

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

The Study on the Solid Waste Management
Improvement for
Surabaya City

The Republic of Indonesia

FINAL REPORT

Volume 1

MAIN REPORT

May 1993

Pacific Consultants International
EX Corporation

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The Study on the Solid Waste Management
Improvement for Surabaya City
FINAL REPORT Volume 1
MAIN REPORT May 1993

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in

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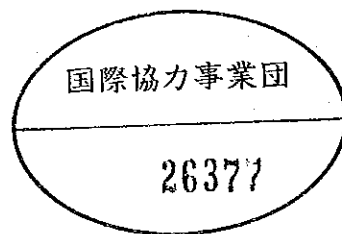
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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Master Plan Study and Feasibility Study on Solid Waste Management Improvement for Surabaya City and entrusted the study to the Japan International Cooperation Agency (JICA).

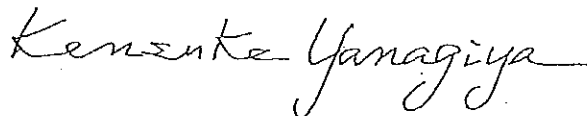
JICA sent to Indonesia a study team headed by Mr. Kihachiro Urushibata, Pacific Consultants International (PCI), and composed of members from PCI and EX Corporation, three times between February 1992 and February 1993.

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

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

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

May, 1993



Kensuke YANAGIYA

President

Japan International Cooperation Agency

**STUDY ON THE SOLID WASTE
MANAGEMENT IMPROVEMENT FOR SURABAYA CITY**

Mr. Kensuke YANAGIYA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

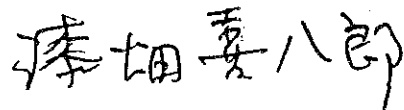
We are pleased to submit to you the final report entitled "THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY". This report has been prepared by the Study Team in accordance with the contract signed on 17 January 1992 and 1 October 1992 between the Japan International Cooperation Agency and Pacific Consultants International.

The report examines the existing conditions of solid waste management in Surabaya, and presents a master plan for its improvement and the results of a feasibility study on the priority projects selected through the master plan.

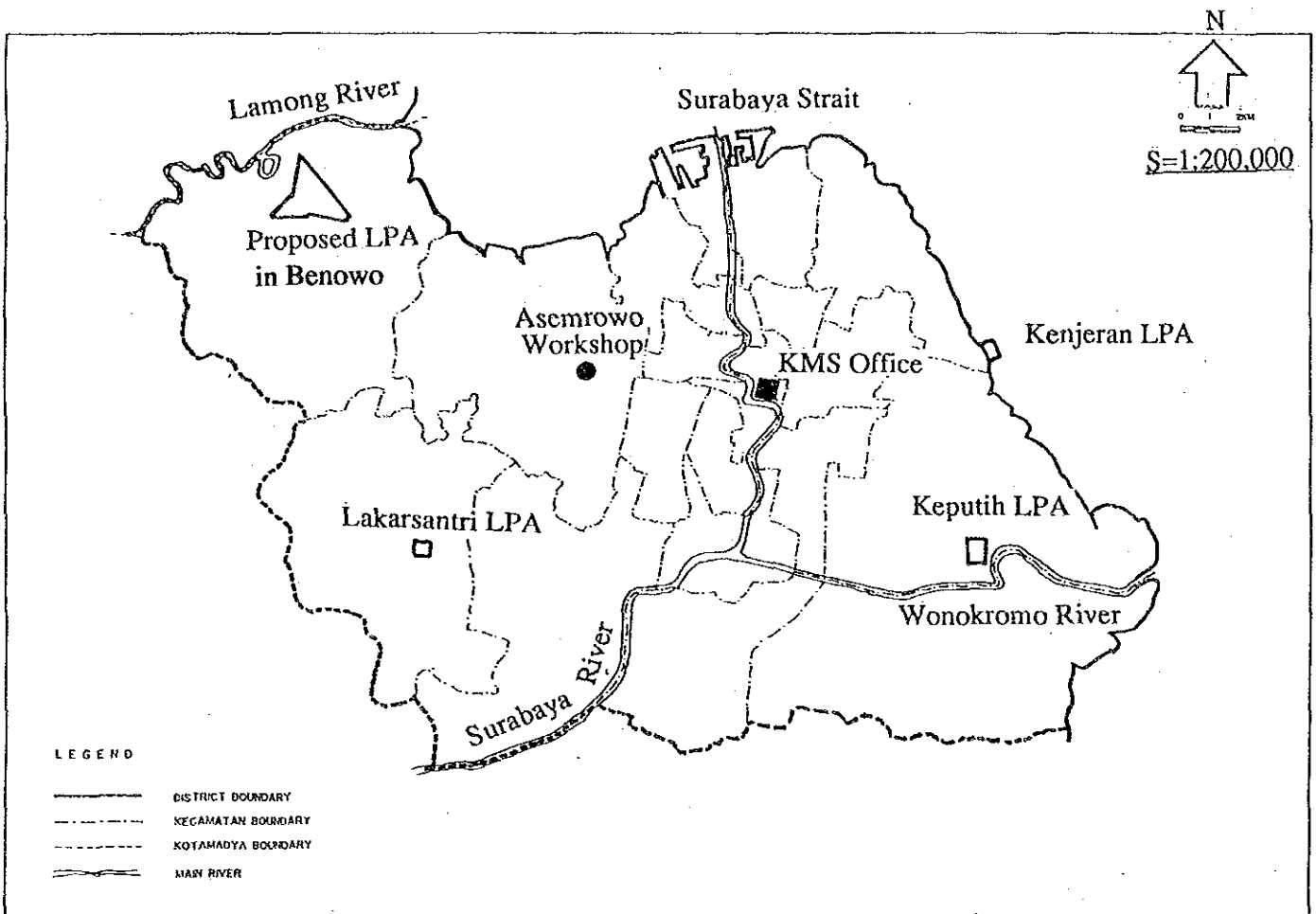
The report consists of the Summary, Main Report, Supporting Reports, Data Book and Drawings. The Summary summarizes the results of all studies. The Main Report contains background conditions, overall sanitation and solid waste management plan, urgent improvement project, conclusions and recommendations. The Supporting Reports include technical details.

All the members of the Study Team wish to express grateful acknowledgments to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Health and Welfare, and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistances extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the socio-economic development and the improvement of health and Environmental Sanitation in Surabaya.

Yours faithfully,



Kihachiro URUSHIBATA
Team Leader



Location of SWM Facilities in Surabaya

KMS: Municipal Government of Surabaya

LPA: Final Disposal Site

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Abbreviations & English Translations

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1. ADIPURA : Noble City Award, an award presented by the Central Government to the local government for their efforts in sustainable improvement of the overall urban environmental quality.
2. AMDAL : Environmental Impact Assessment System.
3. ANDAL : Environmental Impact Analysis.
4. BAPEDAL : Environmental Impact Control agency.
5. BAPPEDA : Local Development Planning Agency.
6. BAPPENAS : National Development Planning Agency.
7. Bina Marga : Directorate General of Highways, a name of a directorate general under the Ministry of Public Works.
8. Biro KLH : Provincial Bureau of KLH.
9. BPPT : Technology Study and Application Agency.
10. Cabang : Branch office for sanitary management at District Level.
11. Camat : Chief of District.
12. Cipta Karya : Directorate General of Human Settlements, a directorate general under the Ministry of Public Works.
13. CBD : Central Business District.
14. Depo : Waste transfer station with an administrative office.
15. Dinas Kebersihan : Cleansing Department.
16. Dinas Marga : Road Department.
17. IUIDP : Integrated Urban Infrastructure Development Project.
18. JATIM : East Jawa Province.
19. JKT : Jakarta.
20. KA ANDAL : Terms of Reference of ANDAL.
21. Kampung : Unplanned low-income residential area naturally originated from villages and inhabited by people migrated from rural areas.
22. Kecamatan : District, an administrative area.
23. Kelurahan : Sub-District, an administrative area.
24. KLH : Ministry of Population and Environment.
25. KMS : Surabaya Municipality; Surabaya Municipal Government.
26. LPA : Final Disposal Site.
27. LPS : open-dumping waste transfer station without administration office (literally means temporary disposal site).
28. Lurah : Chief of Sub-District.
29. MCK : Public facilities for taking shower, washing, and toilet.

30. Pasar : Traditional market.
31. Pasukan Kuning : "Yellow Troop" (waste collection workers and street sweepers).
32. PDAM : Water Supply Municipal Company.
33. PEL : Preliminary Environmental Evaluation Report.
34. Perda : Municipal Regulation.
35. PIL : Preliminary Environmental Information Report.
36. PLN : State Electric Company
37. Rayon : Working area of each Assistant to the Mayor.
38. RT : Neighbourhood Unit.
39. RW : Community Unit.
40. SBY : Surabaya.
41. SEL : Environmental Evaluation Study.
42. SMA : Surabaya Metropolitan Area.
43. SUDP : Surabaya Urban Development Plan.
44. SWM : Solid Waste Management.

PART 1.

***BACKGROUND AND
EXISTING SOLID
WASTE MANAGEMENT
CONDITIONS IN
SURABAYA***

PART 1. BACKGROUND AND EXISTING SOLID WASTE MANAGEMENT CONDITIONS IN SURABAYA

Chapter 1. Introduction

1.1 Background

The City of Surabaya (KMS) has made remarkable improvements on solid waste management (SWM) over the past decade through the implementation of the Solid Waste Improvement Program (SWIP) which was a component of the City Development Project III (named Urban III), and the second SWIP in the Urban V during 1984/85-1987/88. KMS plans to make further improvements on SWM through the implementation of the Surabaya Urban Development Program (SUDP) during 1993/94-1998/99

Under the above-described situation, the Ministry of Public Works, the Republic of Indonesia requested the Government of Japan to conduct a study on the solid waste management improvement for Surabaya. The current study has been executed based upon the Scope of Work for the Study, and the Minutes of Meeting signed by both Cipta Karya, the Ministry of Public Works, and JICA on 19th March 1991. The Scope of Work and the Minutes of the Meeting are attached as Appendix 1 to this report.

1.2 Purpose of the Study

The purposes of the current study are as follows:

1. Formulation of a Master Plan for the improvement of solid waste management in Surabaya for the period 1993 - 2010. (Shown in Part 2 of this report)
2. Feasibility study of priority project (identified in the Master Plan) which are to be implemented during the SUDP implementation period 1993/94 -1998/99. (Shown in Part 3 of this report)

1.3 Surabaya Urban Development Projects (SUDP) and the Current Study

It is intended that the second component (results of the Feasibility Study) will be used as the Solid Waste Management sector plan of the SUDP.

