

JAPAN INTERNATIONAL COOPERATION AGENCY
METROPOLITAN WATERWORKS AND SEWERAGE SYSTEM
THE REPUBLIC OF THE PHILIPPINES

STUDY ON WATER SUPPLY AND SEWERAGE
MASTER PLAN OF METRO MANILA
IN
THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
VOLUME I
SUMMARY REPORT

JICA LIBRARY



J 1126021 (3)

FEBRUARY 1996

NIPPON JOGESUIDO SEKKEI CO., LTD.
TOHMATSU & CO.

S.S.S.

96-006

EXCHANGE RATE (As of 1 August 1995)

US \$ 1.0 = Peso 25.7 = Yen 88.3

JAPAN INTERNATIONAL COOPERATION AGENCY
METROPOLITAN WATERWORKS AND SEWERAGE SYSTEM
THE REPUBLIC OF THE PHILIPPINES

STUDY ON WATER SUPPLY AND SEWERAGE
MASTER PLAN OF METRO MANILA
IN
THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
VOLUME I
SUMMARY REPORT

FEBRUARY 1996

NIPPON JOGESUIDO SEKKEI CO., LTD.
TOHMATSU & CO.



1126021 [3]

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a study on the Water Supply and Sewerage Master Plan of Metro Manila in the Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Toru Hayashi, Nippon Jogesuido Sekkei, Co., Ltd., and composed of members from Nippon Jogesuido Sekkei, Co., Ltd. and Tohmatsu & Co., four times between November 1994 to January 1996.

The team held discussions with the officials concerned of the Government of the Philippines and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of the friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

February 1996



Kimio Fujita

President

Japan International Cooperation Agency



February 1996

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Japan

Dear Sir,

Letter of Transmittal

We are pleased to submit herewith the final report of the Study on Water Supply and Sewerage Master Plan of Metro Manila in the Republic of the Philippines.

The Study was completed through the discussions with the officials of the Government of the Philippines and the field investigation during four visits from November 1994 to January 1996 and the home work thereafter.

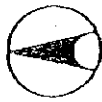
The Final Report consists of four volumes consolidating the two progress reports and the interim report ; Volume I - Summary Report which succinctly describes the study and recommendations; Volume II - Main Report which covers not only the long-term development plan on water supply and sewerage for the Metro Manila but also institutional, organizational, operational and financial strengthening plan for the implementing agency ; Volume III - Supporting Report including detailed analysis and relevant information, and Volume IV - Data Report compiling collected data.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Health and Welfare and the Ministry of Construction. We also would like to show our appreciation to the officials of the Metropolitan Waterworks and Sewerage System, the JICA Philippine Office, and the Embassy of Japan in the Republic of the Philippines for their kind cooperation and assistance throughout our field survey.

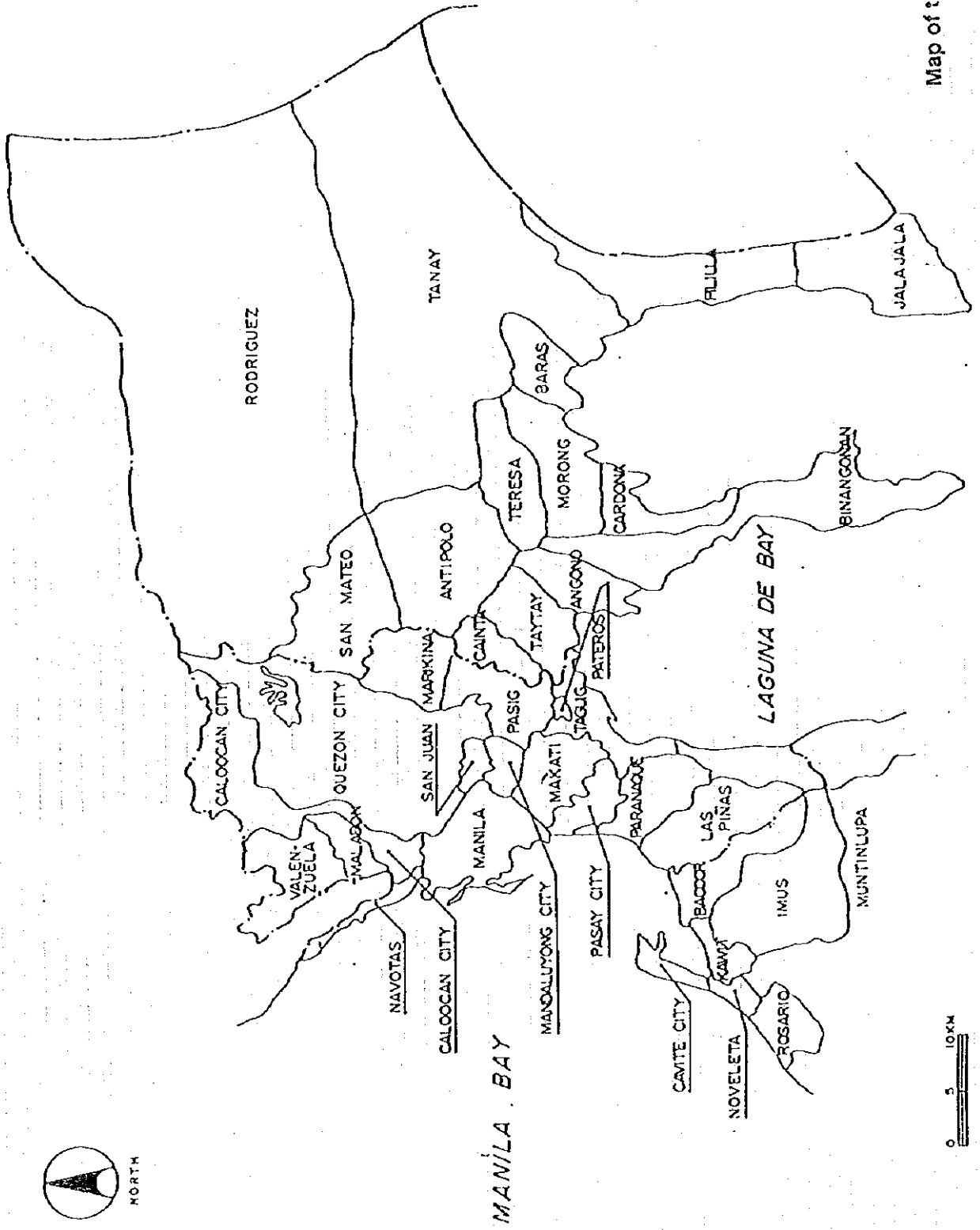
Very truly yours,

Toru Hayashi

Toru Hayashi
Team Leader for the Study on
Water Supply and Sewerage Master Plan of
Metro Manila in the Republic of the Philippines



NORTH



MANILA BAY

LAGUNA DE BAY



Map of the Study Area

Executive Summary



**STUDY ON WATER SUPPLY AND SEWERAGE
MASTER PLAN OF METRO MANILA
IN THE REPUBLIC OF THE PHILIPPINES**

EXECUTIVE SUMMARY

1. General

1.1 Background

At present, the MWSS faces a very important situation regarding its operations. There are many problems to be overcome, such as considerably high non-revenue water (NRW), significant delay in the provision of distribution lines for the expanded water supply areas, lack of groundwater to supply the separate water supply system areas, delay of water source augmentation to meet ever-increasing demand, delayed progress of the sewerage system, shortage of necessary staff, etc.

Therefore, this Master Plan Study reviewed and analyzed the above-mentioned issues comprehensively and from all angles, and formulated a useful plan which gives a realistic guideline aimed at the target year 2015.

1.2 Objectives of the Study

The objectives of the study are as outlined below:

- (1) To establish the development strategy on expansion of service areas as well as quality improvement for water supply, sewerage and sanitation.
- (2) To study how the MWSS (the implementing agency) should carry out efficient water supply, sewerage and sanitation services; and to establish strategies for strengthening the organization and management.
- (3) To transfer the technology and expertise related to the relevant planning and strategic development to the MWSS.

1.3 Study Area

The study area will cover the eight cities and twenty nine municipalities in Metro Manila, Cavite and Rizal Province under the jurisdiction of the MWSS.

1.4 Target Year

The project target is to develop a master plan to serve the water demand up to the year 2015 of the entire MWSS jurisdiction as well as to develop a practicable master plan of sewerage and sanitation systems.

2. Water Supply

2.1 Master Plan

The basic indicators for water supply development are concluded as shown in Table 1. Figure 1 shows the relations between the implementation of the proposed projects and the water demand projection.

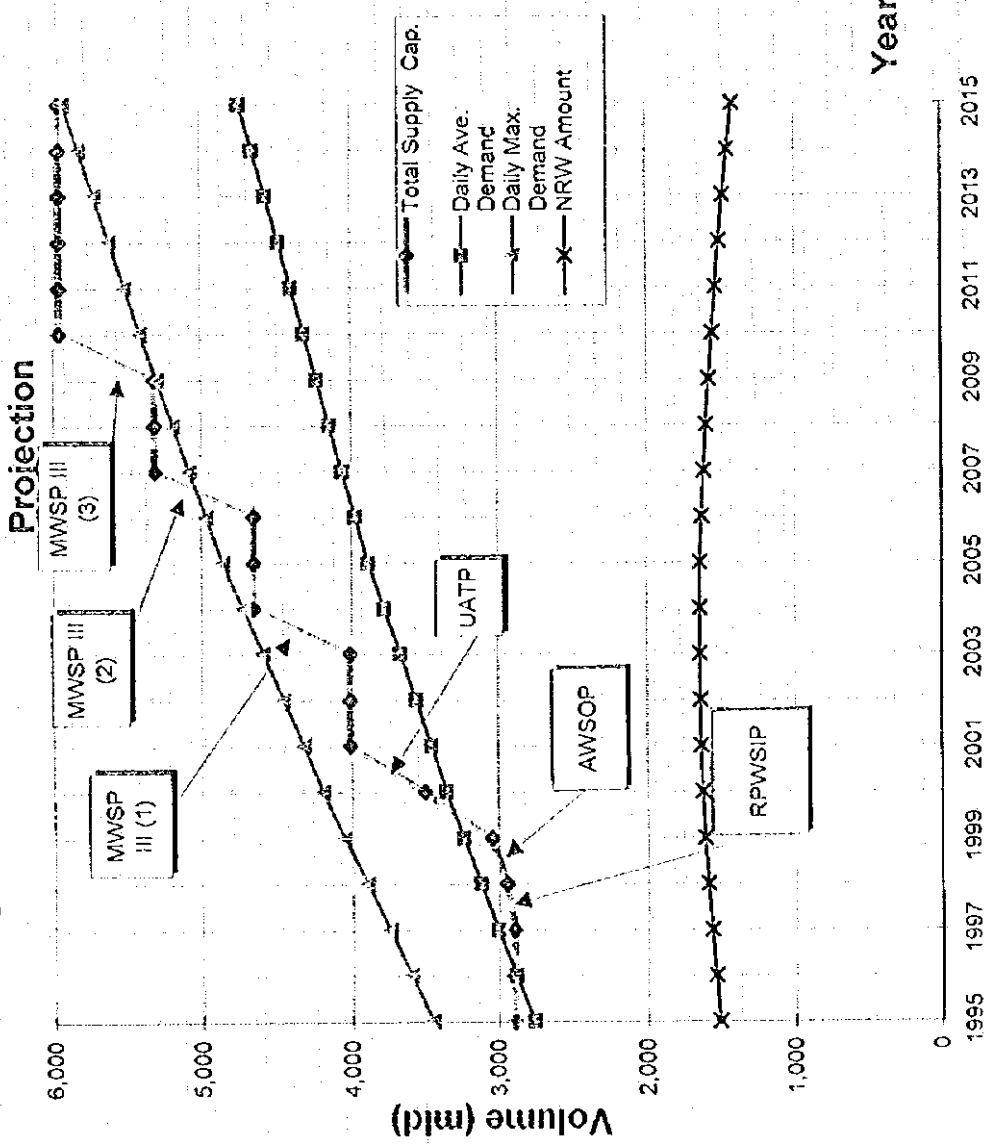
Table 1 Water Supply Basic Indicators

Description	1995	2000	2005	2010	2015
Projected Population (million)	10.787	12.152	13.385	14.595	15.729
Supply Coverage (%)	60	67	74	83	90
Served Population (million)	6.449	8.139	9.839	12.065	14.199
Ave. Unit Consumption Rate(l/capita/d)	193	211	226	230	234
NRW (%)	55	49	43	36	30
Daily Ave. Water Demand (mld)	2,765	3,360	3,889	4,324	4,746
Daily Max. Water Demand (mld) (a)	3,456	4,200	4,861	5,405	5,932
Prospective Production Cap. (mld) (b)	2,896	3,514	4,014	4,014	4,014
System Deficit (mld) = (a) - (b)	560	686	847	1,391	1,918

2.1.1 Production Capacity to be Expanded

Deficit in the production capacity increases from 560 mld in 1995 to 1,918 mld in 2015. Thus, a new water supply system shall be developed including new raw water sources, because it is apparently that the capacity of the "Angat Novaliches Water Supply System" reaches at its limit. It functions not only as an additional water supply system but also to ensure a supplemental system in the event of an emergency.

Figure 1. Implementaion of the Projects and Water Demand





2.1.2 Acquisition of Water Source

The Kaliwa River is recommended as the most suitable source, in view of quantity and quality, on which MWSS could depend on up to the target year 2015. A dual water source system is necessary for a megalopolis like Metro Manila in case of unexpected emergencies.

2.1.3 Distribution System to be Improved

The areas supplied by pump should be as small in size as practicable and should be totally isolated from the gravity served areas to minimize maintenance and power cost. The main pipes should be looped and reinforced to attain a stable water supply, uniform system pressures and flexible enough during emergencies. The service area should be subdivided into seven large blocks to simplify operation and maintenance.

New pipes should be installed to replace old pipes and for filling-out the network to achieve a stable water supply and uniform system pressures. Consequently, a total of 370 km of main pipe, from 300 to 3,500 mm in diameter, and several reservoirs should be expanded.

Figure 2 shows the water supply coverage of the proposed Balara-La Mesa lineage and the Pantay lineage in the target year of 2015.

2.1.4 Service Network to be Expanded

The quantity of small diameter pipes (250 mm and smaller pipes) planned for in-filling pipe networks was estimated considering the existing pipe density and the increasing served population. The total estimated quantity of small pipes to be expanded is 4,913 km.

2.1.5 Pipe Replacement

The existing distribution pipes has a total length of about 4,300 km. Out of which, 50 % of the pipes are of ACP or of unverified materials, which is possibly a primary cause of pipe breakage or water leakage, totaling 2,054 km should be replaced.

2.2 Development Priority of the Proposed Projects

Emphasizing low-cost but high benefit projects, the assigned priority of the proposed projects are summarized in the following table. The first priority is given to the completion of the ongoing projects AWSOP, UATP, and RPWSIP as scheduled. The "Controlling Unauthorized Water Use Project" and the "Old pipe Renovation Project" are ranked 2nd and 3rd, respectively, aiming at NRW reduction. MWSP III is then prioritized, as a water supply augmentation/expansion project, to cope with the increasing water demand. For reinforcement of the existing water supply capacity, the "La Mesa TP 1 Rehabilitation Project" is assigned 5th priority.

Table 2 Priority of the Proposed Projects

Priority	Projects
1	Accomplishment of the ongoing projects (AWSOP, UATP, and RPWSIP)
2	Controlling Unauthorized Water Use Project
3	Old Pipe Renovation Project
4	MWSP III, including Distribution System Improvement/Expansion Project Service System Expansion Project
5	La Mesa TP 1 Rehabilitation Project

2.3 Project Cost

The project cost is estimated using August, 1995 prices with consideration of the past construction costs under previous MWSS projects. The summary of the cost estimates for the proposed projects is shown in Table 3.

Table 3 Project Cost

Foreign Portion	Local Portion	Total
15,895	41,567	57,462

Note: Unit in Million Pesos

2.4 Implementation Plan

Figure 3 shows the implementation schedule for the five selected projects. It is recommended that they be implemented on a per block basis for the entire system to be more effective. This manner of implementation of projects will also mean an absence of unnecessary delays due to a lack of coordination.

