

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

METROPOLITAN MANILA DEVELOPMENT AUTHORITY
THE REPUBLIC OF THE PHILIPPINES

**THE STUDY
ON
SOLID WASTE MANAGEMENT
FOR
METRO MANILA
IN
THE REPUBLIC OF THE PHILIPPINES**

FINAL REPORT

**MAIN REPORT I
(MASTER PLAN)**

MARCH 1999

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The exchange rate applied in this report is

**Master Plan &
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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on Solid Waste Management for Metro Manila and entrusted to study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. KATSUhide NAGAYAMA of Pacific Consultants International and consist of Pacific Consultants International and Kokusai Kogyo Co., Ltd. to Philippines, 5 times between February 1997 and February 1999. In addition, JICA set up an advisory committee headed by Dr. KUNITOSHI SAKURAI, President of Tokyo International Environmental Planning Institute, between February 1997 and February 1999, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

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

March 1999



Kimio Fujita
President
Japan International Cooperation Agency

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir:

We are pleased to officially submit herewith the final report of "The Study on Solid Waste management for Metro Manila in the Republic of the Philippines".

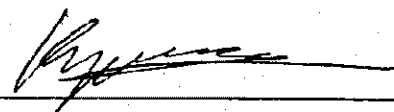
This report compiles the results of the study which was undertaken in the Republic of the Philippines, from February 1997 to February 1999 by the Study Team, jointly organized by Pacific Consultants International and Kokusai Kogyo Co., Ltd.

We would like to express our deep appreciation and sincere gratitude to all those who extended their kind assistance and cooperation to the Study Team, particularly the officials concerned of Metropolitan Manila Development Authority, and other members of the Philippine Counterpart Team.

We also acknowledge and appreciate greatly the excellent support given by your agency, the JICA Advisory Committee and the Embassy of Japan in the Republic of the Philippines.

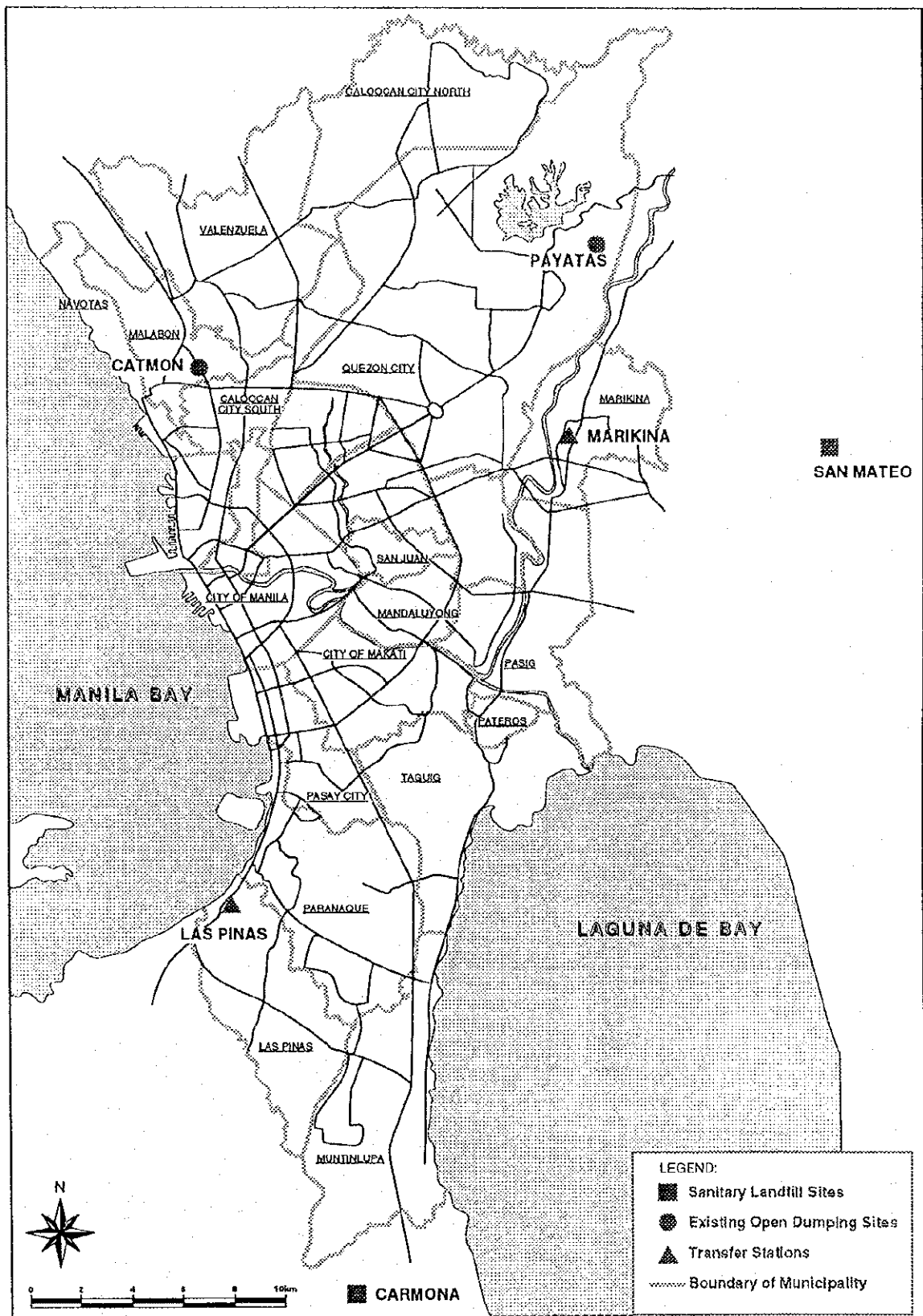
We sincerely hope that this report will be of help for the socio-economic development of the country as a whole. This report would be able to contribute really to Philippine people and socio-economic development in the future.

Very truly yours,

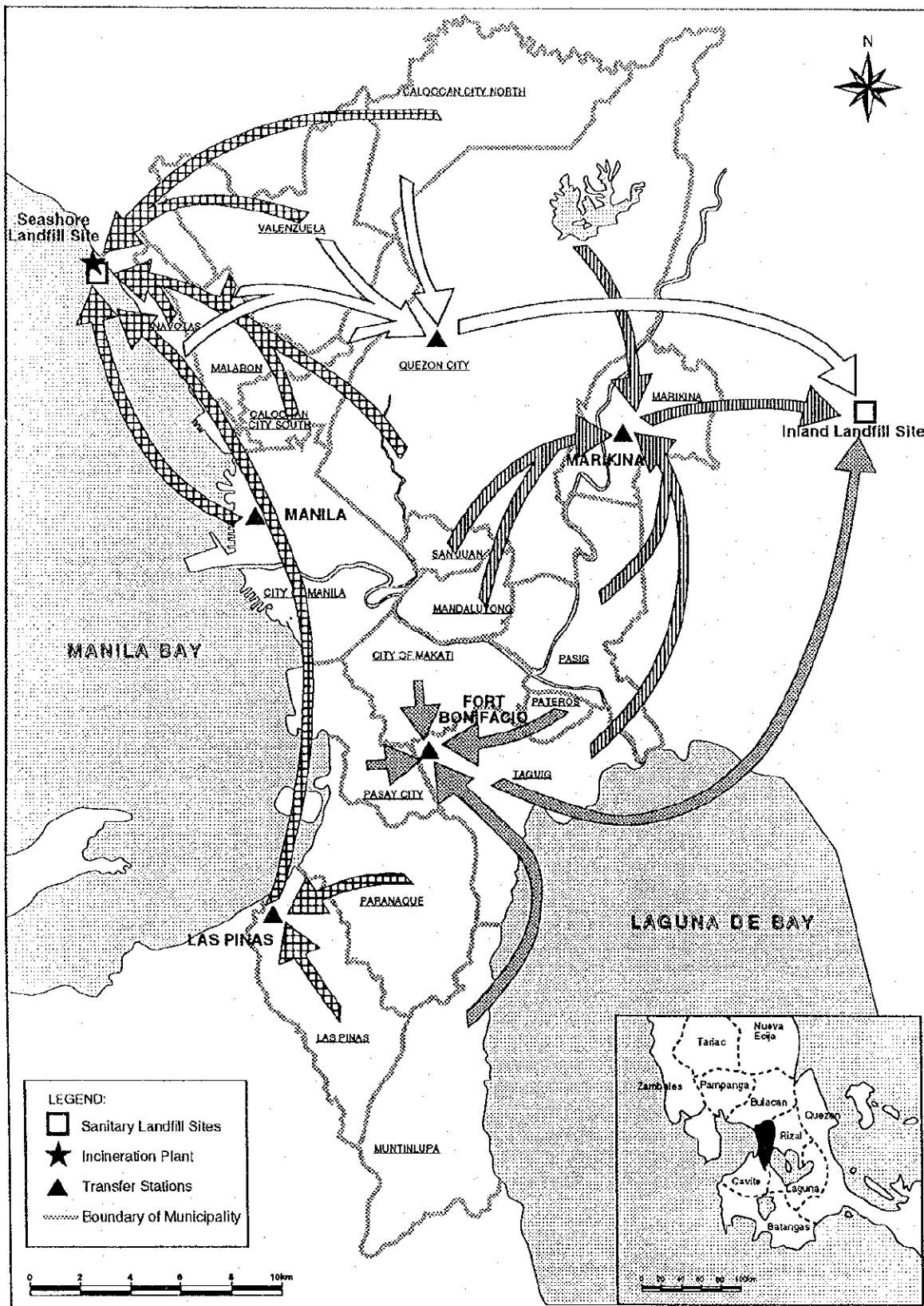


Katsuhide Nagayama
Team Leader

The Study Team for the Study on Solid
Waste management for Metro Manila in
the Republic of the Philippines



Study Area and Existing Facilities for Solid Waste Management



Proposed Waste Flow in Metro Manila in the year 2010

The Study on Solid Waste Management for Metro Manila Master Plan Report

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LIST OF ABBREVIATIONS/ACRONYMS

ASG	Apparent Specific Gravity
BOI	Board of Investments
BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
CBO	Community Base Organization
COD	Chemical Oxygen Demand
CMEES	Community Mobilization and Environmental Education Section
CWM	Community Waste Manager
DBM	Department of Budget and Management
DECS	Department of Education, Culture and Sports
DENR	Department of Environment and Natural Resources
DPWH	Department of Public Works and Highways
DTI	Department of Trade and Industry
ECC	Environmental Compliance Certificate
EMB	Environmental Management Bureau
ESC	Environmental Sanitation Center
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
IRA	Internal Revenue Allocation
ISW	Industrial Solid Waste
LGU	Local Government Unit
LCV	Lower Calorific Value
MEFCON	Marikina Environment Forest Conservation Project
MMC	Metro Manila Council
MMDA	Metro Manila Development Authority
MSW	Municipal Solid Waste
NCR	National Capital Region
NEDA	National Economic and Development Authority
NGO	Non-Governmental Organization
NIMBY	Not In My Back Yard
NPV	Net Present Value
O&M	Operation and Maintenance
PEA	Public Estates Authority
PMO	Project Management Office
PPA	Philippine Ports Authority
PPP	Polluters Pay Principle
PTFSWM	Presidential Task Force on Solid Waste Management
ROE	Return on Equity
SLF	Sea Landfill
SWM	Solid Waste Management
WACS	Waste Amount and Composition Survey
WGR	Waste Generation Rate

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The fast economic growth and rapid urbanization in the Philippines have been accompanied by deterioration of the urban environment. One of the urban areas that is currently experiencing this problem is Metro Manila, where conditions are becoming critical due to escalating generation of solid waste. It is estimated that of its total solid waste generation of 5,000 – 6,000 tons/day, only around 3,500 tons/day are handled, while the rest are illegally dumped on vacant land, thrown in rivers, etc.

Since 1968, a number of studies have tried to identify suitable means to improve the solid waste management situation in Metro Manila. However, due to lack of funds and an inappropriate organizational and institutional structure, problems still remain.

In January 1995, the Philippine Government submitted an official request for support for a Master Plan and Feasibility Study to the Government of Japan. In response to the request, The Government of Japan decided to conduct the Study on Solid Waste Management in Metro Manila.

1.2 Objectives of the Study

The main objective of the study is to improve the solid waste management system in Metro Manila. This will be achieved through formulation of a practical and sustainable Master Plan for solid waste management. The plan will take into account a wide variety of planning issues regarding public awareness and participation, technical alternatives, and institutional and financial arrangements. The Master Plan will identify prompt and appropriate measures for improvement of the present solid waste management systems, with emphasis on upgrading the service level, expansion of service coverage and improvement of the institutional and financial status of organizations concerned.