The purpose of the SUDP is both to improve the physical infrastructures, and to strengthen the financial and institutional capability of KMS. (The former component for the improvement of physical infrastructures is referred to as the Integrated Urban Infrastructure Improvement Development Project - IUIDP, while the latter component is referred to as Non - IUIDP.)

The IUIDP component consists of the six sectors : drainage, water supply, roads, Kampung Improvement Program (KIP), human waste and solid waste. The total project cost is estimated at Rp 868 billion.

<u>IUIDP Project Components</u>	<u>% of Component Cost</u>
a. Drainage	: 31%
b. Water Supply	: 30%
c. Roads	: 28%
d. KIP	: 5%
e. Human Waste	: 4%
f. Solid Waste	: 2%
g. Total	: 100%

The SUDP will be financed by the following institutions :

- The World Bank (IBRD)
- A Bi-lateral Assistance Organization
- Central Government of Indonesia
- The City of Surabaya (KMS)

At national level, Cipta Karya is responsible for the execution of the SUDP, while at KMS level, the Urban Management Unit chaired by BAPPEDA will be responsible for the coordination and implementation of the SUDP.

SUDP Solid Waste Management Sector Report was prepared by P.T. Indulexco in association with Mott MacDonald International and P.T. Persada Adhi Cipta.

The report contains useful recommendations and plans. The SUDP Solid Waste Management Sector Plan was fully reviewed by the JICA Study Team. As a result, the Study Team utilized all parts of the plan that do not need further modifications. However, the Study Team made additions and modifications to the plan wherever necessary to strengthen the spirit of the original plan. Major addition and modifications in the feasibility studies are shown below.

- Major Additions:
1. Construction of the sanitary landfill site (LPA) in Benowo (west part of Surabaya).
 2. Improvement of Asemrowo Workshop

Major Modifications: Types of waste haulage trucks (as shown in the table below.)

	Equipment Recommended by the JICA Study Team	Equipment Recommended in the Original SUDP SWM Plan
1. For haulage of waste from Depo/LPS	a. 14 m ³ containers & Arm-roll trucks of 14 GVW chassis with single rear axle, and b. 8 m ³ containers & Arm-roll trucks of 7 GVW chassis with single rear axle GVW: Gross Vehicle Weight	a. 16 m ³ containers & Arm-roll trucks with 10 GVW chassis uprated from 7 GVW by adding an additional rear axle.
2. For haulage of waste from small containers placed on roadsides	No procurement. (KMS will use contractors for hauling this type of waste.)	Front End Loader (FEL) Compactor trucks with 17 m ³ capacity and 10 GVW chassis uprated from 7 GVW by adding an additional rear axle.

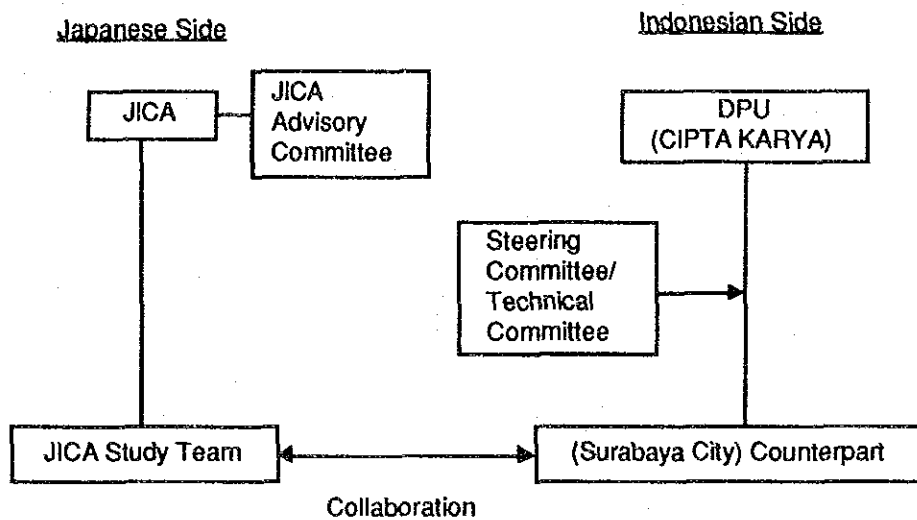
1.4 Previous Studies

There have been numerous studies conducted, by consultants and the governmental agencies, with respect to the solid waste management in Surabaya and Indonesia. Cipta Karya has issued several guidelines and policies regarding solid waste management. The Study Team has carefully studied those guidelines and reports to prepare an appropriate Master Plan.

1.5 Organization of the Study

The Study has been jointly executed by both the JICA Study Team and the Indonesian Counterparts in close consultation with the Steering and Technical Committees as well as the JICA Advisory Committee under the organization shown below. Members of these committees and Indonesian Counterparts as well as the Study Team are shown in Appendix 3.

Organization of the Study



1.6 Reports

The Study reports consist of the following reports:

- Volume 1. Main Report
- Volume 2. Summary
- Volume 3. Supporting Report 1 for Master Plan
- Volume 4. Supporting Report 2 for Feasibility Study
- Volume 5. Data Book
- Volume 6. Drawings

Chapter 2. Outline of Surabaya

2.1 General Description

Surabaya is known as the oldest living city in Indonesia. It was established in the year 1293 A.D. In modern time, it is also known as the City of Heroes. The term "Surabaya" derived from two terms, i.e. "sura" (which means "courage") and "baya" (which means "danger"). This indicates the perception of its people in the era of development. 'Danger' refers to problems of development and "courage" means never having to say impossible. It is said the people of Surabaya is always ready to take active part to make the city better and better.

Surabaya, the second largest city in Indonesia after Jakarta, is a capital city of East Java Province. Due to the rapid development progress of the city, Surabaya is somehow making strong influence upon the growth of its surrounding areas so that it forms a greater area known as GERBANGKERTOSUSILA, which consists of seven local authorities, i.e. GEResik, BANGkalan, MojoKERTO, SURabaya, SIDoarjo, and LAMongan. Among these seven cities, only Surabaya and Mojokerto are municipal cities, while the others are regency capital cities. In East Java Province, there are altogether 8 Municipalities and 29 Regencies.

In the aspect of sanitary management in Surabaya Municipality, before 1982 it was the responsibility of Municipal Public Work Department. Due to the rapid population growth, and based on a municipal regulation, i.e. Surabaya Municipal Regulation No.4/1980, a Municipal Cleansing Department was established in September 1982 in order to handle the sanitary management more freely, and to provide better services to the people.

The Central Government created a Noble City Award [the so-called ADIPURA] in 1985 in order to stimulate efforts in sustainable improvement of the overall urban environmental quality throughout Indonesia. Surabaya was the first city that received the Award. So far, Surabaya has received the Award five times. These achievements were made due to not only the efforts taken by the Municipal Cleansing Department, but also the active participation of all the citizens, irrespective of their economic and social status, creed or ethnic origin. Indeed, such participation reflects the principle that the sanitary management is a mutual responsibility of both the Surabaya Municipal Government and the people.

2.2 Natural Conditions

1) Climate

Surabaya belongs to an area of tropical climate. Generally speaking, the climate of Surabaya can be divided into two antipode seasons by the amount of rainfall as follows:

- dry season : from May to October

- wet season : from November to April

(the wettest period is normally December and January)

From November to February, the northern monsoon gives rise to heavy rain during wet season. The southeast tradewinds carry a slightly cooler air from the Australian Continent in dry season.

Climatological data between 1982 and 1991 at Perak I weather station is shown in Table 1.2-1 and Fig.1.2-1. This summary shows an apparent nature of the climate that there are very small fluctuations in both temperature and humidity whereas the rainfall changes remarkably by month.

Annual mean temperature is about 28 °C. The highest monthly mean temperature is 34 °C in April, and the lowest monthly mean temperature is 21 °C in August. The monthly mean humidity during rainy season is over 80 %, and the lowest value of 66 % appears in September and October.

The mean annual rainfall from 1982 to 1991 is 1,567 mm. The maximum mean monthly rainfall is over 300 mm in January, and the minimum 5 mm in August.

On the other hand, Evaporation intensity does not change so severely as the intensity of rainfall, and it exceeds the rainfall during dry season and consequently it also exceeds in annual total.

Table 1.2-1 Climatological Data in Surabaya, 1982-1991

Station : Perak I

	Temperature			Humidity	Rainfall	Rainy days	Evaporation	Average wind speed
	Ave.	Max.	Min.					
				%	mm	days	mm	knot
January	27.1	33.1	22.6	83	336	22.7	133	3.7
February	27.0	32.7	22.5	84	266	21.3	117	3.7
March	27.4	33.5	22.7	83	265	18.3	136	4.3
April	27.9	33.9	23.2	81	156	15.3	129	3.9
May	28.0	33.5	22.6	79	86	10.1	136	3.8
June	27.4	32.9	21.4	77	56	7.2	131	4.2
July	26.9	32.6	20.9	75	15	3.3	152	4.4
August	27.0	33.7	20.6	70	5	1.6	176	4.5
September	28.0	35.4	21.6	66	18	1.8	194	4.6
October	28.9	36.0	22.6	66	35	4.8	205	5.3
November	28.8	36.0	22.8	71	101	12.3	170	4.4
December	27.7	34.4	22.4	79	228	20.2	135	4.9
Year	27.7	34.0	22.2	76	1,567	11.6	1,814	4.3

Source : Meteorology & Geophysical Department

- Note
1. Sunshine duration ratio : 8 hr (8:00-16:00) = 100%
 2. Average wind speed : 1 knot = 1.8 km/h = 0.5 m/s
 3. Year : Rainfall and Evaporation are given a total