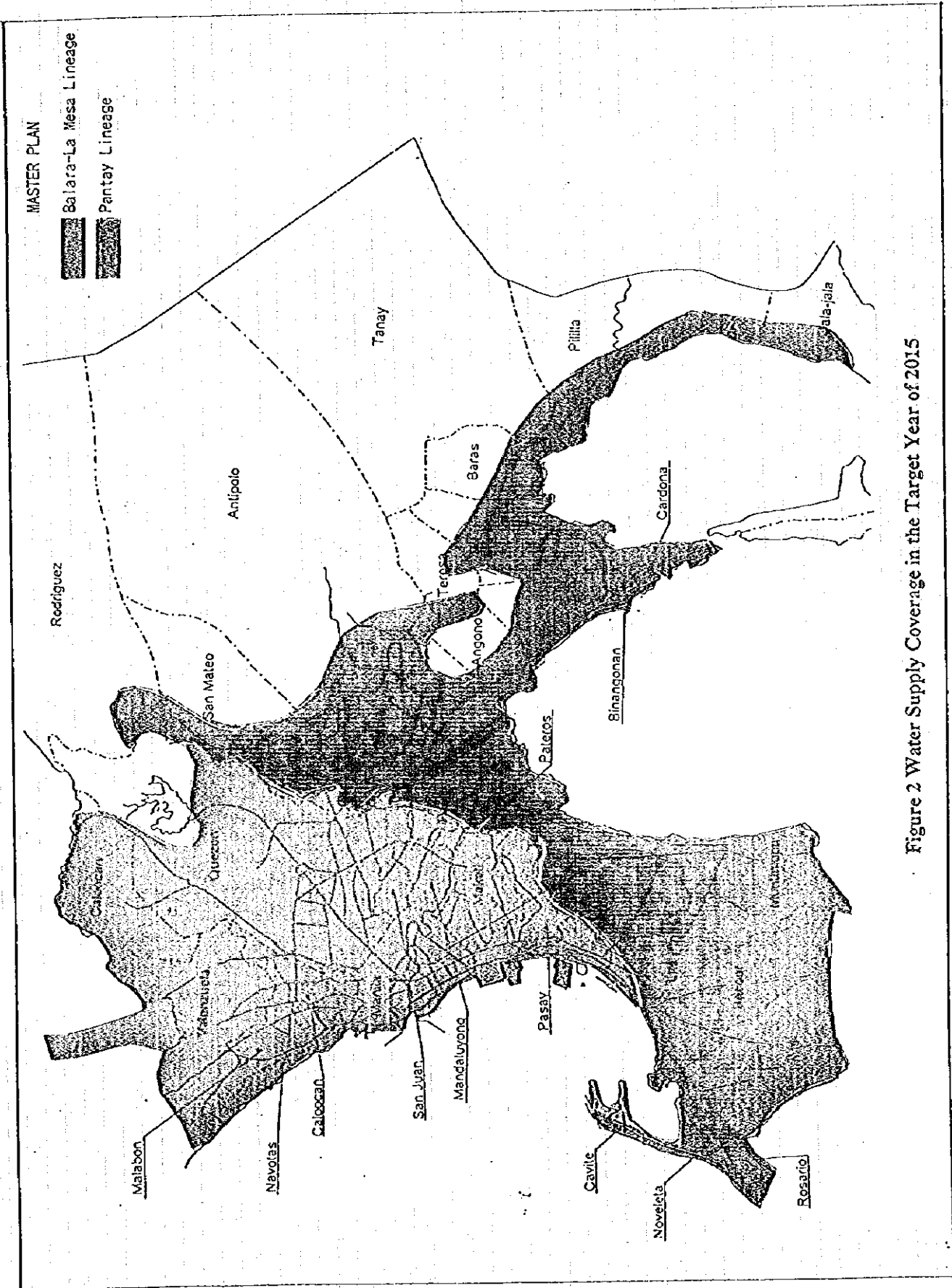


Figure 2 Water Supply Coverage in the Target Year of 2015

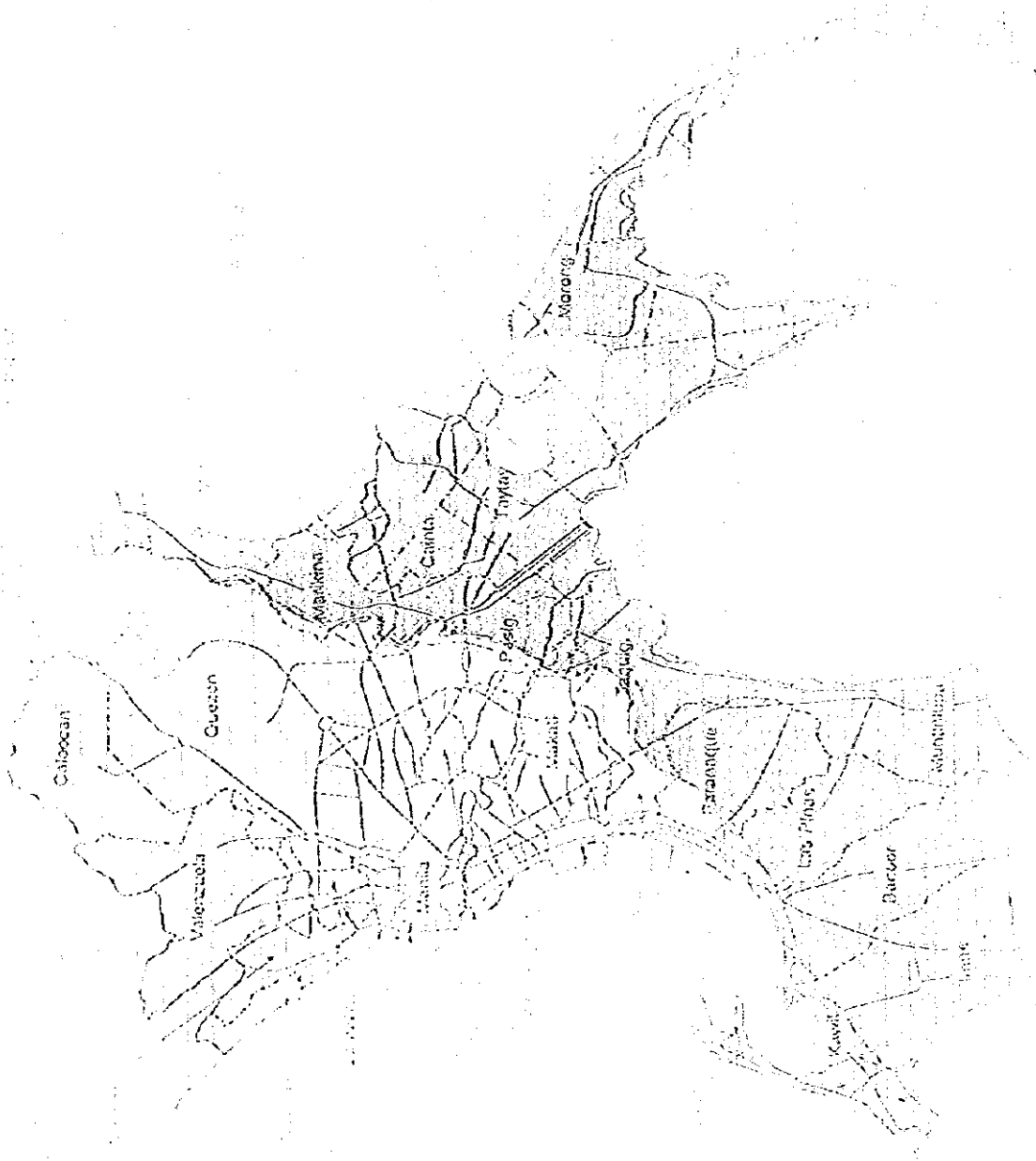


Figure 2. Luzon, Philippines, showing provincial boundaries and major cities.



Figure 3. Implementation Schedule

Item No.	Description	Remarks	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2016
1	(La Mesa TP 3), La Mesa- Balara distribution main La Mesa TP 1 Rehabilitation	Construction by UATP																				
2	Block No.1 Reservoirs, pump stations Pipelines	Construction by AWSOP Extension																				
3	Block No.2 Reservoirs Pipelines	Extension Extension																				
4	Block No.3 Reservoirs, pump stations Pipelines	Rehabilitation by AWSOP Extension																				
5	Block No.4 Pump stations Pipelines	Rehabilitation by AWSOP Extension																				
6	Block No.5 Reservoirs Pipelines	Extension Extension																				
7	Block No.6 (refer to pipe replacement)																					
8	Block No.7 Intake headworks Pantry TP Reservoir Pipelines	Construction by MWSP 3 ditto ditto ditto																				
9	Pipe replacement	NRW reducing project																				
10	Small pipe for in-filling	Extension																				



Small vertical text or stamp on the right side of the page.



2.5 Evaluation

2.5.1 Technical Evaluation

Figure 2 presents the balance between the projected water demand and supply. Figure 2 shows the coverage areas by the target year 2015.

Each phase is characterized as shown below:

(1) Phase I (1996-2000; full accomplishment of the ongoing projects and preparation for new water supply system)

Depressed water supply conditions will persist during the first phase. The water supply capacity will be less than the daily average demand even when the ongoing projects be accomplished. The private wells will serve as a dependable water source until the second phase.

(2) Phase II (2001-2005; accomplishment of new water supply system)

All the ongoing projects and the first phase of MWSP III will be accomplished. The water supply capacity will reach just over the average demands but less the maximum demand. In conjunction with that, the depressed water supply conditions will gradually improve if the private wells are utilized effectively. NRW should be reduced preferably as scheduled in Phase 1 by the replacement/renewal of deteriorated pipes.

(3) Phase III (2006-2010; stable implementation of augmentation/expansion projects)

After the second phase of the MWSP III project will be conducted during the third, the supply capacity will achieve a surplus against the daily maximum demand. There will be a remarkable improvement in the affected service areas.

(4) Phase IV (2011-2015; achievement of the master plan goals)

The surplus during the third phase will be further increased with the completion of the MWSP III project during the fourth phase. However, it might be necessary for a new water source to be developed in response to the actual population increase or living standard improvement. A review of the groundwater sources in the Rizal area, in which unexpected population growth can

be expected, might become a pressing issue. The targets set in Phase 1 should be reviewed in light of the Master Plan.

2.5.2 Environmental Considerations

The overall conclusion of the environmental impact assessment that the effects of both construction and operation will cause no significant or lasting harm to the environment and should not be considered a factor inhibiting the implementation of the project, provided that practical countermeasures are taken.

2.5.3 Financial Evaluation

Financial data for the proposed master plan projects for water are as follows:

Average tariff	Tariff increase	% of household income	Financial Benefits	Financial Costs	FIRR
6.43	Current level	0.74	46,456	66,001	-5.4%
8.68	35%	1.00	58,070	66,001	-1.9%
13.05	103%	1.50	80,635	66,001	3.0%
17.36	170%	2.00	102,868	66,001	6.7%

It appears that in order for the master plan projects to be financially viable, the tariff level need to be at least 2.7 times as much as the current tariff.

3. Sewerage and Sanitation

3.1 Master Plan

3.1.1 Basic Policy and Conditions for Preparation of Master Plan

(1) Basic Policy

- Utilization of existing facility/system based on a low cost sewerage/sanitation system.
- Cooperation with related sectors especially utilization of private sector or the adoption of a BOF scheme

- **Balanced development of water supply and sewerage/sanitation**

A well-balanced development of water supply level and sewerage/sanitation facilities has been emphasized.

- **Cooperative development of sewerage and sanitation facilities**

The improvement of human health is mainly shouldered by the development and appropriate management of sanitation facilities and sewerage systems, aimed at water environmental protection.

(2) Target Level

- **Regular desludging once every 5 to 10 years in target year 2015 in Level III supply areas**
- **Sewerage coverage: around 30 % of MMR**
- **Effluent: less than 30 mg/l at all proposed treatment plants for environmental protection**

(3) Basic Frame Value

The basic frame value was considered in compliance with the development plan and water supply projection. Among the frames, one feature is not to allow industrial wastewater into the sewer system.

(4) Classification into off-site treatment area and on-site treatment area

MWSS's jurisdiction is divided into two areas in compliance with criteria such as population density, construction cost, development trends, environmental impact and water supply levels. A total of 50,692 ha is demarcated into off-site treatment and called sewerage framework plan areas.

3.1.2 Development Plan on Sewerage

(1) Collection System and Treatment System

Interceptor system (first stage of combined system) is basically recommended as a collection system with an emphasis on the low construction cost to realize sanitation improvement and

public water quality improvement considering financial viability. As to the treatment system, low construction/maintenance treatment method is recommended.

(2) Sewerage Framework Plan

The target year is not fixed for this plan as it is a future framework. Considering the potential wastewater treatment plant site, the following plans were compared and the Medium-Scale Inland Treatment System was adopted.

- Small-Scale Inland Treatment System (SSITS)
- Medium-Scale Inland treatment system (MSITS)
- Large-Scale Inland treatment System (LSITS)
- Ocean Outfall System (OOS)
- Improved Ocean Outfall System (IOOS)

Through careful investigation of the recommended MSITS catchment area, the optimized Sewerage Framework Plan was finalized and shown below in Table 4

Table 4 Outline of Sewerage System

	System Name	Area (ha)	Population (persons)	Wastewater (daily max) (m ³ /D)
1	Marikina	5,814	1,104,226	274,057
2	East Mangahan	3,945	739,484	171,429
3	West Mangahan	5,111	1,062,550	254,277
4	Muntinlupa	3,786	665,929	162,347
5	Paranaque	6,557	1,323,275	317,313
6	South Manila	4,666	1,557,338	396,447
7	Ayala	900	273,985	83,024
8	Bonifacio	1,080	192,918	48,273
9	Central Manila	3,692	1,723,686	386,890
10	North Manila (MNTT river basin)	5,851	1,480,709	337,492
	North Manila (San Juan River basin)	9,290	2,023,217	515,183
	sub-total	15,141	3,503,926	852,675
	Total	50,692	12,147,320	2,946,732

(3) Sewerage Master Plan

10 systems were evaluated and prioritized. The areas where sewerage development is highly recommended and financially feasible up to 2015 have been designated in the Sewerage Master Plan area. The Master Plan area is shown in Table 5.

Table 5 Outline of Master Plan Area

System	zone	Area (ha)	Population (persons)	WWTP		Remarks
				System	Capacity (daily.ave m ³ /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 of Cubao and 200ha of North Quezon are already sewered
	San Juan	2,244	519,000			
	Mandaluyong	460	123,000			
	North Quezon	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

3.1.3 Development Plan on Sanitation

Focus is put on the septage management plan composed of the regular desludging, collection and disposal of septic tank septage. Ocean dumping of septage was also proposed as an intermediate plan. Covering the level III water supply area in 2015 by MWSS, construction of five septage treatment plant was proposed. Their target capacity is as follows:

Table 6 Septage Treatment Plant

	Capacity(m ³ /d)
Dagat-Dagatan STP	900
Quezon City STP	1,100
Taguig STP	600
Paranaque STP	800
Binangonan STP	600

As to the on-site treatment facilities, criteria for the septic tanks, like the groundwater level and permeability were investigated. The upgrading of on-site facilities to communal off-site systems was also considered.

3.2 Proposed project cost

Proposed project cost by sewerage and sanitation is shown below.

Table 7 Project Cost (in Million Pesos)

	Total Cost	Foreign	Local
Sewerage Project	7,421.36	1,748.76	5,672.60
Sanitation Project	10,226.23	4,052.02	6,174.21
Grand total	17,647.59	5,800.78	11,846.81

3.3 Evaluation

One of significant benefit that may be derived from the sewerage/sanitation project is public water quality improvement. The water quality in 2015 is estimated Table 8.

Table 8. 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 IEPC; DENR project	7	12	15	14	29

Financially, it appears that the application of the full cost recovery concept to the sewer/sanitation operation will be very difficult as indicated by the above financial data considering the fact that the master plan projects will not be sufficient to fulfill MWSS's mandate concerning sewer/sanitation. The following is the FIRR calculation result.

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.

4. Institution, Organization and Operations

The most critical management issue for MWSS is "inefficiency of organization and operations." There are two fundamental causes for the inefficiency of MWSS organization and operations. One is the monopoly of MWSS operations and the other is government regulations. In order to improve the overall efficiency of MWSS organization and operations, MWSS must be transformed into a more responsive and accountable organization for consumers and other stakeholders through reform measures at various levels.

