Central System. Finally, the south area of the Pasig River will be converted to this system. An aerated lagoon is considered but future upgrading to a more space-saving method is necessary.

Ayala

An additional 300 ha will be sewered. The existing sewage treatment plant does not have enough capacity for the additional area, and future expansion of the treatment plant is necessary. The required capacity is calculated to be 29,000 m^3/d (daily average 69,000 - 40,000). The daily maximum is 35,000 m^3/d and activated sludge will be adopted for the efficient use of the existing treatment plant site.

Bonifacio

This is an area redevelopment is projected by the private sector. The sewerage system should be constructed by its developers with activated sludge as the recommended method to be utilized.

Central Manila

As proposed in the preliminary report of the MSSP, wastewater collected through the Central System will be transferred to Dagat-Dagatan together with the wastewater from Sampaloc, Caloocan, Balut and Dagat-Dagatan. The existing Dagat-Dagatan treatment plant can first be upgraded to an oxidation ditch for only the expanded areas. As a second step, the activated sludge method will be adopted to treat all the sewage including now discharged into Manila Bay to utilize the existing site efficiently.

North Manila

This area is divided into two river basins; the MNTT and the San Juan river basins. Of these, the MNTT area is comparatively easy to collect wastewater from upstream of the river to downstream along the river. On the other hand, the San Juan river basin is to be converted to the North system against the ground slope by the pumping station. An aerated lagoon is considered for both systems using the existing marine pond in the Malabon/Navotas area.

3.2.4 Sewerage Master Plan

(1) Selection of the Master Plan Area

The 10 systems were evaluated and prioritized from the following points: development of the area, cost-benefit (cost per beneficiary), cost recovery (willingness/affordability to pay), and environmental impact. (See in Table 3.3.13). The areas where sewerage development is highly recommended and financially feasible up to 2015 have been designated in the Master Plan area including existing service areas.

Table 3.3.13 Comparison of Priority Area

System Name	Development	Cost-Benefit	Cost-Recovery	Environmental Impact	Total Priority	Remark
Marikina	This area shows high population increase Future density 190 persons/ ha	Beneficiary 1,104,226 persons Cost 5,486 m.p cost per person 4,968 peso/person	not so high income except some subdivision	Due to comparative large flow of Marikina river, impact on river is not so important	Low	
East Mangahan	Cainta area also shows rapid increase rate in population 187 persons/ha	Beneficiary 739,484 persons Cost 3,562 m.p cost per person 4,817 peso/person	not so high income except some subdivision	This area is one of pollutively contributing areas for Laguna Lake	Low	
West Mangahan	Ortigas, right bank of Marikina river is now rapidly developing Especially, Ortigas has become new core area as is described in frame plan 208 persons/ha	Beneficiary 1,062,550 persons Cost 4,595m.p cost per person 4,324 peso/person	Ortigas area has high income resident	Ortigas discharge pollutive load to Marikina River, while Pasig/Taguig to Laguna Lake. Importance is not so high	Middle	Ortigas area is recommend ed to be sewered as early as possible
Muntinlupa	High income sub-division is concentrated in this area 176 persons/ha	Beneficiary 665,929 persons Cost 4,269m.p cost per person 6,411 peso/person	Comparatively high income residence	This area is also one of most pollutive areas around Laguna Lake both from industry and residents	Middle	
Paranaque	high population growth area 202 persons/ha	Beneficiary 1,323,275 persons Cost 5,784m.p cost per person 4,371 peso/person	Not so high income	Pollutive water is stagnant in low-land areas and improvement is urgent	Middle	
South Manila	Highly populated area and much commercial facility like hotels and restaurants are located 334 persons/ha	Beneficiary 1,557,338 persons Cost 3,492m.p cost per person 2,242 peso/person	Due to high economical activity, cost-recovery is easier than other areas	Highly developed area discharges much pollutive load to Manila Bay	High	METROSS -II area

Ayala	Already partly sewered area with residential and commercial building 304 persons/ha	Beneficiary 273,985 persons Cost 725m.p cost per person 2646 peso/person	high income resident	High standard of living discharges much pollutive load to the creek/esteros	middle	Rehabilitat-ion of existing facility has priority
Bonifacio	New development is expected in this areas 179 persons/ha	Beneficiary 192,918 persons Cost 1,171m.p cost per person 6,070 peso/person	New development should be proceeded on the expense of developer	New large development should be environmentally friendly using recycling system	Low	
Central Manila	Most part of Manila City has already sewered. North areas are highly populated areas 467 persons/ha	Beneficiary 1,723,686 persons Cost 4,250m.p cost per person 2,466 peso/person	Income level is not so low in the unsewered area of Manila City and Caloocan	Unsewered areas discharge high pollutive load directly to Manila Bay	High	Part of METROSS -III area
North Manila (MNTT river basin)	Highly populated area 253 persons/ha	Beneficiary 1,480,709 persons Cost 5,291m.p cost per person 3,573 peso/person	Income level is not so high except some sub-division	This river is most polluted river in MMR and improvement is urgent net to the Pasig River	Middle	Part of METROSS -III area
North Manila (San Juan river basin)	San Juan basin has much commercial/political/institutional center 218 persons/ha	Beneficiary 2,023,217 persons Cost 7,380m.p cost per person 3,648 peso/person	Economical activity is lively, especially in and around Cubao. Cost-recovery can be easier	San Juan river basin is also very polluted basin with high social/economical activities	High	

Cost includes sewer network construction cost calculated in supporting report

The selected development areas are the South Manila System (former METROSS-II area), Central Manila System (part of former METROSS-III area), south part of the San Juan River basin in the North Manila System and Ortigas and its vicinity in the West Mangahan System. Bonifacio area can be involved in case a privately developed sewerage facility will be turned over to MWSS. MNTT river mouth area, where is designated as part of METROSS-III in former Master Plan, is excluded because the focus is laid on the protection of the Pasig River and its tributaries. Master Plan area is shown in Figure 3.3.9.

(2) Development of the Master Plan Area

Considering the budgetary constraints and development period, the following development level is considered for each system. The collection system is basically an interceptor system. The required WWTP area is calculated in the supporting report.

- North Manila System(San Juan River basin)

The separate communal systems in Quezon City are all connected to the newly developed interceptor system to upgrade existing communal systems. Considering the wastewater volume, aerated lagoon method needs more than 120 ha of treatment area. In case these areas can not be secured more space saving method like Oxidation ditch method is recommended.

- Central Manila System

Only the newly developed area of Sampaloc, Balut, Dagat-Dagatan and Caloocan will be connected to the Dagat-Dagatan WWTP, which will be upgraded to the oxidation ditch method to deal with the increased wastewater volume. The existing Tond Pump Station will continue operating for the time being.

- South Manila System

Of the existing Central system catchment area which will be converted to South Manila System in the Framework Plan, only the Pandacan area will be transferred to the South Manila system by the target year. Another tributary area is not considered in its capacity calculation. The WWTP area required for this system is 94 ha for the Aerated Lagoon method and 23 ha for the Oxidation Ditch. The Aerated Lagoon method is recommended considering the inexpensive O&M cost.

- West Mangahan

Ortigas area is priorily developed using the interceptor system. Of the area considered in Master Plan, South part of the area, where high-rised building and commercial facilities are concentrated has higher priority. The aerated lagoon method is recommended considering the comparatively less difficult site aquisition.