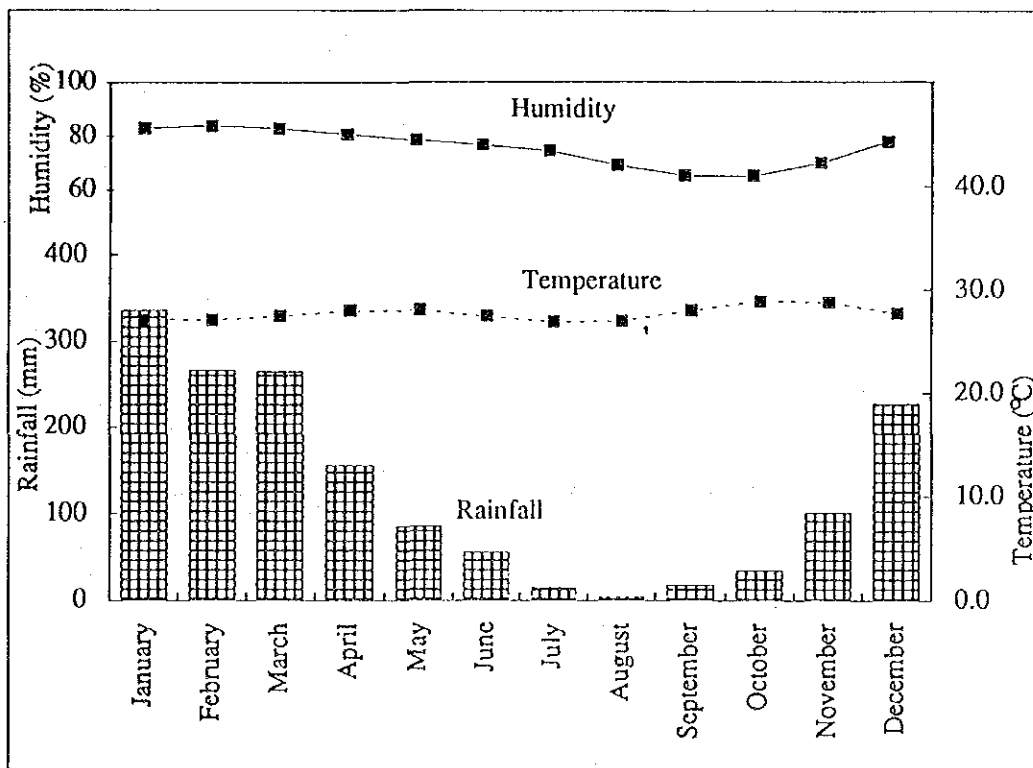


FIG 1.2-1 ANNUAL CLIMATICAL DATA

2) Topography

Surabaya is divided into two topographic areas: lower plain area and rolling hill area. Suburb and coastal area, which are included in the lower plain, have tidal influence and are used for fish and salt ponds. The rolling hill area is located in the southwest of Surabaya.

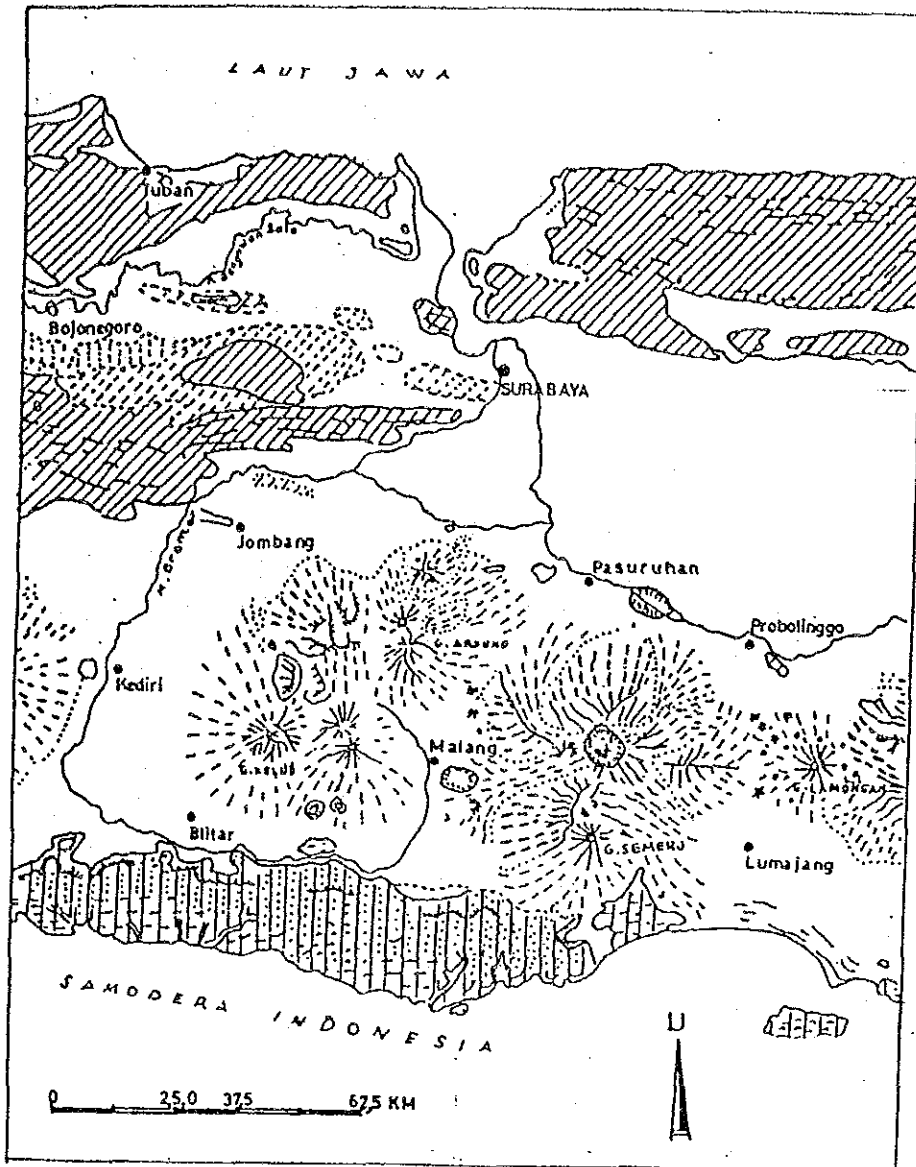
The alluvium derived from the Surabaya River forms a very large plain with little difference in elevation. The area is not higher than 4 m above the sea level and covers most of the eastern and northern areas. The tongue shaped terrace is located in the western part of Surabaya. This hilly area leads to the west direction and has a mild slope with the maximum altitude of about 50 m.

3) Geology









East Jawa is divided into three geologic typical zones as follows:

- the Southern Plateau Zone
- the Central Volcanic Depression
- Folded Zone

The northern part of Jawa is as a continuation of Kendeng Ridge getting lower to the east. Kendeng Ridge is also going deeper and then down and covered with young sediment in Brantas Land. Some of anticlines covered with sediment in several places seem to stick out, it is shown that the anticlines are going continuously flat. Brantas Land delta particularly contained thin young sediment layers which are probably from marine sediment. Some of them consist of young black clays and is estimated by 1.8 m below the sea level. Therefore, it is clear that Brantas delta is a part of subsidence zone where the sedimentation can balance the drowning level. Geological map in East Jawa and conditions of sedimentation in Surabaya are shown in Fig. 1.2-2.



LEGEND

-  Folded zone
-  Folded zone very low
-  Folded zone highest ridges
-  Folded zone with ridges determined by structure
-  Southern plateau zone
-  Southern plateau zone very low
-  Southern plateau zone strongly dissected
-  Flat plateaus divided into Lower (left) and upper level (right)















-  Alluvial plains
-  Conical mounds
-  Escarpments
-  Northern escarpment of southern zone
-  Narrow valleys transverse valleys
-  Youngest volcanoes
-  Volcanoes of medium age
-  Old volcanoes
-  Craters small volcanic cones
-  Vecks
-  Foot of volcano fluvio volcanic
-  Foot of volcano fluvio volcanic dissected
-  Alluvial fans extensive terrace deposits
-  Old shore bars and dunes

Fig. 1.2-2

CONDITION OF GEOLOGY IN JAWA TIMUR

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

4) Surface Water

Surabaya has two principal rivers, River Brantas and River Lamong. The Brantas (Surabaya) River streams from south to north in the center of Surabaya and its main stream and its tributary covers most part of Surabaya except north-western part. And, there are some channels connected to River Brantas. These channel accept waste water from urban life and is stagnated so the water quality is deteriorated. River Lamong is located on the west boundary of Surabaya and has numerous tributaries that covers northwestern part of coastal plain.

There are two water intakes for water supply by PDAM on the Brantas River, however, the surface water is used for agriculture, bathing, washing and fishing except drinking.

5) Ground Water

According to the Report of "Working Implementation of Instruction Study on Sea water and Back water in Surabaya, 1988", the ground water level is not so deep in Surabaya. It is around 2-3 m under the ground level.

The remarkable nature of the ground water quality is its salinity. Because of this nature, it is not suitable for drinking or agricultural use.

2.3 Population

2.3.1 Present Population

The population of Surabaya was 2,473,272 in 1990 according to the census. The characteristics of the population of Surabaya may be summarized as follows:

1. About 60 % of the population live in the central part of Surabaya (consisting of 11 Kecamatan), while the remaining 40 % live in the outskirts (8 Kecamatan).
2. The population has been increasing with an average increment of about 48,000 persons/year during the past 20 years since 1971. Consequently, the rates of annual growth have been declining. The average annual growth rate was 2.84 %/year during the period 1971 - 1980. It dropped to 2.06 %/year during the next decade 1980 - 1990.
3. The population growth in the central part of Surabaya was negative (- 0.32 %/year) during the period 1980 - 1990, while the corresponding rate of the outskirts (such as Surabaya West and East) was 7.54 %/year during the same period, leading to the average growth rate of the whole Surabaya being 2.06 %/year.
4. It is said that about 10 % of the population is non-registered.

2.3.2 Future Population

The future population of Surabaya is estimated to be approximately 2.9 million in 2000, and 3.4 million in 2010 as shown in the table below.

During the past 20 years, the population of Surabaya has increased linearly with annual incremental population being more or less constant, instead of having grown exponentially with a constant annual growth rate.

It is, therefore, considered reasonable to assume that the future population will increase linearly rather than exponentially. It is projected that the population of Surabaya will increase by 45,500 persons annually judging from the fact that the past incremental population was 45,575 persons/year on average during the period 1980 -1990.

With the application of the linear model, the average annual growth rates will be 1.70% between 1990 - 2000 and 1.45% between 2000 - 2010.