4.1 Institution

As a result of our study on the types of ownership and management, the following conclusions were reached:

1. The core functions of MWSS (resource management, infrastructure development and wholesale area) shall remain as a GOCC. MWSS shall own the entire assets of infrastructure from sourcing through treatment and transmission to distribution.
2. The Customer Service Area shall be divided into two or more units and privatized through the sale of franchises.
3. As an initial step, one or two service sector(s) of the Customer Service Area could be privatized on a pilot basis.
4. In the infrastructure development area, BOT or similar schemes shall be promoted for the development of water sources, treatment plants and major transmission facilities in order to expand capital assets.
5. In order to secure financing for the major rehabilitation projects on the existing treatment plants or other facilities, MWSS may sell franchises to the private sector to operate those facilities based on a lease or concession arrangement.

MWSS should retain its sewerage and sanitation operations and create an independent and separate operating unit independent of water supply operations within MWSS. The new sewerage and sanitation unit should be headed by a Deputy Administrator who reports directly to the Administrator or other senior executive.

In the long run, the independent sewerage and sanitation system from MWSS may be sought as capital projects and operations will expand.

4.2 Organization

In order to strengthen the MWSS organization, the following should be considered in the reorganization:

1. A centralized organization directly headed by the Administrator should concentrate on resource management, engineering and construction, finance and administration.
2. A decentralized organization headed by COO or SDA should be directly involved in operations and customer service.
3. Corplan, MIS and PM&E should be combined to enhance planning and monitoring capacity and to maintain integrity in the planning and monitoring cycle.
4. Part of the material management functions (WSD and PMD) should be integrated with the facility and equipment maintenance function (CMD).

4.3 Operations

MWSS needs to develop and implement a corporate planning process for long-, medium- and short-term planning cycles and to monitor progress of such plans. 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 such as maintenance and logistics, and contracting out non-mission critical activities that include meter reading, leak repair, desludging, etc.

4.4 Human Resources

At present, MWSS employs approximately 7,800 regular and casual employees. The number of MWSS employees and their functional composition will gradually change over the next 20 years due to various factors such as fewer predicted major construction projects after the year 2005, a constant increase of work volume in customer service and contracting out some routine operations to the private sector.

As a result of the human resource projection, the total number of employees will decrease by 1,660 from 7,796 in the year 1995 to 6,136 in the year 2015. The number of regular employees will increase by 579 from 4,616 to 5,195 during the same period because of a rapid increase in service connections while the number of casual employees will decline drastically from 3,180 to 941.

4.5 Proposed Projects

There are numerous organizational and operational areas MWSS can strengthen. Nevertheless the Study Team selected the following five key areas to formulate the proposed projects MWSS should envisage:

- Corporate Planning and Monitoring
- Maintenance and Logistics
- R&D and Laboratory Strengthening
- Human Resources
- Management Information Systems.

5. Financial Study

MWSS's profitability was at its highest in 1992. Since then it has kept deteriorating and 1995 may be at around break even point if not for interest income. The increase in revenue has been constrained by the limited supply capacity and the static tariff level while such expenses as personnel, depreciation and finance charges have been increasing much faster.

It is projected that the future operations of water and sewer/sanitation will be both fairly profitable thanks to a higher tariff level and increased service volume. However, some of the financial covenants of the international loans will be missed, especially for the water operation.

The current tariff level has been fairly high as compared to other water utilities in ASEAN countries. When it is revised in the future, it should be set at between "revenue adequacy level" and "affordability level". The Study Team is of the opinion that the tariff is considered affordable if the charge for water and sewer services is less than 1 percent of customers' income. The Study Team further concludes that sewer and sanitation customers should be charged equally at a rate of 30 percent of the water charge.

**STUDY ON WATER SUPPLY
AND
SEWERAGE MASTER PLAN OF METRO MANILA**

**FINAL REPORT
SUMMARY REPORT**

Preface
Letter of Transmittal
Map of the Study Area
Executive Summary

TABLE OF CONTENTS

List of Tables
List of Figures
Abbreviations

	Page
<u>Part I General</u>	
1. Introduction	I-1
1.1 Authorization.....	I-1
1.2 Background.....	I-1
1.3 Objectives of the Study.....	I-2
1.4 Study Area.....	I-3
1.5 Target Year.....	I-3
1.6 Study Organization.....	I-4
1.7 Organization of the Report.....	I-5
2. Project Framework	I-6
2.1 National Economy.....	I-6
2.1.1 General Conditions.....	I-6
2.1.2 GDP.....	I-6
2.1.3 Inflation.....	I-6
2.1.4 Foreign Currency Exchange Rate.....	I-6
2.2 Sector Plan.....	I-7
2.3 Population Projection.....	I-10
2.4 Existing Land Use.....	I-11
2.5 Land Use Plan.....	I-12
2.6 Zoning Plan.....	I-16
2.7 Categorization of Fastest Growing Municipalities.....	I-17
2.8 Conclusion.....	I-19
3. Corporate Mission	I-20
3.1 Corporate Mission.....	I-20

Part II Water Supply

1. Review of Current Operations	II-1
1.1 General.....	II-1
1.2 Raw Water Sources.....	II-1

1.3 Raw Water Conveyance Facilities.....	II-2
1.4 Water Treatment Facilities.....	II-2
1.5 Distribution Facilities.....	II-3
2. Master Plan.....	II-6
2.1 Basic Development Concept.....	II-6
2.2 Water Demand Projection.....	II-6
2.2.1 Domestic Water Demand.....	II-7
2.2.2 Commercial Water Demand.....	II-8
2.2.3 Industrial Water Demand.....	II-8
2.2.4 Other Indicators.....	II-8
2.3 Development Plan.....	II-8
2.3.1 General.....	II-8
2.3.2 Acquisition of Water Source.....	II-9
2.3.3 Existing Water Supply Capacity.....	II-9
2.3.4 Production Capacity to be Expanded.....	II-10
2.3.5 Distribution System to be Improved.....	II-10
2.3.6 Service Network to be Expanded.....	II-12
2.3.7 Pipe Replacement.....	II-12
2.3.8 Staged Development Plan.....	II-12
2.4 Operation and Maintenance.....	II-13
2.4.1 Non Revenue Water Reduction.....	II-13
2.4.2 Maintenance and Logistics.....	II-14
2.4.3 Water Quality Control.....	II-15
Chapter 3. Proposed Projects.....	II-16
3.1 Expansion/Augmentation Project.....	II-16
3.1.1 MWSP III.....	II-16
3.1.2 Distribution System.....	II-16
3.1.3 Service Network Expansion Project.....	II-17
3.1.4 Alternative Plan.....	II-17
3.2 NRW Reducing Project.....	II-18
3.2.1 Old Pipe Renovation Project.....	II-18
3.2.2 Controlling Unauthorized Water Use Project.....	II-18
3.3 La Mesa Plant No. 1 Rehabilitation Project.....	II-18
3.4 Priority of the Proposed Projects.....	II-19
3.5 Implementation Plan and Cost.....	II-19
3.5.1 Implementation Plan.....	II-19
3.5.2 Project Cost.....	II-19
4. Evaluation.....	II-20
4.1 Technical Evaluation.....	II-20
4.1.1 Balance in Demand Supply.....	II-20
4.1.2 Water Supply Scheme.....	II-21
4.2 Financial Evaluation.....	II-21
4.2.1 Approach.....	II-21
4.2.2 Financial Benefits.....	II-21
4.2.3 Financial Costs.....	II-23
4.2.4 FIRR.....	II-23
5. Conclusion and Recommendation.....	II-25
5.1 Water Sources.....	II-25
5.2 Water Treatment Facilities.....	II-25
5.3 Distribution Facilities.....	II-25
5.4 NRW Reduction.....	II-26
5.5 Finance.....	II-26

Part III Sewerage and Sanitation

1. Introduction.....	III-1
2. Review of Current Operations.....	III-1
2.1 Existing Sewerage/Sanitation and Drainage System.....	III-1
2.1.1 Sewerage Systems.....	III-1
2.1.2 Sanitation Facilities.....	III-2
2.1.2 Drainage System.....	III-2
2.2 Previous Studies Relevant to Sewerage/Sanitation Project.....	III-3
2.3 Water Pollution Status and Future Problems in Metro Manila River.....	III-4
2.3.1 Present Water Pollution Analysis.....	III-4
2.3.2 Future Water Pollution Analysis.....	III-4
3. Master Plan.....	III-7
3.1 Basic Policy and Conditions for Preparation of Sewerage/Sanitation Master Plan.....	III-7
3.1.1 Type of Plan and Definition.....	III-7
3.1.2 Basic Policy.....	III-7
3.1.3 Target Level.....	III-8
3.1.4 Basic Frame of the Plan.....	III-8
3.1.5 Framework Plan Area.....	III-11
3.2 Development Plan on Sewerage.....	III-12
3.2.1 Wastewater Collection System.....	III-12
3.2.2 Wastewater Treatment System.....	III-12
3.2.3 Sewerage System.....	III-14
3.2.4 Sewerage Master Plan.....	III-17
3.2.5 Staged Development Target.....	III-18
3.2.6 Operation and Maintenance of Sewerage System.....	III-18
3.3 Development Plan on Sanitation.....	III-18
3.3.1 On-site Treatment Facilities.....	III-18
3.3.2 Septage Management Plan.....	III-18
3.3.3 Staged Development Plan.....	III-20
4. Proposed Projects.....	III-20
4.1 Type of Projects and Prioritization.....	III-20
4.2 Project Cost.....	III-23
4.3 Implementation Schedule.....	III-24
5. Evaluation.....	III-27
5.1 Technical Evaluation.....	III-27
5.1.1 Environmental Improvement.....	III-27
5.1.2 Environmental Protection.....	III-27
5.2 Financial Evaluation.....	III-30
5.2.1 Approach.....	III-30
5.2.2 Financial Benefits.....	III-30
5.2.3 Financial Costs.....	III-31
5.2.4 FIRR.....	III-31
6. Conclusion and Recommendation.....	III-32

Part IV Institution, Organization and Operations

1. Reform.....	IV-1
1.1 Background.....	IV-1
1.2 Key Issues.....	IV-2
1.3 Approaches.....	IV-4
2. Review of Current Operation.....	IV-7

2.1	Laws and Regulations	IV-7
2.2	Organization	IV-7
2.3	Operations	IV-8
2.4	Human Resources	IV-13
3.	Strengthening Plan	IV-14
3.1	Institution	IV-14
3.2	Organization	IV-16
3.3	Operations	IV-18
3.4	Human Resources	IV-19
3.5	Water Sector Activities	IV-20
4.	Proposed Projects	IV-21
4.1	Corporate Planning and Monitoring	IV-21
4.2	Maintenance and Logistics	IV-23
4.3	R&D and Laboratory	IV-24
4.4	Human Resources	IV-24
4.5	Management Information System	IV-26
5.	Evaluation	IV-27
5.1	Quantitative Analysis	IV-27
5.2	Qualitative Analysis	IV-27

Chapter V Financial Study

1.	Review of Current Operation	V-1
1.1	Financial Performance	V-1
1.1.1	Profitability	V-1
1.1.2	Liquidity	V-2
1.1.3	Financial Capacity	V-3
1.2	Tariff	V-4
1.2.1	Overview	V-4
1.2.2	Revenue Adequacy	V-4
1.2.3	Affordability	V-5
1.2.4	Sewerage and Sanitation Charge	V-5
2.	Recommendations and Proposals	V-6
2.1	Financing and Accounting	V-6
2.2	Tariff	V-6
2.2.1	Tariff Level	V-6
2.2.2	Reconfiguration of Sewer/Sanitation Charges	V-7
2.2.3	Strengthening of Water Service Charge	V-7
3.	Financing Scheme and Financial Projections	V-8
3.1	Financing Scheme	V-8
3.1.1	Past Financing Performance	V-8
3.1.2	Future Outlook	V-8
3.2	Financial Projections	V-9
3.2.1	Water	V-9
3.2.2	Sewer/Sanitation	V-9

List of Tables

Page

Part I General

2. Project Framework

Table 1.1	Population Projection (Summary)	I-10
Table 1.2	Summary of Existing Land Use	I-11
Table 1.3	Future Land Use (1994 and 2015).....	I-12
Table 1.4	Categorization of Fastest Growing Municipalities.....	I-17

Part II Water Supply

2. Master Plan

Table 2.1	Water Supply Basic Indicators	II-7
Table 2.2	Production Capacity to be Expanded	II-9
Table 2.3	Proposed Distribution Blocks.....	II-11
Table 2.4	Staged Development Plan	II-12

3. Proposed Projects

Table 2.5	Pipeline Expansion	II-17
Table 2.6	Numbers of Reservoir or Pump Station Expansion.....	II-17
Table 2.7	Service Network Expansion	II-17
Table 2.8	Proposed Alternative Plan for Expansion/Augmentation Project	II-17
Table 2.9	Pipe Replacement	II-18
Table 2.10	Priority of the Proposed Projects	II-19
Table 2.11	Project Cost	II-19

4. Evaluation

Table 2.12	Financial Benefits of Proposed Projects	II-22
Table 2.13	FIRR of Proposed Projects	II-23

Part III Sewerage and Sanitation

2. Review of Current Conditions

Table 3.1	Existing Sewerage Systems in the Study Area	III-2
Table 3.2	Conditions and Status of 1979 Master Plan Sewerage Project.....	III-3
Table 3.3	River Water Quality	III-6

3. Master Plan

Table 3.4	Target Level	III-8
Table 3.5	BOD Load of Domestic Wastewater	III-9
Table 3.6	Wastewater Volume.....	III-10
Table 3.7	Comparison Table of Sewerage System.....	III-15
Table 3.8	Outline of Sewerage System	III-15
Table 3.9	Outline of Master Plan Area	III-17

4. Proposed Projects

Table 3.10	Project Summary	III-21
Table 3.11	Project Cost	III-24

5. Evaluation

Table 3.12	Water Quality in Pasig River in Terms of BOD.....	III-27
------------	---	--------

Table 3.13	Environmental Problems.....	III-29
Table 3.14	Financial Benefits of Proposed Projects.....	III-30
Table 3.15	FIRR of Proposed Projects.....	III-31

Part IV Institution, Organization and Operations

1. Reform

Table 4.1	Comparison of Macro Measures.....	IV-2
-----------	-----------------------------------	------

3. Strengthening Plans

Table 4.2	Projected Number of Employees.....	IV-20
-----------	------------------------------------	-------

5. Evaluation

Table 4.3	Estimated Project Duration and Cost.....	IV-27
Table 4.4	Qualitative Analysis of Proposed Projects.....	IV-28

List of Figures

Page

Part I General

2. Project Framework

Figure 1.1	Projected Population (1990, 2000 and 2015).....	I-10
Figure 1.2	Land Use Map, 1994.....	I-13
Figure 1.3	Estimated Area (%) by Land Category.....	I-14
Figure 1.4	Future Land Use.....	I-15
Figure 1.5	Zoning Plan.....	I-18

Part III Sewerage and Sanitation

2. Review of Current Conditions

Figure 3.1	Metro Manila River System.....	III-5
------------	--------------------------------	-------

3. Master Plan

Figure 3.2	Staged Improved Plan.....	III-13
Figure 3.3	Sewerage Framework Plan.....	III-16
Figure 3.4	Master Plan Area.....	III-19
Figure 3.5	Septage Collection Plan.....	III-22

4. Proposed Projects

Figure 3.6	Implementation Schedule.....	III-25
Figure 3.7	Septage Treatment Plant Staged Plan.....	III-26

5. Evaluation

Figure 3.8	Water Quality Projection.....	III-28
------------	-------------------------------	--------

List of Abbreviations

Philippine Government Organizations:

barangay	Smallest administrative unit in the Philippines
BOI	Board of Investment
BSWM	Bureau of Soils and Water Management
COA	Commission on Audit
CSC	Civil Service Commission
DBM	Department of Budget and Management
DBP	Development Bank of the Philippines
DECS	Department of Education, Culture, and Sports
DENR	Department of Environment and Natural Resources
DOF	Department of Finance
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
DPWH	Department of Public Works and Highways
EMB	Environmental Management Bureau
GOP	Government of the Philippines
HLURB	Housing and Land Use Regulatory Board
HSRC	Human Settlements Regulatory Board
HUDCC	Housing and Urban Development Coordinating Council
ICC	Investment Coordination Committee
LDPO	Local Development Planning Office
LFP	Locally Funded Project
LGU	Local Government Unit
LLDA	Laguna Lake Development Authority
LWUA	Local Water Utilities Administration
MGB	Mines and Geoscience Bureau
MMA	Metropolitan Manila Authority
MMDA	Metro Manila Development Authority
MWSS	Metropolitan Waterworks and Sewerage System
NAMRIA	National Mapping and Resource Information Authority
NEDA	National Economic and Development Authority
NEPC	National Environmental Protection Council
NHA	National Housing Authority
NHRC	National Hydraulic Research Center
NAPOCOR/NPC	National Power Corporation
NIA	National Irrigation Authority
NSO	National Statistics Office
NSCB	National Statistical Coordination Board
NWRB	National Water Resources Board
PCUP	Presidential Commission for the Urban Poor
PEA	Public Estates Authority
PIA	Public Information Agency
PID	Public Information Department
PHO	Public Health Office
PNR	Philippine National Railways