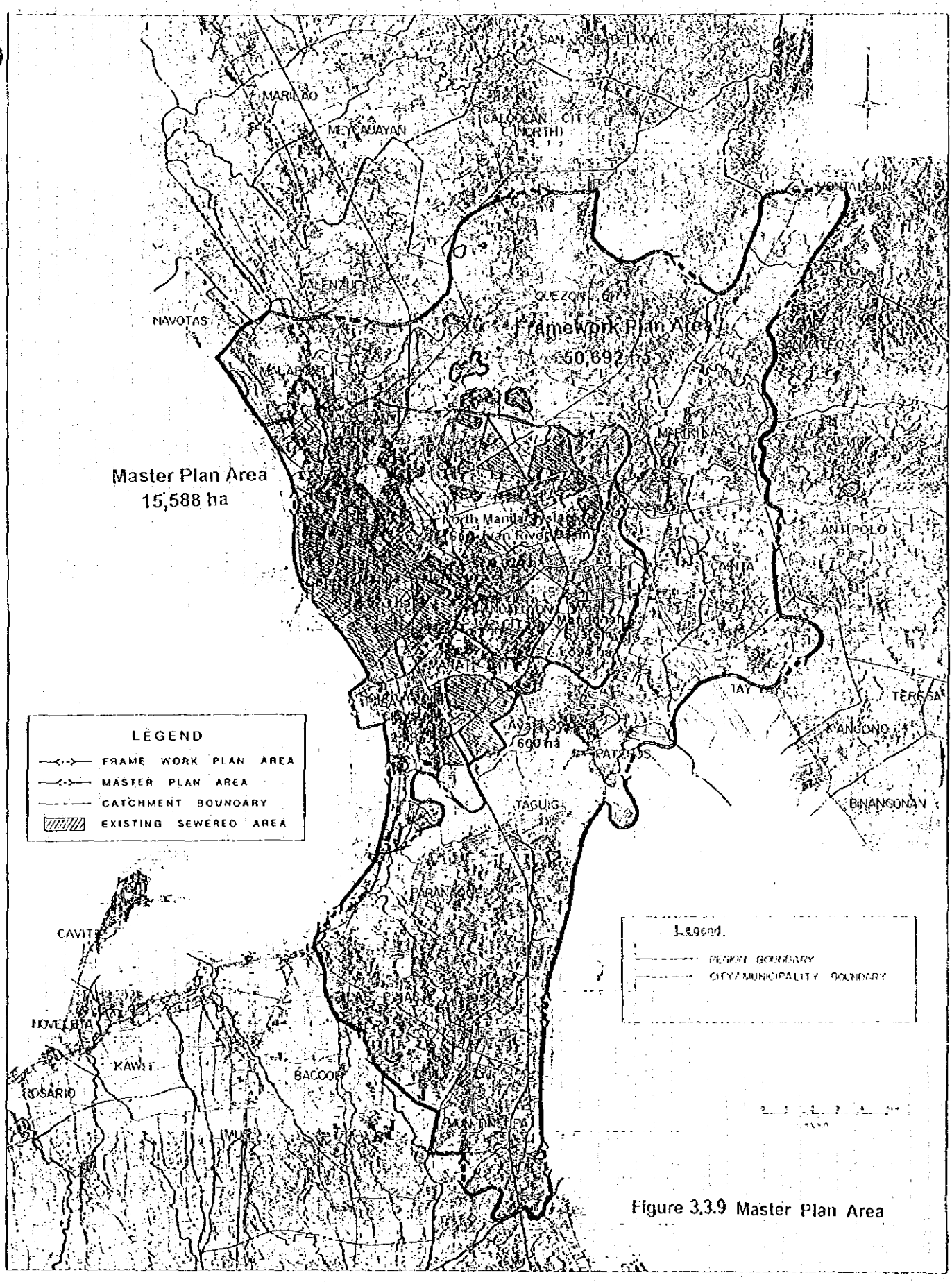


Figure 3.3.9 Master Plan Area

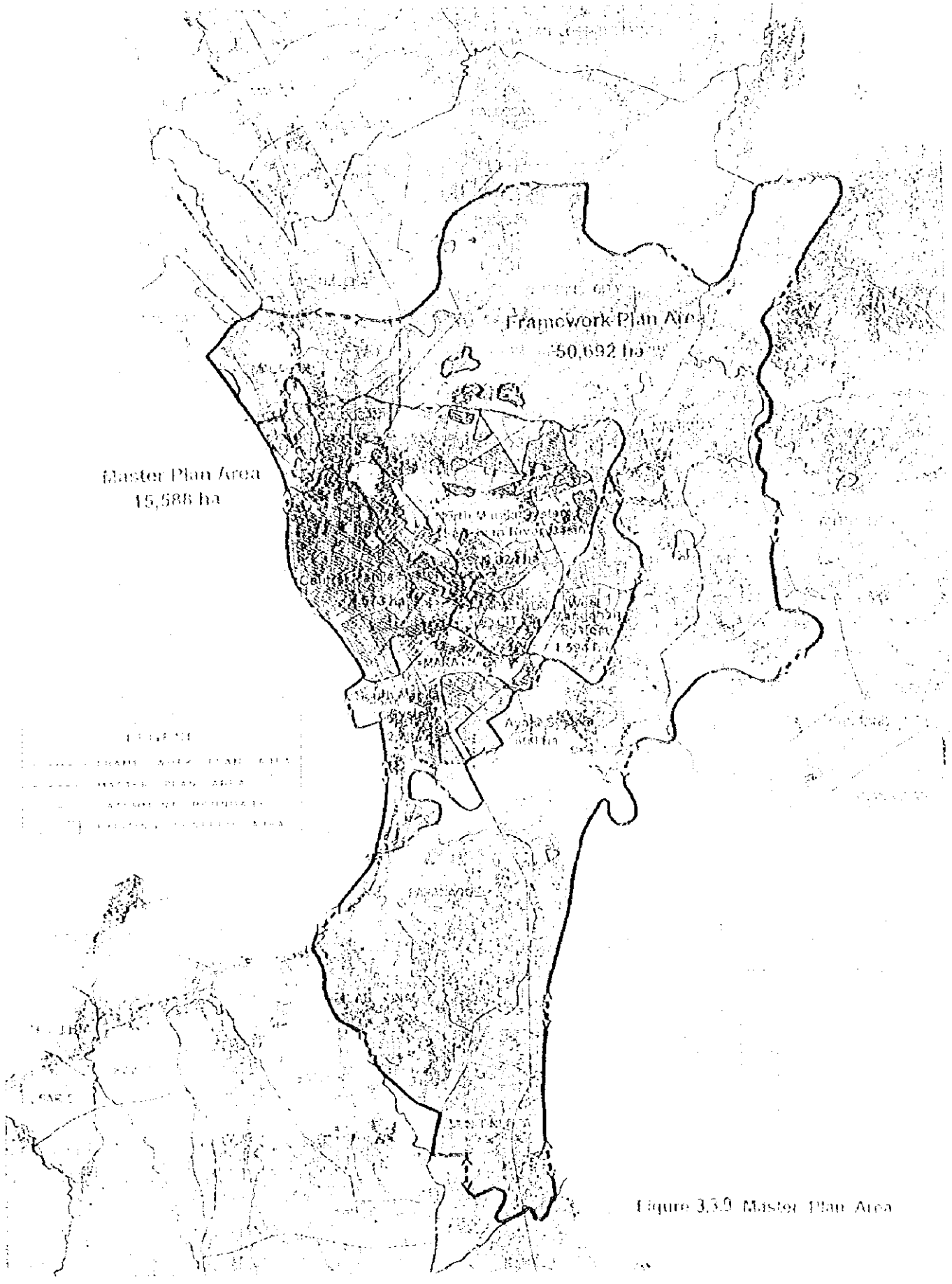


Figure 3.3.9 Master Plan Area

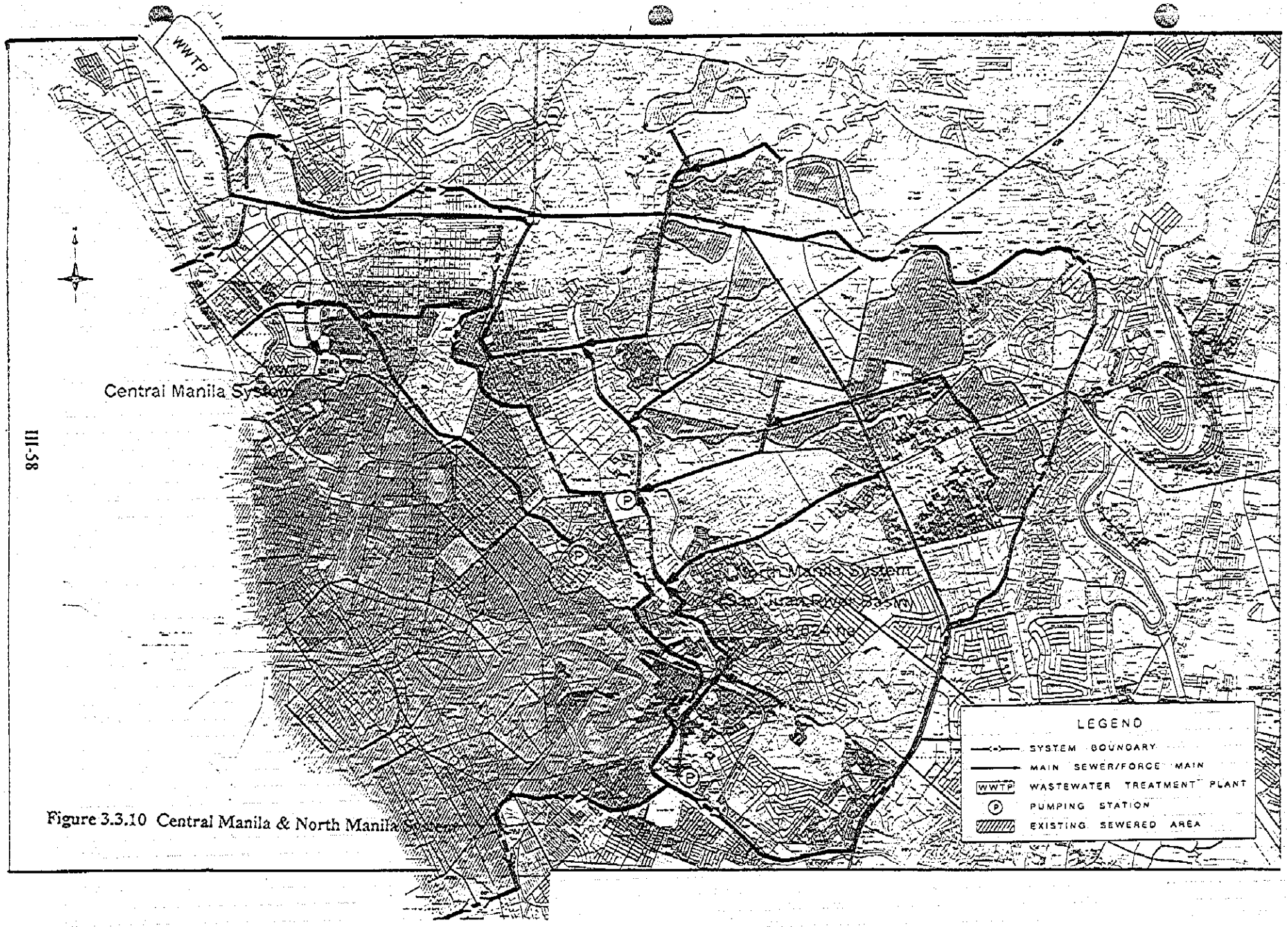


Figure 3.3.10 Central Manila & North Manila Sewerage

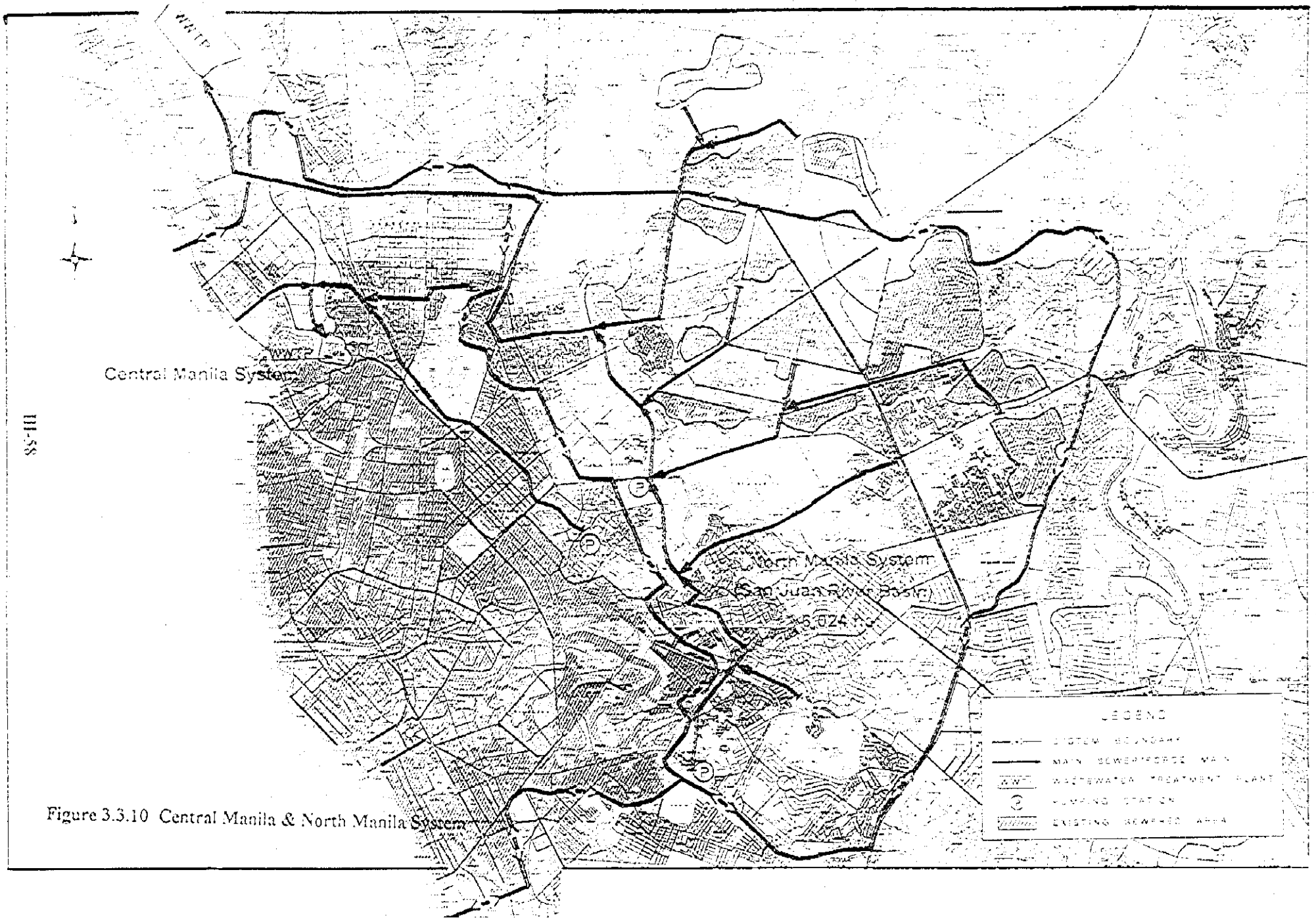
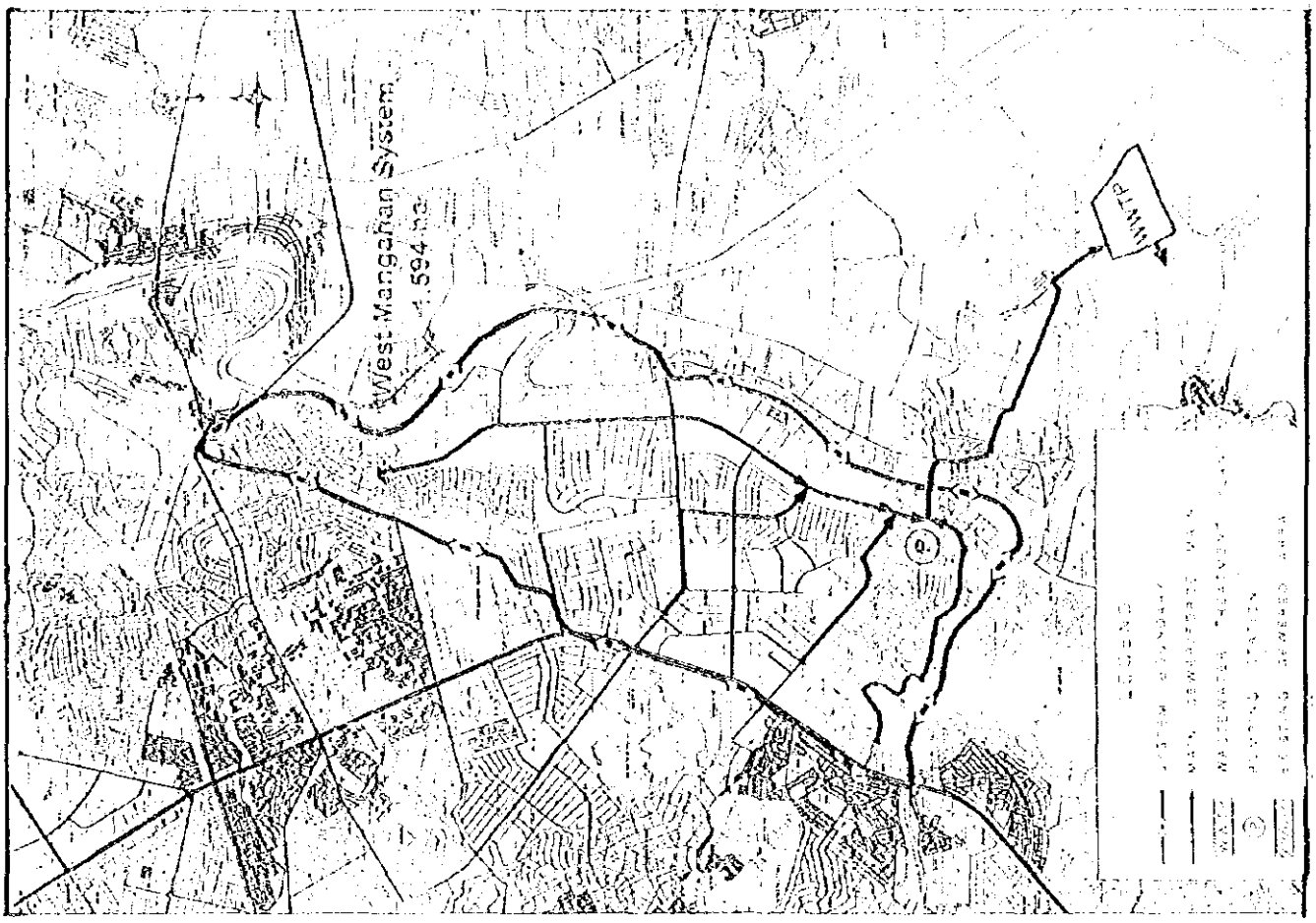


Figure 3.3.10 Central Manila & North Manila System

Figure 3.3.11 South Manila & West Mangahan System



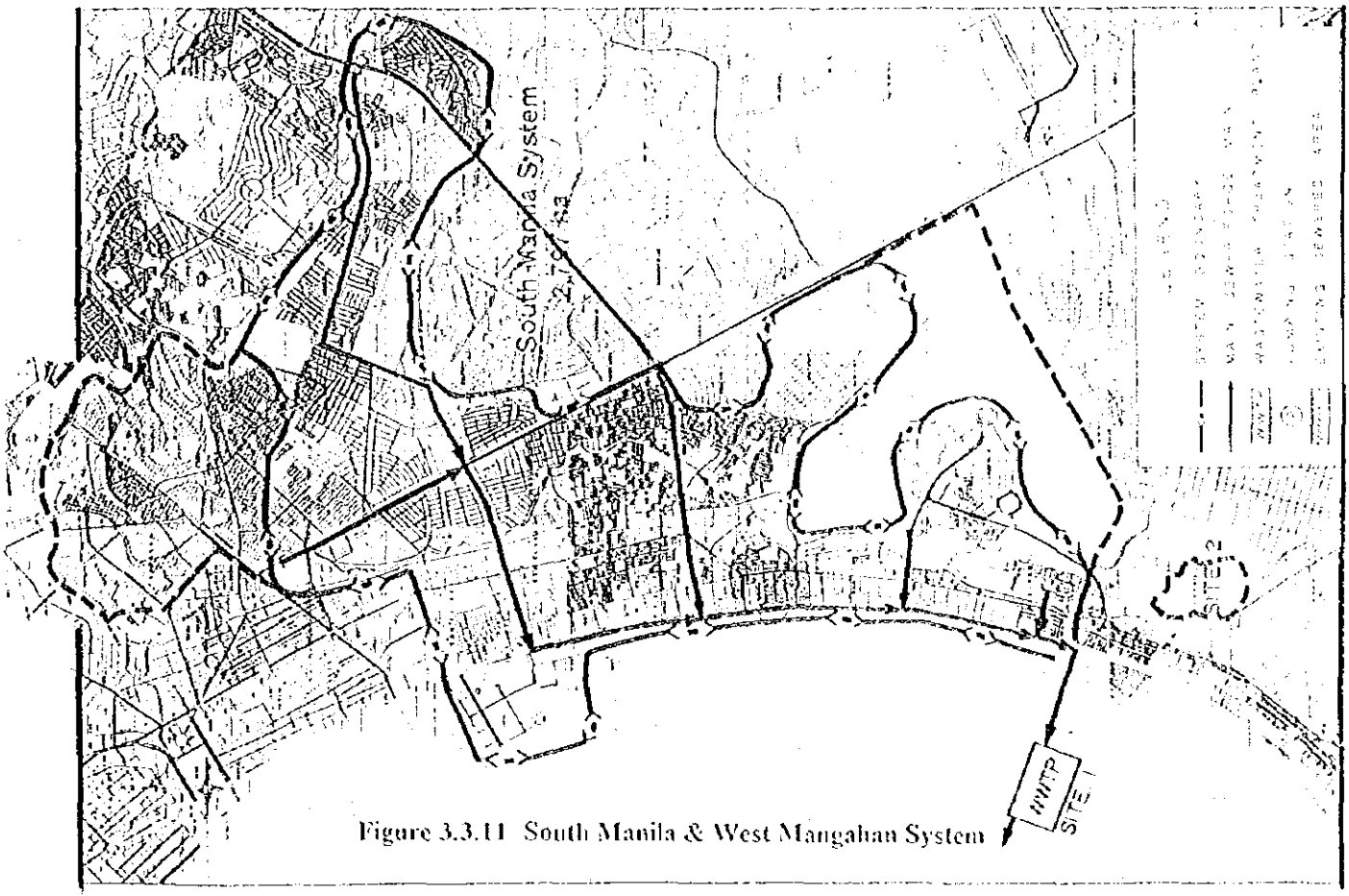


Figure 3.3.11 South Manila & West Mangahan System

- Ayala System

Only the rehabilitation of the existing facilities is taken into account in this Master plan

Outline of Master Plan area is summarized in Table 3.3.14

Table 3.3.14 Outline of Master Plan Area

System	zone	Area (ha)	Population (persons)	WWTP		Remark
				System	Capacity (daily.ave m3/d)	
West Mangahan	Ortigas	1,594	347,000	A.L	72,000	
South Manila	Gadalupe	588	162,000	A.L	207,000	
	South Manila	1,779	561,000			
	NAIA	430	228,000			
	Total	2,797	951,000			
Ayala	Ayala	600	183,000	A.S	40,000	Existing
Central Manila	Central+Pandacan	2,620	1,383,000	(1) O.D (2)Ocean Outfall for the existing system	OD 162,000 for Sampaloc Caloocan Balut Dagat-Dagatan	2,620 (Manila) +333 (D.D) are already sewered
	Sampaloc	511	173,000			
	Caloocan	628	353,000			
	Balut	138	66,000			
	Dagat-Dagatan	676	355,000			
	Total	4,573	2,330,000			
North Manila	Cubao	3,120	649,000	A.L	282,000	800ha od Cubao and 200ha of North Quezon are already sewered
	San Juan	2,244	519,000			
	Mandaluyong	460	123,000			
	NorthQuezon	200	42,000			
	Total	6,024	1,333,000			
Ground Total		15,588	5,144,000			

A.L= Aerated Lagoon, OD= Oxidation Ditch, A.S= Activated Sludge

3.2.5 Adjustment of Existing Development/Rehabilitation Plan with Master Plan

As for sewerage, the on-going/proposed projects now on the F/S or D/D stage are enumerated below

- Interceptor System in South Sewerage System (ADB report 1991)
- Rehabilitation of the existing Manila Central System, Ayala Sewage Treatment Plant, Ayala Sewerage System and Supply of laboratory equipment (MSSP 1994)

Interceptor System in South Sewerage System

One of the reasons for its high cost is attributed to the wide tributary area. (2.4 times of the direct service area in hectare, one time in population and 1.2 times in wastewater volume in the report)

Of these areas, Fort Bonifacio, MCCRRP and Villamor Air Base are considered re-development areas and their completion dates have not been set. As was mentioned before, these re-development areas, including NAIA which already has its own system, should be equipped with a separate off-site treatment system put up at the developers' own expense, thus a cost saving measure for the MWSS.

