3/d)	O&M Cost(million peso/year)	Remark
Dagat-Dagatan STP	1997-2001	200	30.20	.151mill peso/year/(m3/d)
	2002-2007	500	75.50	
	2008-2015	900	135.90	
Quezon City STP	2003-2005	600	90.60	
	2006-2014	1000	151.00	
	2015	1100	166.10	
Taguig STP	2004-2015	600	90.60	
Paranaque STP	2008-2010	600	90.60	
	2011-2015	800	120.80	
Binangonan STP	2014-2015	600	90.60	
# 0.151=20,488,000 x 27 / 3,800x 1.035 / 1,000,000				
20,488,000 us$ = Option 1(Treatment Plant) O&M cost in Preliminary Report of MSSP with 3,800 cu.m volume				
1us$=27 p, escalation rate 1.035				
(2) Collection and Sea Dumping				
Dumping	Period	volume(m3/d)	O&M cost(million pesos/year)	Remark
	1999~2001	1,500	66.00	.044mill.peso/year/(m3/d)
	2002	1,200	52.80	
	2003	600	26.40	
# 0.044=5,964,000 x 27 / 3,800x 1.035 / 1,000,000				
5,964,000 us$ = Option 2(Ocean Dumping) O&M cost in Preliminary Report of MSSP with 3,800 cu.m volume				
1us$=27 p, escalation rate 1.035				
1996~1998 cost is included in Project 2-A				

1.Sewerage Project Construction Cost																							
	Total cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	sum
1-A																							
Foreign	55.94		27.97	27.97																			55.94
Local	41.51		20.76	20.76																			41.51
Total	97.45		48.73	48.73																			97.45
Annual Percentage			0.50	0.50																			1.00
1-B																							-
Foreign	-																						-
Local	144.53		36.13	36.13	36.13	36.13																	144.53
Total	144.53		36.13	36.13	36.13	36.13																	144.53
Annual Percentage			0.25	0.25	0.25	0.25																	1.00
1-C																							-
Foreign	69.50		31.28	31.28					6.95														69.50
Local	135.51		60.98	60.98					13.55														135.51
Total	205.01		92.25	92.25	-	-	-	-	20.50														205.01
Annual Percentage			0.45	0.45					0.10														1.00
1-D																							-
Foreign	311.67			38.9588	77.9175	77.9175	77.9175	38.95875															311.67
Local	1,048.60			131.075	262.15	262.15	262.15	131.075															1,048.60
Total	1,360.27			170.03	340.07	340.07	340.07	170.03															1,360.27
Annual Percentage				0.125	0.25	0.25	0.25	0.125															1.00
1-E																							-
Foreign	382.29						53.5206	53.5206	53.5206	114.687	53.5206	53.5206											382.29
Local	926.53						129.7142	129.7142	129.714	277.959	129.714	129.7142											926.53
Total	1,308.82						183.23	183.23	183.23	392.65	183.23	183.23	-	-	-	-	-	-	-	-	-	-	1,308.82
Annual Percentage							0.14	0.14	0.14	0.3	0.14	0.14											1.00
1-F																							-
Foreign	473.15											52.0465	52.0465	106.4588	106.459	52.0465	52.0465	52.0465					473.15
Local	2,286.13											251.4743	251.4743	514.3793	514.379	251.474	251.474	251.4743					2,286.13
Total	2,759.28											303.52	303.52	620.84	620.84	303.52	303.52	303.52	-	-	-	-	2,759.28
Annual Percentage												0.11	0.11	0.225	0.225	0.11	0.11	0.11					1.00
1-G																							
Foreign	187.85																	31.9345	31.9345	60.112	31.9345	31.9345	187.85
Local	687.26																	116.8342	116.834	219.923	116.834	116.834	687.26
Total	875.11																	148.77	148.77	280.04	148.77	148.77	875.11
Annual Percentage																		0.17	0.17	0.32	0.17	0.17	1.00
1-K																							
Foreign	268.36				67.09	67.09	67.09	67.09															268.36
Local	402.53				100.633	100.6325	100.6325	100.6325															402.53
Total	670.89	-	-	-	167.72	167.72	167.72	167.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	670.89
Annual Percentage					0.25	0.25	0.25	0.25															1.00
1. Sewerage Total																							
Foreign	1,748.76		59.25	98.20	145.01	145.01	198.53	159.57	60.47	114.69	53.52	105.57	52.05	106.46	106.46	52.05	52.05	83.98	31.93	60.11	31.93	31.93	1,748.76
Local	5,672.60		117.87	248.94	398.92	398.92	492.50	361.42	143.27	277.96	129.71	381.19	251.47	514.38	514.38	251.47	251.47	368.31	116.83	219.92	116.83	116.83	5,672.60
Total	7,421.36		177.11	347.15	543.92	543.92	691.02	520.99	203.74	392.65	183.23	486.76	303.52	620.84	620.84	303.52	303.52	452.29	148.77	280.04	148.77	148.77	7,421.36

2. Sanitation Project Construction Cost																							
	Total cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	sum
2-A																							-
Foreign	-																						-
Local	260.02		85.81	85.81	88.41																		260.02
Total	260.02		85.81	85.81	88.41																		260.02
Annual Percentage			0.33	0.33	0.34																		1.00
2-B																							-
Foreign	-																						-
Local	160.76		53.05	53.05	54.66	-																	160.76
Total	160.76		53.05	53.05	54.66	-																	160.76
Annual Percentage			0.33	0.33	0.34																		1.00
2-C																							-
Foreign	-		-	-					-														-
Local	22.19	22.19																					22.19
Total	22.19	22.19																					22.19
Annual Percentage		1.00																					1.00
2-D																							-
Foreign	130.81		43.17	43.17	44.48																		130.81
Local	192.98		63.68	63.68	65.61																		192.98
Total	323.79		106.85	106.85	110.09																		323.79
Annual Percentage			0.33	0.33	0.34																		1.00
2-E																							-
Foreign	141.93		46.84	46.84	48.26																		141.93
Local	35.48		11.71	11.71	12.06																		35.48
Total	177.41		58.55	58.55	60.32													-	-	-	-	-	177.41
Annual Percentage			0.33	0.33	0.34																		1.00
2-F																							-
Foreign	215.97					107.985	107.985																215.97
Local	234.90					117.45	117.45																234.90
Total	450.87					225.44	225.44												-	-	-	-	450.87
Annual Percentage						0.5	0.5																1.00
2-G																							-
Foreign	254.49												127.245	127.245									254.49
Local	375.45												187.725	187.725									375.45
Total	629.94												314.97	314.97									629.94
Annual Percentage													0.5	0.5									1.00
2-H																							-
Foreign	622.00						205.26	205.26	211.48														622.00
Local	917.60						302.81	302.81	311.98														917.60
Total	1,539.60	-	-	-			508.07	508.07	523.46	-	-	-	-	-	-	-	-	-	-	-	-	-	1,539.60
Annual Percentage							0.33	0.33	0.34														1.00
2-I																							-
Foreign	469.04										234.52	234.52											469.04
Local	691.96										345.98	345.98											691.96
Total	1,161.00										580.50	580.50											1,161.00
Annual Percentage											0.50	0.50											1.00
2-J																							-
Foreign	622.00		-	-					-			205.26	205.26	211.48									622.00
Local	917.60											302.81	302.81	311.98									917.60
Total	1,539.60											508.07	508.07	523.46									1,539.60
Annual Percentage												0.33	0.33	0.34									1.00
2-K																							-
Foreign	622.00							205.26	205.26	211.48													622.00
Local	917.60							302.81	302.81	311.98													917.60
Total	1,539.60							508.07	508.07	523.46													1,539.60
Annual Percentage								0.33	0.33	0.34													1.00
2-L																							-
Foreign	117.26																				117.26		117.26
Local	172.99																				172.99		172.99
Total	290.25																	-	-	-	290.25	-	290.25
Annual Percentage																					1		1.00
2-M																							-
Foreign	234.52															117.26	117.26						234.52
Local	345.98															172.99	172.99						345.98
Total	580.50															290.25	290.25	-	-	-	-	-	580.50
Annual Percentage																0.5	0.5						1.00
2-N																							-
Foreign	622.00																	205.26	205.26	211.48			622.00
Local	917.60																	302.81	302.81	311.98			917.60
Total	1,539.60																	508.07	508.07	523.46			1,539.60
Annual Percentage																		0.33	0.33	0.34			1.00
2-O																							-
Foreign	-																						-
Local	11.10				11.10																		11.10
Total	11.10	-	-	-	11.10													-	-	-	-	-	11.10
Annual Percentage					1																		1.00
2. Sanitation Total																							
Foreign	4,052.02	-	90.00	90.00	92.73	313.25	518.51	416.74	211.48	-	234.52	439.78	332.51	338.73	-	117.26	117.26	205.26	205.26	211.48	117.26	-	4,052.02
Local	6,174.21	22.19	214.25	214.25	231.84	420.26	723.07	614.79	311.98	-	345.98	648.79	490.53	499.71	-	172.99	172.99	302.81	302.81	311.98	172.99	-	6,174.21
Total	10,226.23	22.19	304.25	304.25	324.57	733.50	1,241.57	1,031.53	523.46	-	580.50	1,088.57	823.04	838.43	-	290.25	290.25	508.07	508.07	523.46	290.25	-	10,226.23
3. Sewerage&Sanitation																							
Foreign	5,800.78	-	149.25	188.21	237.74	458.25	717.03	578.31	271.95	114.69	288.04	545.35	364.55	445.18	106.45	169.31	169.31	289.24	297.19	271.59	140.19	31.93	5,800.78
Local	11,846.81	22.19	332.12	463.19	630.76	819.17	1,215.56	976.21	455.25	277.96	475.88	1,009.98	742.01	1,014.09	514.38	424.48	424.48	671.12	419.64	531.91	289.07	115.83	11,846.81
Total	17,647.59	22.19	481.37	651.40	868.50	1,277.43	1,932.60	1,554.52	727.20	392.65	763.73	1,555.32	1,106.56	1,459.27	620.84	593.77	593.77	960.36	716.84	803.50	429.02	148.77	17,647.59