PPDCO
PWWA
UP

Provincial Planning and Development Coordination Office
Philippine Waterworks Association
University of the Philippines

Other Organizations:

AWWA	American Waterworks Association
ACI	American Cement Institute
ADB	Asian Development Bank
ASTM	American Society for Testing & Materials
IBRD	International Bank for Reconstruction and Development
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
OECF	Overseas Economic Cooperation Fund
UNICEF	United Nations Children's Fund
WB	World Bank

Other Abbreviations:

AWSOP	Angat Water Supply Optimization Project
EMS	Environmental Management Strategy
FAP	Foreign Assisted Project
GOCC	Government Owned and Controlled Corporations
FAWSP	Fringe Areas Water Supply Project
GWD-MWSPH	Groundwater Development - Manila Water Supply Project II
IEPC	Industrial Efficiency and Pollution Control
LFP	Locally-funded Project
MAC	MWSS Action Center
METROSS	Metro Manila Sewerage and Sanitation Project
MMREIS	Manila Metropolitan Region Environment Improvement Study
MMWDP	Metro Manila Water Distribution Project
MRWDNP	Manila Renovation for Water Distribution Network Project
MSSP	Manila Sewerage and Sanitation Project
MSWDP	Manila South Water Distribution Project
MWSP II	Manila Water Supply Project II
MWSP III	Manila Water Supply Project III
MWSRP I	Manila Water Supply Rehabilitation Project I
MWSRP II	Manila Water Supply Rehabilitation Project II
NAWASA	National Waterworks and Sewerage Authority
NCR	National Capital Region
PROGRESS	Program to Reduce and Eliminate Sewage from the Streets
PRRP	Pasig River Rehabilitation Project
STAMP	Septic Tank Maintenance Program
UATP	Umiray-Angat Transbasin Project

Technical Terms:

AC	Asphaltic Concrete/Asbestos Cement
APC	Accredited Plumbing Contractor
BCR	Benefit/Cost Ratio
BOD, BOD5	Biochemical Oxygen Demand (5 days)
BOT	Build-operate-and-transfer
CDS	Central Distribution System
CERA	Current Exchange Rate Adjustment
CI	Cast Iron, Grey
CIF	Cost, Insurance and Freight
Cl	Chloride Ion
CMP	Change Management Program
COD	Chemical Oxygen Demand
COO	Chief Operating Officer
CPI	Consumer Price Index
DA	Deputy Administrator
DB	Data Base
DF/R	Draft Final Report
DO	Dissolved Oxygen
ECC	Environmental Compliance Certificate
EIRR	Economic Internal Rate of Return
EIS	Executive Information System
EO	Executive Order
EUC	End User Computing
F	Full Charge
FIRR	Financial Internal Rate of Return
forex	Foreign Exchange
F/R	Final Report
F/S	Feasibility Study
FY	Fiscal Year
FYE	Fiscal Year End
GDP	Gross Domestic Product
GI	Galvanized Iron
GIS	Geographic Information System
GNP	Gross National Product
GRDP	Gross Regional Domestic Product
GPP	Gross Provincial Product
HRD	Human Resources Development
IA	Implementing Arrangement
ICG	Internal Cash Generation
IC/R	Inception Report
ILA	International Lending Agency
IRR	Implementing Rules and Regulations
ISP	Integrated System Plan/ Information System Plan
IT	Information Technology
IT/R	Interim Report
IRR	Internal Rate of Return
JV	Joint Venture
LO	Letter Order
M/M	Man-months

M/P	Master Plan
MPN	Most Probable Number
MSA	MWSS Service Area
MSL	Mean Sea Level
MORE	Motivation by Resource and Evaluation
M&E	Monitoring and Evaluation
NCR	National Capital Region
NPV	Net Present Value
NRW	Non-Revenue Water
ODA	Official Development Assistance
O & M	Operation and Maintenance
P	Partial Charge
p.a.	Per Annum
PBX	Private Branch Exchange
pH	pH Value
PUPA	Philippine Urban Poor Analysis
PVC	Polyvinyl Chloride
R.A.	Republic Act
RO	Requisition Order
ROR	Rate of Return
R&D	Research and Development
SDA	Senior Deputy Administrator
SDR	Special Discount Rate
SIG	Special Interest Group
SOP	Standard Operating Procedure
TOR	Terms of Reference
UDHA	Urban Development and Housing Act
WACC	Weight Average Capital Cost

Units of Measurement:

baud	baud rate	Data transmission rate
°C	degree Celsius	Temperature Unit
cm	centimeter	Length Unit
d	day	Time Unit
g	gram	Weight or Mass Unit
ha	hectare	Area Unit
h	hour	Time Unit
HP	horsepower	Power Unit
Hz	hertz (cycle per second)	Frequency Unit
kg	kilogram	Weight Unit
km	kilometer	Length Unit
km ²	square kilometer	Area Unit
kV	kilovolt	Electrical Potential Unit
kW	kilowatt	Power Unit
kWh	kilowatt-hour	Energy Unit
l	liter	Volume Unit
m	meter	Length Unit

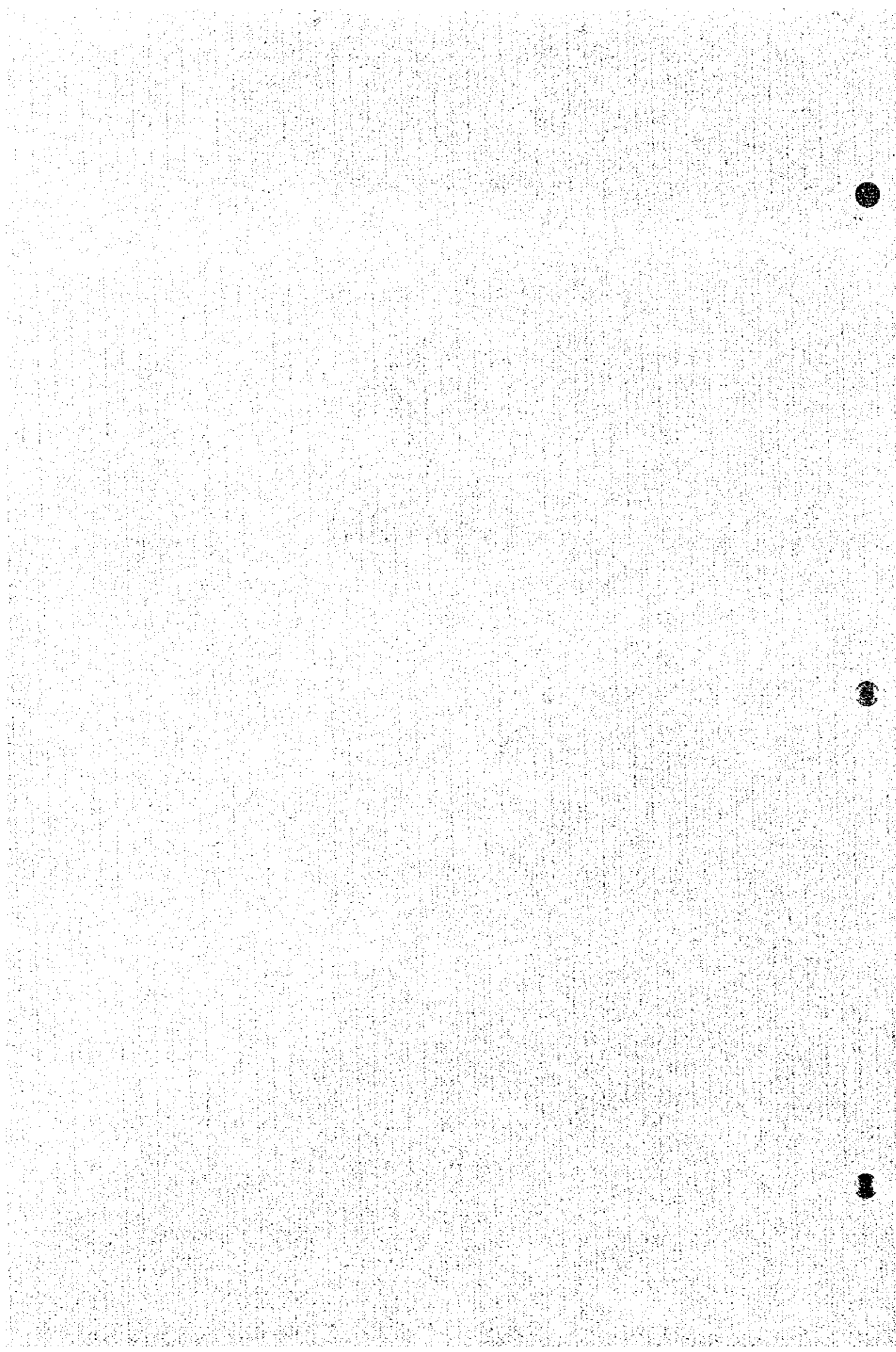
mm	millimeter	Length Unit
m/sec	meter per second	Velocity Unit
m ²	square meter	Area Unit
m ³	cubic meter	Volume Unit
m ³ /s	cubic meter per second	Flow Rate
m ³ /d	cubic meter per day	Flow Rate
MGD	million gallon per day	Flow Rate
ML/d (MLD)	million liter per day	Flow Rate
m ³ /min	cubic meter per minute	Flow Rate
m ³ /m ² /d	cubic meter per square meter per day	Surface Loading
m ³ /m/d	cubic meter per meter per day	Overflow Rate
mg	milligram	Weight or Mass Unit
mg/l	milligram per liter	Density Unit
P	peso	Philippine national currency
rpm	revolution per minute	Angular Velocity
s	second	Time Unit
yr	year	Time Unit

Part I

General

Part I

General



Part I General

1. Introduction

1.1 Authorization

The Study on the Master Plan of the MWSS's long-range strategy is in pursuance of the Implementing Arrangement, signed on April 15, 1994, between the Metropolitan Waterworks and Sewerage System (MWSS) and Japan International Cooperation Agency (JICA). JICA has organized a study team ("the Study Team") consisting of experienced specialists in the fields required in the study.

The Study started at the beginning of November 1994, and was completed by the end of January 1996. This Final Report compiles the results of the studies during the period from November 1994 to January 1996.

1.2 Background

The Republic of the Philippines is home to some 68 million people, 16 % of whom live in and around the capital of Manila. As with many of the other countries in the region, the main urban center of the Philippines (the Metropolitan Manila area) is suffering from an increasing population (2.41 % average annual growth rate) while its infrastructure is straining to meet the current demand placed on it by the existing populace. By the year 2015, the population of the area is projected to grow to 15.8 million people, further adding to the demand for infrastructure services.

The water supply in Metro Manila was established in 1878 by the found of Don Francisco Carriedo y Peredo in 1878 as shown in "Brief History of Manila's Water Supply", Supporting Report. Currently, water and sewage services are supplied to the populace of the Manila area by the Metropolitan Waterworks and Sewerage System (MWSS). The service area of MWSS covers 2,110 km², encompassing eight cities and 29 municipalities the National Capital Region (NCR), Cavite Province and Rizal Province. MWSS provides water supply to roughly 66 % of the people in the NCR, 32 % in Cavite Province and 16% in Rizal Province with water. MWSS

operates sewerage systems for about one million people, or 11% of the residents of the Metro Manila Region.

The seriousness of the difficulty facing MWSS is such that it was deemed best that a comprehensive study be conducted.

1.3 Objectives of the Study

The objectives of the study are as mentioned below:

- (1) To establish the development strategy on expansion of service areas as well as quality improvement for water supply, sewerage and sanitation.
- (2) To study how the MWSS (the implementing agency) should carry out efficient water supply, sewerage and sanitation services, and to establish strategies for strengthening the organization and management.
- (3) To transfer the technology and expertise related to the relevant planning and strategic development to the MWSS.

In addition to the objectives outlined above, the Study adheres to the following general points:

- To follow a macro-level versus a micro-level approach. It is important in a study of this scale that the larger issues be considered as the primary effort. In so doing, the medium and long-range goals of the MWSS can best be served.
- To base the recommendations of the Study on a realistic approach. It is important that practical application be stressed so that the recommendations of the Study be put into practice rather than on a bookshelf.
- To review the Master Plan on a regular basis. The projections and assumptions contained in the Study must be examined and if necessary modified to ensure that they accurately reflect the actual conditions in the Study Area.

1.4 Study Area

The study area will cover the following eight cities and twenty nine municipalities in Metro Manila, Cavite and Rizal Province under the jurisdiction of the MWSS.

(1) National Capital Region (NCR)

Cities (7)

Manila, Pasay, Quezon, Caloocan, Mandaluyong, Pasig, Makati

Municipalities (10)

Las Pinas, Malabon, Marikina, Muntinlupa, Navotas

Paranaque, Pateros, San Juan, Taguig, Valenzuela

(2) Province of Cavite

City (1)

Cavite

Municipalities (5)

Bacoor, Imus, Kawit, Noveleta, Rosario

(3) Province of Rizal

Municipalities (14)

Angono, Antipolo, Baras, Binangonan, Cainta, Cardona, Morong,

Jala-jala, Pililla, Rodríguez, San Mateo, Tanay, Taytay, Teresa

1.5 Target Year

The project target is to develop a master plan to serve the water demand up to the year 2015 of the entire MWSS jurisdiction as well as to develop a practicable master plan of sewerage and sanitation systems.

1.6 Study Team Organization

Based on a mutual understanding between JICA and MWSS that the Study will be undertaken with close coordination of both parties. MWSS created the Steering Committee as well as Counterpart Team soon after the commencement of the Study in the Philippines. Since then, vital assistance has been provided to the Study Team by all the department of MWSS related to the Study.

JICA Advisory Committee

<u>Name</u>	<u>Position</u>
1. Mr. Hidenori Aya	Chief, Advisory Committee
2. Mr. Sadao Nagaoka	Ph. D, Prof., Musashi Institute of Technology Member, Public Corporation Management
3. Mr. Osamu Ikeda	Ph.D, Prof., Seikei University Member, Water Supply Planning Chief Engr., Southern Fukuoka Water Supply Authority
4. Mr. Hirofumi Okahisa	Member, Sewerage Planning Manager, Research and Technology Development Division, Japan Sewage Works Agency
5. Mr. Shigeo Kanai	Member, Sewerage Planning Senior Counselor, Infrastructure Development Institute - Japan (After Stage III, replaced by Mr. Okahisa)

JICA Study Team

<u>Name</u>	<u>Position</u>
1. Toru Hayashi	Team Leader
2. Takashi Kawabe	Public Corporation Management
3. Yoshihiko Sato	Water Supply Planning (1)
4. Masanobu Ishioka	Water Supply Planning (2)
5. Satoshi Omoto	Sewerage/Sanitation Planning
6. Kenji Hiramatsu	Organization Management (1)
7. Toru Suetake	Organization Management (2)
8. Kunio Kishino	Financial Management
9. Arsenio J. Vistro	Laws & Regulations/Socioeconomics
10. Masaharu Kina	City Planning
11. Elmer E. Escoto	Water Quality/Environment
12. Toshihiro Hanyu	Coordinator

MWSS Steering Committee

<u>Name</u>	<u>Position</u>
1. Mr. Eduardo M. Del Fierro	Chairman, Sr. Deputy Administrator
2. Mr. Leovigildo S. Veroy	Member, DA for Engineering
3. Ms. Macra A. Cruz	Member, DA for Construction
4. Mr. Alfredo U. Tirante	Member, DA for Administration
5. Ms. Loida S. Dino	Member, DA for Customer Service
6. Mr. Gregorio N. Garcia	Member, Acctg. DA for Finance

7. Mr. Nestor C. Fernando Member, Acctg. DA for Operations
 8. Mr. Rolando E. Roca Resource Person, Manager, PPD

MWSS Counterpart Team

	<u>Name</u>	<u>Sector Involved</u>	<u>Position</u>	
1.	Graciano B. Calayan, Jr.	Project Coordinator	Div. Manager.,	PPD
2.	Alfredo C. Abalos, Jr.	Asst. Proj. Coordinat'r	Principal Engr. A,	PPD
3.	Senen S. Dizon	Water Supply	Principal Engr. C,	PPD
4.	Evangeline B. Dacanay	Water Supply	Principal Engr. A,	PPD
5.	Edgardo Q. Esteban	Sewerage	Department Mgr.,	SSD
6.	Beneleo A. Fontanilla	Sewerage	Utilities Services Officer,	SSD
7.	Romeo P. Austria	Sewerage	Sr. Utilities Services Officer,	SSD
8.	Rodrigo O. Yabut	Facility Management	Chief, Utilities Services	WSTD
9.	Amparo C. Canamo	Water Quality/Env't.	Chief Chemist,	WSTD
10.	Marietta G. Flores	City Planning	MIS Development Chief B,	PPD
11.	Merilyn O. Ortha	City Planning	Chief Economist	PPD
12.	Ma. Asuncion J. Bandiola	Organization Mgt./ Public Corp. Mgt.	IRD Chief,	HRDD
13.	Cristina A. Aguilar	Socioeconomics	Sr. Economist,	PPD
14.	Allan M. Mendoza	Socioeconomics	Administrative Services Officer	UATP
15.	Noel M. Angeles	Laws & Regulations	Sr. Corp. Atty.	LD
16.	Rolando C. Pulido	Customers Service	Acctg. Tech'l. Asst.	ODACS
17.	Philip E. Cases	Financial Mgt.	Division Manager	CORPLAN
18.	Basilisa P. Celso	Financial Mgt.	Sr. Corp. Budget Analyst,	FCBD

1.7 Organization of the Report

The Study Report prepared are as follows:

Summary Report (Volume I)

Main Report (Volume II)

Supporting Report (Volume III)

Data Report (Volume IV)

The Summary Report presents the essential results of the whole Study which is extracted from the Main Report. Details are discussed in the Supporting Report in supplement to the main report. Further, data referred to the Main and Supporting Reports are summarized in the Data Report.