Table 1.2-2 Projection of the Future Population of Surabaya 1990-2010

Year	Population	Year	population	Year	population	Year	Population
1990	2,473,272						
1991	2,518,772	1996	2,746,272	2001	2,973,772	2006	3,201,272
1992	2,564,272	1997	2,791,772	2002	3,019,272	2007	3,246,772
1993	2,609,772	1998	2,837,272	2003	3,064,772	2008	3,292,272
1994	2,655,272	1999	2,882,772	2004	3,110,272	2009	3,337,772
1995	2,700,772	2000	2,928,272	2005	3,155,772	2010	3,383,272

Population Projection by 5 Rayons

The population of each Rayon is estimated as shown in the table below by distributing the projected population of the whole Surabaya into 5 Rayons.

Table 1.2-3 Projection of the Future Population by Rayon

Rayon	Population in 1990	Annual Average Increment 1990-2000	Population in 2000	Annual Average Increment 2000-2010	Population in 2010
Surabaya Center	399,000	-2,800	371,000	0	371,000
Surabaya North	459,000	2,700	486,000	2,500	511,000
Surabaya East	665,000	21,200	877,000	20,100	1,078,000
Surabaya South	661,000	10,900	770,000	10,200	872,000
Surabaya West	289,000	13,500	424,000	12,700	551,000
Total	2,473,000	45,500	2,928,000	45,500	3,383,000

2.4 Economic Activity

The economy of Surabaya has been growing rapidly. During the past 5 years from 1985 to 1990, real GDP of Surabaya has increased by 57%, or 9.5% increase on annual base. In term of GDP per capita, the corresponding growth percentages are 41% and 7% respectively during the same period. In 1990, GDP per capita was Rp 1,677,410/year, while the income per capita was Rp 1,367,090/year.

Table 1.2-4 Gross Domestic Product (GDP) in Surabaya 1985-1990

Unit: Billion Rupiahs

Year	Nominal GDP	Real GDP [base-year 1985]
1985	1,948	1,948 (100%)
1986	2,098	2,008 (103%)
1987	2,444	2,201 (113%)
1988	2,896	2,484 (128%)
1989	3,499	2,798 (144%)
1990	4,122	3,062 (157%)

Source: Processed from *Pendapatan Regional Kotamadya Surabaya 1985-1990*

Table 1.2-5 GDP Per Capita in Surabaya 1985-1990

Unit: Thousand thousand Rupiahs

Year	Nominal GDP Per Capita	Real GDP Per Capita [base-year 1985]
1985	877.73	877.73 (100%)
1986	926.27	879.59 (102%)
1987	1,057.18	944.74 (108%)
1988	1,227.46	1,044.61 (119%)
1989	1,453.15	1,152.71 (131%)
1990	1,677.41	1,236.39 (141%)

Source: Processed from *Pendapatan Regional Kotamadya Surabaya 1985-1990*

Surabaya is a commercial city. As shown in the table below, service industries such as trade, hotel, restaurant, banking, transportation, communication, etc. shared as much as 69.5% of the GDP of Surabaya in 1989, while the manufacturing and primary industries shared 29.3% and 1.2% only, respectively.

Table 1.2-6 Gross Regional Domestic Product (GRDP) by Sector based upon 1989 Price

Unit: Million Rupiahs

No.	Sector	1989 (%)	
A	Primary Industries		1.2
	1) Agriculture	1.1	
	2) Mining	0.1	
B	Manufacturing Industries		29.3
	3) Industry & Processing	17.5	
	4) Electricity, Gas & Water Supply	2.8	
	5) Construction	9.0	
C	Service Industries		69.5
	6) Trade, Hotel & Restaurant	20.6	
	7) Transportation & Communication	14.3	
	8) Bank & Financial Institution	16.5	
	9) Services	6.9	
	10) House Rent	5.5	
	11) Governmental & Defense	5.7	
Gross Regional Domestic Product		100.0	100.0

Source: *Surabaya Dalam Angka 1990*

Annual inflation was 8.1 % on average during 1983 - 1990 as shown in the table below.

Table 1.2-7 Inflation Rate in Surabaya 1983-1990

Unit: Percentage/year

Year	Food	Housing	Clothing	Services	General
1983	7.95	12.47	5.48	14.30	12.10
1984	4.89	10.75	4.42	10.58	7.82
1985	2.31	8.45	2.97	3.66	4.53
1986	14.26	3.42	6.28	6.09	8.48
1987	10.68	7.10	14.50	8.05	9.26
1988	9.11	5.23	4.35	3.88	6.46
1989	5.17	10.17	5.55	5.96	6.73
1990	13.60	15.55	6.16	9.92	9.69
Average	8.50	9.14	6.21	7.81	8.13

Source: *Surabaya Dalam Angka 1990*

2.5 Environmental Sanitation

1) Air Quality

There seemed to be no prevailing air pollution reported.

2) Water Quality

In residential area, household waste water is discharged to rivers through open conduits without any treatment, and it brings a lot of organic pollutant to the river. In industrial area, hazardous chemicals and heavy metals may be probably discharged because laws and standards specifying the obligation to build the industrial waste water treatment facilities have not been enforced yet.

A row of floating foam can be seen on the surface of Surabaya River almost once a week, which is suggested to be caused by the excessive concentration of detergent or some other surface active substances.

The ground water in Surabaya is said to be too saline to use it for drinking water, and most people who use the well water limit the purpose of utilization to the miscellaneous use only. The high salinity of groundwater is also recognized in the survey at both Keputih and Lakarsantri by the Study Team.

3) Wild Life

The territory of KMS is already developed by human activity so there are very few areas where the wild life has been preserved as its natural condition. In dry field, most area are utilized as farm land, urban area and other productive land, consequently it is very rare natural forest or secondary forest area are preserved. In wet field, most areas are utilized as fish pond or salt farm, and after reclaiming utilized as a part of urban area except the coastal zone which is covered with mangrove bush.

Most of mangrove bush is included in the designated green area by a long term city plan "Surabaya 2,000". The designation of green area requires a series of specific permission for development, so that the wild life there may be kept the present level better than the other area.

2.6 City Planning

1) Current Land Use

According to the City Planning Department, KMS has an area of approximately 350 km². Organized and unorganized housing area are the dominant land use that occupy 40 % of total area. And the next dominant uses are Swamp/Fish Pond and Dry/Wet Field that occupy 23 % and 26 % respectively. The housing area is distributed on both sides of River Brantas. Swamp/Fish Pond area are along the east coast and the north coast of Surabaya. Dry/Wet Field area distribute in the peripheral part of the City as shown in Fig. 1.2-3.

2) Traffic Conditions

The total length of the road is 830 km in Surabaya, and the asphalt paved roads occupies 78 % of total length, and 63 % of asphalt paved road is maintained in good condition.

The fluctuation pattern of road traffics depends on the operation hours of offices, markets, and commercial areas. The maximum peaks of the most roads (Particularly of the arterials leading to the city center) appear during 7 a.m. to 8 a.m. The next peak appears around 4 to 6 p.m. The worst traffic peak occurs at Saturday midday of the week when both governmental sectors and business sectors finish their daily work at the same time, and the traffics from the both sectors are combined with the shopping traffics. One-way road links generally have only one major peak in a day. The time and the magnitude of the peak depends on the function of the road and the traffic flow direction. The average peak hour traffic is considered to be 8.3 % of daily traffics.

An index to describe the traffic congestion is defined by the rate of actual traffic volume to the capacity of the road: it is called as the congestion ratio. The peak traffic volume at 25 points proved exceeding the congestion ratio of 0.9 that means a critical point over which a traffic jam may happen. Most cases of traffic congestion are caused by parking vehicles, roadside trading, Bus/Bemo stop and U-turn vehicles besides excessive vehicle concentration.

The present intra-city public transport system consists of Damri Buses, Bemos and Becaks. The total passenger trips was counted at 657 thousand per day in

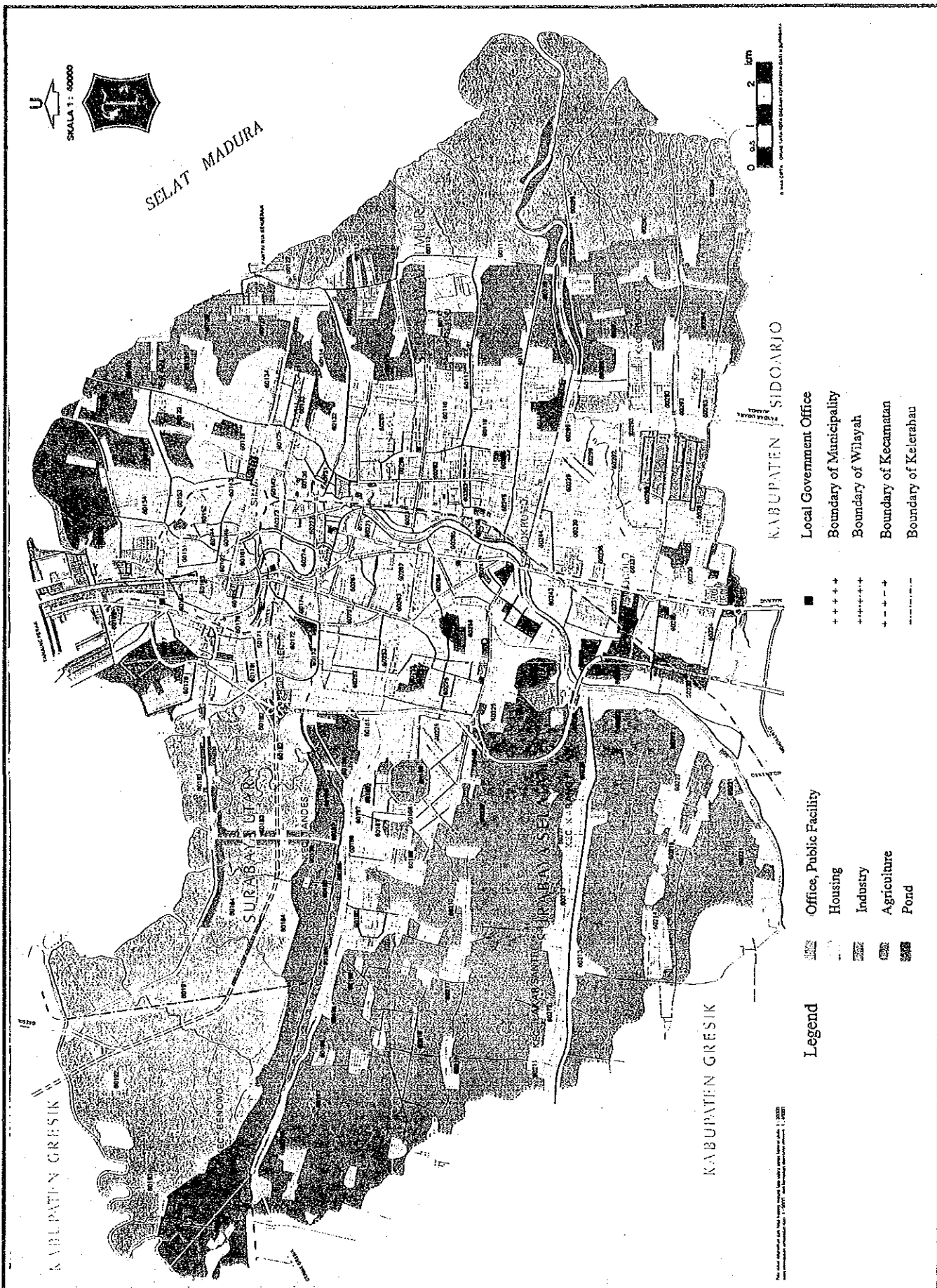


FIG. 1.2-3

CURRENT LAND USE IN SURABAYA

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



FIG. 1.2-3

CURRENT LAND USE IN SURABAYA

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

the city, and it exceeded the number of the average inter-city passenger trips of 528 thousand per day (Bus 520,000 Trips/day + Railway 8,000 trips/day).