The St. Ana and Pandacan areas are now served by the Central Sewerage System. The Ayala Sewerage System has its own treatment plant and its rehabilitation is one component under the MSSP. There is no urgency in putting these areas into the South Sewerage System right now.

The use of the combined collection system should be considered without the tributary areas. Untreated discharge of wastewater should also be reviewed considering the conditions for land fill at Manila Bay.

Manila Second Sewerage Project

Some points that have been observed are as follows:

Ayala Sewage Treatment Plant

The MSSP recommended only Phase 1 at the time of planning, because the role of Ayala Sewage Treatment Plant within the overall sewerage system in Metro Manila was temporary and the sewage was to be transferred to the south sewerage system pumping station in accordance with the former 1979 master plan and also the 1991 pre-F/S. But a total rehabilitation including Phase 2 is recommended on the following grounds:

- Ayala System should be maintained as the separate system for its efficient use. Its advanced activated sludge method can also supply useful and experimental field data for the MWSS.
- It will take a long time to complete the south system pumping station and the connecting pipe construction from the existing plant to the station.
- It will be difficult to attain the EMB effluent standard by the implementation of Phase 1.

Total cost is estimated at 94.10 million pesos for Phase 1; while that of Phase 2 has not been calculated.

Judging from the preliminary report cost calculation, Phase 2 is estimated 570 million pesos(see supporting report)

Expansion of Ayala Sewerage System and Treatment Plant

In case sewerage area is expanded to the now unsewered area (approximately total 300 ha), wastewater is expected to increase to 69,000 m^3/d in 2015 on average daily wastewater flow including 20% of infiltration. Judging from the existing capacity of roughly 40,000 m^3/d, it seems difficult to expand sewer coverage without expanding treatment capacity, although the existing influent flow is still about half of capacity. Expansion of the area should be reviewed after the proposed rehabilitation of sewer system. The existing sludge drying bed site can be utilized for the expansion of capacity.

Central System Rehabilitation

The construction of a new pumping station was recommended instead of existing low-capacity siphon. But the detailed design was deferred due to the uncertainty of land acquisition, the land presently being occupied by the Philippine Navy. Negotiations should be continued, but should these fail, other alternatives should be considered. One of them is the upgrading of the Luneta Lift station to the pumping station whose force main reaches up to the north bank of Pasig River or up to the Tondo Pumping Station. This compensates for the shortage of existing siphon capacity.

3.2.6 Staged Development Target

The staged implementation plan is described in 4.3. The first Stage is the implementation of all on-going MWSS projects. These are the rehabilitation of the existing system, including the implementation of Phase 2 of the Ayala Treatment Plant and alternatives for the Fort Santiago Pumping Station.

The second stage is the expansion of sewerage system (interceptor system) to the high priority areas of South Manila, Central Manila, south part of San Juan basin (Cubao and San Juan) and the Ortigas areas. In case all these areas will be sewered, coverage will increase from 4,553 to 15,588 ha. It should be noted, however, that coverage does not mean households can be accessible to the sewer line. The second stage requires 20 years, up to the target year.

Staged development plan for Central Manila System

For the Central Manila area to be covered by a sewerage system, two steps should be considered where only step 1 is included in Master plan scheme.

(Step 1 - Coverage expansion)

Sampaloc, Caloocan and Dagat-Dagatan (Balut area has a re-development plan and may be omitted from this step) will be sewer-covered and their wastewater will be conveyed to Dagat-Dagatan WWTP, which would have been upgraded from the existing aerated lagoon to an oxidation ditch to cope with the flow of about 160,000 m^3/d.

(Step 2 - abolishment of ocean discharge of untreated sewage)

Wastewater from the existing Central System (south part of Pasig river is converted to South Manila system) will be transferred to Dagat-Dagatan WWTP instead of existing outfall, which will be upgraded again to the activated sludge method to accommodate the large amount of volume (roughly 380,000 m^3/d). Utilization of the existing Dagat-Dagatan WWTP site for the WWTP, as well as the proposed construction of septage treatment plant as described in the MSSP preliminary report, is constrained by the squatters who have now occupied a portion of the area. But even with open and available areas, staged upgrading is still possible. (available area is 14.6 ha, future septage treatment plant occupies 5.0 ha and the rest is 9.6 ha). The future development schedule before 2015 is shown in chapter 4.

3.2.7 Operation and Maintenance of Sewerage System

(1) Preventive maintenance and logistics

In order to prolong the life of the facilities, these should always be kept in good operating condition. This can be achieved through planned inspection, repair, replacement and overhaul, as required. The importance of preventive maintenance and logistics are emphasized in the waterworks study. The same operation and maintenance concepts and methodologies are also applicable for the sewerage/sanitation facilities.

(2) Mapping system and utilization of document

Accurate data or information on the existing facility is the basic tool for technical operation and maintenance. But sometimes these data are not available, making O&M work difficult.

Plans, designs, and construction drawings should be preserved or revised regularly as the facilities are improved or expanded. It is best to incorporate the facilities into a mapping system.

(3) Sewer Pipe System

- **Inspection**

Inspection should be done regularly, or at least once a year for the early detection of any defect in the facility. The dumping of solid waste and weeds should be also checked.

Inspection items by facility are enumerated below. Before the rainy season, the point where is directly affected by heavy rain, the overflow, siphon and others, should be given priority. The main check points are as follows.

Facility	Inspection Item
Covered/underground pipe	① flow condition and deposit amount ② subsidence of ground surface ③ damage of the pipe ④ infiltration of groundwater or toxic waste ⑤ toxic gas generation
Open channel	① flow condition and deposit amount ② obstacles of flow ③ illegal structure
Siphon	① water level ② gate, valve and stop log
Manhole	① cover ② Inside damage
Overflow structure	① clogging ② facility damage
Discharge facility	① condition of discharging point, water level ② discharging pipe subsidence ③ gate, valve condition
Lateral pipe and inlet box	① deposit condition ② pipe clogging or damage

A useful method in finding defects in the sewer lines is TV inspection. The MSSP will include TV inspection in its Ayala Sewerage System rehabilitation/upgrading works and it would be a good opportunity to learn this inspection technic.

- **Cleaning and dredging**

Pipelines should be cleaned or dredged to keep the smooth flow of wastewater. It is desirable to clean and dredge once every two years.

The cleaning of siphons and overflow structures should be prioritized because sedimentation is most likely to occur in these structures. In Japan, this is usually done in with high pressure cars in combination with vacuum-type desludging cars. In case a large amount of sludge has been accumulated, bucket machine-type cleaners may be used; while small diameter pipes or pipes with a small amount of deposit may be cleaned manually or by small automatic-type cleaners.

- **Repair**

In the case that a facility is found to be damaged or its function cannot be restored by cleaning or dredging, repair work should immediately be done. Preventive measures shall be worked out

with the concerned officials in case repair work might affect the facilities located downstream such as the pumping stations and/or the treatment plants.

The construction methods will not include only chemical grouting or replacement; but may also involve a newly developed renovation/revitalization method like the pipe-in-pipe method. This new technology should be learned.

(4). Pump Station

Pump station breakdowns cause much damage, such as the overflow of sewage into the road, flooding in low areas, or stoppage of treatment plant operation. So the emphasis should be at preventing operational breakdown. Emergency facilities, like generators should be installed as required.

Main items of maintenance works are as follows;

- Monitoring of pump operation
- Inspection, replacement of equipment parts and its recording
- Inspection and repair of water level gauge
- regular inspection and trial operation of stand-by pump
- Storage and procurement of spare parts, fuel, and others
- Removal of scum, deposit in wet pit
- Maintenance of grit chamber, screen facility
- Maintenance of mechanical and electrical facility

The required cost for the rehabilitation of pumping/lift station is shown in the MSSP report.

(5) Wastewater Treatment Facility

Biological treatment is widely accepted wastewater treatment method and water quality control has been considered important in the same way as mechanical and electrical operation and maintenance.

The operator of the plant should understand the biological mechanism of the unit and take effort to keep conditions desirable. The detailed mechanism of the treatment plant and the definition of each parameter are omitted here.

a. Water quality control

The MMSP proposed an improved sampling schedule and analysis program for the WWTP. The laboratory system was also reviewed in terms of staff and equipment to cope with the proposed increase in sampling and analysis. Considered were consigning the analysis outside the

MWSS, conducting an in-house training course on planning, reporting systems and report formatting. These can be adopted for the future.

- **Wastewater quality test, parameter, frequency and record**

There are two types of water quality tests. One is a daily (routine) test and the other is a periodical test. The frequency of periodical test is decided on need-basis. But another type of test, the 24-hour test, should be conducted to recognize hourly fluctuation in quality of raw and treated sewage in a day, its average concentration and loads, which is important for the operation and maintenance of the WWTP.

Analytical parameters and their test frequency are basically decided corresponding to the present situation of the particular WWTP, using the result for water quality control. The proposed sampling schedule and test program are shown in supporting report including septage treatment plant test. Basically, simple daily tests and sampling for the periodical test are conducted at each plant's laboratories, while the periodical test is done in the MWSS Central Laboratory.

Besides the WWTP, the Tondo Pumping Station, which discharges wastewater quality and bay water quality, should be checked periodically by MWSS at their discharge points.

The results of the tests performed, as recorded, will provide a clear performance of the system with regard to water quality control. This will also be an input into the planning and designing of the sewerage system by comparing plan vs reality. A recording format was proposed in the MSSP.

b. Operation and Maintenance

To maintain the function of the WWTP in meeting the discharge standard or target water quality level, the following items should be observed:

Facility	Item
grit chamber	① adjustment of velocity ② adjustment of inlet gate ③ removal of screening and deposited sand
primary sedimentation tank	① adjustment of retention time ② adjustment of inlet gate ③ operation of sludge-collecting facility ④ adjustment of sludge balance among sucked volume, excess sludge and returned volume from sludge treatment facility ⑤ concentration of sludge ⑥ sludge level and water level

Aeration tank	① adjustment of aeration time ② adjustment of air volume or operation of aerator ③ adjustment of return and excess sludge ④ measurement of SV
Final sedimentation tank	① adjustment of retention time ② adjustment of inlet gate ③ operation of sludge-collecting facility ④ adjustment of sludge balance between sucked volume, excess sludge ⑤ adjustment of SV value of aeration tank ⑥ sludge level and water level and transparency of effluent
Stabilization pond (anaerobic pond, facultative pond and maturation pond)	① weeding ② inspection and protection of bank ③ protection from vermin ④ removal of screenings and scum ⑤ inspection of inlet and outlet ⑥ sludge level
disinfection tank	① contact time ② dose of chemical
sludge thickener	① volume of sludge ② concentrated sludge volume ③ operation of collecting machine ④ return of overflow ⑤ water and sludge level
Sludge digestion tank	① operation of mixing machine and scum removal equipment ② balance of sludge volume ③ return of overflow and catchment of digestion gas ④ deposit of sand
Drying bed	① carriage of sludge ② removal of dried sludge ③ replacement of sand bed

- **Organizational Support System**

The following items are being proposed for the water quality control system to be upgraded:

1) Increase in laboratory staff

Increase in laboratory staff was recommended in the MSSP. As the sewerage system is expanded and a new treatment plant is constructed, there is a need to hire new staff or contract-out water quality analysis.

2) Improvement of laboratory equipment

To cope with the increase in test parameters, the purchase of equipment and sampling cars as well as laboratory rehabilitation were analyzed. The initial cost of laboratories was also examined in the MSSP.

3) Internal training system

To upgrade technical skills and knowledge of MWSS staff , in-house training was proposed.

3.3 Development Plan on Sanitation

3.3.1 General

This sanitation plan includes the improvement of individual on-site treatment facilities, plus the review of the septage management contained in the MSSP and communal system plans. Drainage, considered a sanitation project, was omitted from this study. This sanitation development plan has been further divided into phases or manageable stages.

3.3.2 On-site treatment facilities

The use of septic tanks is recommended in the areas where the sewerage system is not available. Its effluent shall be discharged into the subsurface soil, into an absorption field where applicable, or it shall be treated with some type of purification device as contained in the "Sanitation Code." In the study area, septic tanks are widely used and at least a 35-40% of BOD reduction and a 65% SS removal are achieved if such septic tanks are properly maintained.

a. Septic tank adoption criteria

The main criteria for effluent treatment are groundwater level and subsurface soil condition and permeability.

1) ground water level

Ground water level should be 3 ~ 5 m lower than ground surface level considering the leaching chamber depth. According to the Study for the Groundwater Development in Metro Manila, groundwater level has become lower due to over pumping; but it is still below sea level except in North Quezon where the ground level is high. This criteria can easily be satisfied.

2) permeability

Geologically, Metro Manila is divided into four areas: ① low land along Manila Bay, ② hill/plateau covering Quezon City, Mandaluyong and Makati,③low land along Marikina river /drainage basin of Laguna Lake, and ④ hill/plateau from Sierra Madre.

Surface soil is mainly classified as clay, silt, sand and gravel of alluvium for ① and② ; fine sedimentary rocks, pyroclastic rocks, and coarse sedimentary rocks of Guadalupe Formation for ② ; and basalt of Kinabuan Formation for ④ .

As a whole, Metro Manila soil is clayey judging from the construction site inspections and permeability seems rather low.

In case permeability prohibits soil absorption, some type of purification device (up-grading) or communal treatment system is recommended.

b. Septic tank upgrading investigation

Two types of upgrading should be considered. One is a structural change in the construction of the septic tanks as an on-site individual treatment facility. The other is a change in the collection system using the existing septic tank and newly built off-site treatment plant.

(1) Improvement of septic tank structure

Of the alternative septic tank designs proposed in the WB report "Appropriate Technology for Water Supply and Sanitation," septic tanks with upflow filters are recommended in case groundwater level or soil permeability is critical for the standard septic tank. The Japanese "JOHKASOU" type treatment facility which uses the anaerobic-aeration system is also recommended insofar as power charges permit. In case the combined treatment of night soil and sullage is adopted, this type of sanitary treatment facility can be used as a effective countermeasure.

(2) Upgrading to communal system

To promote the installation of and upgrade to the communal system, some regulations with regards to land use, city planning and building construction should be revised.

1) Collection system

Regardless of the boundaries set for the on-site and off-site treatment, communal/subdivision scale treatment systems should be promoted, if possible by the LGU or private sectors. In the communal level collection system, not only the conventional sewerage system will be utilized; but also more simplified methods like small bore sewerage should be considered.

2) Treatment facility

The treatment facility should be low cost and maintenance free. Anaerobic treatment, like the septic tank is a cost saving treatment device; but from the standards of EMB, aerobic treatment seems inevitable. Some alternatives are described below.

- Communal scale septic tank

  This is the way treatment used to be, but the EMB requires less than 50 mg/l of BOD. It is almost impossible to meet this criteria without additional purification device.

- Japanese type JOHKASOU/ Bio-Module

  This system requires aeration mechanisms in the system, so operating cost is not too low. MWSS is planning to start a cost-saving type Jokaso, Bio-Module pilot plant construction and field test in Kalangaran in cooperation with NHA with the aid of the Japanese Government.

- Anaerobic sludge blanket reactor

  This reactor is said to be the appropriate system for a communal treatment system, but field plant experiment is necessary to test its applicability in the Philippines.

- Korean type of treatment facility

  DOH is now searching for a new type of cost-saving facility developed in Korea.

Promising areas for communal treatment in "on-site treatment area" are Antipolo and the coastal areas of Cavite Province.