2. Project Framework

2.1 National Economy

2.1.1 General Condition

According to the NEDA, the following conditions are expected in the foreseeable future:

- Shift towards exports
- Declining role of the agriculture sector
- Increasing role of the service sector
- Harnessed inflation

Accelerated foreign investments are expected due to more stable political and social climate.

2.1.2 GDP

GDP for the nation is expected to grow from P1,610 billion (1995) to P6,150 billion (2015), representing an annual real growth of 6.9 percent. GDP per capita will likewise go up from P23,500 (1995) to P66,500 (2015), an average 5.3 percent real annual growth.

As for GDP for the NCR, it is expected to increase from P480 billion (1995) to P1,290 billion (2015), an average 5.1 percent real annual growth. GDP per capita for the NCR will be P104,200 (2015) as compared to P53,500 (1995), an average 3.4 percent real annual growth.

2.1.3 Inflation

It is estimated that the inflation rate will gradually go down from the current 8 percent level to 4 percent toward the year 2005 and then remain there through the year 2015.

2.1.4 Foreign Currency Exchange Rate

The future forex rate of Peso to US dollar is estimated to gradually go up from P25.5 to US \$1.00 (1995) to P30.3 to US \$1.00 (2005). It will remain there through the year 2015.

2.2 Sector Plan

Various studies related to the water supply and sewerage and sanitation sector have been conducted by government agencies and ILAs in the past 10 years to develop the following national and sector plans:

- Philippine Water Supply & Sanitation Profile
- Medium-Term Philippine Development Plan (1993 - 1998)
- Philippines Water Supply Sector Reform Study
- Philippine Water Supply, Sewerage and Sanitation Investment Plan (1994 - 2000)
- Philippine Water Summit, 1994
- Water Supply, Sewerage & Sanitation Master Plan of the Philippines (1988 - 2000)

The Government of the Philippines, through the Medium-Term Philippine Development Plan (MTPDP) (1993-1998), has manifested its commitment to the development of safe and dependable water supply, sewerage and sanitation facilities. This document provides policies and investment programs which lay out the foundation of a strategy to accelerate sector development through institutional reforms at all government levels and equitable mobilization of resources between urban and rural areas.

The key measurable targets of the water sector in the MTPDP for the target year of 1998 are as follows:

- Increase the coverage of population (excluding Metro Manila) served with adequate potable water from 78 percent to 84 percent of the population corresponding to 71 percent in other urban areas, and possibly 94 percent in the rural areas.
- Construct sewerage facilities in Metro Manila and other highly urbanized areas.
- Construct 1,765,000 toilet facilities nationwide.

The MTPDP estimated the financing required for the infrastructure program of the sector for the following years (in million pesos at 1993 prices) as follows:

1993	1994	1995	1996	1997	1998	Total
3,914	4,864	5,471	6,506	5,879	5,115	31,749

The investments in water sector have been clearly one of the top priorities of the national government in addressing bottlenecks to economic growth. From 1987 to 1992, public investments in the sector reached over P31 billion, representing almost 22 percent of the total public infrastructure spending and ranking third behind the energy and transport sectors.

As evidenced by the presentation given by the secretary of the Department of Finance at the National Water Summit in December 1994, however, it is considered that compared with the demands of growing population and urbanization in the country, the pace and event of resource mobilization for the water sector requires urgent reform in view of the following indicators:

- Due to the national government's scarce fiscal resources and delays in project execution, infrastructure spending for water in the 1987 to 1992 plan period was only 56.8 percent of the target.
- In terms of physical accomplishments, only modest gains were attained over the previous plan period in regard to improving access to potable water supply. The level of nationwide accessibility to potable water grew from about 63 percent in 1986 to about 76 percent by 1992.
- Over the medium-term, about P82 billion in infrastructure spending is planned under the Public Investment Program from 1995 to 1998. This covers water supply, irrigation, flood control, sewerage and sanitation and hydropower. In addition, some \$3.8 billion (about P99 billion) in projects have been identified for private sector participation in the form of BOT and other similar schemes.

The DOF acknowledges that the past record of government financing and implementation of water infrastructure projects and the urgent future investment requirements in the sector have made it necessary to explore options to involve other players in the economy, broaden funding sources and improve financial administration.

The objective for the water sector financing will be to enable higher levels and quality of investment to meet the demands of the public for well-being and growth. The thrust of water sector financial policy will therefore be to address the limited financial resources of the national government to fully support infrastructure investments over the medium term, promote better cost recovery in the provision of water and sanitation services, focus government intervention,

and support and encourage the participation of local government units and the private sector in water service operations and investment. The DOF identifies the following four key strategies:

1. Greater Reliance on Market Forces
2. Local Government and Private Sector Initiatives
3. Government Support for Water Sector Financing
4. Full Cost Recovery

A number of important initiatives have been recently undertaken that are intended to broaden financing options for the water sector as well as to ensure its fiscal sustainability. The more notable ones together with action plans are as follows:

- NEDA Resolution No. 4
- NEDA Resolution No. 5
- Securing Grant Assistance
- New Local Government Code and Expanded BOT Law
- MWSS Privatization Task Force
- NEDA Investment Coordination Committee
- National Water Resources Board

A very recent law, the National Water Crisis Act of 1995, gives emergency powers to the President for a period of one year to address the nationwide water crisis which adversely affects the health and well-being of the population, food production and industrialization process. Among the powers that the President could exercise under this law are:

- To enter into negotiated contracts for projects to be implemented under BOT and/or related schemes
- To reorganize MWSS, including the privatization of any or all of its segments, operations or facilities
- To upgrade the compensation of MWSS personnel at rates commensurate with improved and efficient revenue collection.

This Act has created a Joint Executive-Legislative Water Crisis Commission which will conduct in-depth and detailed study of the entire water supply and distribution structure, among others.

2.3 Population Projection

The population projection of the Study Area for the year 2000 and the target year 2015 is based on analysis of past population trends, and summarized in the following Table 1.1:

Table 1.1 Population Projection (Summary)

Region/ Province	Population			Growth Rate (%)		Increase 1990-2015 (times)
	1990	2000	2015	2000/1990	2015/2000	
NCR	7,948,392	10,011,629	12,435,785	2.33	1.46	1.6
Cavite	457,020	617,582	875,774	3.06	2.21	1.9
Rizal	982,940	1,523,252	2,435,034	4.48	3.18	2.5
Total	9,388,352	12,152,463	15,728,593	2.61	1.73	1.7

As can be observed in the table, the most populated areas are concentrated in NCR, while the fastest growing areas are located in Cavite and Rizal, the intermediate and outer areas of NCR, as a consequence of the decentralization of economic activities and resettlement areas. Also, growth in the outer areas of the metropolis is increasing rapidly due to the availability of low priced land and the absence of traffic.

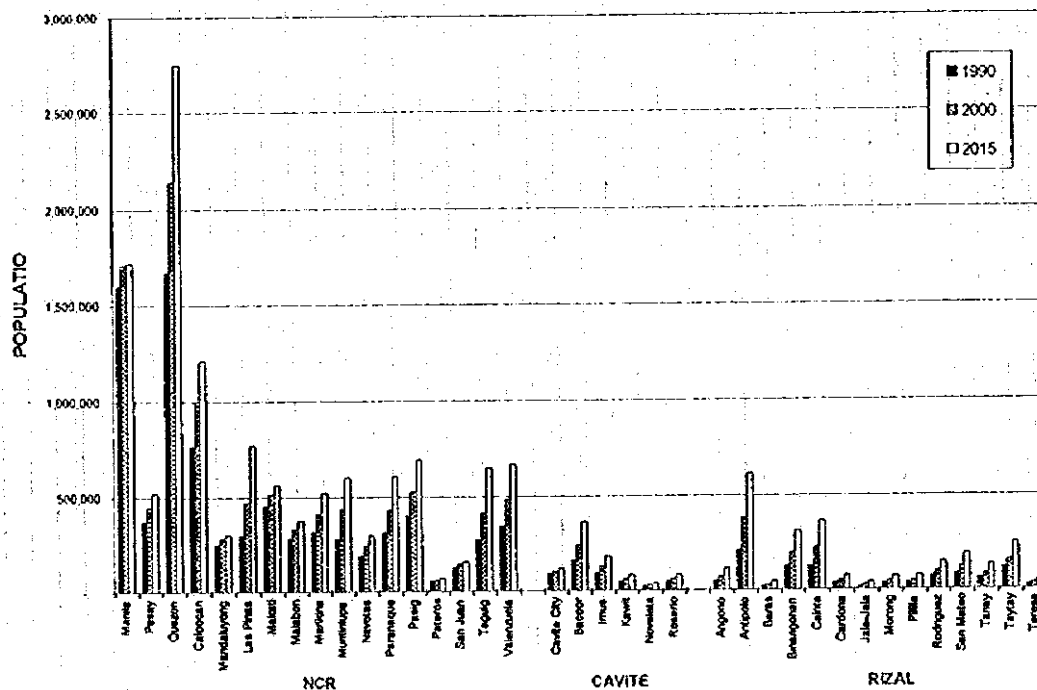


Figure 1.1 Projected Population (1990, 2000 and 2015)

2.4 Existing Land Use

The existing general configuration of land use of the MWSS service area as of 1994 is summarized as shown in Table 1.2:

Table 1.2 Summary of Existing Land Use

Region	Built-up Area	Recreation, Park, Sports, Open Space	Agricult	Forest	Wetland, Others	Total	Percentage Over Total Land Area
NCR	33,932	8,600	5,923	7,771	5,014	61,240	29.02
Cavite	2,640	343	11,027	3,520	1,091	18,621	8.82
Rizal	5,962	1,313	26,195	96,407	1,267	131,144	62.15
Total	42,534	10,256	43,145	107,698	7,372	211,005	100.00
Percentage Over Total Land Area	20.16	4.86	20.45	51.04	3.49	100.00	

The table shows the Study Area to be 51 % forest, mostly in the province of Rizal (Rodriguez, Antipolo, Tanay, Pililla). Agricultural lands dominate the Study Area next at 20 %, ensued by recreational/parks/sports/open spaces, wetlands and others at 4.9% and 3.5 % respectively. Built-up areas (residential, commercial, industrial and institutional areas) which are mostly situated in NCR (79.7 %), Cavite (6.2 %) and the western part of Rizal Province (14.1 %) cover 20.2 % of the Study Area. Fifty-seven percent (57 %) of the existing urban area is residential, while vacant lots owned by private individuals speculating on the ever increasing real estate prices make up a large part of the urban area.

Open spaces refer to the vacant areas within the built-up areas and unoccupied subdivisions which are also made up of grasslands. These open spaces cover 12.4 %, 1.6 % and 1.0 % of NCR, Cavite, and Rizal, respectively. Wetlands cover 1.9 % of the total land area and are mostly concentrated in Navotas, Malabon, Parañaque, Las Piñas, and Taguig (NCR), Taytay (Rizal), and Cavite City, Bacoor, Kawit and Noveleta (Cavite). Others refer to water surface areas, and covers 1.6% of the total land area.

The current land use condition in the Study Area is divided into 6 categories for the water supply study: built-up or residential land use (3 sub-categories: high, medium and low density), industrial land use, agricultural land use, forest land, open space and wetlands, and is shown in Figure 1.2.

2.5 Land Use Plan

The land use forecast based on current trends and plans was produced taking into consideration the urban expansion in the Study Area.

Basically, the estimation of population growth by residential land use is introduced to determine future residential conditions in each city or municipality. Population growth in the residential area is expected to reflect development conditions especially in NCR, and is taken into consideration in the future land use study. Thus, each land area is extrapolated using current and projected patterns of population growth and current land use areas.

Detailed adjustments in the final land areas are made considering urban development, industrial trend, land availability, government policies and other factors.

Table 1.3 shows the estimated six major categories of future land use: residential, commercial, industrial, institutional, open space and others.

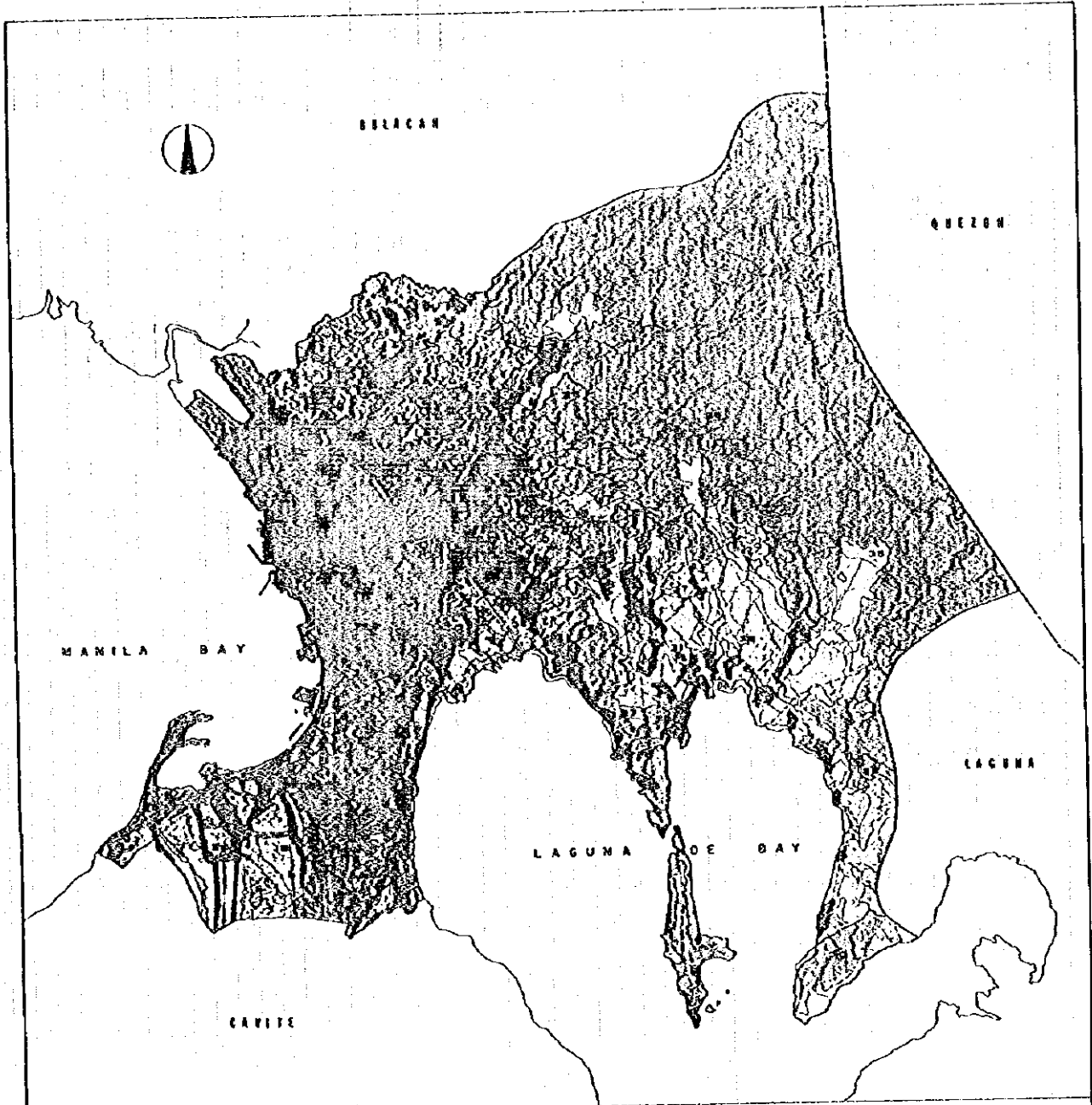
Table 1.3 Future Land Use (1994 and 2015)

Region/ Province	Total Land Area (ha)	1994					2015				
		Resid	Com	Ind	Inst	Others	Resid	Com	Ind	Inst	Others
NCR	60,173	22,861	2,925	3,782	4,214	26,391	33,747	4,149	4,274	5,024	12,979
Cavite	18,621	2,063	96	304	313	15,845	3,600	150	490	406	13,974
Rizal	131,144	5,253	130	473	96	125,192	10,100	277	749	188	119,831
Total	209,938	9,597	3,151	4,559	4,623	167,428	47,447	4,576	5,513	5,618	146,784

Note: NCR (Total land area excluding reclamation land)

Comparative bar graphs are presented in Figure 1.3 by regions and for the entire Study Area, showing the changes in the land areas from 1994 to 2015.