1.Sewerage O&M cost(million pesos / year)																
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Manila System							10.81	10.81	10.81	10.81	10.81	10.81	10.81	10.81	10.81	10.81
Central Manila System										121.53	121.53	121.53	121.53	121.53	121.53	121.53
North Manila System															31.35	31.35
West Mangahan System																
sewerge O&M total	-	-	-	-	-	-	10.81	10.81	10.81	132.34	132.34	132.34	132.34	132.34	163.69	163.69
2.Sanitation O&M cost(million pesos / year)																
Sea Dumping					66.00	66.00	66.00	52.80	26.40							
Dagat-Dagatan STP					30.20	30.20	30.20	75.50	75.50	75.50	75.50	75.50	75.50	135.90	135.90	135.90
Quezon City STP									90.60	90.60	90.60	151.00	151.00	151.00	151.00	151.00
Taguig STP										90.60	90.60	90.60	90.60	90.60	90.60	90.60
Paranaque STP														90.60	90.60	90.60
Binangonan STP																
SanitationO&M total	-	-	-	-	96.20	96.20	96.20	128.30	192.50	256.70	256.70	317.10	317.10	468.10	468.10	468.10
Sewerage &Sanitation total	-	-	-	-	96.20	96.20	107.01	139.11	203.31	389.04	389.04	449.44	449.44	600.44	631.79	631.79

2011	2012	2013	2014	2015	sum
10.81	10.81	10.81	10.81	10.81	162.15
121.53	121.53	121.53	121.53	121.53	1,458.36
31.35	31.35	31.35	31.35	31.35	219.45
			8.14	8.14	16.28
163.69	163.69	163.69	171.83	171.83	1,856.24
135.90	135.90	135.90	135.90	135.90	1,630.80
151.00	151.00	151.00	151.00	166.10	1,796.90
90.60	90.60	90.60	90.60	90.60	1,087.20
120.80	120.80	120.80	120.80	120.80	875.80
			90.60	90.60	181.20
					-
498.30	498.30	498.30	588.90	604.00	5,571.90
					-
661.99	661.99	661.99	760.73	775.83	7,428.14

Chapter 5.

Evaluation

Chapter 5. Evaluation

5.1 Technical Evaluation

5.1.1 Comparison Table with former Study

Sewerage Project (mainly Development Concept)

Desigh Frame			1979 Master Plan	1991 ADB Feasibility Study	This Study	Remark
Target Year			2,000	2,010	2,015	Usually 20 years later
Target Area		total area	51,709 ha (including Manila Bay Reclamation Area)		50,692 ha (excluding Reclamation area but include Muntinlupa area)	
		Coverage up to Target Year	METROSS I ~ III project area Only METROSS I has completed so far.	F/S of METROSS II and Rehabilitation of Existing Facilities	South Sewerage System, Expansion of Central System, South part of Quezon City and Ortigas area	socially and economically prioritized area was reviewed
		After Target Year	METROSS IV ~ V		Other areas	
System	Collection System		Separate System for METROSS I to III, and Combined System for METROSS IV to V	Combined System for South Sewerage System (former METROSS II area)	Basically, combined system (interceptor system) is adopted to all new development area.	sub-area should be developed step by step either separate system or combined system
	Treatment System		Outfall without treatment. Future treatment was considered.	same as 1979 Master Plan	Inland treatment	No more degradation of Manila Bay is required.
	System Nos.		4 (including existing Central System)	-	10 systems More system is proposed, for example, Ayala system will remain as separate system, Bonifacio should be developed by private sector and others.	Due to large hectares of one catchment area in 1979 M/P, especially South System, construction cost was estimated quite expensive.
Waste-water	Industrial Wastewater		Combined collection with domestic wastewater	same as 1979 MasterPlan	Industrial Wastewater is not allowed into sewer system	Industrial Wastewater should be treated in individual/common tretment facility.

Sanitation Project

Item	1979 Master Plan	1991 ADB Feasibility Study	1994 MSSP	This Study	Remark
Elimination of sewage from street	PROGRESS Phase I & II was completed	PPOGRESS Phase III & IV was proposed but not implemented	Preliminary study of Street Drainage was investigated but deferred.	No consideration Argument with DPWH,LGU is necessary	
Desludging of septic tank	STAMP was planned but accomplishment was low	Feasibility Study of septage management plan was considered	Regular desludging with efficient vacuum car and treatment (initially ocean dumping) was formulated into Projects	**Basically, this study recofirmed 1994 MSSP.**	
Other Projects	Pilot sanitation facility was constructed				

5.1.2 Water Quality Improvement

In case sewerage and sanitation project will complete by 2015 together with IECP, BOD load is calculated in Table 3.5.1. Figure 3.5.1 is the service area by sewerage system. BOD load generated from these areas is not discharged into river system. BOD load discharged from other area is reduced by regular desludging of septic tank. Septic tank is assumed to remove 35 % of total domestic BOD load. Water quality is also calculated in Table 3.5.2.