Buses are operated by a semi-governmental enterprise, Damri, through north-south trunk lines with many prescribed bus stops.

Bemo operates among 26 fixed terminals which are located in the peripheral area of the city. The routes of Bemo are fixed but no prescribed stations are installed. The Bemo is operated by private companies.

Becaks serve almost all the urbanized area including those area where it is hard to utilize Bus/Bemo system.

3) Land Use Plan

A future land use plan is authorized as a part of the "Master Plan Surabaya 2,000" as shown in Fig. 1.2-4. The principal planning items are explained as follows:

a. Urbanized Area

The urbanized area is mainly expanded in the western part of Surabaya where there still remains the space for development. Consequently the distribution of densely inhabited district will be shifted westward as the result of the Master Plan implementation.

b. Commercial Area and Public Facilities

The commercial area and the public facilities are expected to develop at almost the same location as present.

c. Industrial Area

A new concentrated industrial area is planned in the western coastal area along the proposed Gresik-Surabaya toll road. The area is adjacent to the proposed harbor area which is planned on the north coast from the existing harbor area to the western boundary with Kabupaten Gresik.

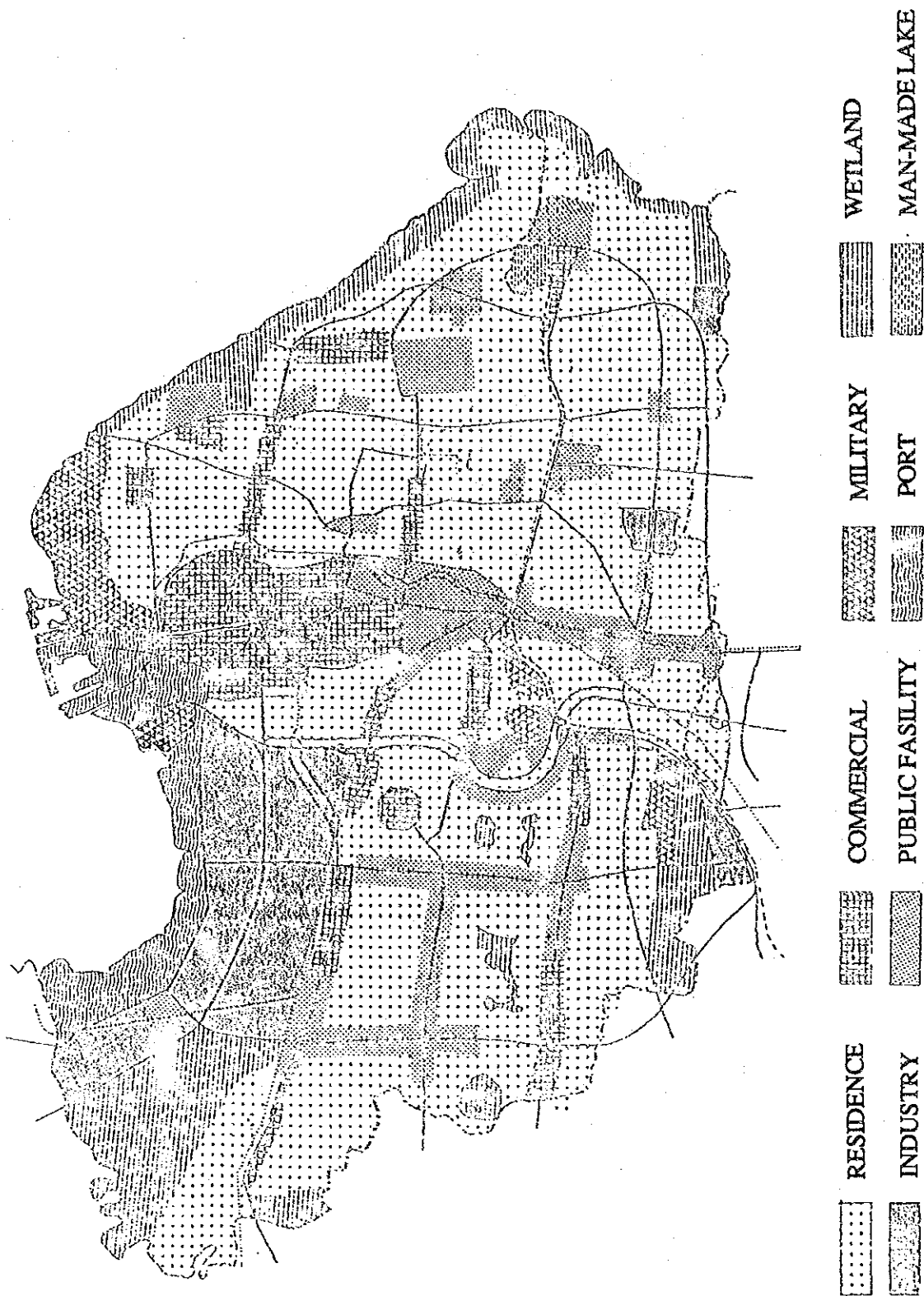


FIG. 1.2-4

FUTURE LAND USE PLAN IN SURABAYA

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

d. Green Area

There are four principal green area planned in the following district:

- Sukolilo and Rungkut (Swampy area along the east coast)
- Benowo (Swampy area along the River Lamong which forms the border between Gresik and Surabaya)
- Karang Pilang and Lakarsantri (Farm land in the hilly area located along the River Rowo)
- karang Pilang South (Farm land in the hilly area along the River Surabaya)

4) Future Road Network

An additional new line of toll road is proposed in the western coastal area to connect the central zone to Gresik.

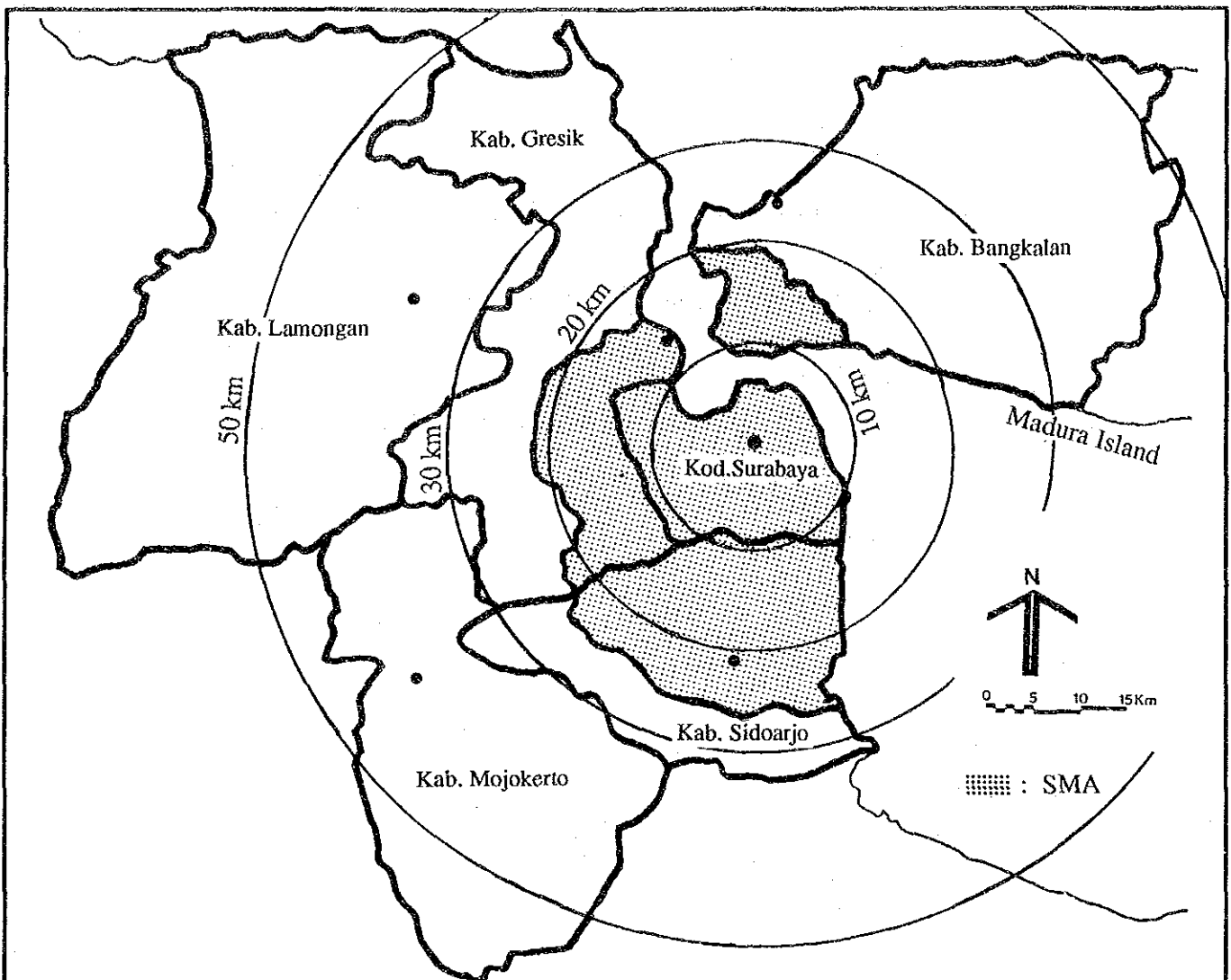
Two (2) primary outer ring roads are also planned in both the west and the east part of the city that is expected to reinforce the north-south traffic axis.