A colored land use map has also been produced, giving the results of the study in a condensed form (Figure 1.4).



- CITY / MUNICIPALITY**
- | | |
|---------------|---------------|
| 1. Manila | 20. Taguig |
| 2. Pasig | 21. Marikina |
| 3. Quezon | 22. Navotas |
| 4. Calabarzon | 23. Pasig |
| 5. Las Piñas | 24. Baguio |
| 6. Marikina | 25. Antipolo |
| 7. Marikina | 26. San Jose |
| 8. Marikina | 27. Marikina |
| 9. Marikina | 28. Calamba |
| 10. Marikina | 29. Calamba |
| 11. Marikina | 30. Jala-Jala |
| 12. Marikina | 31. Marikina |
| 13. Marikina | 32. Marikina |
| 14. Marikina | 33. Marikina |
| 15. Marikina | 34. Marikina |
| 16. Marikina | 35. Marikina |
| 17. Marikina | 36. Marikina |
| 18. Marikina | 37. Marikina |
| 19. Marikina | 38. Marikina |

— STUDY AREA
 - - - PROVINCIAL BOUNDARY
 - - - CITY / MUNICIPALITY BOUNDARY

SCALE
 0 2 4 6 8 10

LEGEND

[Symbol]	LOW DENSITY
[Symbol]	MIDDLE DENSITY
[Symbol]	HIGH DENSITY
[Symbol]	INDUSTRIAL AREA
[Symbol]	AGRICULTURAL LAND
[Symbol]	FOREST / GRASSLAND
[Symbol]	WETLAND
[Symbol]	OPEN SPACE

BUILT-UP AREA

**STUDY ON WATER SUPPLY AND SEWERAGE
 MASTER PLAN OF METRO MANILA**

Figure 1.2

**LAND USE MAP
 1994**

Figure 1.3 ESTIMATED AREA (%) BY LAND CATEGORY

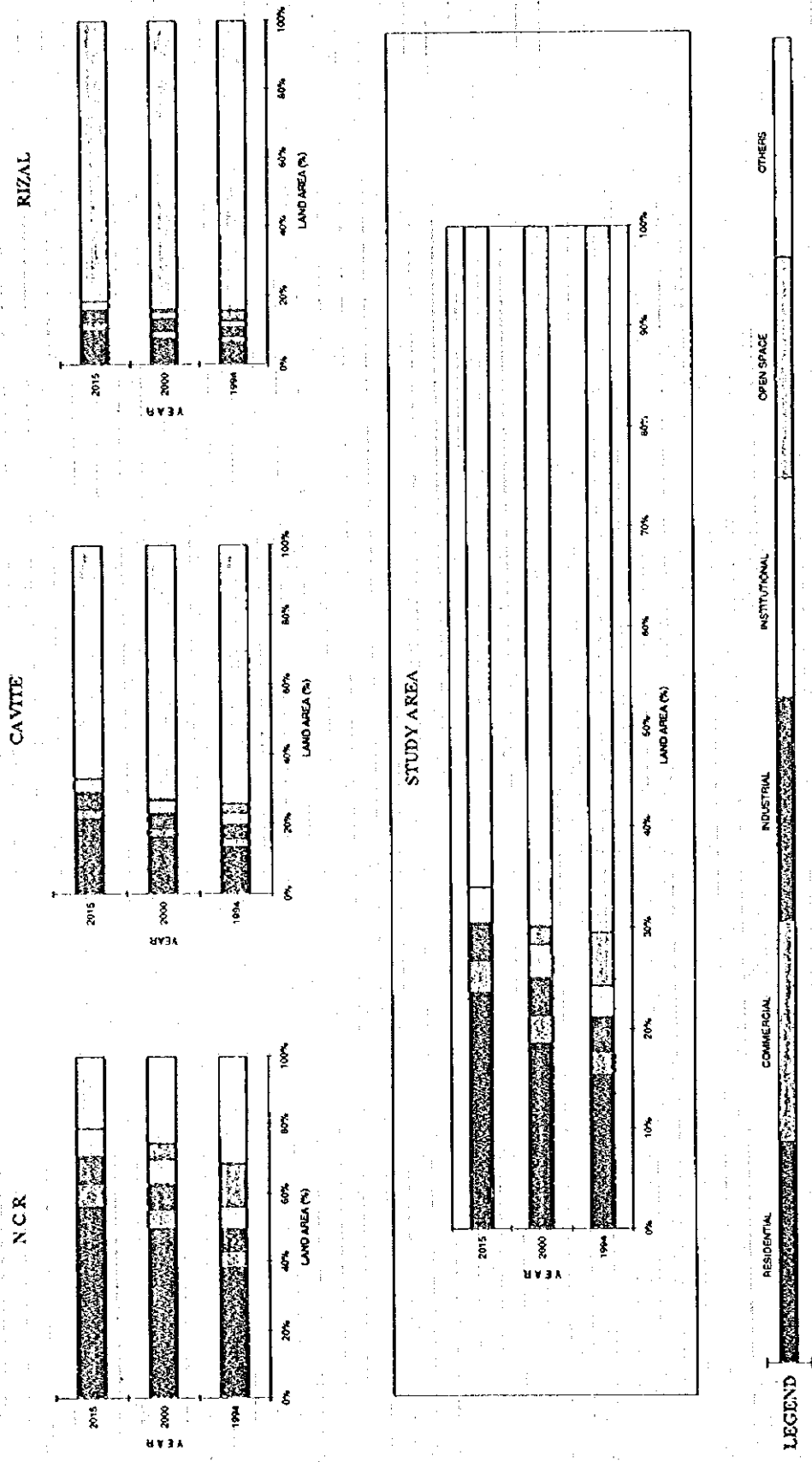
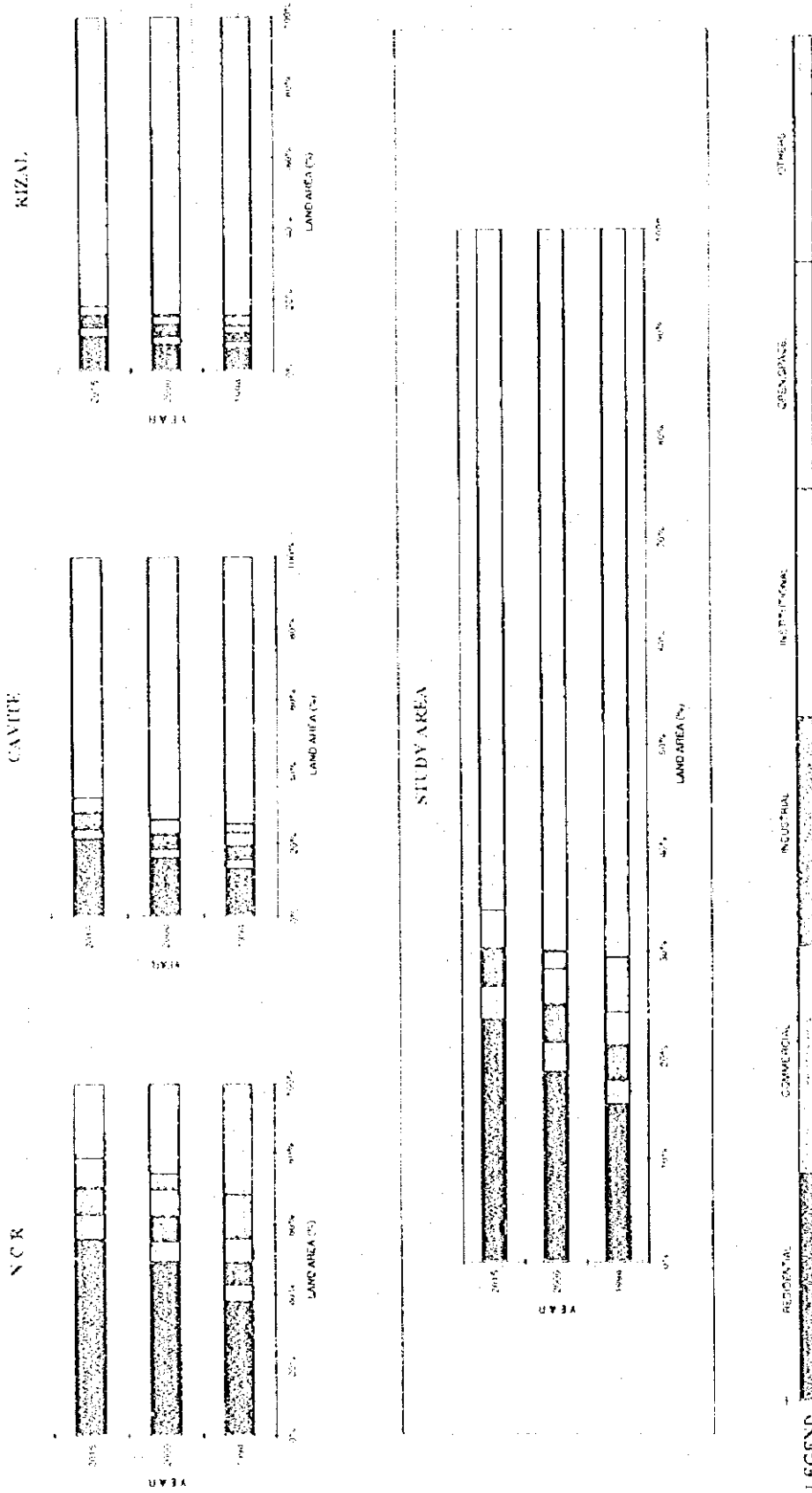
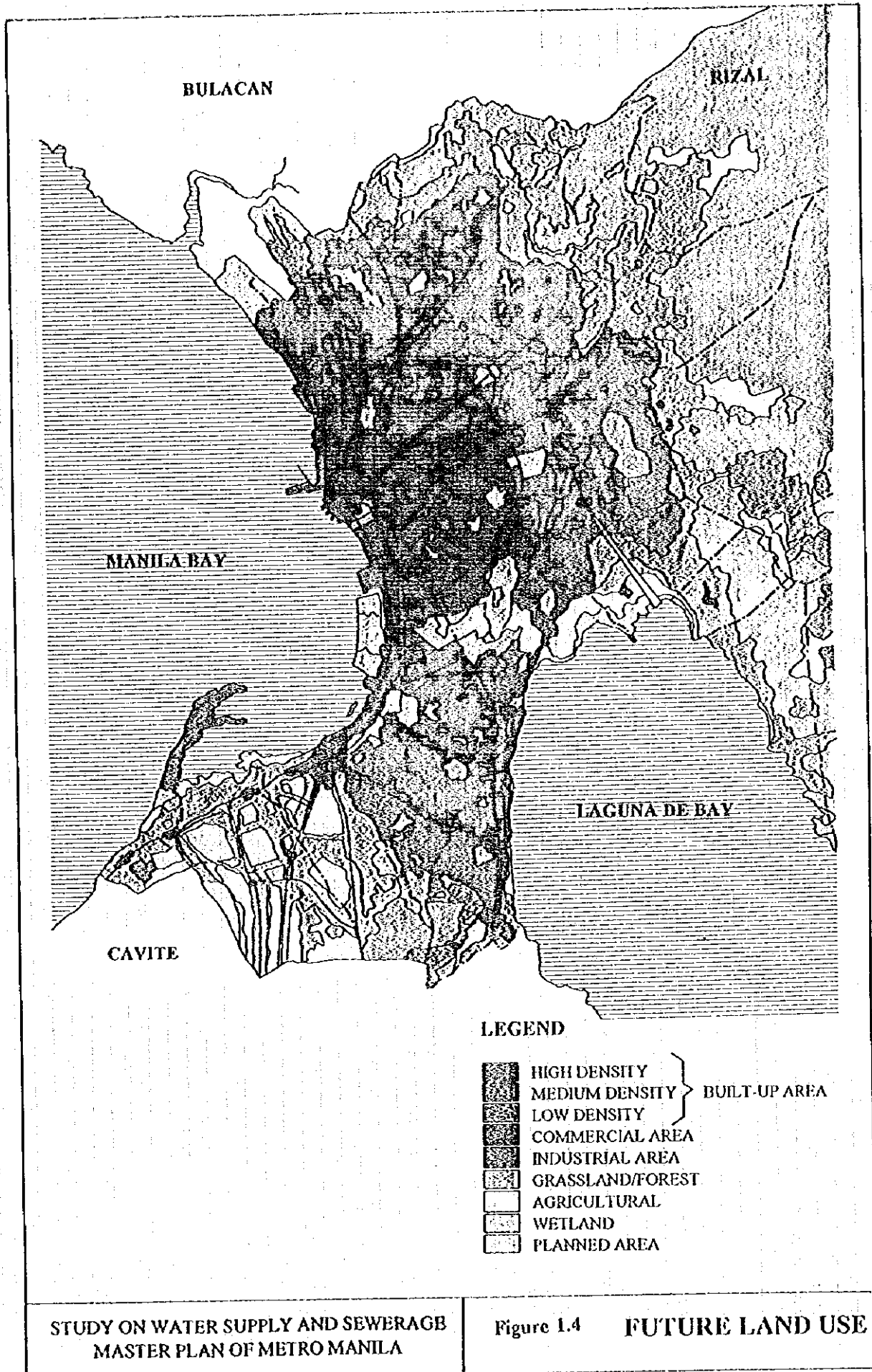
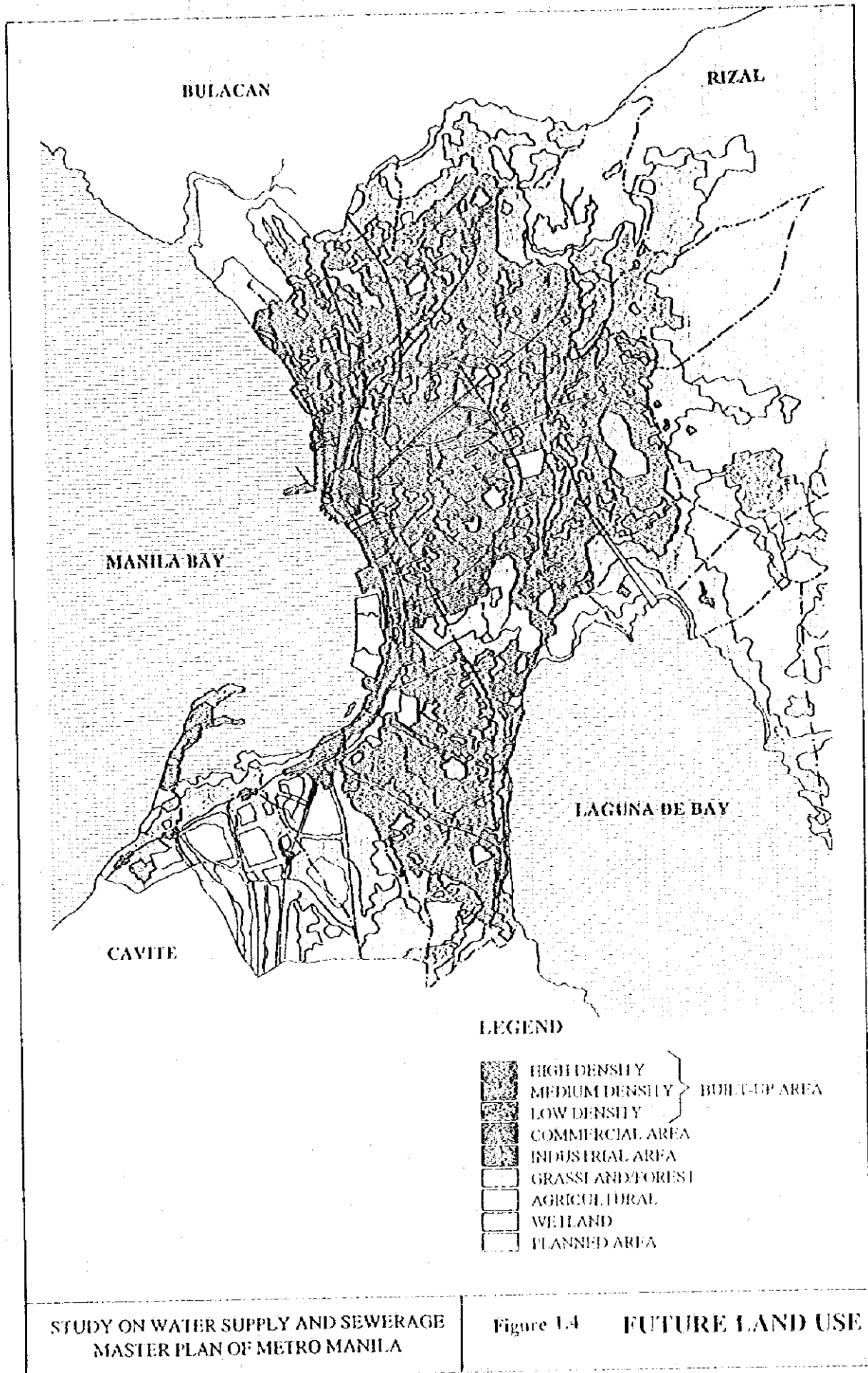