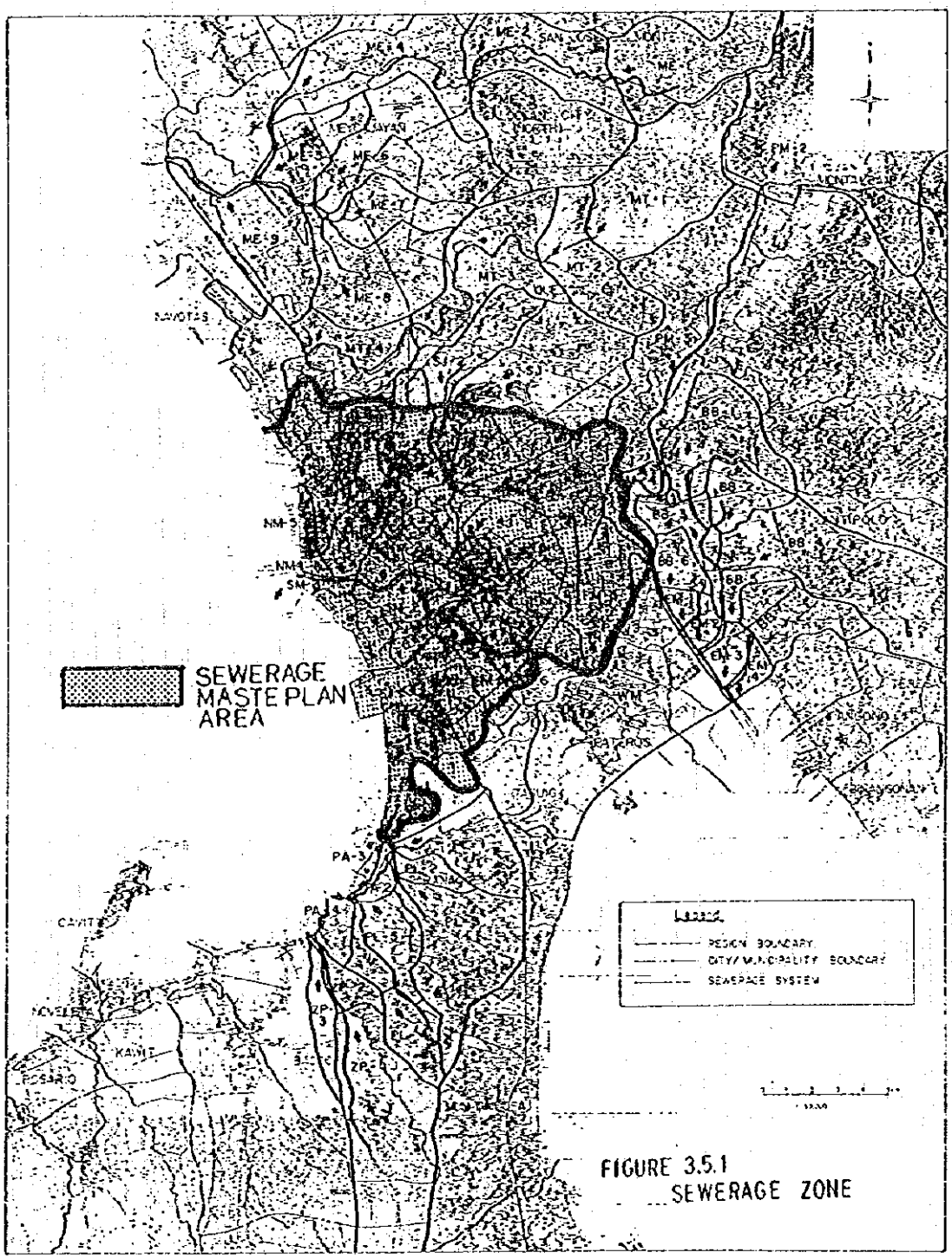


FIGURE 3.5.1
SEWERAGE ZONE

Table 3.5.1(1) PM - Basin BOD discharge (2015) with sewerage/Sanitation Project and IEPC

		PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	Total
Taguig	Area(km2)	33.32	-	-	-	-	-	-	33.32
	Pop.(persons)	12,774	-	-	-	-	-	-	12,774
Antipolo	Area(km2)	174.93	-	40.61	-	-	-	-	215.54
	Pop.(persons)	60,966	-	182,959	-	-	-	-	243,945
Rodriguez	Area(km2)	69.41	97.53	-	-	-	-	-	166.94
	Pop.(persons)	-	146,584	-	-	-	-	-	146,584
San Mateo	Area(km2)	-	-	64.90	-	-	-	-	64.90
	Pop.(persons)			184,618					184,618
Quezon	Area(km2)	-	-	23.30	-	-	-	-	23.30
	Pop.(persons)			303,680	-	-	-	-	303,680
Marikina	Area(km2)	-	-	8.20	2.00	-	-	-	10.20
	Pop.(persons)			185,320	45,200				230,520
Pasig	Area(km2)	-	-	-	1.73	-	-	-	1.73
	Pop.(persons)				37,887	-	-		37,887
Taguig	Area(km2)	-	-	-	-	-	3.30	-	3.30
	Pop.(persons)						46,860		46,860
Mandaluyong	Area(km2)	-	-	-	-	-	-	-	-
	Pop.(persons)						-		-
Makati	Area(km2)	-	-	-	-	-	-	-	-
	Pop.(persons)						-	-	-
Manila City	Area(km2)	-	-	-	-	-	-	-	-
	Pop.(persons)							-	-
Total	Area(km2)	277.66	97.53	137.01	3.73	-	3.30	-	519.23
	Pop.(persons)	73,760	146,584	856,575	83,087	-	46,860	-	1,206,966
	BOD-domestic(kg/D)	2,397	4,767	27,839	2,700	-	1,523	-	39,226
	BOD-Industry(kg/D)	1,014	1,014	1,014	3,769	5,954	3,848	3,848	20,461
	Total BOD discharge	3,411	5,781	28,853	6,469	5,954	5,371	3,848	59,687

Table 3.5.1(2) SJ - Basin BOD discharge (2015) with sewerage and IEPC

		SJ-1	SJ-2	SJ-3	SJ-4	SJ-5	SJ-6	SJ-7	SJ-8	SJ-9	SJ-10	Total
Quezon City	Area(km2)	23.27	10.53	-	-	1.65	-	-	-	-	-	35.45
	Pop.(persons)	454,016	219,024	-	-	34,320	-	-	-	-	-	737,360
Pasig	Area(km2)	-	-	-	-	-	-	-	-	-	-	-
	Pop.(persons)	-	-	-	-	-	-	-	-			-
San Juan	Area(km2)	-	-	-	-	-	-	-	-	-		-
	Pop.(persons)	-	-	-	-	-	-	-	-	-	-	-
Mandaluyong	Area(km2)	-	-	-	-	-	-	-	-	-	-	-
	Pop.(persons)				-				-	-	-	-
Manila City	Area(km2)	-	-	-	-	-	-	-	-	-	-	-
	Pop.(persons)								-	-		-
Total	Area(km2)	23.27	10.53	-	-	1.65	-	-	-	-	-	35.45
	Pop.(persons)	484,016	219,024	-	-	34,320	-	-	-	-	-	737,360
	BOD-domestic(kg/D)	15,731	7,118	-	-	1,115	-	-	-	-	-	23,964
	BOD-Industry(kg/D)	1,622	734	152	694	574	977	353	1,201	650	108	7,065
	Total BOD discharge	17,353	7,852	152	694	1,689	977	353	1,201	650	108	31,029

Table 3.5.1(3) SM/NM - Basin BOD discharge (2015) with Sewerage and IEPC

		SM-1	SM-2	SM-3	NM-3	NM-1-1	NM-4	Total
Manila City	Area(km2)	-	-	-	-	-	-	-
	Pop.(persons)	-	-	-	-	-	-	-
Makati	Area(km2)	-	-	-	-	-	-	-
	Pop.(persons)	-	-	-	-	-	-	-
Quezon City	Area(km2)	-	-	-	-	-	-	-
	Pop.(persons)	-	-	-	-	-	-	-
Total	Area(km2)	-	-	-	-	-	-	-
	Pop.(persons)	-	-	-	-	-	-	-
	BOD-domestic(kg/D)	-	-	-	-	-	-	-
	BOD-Industry(kg/D)	3,848	1,435	-	1,435	1,435	-	8,153
	Total BOD discharge	3,848	1,435	-	1,435	1,435	-	8,153

Table 3.5.2 River Quality (2015 with IEPC and Sewerage/Sanitation)								
Check Point	Catchment Area	River Flow	Discharged domestic BOD	Discharged industrial BOD	domestic run-off ratio	Industrial run-off ratio	Run-off BOD	BOD concentration
	(km2)	(m3/sec)	(kg/day)	(kg/day)	(-)	(-)	(kg/day)	(mg/l)
1	277.66	10.83	2,397	1,014	0.2	0.6	1,088	1
2	277.66	10.83	2,397	1,014	0.2	0.6	1,088	1
3	375.19	14.63	7,164	2,028	0.2	0.6	2,650	2
4	512.2	19.98	35,003	3,042	0.2	0.6	8,826	5
5	518.38	20.22	37,703	6,811	0.2	0.6	11,627	7
6	518.38	20.22	37,703	6,811	0.2	0.6	11,627	7
7								
8	549.07	21.41	39,226	24,309	0.2	0.6	22,431	12
9	640.51	24.98	63,190	31,374	0.2	0.6	31,462	15
10	23.27	0.91	15,731	1,622	0.2	0.6	4,119	53
11	10.53	0.41	7,118	734	0.2	0.6	1,864	53
12	33.8	1.32	22,849	2,356	0.2	0.6	5,983	53
13	71.75	2.80	23,964	5,106	0.2	0.6	7,856	32
14	91.44	3.57	23,964	7,065	0.2	0.6	9,032	29
15	661.81	25.81	63,190	31,374	0.2	0.6	31,462	14

Part IV

Institution, Organization and Operation

Chapter 1.