1.3 Study Framework

The study is being conducted by the Japan International Cooperation Agency (JICA) and a team of consultants from Pacific Consultants International and Kokusai Kogyo Co., Ltd. The Metropolitan Manila Development Authority (MMDA) acts as the counterpart agency to the JICA Study Team and also as a coordinating body in relation with other government and non-governmental organizations to ensure a smooth implementation of the study. An outline of the framework for the study is given below.

Study Area: The nine (9) cities and eight (8) municipalities in Metropolitan Manila.

Target Year: The target year of the Master Plan is 2010.

Time schedule: The timetable is as follows:

Master Plan	:	1998-2010
Short Term Improvement Plan	:	1998-2004
Long Term Improvement Plan	:	2005-2010

CHAPTER 2 FINDINGS AND PLANNING ISSUES FOR SOLID WASTE MANAGEMENT



CHAPTER 2 FINDINGS AND PLANNING ISSUES FOR SOLID WASTE MANAGEMENT

2.1 Urbanization and Economic Activities of Metro Manila

2.1.1 Population

The Philippines is now experiencing rapid economic growth. The economic development is accompanied by urbanization, a trend that is particularly pronounced in the capital region Metro Manila. The population situation in Metro Manila is given in Table 2.1.1.

Table 2.1.1 1990 and 1995 Population of Metro Manila

Area (km ²)	Population (000)		Population Density (persons/ha)	
	1990	1995	1990	1995
632.2	7,948	9,454	124	148

Source: NSO

2.1.2 Economic Development

Metro Manila constitutes 0.2% of the total land area and 13% of the total population of the Philippines. However, the region's contribution to the national economy is around 30% of the gross domestic product (GDP) of the whole country.

The economic growth rate in the Philippines can be evaluated by comparing the GDP, measured in constant 1985 prices, for 1990 (720,690 million pesos), 1993 (734,156 million pesos) and 1995 (802,866 million pesos). The increases in GDP represented yearly average growth rates of 2.3% over the five-year period from 1990 to 1995, and 4.7% for the period 1993 to 1995.

Looking at the GDP per capita in constant 1985 prices, however, it turned out that there had been an average yearly decrease in GDP per capita of 0.5% from 1990 to 1995. Over the period 1993 to 1995, the GDP per capita showed an average yearly increase of 2.1%.

The gross regional domestic product (GRDP) of Metro Manila in 1990, 1993 and 1995, at constant 1985 prices, were 221,753 M Pesos, 216,149 M Pesos and 240,121 M Pesos, respectively. This represented an average yearly growth rate of 1.7% from 1990 to 1995, and 5.5% from 1993 to 1995.

The GRDP per capita in Metro Manila, as measured in constant 1985 prices, however, showed an average yearly decrease of 0.7% from 1990 to 1995, while an average yearly increase of 3.1% could be seen during the period from 1993 to 1995.

The economy of Metro Manila recently seemed to have shifted to a sharp upward curve, driven by domestic investment as well as foreign direct investments in the business sector.

This will naturally stimulate consumer demand, and impose a greater burden on the solid waste management system.

2.1.3 Current Urbanization Pattern

Two parameters used in the study are the population growth rate from 1980 to 1995, and population density. Utilizing these parameters, 256 zones in Metro Manila were classified into nine classes as described in Table 2.1.2. A distribution of zone categories in Metro Manila is given in Table 2.1.3. As expected, a high growth rate is mainly found in areas with middle or low population density, and a low growth rate is mainly found in areas with high population density.

Table 2.1.2 Categorization Criteria for Urbanization in Metro Manila

Growth Rate: % (1980-1995 average)	Population Density (person/ha) as of 1995 census		
	High (above 250)	Middle (100-250)	Low (100 or less)
7 or more	A	B	C
3 to 7	D	E	F
below 3	G	H	I

Table 2.1.3 Distribution of Categorized Zones in Metro Manila^{1/}

Category	A	B	C	D	E	F	G	H	I	Unknown
Distribution	10	16	22	8	26	12	84	40	31	16

^{1/} worked out based on Table 2.1.2

2.2 Solid Waste Stream

A Waste Amount and Composition Survey (WACS) was conducted in April and June 1997, in order to analyze the solid waste stream during dry and rainy seasons. A total 3,402 samples were collected from 9 categories of generation sources in three sample areas believed to represent Metro Manila, namely Quezon City, Makati, and Parañaque.

For the purpose of this survey, waste materials were categorized as follows: (1) residential waste (high, middle and low income households), (2) commercial waste (restaurants and other shops), (3) institutional waste, (4) market waste, (5) street-swept waste, and (6) river waste.

A summary of the results from the WACS is given in Tables 2.2.1 and 2.2.2. Highlights are as follows:

- Based on the waste generation rate (g/person/day) derived from the WACS, the total waste generation in Metro Manila has been estimated at 5,350 t/day, characterized by the following:
- Out of the total generation, household waste constitutes around 74% or 4,000 t/day.
- A considerably significant difference in the generation amounts among income levels appeared: 500 g/person/day for the high income group; 451 for the middle income

- group and 344 for the low income group. Utilizing statistics on distribution of income level in the study area from the National Statistics Office, a weighted average of household waste generation in the study area of 419 g/person/day was calculated.
- (d) The results from the apparent specific gravity (ASG) of municipal solid waste (MSW) measurements yielded an average of 0.20 kg/l.
 - (e) The percentages of paper and plastics are very high compared to other developing countries.

Table 2.2.1 Waste Generation Rate by Nine Categories of Generation Sources

Category	Unit	Quezon City	Makati	Parañaque	Average
High Income	g/person/day	465	553	483	500
Middle Income	g/person/day	449	432	473	451
Low Income	g/person/day	372	340	321	344
Restaurant	g/shop/day	15,284	41,732	6,939	21,318
Other Shops	g/shop/day	1,688	2,150	1,618	1,818
Institution	g/person/day	59	101	57	72
Market	g/shop/day	4,065	3,945	13,774	7,261
Street Sweeping	g/km/day	10,560	19,010	2,535	10,702
River	g/km/day	41,555	3,595	9,035	18,062

Source: WACS conducted by JICA in 1997

Table 2.2.2 Waste Composition in Metro Manila (%)

Category	Kitchen Waste	Paper	Plastic	Grass & Wood	Metal
High Income	42	18	12	15	4
Middle Income	50	16	16	5	6
Low Income	42	14	17	7	5
Restaurant	55	16	15	4	6
Other Shops	31	27	17	2	5
Institution	20	47	16	2	5
Market	58	15	14	8	1
Street Sweeping	13	14	9	35	1
River	14	8	49	14	4

Source: WACS conducted by JICA Study Team in 1997

The 1997 data on moisture, combustible and ash contents of the wastes obtained by the JICA Study Team and their lower calorific value is shown in Table 2.2.3. The data are weighing average figures of mixed wastes, taking the waste generation ratio by each category into account. The moisture content ranged between 30% - 55%. On the other hand, the lower calorific value was high, mainly because of the high proportion of paper and plastic in the waste. However, the value is lower than in 1982.

The following differences are pointed out from the data between 1982 and 1997:

- (a) Increase of moisture content from 1982 to 1997 is accurately accompanied by a decrease of calorific value;
- (b) On the other hand, an increase of combustible content, especially high calorific value plastic content, is accompanied by a decrease, and not an increase, as expected, in calorific value; and
- (c) The 1982 and 1997 calorific values were estimated based on each combustible component of waste from middle income residential areas, as follows:
 - For 1997, the calorific value was estimated at 1,570 kcal/kg, with a difference between the analyzed and calculated data of only 140 kcal/kcal, which is a reliable figure.
 - For 1982, the calorific value was estimated at 1,455kcal/kg, with a difference between analyzed and calculated data of around 400 kcal/kcal.

Table 2.2.3 Comparison of Moisture, Combustible, Ash Contents and LCV (1982 and 1997)

Type		1997 JICA Study		1982
		Household	MSW	
Moisture Content (%)		45.76	45.00	42.6
Combustible Content (%)		45.89	46.65	33.8
Ash Content (%)		8.35	8.35	23.6
Lower Calorific Value (kcal/kg)	analyzed data	1,686	1,709	1,843
	calculated data	1,537	1,570	1,455

Source: WACS conducted by JICA Study Team in 1997

The calculated LCV were estimated based on the LCV and ratio of each combustible component of waste.

In addition to the WACS, the following surveys have been carried out to determine the waste flow in Metro Manila:

- Interview Survey in sampling points conducted prior to the WACS
- Recycling Survey
- Interview Survey of Waste Pickers and Waste Collection Workers on Recycling
- Incoming Waste Survey (Disposal Waste Amount Survey)
- Waste Haulage Amount Survey by Truck Scale

The present solid waste flow in Metro Manila diagrammed in Figure 2.2.1 is based on the survey conducted by the JICA Study Team. The coverage of waste collection services is approximately 73% in Metro Manila.

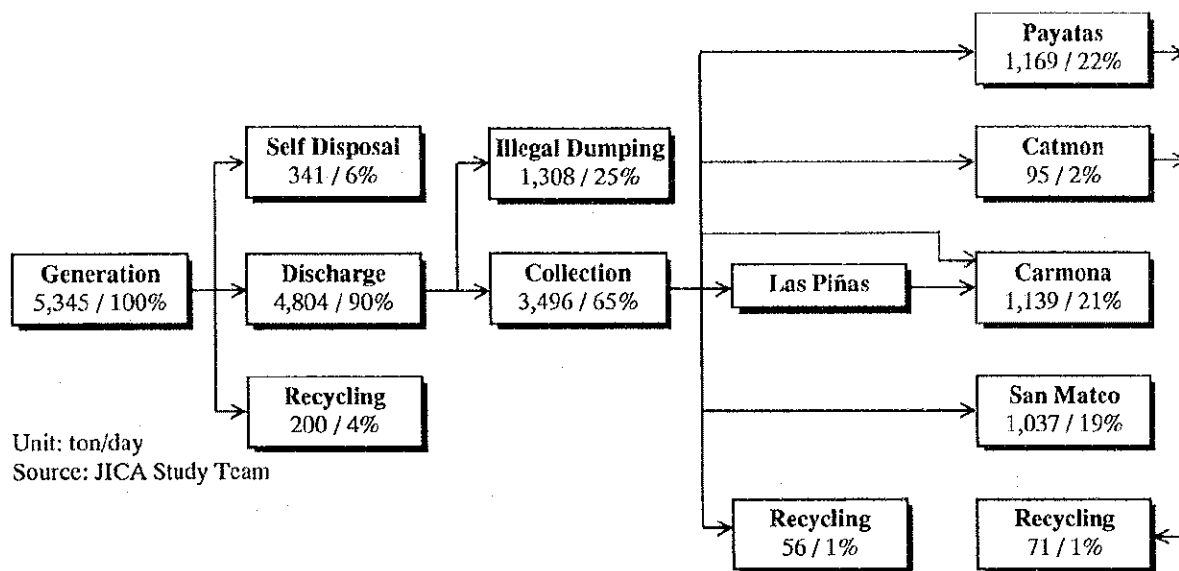


Figure 2.2.1 Waste Flow in Metro Manila

2.3 Collection Activities and Systems

2.3.1 Findings

As can be seen in Figure 2.2.1 above, the waste generated in Metro Manila totals around 5,350t/day, of which about 4,800 tons are discharged. Of the total amount of discharged waste in Metro Manila, around 73% or 3,500t/day are collected. The rest are either illegally dumped on nearby spaces or thrown into rivers.

Based on the waste stream prepared from the results of the WACS, uncollected waste volume - those illegally dumped in vacant lots and rivers - amounts to approximately 1,300 tons and makes up 25% of the total waste generation amount. This uncollected amount is presumed to have originated from about 3,100,000 people, that is 646,000 households, mostly from squatter areas.

In squatter areas, which house 30-40% of Metro Manila's citizens, wastes are not collected properly. This is a major cause for illegal dumping, which constitutes a health hazard. Waste thrown in rivers and creeks also contributes to the frequent flooding in Metro Manila.

The LGUs do not specify any particular container for waste discharge, so wastes are discharged in many kinds of plastic bags, bamboo baskets, drum cans and tire dustbins. Special collection containers, usually 1m³ in size, are used in some areas, such as markets, shopping centers, hotels, etc., where wastes are collected by private companies.

The manner of waste discharge is, in most households, mixed and not segregated. However, waste recycling at source is carried out by NGOs and private collectors on a

small-scale basis. According to the results of the Waste Amount and Composition Survey, 54% of households recycle their waste. The total amount of wastes recycled at generation sources in Metro Manila was estimated at 200t/day.

Large wastes, such as garden waste and pruning waste, should be reduced in size or bound with a rope prior to discharge. However, this is generally not done, resulting in the inefficient manner in which wastes are collected.

Generally, collection routes are fixed. However, due to the critical traffic conditions in Metro Manila, collection times are irregular. Delay in the arrival of collection vehicles usually render the area dirty and unsanitary, as wastes put out earlier scatter or pile up.