Figure 1.5 ESTIMATED AREA (%) BY LAND CATEGORY









2.6 Zoning Plan

Zoning classifies the cities and municipalities in the Study Area by order of priority in terms of urban development growth and water demand by 2015. Therefore, the zoning plan is formulated taking into account the results of the population studies and the development issues and concerns described in previous reports.

Accordingly, a tentative zoning plan is formulated considering the results of the population study, urban development trends, and industrial projection.

Consequently, the following prioritization of zones was carried out according to the potential of the areas for development:

1. High potential for development
2. Moderate potential for development
3. Consolidated urban zone
4. Future urban expansion zone
5. Agricultural/ forest zone
6. Preservation zone

In conclusion, while development policies provide direction for urban growth, metropolitan Manila is a picture of urban sprawl and high density centers (Manila, Makati, etc.) expanding towards the peripheral areas of the metropolis, particularly the south (Bacoor and Imus in Cavite) and the east (Cainta, Antipolo and Angono in Rizal). Future development trends within the NCR project the in-filling and intensification of land uses. Portions of Quezon City, northern Caloocan, Parañaque, Las Piñas and Muntinlupa are expected to be fully populated by the target year 2015.

The zoning plan is shown in Figure 1.5, according to the potential of the areas for development.



2.7 Categorization of Fastest Growing Municipalities

To permit the full comprehension and optimum use of the results of the present study, and for comparison between each trend analysis, mainly within the urbanized areas, fastest growing municipalities were categorized and shown in the table below:

Table 1.4 Categorization of Fastest Growing Municipalities

Region	Fastest Growing Municipalities in Terms of Population Growth	Fastest Growing Municipalities by Land Development (Urban Land Increase)	Fastest Growing Municipalities in Terms of Industrial Land Growth	Evaluation and Selection of Priority Areas (High Potential Development Areas) (*)	Remarks
NCR	Las Piñas Muntinlupa Taguig Valenzuela Parañaque Caloocan (north)	Las Piñas Muntinlupa Parañaque Taguig Valenzuela Quezon	Muntinlupa Valenzuela Caloocan Las Piñas	Muntinlupa Quezon City (northern portion) Las Piñas Parañaque Caloocan (North) (**)	(*) Showing only the A category (Areas with high potential for development) (**) Taguig, Manila-Cavite Coastal area, and Laguna de Bay Reclamation Area may be included if the proposed development by the government takes effect.
Cavite	Bacoor Imus	Bacoor Imus Rosario	Bacoor Imus Rosario	Bacoor Imus	(*) Showing only the A category (Areas with high potential for development)
Rizal	Antipolo Cainta Angono San Mateo Rodriguez	Antipolo Angono Baras Rodriguez Tanay Binangonan	Cainta Antipolo Taytay San Mateo	Angono Antipolo San Mateo and portions of Cainta and Taytay	(*) Showing only the A category (Areas with high potential for development)

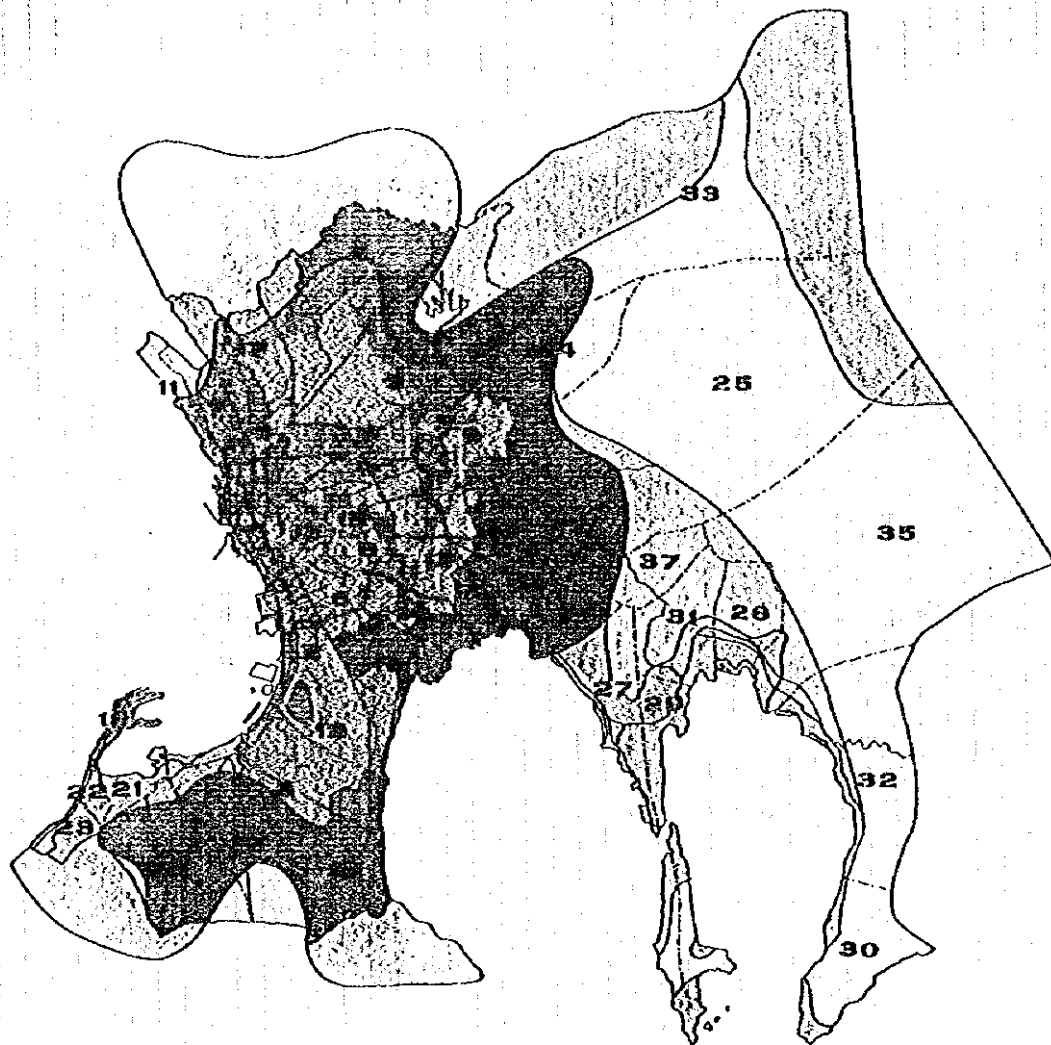
Legend:

-  High potential for development
-  Moderate potential for development







These growing municipalities which are expected to have high potential for development may be considered as the priority areas for development and water supply projects.

While development policies provide the direction for urban growth, Metropolitan Manila gives a picture of urban sprawl and high density formations in major city sectors, extending towards the peripheral areas of the metropolis, particularly the south (Bacoor and Imus in Cavite) and the east (Cainta, Antipolo, Angono in Rizal).

Present development trends see the in-filling and intensification of land uses within NCR and peripheral areas of the metropolis.






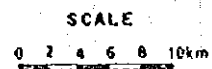
LEGEND

-  High potential for development
-  Moderate potential for development
-  Consolidated urban area
-  Future urban expansion
-  Agricultural and forest land
-  Preservation area

CITY/MUNICIPALITY

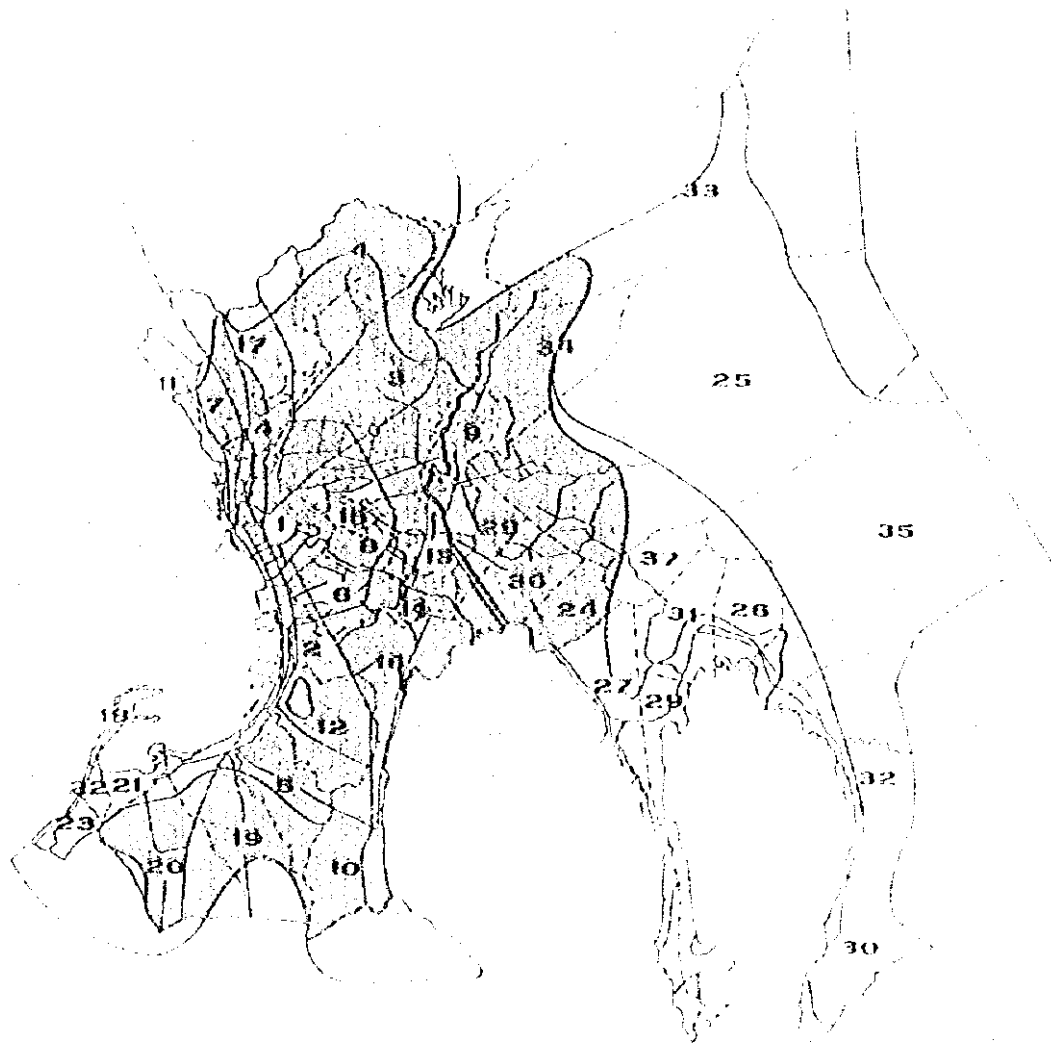
- | | |
|-----------------|----------------|
| 1. Manila | 20. Imus |
| 2. Pasay | 21. Kewit |
| 3. Quezon | 22. Novleta |
| 4. Caloocan | 23. Rosario |
| 5. Las Pinas | 24. Angono |
| 6. Makati | 25. Antipolo |
| 7. Malabon | 26. Baras |
| 8. Mandalayong | 27. Binangonan |
| 9. Marikina | 28. Cainta |
| 10. Muntinlupa | 29. Cardona |
| 11. Navotas | 30. Jala-Jala |
| 12. Paranaque | 31. Morong |
| 13. Pasig | 32. Piliilla |
| 14. Pateros | 33. Rodriguez |
| 15. San Juan | 34. San Mateo |
| 16. Taguig | 35. Tanay |
| 17. Valenzuela | 36. Taytay |
| 18. Cavite City | 37. Teresa |
| 19. Bacoor | |

-  STUDY AREA
-  PROVINCIAL BOUNDARY
-  CITY / MUNICIPALITY BOUNDARY



**STUDY ON WATER SUPPLY AND SEWERAGE
MASTER PLAN OF METRO MANILA**

Figure 1.5 ZONING PLAN



LEGEND

- High potential for development
- Moderate potential for development
- Low potential for development
- Agricultural and forest land
- Preservation area

- | | |
|----------------|----------------|
| 1. Manila | 21. Marikina |
| 2. Pasig | 22. Alabang |
| 3. Calabarzon | 23. Muntinlupa |
| 4. Quezon City | 24. Marikina |
| 5. San Jose | 25. Alabang |
| 6. Marikina | 26. Marikina |
| 7. Marikina | 27. Marikina |
| 8. Marikina | 28. Marikina |
| 9. Marikina | 29. Marikina |
| 10. Marikina | 30. Marikina |
| 11. Marikina | 31. Marikina |
| 12. Marikina | 32. Marikina |
| 13. Marikina | 33. Marikina |
| 14. Marikina | 34. Marikina |
| 15. Marikina | 35. Marikina |
| 16. Marikina | 36. Marikina |
| 17. Marikina | 37. Marikina |
| 18. Marikina | |
| 19. Marikina | |
| 20. Marikina | |

STUDY ON WATER SUPPLY AND SEWERAGE
MASTER PLAN OF METRO MANILA

Figure 1.5 ZONING PLAN



This is evidenced by the construction of highly-dense townhouses and condominiums within the mature sections of the urban core adjacent to major arteries. Development trends in the future will also see the renewal and redevelopment of large scale mixed-used developments in strategic locations of the metropolis, particularly in the remaining open or vacant lots and former military camp areas.

2.8 Conclusion

Population, land use, water use and other related factors provide the basis for planning the MWSS Water Supply and Sewerage System Programs. Population projections for the MWSS Study Area are prepared for the target year 2015 when the population in the Study Area is forecast to reach 15.7 million.

Other factors, such as future government programs and land uses, may also influence the MWSS service area. Sectoral spending in the MMA in the foreseeable future will sustain the emphasis currently placed on environmental and social services, yet the same trends in infrastructure development will continue. Future land use and zoning plans in the NCR show that migration will veer towards intermediate and outer areas. Nevertheless, water supply and waste water programs will be phased to accommodate any unpredicted changes in population, land use and government policies by adjusting the time and sequence of later phases.