Introduction

Part IV. Institution, Organization and Operations

Chapter 1. Introduction

1.1 Current Status of MWSS

1.1.1 Sector Targets

The objectives and targets set by GOP for the water supply, sewerage and sanitation sector were originally established in the Mid-term Philippine Development Plan (MTPDP) (1993-1998), and the MWSS Strategic Plan: Toward Philippines 2000 (1994-2000) was developed based on the national plan. Then MWSS has realigned its development plan according to the Philippines 2000 to support President Ramos' bid to transform the Philippines into a Newly Industrialized Country. The targets were defined in MTPDP and Philippine 2000 as follows:

MTPDP Targets for Year 1998 (MWSS Service Area)

- Service of potable water: 71 % or 9.1 million
- Sewerage service: No specific target defined.
- Sanitation: No specific target defined.

Philippines 2000 for Year 2000 (MWSS Service Area)

- Service of potable water: 90 % or 12.6 million
- Sewerage service: 14 % of the entire service area population
- Sanitation: No specific target is defined. (93 % nation wide)

In order to achieve the above sector targets, GOP has developed national sector financing policies of which details are described in Chapter 3 of Part I.

1.1.2 Current Status

Service Coverage as of 1995 of each sub-sector in the MWSS service area is as follows:

Table 4.1.1 Current Status of MWSS

Area	Current Status
Water Supply	• 63 percent or 6.8 million (approx. 788,000 connections) • Designed water distribution capacity ... 3,100 MLD • Average water distribution amount ..... 2,700 MLD
Sewerage Service	• 8.8 percent or 954,000 persons • Catchment area .... 4,553 ha
Sanitation	• 88 percent or 9.5 million

1.2 Impediments for Expansion

1.2.1 General

There are several factors that impede the expansion of the MWSS business to fulfill its public duties and the enterprise efficiency of the missions. They are categorized as follows:

- Political factor
- Organizational
- Financial
- Technical
- Social.

1.2.2 Political Factor

This is one of the external impediments that is created by government agencies, the legislative body and politicians. The major impediments are as follows:

(1) Delay in Legislation

- Amendment of MWSS Charter (RA 6234) to increase authorized capital of MWSS and amounts of local and foreign loans that MWSS could incur.

(2) Political Pressure

- Difficulty in increasing water tariff to improve operations of MWSS depending on the political environment
- Appointment of Administrator and members of the Board of Trustees that affect the change of policies and directions and priority of construction projects
- Influence exercised on the hiring of employees.

(3) Government Regulations and Control

- DBM - regulates and controls annual and project budgets of MWSS
- DBM - reviews and approves increase and decrease in number of authorized positions, and CSC - regulates compensation and employee benefits
- COA - regulates the operating and accounting procedures of MWSS.

(4) Lack of Coordination among Water-Related Agencies

- Absence or inadequacy of long-range sector plan
- Insufficient coordination among related agencies including NWRB, DPWH, DOH, MWSS, LUWA, and LGUs.

1.2.3 Organizational Factor

It is one of the internal impediments created from the organizational and operational setup. The major impediments are:

(1) Large and Bureaucratic Organization

- Heavily centralized and functionally divided into too many inter-dependent departments and divisions and too big to manage the whole organization centrally
- Narrowly defined control span requires a large number of operational units and middle managers
- Excess management layers prevents smooth decision making.

(2) Weakness in Planning and Control Functions

- Absence of corporate and functional planning process
- Lack of coordination in corporate, project and functional planning
- Lack of integration between planning and monitoring/evaluation functions.

(3) Absence of Human Resource Development Strategy

- Lack of comprehensive human resource development programs and absence of a career development plan
- Ineffective performance evaluation and lack of effective incentive systems.

(4) Lack of Delegation of Power and Authority

- Delay in actions due to lengthy and slow decision making process with much red tape.
- Imbalance of authority and responsibility due to lack of delegation of power.

1.2.4 Financial Factor

The financial factor includes the external and internal impediments created from the requirements of outside organizations and the internal operational setup. The major impediments are as follows:

(1) ADB Covenant

- The high rate of return (8 %) requested by ADB restricting budget appropriation to the operating expenses.

(2) Low Collection Efficiency

- Large accounts receivable balance due to the inefficient collection and poor accounts receivable control system
- Delay in the development of a comprehensive accounts receivable control system.

(3) Limited Financial Sources

- Limited financial sources including foreign loans, government equity contribution and ICG
- Lack of ability to develop new financial sources.

(4) O & M Expenses

- Budget constraints and lower priority of budget appropriation on the O&M expenses
- Lack of a measurement factor for operations.

1.2.5 Technical Factor

The technical factor covers the internal and external impediments created from the internal operational setup and the external organizations. The major impediments are:

(1) High NRW (Leakage/Breakage)

- Lack of monitoring system
- Lack of leak detection and prevention technology
- Scarcity of leak repair resources.

(2) Superannuated Facilities

- Deteriorated facilities
- Improper maintenance.

(3) Poor Quality of Materials, Tools and Equipment

- Procurement of poor quality of materials, tools and equipment due to a public bidding policy of awarding contracts to the lowest bidders
- Few qualified domestic suppliers of pipes, materials, meters and equipment
- Lawsuits by lost bidders on the quality of materials.

(4) Few Qualified Contractors

- Lack of skills and experience and construction equipment
- Unwillingness to deal with government contracts due to low profitability, too much paper work, and slow payments
- Weak cash flow of contractors.

1.2.6 Social Factor

The social factor covers the external impediments that are created from the social environment. The major impediments:

(1) Absence of Policies for Poverty Group

- Shortage of water supply facilities for poverty areas
- Lack of policies for financial subsidy for poverty group.

(2) Weakness in Public Health and Hygiene Education

- Lack of public education program.

1.3 MWSS Internal Survey

1.3.1 Survey Objectives

The survey was undertaken to look into the following aspects of the MWSS organization:

- Awareness of organizational and functional goals and objectives
- Clarity and acceptance of performance standards and evaluation measures
- Awareness of inter-agency and inter-office interdependencies
- Efficiency of inter-agency and inter-office linkages

In addition, the survey was designed to identify problem areas and issues affecting performance at three levels of organization: corporate, functional and work group.

1.3.2 Methodology

The survey was conducted using one-on-one interviews, and a questionnaire pre-tested during the first week of January 1995. For the actual interviews, held from mid-January to February 1995, sixty respondents from various MWSS offices were pre-selected. The MWSS Corporate Planning Group coordinated schedules with individuals and in some cases some failed to appear for the pre-arranged appointments. In these instances, up to two follow-up attempts were made before the person was then replaced with someone occupying a similar position.

1.3.3 Findings

Major observations based on the results of the interviews are shown below. The complete tabulation of responses is shown in **Part IV of the Data Report**.

(1) Organization Level

- Most respondents are familiar with the mission statement for the MWSS and readily identified water and sewerage services as key deliverables. However, only a minority could recall the performance and service quality related key words in the mission statement (e.g., continuous and adequate, fair and affordable rates, conservation of the environment, model water service utility).
- While most seemed aware of the organizational mission, only a minority could identify vital support functions such as: construction management, system maintenance, and billing and collection. Even those who were able to identify critical functions towards achieving the mission were not clear on functional goals and performance standards, and could not identify performance measures currently in use.
- In a related way, they readily cited major projects being undertaken by the MWSS. The same projects, however, were mentioned in several functional categories. This could indicate a lack of awareness as to the potential impact of major projects on specific areas of operations.
- In the absence of clear performance measures, respondents displayed a tendency to give high self-ratings on mission awareness and functional performance, even in those areas where gross inadequacies were noted (e.g., sewerage services). Quoted as a driving force for organizational performance are the ongoing service expansion projects. On the other

hand, bureaucratic red tape and the lack of sewer handling and waste water treatment facilities were considered major weaknesses.