The other roads with lower rank are also planned to be improved based on the study "A Transportation Strategy for Surabaya (1990 - 2000)".

5) Development Plan in Wider Area

There is an urban development plan for Gerbangkertosusila (GKS) region prepared by CIPTA KARYA in 1983. It covers the area within a circle of about 60 km radius with the center placed at Surabaya City. GKS area consists of Surabaya City and five (5) Kabupatens as shown in Fig. 1.2-5. Total population of GKS area is 31 thousand that occupies 22 % of the whole JATIM province. Among GKS area, the central part within a circle of 20 to 30 km in radius was recommended to be the urbanized area which should own a common urban development plan jointly.

The socio-economic frame of the plan was proposed to grow seven (7) % every year up to the year of 2,000. The growth would raise the economic basis of Surabaya Metropolitan Area (SMA) up to the level that enables to accept six (6) million people at 2,000 from the starting level of three (3) million.



Population of GKS Region at Mid 1990

Regency or Municipality	Area (km ²)	Population (10 ³ person)	Density (person/ha)
Surabaya	274	2,185	80
Gresik	1,137	825	7
Bangkalan	1,145	714	6
Mojokerto	843	882	10
Sidoarjo	592	1,003	17
Lamongan	1,813	1,133	6
GKS Total	5,804	6,742	12
JATIM	47,922	31,113	6
GKS/JATIM	12%	22%	-

Note: SMA = Surabaya Metropolitan Area:
Urban Structure Planning Area

FIG. 1.2-5

PLANNING AREA OF URBAN DEVELOPMENT FOR GERBANGKERTOSUSILA (GKS)

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

2.7 Organization of Surabaya Municipal Government

The organizational structure of Surabaya Municipal Government (KMS) is shown the figure on the next page. There are 16 Departments carrying out development and public service affairs in Surabaya Municipality; one of which is CLEANSING Department. At municipal level, administrative affairs are done by the Municipal Secretariat, of which the organizational structure is shown in the second figure.

KMS has 8,985 employees in total as of the end of 1991. This figure includes employees working at 19 District offices and 163 Sub-District offices. The breakdown of the total employees is shown in the following table.

Table 1.2-8 Number of Employees in KMS

No.	Type of Employee	Sub-Total	Total
1	Employees of Central Government temporarily dispatched to KMS:		985
	a. Permanent Civil Servant	984	
	b. Candidate Civil Servant	1	
2	Employees of Central Government permanently staying at KMS:		844
	a. Permanent Civil Servant	840	
	b. Candidate Civil Servant	4	
3	Pure Employees of KMS:		6,002
	a. Permanent Civil Servant	5,881	
	b. Candidate Civil Servant	121	
4	Honorarium Employees of KMS:	843	843
5	Honorarium Army in charge of KMS	311	311
GRAND TOTAL		8,985	8,985

Since 1991, in parallel with the development progress of Surabaya City, the Mayor has been assisted by 5 Assistants, 19 *Camat* (Chief of *Kecamatan*/District), and 163 *Lurah* (Chief of *Kelurahan*/Sub-District). Each Assistant to Mayor is responsible for one *Rayon* (administrative working area comprising several districts). In addition, every Sub-District has minimum 3 non-administrative community units called RW [*Rukun Warga*], and every RW is divided into minimum 3 neighborhood units named RT [*Rukun Tetangga*]. Generally, one RT comprises maximum 75 households. The total number of RW and RT in Surabaya Municipality is 1,224 and 7,711 respectively.

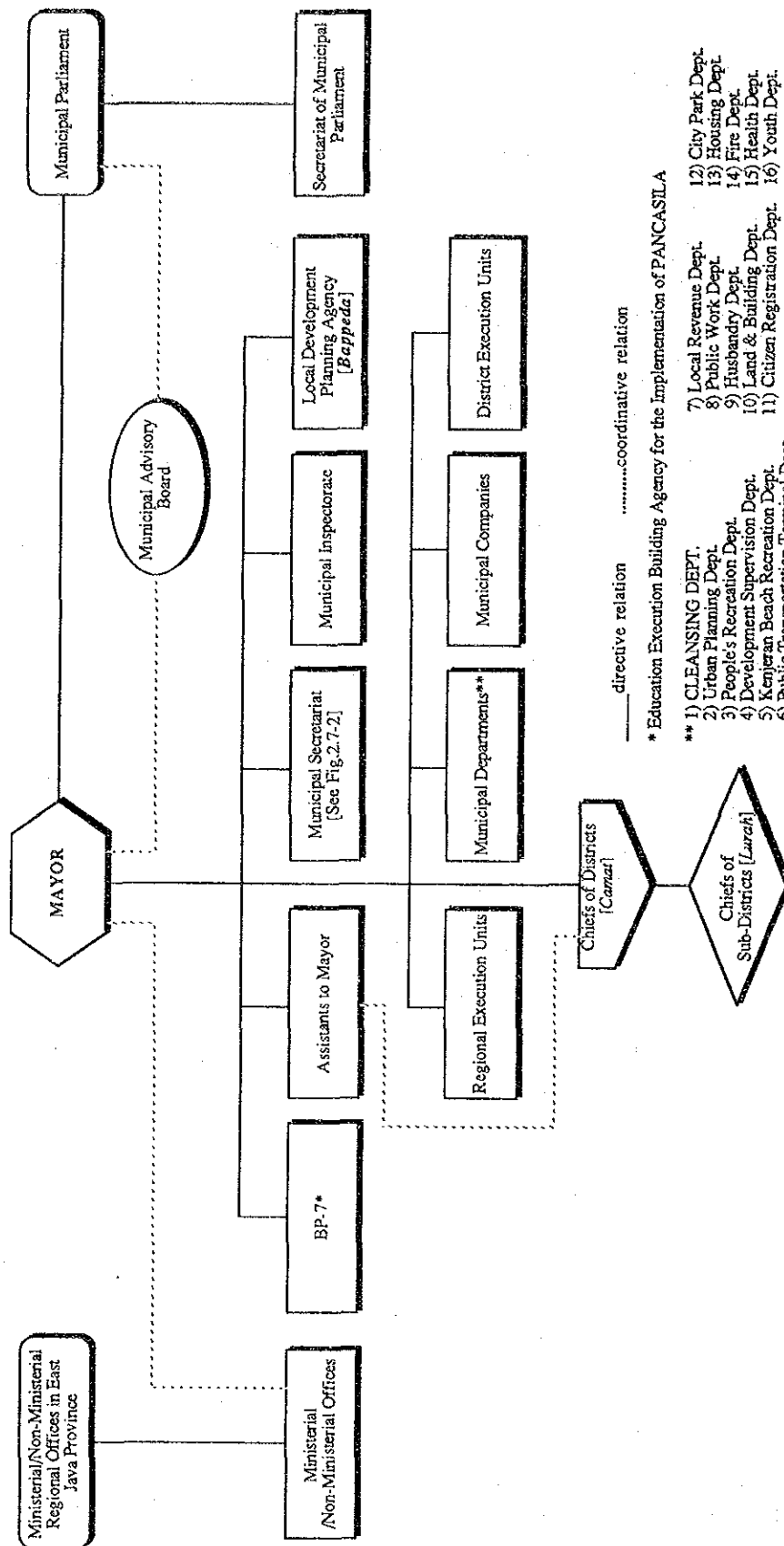
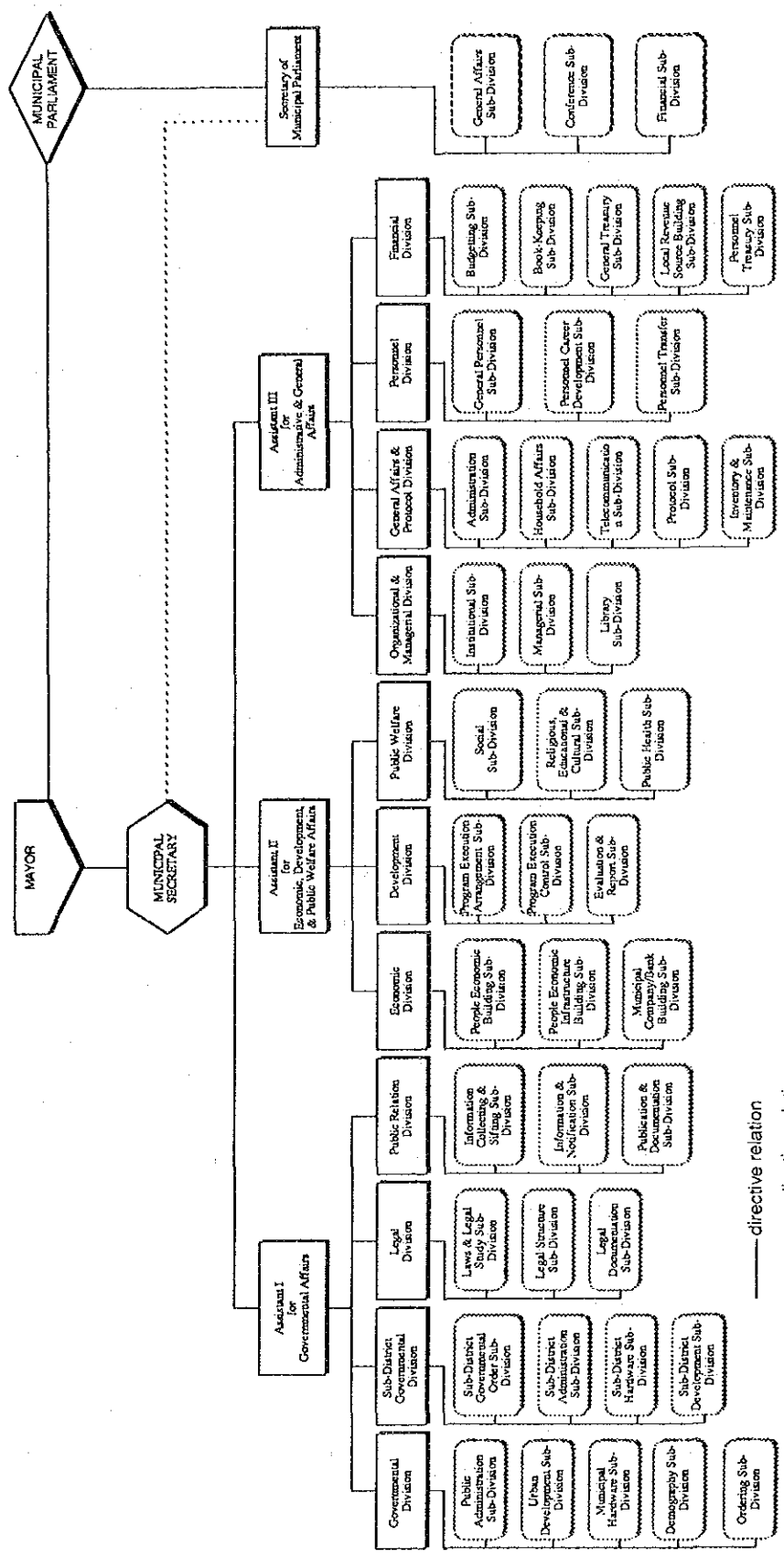