Collection services are not the responsibility of the MMDA, but of LGUs which mostly entrust collection and haulage to private collection companies. Accordingly, an administrative system should be established within every LGU to provide the residents with adequate collection and haulage services.

The assignment of street sweeping services in Metro Manila between MMDA and LGUs is unclear. The total amount of street sweeping waste is estimated at 3 tons/day, and the total length of serviced streets is estimated at 2,100 km.

River cleansing in Metro Manila is provided by MMDA, DENR, LGUs, etc. Environmental Concern Task Group (ECO-TAG) is the MMDA sector responsible for river cleansing. The total amount of river cleansing waste is estimated at 6 tons/day, and the total length of river cleaned is approximately 330 km.

2.3.2 Planning Issues

Based on the findings on waste collection activities and systems, a number of issues have been identified as having importance in the formulation of the Master Plan. The main issues are discussed below.

(1) Expansion of Waste Collection Area Coverage

The present collection coverage is not sufficient, especially in squatter areas and other inaccessible areas, resulting in clandestine dumping on vacant lots and in rivers that consequently compromises environmental and public health conditions, and contributes to the frequent flooding problems in Metro Manila. Hence, ways to expand waste collection coverage and the identification of the following points should be considered when studying policies for improvement:

- Establishment of a system with local government units as responsible bodies.
- Selection of a waste storage and discharge system (waste discharge point, discharge containers) for the squatter area.
- Selection of a collection system suited to the storage and discharge system.
- Establishment of a system for the extension of guidance to and supervision of barangay residents or the community regarding the management and maintenance of discharge points and containers.

- Execution of trial collection to determine the storage, discharge and collection systems suited to this area, as well as the implementation system to adopt. Education programs should be organized also to teach residents on the significance of sanitation.

(2) **Improvement and Standardization of Waste Collection Services**

To properly conduct collection and haulage in the entire Metro Manila area, a manual should be prepared with the cooperation of MMDA. The manual will contain the following:

- Proper procedures for the selection of a private collection company
- Considerations for the safety and health of collection crews
- Selection of collection vehicles suited to area conditions and discharge sectors

(3) **Dissemination of Environmental Education and Encouragement of Public Participation**

The existing problems in waste collection are believed not only to be of a technical nature, but also related to the prevailing social conditions. This aspect should be considered, as well as the ways of increasing public participation in waste collection services.

(4) **Use of Containers**

To efficiently collect wastes from large generation sources and in consideration of the effects of storage and discharge on environmental sanitation, the use of containers is recommended.

2.4 Haulage System

2.4.1 Findings

In some cases, collected wastes are either hauled directly to the final disposal site, or brought to a transfer station. Most wastes taken to the Carmona landfill site are first brought to the Las Piñas transfer station and loaded onto trailer trucks. The amount is estimated at 670t/day. Collection vehicles often have to wait extensively for their turn to unload due to time restrictions for loading and unloading, lack of temporary storage facilities, and insufficient trailer truck units. This drastically reduces collection efficiency. According to the Time and Motion Survey conducted by the Study Team, 10 of the total of 16 hours for 2 assignment trips are spent waiting at the transfer station gate.

Some LGUs using small trucks for collection adopt a stage type transfer system or conduct reloading by pay loader as a means of improving haulage efficiency. Still, these transfer systems do not always contribute to improving haulage efficiency.

About 1,000t/day of wastes are estimated to be transported to the San Mateo landfill site using 10 wheeler trucks with a 15m³ loading capacity. But due to the site's narrow and steep access road, haulage is difficult and therefore inefficient.

Collection vehicles carry out two trips per day on average. In every trip, they are required to go to the district office twice: at the beginning of the trip to get a trip ticket, and at the end of the collection for volume checking. The trip for volume checking is required to evaluate the contribution of each vehicle. In actuality, however, this practice makes collection inefficient and intensifies traffic congestion.

2.4.2 Planning Issues

Issues relevant to the planning of waste transport and haulage systems are as follows:

(1) Expansion of Transfer Station

Transfer stations of local government units should be expanded, and the appropriate arrangement of transfer stations by LGU grouping must be taken into account. The designation of a body to supervise transfer station operation and maintenance should be given serious thought as well.

(2) Installation of Truck Scale

A truck scale estimates the weight of waste collected. The installation of a truck scale in the San Mateo and Carmona disposal sites, and the Las Piñas transfer station would provide local government units with a uniform system for checking waste volume. The receipt issued to collection vehicles after weight of waste load is measured on the scale can be used in exchange for the trip ticket. When forming this uniform waste management system, the following should be taken into account:

- The consensus of the MMDA and local government units regarding the proposed system's mode of operation
- The details of the weighing slip and receipt system

2.5 Intermediate Treatment

2.5.1 Findings

There are no substantial intermediate treatment facilities, such as incinerators, existing presently in Metro Manila. However, a number of recycling activities and some waste reduction programs are carried out, as discussed in section 2.7.

Incineration of wastes is the most effective option to reduce the amount of garbage to be finally disposed of. However, it is costly compared to other options. Furthermore, the operation of an incineration plant requires advanced technology supported by technical experts.

Several proposals to construct a number of incinerator plants in Metro Manila under the Build-Operate-Transfer (BOT) scheme have been made by proponents from the private sector. But most of these projects are business proposals with, of course, profit as the motivation, and therefore, have a high internal rate of return. This may be feasible but totally unacceptable since SWM is a basic service rendered to the public. Expansion of incinerators into waste-to-energy plants may not also be a better option considering that the cost recovery scheme through sale of energy is still questionable.

This is the reason why these proposals were not included in the study since the Master Plan's objective is the establishment of an integrated solid waste management system for the entire Metro Manila. If the study will finally determine that waste reduction is necessary for the future SWM, incineration may be proposed but it shall be different from the present proposals.

Furthermore, the proposals have rekindled the objections against incineration, especially by the media, focusing on environmental problems and on destruction of recyclable materials. In fact, safety in terms of environment and public health against, for instance, dioxin emission and toxic ash, has not been technically guaranteed, although it has been proven that the emission level of dioxin depends significantly on combustion techniques.

In light of the above, there is a need to recognize that the present urban scenario in terms of solid waste can deteriorate further depending upon illegal dumping activities, uncollected garbage, or the burning of waste piles in open dumpsites. Likewise, the burden of SWM is rising as waste generation increases year by year, and the acquisition of final disposal sites is becoming more costly and difficult. In view of this, the intermediate treatment option is examined.

2.5.2 Planning Issues

Based on the findings on intermediate treatment, a number of issues have been identified as having importance in the formulation of the Master Plan. The main issues are discussed below.

(1) Reduction of Waste to Increase the Life Span of Disposal Sites

The findings of the Study Team pointed to the fact that only around 6% of total solid waste generated is being recycled. Recycling is carried out at source, during haulage, and at open dumpsites in Payatas and Catmon. To further reduce the volume of waste in Metro Manila, the setting up of recycling centers can be considered, but only after a separate collection system is established.

(2) Feasibility of Utilization of Recyclable Waste

To assess the feasibility of utilization of recyclable waste, the present market for recyclable waste, as well as the ways to increase demand, must be evaluated. This will also determine the size and number of composting plants to be constructed at disposal sites.

(3) Examination of Other Waste Management Systems, e.g. incinerator, from a Technical, Economic, Environmental, and Social Viewpoints

Metro Manila is currently faced with problems concerning final disposal sites. Even the acquisition of a site outside of the metropolis is expected to encounter many difficulties. Preferably, the disposal sites should be within the metropolis, with measures taken to prevent conceivable risks. Accordingly, the development of a sea landfill site in Manila Bay should be considered as a significant part of the future waste management services. However, in view of the tremendous embankment costs the sea landfill development would incur, large-scale waste reduction should be considered. Accordingly, the introduction of an incinerator should be fully examined from the technical, economical, environmental and social point of view.

2.6 Final Disposal

2.6.1 Findings

Today, there are only four sites available for disposal of waste from Metro Manila, and its 9.5 million population; the two open dumpsites Payatas and Catmon, and the two landfills San Mateo and Carmona. The present distribution of waste between the disposal and dumpsites is displayed in Figure 2.6.1.

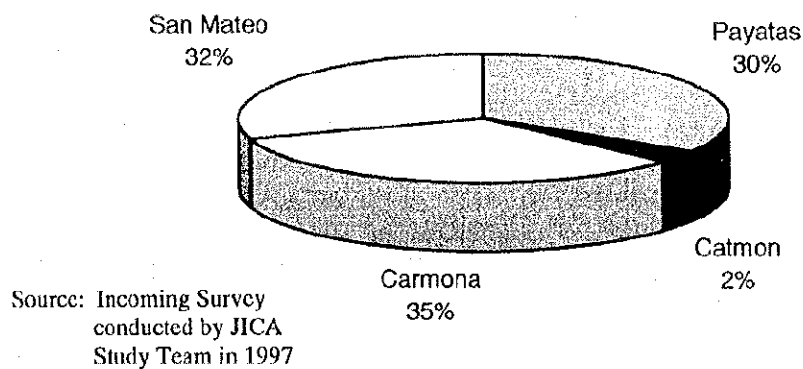


Figure 2.6.1 Distribution of Waste to the Metro Manila Disposal Sites in 1997

The Payatas and Catmon open dumpsites are operated without measures to minimize their impacts on health and environment. A large number of waste pickers are living and working on the sites under very poor conditions. The two sites will, according to the presidential task force, be closed in the near future. This will increase the load on the remaining two landfills in San Mateo and Carmona. If the Carmona landfill also has to be closed, and without measures to extend the life span of the San Mateo landfill, its capacity will probably not be sufficient to cope with all wastes generated in Metro Manila. Under these conditions a situation with no disposal sites available for the waste, or a new 'garbage crisis,' can be expected before the year 2000.

The San Mateo and Carmona sites have been designed as "sanitary" landfill sites. However, the construction of the landfills deviated from the plans, and the present operation of the landfills does not follow the operational procedures specified. Daily cover is, for example, not applied according to specifications. Furthermore, there are no functional rainwater diversion and gas collection systems, and the leachate treatment systems are not properly designed and operated/maintained. Thus, the landfills can hardly be regarded as sanitary, but merely controlled landfills.

The two landfills in Carmona and San Mateo are located quite far from Metro Manila, and the roads to San Mateo are in parts narrow and steep, which restrict access to the landfill to 10-wheeler trucks or smaller. Trailer trucks, which would improve the efficiency of haulage, cannot reach the San Mateo landfill.

2.6.2 Planning Issues

In the formulation of the Master Plan, the following findings on final disposal have been identified as having importance.

- (1) Improvement of Environmental Conditions and Extension of the Life Span of Existing Landfill Sites

To improve the final disposal situation, it is recommended that the life span of the existing landfill sites can be used until the end of year 2003, given proper

engineering and management. Furthermore, improvements of the operational procedures at the San Mateo and Carmona disposal sites must be made, to minimize their environmental impact. Both access roads and internal roads must also be improved and/or constructed, and properly maintained.

(2) Identification of New Landfill Sites

The closure of the Carmona final disposal site in March 1998 is very likely due to difficulties in negotiations. To prepare for this and the closure of San Mateo landfill in 2004, sites for new landfills need to be identified, and the preparatory work for development of the sites should commence as soon as possible.

2.7 Recycling Activities

2.7.1 Findings

Presidential Decree No. 1152, the Philippine Environmental Code No. 1152 in 1977, stipulates a regulation *"to encourage, promote and stimulate technological, educational, economical and social efforts to prevent environmental damage and unnecessary loss of valuable resources of the nation through recovery, recycling and re-use of wastes and waste products."* However, no specific actions related to recycling, and no incentives for promotion of recycling, are promulgated. There are various organizations involved in recycling in Metro Manila. The most important organizations, and their functions and activity in recycling, are described in Table 2.7.1.

Table 2.7.1 Delineation of Recycling Functions and Activities for Existing Organization

Functions	Policy Maker	Establishment of Regulations	Implementation				Education/Enlightenment	Active in Recycling
			Segregation	Collection	Haulage	Recycling		
Agencies								
DENR	✓	✓					✓	
DECS							✓	
MMDA				✓				
LGUs		✓		✓				✓
Private Sector				✓	✓	✓		✓
Community			✓					✓
NGOs				✓	✓		✓	✓
Waste Pickers				✓				✓

For the waste flow in Metro Manila, recycling activities occur on three levels; at the generation place, during collection and transport, and at the disposal sites (refer to Figure 2.7.1.)