- This tendency towards high self-ratings extended to the evaluation of linkages with external agencies, even as some pointed to a lack of coordination on infrastructure development plans and projects being undertaken by various agencies. They identified DPWH, local government units (including the Metro Manila Development Authority), PLDT, NIA, NAPOCOR, and MERALCO as the major external agencies with whom the MWSS must coordinate.
- Finally they were somewhat ambivalent towards privatization as a strategy (31 in favor, 18 against). Sectoralization and computerization were viewed more positively.

(2) Function Level

- Overall, they manifest inadequate client awareness. Other than those from operations and customer service which interface directly with water users, they failed to cite major external clientele, e.g., contractors. Similarly, most could not to identify other MWSS units as their clients. This would indicate a lack of awareness of the interdepencies among various MWSS units.
- Internal policy decisions and ad hoc assignments were mentioned almost as frequently as the official charter of the MWSS as the basis for current duties and responsibilities. This raises the possibility of inconsistencies between the official charter and current functional assignments.
- Respondents indicate that management undertakes consultation with superiors and subordinates before giving out assignments and setting performance objectives. Assignments are communicated during regular staff meetings, or in informal discussions with the individuals concerned. Similarly, managers provide evaluation feedback in one-on-one discussions and regular staff meetings. Both modes provide ample opportunity for discussion and clarification.
- However, they had difficulties in identifying functional goals and targets and corresponding performance measures. Performance evaluation appears to be limited to the semi-annual Performance Appraisal Rating (PAR) and Management of Objectives for Results (MORE), which focus on individual accomplishments rather than functional unit or work group performance. Accomplishment reports are submitted by each

organizational unit at regular intervals, but these are not evaluated and no formal feedback is given. The system is treated more as a reporting requirement, rather than an evaluation tool. The high number of no evaluation and no response answers on evaluation practices raises the question on whether current performance evaluation mechanisms are adequate.

- Inter-group coordination suffers from delayed reporting and/or transmission of written communications. Personal differences among some managers also affect coordination.

(3) Operating Systems

- Respondents had difficulty in estimating response times of the individual processes under their control and could not provide ratings. The lack of customer orientation and the consequent lack of appreciation of client expectations could be a major factor in this inability to evaluate throughput performance.
- As stated before, employee performance is formally evaluated only twice a year, using the Performance Appraisal Rating (PAR) and the Management of Objectives for Results (MORE) systems.
- Other than salary levels and timely releases, employee motivation hinges on performance recognition, promotion opportunities, and management styles/role modeling. Departures from ideal management practice (e.g., partiality in application of rules, subjective criteria for promotion, patronage) are considered demotivators.
- Systems and procedures have remained untouched for some time. Most claimed to have a manual of procedures to guide their work areas, but could not produce a copy of the same upon request.
- The computerization and decentralization/sectoralization initiatives currently being undertaken are viewed favorably. However, these initiatives appear to have limited impact on the organization as a whole. Only the engineering design, sewerage services, customer service, FCBD, accounting, and treasury units identified sectoralization and decentralization as having affected their operations. On the other hand, only central maintenance, customer service, accounting and personnel quoted computerization as having affected operations.

Chapter 2.

Review of Current Operation

Chapter 2. Review of Current Operations

2.1 Laws and Regulations

The following table summarized laws and regulations directly or indirectly related to the water supply, sewerage and sanitation operations in the Republic of Philippines:

Table 4.2.1 Structure of Laws & Regulations for Water Supply, Sewerage & Sanitation

Category	Laws and Regulations	
A. Water Supply	a. Water resources	SB 2061 - National Water Crisis Acto of 1995 (5/31/95) PD 1067 - Water Code of the Philippines (12/31/66) RA 3601 - Created the National Irrigation Administration (6/22/63) PD 424 - Creating a National Water Resources Council (3/28/74) RA 6234 - Creating the Metropolitan Waterworks and Sewerage System (6/19/71) amended by PD 425/1269/1406/1940; EO 796/1063/197/799 EO 385 - Delineating Jurisdiction over Waterworks Systems between MWSS and DPWH (3/14/72) LI 683 - Instructed implementation of the following basic policies for the water supply sector (3/30/78) PD 1345 - Authorizing MWSS to take over centralized water systems of residential subdivisions (4/2/78) LI 619 - Directed the issuance of a new certificate in favor of MWSS covering a land known as Boso-Boso Property within the Marikina Watershed Area PD 1145 - Authorized MWSS to take over centralized water systems of residential subdivisions (4/2/78) PD 198 (Provincial Water Utilities Act of 1973) - Created the Local Water Utilities Administration to administer local water systems (9/28/78) EO 577 - Created the Rural Waterworks Development Corporation RA 6716 - Mandated DPWH to construct water wells and rainwater collectors, among others (8/14/89)
	b. Integrated dev. of water	RA 4850 - Created the Laguna Lake Development Authority (6/19/66) LI 401 - Ordering certain agencies to work together in the implementation of the Manila Urban

	Development Project (5/13/76)
B. Land Use	PD 296 - Directing all persons, natural or juridical, to renounce possession and move out of portions of river, creeks, esteros (estuaries), drainage channels and other similar waterways encroached upon by them and prescribing penalty for violation (9/18/73) PD 18 - Establishing the Metropolitan Manila Flood Control and Drainage Council (10/7/72) PD 324 - Excluding a portion of land from the Marikina Watershed Reservation (10/29/73) PD 814 - Prescribing the Land Tenure System for the Tondo Foreshore and Dagat-Dagaan Urban Development (10/20/75) PD 825 - Commanding the cleaning of canals and esteros (estuaries), among others (11.7/75)
C. Labor Relations	1987 Constitution of RA - The coverage of MWSS employees by civil service laws is explicit from Sec. 2(1) of art. IX B of the constitution EO 292 - Instituting the Administrative Code of 1987 (7/25/87)
D. Water Related Environmental Protections	PD 1152 - Philippine Environment Code (6/6/77) RA 3931 - Creating the National Water and Air Pollution Control Commission (6/18/64) PD 602 - National Oil Pollution Operations Center Decree (12/9/74) PD 979 - Providing for the Revision of PD 600 Governing Marine Pollution (8/18/76) EO 117 - Establishing an Inter-Agency Task Force for Coastal Environmental Protection (IATFCEP) ((/11/93) EO 430 - Constituted the National Committee on Bio-safety of the Philippines (10/15/90) PD 984 - Pollution Control Law with Implementing Rules and Regulations and DENR Administrative Orders #34 & 35 PD 1160 - Vested to Barangay Captains enforcement of pollution and environmental control laws PD 1586 - Established Environmental Impact Statement System EO 162 - Restored to DENR control of Angat Watershed Reservation
E. Sewerage & Sanitation	Direct laws on sewerage management PD 856 - Sanitation Code of the Philippines (12/23/75) PD 957 - Regulating the sale of subdivision lots, condominiums, providing penalties for violations (7/12/76) The Local Government Code of 1991, mandated to LGUs in providing sanitation and sewerage services in their localities
	Laws supportive of sewerage mgmt.