FIG. 1.2-6

ORGANIZATIONAL STRUCTURE OF SURABAYA MUNICIPAL GOVERNMENT

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



— directive relation
 coordinative relation

FIG. 1.2-7 ORGANIZATIONAL STRUCTURE OF SURABAYA MUNICIPAL SECRETARIAT
THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



Chapter 3. Existing Solid Waste Management Conditions in Surabaya

3.1 Introduction

3.1.1 General

Surabaya is one of the cleanest cities in Indonesia. The City of Surabaya was awarded with Adipura 4 times so far since the establishment of the Award in 1985. (Adipura is an award given by the Central Government to the local government that was judged as the best in the urban environmental sanitation management.) The City of Surabaya was also awarded with AGA KHAN Award in 1986, UNEP Award in 1990, and UNCED Award in 1992, and HABITAT Award from the United Nations in 1992.

The acquisition of Adipura Award is attributable to the remarkable efforts of both the city authority (KMS) and the citizens. The Administrators of KMS are very keen in the environmental cleanliness. The citizens' participation in the sanitary management is very active as shown below:

1. Local communities, RT/RW, take the responsibility for collection and transfer of waste from households to the nearest transfer stations called Depo or LPS.
2. The citizens pay monthly sanitary retribution charge to Surabaya Municipal Government as service charge for hauling waste from Depo/LPS to LPA (final disposal sites as well as for street and other public facilities cleaning.
3. The citizens donate some sanitary equipment and facilities such as small containers to the municipal government.
4. The citizens carry out mass voluntary cleaning of public places occasionally.

Strong and Weak Points of the SWM in Surabaya

Solid waste management service comprises of two major services, i.e., 1) Collection and haulage & 2) Treatment and disposal. In Surabaya, it is considered that the former is rather satisfactory, while the latter has much to be improved.

A strong advantage in the waste collection and haulage in Surabaya is that there are as many as 168 Depo or LPS in Surabaya (58 Depo and 110 LPS), which are very good

from the efficiency view point. Another superior aspect is that the local communities take the responsibility for waste collection. This system enables the local communities to choose appropriate level of services that match with the level of their income and priority.

On the other hand, the waste disposal method practiced in Surabaya is not so impressive. KMS has been still practicing an open dumping method that causes environmental problems, while, on the other hand, KMS uses an extremely costly treatment method (an incinerator) for a small part (17%) of the waste disposed of by KMS although this incinerator may provide both Surabaya and Indonesia with valuable experience as it is the first solid waste incinerator of this scale introduced in Indonesia.

3.1.2 Responsibility of Solid Waste Management (SWM)

The responsibilities of the solid waste management (SWM) are shared by the local communities, KMS and waste generators as shown in the Table 1.3-1. The local communities called RT/RW perform the great rôle in the solid waste management in Surabaya. They are directly responsible for the collection of solid waste, and for the transfer of collected waste to the nearest transfer stations that are locally called Depo or LPS, while the city authority (KMS) takes the responsibility for haulage (from Depo or LPS to LPA), disposal of municipal solid waste, and for street sweeping as well as for the disposal of night soil sludge. Generators of hazardous solid waste are responsible for disposal of their waste.

Table 1.3-1 Type of SWM Services and Responsible Bodies

Type of Solid Waste	Types of SWM Services	Responsible Body
A. Household waste & Non-hazardous commercial and industrial waste which is less than 2.5 m ³ /day per generator	1. Waste Collection and Transfer to Depo/LPS	Local communities (RT/RW)
	2. Haulage to LPA (final disposal sites)	KMS (Cleansing Dept.)
	3. Treatment & Disposal	KMS (Cleansing Dept.)
B. Market Waste & Other non-hazardous commercial & industrial waste that is 2.5 m ³ /day or more per generator	4. Collection and Haulage	Generators & KMS* ¹
	5. Disposal	KMS (Cleansing Dept.)

C. Hazardous waste	6. Collection, Haulage & Disposal	Generators
D. Street waste	7. Collection (Street sweeping), Haulage & Disposal	KMS (Cleansing Dept.)
E. Night soil sludge	8. Collection and Haulage	Residents (Service users)*2
	9. Treatment and Disposal	KMS (Cleansing Dept.)

Notes:

*1: According to the municipal regulation, generators of waste that generate 2.5 m³ or more each day are responsible for collection and haulage of their waste. In reality, however, much of those waste are handled by local communities.

*2: Night soil sludge of MCK (public toilets) are collected by KMS.

3.1.3 Outline of SWM in Surabaya

1) Waste Generation

It is estimated that the waste generation amount in Surabaya is 1,626 ton/day on average, of which details are shown below.

<u>Generation Sources</u>	<u>Average Waste Amount (ton/day)</u>
1. Household:	1,108 (68%)
2. Market:	258 (16%)
3. Commercial & Industrial waste:	177 (11%)
4. Street & open space:	83* (5%)
Total:	1,626 (100%)

* The waste amount of "Street & Open Space" partly include waste discharged from households located nearby street waste containers.

2) Waste Collection and Disposal

Of the generated 1,626 ton/day of waste, 1,116 ton/day (69 %) is either collected and disposed properly or recycled as shown below.

	<u>Average Waste Amount (ton/day)</u>	
1. Either collected and disposed properly or recycled:	1,116	(69%)
1.1 Collected and disposed properly:	936	(58%)
1.2 Recycled;	180	(11%)
2. Collected but disposed at unofficial places:	261	(16%)
3. Not collected:	249	(15%)
Total:	1,626	(100%)

2) Manpower Involved in SWM

It is estimated that the local communities (RT/RW) use about 10,500 workers in total to collect waste and transfer it to Depo and LPS. Number of KMS employees involved in the solid waste management services is about 1,700, of which 1,060 are street sweepers. In addition, KMS uses 5 waste haulage contractors (which use 113 workers in total for the service), and 25 street sweeping contractors (which use 404 sweepers in total). The total number of persons involved in solid waste management services in Surabaya is estimated at about 13,000, which corresponds to about 0.5 % of the population (about 2.5 million) in Surabaya. In addition, there are over 3,000 scavengers engaged in the recycling activities.

3) Money Used for SWM

It is estimated that the local communities (RT/RW) spend about Rp 8.5 billion/year for waste collection and transfer to Depo/LPS. KMS uses about Rp 11.5 billion/year for solid waste management in fiscal year 1992/93. Of KMS's SWM expenditure Rp 11.5 billion, Rp 4 billion is funded by the SWM fee (called Sanitary Retribution) paid directly by the citizens, while the remaining Rp 7.5 billion is covered by various kinds of taxes.

Total SWM expenditure in Surabaya is Rp 20 billion (Rp 8.5 billion + Rp 11.5 billion), which corresponds to 0.5 % of the gross domestic product (GDP) of Surabaya recorded in 1990. The per capita SWM expenditure is estimated at about Rp 8,000/person/year (Rp 20 billion divided by 2.5 million persons) or Rp 40,000/household/year (Rp 20 billion divided by 0.5 million households) on average.

4) KMS's Major SWM Facilities and Equipment

KMS's major facilities and equipment used for solid waste management are shown below. Locations of the existing Depo, LPS, LPA (final disposal sites) and incinerator are shown in Fig. 1.3-1.

a. Haulage Equipment

(1) Vehicles	
- Arm-roll container trucks:	43 units
- Rear End Loader (REL) Trucks:	15 units
- Open trucks:	6 units
- Mechanical road sweepers:	3 units
- TOTAL:	67 units

Note: Arm-roll trucks are used to haul waste-filled large containers (6 m³, 10 m³ & 12 m³) from Depo/LPS to LPA, while the REL trucks are used to collect waste from small containers.

(2) Containers	
- Large containers (6 m ³ , 10 m ³ & 12 m ³):	260 units
- Small containers (0.6 m ³ and 1.0 m ³):	436 units
- TOTAL:	696 units

Note: Large containers are placed in Depo and LPS, while small containers are placed mainly on the streets.

(3) Depo and LPS	
- Depo:	58
- LPS	110
- TOTAL:	168

b. Treatment Facility

- Incineration Plant (capacity: 200 ton/day):	1
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c. Final Disposal Facility