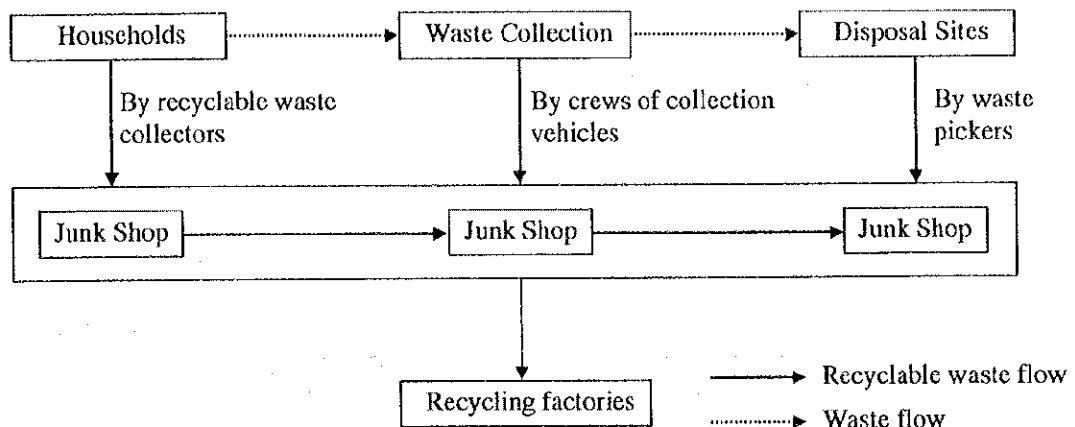


Figure 2.7.1 General Recyclable Waste Flow

The major recyclable waste items in Metro Manila are glass bottles, cullet (chipped bottles), paper, plastic, and organic matter.

A number of problems and constraints in promotion of recycling have been identified. They are as follows:

- Neither institutional guidelines nor governmental support are available for promotion of recycling;
- No incentives for recycling are given to the private industry;
- The management and financial capabilities of the private recycling sector is weak and/or poor;
- No organized tripartite cooperation exists among the business sector, the consumers and the governmental sector; and
- The market for recyclable goods is still immature, small and unstable.

2.7.2 Planning Issues

In the formulation of the Master Plan, it is believed that the following issues must be addressed to encourage and promote recycling activities at several levels:

- 1) Definition of roles and responsibilities of both the central and local governments for recycling activities towards a Zero-Waste Society.
- 2) Provision of incentives for recycling projects/programs by both the business sector and NGO.
- 3) Development of appropriate collection and segregation systems, taking into account the recycling market.
- 4) Promotion of public awareness of the importance of establishing a "Recycling Society" for sustainable growth.
- 5) Diversification of value-added "recycled products" by the private sector and NGOs.

- 6) Formation of an industrial policy to encourage investment in recycling industry, installation of the recycling process at factories and stabilization of the market for recycling materials.

2.8 Social Issues

2.8.1 Findings

Social Iniquities Affecting the Solid Waste System. The existence of squatter housing areas places a burden for extending collection to these areas due to access difficulties. Furthermore, the service provision is unequal, with parts of the study area being serviced regularly three times (or more) a week, others less frequently and more than 20% of the population without any service at all.

Waste picking of solid wastes and the buying of recyclable materials are extensively carried out in Metro Manila: in the houses before collection, in the streets during collection and during transport, and at the dumpsites. Scavenging at the dumpsites presents unhealthy situations with people mingled with the refuse heaps searching for food and recyclable materials. They have their livelihood based on the collection and primary processing of recyclable materials found in the waste stream. This means that the planned closure of the open dumpsites will lead to a conflict situation. Therefore, these activities should be discouraged, possibly by way of offering a more dignified way of livelihood and living for these groups of people.

Work conditions of the informal sector workers (street and dump scavengers) as well as of the formal ones (refuse collectors and street sweepers) seem to be unhealthy and distressing. These workers do not use any personal protective gears and generally get meager salaries. This situation is eased by their scavenging activities.

Public Participation. Citizen cooperation and participation in the solid waste systems operation is very limited in most of the cities in Metro Manila. This is for example reflected in limited compliance with the collection schedules and not properly storing the garbage for collection.

Compliance of solid waste ordinances is not met and enforcement of these ordinances is poor or nonexistent.

As in other third world metropolises, littering is a serious problem, specially in the most poor neighborhoods, the slums and squatter areas, housing around 38% of the urban population. It should be noted, however, that in these areas, collection and street sweeping is faulty or nonexistent.

User charges are not practiced in general, except in affluent areas, such as the villages and subdivisions, where service is provided by the villages' own administration, and sometimes, paradoxically, in very poor districts, which do not have access to public service and therefore relies on informal collectors that charge by the bag.

Public Awareness. Many programs and initiatives have been provided or are underway by NGOs or government agencies regarding promotion of separate collection for composting, recycling, etc. The impacts of these initiatives on the problem of solid waste management however have not been perceived so far in the city as a whole. Environmental education programs have also been tried but results so far are not significantly perceivable.

Professional training of solid waste management workers, foremen and managers on operational, as well as in public relation matters, is almost nonexistent and this also impedes the public awareness for the refuse problems.

2.8.2 Planning Issues

In the formulation of the Master Plan it is believed that the social aspects of solid wastes management have to be addressed in order to guide and support the technical systems envisaged, specially those which will depend upon the acceptance of the public in general or of specific groups.

This is specially true in regard to the construction of new sanitary landfill sites and transfer stations necessary for the implementation of the Master Plan, and in the imposition of a user charge for garbage collection which may be required to assure the economical sustainability of the proposed technical systems.

For the location of new solid waste management facilities, it should be stressed that the NIMBY (Not In My Back Yard) syndrome is omnipresent worldwide. Especially in Manila where the image of Smokey Mountain is still fresh, a strong community reaction to new facilities can most probably be expected. The imposition of user charges is another crucial issue, which cannot be implemented without public acceptance.

In summary the following matters regarding social consideration will be considered in the formulation of the Master Plan;

- (1) Leadership and political will towards solid waste management improvements, especially from the LGU mayors, is fundamental for improving the community participation in solid waste management matters;
- (2) Public acceptance to the Master Plan is fundamental to the project's success;
- (3) Promotion of public health benefits is a valuable tool to gain public endorsement of the project proposals;
- (4) Establishment/improvement of refuse recycling systems is an important aspect of the waste minimization efforts and a way to gain public awareness;
- (5) Extension of collection services to squatter areas is indispensable to reduce the amount of uncollected waste;

- (6) Provision of better working conditions to the most disadvantaged workers of the solid waste management sector (formal or informal ones) should be addressed;
- (7) Coordination among several on-going initiatives aimed to improve the present solid waste management should be sought.

2.9 Environmental Issues

2.9.1 Findings

Discharge and Storage System. Waste collection coverage is not sufficient, and the service level is uneven in Metro Manila, especially in squatter areas and in areas without access roads. Unclear rules and regulations for waste discharge have resulted in waste being illegally dumped and left scattered on open spaces and back streets, thrown in rivers/creeks, or burned in fields. The impacts of this practice on the environment are polluted air and water, degradation of land, worsening flooding problems, and health hazards owing to animals which feed on garbage.

Collection and Haulage System. Waste collection vehicles cause traffic congestion, noise and air pollution. The long wait to unload at the Las Piñas Transfer Station is one reason; another is the poor access roads to the final disposal sites (especially to San Mateo). In addition, many of the vehicles being used by private waste collectors are old. Offensive odor is emitted when refuse water drains from the vehicles.

The system of volume checking at the district offices also gives rise to unnecessary waste transportation and associated increased air pollution, noise/vibrations, offensive odor and traffic congestion.

Intermediate Treatment System. The residual wastes resulting from recycling activities carried out at source, during haulage and at open dumping sites in Payatas and Catmon, are sometimes dumped illegally on open spaces, back streets and rivers/creeks, thus negatively affecting the environment and health.

Final Disposal Sites. At the disposal sites, fires often occur; dust is generated, and toxic gas is emitted. All these pose health hazards to the workers, waste pickers and residents in the surrounding areas.

Although the San Mateo and Carmona landfill sites are designed as sanitary landfills, they have been constructed, operated and maintained inadequately. There are no functional rainwater diversion and gas collection systems, and the leachate treatment systems are not properly designed, operated, or maintained. The soil covering and extinguishing for occasional fires are not implemented effectively and sufficiently. This gives rise to pollution of surface water and groundwater by leachate and untreated drainage leaking from the site. This may cause health hazards and can affect the use of water for drinking, agriculture and fishery. Especially, the groundwater polluted by leachate and hazardous substances from the disposal sites may affect the health of inhabitants who use the water

for drinking. The contamination in farmland would be absorbed by crops and could affect human health.

The table below presents a preliminary environmental assessment for existing final disposal sites based on the site reconnaissance survey done by the Study Team.

Table 2.9.1 Preliminary Environmental Assessment for Existing Final Disposal Sites

Factors	San Mateo & Carmona Sanitary Landfill Sites		Catmon & Payatas Open Dumping Sites	
<i>Social Environment</i>				
Traffic and Public Facilities	There are a few traffic and public facilities.	x	same	x
Public Health Condition	Residents or workers may be affected by pathogenic animals and insects. Adequate management is required.	O	Residents, workers or waste pickers may be affected by pathogenic animals, insects, and smoke by occasional fires. Adequate management is required.	O
<i>Natural Environment</i>				
Groundwater	Penetration of leachate and hazardous substances would affect drinking water. Installation of treatment facilities for effluent is required. Some treatment for drinking water is required	O	same	O
Hydrological Situation	Water pollution by effluent would damage plants and animals. Fishermen's source of income may also be affected. Detailed survey on economic activities is required.	Δ	same	Δ
Fauna and Flora	Effects on plants by water pollution by leachate may occur. Increased numbers of flies, birds and rats may obstruct the breeding of other species. Detailed survey is required.	Δ	Effects on plants by occasional fires, and water pollution by leachate may occur. Increased numbers of flies, birds and rats may obstruct the breeding of other species. Detailed survey is required	Δ
Landscape	There are no valuable landscape and important tourism resources around the sites.	x	same	x
<i>Pollution</i>				
Air Pollution	There are few occasional fires.	x	Health hazards, such as asthma, and obstruction to growth of plants due to toxic gas emission by occasional fires may occur. Frequent covering or extinguishing of open dump is required.	O
Water Pollution	Drinking water, agriculture, fishery, landscape and recreation in downstream would be affected by inflow of leachate. Installation of wastewater treatment plants with sufficient capacity is required.	O	same	O

Cont. Table 2.9.1

Factors	San Mateo & Carmona Sanitary Landfill Sites		Catmon & Payatas Open Dumping Sites	
Soil Contamination	Toxic substances would leak with rainwater and affect water use and the downstream water value. Detailed survey is required.	△	same	△
Noise and Vibration	There is a few operation of collection vehicles and treatment of vehicles.	x	same	x
Offensive Odor	Offensive odor of dumped waste and leachate occurs because of the open dump sites with inadequate soil covering. Covering of refuse is required.	△	Offensive odor of dumped waste and leachate occurs by open dumping. The establishment of adequate management system is required.	O

Legend: O: serious impact; △ : significant impact; x : not significant impact

2.9.2 Planning Issues

Based on the findings on environmental problems in the present solid waste management system, the following have been considered relevant in the formulation of the Master Plan. The main issues are described below.

Discharge and Storage System:

- (1) Reduction of waste through publicity and promotional activities on how this can be achieved
- (2) Promotion of health education
- (3) Improvement of collection coverage. Curbside collection system in areas not covered, especially in squatter areas, is recommended.
- (4) Provision of adequate storage system, rules and regulations, and container

Collection and Haulage System:

- (1) Reexamination of collection methods and frequency, including collection points and schedule
- (2) Management and maintenance of collection points
- (3) Use of small vehicles for narrow access roads
- (4) Improvement of roads around final disposal sites, including installation of turnouts and traffic safety facilities
- (5) Installation of new transfer stations

Intermediate Treatment System:

- (1) Consideration of waste segregation at source
- (2) Construction of recycling centers after a separate collection system is determined

Final Disposal System:

- (1) Closure of the dump sites in Payatas and Catmon and the landfill in Carmona as soon as possible and suitable measures taken to minimize the adverse environmental and health impacts from these sites
- (2) Improvement of existing environmental protection system at San Mateo landfill, especially the management and/or rehabilitation of the existing leachate water treatment facilities, installation control against leachate seepage, and ditches and pipes to collect wastewater
- (3) Monitoring of environment and health of inhabitants living in the areas surrounding the four final disposal sites and undertake countermeasures to combat the adverse effects

2.10 Institutional Issues

2.10.1 Findings

Based on Republic Act No. 7974, an institutional demarcation system for SWM is stipulated as follows:

- DENR is responsible for general planning and policy formulation for solid waste management;
- MMDA shall plan and implement its own solid waste management program in accordance with DENR policy directions, and shall ensure the following:
 - (a) proper disposal of domestic, commercial and hospital waste; and
 - (b) development of waste disposal programs and the operation of disposal sites and transfer stations.
- LGUs are responsible for the collection and transport of garbage.