3.3.3 Septage Management Plan

Regular desludging is indispensable for the proper management of septic tanks. In 1994, the septage management plan consisting of regular desludging and transfer by an appropriate vehicle, temporary ocean dumping, and construction of septage treatment plant was recommended by a World Bank consultant. Since its target area was limited within NCR, service area shall be expanded to the area where MWSS is expected to serve with Level III by 2015 to balance the water supply and sanitation level.

(1) NCR area

The sanitary project of MSSP was formulated based on the Septage Management Plan.

The outline of the septage management plan is as follows.

Collection system

NCR was divided into four areas, each with a treatment plant. The collection system considered the distribution of septic tanks, even the traffic condition. With the desludging frequency of once every five to 10 years, the procurement of a vacuum-type collection vehicle was recommended

instead of the existing low efficient facilities. A total 143 x 4m^3 and 155 x 10m^3 collection vehicles are projected for NCR by the target year 2010.

Treatment system

Inland treatment (physical-biological-chemical) was selected after comparing with ocean dumping, lahar site disposal, dewatering, and incineration.

The recommended method was basically Coagulation + Activated sludge considering the future upgrading to denitrification treatment. The generated sludge is disposed to the landfill site together with the solid waste. Of the four treatment plants, the Dagat-Dagatan treatment plant utilizes an existing aerated lagoon for treating the effluent from primary treatment process. Target treatment capacity in 2010 is as follows.

Dagat-Dagatan septage treatment plant	900m3 / d
Quezon City septage treatment plant	1,000m3 / d
Taguig septage treatment plant	600m3 / d
Las Pinas septage treatment plant	600m3 / d

The sludge is disposed to a landfill site together with the solid wastes.

Initial works and interim countermeasure

Data/information collection on septic tanks will be conducted during the first three years to determine/confirm the criteria on the design of the plant. As an interim countermeasure, dumping of septage from three loading stations into the designated dumping site 68 km off Corregidor island at the inlet of Manila Bay has been planned. Ocean dumping of septage will continue up to year 2003.

(2) Other MWSS water supply area

Outside of the NCR, septage collection and treatment for the area where MWSS is going to supply water is necessary as far as environmental tax will be charged. Alternatives are (1) expansion of the STP proposed in MSSP for adjacent provinces,(2) construction of another STP.

By 2015, approximately 90 % of MWSS jurisdiction will be Level III - supplied and the number of septic tanks within this area is estimated in table 3.3.15 assuming one tank covers 8 persons. Judging from the number of septic tanks and also areawise coverage, recommendation is;

1. Cavite Province will be covered by the proposed Paranaque STP since total septic tank number in the Province is not so large to construct a new STP.
2. Rodriguz and San Mateo will be covered by MSSP-proposed Quezon STP.
3. A new STP will be constructed for the Pizal Province except Rodriguez and San Mateo because water supply will cover wide areas. The treatment method is the same as other proposed plants in NCR. It covers wide areas and transfer station is to be considered.

Table 3.3.15 Number of Septic Tank in Rizal and Cavite Province

Province	Population (persons)	Served Population (persons)	Septic Tank	Required capacity of STP(m^3/d)
Cavite	858,000	772,000	96,500	200-Paranaque STP expansion
Rizal (Rodriguez San Mateo)	331,000	298,000	37,300	100-Quezon City STP expansion
Rizal (Other area)	2,104,000	1,894,000	236,700	600 New plant
Rizal total	2,435,000	2,192,000	274,000	900

Capacity = Septic Tank / 7(years) x 6 (m^3/unit) /365 (d)

Total septage management plan is shown in Figure 3.3.12 for both NCR and other MWSS water supply area.

3.3.4 Communal Treatment

Communal treatment shall be developed as described in 3.3.2

3.3.5 Adjustment of Septage Management Plan with Sewerage Project

The septage management plan was constructed under the assumption that sewerage service will be limited to the existing area before 2010. Although the interceptor system will be constructed during the first stage of the planned development, the use of septic tanks will likely remain even in areas where the sewerage system would be in place.

The implementation of the septage management plan or other changes therein, will depend on whether the sewerage sub-area development will materialize, which will depend, in turn, on the willingness of the beneficiaries to pay for sewerage fees and consciousness of each LGU.

The location of the septage treatment plant is, if possible, in the vicinity of the WWTP. The effluent of primary septage treatment can then be easily inputted into the WWTP, omitting the bio-chemical secondary treatment like Dagat-Dagatan WWTP.

3.3.6 Staged Development Plan

The development of the septage management plan into stages up to the year 2010 was also included in MSSP). Construction of the proposed STP will end in 2008 and expansion and new construction of the STP outside of NCR will be scheduled for 2009~2015 period. (in Chapter 4)

3.3.7 Operation and Management of Sanitation Facility

(1) Septic tank data collection system

MWSS needs to collect data on the number of septic tanks, their volume and capacity systematically through the building officer of each city/municipality because MWSS is the agency in charge of desludging.

(2) Septage Collection System

According to the Septage Management Plan, collection and delivery of septage will be mainly done by outside contractors and appropriate control over them is the important point.

(3) Septage Treatment Facilities

a. Water quality control

As to the proposed Dagat-Dagatan pilot STP, MSSP proposed a sampling schedule and analysis program together with water quality test for existing WWTP. Water quality testing, parameters, frequency and recording were summarized. Basically, such schedules will be adopted for use in the STPs in Quezon, Taguig, Paranaque and Binangonan.

b. Operation and Maintenance

The main facilities of the STP are screening/degritting, coagulator, settling tank, thickening facility, dewatering facility, and secondary treatment facility consisting mainly of biological treatment. The septage treatment system is new for MWSS and an appropriate O&M plan will be formulated through the operation of pilot plant in MSSP.

c. Organizational support

An increase in laboratory staff was proposed together with improved WWTP plan. Manpower needed for the four STP systems was considered in the preliminary study of the MSSP. In terms of upgrading technical skill, advance training in a country where septage treatment facilities have long been in operation is recommended to obtain technical know-how.

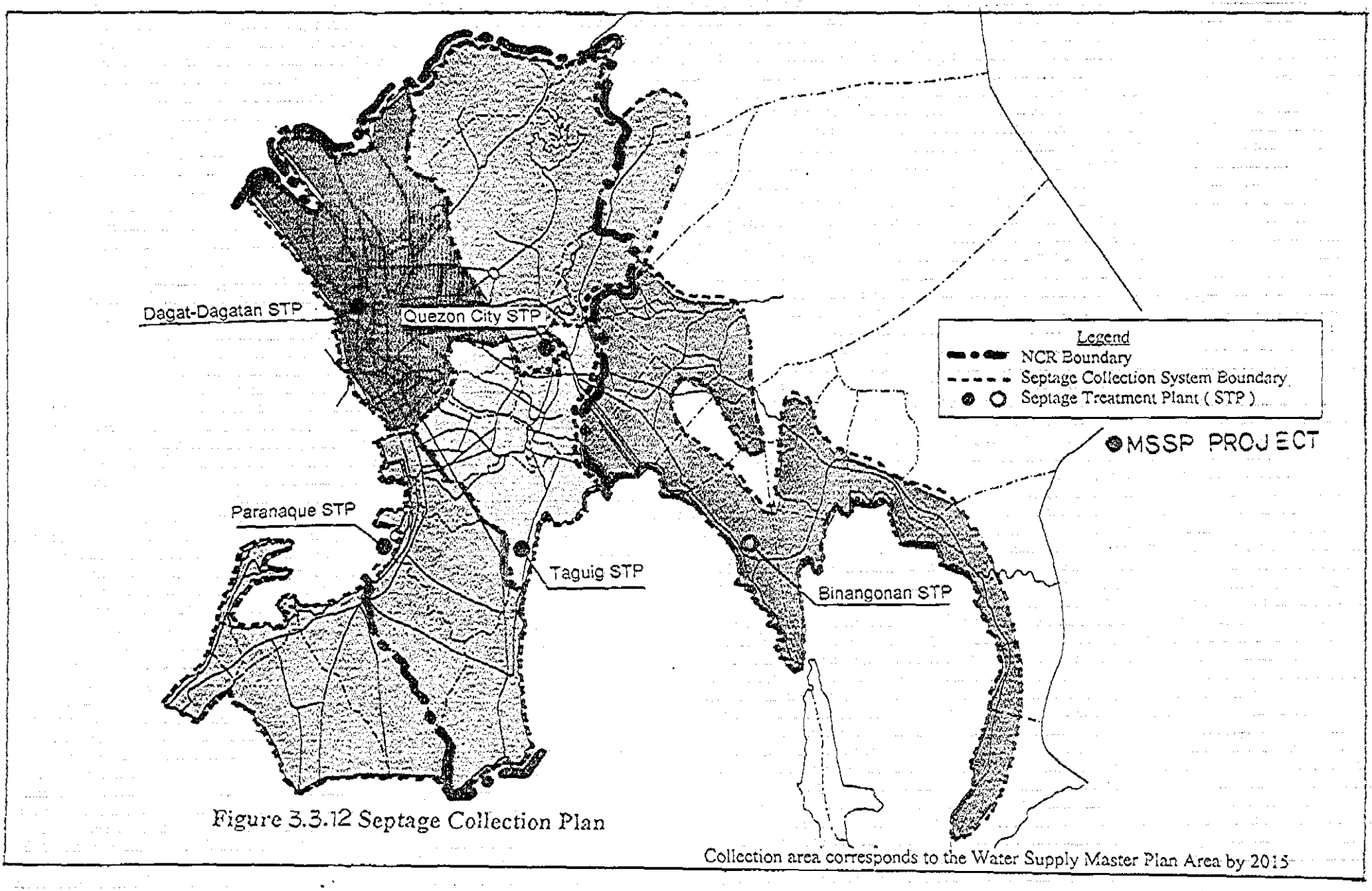


Figure 3.3.12 Septage Collection Plan

Chapter 4.

Proposed Projects

Chapter 4 Proposed Projects

4.1 Type of Projects and Their Prioritization

4.1.1 Type of Projects

Technical projects on sewerage/sanitation, where design and physical implementation are involved, are categorized into (1) septage management project, (2) rehabilitation/upgrading project of existing sewerage facilities and (3) augmentation (expansion) of sewerage system to the unsewered areas. The other type is non-technical projects where advisory service or recommended studies are involved. The organizational or institutional project for the sewerage/sanitation sector is mainly described in another chapter. The sewerage/sanitation projects are enumerated in Table 3.4.1 including the projects proposed in the MSSP.

Table 3.4.1 Project Summary

1. Sewerage Project			
No.	Project Name	Project Type	Remarks
1-A	Ayala Sewage Treatment Plant Rehabilitation (Phase 1)	Rehabilitation of existing sewerage facilities	MSSP - Phase 1 project
1-B	Ayala Sewerage System Rehabilitation	Rehabilitation of existing sewerage facilities	MSSP - Phase 1 project
1-C	Manila Central Sewerage System Rehabilitation	Rehabilitation of existing sewerage facilities	MSSP - Phase 1 project
1-D	South Manila System Expansion	Expansion of Sewerage System	
1-E	Central Manila System Expansion	Expansion of Sewerage System	
1-F	North Manila System Expansion	Expansion of Sewerage System	
1-G	West Mangahan(Ortigas) System Expansion	Expansion of Sewerage System	
1-H	Ayala STP Rehabilitation (Phase 2)	Rehabilitation of existing sewerage facilities	MSSP - Phase 2 project
2. Sanitation Project			
2-A	Septage Collection and Hauling	Septage Management Project	MSSP - Phase 1 project
2-B	Barging of Septage for Sea Dumping	Septage Management Project	MSSP - Phase 1 project
2-C	Barge Loading Station Construction (Phase 1)	Septage Management Project	MSSP - Phase 1 project
2-C'	Barge Loading Station Construction (Phase 2)	Septage Management Project	MSSP - Phase 2 project
2-D	Dagat-Dagatan Septage Treatment Plant Construction	Septage Management Project	MSSP - Phase 1 project
2-E	Supply of Laboratory Equipment, Vacuum Car/Accessories and Other Vehicles	Septage Management Project	MSSP - Phase 1 project
2-F	Dagat-Dagatan STP 2nd Stage Construction	Septage Management Project	MSSP - Phase 2 project
2-G	Dagat-Dagatan STP 3rd Stage Construction	Septage Management Project	MSSP - Phase 2 project
2-H	Quezon City STP 1st Stage Construction	Septage Management Project	MSSP - Phase 2 project
2-I	Quezon City STP 2nd Stage Construction	Septage Management Project	MSSP - Phase 2 project
2-J	Paranaque STP 1st Stage Construction	Septage Management Project	MSSP - Phase 2 project
2-K	Taguig STP Construction	Septage Management Project	MSSP - Phase 2 project
2-L	Quezon City STP 3rd Stage Construction	Septage Management Project	Septage Treatment Plant expansion for Rizal Province
2-M	Paranaque STP 2nd Stage Construction	Septage Management Project	Septage Treatment Plant expansion for Cavite Rizal Province
2-N	Binangonan STP Construction	Septage Management Project	Septage Treatment Plant expansion for Rizal Province

Another promising studies/researches related to the technical problems are as follows.

- Manila Bay Monitoring plan
- Manila Bay environmental survey
- Dagat-Dagatan Collection System Rehabilitation Study

Although sewer system is not completely turned over to MWSS, the pumping station for the Dagat-Dagatan WWTP and force main should be investigated because inflow data from the operation record of the pumping station and effluent flow measured by the World Bank consultant are quite different, which means quite high percentage of pumped wastewater has been leaking out.

4.1.2 Prioritization of the Project

The priorities of the different physical projects have to be evaluated from the technical, environmental, health, socio-economic and financial aspects. Especially, the financial aspect has highest priority as far as willingness to pay by the beneficiaries are limiting factor of the implementation of projects under existing conditions.

From the aspect of human health protection, the interceptor sewerage system is less contributive than septage management, although sewerage system is more helpful for the improvement of water quality of public water body. A higher sewerage service rate may be accepted in the future when people become more environment-conscious. At present, septage management project has higher priority to the sewerage projects. Rehabilitation of existing sewerage facilities have higher priority to the expansion of the system judging from the expensive cost of new construction.

Therefore, priority should be in the following order.

1 septage management project,
2 rehabilitation/upgrading project of existing sewerage facilities and
3 augmentation (expansion) of sewerage system to the unsewered areas.

In each type of project, areawise prioritization is described as follows.

a) septage management project

Prioritization in NCR was set up in the MSSP and service coverage of Cavite City comes next prior to the Rizal Province due to its dense population.

b) Rehabilitation

Implementation plan is shown in the MSSP and it is observed.

c) Expansion of Sewerage System

The former METROSS I&II area has higher priority in compliance with the National Master Plan in 1988 except the MNTT river basin. San Juan River basin comes next due to its high BOD discharging load. Ortigas along the Pasig River has less priority to the other areas.

4.2 Project Cost

4.2.1 Conditions and Assumption for Cost Estimate

(1)Cost Estimate Base and Condition

The MSSP adopted 1994-1995 escalation rate of 1.035 in its financial study, so the MSSP cost is updated to 1995 basis using this rate. The other unit cost proposed in previous studies is updated to 1995 basis assuming recent escalation rate 10 % annually. The engineering fee and other contingencies are calculated in the same way water works project adopt.

(2) Unit Cost

Sewerage facility construction cost

wastewater collection system cost

In this report, cost co-relation between service area and construction cost is shown as follows.

$$C = 14.5 \times S + 35.0 \quad \text{.....(2)}$$

where, C ; construction cost (million Pesos)
S ; service area (km2)

This cost function is developed based on the JICA study in Thailand and this cost stands for interceptor cost only.

Wastewater plant & Pumping station

Wastewater and Pumping station cost function is adopted from "National Strategy and Action Plan " 1993 World Bank report, where cost function is calculated on 1993 basis.