	RA 1364 - Sanitary Engineering Law (6/18/55) RA 1378 - Plumbing Law (6/18/55)
F. Criminal Laws	PD 401 - Penalizing the unauthorized installation of Water, Gas, Electrical or Telephone connections (6/12/85)
G. Water Tariff	EO 204 - Created Special Committee to conduct public hearings on proposed increases in water rates (1/5/70)
H. Governing MWSS Internal Operations	Government Accounting & Auditing Manual Volume I to III prescribed by COA RA 6758 - Compensation and Position Classification Act of 1989 (7/1/89) EO 292 - Appointment, promotion, and discipline, among others, of personnel RA 7430 (Attrition Law) - Providing optimum utilization of personnel in government service through a system of attrition, providing penalties for violation (6/16/92)
Privatization Law	RA 7718 - BOT (Built-Operate-Transfer) Law

2.2 Organization

2.2.1 MWSS Organization

MWSS is a government controlled and owned utility of which the main goal is to attain economy of scales in its operations as a monopoly licensed by the government. The following is a summary of MWSS organizational characteristics:

- Public corporation and fully owned and controlled by GOP
- Utility which is a monopoly with a service area covering Metro Manila and contiguous areas
- Heavily centralized with multiple functions including planning, development, O&M, customer service and various supporting functions
- Bureaucratic functional organization employing approximately 8,000 people with high interdependency throughout the enterprise
- Quasi-governmental agency and semiautonomous organization regulated by the various government agencies such as DBM, CSC and COA
- Self-reliant operations on a full cost recovery basis except for GOP equity contribution to foreign assisted infrastructure developments, operations maintaining independence from DPWH.

In order to perform its duties and responsibilities, MWSS has the following major functional areas:

- Planning and Control
- Infrastructure Development
- Operations and Maintenance
- Customer Services
- Supporting Functions.

(1) Planning and Control

The major characteristics to be considered for organizational development are:

- Corporate staff function
- Required mixed professional skills in corporate planning, engineering, finance, etc.
- Required close coordination with other core and supporting functions
- Project-oriented tasks and nonroutine work.

Currently planning and control activities are partially performed by Corplan, PMED and FCBC.

(2) Infrastructure Development

Major characteristics to be considered for organizational development are:

- Required centralized organization to consolidate management resources for infrastructure developments
- Project-oriented tasks with duration from a few months to several years and requiring manpower of several people to hundreds
- Required mixed core skills in engineering and construction management.

Currently the entire activities are performed in the Engineering and Construction Areas.

(3) Operations & Maintenance

The major characteristics for organizational development are:

- Daily routine work and maintenance of 24-hour operations and services
- Operations and maintenance of many different types of facilities and equipment located in various areas
- Development and maintenance of logistics for O&M resources
- Required centralized O&M organization for water source and treatment, and waste water treatment. Decentralized O&M organization for distribution network and sewer line.

Currently operations and maintenance activities are performed mainly in O&M. Leak repair work for distribution network is performed by the Service Centers in the Customer Service Area.

Logistics for operations and maintenance resources are covered by the Treasury Department and the Procurement Department.

(4) Customer Service

Major characteristic for organizational development are:

- Customer oriented to attain satisfaction of customers
- Provision of one-stop type service for application of connection service, collection of payments for water bills and sewerage fees, and responses to customer claims
- Required decentralized organization by region for quick response to consumers
- Daily routine work that deals with a great number of customers and transactions with heavy paper work.

Currently activities are performed mainly in the Customer Service Area. Tariff planning and adjustment activities are done by Corplan.

(5) Supporting Functions

The major characteristics of the supporting functions to be considered for the organizational development are:

- Functional and centralized organization to attain scale of economy throughout the MWSS organization
- Provision of various administrative services to support other functions as their internal customers through extensive coordination and communication
- Requires different type of specialists with skills in finance and accounting, HR management and development, information technology, public relations, legal affairs, procurement, health and safety, etc.

Currently their activities are carried out mainly in the Finance and Administration Areas, and the MIS Group.

2.2.2 Consideration for Future MWSS Organization

Based on the definition of organizational characteristics discussed above and the policies to achieve the mission of MWSS, the future MWSS organization will be characterized as follows:

(1) Public Duties

In order to achieve the mission of public duties, MWSS must stay as a public corporation owned by GOP with privatization of part of the operations for improving enterprise efficiency. The following defines future characteristics:

a) Public Corporation with Partial Privatization

- Fully owned by GOP and maintaining the planning and control, infrastructure development, operations and maintenance, customer service and supporting functions
- Introduction of BOT schemes in viable infrastructure developments and O&M of water source and treatment facilities to accelerate development and expansion
- Improvement of operational efficiency in the customer service area through the private sector participation (PSP) based on a delegated contract scheme(s).

b) Mission-oriented Functional Organization

- Mission-oriented organizational setup to attain corporate objectives and goals
- Functionally structured organization consisting of planning, infrastructure development, O&M, customer service and supporting functions.

c) Mixture of Centralized and Decentralized Organization

- Centralized planning and control, infrastructure development and supporting functions
- Mixture of the centralized organization for water production and the decentralized organization for distribution of O&M function
- Independent O&M function for sewerage system
- Decentralized and self-contained organization by Sector for the customer service function
- Centralized supporting functions that consist of HR management and development, finance, information systems and communication, and administration.

d) Less Regulated by the Government

- Removal of governmental regulations and controls that prevent the effective operation of MWSS
- Partial privatization in order to free MWSS from the governmental regulations and controls, which may then be exempted.

e) Self-reliant Operations

- Full cost recovery base operations for the Water Supply sub-sector
- Full cost recovery base for operations and maintenance and partial cost recovery for capital expansion with government financial assistance for the Sewerage and Sanitation sub-sector.

(2) Enterprise Efficiency

In order to achieve this second mission, MWSS must have a leaner and meaner organization and introduce commercial principles to the organization. The following defines the characteristics of the future organization on this account:

a) Organizational Setup

- Leaner and meaner organization through rightsizing, simplification and more power delegation to operating units
- Private enterprise type organization through introduction of commercial principles such as the self-supporting intra-company concept for some functions
- Introduction of the principle of competition to customer service areas
- Integration and strengthening of planning, monitoring and evaluation functions
- Cross-functional integration and coordination of infrastructure development projects.

b) Partial Privatization

- Through a management contract privatization of some Sectors in the Customer Service Area that have reached or exceeded the targets of the service coverage
- Contracting out non-mission activities to the private sector.

2.2.3 Organizational Reform

As discussed in **Sections 2.2 and 2.3 of Part IV in the Main Report**, MWSS faces many management issues and must improve and strengthen its organizational and operational setup in order to fulfill its public duties and attain enterprise efficiency. Based on the study conducted on the corporate mission, organizational characteristics and impediments for fulfilling public duties and enterprise efficiency, the following scenario for the organizational reform has been formulated by the Study Team.

In order to develop the Master Plan for MWSS institutional strengthening targeted for the year 2015, the period of 20 years is divided into four phases, each a five-year span. In addition, each one is characterized based on the key objectives to be achieved as follows:

- Phase I (1996 - 2000): Restoration Period
- Phase II (2001 - 2005): Restructuring Period
- Phase III (2006 - 2010): Expansion Period
- Phase IV (2011 - 2015): Stable Period

(1) Phase I (1996 - 2000): Restoration Period

In this period, the most important issue for MWSS is to concentrate its efforts on mission critical tasks and to eliminate the waste of management resources that could be performed at the operating unit level by focusing on the most important tasks at hand and by removing low or non-value added activities.

At present, several critically important projects for MWSS are taking place. They are the Revenue Improvement Program, the Sectoralization Scheme, the Information Systems Plan (ISP) and the Change Management Program (CMP). However, they have not been smoothly implemented and may require more management resources and time to fully complete. Since those projects have already started and are being implemented, it would not be advisable that they be replaced by totally new plans. In order to make them successful, each one should be reviewed and re-prioritized considering the expected benefits, required time and costs to complete, complexity and risks, and required skills. They could also be disintegrated or integrated to manageable size, phased into

several time spans based on the priority and resources to be reallocated. The monitoring and evaluation process for their progress must also be developed and implemented. The efforts required may take at least two to five years, so the Phase I period may be dedicated to complete them.

Another critical area to be improved in Phase I is the design and implementation of the management planning and control process in MWSS.

During Phase I, the operational improvement in areas not regulated by other government agencies could also be implemented. In addition, efforts to remove or lessen governmental regulations and controls that prevent efficient operations must be made.

(2) Phase II (2001 - 2005): Restructuring Period

In Phase II, the main issue is a structural change of the organization and operational setup to further enhance its performance dramatically based on the improvement made in Phase I and the re-engineering of core and support processes. During this phase, there may be a need to develop an integrated O&M and logistics system and a comprehensive HR management and development program.