However, MMDA and LGUs are currently facing institutional problems that need to be addressed. These problems are as follows:

- (1) Weakness of MMDA, which can be attributed to:
 - institutional instability,
 - lack of membership in the Presidential Task Force, and
 - lack of autonomous financial resources.
- (2) Poor coordination between MMDA and LGUs because of:
 - lack of inter-agency mechanism in the MMDA, and
 - lack of coordinated operational system between MMDA and LGUs for final disposal sites.

- (3) Capability building is necessary for creation of a technically appropriate system for SWM, in order to overcome the lack of financial resources and manpower in MMDA and LGUs.
- (4) Participation of stakeholders, especially the LGUs, barangays and local communities in decision-making process of SWM is extremely important to seek project and/or program support by the society, as a whole. Yet, there are underlying problems such as:
 - conflict between MMDA and many agencies/groups, and
 - lack of support for MMDA from the central and local governments.
- (5) Lack of transparency with respect to SWM decision making process may lead to politicizing of SWM projects and inefficient management with less cost-efficient operation.

2.10.2 Planning Issues

In light of the above, the following have been identified as having importance in the formulation of the Master Plan:

- (a) Formation of well-functioning institutional linkages of relevant organizations;
- (b) Improvement of MMDA's institutional and mandatory capability for solid waste management;
- (c) Facilitation of coordination with DENR, MMDA, LGUs and all stakeholders;
- (d) Capability building of human resources in relevant organizations;
- (e) Assurance of transparency of decision-making process; and
- (f) Study on the best option for institutional restructuring to meet financial and managerial requirements for project implementation for SWM in Metro Manila.

In order to address the above mentioned institutional problems on the operation and management of SWM, the Team preliminarily considered four (4) options as follows:

Option 1: Strengthening of Mandatory Functions of MMDA

As the main agency responsible for SWM, MMDA shall be further strengthened in its institutional and financial powers. The rationale behind this option is as follows:

- Solid waste disposal, including transfer of refuse, is better handled at the metropolitan level, or by MMDA;
- Solid waste disposal facilities cuts across geo-political boundaries of cities and municipalities, and disposal sites need to be located outside their respective local jurisdictions;
- Investment costs for land acquisition, development and operation of transfer stations, and sanitary landfills are beyond the means of most cities and municipalities; and
- MMDA is the sole agency that has an extensive experience in SWM.

On the other hand, this option holds the following constraints:

- MMDA has not the necessary institutional stability and financial capability to assume responsibility over proposed long-term projects;
- New disposal system to be proposed requires different/new expertise than those presently available in the existing MMDA;
- MMDA already has financial and technical constraints to solve problems in operation at sanitary landfills at San Mateo and Carmona; and
- MMDA is over-staffed which affects the cost efficiency of its operation.

Option 2: Partial Devolution of Functions of MMDA to DENR

The rationale behind this option is as follows

- As the agency primarily responsible for the preservation, protection and conservation of the environment, DENR can be responsible for the operation and management of sanitary landfills and transfer stations in accordance with its own environmental quality standards and regulations;
- DENR covers its administrative mandates outside Metro Manila where final disposal sites are and shall be located; and
- DENR has a number of well-trained technical staff.

However, this option has weaknesses, as follows:

- The current legislative framework for SWM needs to be amended, and there may be a conflict between its regulatory functions and its implementing responsibilities;
- Duties for SWM are to be removed from local initiative to the national government;
- DENR may not be with an experience in managing and undertaking actual operations of facilities;

Option 3: Separation of Responsibilities of Transfer Facilities and Sanitary Landfills

This option is underlying a concept that MMDA shall own, manage, implement and operate transfer facilities, while DENR shall own, manage, implement and operate sanitary landfills. Thus, MMDA provides an intermediate service between collection at the local level, and DENR handles final disposal duties that are environmentally sensitive. This option has the following strengths on both sides:

- MMDA can concentrate on providing better services for LGUs requiring inter-municipal cooperation and coordination;
- MMDA can enjoy cost efficiency and economies of scale in intermediate transfer facilities;
- DENR, as a national agency, is in a better position than MMDA to handle sanitary landfills with more environmental attentions;
- DENR can handle necessary coordination among several levels of government such as central agencies concerned, provincial and municipal governments even outside Metro Manila where the sanitary landfills are to be located;

- DENR can handle the management, implementation and operation of the sanitary landfills, referring to its own environmental policy and standards to ensure environmental quality.

Nevertheless, this option has the following defects:

- Unless MMDA is provided with stable and sufficient revenues, it will still have a limited capability to embark on long-term projects requiring massive capital outlays;
- Unless MMDA has institutional stability, it may neither have sufficient absorptive capacity to receive long-term loans or economic supports from potential international financing institutions, nor make multi-million contracts with the private sector;

Option 4: Formation of Management Cooperatives with LGU Groups

This option is derived from the concept that the LGUs shall be the main overall institution responsible for the whole process of SWM, from collection to final disposal, by harnessing their collective power. Strengths of this option are thought to be as follows:

- This could overcome the primary cause of the current SWM crisis in Metro Manila, i.e., the fragmentation of responsibility among concerned agencies;
- This is in accordance with the Local Government Code—that LGUs have the primary role in the delivery of basic services;
- This could achieve cost efficiency and economy of scale;
- This option may lead to improvement of LGU administration system in terms of: 1) enhancement of the participation of affected groups; 2) simplification of the roles assigned to concerned agencies; and 3) best utilization of local resources for SWM.

On the other hand, many LGUs do not possess sufficient manpower, financial resources and technical expertise to handle SWM. A well-functioning cooperative management system in terms of dispatch of personnel, financial contributions and risk-management should be based on a consensus among the LGUs concerned.

2.11 Financial and Budgetary Issues

2.11.1 Findings

(1) Financial Capability of MMDA

- (a) Dependency of MMDA's Revenue on National Government: As the Local Government Code took effect in 1991, the revenue structure of MMDA has undergone a drastic change, as shown in Table 2.11.1. MMDA has lost its revenue from local tax and real estate tax, which were entirely transferred as LGU revenues, and extremely increased their dependency to the grants coming from the national government to almost half of their total revenue.

Table 2.11.1 Change in Revenue Structure of MMDA

Revenue Item	million pesos			
	1991 (actual)		1997 (estimated)	
	Amount	%	Amount	%
Tax revenue	405.96	36.9	0.00	0.0
Non-tax revenue	100.10	9.1	109.13	6.1
LGUs' contribution	429.74	39.1	372.96	20.8
IRA	128.36	11.7	373.07	20.8
Grants & aids	4.28	0.4	848.82	47.3
Others	31.11	2.8	89.17	5.0
Total	1,099.55	100.0	1,793.15	100.0

However, the grants are not regularly allocated to MMDA, furthermore, the remittance of mandatory contribution by LGUs is irregular. This irregularity of financial sources makes MMDA financially unstable and dependent.

- (b) Large Weight of Recurrent Costs: The total expenditure of MMDA increased by 1.6 times between 1991 and 1997. Particularly, personal expenses are continuously increasing even after the Local Government Code took effect. More than 85% of MMDA's expenditure is appropriated to the recurring costs for personal services and maintenance and operating costs in 1997.

Particularly, MMDA assigns almost 4,000 employees of Environmental Sanitation Center (ESC) for garbage collection and sweeping services. ESC spends the largest portion of expenditure amounting to 42% of the total budget in 1997.

Therefore, MMDA could not have shouldered the investment costs of solid waste management if not for the grants from the national government.

(2) Financial Capability of 17 LGUs

- (a) Financial Autonomy of 17 LGUs: With regards to the revenue sources of 17 LGUs, the autonomous income from tax revenue (local tax and real property tax) shares 40-80% (or 67% on the average), while IRA shares 22% on the average. This means that the LGUs in NCR have abundant revenue sources at their disposal compared with MMDA and other LGUs outside Metro Manila, who have smaller tax revenue, and consequently greatly depend on IRA by 63% on national average. LGUs in NCR are regarded as autonomous body from the financial viewpoint.
- (b) Budgetary Disparity among 17 LGUs: The sizes of budget remarkably vary among the 17 LGUs. In 1996, the cities of Makati and Manila gained more than 3 billion pesos of revenue, while the municipality of Pateros received only 80 million in the same year. Manila had about 40 times as large revenue as Pateros. Per Capita budget revenue also shows a conspicuous disparity, extremely high in Makati City with 7,000 pesos per person per year, and the

bottom level in Malabon and Navotas with 487 pesos and 456 pesos, respectively.

(3) Expenditures for SWM in Metro Manila

- (a) MMDA's Expenditure for Solid Waste Management (SWM): In MMDA, the Environmental Sanitation Center (ESC), including Project Management Office (PMO), is formally assigned to SWM. ESC, which once undertook SWM in the era of MMA, had more than 10 thousand employees in 1991 and still keeps a large portion of those employees (7,976 positions are funded in 1997 budget) at the same status even after the garbage collection services were transferred to LGUs. It is estimated that the expenditure for SWM amounts to 751 million pesos or 42 % of total expenditure of MMDA in 1997 as shown in Table 2.11.2. Approximately half of the expenditure of ESC is supposed to be consumed by SWM in the above estimation because almost half of the ESC employees are assigned to positions other than SWM.
- (b) LGU's Expenditure for SWM: In 17 LGUs, expenditures for SWM took a share between 5-18 % of their total expenditures, based on the result of the Questionnaire Survey of LGUs (Table 2.11.3). LGUs appropriated approximately 1,650 million pesos in total, 11% of their expenditure, to SWM in 1996.

Table 2.11.2 SWM Expenditure of MMDA in 1996 and 1997

	1996 (actual)		1997 (budgeted)	
	Amount	%	Amount	%
SWM Expenditure*				
- Personal service	341.70	51	349.33	47
PMO	(4.99)		(2.55)	
ESC	(336.71)		(346.78)	
- Maintenance & operation	238.82	35	235.70	31
PMO	(206.40)		(206.05)	
ESC	(32.42)		(29.65)	
- Capital outlay/PMO	92.35	14	165.99	22
Total SWM Expenditure	672.87	100	751.02	100
Share of MMDA Expenditure	43%		42%	
Total Expenditure of MMDA	1,552.18		1,793.15	

Source: MMDA

* PMO and 50% of ESC expenditures are included in the estimate.

Table 2.11.3 SWM Expenditure of 17 LGUs in 1996

LGU	Total expenditure in 1996 (million pesos)	SWM expenditure in 1996 (million pesos)	Share of SWM in 1996 (%)
Kalookan	904.7	51.7	6
Makati	2,504.2	157.7	6
Manila	3,203.8	581.5	18
Mandaluyong	780.0	73.7	9
Muntinlupa	278.8	51.1	18
Pasay	556.8	54.2	10
Pasig	821.8	98.3	12
Quezon	2,995.0	310.2	10
Las Piñas	301.8	22.0	7
Malabon	169.6	14.2	8
Marikina	378.0	25.6	7
Navotas	138.2	n.a.	n.a.
Parañaque	764.4	135.0	18
Pateros	64.0	3.0	5
San Juan	216.2	26.4	12
Taguig	226.8	14.4	6
Valenzuela	317.8	25.8	8
Total	14,621.9	1,644.8	11

Source: financial survey of 17 LGUs and MMDA, JICA

- (c) Total Expenditure for SWM in NCR: Assuming that 40% of MMDA revenue and 10% of the 17 LGUs' revenues for 1997 are allocated for SWM, the total SWM cost is estimated at 2,800 million pesos. This estimation induces some indicators, as follows:

- SWM expenditure is shared by MMDA and LGUs by 70% and 30% respectively.
- SWM costs at 0.35 % of GRDP in Metro Manila (0.10 % by MMDA and 0.25 % by LGUs). Out of 0.10% by MMDA, almost half (0.05%) is spent for ESC and is not exactly mobilized to SWM. Therefore, 0.05% of GRDP is borne by MMDA and, in total, 0.30% of GRDP is spent for SWM in Metro Manila
- SWM costs at about 300 pesos (or US\$ 7.50) per capita per year
- SWM costs at 25 pesos (or US\$ 0.625) per capita per month
- SWM costs at about 2,200 pesos per ton.

- (d) Scarcity of Budgetary Information on SWM: A more accurate data analysis on the cost-efficiency in SWM is necessary to seek financial improvement; however, the accounting systems of most of the LGUs, as well as MMDA, do not give an explicit figure of expenditure for SWM. From this, one may derive that cost-efficiency is not a major concern of officials of LGUs and MMDA.

2.11.2 Planning Issues

Based on the findings on current financial and budgetary situation, the following issues have been identified as having importance in the formulation of the Master Plan:

- (1) Improvement of financial status and strengthening of budgetary capability of LGUs;
- (2) Promotion of cost efficient budgetary system for Solid Waste Management by LGUs; and
- (3) Establishment of a sustainable financial and budgetary scheme to meet the demand for capital outlay for investments and recurrent costs.