3. Corporate Mission

3.1 Corporate Mission

A corporate mission defines the universal objectives, roles and responsibilities of the enterprise to carry out its business. The corporate mission of MWSS to fulfill its public duties and enterprise efficiency is defined in four areas as follows:

1. Provision of Water
2. Contribution to Public Health and Safety
3. Securing Environmental Conservation
4. Efficient Management of Enterprise

Public duties of the corporate mission to be achieved by MWSS are further expanded as follows:

- Provision of Water to All Customers
- Uninterrupted Water Supply
- Adequate Amount of Water Supply
- Supply of Safe and Potable Water
- Affordable and Fair Price
- Responsibility for Public Health and Safety
- Securing Environmental Conservation

In order to fulfill its public duties in an effective manner, enterprise efficiency in the following area must also be achieved:

- Efficient and Effective Operations
- Financial Soundness

At present, the service coverage of MWSS in the water supply sub-sector is 69 percent or 6.9 million people in Metro Manila and its contiguous area. In the sewerage sub-sector, only 12 percent or 945,000 people is covered by the sewerage system that is operated and maintained by

MWSS. These service coverage is below the national water supply, sewerage and sanitation sector targets and present and future consumer demands in its service area. In order to support expansion of infrastructure developments, the national financing policies have been formulated by GOP.

Based on the study on the corporate mission, sector objectives and targets, and the current status of MWSS, key issues of MWSS to expand and improve its operations are identified as follows:

- **Securing of Stable Water Supply:** Securing and stabilizing water supply to meet present and future water demand on a long-term basis
- **Improvement of water supply service level:** Provision of safe potable water and reliability of operations and maintenance
- **Development of sanitary and safe urban environment conservation:** Aiming to build a healthy and civilized urban environment
- **Reinforcement of environmental conservation:** Infrastructure development taking into consideration environmental conservation
- **Revitalizing of MWSS organization:** Efficient operations that improve customer service levels
- **Strengthening organizational infrastructure:** Achieving organizational efficiency and financial soundness

In order to deal with the key issues identified above, MWSS must establish the long-term key strategies to expand and improve the water supply, sewerage and sanitation operations.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the tools used for data collection.

3. The third part of the document presents the results of the study, including a comparison of the different methods and techniques used. It discusses the strengths and weaknesses of each method and provides a summary of the findings.

4. The fourth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.



5. The fifth part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.

6. The sixth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.

7. The seventh part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.

8. The eighth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.

9. The ninth part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.

10. The tenth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.



11. The eleventh part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.

12. The twelfth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.

13. The thirteenth part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.

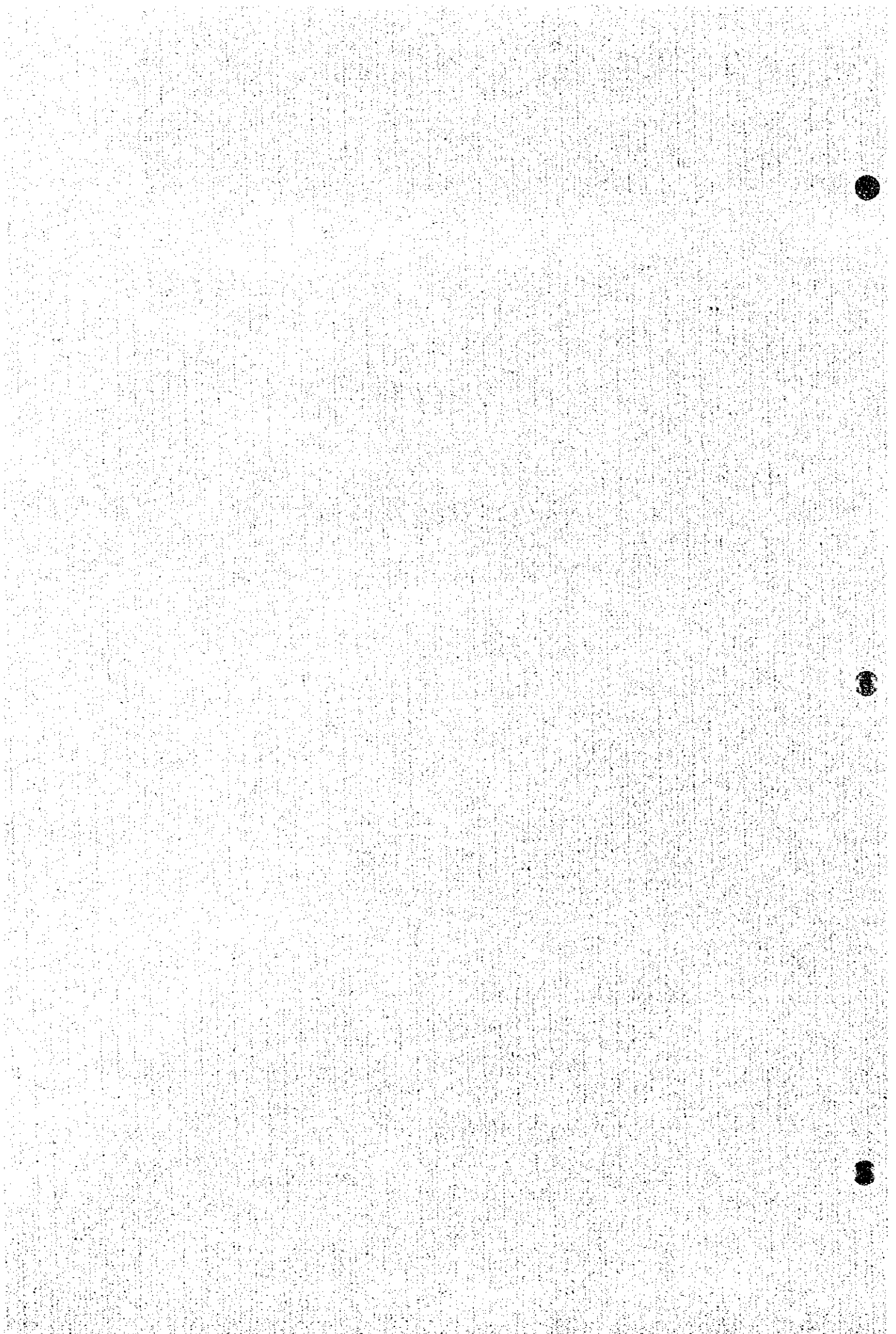
14. The fourteenth part of the document discusses the implications of the study and provides recommendations for future research. It highlights the need for further investigation into the effectiveness of the different methods and techniques used.

15. The fifteenth part of the document discusses the limitations of the study and provides a summary of the conclusions. It highlights the need for further research and the importance of maintaining accurate records of all transactions and activities.



Part II

Water Supply



Part II Water Supply

1. Review of Current Operations

1.1 General

As a result of the site survey, the following summarizes major issues and concerns of the current operation of the water supply system.

The main problem, which is the basic reason for making this study, is the lack of overall coordination among the various projects undertaken for the expansion and rehabilitation of raw water sources, water treatment and distribution facilities, including those for the reduction of non-revenue water. With different offices of MWSS taking charge of these projects, and with no comprehensive master plan as a common guide, harmonious and well organized implementation of the projects was never completely realized. For example, due to the absence of good coordination in the execution of the AWSOP water treatment and distribution components, losses are being incurred by the delay in the operation of the newly constructed La Mesa Treatment Plant No. 2.

1.2 Raw Water Sources

The MWSS has been limited to draw, based on its water right, an average of 22 m³/s from Angat Reservoir. Adjustment is required on the operation rule curve to optimize the use of Angat Reservoir and realize the 15 m³/s additional supply under AWSOP.

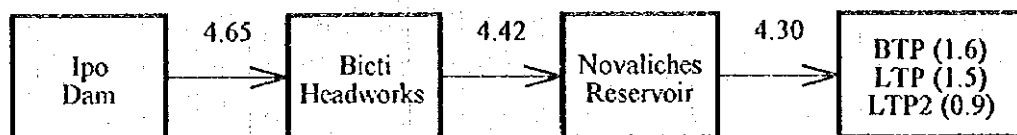
Commencement of the UATP construction work is most urgently needed and decision on the next water source expansion project is required at the earliest possible time.

Agreement is yet to be made between MWSS and concerned government agencies as well as fishermen regarding the use of Laguna Lake as water supply source. Although Laguna Lake is not an ideal source because of its poor water quality, its use appears to be an unavoidable alternative for the moment considering the long construction period required by any river basin developments and the required immediate solution to the worsening water supply problem in the MSA.

Ground water sources, despite their limited capacity, are required to be developed as complementary sources for the time being, especially for areas not connected to the CDS. However, as soon as additional surface water supply becomes available, developing areas with individual ground water supply systems have to be taken over by the CDS to help check the deteriorating groundwater situation in Metro Manila.

1.3 Raw Water Conveyance Facilities

Raw water conveyance systems have been developed as the water demand increases in the MWSS service area. At present, the potential water intake capacity and the total design capacity of tunnels and aqueducts are higher than the designed capacity of the downstream treatment facilities as summarized below:



(unit in million m³/d)

Considering that 65 years has already passed since the system was constructed in 1929, a total safety program, covering structural strength, probable leakage from concrete structures, flow monitoring, etc. must be implemented to ensure stable and continuous water supply to the Metro Manila.

1.4 Water Treatment Facilities

(1) Deteriorated Facilities

A lot of facilities/equipment has remained at their deteriorated state especially in the Balara Plant, which is under rehabilitation, and also in the La Mesa Plant which was constructed only nine years ago. This is due to budgetary constraints and delays in the spare parts procurement proceedings for defective facilities/equipment.

(2) Inconsistent Operation

Every treatment facility must be carefully operated all the time considering the fluctuation of raw water quality in order to attain suitable water quality that will meet the levels established in the Philippine National Drinking Water Standards. High technology application like computer based instrumentation and control does not automatically guarantee qualitatively and quantitatively safe water. Needed are well organized operation and maintenance manuals which, at least, include technical literature of equipment, process operating instructions, preventive maintenance procedures, etc. These effective manuals are obviously not yet prepared by MWSS.

(3) No Facility/Equipment Logs

A well organized manual is essential for proper equipment operation and maintenance. Effective tools such as facility/equipment data form and maintenance records are also important in preventive maintenance.

(4) Water Quality Control

Almost all the equipment used at the MWSS laboratory are obsolete due to same constraints in the water treatment facilities/equipment. Some equipment needing higher degree of accuracy are utilized even without proper calibration. In 1993, when WHO adds necessary monitoring items for drinking water, the Drinking Water Standards was revised accordingly, but there was no corresponding modernization of the analytical equipment owned by MWSS. At present, there are still some items in the revised Drinking Water Standards which can not be analyzed in the MWSS laboratory.

1.5 Distribution Facilities

(1) High Rate of NRW

The non-revenue water rate of MWSS is high compared to that of most Asian and underdeveloped countries. From the ADB Water Utilities Data Book (November 1993), NRW in Metro Manila is 58 % while that in Kuala Lumpur, Malaysia and Bangkok, Thailand are 37 % and 31 %, respectively.

This NRW problem in Metro Manila has long been recognized and major programs have been launched with the primary objective of reducing it. At present, however, several years after the NRW reduction projects were implemented, the NRW is still relatively high so that NRW reduction is getting more attention from the government and projects for developing additional sources are receiving less priority from funding institutions. In January 1995, the Philippine House of Representatives passed a bill (HB12400) penalizing the unauthorized tapping of waterlines and the use of tampered meters. In the same period, the President directed the MWSS to implement measures to bring down the NRW to 30% by the year end. The allotted time is considered very short. In 12 cities in Japan, a reduction of unaccounted-for water by more than 25 % of the total supply was only achieved in a period exceeding 35 years, from 1955 to 1992.

(2) Lack of Supplied Water Amount and Pressure

Lack of water supply and pressure is common in most parts of the service area. Some areas receive water intermittently because of rationing operation which has to be resorted to because of insufficient water from the treatment plants.

Other areas experience low system pressures which are intentionally lowered to reduce non revenue water in the form of losses through leaks and breakages in old pipelines.

(3) Insufficient Reservoir Capacity

Due to insufficient reservoir capacity, the treatment plant production is reduced during minimum demand hours to prevent water in the presently used reservoirs to reach predetermined maximum levels and to avoid losses due to overflowing in the treatment plants. Sufficient reservoir capacity is needed to allow constant treatment plant production every hour of the day for optimum use of the treatment plants.

(4) Pipe Materials

The existing distribution pipelines are made up of different pipe materials, but unfortunately, no comprehensive data is available on the performance of each pipe material in the distribution system. There are no statistical records on problems encountered in the installation, repair and maintenance of pipes in the MWSS service area which can be used as basis to modify AWWA, JIS and other reference international standards to come up with specifications for pipes most appropriate for the MWSS distribution system.

(5) Maps

Maps, as-built plans and computerized statistical records on distribution facilities are available, but more efforts are needed to make them more complete, accurate, updated, secured, and easily available to those requiring them for planning, designing, construction, operation and maintenance purposes.

Availability of information on some distribution facilities are dependent on some persons' memory only. Documentation is necessary to save vital information from getting lost due to personnel resignation or retirement..

Some maps are available in their original sheets only. There are no back-up copies to prevent information loss an no extra copies to make the information readily available to more than one group that will be using the same maps at the same time.

2. Master Plan

2.1 Basic Development Concept

As basic development concept, service areas, target supply coverage, service level and NRW reduction level were concluded in this master plan as follows:

(1) Service Areas

The service areas cover the whole MWSS jurisdiction area, namely; National Capital Region (NCR), Rizal province, and part of the province of Cavite. In all, the service area of the MWSS comprises of eight cities and 29 municipalities.

(2) Supply Coverage

The target supply coverage was set at 60 % in 1995, 67 % in 2000, 74% in 2005, 83 % in 2010, and 90 % in the target year 2015. It was realigned based on the aim of two sector plans, namely; the Medium Term Philippines Development Plan (1993-1998) and the MWSS strategic plan, taking into the technical and economic practicability of the proposed projects.

(3) Service Level

Supply time targets 24 hour basis by means of a Level III system. Unit consumption rate is set from 160 to 200 l/capita, depending on the areawise development state. Higher level of rate was applied for those areas where current water consumption rate is relatively higher in relation to income level.

(4) NRW Reduction

The target level of NRW was also reviewed to be 30% of the practical level by the target year of 2015 due to technical difficulties accompanied with economic constraints.

2.2 Water Demand Projection

Water demand projection, conducted based on the above basic development concept, serves as the fundamental basis for preparing the master plan. The projection is largely dependent on the

past trend which forecasts the future from past experience by category. The water demand projection was based on the revenue water amount which is known in past water use trend. Classification by use is categorized into domestic (house connection and public faucet), commercial, and industrial. In addition to those classification, the estimated NRW will be sum up for the total water demand.

The result of projection is summarized as shown in the following "Water Supply Basic Indicators".

Table 2.1 Water Supply Basic Indicators

Description	1995	2000	2005	2010	2015
Projected Population (million)	10.787	12.152	13.385	14.595	15.729
Supply Coverage (%)	60	67	74	83	90
Served Population (million)	6.449	8.139	9.839	12.065	14.199
Ave. Unit Consumption Rate(l/capita/d)*	193	211	226	230	234
NRW (%)	55	49	43	36	30
Daily Ave. Water Demand (mld)	2,765	3,360	3,889	4,324	4,746
Daily Max. Water Demand (mld)	3,456	4,200	4,861	5,405	5,932

Note: Ave. unit consumption rate shows the ratio revenue water amount (mld) and served population, including domestic water, commercial, and industrial uses.

Each water use in domestic, commercial, and industry was identified as follows:

2.2.1 Domestic Water Demand

There is an increased trend in total domestic water use, a result of population increase and the expansion of the distribution network. On the other hand, there is a decreased trend in the per capita domestic use of about 20 % from a survey of the per capita domestic use in the last 10 years. This decreasing trend is attributable to the slow rate of installing additional lines which sorely lags behind the population growth, and to the reduced distribution system pressures which were resorted to prevent excessive leaks and breakages of the old watermains.

It is therefore stressed that the water supply should be expanded to catch up the same level in the unit water consumption rate as ten years ago as soon as possible. Furthermore, providing individual connections to the low income group is difficult at present, thus, public faucets are still needed and the rate is allocated to be 30 l/capita in 2015.