(million pesos)

Process/Flow(m^3/d)	750	3,030	7,575	28,400	cost function-1993	cost function 1995
Pump Station	1.9	4.7	8.4	20	$C=0.026\ Q^{0.647}$	$C=0.031\ Q^{0.647}$
Primary Treatment	6.2	18	33	88	$C=0.051\ Q^{0.726}$	$C=0.062\ Q^{0.726}$
Stabilization Pond	8.2	22	43	115	$C=0.066\ Q^{0.727}$	$C=0.080\ Q^{0.727}$
Aerated Lagoon	17	38	66	165	$C=0.264\ Q^{0.624}$	$C=0.319\ Q^{0.624}$

Oxidation Ditch	15	39	74	190	$C=0.146\ Q^{0.699}$	$C=0.177\ Q^{0.659}$
Activated Sludge	24	64	135	325	$C=0.200\ Q^{0.723}$	$C=0.242\ Q^{0.723}$

Outfall

In 1991 ADB report, Outfall cost is estimated to be 1,134 million pesos for the first barrel of 1.8m diameter steel pipe with the length of roughly 5.5 km. 1995 cost is estimated to be 1660 millions pesos.

Sewerage facility O&M Cost

Collection System

Annual maintenance cost is estimated 0.5% of construction cost as is estimated in 1979 master plan.

Wastewater treatment plant & Pump station

Likewise interceptor construction cost, operation & maintenance cost is calculated from the JICA study in Thailand considering the escalation cost.

	Cost function(1993)	Cost function(1995)	
Pump Station	$O/M=40.7\ Q_{max}^{0.93}$	$O/M=49.2\ Q_{max}^{0.92}$	O/M; 1,000 peso, Q; hourly max in m^3/sec
Stabilization Pond	$O/M=0.070\ Q^{0.867}$	$O/M=0.085\ Q^{0.867}$	O/M; 1,000 peso, Q; m^3/d
Aerated Lagoon	$O/M=0.750\ Q^{0.748}$	$O/M=0.908\ Q^{0.748}$	O/M; 1,000 peso, Q; m^3/d
Oxidation Ditch	$O/M=0.543\ Q^{1.009}$	$O/M=0.657\ Q^{1.009}$	O/M; 1,000 peso, Q; m^3/d
Activated Sludge	$O/M=0.493\ Q^{1.000}$	$O/M=0.597\ Q^{1.000}$	O/M; 1,000 peso, Q; m^3/d
Rotating Biological Contractor	$O/M=0.551\ Q^{0.998}$	$O/M=0.667\ Q^{0.998}$	O/M; 1,000 peso, Q; m^3/d

Sanitation facility construction cost

Cost estimation conducted in the MSSP is the fundamental data for the new construction and expansion of a septage treatment plant. Expansion cost is assumed to increase in proportion to the water volume.

Sanitation facility O&M Cost

In the preliminary report of the MSSP, O&M cost for the septage collection-treatment-disposal (option 1) and ocean dumping (option 2) is calculated respectively at 20,488 x 10^3 $ /year and 5,964 x 10^3 $ /year for the assumed volume of 3,800m^3/d of septage. Unit O&M cost per capacity (million pesos per year/ capacity in cu.m) is calculated from above data and applied to this Master Plan.

4.2.2 Project Cost

Project Cost in 1995 cost base is summarized below including the MSSP project

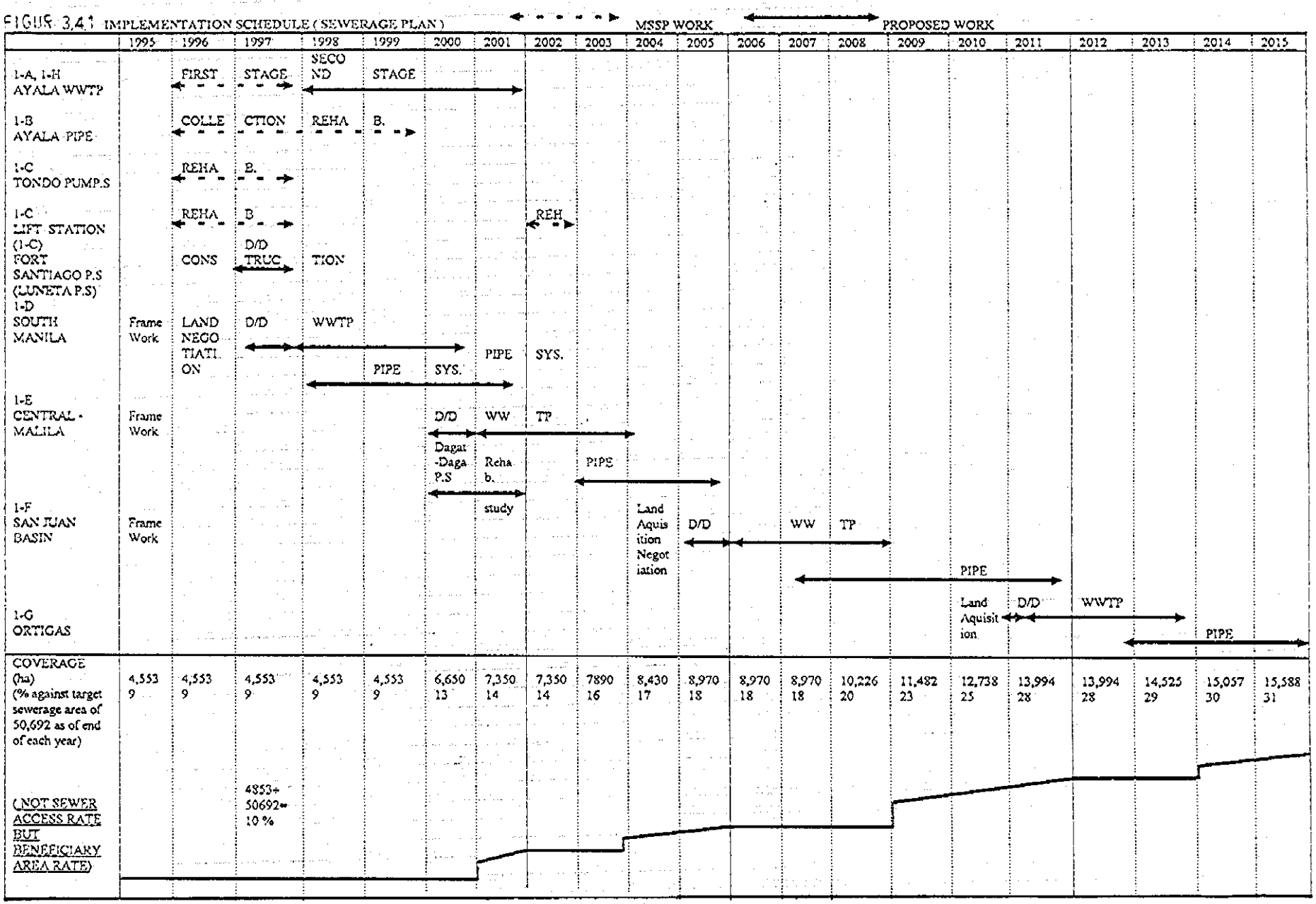
Table 3.4.2 Project Cost (in Million Pesos)

1. Sewerage Project					
No.	Project Name	Total Cost	Foreign	Local	Remark
1-A	Ayala Sewage Treatment Plant Rehabilitation (Phase 1)	97.45	55.94	41.51	MSSP
1-B	Ayala Sewerage System Rehabilitation	144.53	-	144.53	MSSP
1-C	Manila Central Sewerage System Rehabilitation	205.01	69.50	135.51	MSSP
1-D	South Manila System	1,360.27	311.67	1,048.60	Expansion
1-E	Central Manila System	1,308.82	382.29	926.53	Expansion
1-F	North Manila System	2,759.28	473.15	2,286.13	Expansion
1-G	West Mangahan(Ortigas) System	875.11	187.85	687.26	Expansion
1-H	Ayala STP Rehabilitation (Phase 2)	670.89	268.36	402.53	
Sub-total		7,421.36	1,748.76	5,672.60	
2. Sanitation Project					
2-A	Septage Collection and Hauling	260.02	-	260.02	MSSP
2-B	Barging of Septage for Sea Dumping	160.76	-	160.76	MSSP
2-C	Barge Loading Station Construction (Phase 1)	22.19	-	22.19	MSSP
2-C'	Barge Loading Station Construction (Phase 2)	11.10	-	11.10	
2-D	Dagat-Dagatan Septage Treatment Plant Construction	323.79	130.81	192.98	MSSP
2-E	Supply of Laboratory Equipment, Vacuum Car/Accessories and Other Vehicles	177.41	141.93	35.48	MSSP
2-F	Dagat-Dagatan STP 2nd Stage	450.87	215.97	234.90	
2-G	Dagat-Dagatan STP 3rd Stage	629.94	254.49	375.45	
2-H	Quezon City STP 1st Stage	1,539.60	622.00	917.60	
2-I	Quezon City STP 2nd Stage	1,161.00	469.04	691.96	
2-J	Paranaque STP 1st Stage	1,539.60	622.00	917.60	
2-K	Taguig STP	1,539.60	622.00	917.60	
2-L	Quezon City STP 3rd Stage	290.25	117.26	172.99	
2-M	Paranaque STP 2nd Stage	580.50	234.52	345.98	
2-N	Binangonan STP	1,539.60	622.00	917.60	
Sub- total		10,226.23	4,052.02	6,174.21	
Grand total		17,647.59	5,800.78	11,846.81	

4.3 Implementation Schedule

As to the septage treatment plant, the MSSP proposed construction schedule up to 2008 and additional construction plan after the MSSP is set-up from 2009 to 2015. Sewerage system expansion schedule is set-up in accordance with the areawise priority.

FIGURE 3.4.1 IMPLEMENTATION SCHEDULE (SEWERAGE PLAN)