CHAPTER 3 PLANNING GOALS, TARGETS AND FRAMEWORK



CHAPTER 3 PLANNING GOALS, TARGETS AND FRAMEWORK

3.1 Goal and Objectives of the Master Plan

The ultimate goal of the Master Plan is to upgrade the sanitary level of areas affected by solid waste thereby providing a hygienic and healthy living environment in Metro Manila. Towards this goal, the Master Plan is to develop a well functioning and environmentally sustainable solid waste management system at the target year 2010. The Master Plan will be formulated considering the planning issues mentioned in Chapter 2, and the following three major objectives.

- (a) To promote public participation in SWM;
- (b) To build self-supporting and sustainable operation of SWM in every LGU; and
- (c) To increase recycling and resource recovery

These three objectives are closely interrelated and need to be pursued as one combined target (refer to Figure 3.1.1). Therefore, balance is necessary to effectively implement the Master Plan.

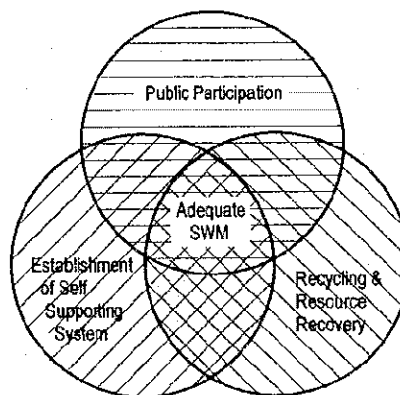


Figure 3.1.1 Objectives of Master Plan

To achieve and upgrade the sanitary level in Metro Manila, waste collection needs to be improved. It is expected that the present collection rate of discharged waste, which is estimated at 73 %, will expand, particularly in densely inhabited areas and riversides. LGUs should, therefore, be prepared to considerably increase their capacity of garbage collection toward the target year when the waste generation is projected to be almost double compared to present generation. Efforts should also be made to restrain the amount of wastes illegally dumped at not more than the present level.

Another area that needs to be improved in order to reach the goal of the Master Plan is the manner of final waste disposal, which still remains at a so-called controlled tipping level. Considering the requirement of ECC and the interest of neighboring areas of existing final

disposal sites, it seems necessary to raise the manner of dumping operation to the standards of a sanitary landfill at any site in operation at the target year. This goal induces a corollary of certain improvements of existing final disposal sites with remaining life, that would demonstrate the effectiveness of a "sanitary landfill" and consequently promote the acceptability of the following plan for the other final disposal sites.

Objective 1: To Promote Public Participation in SWM

The population in Metro Manila is projected to reach near 15 million in 2010, which is an increase of approximately 50% from the present population. Furthermore, economic activity is expected to grow more rapidly than population. These two factors will inevitably result in an even more congested Metro Manila, including squatted areas and considerable solid waste generation. This development of Metro Manila will impose a serious burden of SWM on both MMDA and LGUs, as well as bring pressure for expansion of various urban infrastructures to meet the demands. Severe struggle to get budgetary sources among various sectors, to comply with demand for investment and maintenance, can be foreseen.

To reduce the load of SWM, cooperation in garbage collection, reduction and proper manner of waste discharge by residents are essential. The situation in Metro Manila urges the promotion of public participation in SWM as an inseparable part of the Master Plan. Efforts to reduce and recover resources out of solid waste are also encouraged with the aid of policies by MMDA and other relevant authorities.

Objective 2: To Build a Self-sufficient Operation by Each LGU and MMDA for SWM

LGUs in Metro Manila are, in principle, requested to cover all the aspects of SWM, as is the case of LGUs in other parts of the Philippines. However, a certain part of the operation is shared with MMDA. This exception was rationalized because of the heavily urbanized land use in Metro Manila, and the necessity of collective efforts by LGUs. Though the present demarcation of responsibility for SWM has a reasonable background, the self-sufficient operation by the LGUs is an indispensable prerequisite to achieve the goals stated above. The LGUs have a closer contact with inhabitants in their respective jurisdiction than MMDA, and are, furthermore, advantageous to organize and promote public participation, which is a vital factor to implement advanced SWM under limited financial resources.

On the other hand, it can be said that MMDA should concentrate on matters commonly related to the whole metropolitan area such as operation of large-scale final disposal, and assistance in introduction of new technologies for intermediate treatment. Toward this goal, rearrangement of responsibility and budgetary sources for SWM is needed between MMDA and LGU. Another form of reinforcement of LGUs is to develop a new rule of cooperative organization among LGUs that can contribute to make some specific phases of SWM more effective than can be done individually.

Objective 3: To Increase Recycling and Resource Recovery

A sustainable growth under limited resources cannot materialize until the society and the economy are run with a resource-recovery mechanism. This has been widely recognized among the people, and further activated by several notable movements of NGOs as well as the Government, such as the "No Waste Campaign" and "Recycling." The Master Plan

addresses the importance of this global concept as an inseparable part of the solid waste management system. Recycling should be encouraged so that it becomes deeply rooted into the people's way of life towards a "recycling society."

From the technical viewpoint, recycling is expected to contribute to "Reduction of Waste" which is absolutely necessary to release the increasing financial burden on all residents in Metro Manila. As of this year, 6% of the generated waste in Metro Manila, or 327 tons/day, is being recycled at various stages in a less-organized manner. The Master Plan is to seek a way to increase this recycling rate, or resource recovery ratio, to the utmost possible level, involving all parties' efforts in the waste management stream. The most important is encouragement of recycling at the household level, therefore involvement of each household in this movement becomes a key factor.

From the socioeconomic viewpoint, recycling is expected to yield long-term benefits on various fields, and create a favorable economic cycle. The social values on conservation and effective use of natural resources will change the people's manner of consumption to less waste and more recyclable products, thereby leading to a change in productive systems in the industrial sector. Such an industrial shift may foster a market for recyclable goods, which may encourage more recycling activities in communities as well as at home. Thus, the industrial sector also has a great responsibility for creation of such a recycling society, and needs to be strengthened as a new business sector by institutional support such as provision of incentives by BOI and DTL.

The Master Plan proposes a social system to connect each household's effort for recycling with the commercial and industrial markets, integrating on-going various activities by communities, NGOs and LGUs. This issue has been recognized as a fundamental and vital element for the solid waste management.

3.2 Planning Targets

3.2.1 Total Risk Management

Towards the goal of the Master Plan, or achievement and upgrading of sanitary level in Metro Manila, appropriate technologies should be adopted. The meaning of "appropriate technologies" is twofold: one is that they are applicable and sustainable for the socioeconomic state in Metro Manila; and the other is that they can assure a total risk management which minimize the social, economic, health and environmental risks to be imposed on Metro Manila as a whole. Individual technology for solid waste management itself is not perfect, but rather, it is still in a process of technical development.

The incineration plant is a good example. The incineration plant may have a risk in emitting hazardous gas such as dioxin, but the total amount of the emission must be much less than that from open burning. What is more important is the knowing of the defect of the technology so that the most adequate operational system can then be sought, instead of totally abandoning it. As far as this technology will be able to contribute to mitigating the total risk in Metro Manila as a whole, its application deserves to be considered.

Another important viewpoint is “social risks” in relation with public health and solid waste management. It has been widely proven that a risk of public health deterioration can be evaded by improving the solid waste management. Particularly, some sort of infectious diseases, such as dengue and acute respiratory diseases, can be eliminated to a considerable extent by upgrading the hygienic situation. It can be said that, in total, social costs for improving the solid waste management shall be offset by benefits on the public health. This social viewpoint should be further stressed in the context of improvement of the solid waste management. For formulation of the Master Plan, the above discussions are taken into account.

3.2.2 Planning Targets

The final objective of the basic plan is to develop an environmentally-friendly SWM system for Metro Manila by promoting public participation, establishing a self-sufficient SWM operation and encouraging resource recovery/recycling. Target years set to accomplish this objective are as follows:

- Master Plan : 1998 – 2010
- Medium Term Improvement Plan : 2005 – 2010
- Short Term Improvement Plan : 1999 – 2004

The timetable of specific targets to be attained by these plans is as follows:

- Close existing open dumpsites by the end of 2000
- Commence partial separate collection by 2005
- Achieve an 80% collection ratio by 2005, and 90% by 2010
- Subject 10% of total waste volume to composting and recycling through government guidance by 2010
- Commence incineration for waste reduction from 2005
- Convert all final disposal sites to sanitary landfills by 2005

As mentioned earlier, public participation and a self-sufficient SWM operation are required to develop an environmentally-friendly SWM system.

- (1) Self-sufficient SWM operation. Institutional arrangements are required in order to achieve a self-sufficient SWM operation. It involves the following:
 - (a) review of resolutions of LGUs and MMDA related to SWM in order to have an effective sharing of responsibility;
 - (b) review of administrative department of LGUs and MMDA in charge of SWM;
 - (c) review of budgetary sources for SWM including involvement of barangay and residents' contribution;
 - (d) review and development of private sector participation in various phases of SWM; and
 - (e) review of managerial methods of SWM in accordance with innovative operation proposed as part of the Master Plan.

(2) **Promote Public Participation.** This is necessary for the following reasons:

- (a) to create an advanced scheme of communal participation in SWM particularly in garbage collection, resource recycling and waste reduction with the aim of cleaning the community environment;
- (b) to design an educational program for residents in Metro Manila; and
- (c) to draw up a policy for encouraging resource recycling.

3.3 Projection of Future Socioeconomic Activities in Metro Manila

3.3.1 Population Growth

The population growth and urbanization in the Philippines is rapid. The population situation in Metro Manila in the census year 1995, and projections of the development until the target year of the Master Plan, 2010, is given in Table 3.3.1.

Table 3.3.1 Population of Metro Manila in 1995 and Projections for 2010

Area (km ²)	1995		2010	
	Population (000)	Population Density (persons/ha)	Population (000)	Population Density (persons/ha)
638.2	9,454	148	14,583	229

Source: NSO and JICA Study Team

Projection of population growth until the target year 2010 was prepared by local government units as shown in Table 3.3.2.

Table 3.3.2 Projection of Population by Local Government Unit up to 2010

City/Municipality	Population (000)				Population Density		Average Annual Growth Rate: %/year					
	Census	Projection					1980-	1990-	1995-	2000-	2005-	
	1995	2000	2005	2010	1995	2010	1990	1995	2000	2005	2010	
City	Kalookan	1,023	1,279	1,514	1,743	192	327	5.0	6.0	4.6	3.4	2.9
	Makati	484	522	561	594	162	199	2.0	1.3	1.5	1.5	1.1
	Mandaluyong	287	317	349	378	254	335	2.0	2.9	2.0	1.9	1.6
	Manila	1,655	1,644	1,638	1,623	429	420	-0.2	0.7	-0.1	-0.1	-0.2
	Muntinlupa	400	565	783	1,036	85	221	7.3	7.5	7.2	6.7	5.8
	Pasay	409	454	503	546	221	295	2.5	2.1	2.1	2.1	1.7
	Pasig	471	561	663	762	152	246	4.0	3.4	3.6	3.4	2.8
	Quezon	1,989	2,349	2,752	3,140	123	195	3.7	3.6	3.4	3.2	2.7
	Marikina	357	420	490	557	105	164	3.9	2.9	3.3	3.1	2.6
	Subtotal	7,075	8,111	9,253	10,379	167	244	2.5	3.0	2.8	2.7	2.3
Mun	Las Piñas	413	550	683	820	100	198	8.1	6.8	5.9	4.4	3.7
	Malabon	347	419	482	542	220	343	3.9	4.4	3.8	2.8	2.4
	Navotas	229	266	297	325	212	301	4.1	4.0	3.0	2.2	1.8
	Parañaque	391	476	574	672	82	141	4.0	4.9	4.0	3.8	3.2
	Pateros	55	60	66	71	262	338	2.5	1.5	1.8	1.9	1.5
	San Juan	124	132	145	155	210	263	-0.2	-0.5	1.3	1.9	1.3
	Taguig	381	499	643	798	84	176	7.1	7.5	5.5	5.2	4.4
	Valenzuela	437	550	683	821	98	184	4.8	5.1	4.7	4.4	3.7
	Subtotal	2,377	2,952	3,573	4,204	111	197	4.7	5.1	4.4	3.9	3.3
	Grand Total	9,452	11,063	12,826	14,583	148	228	3.0	3.5	3.2	3.0	2.6

Source: NSO and JICA Study Team

3.3.2 Economic Growth

The economy of Metro Manila recently seems to have shifted to an acute upward curve, driven by domestic investment as well as foreign direct investment in the business sector. This will naturally stimulate consumer demand and eventually impose a greater burden on solid waste management. Some environmental concerns, such as water and sanitation, will improve with income growth, while some problems including municipal waste may continuously worsen as income increases, without proper policy changes.