In addition, improvements on currently regulated areas could also be made if government regulations and controls are removed or reduced. In financial areas, MWSS may need to seek new funding sources to diversify its financial sources.

(3) Phase III (2006 - 2010): Expansion Period and Phase IV (2011 - 2015): Stable Period

Most of the efforts for institutional strengthening and organizational reform would be completed in Phase I and II. In Phase III and IV, MWSS could enhance and adjust its organizational and operational setup to meet changes in external and internal requirements. In addition, MWSS may be able to shift its focus to the improvement of overall corporate performance and to building a more streamlined and flexible organization.

2.3 Operations

2.3.1 Corporate Planning

(1) Planning Activities

MWSS conducts various type of corporate planning activities, mainly performed by the Corplan Group and PPD in the Engineering Area. Current corporate planning activities include:

- Formulation of the national and sector plans
- Formulation of corporate missions and vision
- Development of capital expansion plans and programs
- Development of tariff structure and schedule
- Demand and financial projections.

a) Formulation of the national and sector plans

MWSS sends its representatives to an inter-agency committee or task force to participate in activities to formulate a national development plan, a master plan for waterworks, sewerage and sanitation sector, and national level infrastructure development plans and programs.

b) Formulation of corporate missions and vision

MWSS formulated its first corporate mission and vision statement in 1987, but it was not well communicated to employees and stakeholders. The new corporate mission and vision statement was developed and approved by the Board of Trustees in February, 1995 to further clarify roles and goals of MWSS for employees and stakeholders.

c) Development of capital expansion plans and programs

Major capital expansion plans are primarily studied and formulated by consultants sent by ILAs. MWSS Engineers participate in these studies as counterparts of ILA consultants. PPD coordinates all capital expansion plans and programs. Feasibility studies on proposed capital expansion projects are also conducted by PPD with assistance from ILA consultants in the technical aspect and by Corplan in the economic and financial aspects. Feasibility reports are then submitted to NEDA and ICC (Investment Coordination Committee) for their review and approval.

d) Development of tariff structure and schedule

The Corplan Group reviews the tariff schedule every year to recommend the new structure and rate and the implementation plan to the Board of Trustees. The tariff rate and structure are also reviewed according to proposals made by ILAs. The most recent study in this area was conducted by the Corplan Group in July, 1995.

e) Demand and financial projections

The Corplan Group and PPD perform water demand projections annually to prepare annual water projection data. In addition, using computerized models financial projections are made by Corplan on revenues, loans, capital expenditures, operating expenses, debt service, depreciation expenses, etc. for the next 10 years or longer.

(2) Monitoring and Evaluation

Corporate performance of MWSS is centrally monitored by PMED in the MIS Group and the Corplan Group. These Groups periodically prepare the following reports respectively:

- Development of the MWSS Corporate Performance Report
- Development of the Management Indicator Report

a) MWSS Corporate Performance Report

PMED monitors the performance in each functional area based on the Accomplishment Report prepared by each functional unit twice a month. It compiles the performance data every month and prepares the MWSS Corporate Performance Report including their evaluation on a quarterly basis in order to report to the Administrator, senior executives, related agencies and ILAs.

b) Management Indicator Report

The Corplan Group prepares the Management Indicator Report on a monthly basis summarizing the historical results of operations for the past 10 years such as water bills collected, water produced, cost per unit and other performance measurements. It is then submitted to the senior executives.

2.3.2 Financial Management

(1) DBM Budget

a) Budget Call

A budget call is received from DBM in the National Government in January/February. It is an official request for MWSS to prepare the DBM Budget for the next year to form part of the National Budget.

b) Level of Operations

FCBD coordinates with operating units for the budget year's level of water/sewer production and billing efficiency (or NRW percentage). In conjunction with a possible tariff revision, the budget year's revenue will be set.

c) Priorities and Major Objectives

FCBD articulates MWSS priorities, dispositions and actions for the budget year based upon the management plans and directions provided by the Board of Trustees.

d) Expenditures

Expenditure level is estimated based upon the past history as a guide and the current year's activities to meet budgetary goals and objectives as to the following:

- Capital outlays and obligations for foreign-assisted capital projects
- Drawdowns of foreign loans and related finance charges
- Operating and maintenance expenses
- Capital outlays to be incurred by operating units
- Personnel headcount and costs

When the Corporate Budget call is made in the summer, for the following year, it is also requested that the operating units submit the succeeding year's budgetary requirements. For example, the

1995 budget call issued in June 1994 requested the budgetary information for FY 1996. This information is used in conjunction with the preparation of the DBM Budget for the next year.

e) Major Factors in DBM Budget Preparation

Playing a major role in preparation of the DBM Budget are the level of NRW, since it has become such a significant issue, and the ROR (ADB covenant), which roughly speaking requires MWSS to attain at least 8 percent return on net fixed assets. Either the NRW level or the expense level might need to be adjusted to achieve this 8 percent requirement in the budget preparation.

(2) MWSS Corporate Budget

a) Authority

The Corporate Budget is managed and consolidated by the Budget Management Division (BMD) of the FCBD from the budget proposals to be provided by the operating units, i.e., departments, sectors and project offices. The Executive Committee meets on the budget proposals. The finalized consolidated budget proposals are to be discussed by the Board Committee on Financial Management, Comptrollership and Auditing (consisting of some of the Board members) and then, submitted for approval to the Board of Trustees with the recommendation of the Administrator.

b) Objectives

The Corporate Budget aims to:

- present MWSS's budgetary thrusts in terms of functions, programs, projects and activities based upon attainable and measurable levels of performance - PLAN
- draw the budget as a work program designed to allocate funds among functional categories and activities, to assure the efficient and effective utilization of available resources and credits - DO
- provide quantitative data necessary for evaluation and measurement of actual results in terms of service, products and benefits derived from the utilization of the appropriated funds within a given period - SEE
- provide a tool of establishing quality and cost standards for every program and activity within MWSS - ACCOUNTABILITY

As indicated above, the Corporate Budget is designed to function as a means of management and control in the fundamental phases of an enterprise's operations, namely PLAN-DO-SEE-ACCOUNTABILITY.

c) Budget Call

A budget call is prepared by the FCBD and issued by the Administrator in June/July, presenting the level of operational performance and development programs of concerned areas in line with the DBM Budget.

d) Level of Production and Revenue

The FCBD coordinates with the Operations Area, the Customer Service Area and the Computer Service Center to determine the level of production and revenue.

e) Expenditure Proposal

The BMD-FCBD receives budget proposals on expenditures from the operating units and project offices prepared on predetermined budget proposal forms.

f) Proposal Evaluation

The BMD-FCBD evaluates budget proposals in the following areas:

- Project cost estimates
- Appropriation requirements for funding the projects
- Cash requirements
- Engineering and administrative costs

g) Budget Hearing and Agreeing with Operating Units

Based upon the comparison between the estimated revenue and the consolidated level of expenditures, the BMD - FCBD conducts a budget hearing and agrees with operating units/project offices on the expenditure budget. The ROR (ADB covenant) plays a significant role here.

h) Finalization

The consolidated budget proposals are presented for discussion in a meeting by the Executive Committee (consisting of Administrator, Senior Deputy Administrator and all other Deputy Administrators). Any changes resulting from the discussion are reflected thereon and the consolidated budget is presented by the Administrator to the Board of Trustees for its approval.

i) Release of Funds

MWSS uses the allotment system to appropriate budgeted funds to different organizational units. Allotments are issued on a quarterly basis by the FCBD upon the approval of the Administrator at least five days before the beginning of each quarter based upon the predetermined estimates necessary for the accomplishments of programs and activities of each performing unit during the ensuing period. The Advice of Allotment is the basis of incurring obligations and expenditures during the quarter. The Accounting Department will not pass upon any expenditure without reference to the corresponding Advice of Allotment and certification of availability of funds pursuant to such allotment. Funds appropriated for various functions, activities and projects are available in principle solely for the specific purpose for which they have been appropriated and for no other.

j) Claims Control

After the operating unit has received goods or services, it prepares a claim form for the processing of the invoice from the supplier. The Claims Control Division of the FCBD reviews all the claims coming from operating units for their legality, validity, propriety, accuracy and reasonableness in accordance with existing budgeting, accounting and auditing rules and regulations.

k) Modification of Released Allotment

If the released allotment for an activity, program or project which has started during the quarter is already exhausted and postponement of such is deemed not practical and economical, the department, project or office head concerned may request for the advance release of the succeeding quarter's allotment. The Administrator will approve the request on the basis of the recommendation of the DA concerned and the DA, Finance.

l) Revision of Budget

There are two occasions where the established Corporate Budget may be revised.