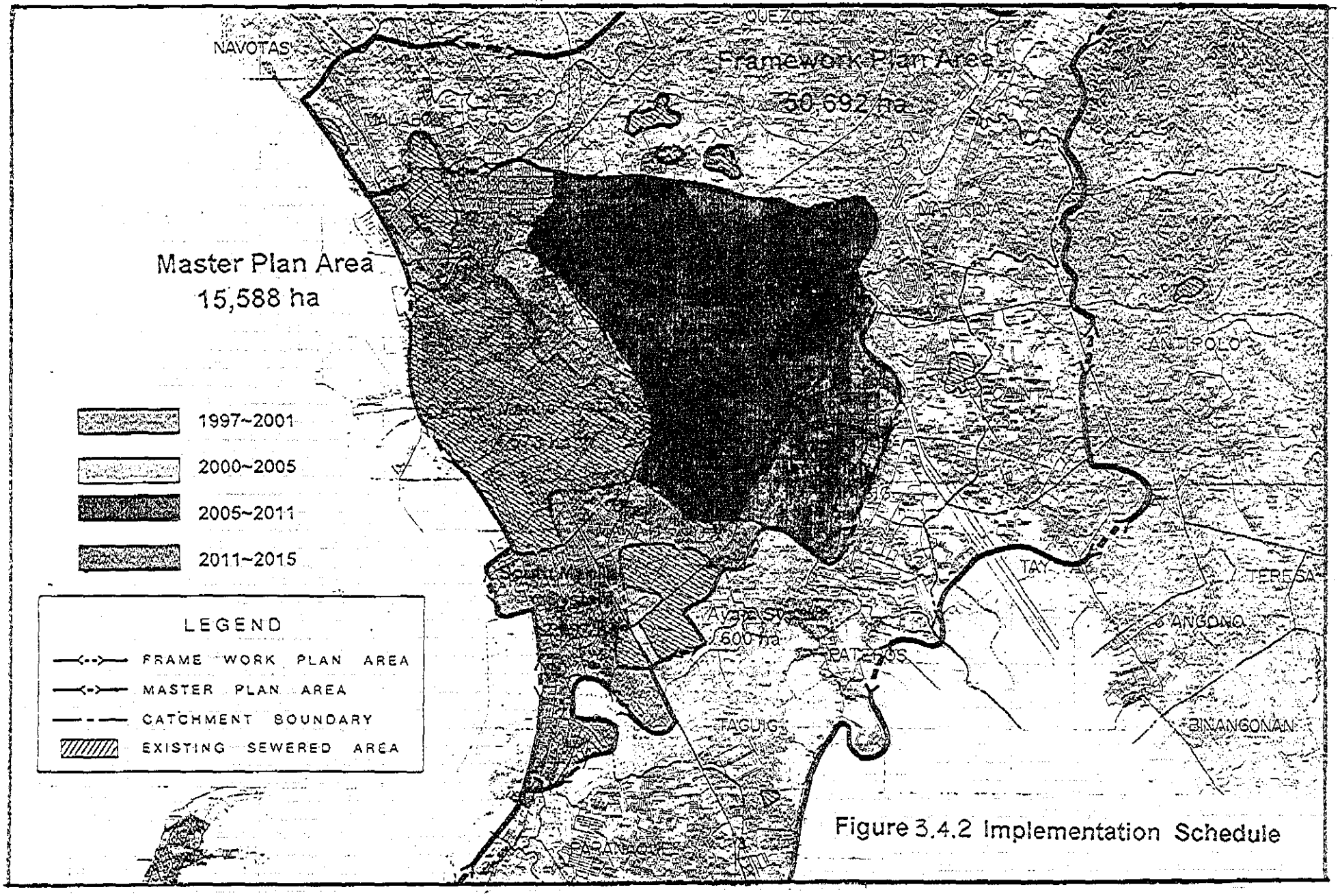


Figure 3.4.2 Implementation Schedule

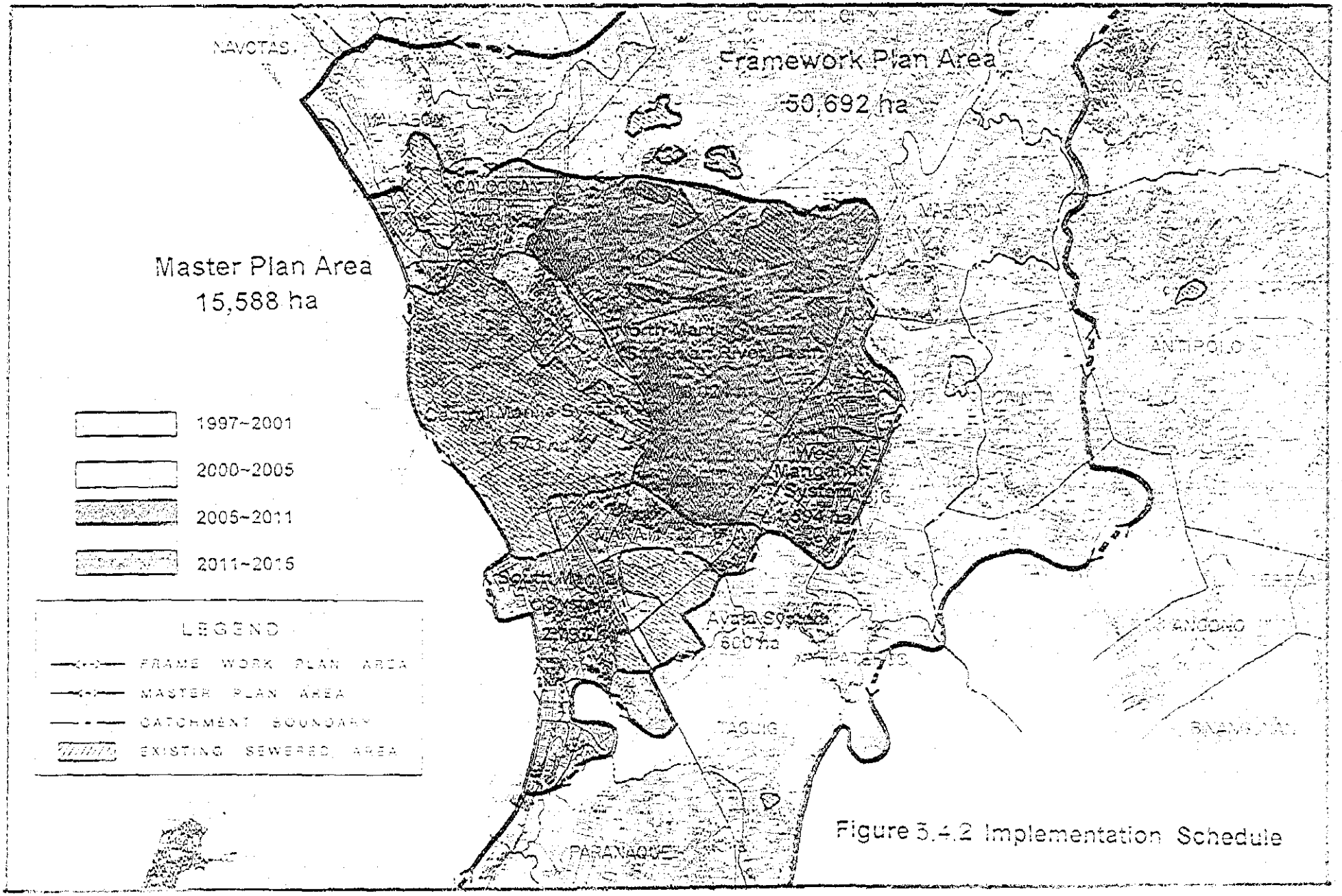
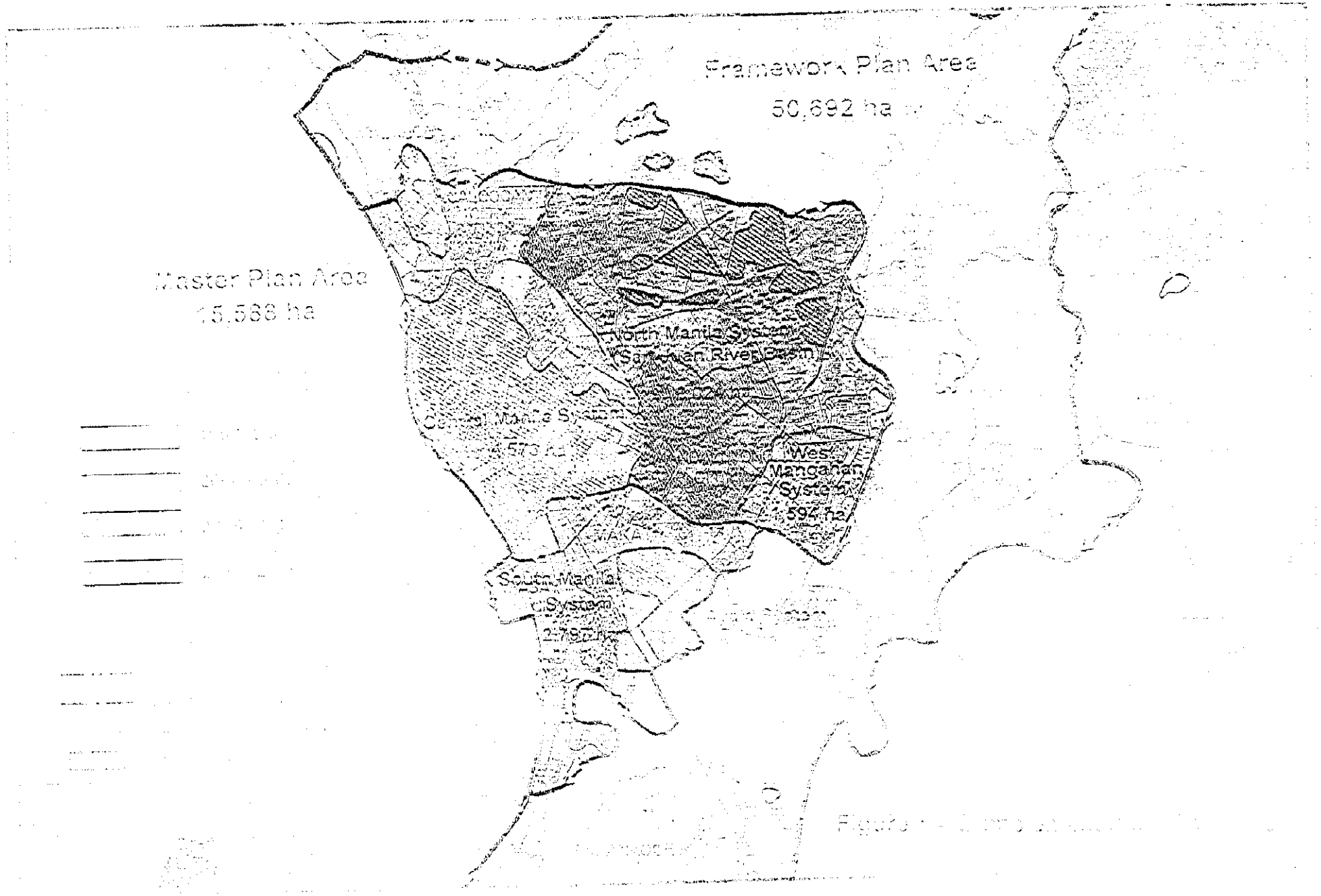
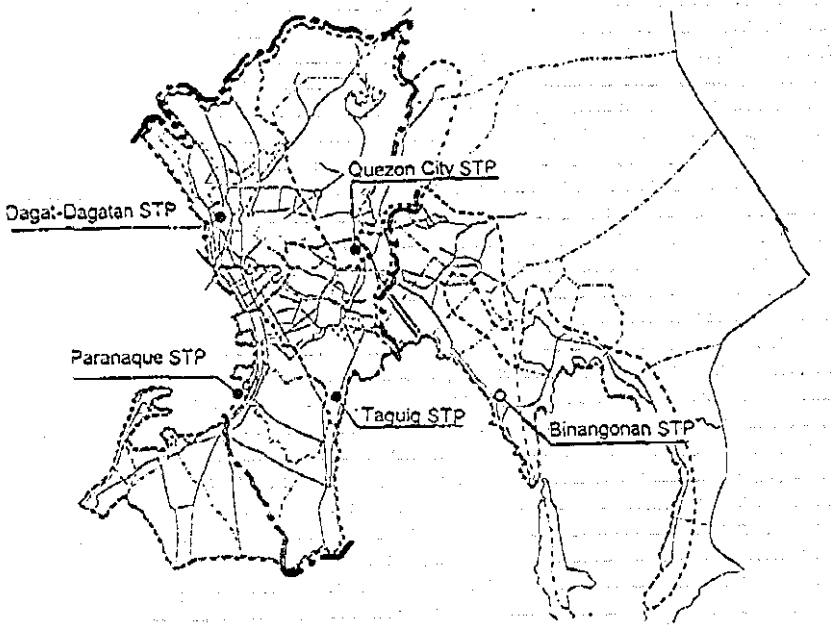


Figure 5.4.2 Implementation Schedule


Framework Plan Area
50,692 ha
Master Plan Area
15,588 ha
North Manila System
West Manganan System
594 ha
South Manila System
278 ha



Septage Treatment Plant Construction Schedule				
STP	Stage	Period	Capacity (m^3/d)	Total Capacity (m^3/d)
Dagat-Dagatan	1st	1996~1998	200	200
	2nd	1999~2000	300	500
	3rd	2006~2007	400	900
Quezon City	1st	1999~2001	600	600
	2nd	2004~2005	400	1,000
	3rd	2014	100	1,100
Taguig		2000~2002	600	600
Paranaque	1st	2005~2007	600	600
	2nd	2009~2010	200	800
Binangonan		2011~2013	600	600

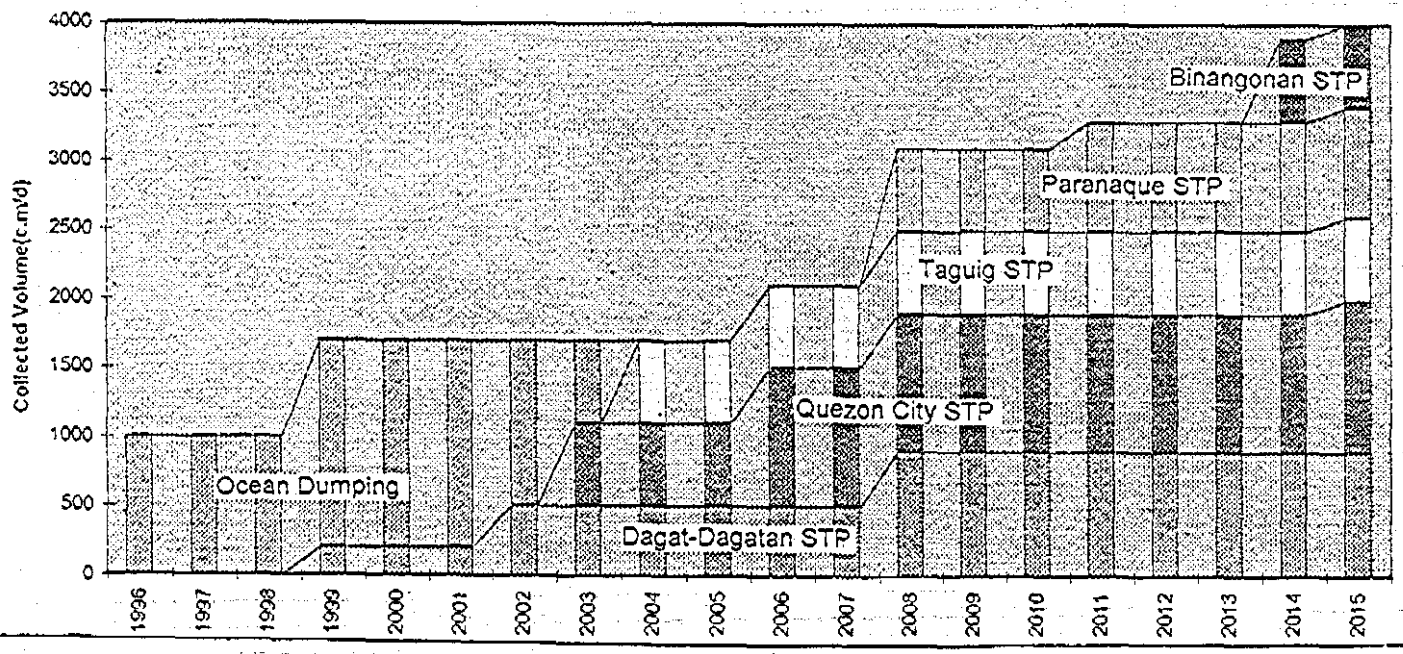
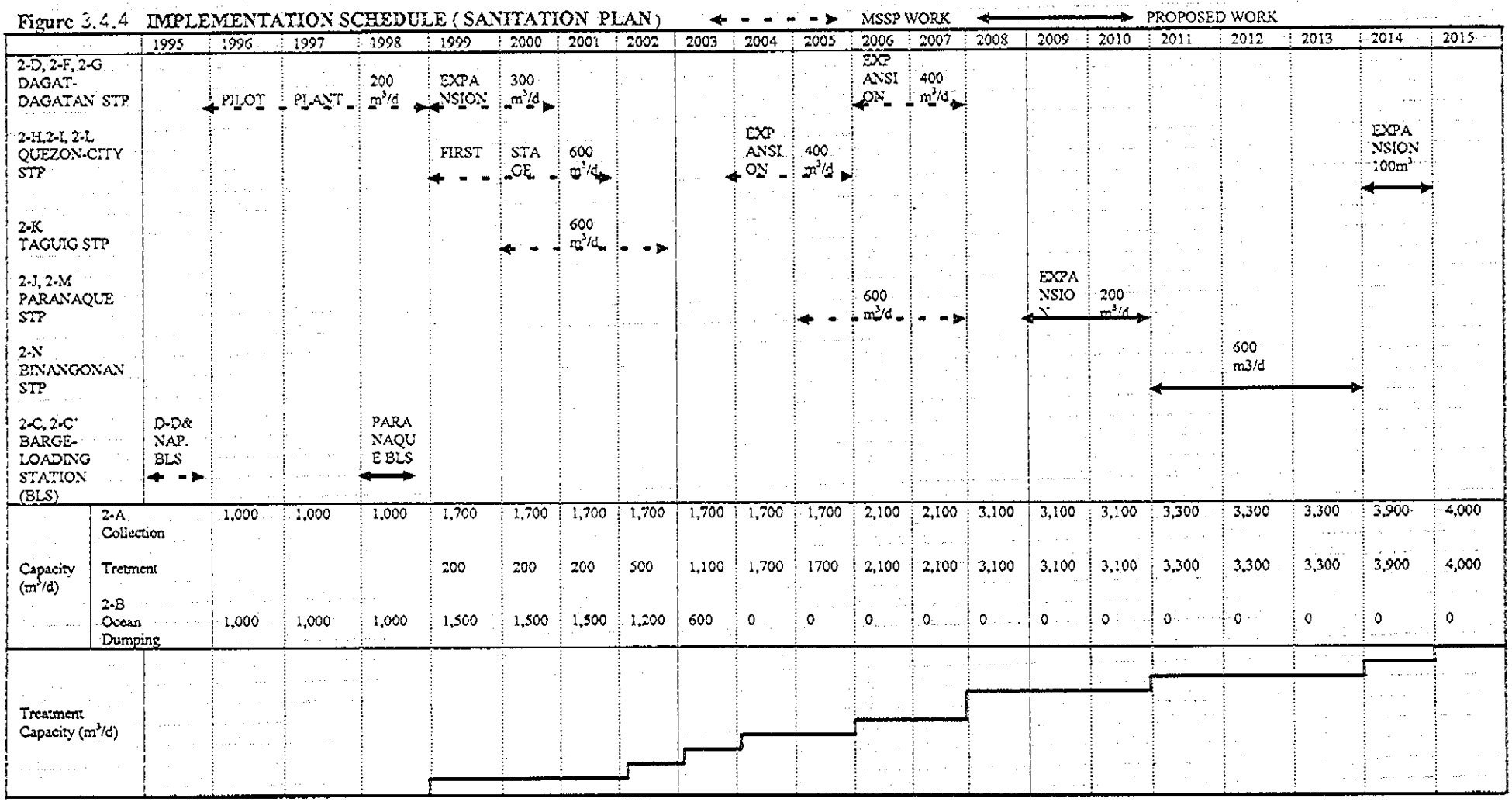


Figure 3.4.3
SEPTAGE TRETMENT PLANT STAGED PLAN

Figure 3.4.4 IMPLEMENTATION SCHEDULE (SANITATION PLAN)



Chapter 5.

Evaluation

Chapter 5 Evaluation

5.1 Technical Evaluation

5.1.1 Technical Evaluation

In the course of planing the Sewerage/Sanitation Master Plan, various kinds of studies with alternatives as to the location of the facilities, structure of the system, and so on were made. The outcome of the Study is aiming at energy- and cost-saving, easy operation and maintenance of the system and minimization of the impact on the surrounding environment. The Project is therefore considered feasible from the technical point of view.

5.1.2 Environmental Improvement

90 % of MWSS jurisdiction population, which means approximately 14.2 million people, will be served regular desludging of septage and it will remarkably reduce danger of human contact with sewage by improving septic tank function. Another significant benefit that may be derived from the sewerage/sanitation project is public water quality improvement, especially that of Pasig River. With sewerage project, BOD load equivalent of nearly 5.1 million people is protected from flowing into River/Bay system in MMR. The water quality in 2015 is estimated in use of flow model established in chapter 2 and summarized in Table 3.5.1 and Figure 3.5.1.

Table 3 .5.1 Water Quality in Pasig River in Terms of BOD (mg/l)

River System / Location / Case	Pasig River				San Juan River
	Check Point No. 6	Check Point No. 8	Check Point No. 9	Check Point No. 15	Check Point No. 14
1990 (calculation basis)	8	24	30	29	67
2015 without countermeasure	12	28	37	36	90
2015 with only IEPC	9	18	25	25	72
2015 IEPC&Sewerage/Sanitation	7	12	15	14	29

From the above table, it is expected that the existing water quality will be remarkably improved by reducing the discharged BOD load from the Pasig-San Juan River basin although it can not comply with the water quality criteria.