For the future projection of solid waste discharge in Metro Manila, the following three cases of economic perspective of Metro Manila were reviewed:

Case 1 (Base Case): The real growth rate of GRDP is estimated at 6.5 % p.a., 1997-2000 and 6.0 %, 2001-2010, which will continuously increase GRDP per capita by 3 % p.a. in Metro Manila. The past highest level of GRDP per capita in 1983 will be recovered in 2001.

Case 2 (High Economic Growth): GRDP per capita of 5,000 US\$ will be attained in the target year of 2010, when the real growth rate of GRDP is estimated to be 7.0 - 7.5 % p.a. up to 2010.

Case 3 (Low Economic Growth): Assuming the real growth rate of GRDP at 4 - 5 % p.a., the level of GRDP per capita in 1983 cannot be regained until 2010.

Figure 3.3.1 shows the past records and future projections of GRDP and GRDP per capita at constant 1985 prices from 1982 to 2010, while Table 3.3.3 summarizes the future projections of GRDP in Metro Manila.

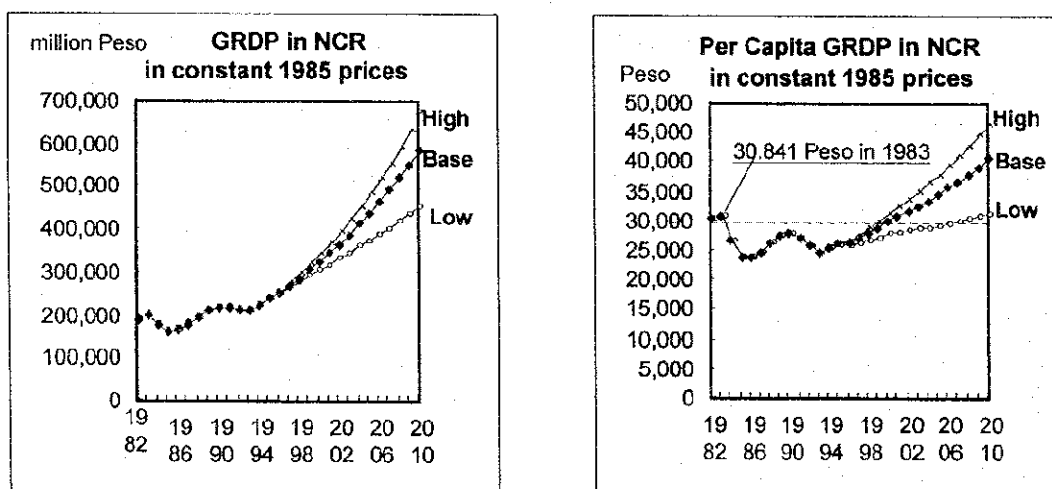


Figure 3.3.1 Projection of GRDP and GRDP Per Capita of Metro Manila (1982-2010)

Table 3.3.3 Future Economic Framework of Metro Manila

Scenario	1995	2000	2005	2010	Increase 1995-2010	Average Growth Rate: %/yr.	
						1996-2000	2001-2010
Population: 000	9,452	11,064	12,827	14,583	5,131	3.2	2.8
Case 1: Base							
GRDP in Metro Manila in constant 1985 prices (million pesos)	240,121 (100)	328,987 (137)	440,258 (183)	589,165 (245)	349,044	6.5	6.0
Per capita GRDP in MM In constant 1985 prices (Pesos)	25,404 (100)	29,735 (117)	34,323 (135)	40,401 (159)	14,997	3.2	3.1
Case 2: High Growth							
GRDP in Metro Manila in constant 1985 prices (million pesos)	240,121 (100)	344,725 (144)	483,494 (201)	678,126 (282)	438,005	7.5	7.0
Per capita GRDP in MM In constant 1985 prices (Pesos)	25,404 (100)	31,157 (123)	37,693 (148)	46,501 (183)	21,097	4.2	4.1
Case 3: Low Growth							
GRDP in Metro Manila in constant 1985 prices (million pesos)	240,121 (100)	306,462 (128)	372,858 (155)	453,639 (189)	213,518	5.0	4.0
Per capita GRDP in MM In constant 1985 prices (Pesos)	25,404 (100)	27,699 (109)	29,068 (114)	31,107 (122)	5,703	1.7	1.2

Source: NSO and the JICA Study Team

3.4 Planning Framework

3.4.1 Waste Generation Rate

The future waste generation rate (WGR) forecast was based on the results of the study conducted by the JICA Study Team. The WGR obtained through this study showed a 2% annual increase when compared with the results of the 1982 study. Waste discharge volume indicates prevailing economic conditions correlating to GDP growth. The factors that define the relationship could not be determined, however, due to sharp fluctuations in the GDP of the Philippines these recent years. Taking future economic development into account, growth in WGR shall be set as before, at 2% per annum. Based on this, household WGR by 2010 has been estimated at 542g/capita/day (see Table 3.4.1).

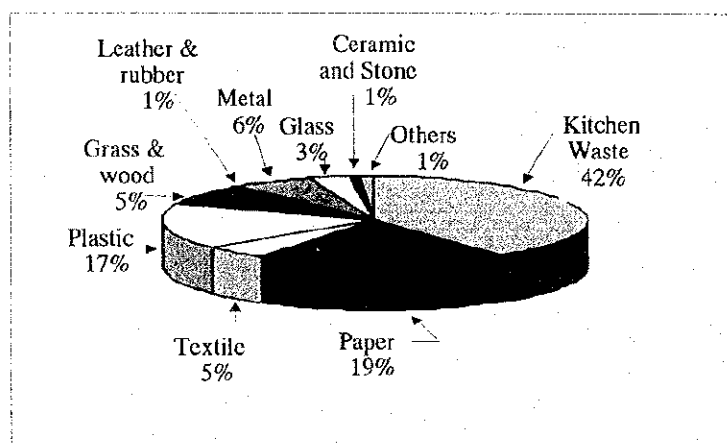
3.4.2 Waste Composition

Future waste composition forecast was based on the results of the study conducted by the JICA Study Team, and in consideration of other urban conditions and future economic developments. Wastes in Metro Manila contain a high proportion of paper and plastic, as is the case in developed nations. Accordingly, future waste composition forecast particularly focused on the rate of increase in paper and plastics, and the rate of decrease in kitchen waste (refer to Figure 3.4.1).

Table 3.4.1 Unit Waste Generation, 2010

Category	Unit	1997	2000	2005	2010
Household Waste	g/person/day	419	445	491	542
Commercial Waste :	Restaurant	g/shop/day	21,318	22,623	24,978
	Other shops	g/shop/day	1,818	1,929	2,130
Institutional Waste	g/person/day	72	75	85	95
Market Waste	g/shop/day	7,261	7,705	8,507	9,393
Street sweeping waste	g/km/day	10,702	11,357	12,539	13,844
River cleansing waste	g/km/day	18,062	19,167	21,162	23,364

Source: worked out by the JICA Study Team



Source: worked out by the JICA Study Team

* Detail data are shown in Chapter 2 of the Supporting Report

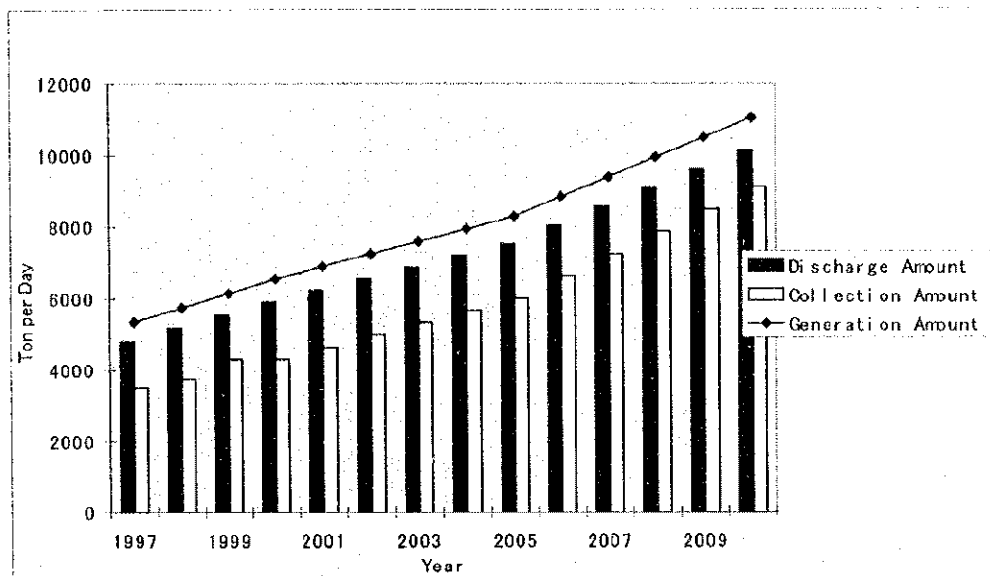
Figure 3.4.1 Waste Composition in 2010

3.4.3 Future Waste Amount

(1) Solid Waste

The population of Metro Manila is estimated to reach 14.5 million by 2010. Waste generation sources are also presumed to increase along with the population. The coverage of road sweeping and river cleansing services, which is quite extensive at present, is assumed to remain the same in the future.

Waste amount was estimated according to the increase in generation source units and the forecast WGR. The present collection ratio of MSW is 73%. With the future expansion of service areas, the collection ratios by 2005 and 2010 are estimated at 80% and 90%, respectively. As a result, the waste generation amount of Metro Manila in 2010 is forecast to be 10,000 tons/day, twice as much as at present (see Figure 3.4.2).



Source: worked out by the JICA Study Team

Figure 3.4.2 Generation and Collection Amount

(2) Medical Waste

Medical waste is not included as a planning issue of this Master Plan. However, to grasp the current waste management in Metro Manila, the Study Team conducted a survey on medical waste. Waste generated in major hospitals is collected by private companies on contract basis. The daily generation amount of the general and infectious medical waste is surveyed at 130 tons and 9 tons, respectively, as of 1997. The rate of hazardous and infectious waste in the total municipality is estimated at 7%.

(3) Industrial Solid Waste

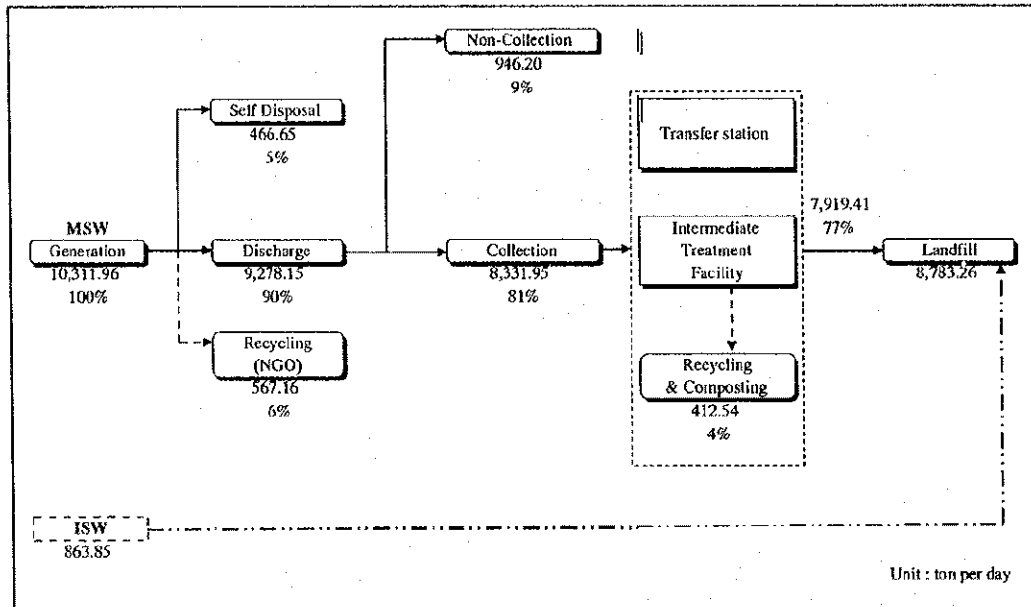
Industrial solid waste (ISW) itself is not discussed in depth in this Master Plan, because the issue is out of the scope of the Study. However, according to the results of the incoming survey carried out at the disposal sites, 460 tons/day of non-hazardous ISW is being disposed of in the landfill sites. Since ISW is expected to be directly hauled to the disposal site even in the future, the ISW amount to be disposed of in the landfill site in 2010 is estimated at 860 tons per day.

3.4.4 Waste Stream

Figure 3.4.3 shows the waste flow in Metro Manila in 2010. Five (5) percent of the generated waste will be self-disposed either through open burning or burying in the backyard; 10% shall be composted (kitchen waste) or recycled (bottles, cans, paper, plastics, etc.) by NGOs and other recyclers. The rest will be discharged for collection. However, about 9% of the waste will not be collected due to poor access, spatial

restrictions, etc.