The Administrator, on his own or upon the recommendation of the DA, Finance, may modify or amend any allotment previously made when it is determined that the periodical receipts from operations and other sources will not reach the estimated level and as a result thereof, the amount available for allotment will be less than the amount already released. In such case, FCBD will formulate, submit and recommend to the Administrator a revised expenditure budget.

In cases where the total appropriations for the year for an activity, program or project have been exhausted and its continued implementation is crucial to public service and/or revenue generation, the department, project or office head will be responsible for requesting from the Administrator the needed additional funds.

m) Performance Monitoring

The BMD-FCBD prepares a quarterly budget performance report, which is a comparative presentation of actual expenditures versus budget for the quarter. The resulting variances are accompanied by comments or narrative explanations on what is attributed to the variances.

The BMD-FCBD also monitors the financial performance of the projects by summarizing disbursements and giving the project offices status of the project cost estimates against appropriations and/or obligations.

2.3.3 Construction Project Management

(1) Project Management Cycle

The implementation of construction projects usually goes through the following construction planning and management process:

a) Project Planning

The project planning phase, mainly performed by PPD in the Engineering Area, includes a preliminary study of population, household incomes and socio-economic conditions. The feasibility study which is part of the project planning phase includes evaluation of technical and

non-technical aspects such as risks, impacts on social, economic and environmental matters, financial aspects such as identification and source of inputs like manpower, equipment and funds, and implementation timetable.

b) Design

It includes a detailed design for project cost estimation, criteria for selecting contractors, vendors, materials to be used and other specific information for bidding and contract preparation purposes.

c) Bidding

It includes preparation of bidding documents, announcement and advertising, bidding, awarding and contracting.

d) Construction Management

Construction management includes monitoring construction progress, evaluation of construction, and testing materials, workmanship and facilities as basis for issuing a certification of accomplishment to constructors as support for payments.

e) Acceptance Test and Transfer to the O&M Area

The final phase is the acceptance test and transfer of completed facilities to the Operations and Maintenance Area.

The above five activities are now conducted by two functional areas in MWSS, namely the Engineering Area and the Construction Area. The Engineering Area covers a) to c), while the Construction Area takes charge of d) and e). These phases are followed for both foreign assisted and locally funded projects. They are also followed for surface and ground water development projects, rehabilitation projects of facilities and pipeline network, and new distribution development projects. In addition, they are undertaken by a project team or group composed of staff mainly from the Engineering and the Construction Areas.

(2) Project Organization

Construction projects are mainly performed between the Engineering and the Construction Management Areas. The Corplan Group and the Finance Area are also involved in the projects at the planning stage to review economic and financial aspects of the projects. All capital expansion projects are performed by project organizations which last the duration of the projects and are mainly staffed by casual employees. Capital expansion projects are classified into two categories, the foreign assisted project (FAP) and the locally funded project (LFP), according to the source of funds.

a) Foreign Assisted Project

The foreign assisted projects, funded by international lending agencies as primary financial sources and by the GOP which makes an equity contribution to match foreign loans, undertake large constructions and rehabilitation of facilities. Typically, projects consist of several components and requires large numbers of casual employees, from dozens of people for the early stage of the project to several hundreds at the peak of a large one. Organizational structures of the project office vary project to project and depending on the project stages. There is no unified project organization, however, the following shows the organization of the Umiray-Angat Transbasin Project as an example:

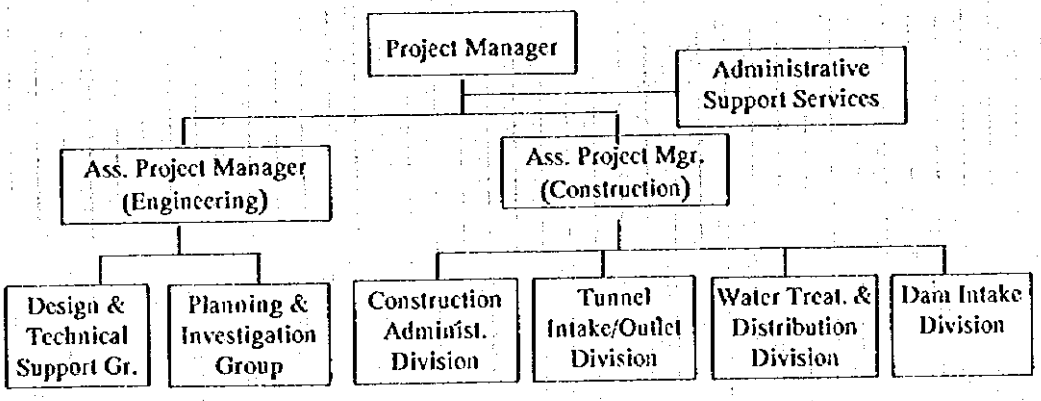


Figure 4.2.1 Example of Foreign Assisted Project Organization

b) Locally Funded Project

They are financed by internal cash generation (ICG) and undertake constructions that require quick response to public requests for improvement, expansion, replacement, interconnection of small

scale watermains extensions and other miscellaneous work that fall outside of ongoing foreign assisted projects. They are part of normal work activities of the Construction Management Area and the Local Funded Project Dept. of the Construction Management Area which manages approximately 100 LFPs. Generally those projects last a short period of time at an average cost of around one million pesos.

(3) Project Monitoring and Evaluation

The progress status of the foreign assisted projects is monitored by each project office and a monthly accomplishment report is prepared by the project manager for distributing to the DAs and department managers in the Engineering and the Construction Management Areas.

The progress status of the locally funded project is monitored by the project manager and reported to the Locally Funded Project Dept., which prepares a monthly accomplishment report for the regular meeting attended by DAs and department managers in the Engineering and the Construction Management Areas.

2.3.4 Operations and Maintenance

(1) Facilities

MWSS operates and maintains facilities such as dams, intake structure, water treatment plants, pumping stations, reservoirs, and sewerage treatment plants on a full 24-hour and 365-day basis to provide uninterrupted water supply and continuous sewer services for its customers. Operation and maintenance work of those facilities are supported by various MWSS operating units and employees who work three shifts a day. The following table lists the major facilities of water sources, water treatment plans, water distribution system, and sewerage system:

Table 4.2.2 Major Facilities of MWSS

Facilities	Locations (Numbers)
Water Sources	La Mesa Dam & Intake Towers (4)
Treatment Plants	Balara Treatment Plant I & II (2) La Mesa Treatment Plant I & II (2)
Reservoirs	Bagbag, Pasig, San Juan (3)
Deep wells	Total 135 deep wells (22 deep wells are not operational) Total 57 chlorinators out of 135 deep wells are operational
Pumping Stations	Caloocan, Algeciras, Tondo, Ermita, Espiritsu, Pasay, Balara, Fort Bonifasio, Makati, San Juan, Cubao, D. Tuazon, Pasig
Distribution Piping Network	Primary Main: Total approx. 330 km/300 mm or over Secondary Main: Total approx. 402 km/200 - 250 mm Tertiary Pipe: Total approx. 3,331 km/150 mm or less
Sewerage System	Lift Stations (7 locations) Tondo Pumping Station Ayala Sewerage Treatment Plant Dagat-Dagatan Wastewater Treatment Ponds Central Sewer Line: Total 305 km Other Sewer Lines: Total 193 km (Quezon City, Dagat-Dagatan, Ayala)

(2) Operations Management

a) Waterworks

The operation management involves scheduling , facility and equipment operations, and monitoring and reporting of operating. The following table summarizes the major facilities and equipment operated and maintained by the Water Sources & Treatment Dept. (WSTD) and Water Distribution & Maintenance Dept. (WDMD):