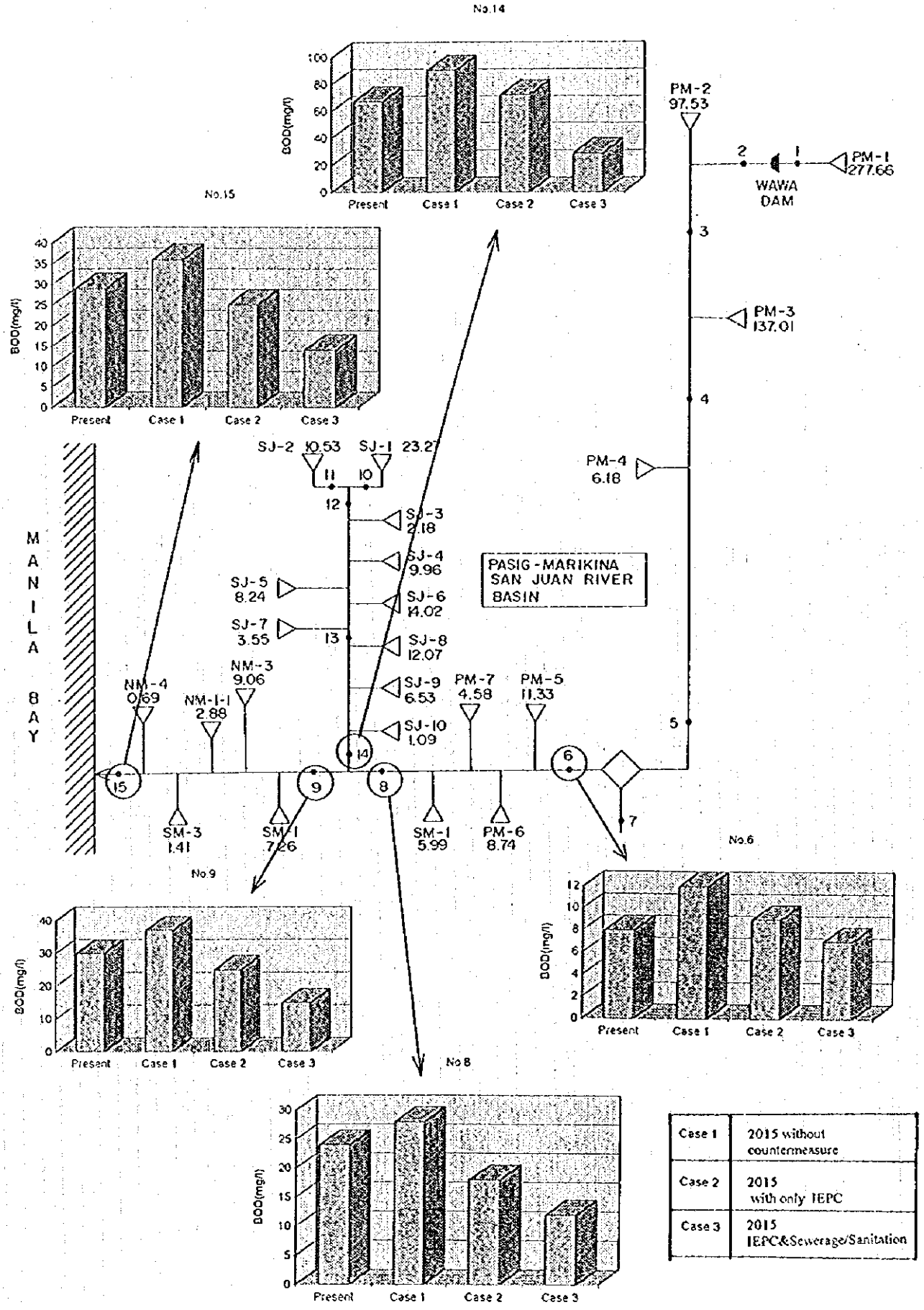


Figure 3.5.1 Water Quality Projection

5.1.3 Environmental Protection

Potential environment-related nuisances are screened and summarized in Table 3.5.3. Of the problems caused during and after the construction of sanitation/sewerage facilities, some impacts peculiar to sewerage/sanitation project are offensive odor, noise, injurious insects and effluent quality problems. Each cause and countermeasures are summarized in Table 3.5.2.

Table 3.5.2 Sewerage-related Major Environmental Problems

Item	*Cause*	*Countermeasures*
Offensive Odor	Facilities like grit chamber, screen, Primary sedimentation tank,aeration tank, sludge thickener, sludge drying bed/dewatering equipment	Provision of cover over the unit facilities,appropriate operation of deodorizing facility and ensuring distance from residential areas as much as possible
	While desludging the septage and conveying it to the STP, odor cause claim from the people around the site and route.	High efficient vacuum car and convey truck can mitigate the odor
Noise	Facilities like pump, blower,aerator and generator	Provision of cover over the unit facilities,appropriate operation of deodorizing facility and ensuring distance from residential areas as much as possible
Injurious Insect	stagnant water in the WWTP	Especially for the lagoon with long detention time, an adequate maintenance could minimize problems
Effluent quality	Color of effluent, high content of SS and bubble by detergent	Control of industrial wastewater and detergent use

As to the septage management plan including septage dumping into the ocean, a detailed environment impact assessment was conducted in the MSSP.

Table 3.5.3 Environmental Problems

Problems by stage	Impact	Countermeasures
Related to the Siting of Facilities		
1. Interference with other utilities/Street, traffic/blocking of access to the building	1. Nuisance/disturbance to public	1. Alignment of sewer route to mitigate interference with other utilities
2. Nuisance hazard to neighboring areas	2. Nuisance/hazards to workers and neighbors	2. Careful planning/ design /O&M and enough buffer zone
3. Inadequate resettlement provision	3. Social inequities	3. Adequate planning and budgeting
4. Impairment of historical /cultural /movements area	4. Loss or impairment of these values	4. Careful planning and offsetting measures
During Design Stage		
1. Overflow/bypassing hazard	1. Pollution and Flooding	1. Proper design/O&M and operation monitoring
2. Inadequate management of industrial wastewater	2. Damage to sewers/treatment plants	2. Careful planning/ design and operation monitoring
3. Hazard of sulfide corrosion	3. ditto	3. ditto
4. Odors and noise from treatment process or sludge disposal operation	4. Nuisance to public	4. Site treatment work only near compatible land use. Select appropriate technology Include odor control and low noise equipment
During Construction Stage		
1. Silt runoff from construction operation	1. Soil erosion, damage to water quality/land value	1. Proper resurfacing and construction monitoring
2. Dust/odors/fume	2. Hazard to the workers and nearby residents	2. Appropriate control
3. Prolonged period of sewer construction	3. Traffic congestion/ blocking of access to building	3. Careful construction scheduling
4. Noise and vibrations	4. Hazard to the workers and nearby residents	4. Appropriate control
During Operation Stage		
1. Hazard to health/safety of workers	1.	1. Careful O&M and operation,monitoring
a) Toxic gas in sewers and hazardous materials in sewage	a) serious health/safety hazards	a) Careful O&M programs of emergency
b) Communicable disease hazards	b) ditto	b) Careful O&M program and monitoring
c) sewer trench cave-in monitoring	c) ditto	c) ditto
2. Inadequate operation stage monitoring	2. O&M likely to depreciate	2. Check in overall system functioning
3. Overflow from sewers	3. Nuisance/public health hazard	3. Routinely inspect sewers for illegal connection and obstruction Clean sewer as required Provide monitoring system with alarms for pump station failure Educate public to prevent disposal of solid waste into sewers

5.2 Financial Evaluation

5.2.1 Approach

As is the case with the water supply study, FIRR is used to financially evaluate the viability of the master plan projects for the sewer/sanitation operation.

Financial benefits of projects will be an incremental revenue amount which will be made possible in future by those projects. This is calculated as the difference in future revenue between when the projects will be undertaken ("with projects") and when the projects will not be undertaken ("without projects").

Financial costs of projects will be capital costs plus operating expenses necessary to operate new facilities that typically consist of direct operating expenses such as electricity, personnel expenses and repair and maintenance expenses.

FIRR is usually calculated for a period of 20 years after the inception of projects using the cash flow based on constant price (i.e., inflation not considered). In the case of the master plan, it is calculated for the study period of 1995 to 2015.

5.2.2 Financial Benefits

The projects proposed in this master planning have the following three components:

- projects to enhance the MWSS capacity to desludge and dispose of septage from septic tanks
- projects to rehabilitate existing sewer treatment plants
- projects to expand the coverage of the MWSS sewerage system

It is estimated that there are currently more than 600,000 septic tanks owned by the MWSS water customers that are subject to the regular desludging service to be provided by MWSS. These tanks are supposed to be desludged every ten years, which means that MWSS needs to take care of 60,000 tanks every year. As mentioned several times in the report, however, it has been mainly outsourcing this service, but the number of desludging has been less than 5,000 per

year. Since MWSS has been collecting the environmental charge for this service and therefore is mandated to perform it satisfactorily, the current situation needs to be remedied. The first component of the master plan projects will address this issue, and will place MWSS in a better position to reconfigure the tariff scheme for the sewer/sanitation service that is explained in Part 5 of this report.

The other two components will not really result in measurable financial benefits, and therefore they should be evaluated from the economic point of view.

The new set-up of the sewer/sanitation tariff should be pushed forward from the following two points:

- It will address the issue of inequity in sharing the costs to preserve the environment between sewered and unsewered customers despite the fact that they are similarly harming it.
- Since the number of sewered customers will not drastically increase at least until the year 2015, the fee scheme based on them will not be advantageous for MWSS. The proposed uniform environmental charge will grow considerably due to the increased service volume of the water operation because the former is directly related to the latter.

The financial benefits of the proposed projects are the difference in financial revenue between "with projects" and "without projects". The financial revenue when the proposed projects are not conducted is that based on the current sewer/sanitation fee scheme.

The peso value of the financial benefits differs depending on the level of the water charge. The following table shows them in four cases:

Table 3.5.4 Financial Benefits

Case	Tariff increase	% of household income	Total financial benefits (million pesos)
1	Current level	0.74	20,634
2	35%	1.00	26,335
3	103%	1.50	37,410
4	170%	2.00	48,323

Cases 1 to 4 are the same as the water operation.

5.2.3 Costs

Financial costs are estimated by the engineering study and summarized as follows (in million pesos):

Construction and land:	
Sewer	7,421
Sanitation	10,226
Total	17,647
Operating expenses:	
Sewer	1,856
Sanitation	5,849
Total	7,705
Total	25,352

5.2.4 Cash Flows and FIRR

Based upon the net cash flows of the incremental revenue and the costs, the financial internal rate of return (FIRR) will be as follows:

Table 3.5.5 FIRR of Proposed Projects

Case	Tariff increase	Financial Benefits (million pesos)	Financial Costs (million pesos)	FIRR
1	Current level	20,634	25,352	-10.8%
2	35%	26,335	25,352	2.0%
3	103%	37,410	25,352	29.0%
4	170%	48,323	25,352	(*)

(*)Note: The cash flow will be positive for most years in this case. Therefore, FIRR cannot be calculated.

As indicated in the above table, FIRR can be justified somewhere between Case 2 and Case 3, and it will apply much less burden to the customers than is the case with water. This is due to the following:

- Strictly speaking, there is no relationship between MWSS's desludging activities and the level of the proposed uniform environmental charge. It is possible that MWSS will need to do much more to justify charging this at the proposed level.
- Because the revenue for the sewer/sanitation operation will be determined by the revenue level of the water operation, at least part of the revenue of the former will be attributable to the latter.

However, it will still exceed the tariff level the Study Team has set. Although it will be easier than the proposed waterworks projects to financially justify, there still remain a need to either increase the financial benefits or lower the financing costs. It appears to be a long way to go before many MWSS customers can be connected with a sewerage system.

Chapter 6.

Conclusion and Recommendation

Chapter 6 Conclusion and Recommendation

(1) Human health should be protected mainly through the appropriate management of sanitation facility. Sewerage aim water quality improvement through interceptor sewerage system.

(2) Of the 50,692 hectare Framework Plan Area, new coverage of 11,035 hectares by interceptor sewer system using existing waterway is the target level of the Sewerage Master Plan. The total service area will increase to 15,588 hectares.

(3) Rehabilitation of the existing sewerage system up to the expected level is another target in the sewerage sector

(4) Although new development is limited to the construction of interceptor and treatment plant considering the budgetary constraint, sub-catchment area development should be also promoted with the cooperation of the central government, LGU and other agencies including private sectors keeping pace with the economic development

(5) Acquisition of WWTP land is to be negotiated urgently

(6) Balancing with water supply service at level III, improvement of septic tank efficiency by regular desludging should be strongly promoted in the MWSS jurisdiction prior to the sewerage projects.

Part IV

Institution, Organization and Operation

Chapter 1.

Introduction

Part IV. Institution, Organization and Operations

Chapter 1. Introduction

1.1 Objective and Scope

One of the key purposes of the MWSS Master Planning Study is to review the implementing agencies that will enable the efficient provision of future water supply, sewerage and sanitation services, and to formulate the strategies to strengthen MWSS management and organization. This Part (IV) covers the institution, organization and operations of MWSS and discusses the review of current MWSS operations, strengthening plans, proposed projects for organizational strengthening, and evaluation of such projects based on the results of the Master Planning Study.

1.2 Inefficiency

The most critical management issue for MWSS is "inefficiency of organization and operations", represented by the following three key macro measures in 1995:

1. Slow expansion of service coverage: Population served by piped water supply is 6.5 million or 60%.
2. High non-revenue water (NRW) ratio: It stands at 55%.
3. Low productivity: Number of staff per 1000 connections is 10 employees.

The following table compares macro measures in three comparable major cities in Asia:

Table 4.1.1 Comparison of Macro Measures

Measures	Manila	Bangkok	Jakarta
Service Coverage	60%	79%	25%
Unaccounted Water (NRW)	55%	31%	57%
Staff per 1000 Connections	10p	5.5p	10.2p

Note: Data on Manila in 1995, Bangkok and Jakarta in 1991
Source: ADB Water Utilities Data Book - Asia and Pacific Region

The above table indicates that operational efficiency of MWSS (Manila) in 1995 is far behind water utilities in Bangkok in 1991, but slightly better than Jakarta.

1.3 Vicious Cycle

The inefficiency of MWSS organization and operations is caused by a vicious cycle in MWSS management as follows:

1. **Low Revenue and High Cost**: Water revenue does not grow as fast as planned by MWSS due to high non-revenue water (NRW) level, inefficient billing and collection, difficulty in increasing water tariffs, etc. In addition, operating expenses, especially personnel, have been increasing every year so internal cash generation (ICG), a funding source of capital expansion projects, is being diminished.

2. **Budget Constraints**: Due to slow growth of water revenue and low level of ICG, budget appropriation for operating expenses and capital expansion projects is always constrained, so MWSS can not allocate a budget to meet the requirements of each operating unit at a reasonable level.

3. **Poor Operations**: Budget constraint then becomes the major contributing factor for delay in capital expansion projects and poor operations, and maintenance of existing equipment, facilities and pipe network. Due to budget constraints, coupled with an inefficient procurement process, construction is often behind schedule; also supply materials, spare parts, tools and maintenance equipment are always in short of supply throughout the MWSS organization.

4. **Degradation of Services**: Delays in construction limit MWSS water supply capacity and slow down the expansion of service connections to meet the population growth in the service area. In addition, poor operations and maintenance together with delays in expansion projects become a major cause of water shortage, thus degrading customer services, e.g., frequent interruption of water supply, low water pressure and poor water quality. Consequently, the number of service connections does not increase as fast as planned, a large amount of water is wasted and customers dissatisfied with MWSS services do not pay

water bills regularly. Those problems are also basis for public criticism against inefficient management of MWSS and create strong opposition to higher water tariffs.

The above problems are closely interrelated and rotate as a vicious cycle in MWSS operations. **Sections 2.2 and 2.3 of Part IV** discuss the existing organizational and operational setups at MWSS, and current issues and concerns in detail.

1.4 Monopoly and Regulations

There are two fundamental causes for inefficiency in MWSS organization and operations. One is monopoly of MWSS operations and the other is government regulations.