By year 2010, the amount of waste collected is forecast to reach 8,300 tons/day. With the establishment of combined technology, e.g. transfer station for efficient collection, intermediate treatment facilities for waste reduction and resource-recovery, suited to the conditions of Metro Manila, these wastes can be disposed of in a landfill. On the other hand, the amount of non-hazardous industrial waste to be disposed in the future is estimated at 860 tons/day.



Source: worked out by the JICA Study Team

Figure 3.4.3 Waste Stream in 2010

3.5 Physical Framework

3.5.1 Land Requirement

The accumulated disposal amount of Metro Manila waste is estimated at 30 million tons from 1997 to 2010 and 66 million tons to 2020 assuming that a volume reduction of waste by incineration will not be introduced. These amounts are equivalent to 21.5 million cum and 47 million cum. A large tract of land is required to dispose of such a huge amount of wastes. Assuming that the landfill height is 20 m, the disposal area needed is 135 ha by 2010, and 300 ha by 2020.

According to the "Criteria for the Selection of a Potential Sanitary Landfill", a potential site must meet anticipated needs for a period of 10 to 20 years. Therefore, the candidate disposal sites being more than 100 ha.

3.5.2 Candidate Disposal Sites

The list of candidate disposal sites was drawn up according to information provided by the

MMDA, DENR-EMB, PNR, etc., and shown in Table 3.5.1.

Table 3.5.1 Candidate Disposal Sites

Candidate Sites	Area (ha)	Information Source
a. MEFCON**	365	DENR-EMB
b. Maragondon	100	MMDA, NEDA
c. Kalawakan, Bulacan	1000	DENR, Malolos
d. Bacolor, Pampanga	300 or more	DENR, Region III
e. Sea Landfill		PEA, etc.

** Marikina Environment Forest Conservation Project

These sites were assessed in terms of topography and accessibility, using field surveys and aerial observation results.

(a) MEFCON (Pintong Bocaue), Rizal

Pintong Bocaue is located within the Marikina watershed, about 36km east of Manila City, and 3km north of the existing San Mateo disposal site. The DENR proposes the use of this site in the future as an extension of the San Mateo disposal site. The site has already completely undergone topographic leveling and geologic surveys needed to acquire an Environmental Compliance Certificate (ECC). Of the candidate sites, Pintong Bocaue is the one highly preferred.

Experience of existing disposal sites indicates no difficulty in accessing this site with a 10-wheel dump truck. If a transfer station is to be considered for effective haulage services, a 3.6km section of the existing access road should be improved, otherwise it will be difficult for trailer trucks to access the site due to the steepness of the grade.

For the realization of the Marikina Environment Forest Conservation Project (MEFCON), an extensive site use plan will be formulated for the existing San Mateo disposal site, the proposed Pintong Bocaue landfill site on the left bank of the Marikina River and the adjacent three areas that can be reclaimed in the future. This conservation project entails the development of public space for the residents of the area and Metro Manila, by conserving the natural environment in the watershed of Marikina River.

A water quality monitoring system, as well as other relevant systems, will be established along the Marikina River to have an extensive and effective control of leachate seepage from the proposed sanitary landfill site within the project area. This project aims to establish a harmonious relationship between man and nature. The reclaimable sites within the project area are shown in Table 3.5.2.

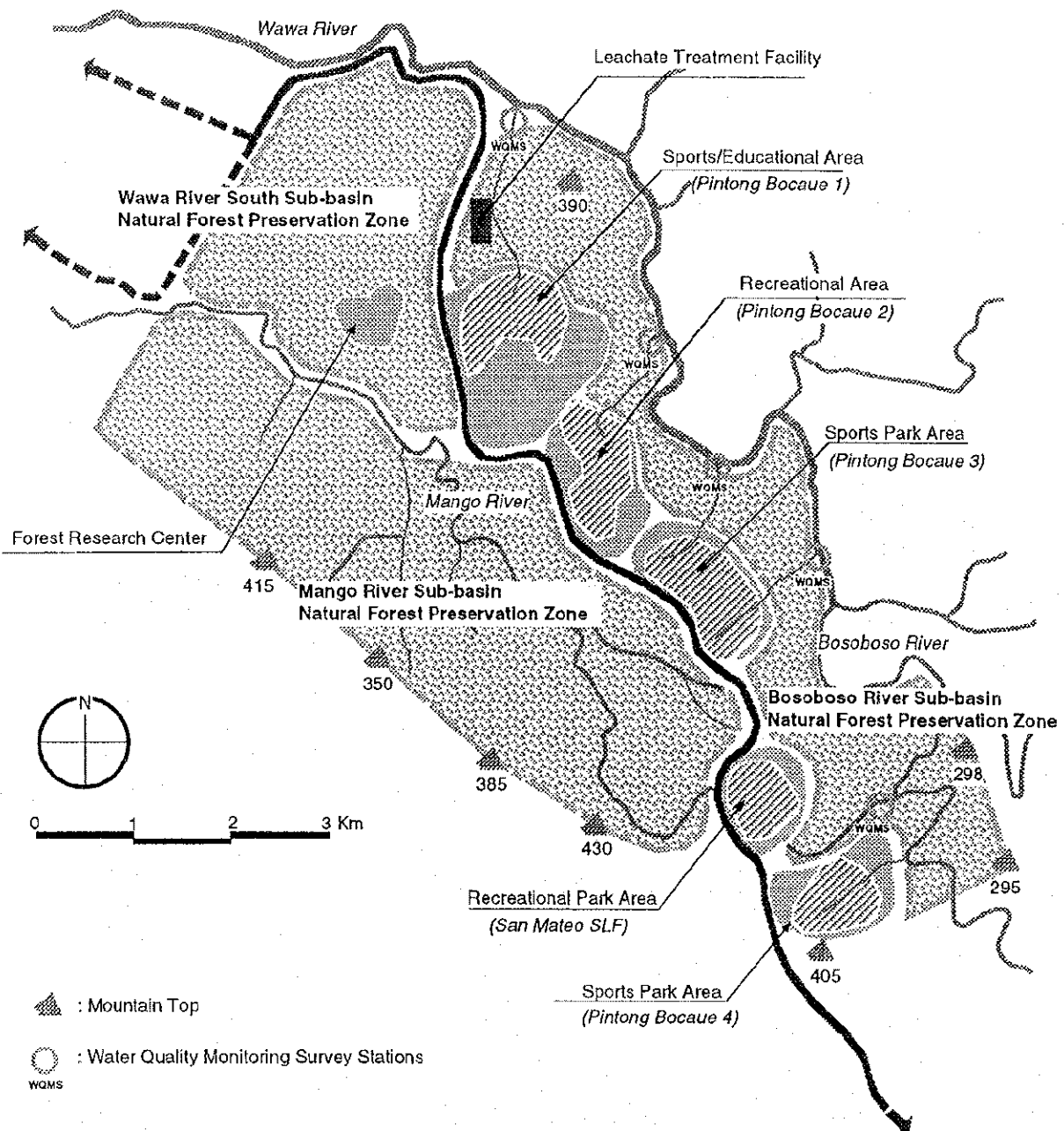


Figure 3.5.1 A Land Use Concept of Marikina Environmental Forest Conservation Project (MEFCON Project)

Table 3.5.2 Potential Landfill Sites in MEFCON Project Area

Site for Reclamation	Area (ha)	Capacity (million m ³)
Pintong Bocaue 1	91.8	10.8
Pintong Bocaue 2(parcel B)	95.9	13.7
Pintong Bocaue 3	65.1	9.1
Pintong Bocaue 4	38.6	9.4
San Mateo	73.6	9.5*

* Remaining capacity of existing disposal sites (if improved)

(b) Maragondon, Cavite

Maragondon is located along the seacoast in the southwest part of Cavite, about 60km from Manila. The candidate disposal site is in a mountainous section 10km south of the town. To access this site, a new road (8km) leading to the site will be constructed connecting to the existing road. The operation of this site would incur high transportation costs due to its distance from the metropolis. And considering that it is limited to 100ha, it will have a short life span. Without an intermediate treatment facility for a large-scale waste volume reduction, this candidate disposal site can only be used for a short period of 5 years. Accordingly, the money invested on infrastructure improvement, e.g. road construction, would not be recoverable.

(c) Kalawakan, Bulacan

This site is a vast tract of land within the mountainous region northeast of the metropolis and, therefore, can be used for a long time. For access, an existing two-way paved road should be extended a further 10km all the way to the site. This candidate disposal site is about 90km from Manila. As it is located within a nature reserve, necessary procedures should be taken to gain permission for development. Incorporating the development of this candidate site into the long-term plan is advantageous.

(d) Bacolor, Pampanga

This candidate disposal site is at the foot of Pinatubo Volcano, about 80km north-northwest of Manila. The disposal site shall be developed on the land on the riverside of the mega-dike to prevent lahar mudflows resulting from volcanic deposits. Access is not difficult due to the existence of a well-paved road that connects the site to the metropolis. This candidate disposal site will also have sufficient storage capacity.

Although mudflow volume has decreased, discharge is intermittent. Hence, as a disposal site, development should commence only after the flow is controlled. As in Kalawakan, the incorporation of the development of this candidate site into the long-term plan is appropriate.

(e) Seashore Landfill

Seashore landfill is one of the best-conceived options for final disposal, what with the accompanying difficulties in acquiring a suitable land in inland areas within the jurisdiction of Metro Manila. However, the development of a seashore landfill site is, in general, of low-cost performance, or hardly feasible, because of the sizeable investment cost required for the construction of embankment, taking into account sufficient environmental measures. In order to seek a more cost-effective use of a seashore landfill, a waste reduction process through incineration is desirable.

Table 3.5.3 shows a model comparison in unit cost among technical alternatives for waste disposal under several premises. As indicated in the table, the most economical way is, of course, "inland landfill without any incinerating process," or sanitary landfill, which has a unit cost of 590 pesos/ton. However, "with incineration" added to inland landfill, the unit cost goes up to be 1,300 pesos/ton.

On the other hand, a "seashore landfill without any incineration" has an estimated cost of 2,150 pesos/ton, which is 3.6 times as much as that in the inland landfill. However, it should be noted here that the "seashore landfill with incineration" would have a unit cost of approximately 2,000 pesos/ton, which is slightly less than that of "without incineration." This is derived from a mechanism whereby the cost for constructing the embankment may be lowered through waste reduction by an incineration plant, thereby offsetting the additional cost of incineration.

In addition to the above economic reason, taking into account the life span of landfill site, it is recommended that the option of seashore landfill needs to be concomitant with substantial waste re-education project(s).

Table 3.5.3 Comparison of Waste Disposal Expenses

Landfill Type	W/o Incineration	W/ Incineration
Inland Landfill	590 pesos/ton	1,300 pesos/ton
Seashore Landfill	2,150 pesos/ton	2,000 pesos/ton

Note: The above values, including initial investment and O&M costs are estimated based on the following assumptions:

- Annual disposal amount: 1.0 million cum (raw waste)
- Project life: 15 years
- Volume reduction rate by incineration: 15%
- "Without incineration" means all the raw waste is disposed of via the landfill site.
- Unit costs are obtained using the following formula:
$$\frac{(\text{Initial investment} + \text{O\&M cost})}{\text{Accumulated waste amount given by raw waste amount}}$$

As for the possible locations of a seashore landfill site, it has been tentatively identified through discussions with the Philippine Estates Authority (PEA) and the Philippines Ports Authority (PPA) that only the northern or southern sections of

Manila Bay are reclaimable, taking into account existing navigation routes and a number of on-going/future reclamation projects.

There is presently a plan, the "Boulevard 2000 Integrated Framework Plan," to reclaim the southeastern shore of Cavite all the way to Las Piñas and Bacoar. There are concerns that this plan could conflict with this seashore sanitary landfill program. In the northeastern section, there is a plan to develop the offshore area of the municipality of Navotas into the "North Bay Business Park. This area will be bounded by the Navotas fishport to the south and the Navotas and Tangos rivers to the north. It is possible to develop the northern part of the planned reclamation area or the offshore area into a seashore landfill site, however, further study is necessary to verify the most suitable location.

3.5.3 Evaluation of Candidate Disposal Sites

From the above evaluation and for the investigation of technical alternatives, Pintong Bocaue site was selected for the development of an inland sanitary landfill site. Accordingly, the technical alternatives will be formulated assuming the development of the Navotas offshore area into a seashore landfill site.

Table 3.5.4 Evaluation of Candidate Disposal Sites

Candidate Sites	Rank
(a) Pintong Bocaue	1
(b) Maragondon	3
(c) Kalawakan, Bulacan	2
(d) Bacolor, Pampanga	4
(e) Sea Landfill	1