A water utility is a natural monopoly because of the nature of water being a basic necessity in life with no alternative service or goods. In addition, MWSS as a government-owned and controlled corporation (GOCC) enjoys an integrated monopoly from development of water sources through distribution of water to the consumer. Due to this natural and government-owned integrated monopoly of operations in the water supply service, the principle of competition to create incentives for efficiency does not work for MWSS at present.

MWSS, as a GOCC and public utility, is also heavily regulated by various laws and government regulations at the same level as other government administrative agencies in areas such as personnel, procurement, finance, etc. This makes it difficult for MWSS to introduce the commercial principle into its organization and operations to improve operational efficiency.

1.5 Reform

In order to improve overall performance of organization and operations, MWSS must be transformed into a more efficient and responsive organization for consumers and other stakeholders through various reforms at the following levels:

1. Institution
2. Organization
3. Operations

4. Human resources
5. Finance

1.5.1 Institution

It is extremely difficult for MWSS to remove vicious cycle of management through self-effort of MWSS themselves for internal improvement because underlying issue of inefficiency of MWSS is deeply related to the institutional setup that commercial and competitive principles do not effectively work. In order to solve this fundamental issue, the existing institutional setup must be structurally changed through external forces.

First, the existing legal framework surrounding MWSS operations must be reviewed and necessary legislative actions must be taken by the government, if necessary, to facilitate the reformation of MWSS. In June 1995, the National Water Crisis Act of 1995 was approved by the Congress and the Implementation Rules and Regulations are being formulated by GOP. The amendment of the MWSS Charter (RA 6234) that is still in discussion in the Congress must also be approved as soon as possible to assist MWSS in strengthening financial aspect. Necessary legislative actions to be taken by the government will be recommended by the Joint Executive-Legislative Water Crisis Commission to be formed under the National Water Crisis Act of 1995. **Section 2.1 of Part IV** discusses the present legal framework surrounding MWSS and recent developments in legislative actions.

Second, MWSS could be break up into multiple units in order to create competitive environment through lessening integrated monopoly. Combined with unbundling, the private sector participation (PSP) could also be introduced to develop incentives for competition and to revitalize MWSS operations based on the introduction of the commercial principle. **Section 3.1 of PartIV** discusses possible options for unbundling and modes of PSP.

1.5.2 Organization

The existing MWSS could be transformed into more efficient and responsive organization for consumers and other stakeholders. The National Water Crisis Act of 1995 stipulates that the President of the Republic is empowered to revamp the executive leadership and reorganize MWSS and LWUA.

The strategy for future MWSS organization will be centered around decentralization of routine operations including customer service and O&M areas, empowerment with enhancing corporate planning capability and rightsizing through operational improvement, an introduction of advanced information technology and outsourcing of non-mission critical operations. **Section 3.2 of Part IV** discusses the key strategies to be taken to transform MWSS organization into more efficient and effective organization.

1.5.3 Operations

MWSS could also be improved at the operational level. Operations of MWSS will be improved through mainly internal self-efforts with minimum support from outside organizations and/or professionals. Operations improvement will be achieved through a full implementation of the Information System Plan (ISP) and the Change Management Program (CMP), re-engineering of the inefficient core operating processes, and contracting out non-mission critical activities. **Section 3.3 of Part IV** discusses improvement to be made at the operational level.

1.5.4 Human Resources

As the characteristics of the MWSS organization and operations change in the future, it will also require change of skill-set of existing employees. An organizational success of MWSS in the future will highly depend upon MWSS ability to secure, develop and retain right people. Since HRD is a long-term issue, strategies for human resource development should be established based on defining future core skills and competency to be required by MWSS.

In addition, incentive system combined with the career path must be reviewed and modified in the manner to motivate managers and employees. **Section 3.4 of Part IV** discusses the strategies to be taken for strengthening the human resources development and management areas.

1.5.5 Finance

In the financial management area, the existing tariff structure must be reviewed and the new one proposed. New financial sources for future capital expansion projects are also being sought. The details on tariff structure and financial management are discussed in **Part V - Finance**.

Chapter 2.

Review of Current Operation

Chapter 2. Review of Current Operations

2.1 Laws and Regulations

2.1.1 Existing Laws and Regulations

Being a government corporation with original charter, R.A. 6234, MWSS is subject to and governed by the authority and powers of other government agencies as well as by other laws and regulations, as follows:

- the Omnibus Civil Service Rules and Regulations regarding the appointment, promotion, and discipline, among others, of MWSS personnel
- the Code of Conduct and Ethical Standards for Public Officials and Employees, per R.A. 6713
- the Salary Standardization Law (R.A. 6758) and Joint Resolution No. 01, series of 1994, as implemented by E.O. 164 and 218 (Under the National Water Crisis Act of 1995, the compensation of MWSS employees may be exempted from the Salary Standardization Law.)
- the Attrition Law (R.A. 7430), which prohibits, for a period of five years from June 16, 1992, any appointments of an officer or employee to fill vacant positions resulting from resignation, retirement, dismissal, death or transfer to another agency (Under the National Water Crisis Act of 1995, this law will not apply in the reorganization of MWSS the President may implement under his emergency powers.)
- the Commission on Audit (COA)
- the accounting and auditing rules and regulations embodied in Volumes I to III of the Government Accounting and Auditing Manual prescribed by the COA

There are also laws and regulations that are pertinent to and/or affect the operations of MWSS in the following areas:

(1) Water Supply/Resources

- R.A. 4850 (1966), creating the Laguna Lake Development Authority, Laguna Lake being a potential source of MWSS water supply

- E.O. 385 (1972), delineating jurisdiction over waterworks systems between MWSS and DPWH
- P.D. 424 (1974) and E.O. 124-A creating the National Water Resources Council (later renamed National Water Resources Board)
- P.D. 1067 (1976), creating the Water Code of the Philippines
- L.I. 683 (1978), regarding basic policies for the Water Supply Sector
- P.D. 1345 (1978), authorizing MWSS to take over centralized water systems of residential subdivisions

(2) Land Use

- P.D. 296 (1973), regulating the use of rivers, creeks, esteros (estuaries), drainage channels and other similar waterways by private persons, natural or juridical.
- P.D. 324 (1973), divesting MWSS of control and supervision over some portions of the Marikina Watershed Reservation.

(3) Water Related Environmental Protection

- R.A. 3931 (1964), creating the National Water and Air Pollution Control Commission, later abolished under E.O. 192 (1987), and its functions, which were transferred to the Environmental Management Bureau of the DENR
- P.D. 1152 (1977), creating the Philippine Environment Code
- E.O. 430 (1990), constituting the National Committee on Bio-safety of the Philippines
- E.O. 117 (1993), establishing an Inter-Agency Task Force for Coastal Environmental Protection

(4) Sewerage and Sanitation

- R.A. 1378 (1955), regulating the practice of master plumbing or "Plumbing Law".
- P.D. 856 (1975), creating the Sanitation Code

2.1.2 Republic Act 6234 (R.A. 6234)

This is an act which created the Metropolitan Waterworks and Sewerage System, vesting in it the jurisdiction, supervision and control of all waterworks within its territory; those outside its territory

were turned over to local government units (LGUs) and to the Local Water Utilities Administration (LWUA). Since its enactment in 1971, several amendments have already been made. The salient features of RA 6234 are the following:

(1) MWSS Mission

The MWSS mission is the establishment, operation and maintenance of waterworks system to insure an uninterrupted and adequate supply and distribution of potable water for domestic and other purposes and of sewerage systems as vital to public health and safety.

Under Sec. 3, among its specific functions for water supply are to construct, maintain, and operate dams, reservoirs, conduits, aqueducts, tunnels, purification plants, water mains, pipes, fire hydrants, pumping stations, machineries and other waterworks for the purpose of supplying water to the inhabitants of its territory; and to purify water, and regulate and control its use, as well as to prevent its wastage .

Its specific provisions on sewerage are as follows: a) supervision and control over all sewerage systems in the covered territory; those beyond are to be turned over to LGUs; b) construction, maintenance and operation of sanitary sewerage; c) authority to approve and regulate the establishment and construction of sewerage systems in private subdivisions within its jurisdiction; and d) imposition of penalty for any act which injuriously affects the quantity/quality of sewage flow and/or for illegal connection to established sewer lines.

(2) MWSS Governing Body

The governing body of the MWSS is made up of a Board of Trustees consisting of nine (9) members, with the Secretary of DPWH as ex officio Chairman, the MWSS Administrator as Vice-Chairman and the Government Corporate Counsel as ex officio member and legal adviser of the Board. The other six (6) members shall be appointed by the President.

(3) MWSS Jurisdiction

The MWSS shall own and/or have jurisdiction, supervision and control over all waterworks and sewerage systems in the territory comprising the cities of Manila, Pasay, Quezon, Cavite, Caloocan, Makati, Mandaluyong, and Pasig, the municipalities of Las Pinas, Malabon, Marikina, Navotas, Paranaque, Pateros, San Juan, Taguig, Valenzuela, all of Metropolitan Manila, the entire province of Rizal, and the municipalities of Bacoor, Imus, Kawit, Noveleta, Rosario, all of Cavite Province, Lungsod Silangan, Muntinlupa, and other areas that may come within the development path of the expanding Metropolitan Manila Area.

(4) MWSS Capitalization

Upon organization, the MWSS has an authorized capital P8.0 billion; of this amount P2,135,467,000 has already been subscribed and paid for, while the balance of P5,864,533,000 shall be subscribed by the Philippine Government and paid from continuing appropriations. As of December 31, 1994, total amount subscribed and paid was P6.807 billion.

(5) MWSS Indebtedness

The MWSS has the authority to incur indebtedness and issue bonds up to a maximum amount of P3.0 billion from domestic sources and US$600.0 million from foreign sources.

(6) Tax Exemptions

Under its original charter, the MWSS was exempt from all taxes, duties, fees, imposts and other charges by other government agencies and instrumentalities. This exemption particularly on taxes and duties was, however, withdrawn under PD 1931 and PD 1955 and EO 93 dated 17 December, 1986.

(7) Laws/Rules and Regulations Governing Internal Operations

Being a government corporation with original charter, the MWSS is subject to the authority and powers of the Commission on Audit (COA) and is governed by the accounting and auditing rules and regulations embodied in Volumes I to III of the Government Accounting and Auditing Manual prescribed by COA.

As to the appointment, promotion, and discipline, among others, of personnel, the same are governed by civil service laws, rules and regulations, particularly Book V of Executive Order No. 292 and its implementing rules, collectively known as the Omnibus Civil Service Rules and Regulations.

Further, all officials and employees of the MWSS are bound to observe the ethical standards laid down in Republic Act No. 6713, otherwise known as the "Code of Conduct and Ethical Standards for Public Officials and Employees."

With respect to the basic monthly salaries and certain other benefits of the MWSS personnel, the same are governed by Republic Act 6758 (Salary Standardization Law) and Joint Resolution as implemented by Executive Orders Nos. 164 and 218.

The MWSS is subject to the provisions of Republic Act 7430 (Attrition Law). Under this law any government office cannot make any appointments of an officer or employee to fill vacant positions resulting from resignation, retirement, dismissal, death or transfer to another agency, except under certain conditions. This prohibition will be for a period of five years from the effectivity of said law on 16 June, 1992.

2.1.3 Recent Developments

(1) BOT Law

Following the thrust of government to give maximum participation to the private sector in infrastructure development, the BOT Law and its variations have been recently amended to make it much easier for private investors to undertake such development for the government. Under this

law the private sector puts up the new infrastructure (or repairs an existing facility) using its own funds, operates the facility for an agreed period, after which it turns over the facility to the government without any cost. This method of infrastructure development could be used by MWSS in putting up new projects and in the repair of its existing facilities.

Republic Act (R.A.) 6957, as amended by R.A. 7718, declares that it is the GOP's policy to recognize the indispensable role of the private sector as the main engine for national growth and development and to provide the most appropriate incentives to mobilize private resources for the purpose of financing the construction, operation and maintenance of the infrastructure and development projects normally undertaken by the Government.

To achieve these goals, the GOP has developed the financial incentives that may be provided by law, such as an income tax holiday and reduced duties on imports, and is encouraging an environment of minimum government regulations and procedures. This BOT Law was enacted to accelerate the process for investment in key sectors.

Implementing Rules and Regulations (IRR) were formulated to effect the BOT Law, covering pre-qualification, submission of the appropriate bid and tender documents, evaluation of the bids, award and approval of contract, investment incentives, and coordination and monitoring of projects. Contractual arrangements in IRR refers the following contractual arrangements or schemes, as well as other variations as may be approved or authorized by the President:

- Build-and-transfer (BT)
- Build-lease-and-transfer (BLT)
- Build-operate-and-transfer (BOT)
- Built-own-and-operate (BOO)
- Build-transfer-and-operate (BTO)
- Contract-add-and-operate (CAO)
- Develop-operate-and-transfer (DOT)
- Rehabilitate-operate-and-transfer (ROT)
- Rehabilitate-own-and-operate (ROO)

(2) National Water Crisis Act of 1995

During its special sessions from late May to early June, 1995, the National Water Crisis Act of 1995 was passed by the House of Congress. This was subsequently signed by the President. At this moment, the Implemetation Rules and Regulations (IRR) are being prepared. The important provisions of this Act are as follows:

- The President of the Republic has the power within 6 months to reorganize both the MWSS and LWUA, including the privatization of any or all segments of these agencies;
- The President of the Republic also has the power for a period of one year to enter into negotiated contracts under BOT for the financing, construction, repair, rehabilitation, improvement, and operations of water supply, its treatment and its distribution; and
- The anti-pilferage acts have been expanded and made more stringent and corresponding penalties increased from previous laws.

(3) Amedment of the MWSS Charter (R.A. 6234)

House Bill No. 14203 which covers proposed amendments to RA 6234, (MWSS Charter) as follows is still under discussion at the Congress:

- Increasing the authorized capital stock of MWSS to P16,000,000,000.00 of which P5,518,147,238.98 shall be subscribed and fully paid, leaving a balance of P10,481,852,761.02 for further subscription and payment.
- Increasing the amount of indebtedness which MWSS may incur from domestic sources to P11.0 billion, and from foreign sources to US$1.0 billion.

2.1.4 Recommendations

In order to improve MWSS operations, the following matters should be addressed, preferably through legislation:

- Increase in the capitalization of MWSS.
- Increase in the amount of loans, local and foreign, that MWSS is authorized to secure.

- More coercive powers for MWSS to enforce collection of customers accounts.
- Uniform state regulation in the drilling of wells and utilization of both ground and surface waters, to prevent the intrusion of salt water in the water sources of MWSS.
- Expeditious resolution of Right of Way problems involving MWSS projects.
- Exemption from dividend payment and income tax to fund major capital projects

Most of the above are covered by proposed bills filed during the 9th Congress and were left unacted upon; these have to be refiled with the current 10th Congress so that they can be acted upon.

In addition to the above current items, there will be much need for legislative actions resulting from changes in MWSS's institutional setup, organization, operations and the degree of autonomy.

2.2 Organization

2.2.1 Legal Status

MWSS, public stock corporation owned and controlled by the GOP, was established in 1971 by virtue of the Republic Act 6234 for the purpose of providing water and sewerage/sanitation services to Metropolitan Manila and its contiguous area.

MWSS is attached to DPWH for policy and program coordination, and the Board of Trustees, MWSS's highest decision-making body, is chaired by the Secretary of DPWH. Its procedures and organization are regulated by various codes including the aforementioned R.A. 6234 (MWSS Charter), but daily operations can be performed without the control of DPWH or other governmental agencies, although it does not have complete autonomy in its business undertakings.

2.2.2 Major Functions

In order to accomplish its mandate, MWSS has the following functions:

Core functions	• Planning
	• Infrastructure development
	• Operations and maintenance
	• Customer services
Supporting functions	• Human resources
	• Financial management
	• Information system and communications
	• Administration

These functions are explained later in this section. They are carried out by various organizational groups that are basically designed around functions but are not necessarily fully self-contained for their respective service.

2.2.3 Business Environment

The Study Team is in the opinion that MWSS is now facing a need for organizational and operational reform to enhance its productivity and efficiency. The underlying external and internal