(1) Final Disposal Sites (LPA):	3
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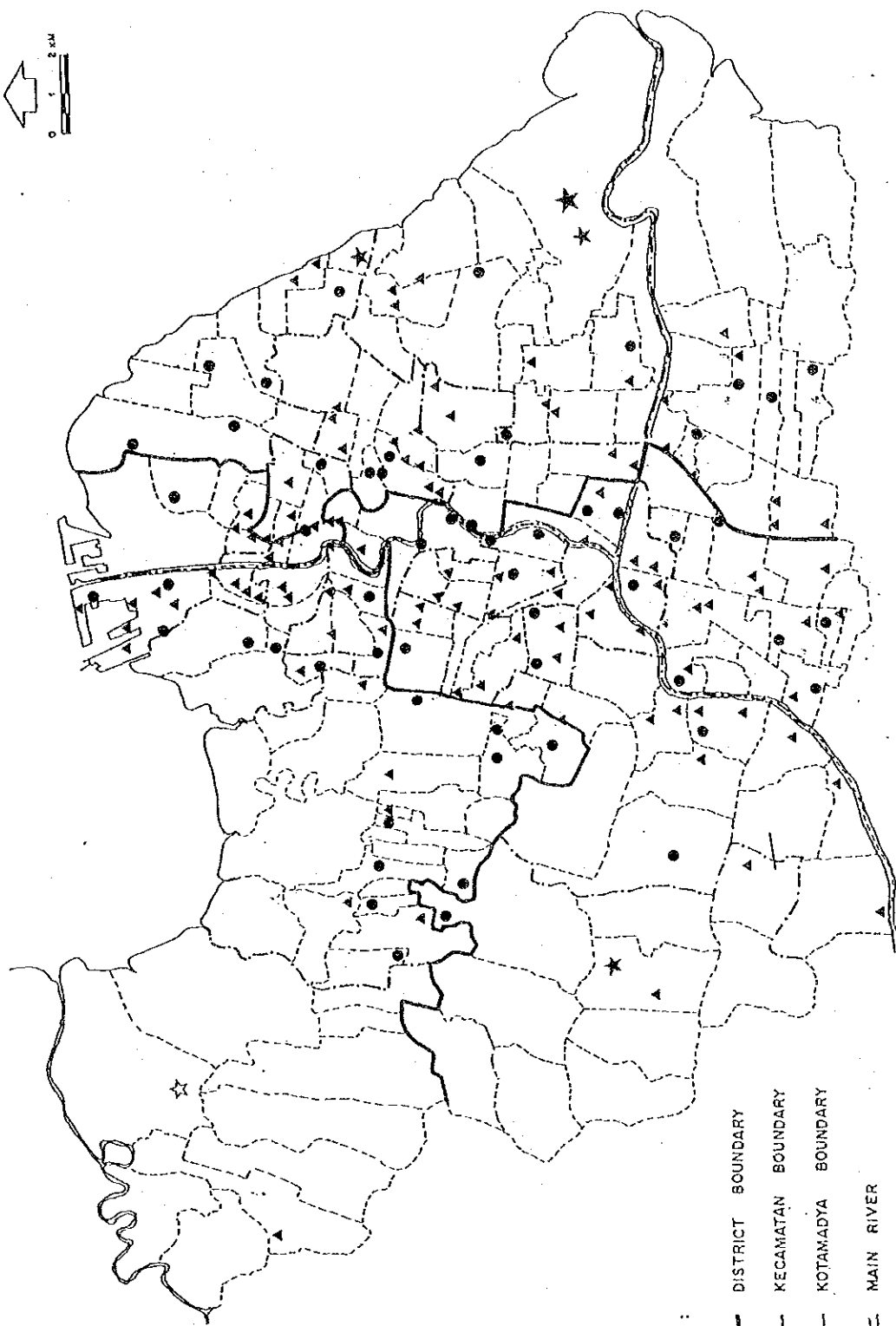
Note:

1. The LPA in Lakarsantri and Keptih are owned by KMS, while the LPA in Kenjeran belongs to a private company. Kenjeran LPA had already finished its operation since early in 1993 because exhausted its capacity.

2. There are several places in Surabaya that are used as unofficial final disposal sites including the one in Asemrowo.

(2) Heavy Equipment (currently used)	
- Bulldozer:	5 units
- Wheel loader	1 unit

d. Workshop :	1 (Asemrowo)
---------------	--------------



LEGEND :

DISTRICT BOUNDARY

KECAMATAN BOUNDARY

KOTAMADYA BOUNDARY

MAIN RIVER

INCINERATOR

DISPOSAL SITE (LPA)

DISPOSAL SITE PLAN (RENCANA LPA)

LPS

DEPO



FIG. 1.3-1

LOCATIONS OF DEPO, LPS, LPA AND INCINERATOR

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

3.2 Waste Amount and Quality

3.2.1 Waste Generation Amount

1) Results of Per Capita Waste Discharge Survey

In order to estimate the present waste collection amount, the Per Capita Waste Discharge Survey was conducted at some selected Depo/LPS in the study area. The survey was conducted at typical residential and commercial areas and markets. Results of this survey are summarized in Table 1.3-2.

The per capita discharge of household waste ranged from 0.45 to 0.50 on average. In Jakarta, a similar survey was conducted by CIPTA KARYA and JICA in 1986 and the average per capital discharge was 0.43 kg/capita/day. Comparing both cities, Surabaya has the bigger per capita discharge than Jakarta by about 10%. Every type of generation sources showed a trend that the unit discharge rates were lower in dry season by 10 to 20% than that of rainy season.

Table 1.3-2 Unit Waste Discharge

(Weight)

Season	Household (kg/capita/day)				Market (kg/m ² /day)	Commercial (kg/shop/day)
	High	Middle	Low	Average		
Rainy Season	0.83	0.77	0.48	0.50	0.93	3.20
Dry Season	0.72	0.60	0.40	0.45	0.72	2.70

(Volume)

Season	Household (liter/capita/day)				Market (kg/m ² /day)	Commercial (liter/shop/day)
	High	Middle	Low	Average		
Rainy Season	4.35	2.60	1.43	1.6	2.64	18.8
Dry Season	2.86	2.49	1.24	1.5	2.60	17.1

Applying the above results to the whole population, market space and shop number, the waste amount discharged at the collection process are calculated as shown in Table 1.3-3.

The household waste is the dominant source of solid waste in Surabaya with the share of about 80% among three major waste sources. The next largest share is market waste (about 20%). Commercial waste has a very small share.

Table 1.3-3 Estimated Waste Discharge Amount

Type of Waste	Population Market Space Shop Number	Weight (ton/day)		Volume (m ³ /day)	
		Rainy Season	Dry Season	Rainy Season	Dry Season
Domestic	2.33 million	1,168	1,048	3,733	3,500
Market	31.3 ha	291	225	827	814
Commercial	12,364 shop	40	33	232	212
Total		1,499	1,306	4,832	4,526

2) Results of Incoming Waste Survey at LPA

To Estimate waste amount brought into the existing LPA (final disposal site) and the Incinerator, the Truck Count Survey and the Truck Weight Survey are conducted. An average of daily disposal amount was estimated at 942 ton/day for rainy season and 756 ton/day for dry season, which however need some adjustments as explained below.

Since the Vehicle Count Survey was conducted for one week with 16 hours (7:00 to 23:00) each day, the vehicles arrived at the final disposal sites during the remaining eight hours (23:00 to 7:00) were not counted. According to the interview to some specific generation sources, the following three kinds of vehicles were supposed to arrive at the final disposal sites during midnight hours or in the early morning; namely vehicle from port area, the KMS vehicle that worked on two shifts and vehicle from highrise office buildings. To estimate the total waste amount arrived at the final disposal sites, it was judged necessary to add these three sources of vehicles to the observed ones.

3) Estimated Waste Generation Amount

The results of Per Capita Waste Discharge Survey are used for estimating household market and commercial waste amounts. The other waste from hotel, office buildings, streets, factories, public spaces, medical facilities and port facilities are estimated by the results of Waste Amount Survey at the final disposal sites and the interview survey to the generators.

Thus the overall waste discharge in Surabaya is evaluated at about 1,626 ton/day as a daily average throughout the year. It suggests that the per capita waste discharge in Surabaya is calculated by dividing by the population of 2.33 million at 0.70 kg/capita.

The result of estimation are summarized in Table 1.3-4.

Table 1.3-4 Estimated Waste Generation Amount by Source

Source Item	Amount (ton/day)			Source Data
	Rainy Season	Dry Season	Average	
1 Household	1,168	1,048	1,108	Per capita survey
2 Market	291	225	258	Per capita survey
3.1 Commercial	40	33	37	Per capita survey
3.2 Hotel	21	21	21	Hearing
3.3 Highrise Office Building	11	11	11	Hearing
4 Street	106	46	76	Amount survey at disposal site
5 Factory	79	93	86	Amount survey at disposal site
6 Public Space	10	4	7	Amount survey at disposal site
7 Medical	5	5	5	Health Dept. KMS
8 Port Waste	17	17	17	Hearing
Total	1,748	1,503	1,626	

4) Estimated Waste Collection Amount

Concerning the waste collection rate of each Kecamatan, the figure is reported in "Answers Explanation of Questionnaire for ADIPURA 1992", which indicates that collection rate of household waste is 77.5%. The share of 76% of the collected waste is brought into Depo/LPS, and the rest is transferred to LPA directly recycled, or disposed at unidentified places. Waste collected at Depo/LPS is classified into five waste sources which are households, markets, commercial, hotels and factories. The waste amount collected at Depo/LPS is estimated in Table 1.3-5.

Table 1.3-5 Waste Amount Collected at Depo/LPS

Source	(unit: ton/day)		
	Rainy Season	Dry Season	Average
Households	694	603	649
Market	154	110	132
Commercials	16	16	16
Hotels	21	21	21
Factories	2	2	2
Total	887	752	820

5) Estimated Incoming Waste at Landfill Site

The total incoming waste amount at the existing final disposal sites (excluding the incineration amount) is estimated at 786 ton/day on average throughout the year as shown in Table 1.3-6.

Table 1.3-6 Estimated Incoming Waste at Landfill Site

	(unit: ton/day)		
	Rainy Season	Dry Season	Average*
Depo/LPS	737	638	695
Port (household)	(5)	(5)	(5)
Port (others)	(17)	(17)	(17)
Port (subtotal)	22	22	22
Street	43	20	32
Highrise Office	6	6	6
Factory	17	31	24
Public Space	10	4	7
Total	835	721	786

* Not equal to the mean value of Rainy and Dry season because the average amount of incineration throughout the year is estimated at 150 ton/day which is lower than a simple average of rainy and dry seasons.

6) Flow of Solid Waste

Based on the amount examination, the flow of solid waste is assumed as shown in Fig. 1.3-2 to Fig. 1.3-4. The flow shows that out of the total generation of 1,626 ton/day in average, 1,116 ton/day is disposed by KMS or recycled. Amount and ratio of each item are summarized in Table 1.3-7.

Table 1.3-7 Flow of Waste Amount by Disposal Type

	Amount (ton/day)			Ratio (%)		
	Rainy Season	Dry Season	Average	Rainy Season	Dry Season	Average
Landfill	(825)	(711)	(776)	(47)	(47)	(48)
Incineration	(194)	(121)	(150)	(11)	(8)	(9)
Disposed (subtotal)	1,019	832	926	58	55	57
Non Collected	263	236	249	15	16	15
Recycled	190	190	190	11	13	12
Unauthorized Disposal	90	90	90	5	6	6
Unidentified Disposal	186	155	171	11	10	10
Total	1,748	1,503	1,626	100	100	100

Note: Waste amount disposed at landfill (776 t/d on average) is smaller than incoming waste (786 t/d on average) by 10 t/d. It is assumed that this difference (10 t/d) is collected and recycled at LPA by scavengers.

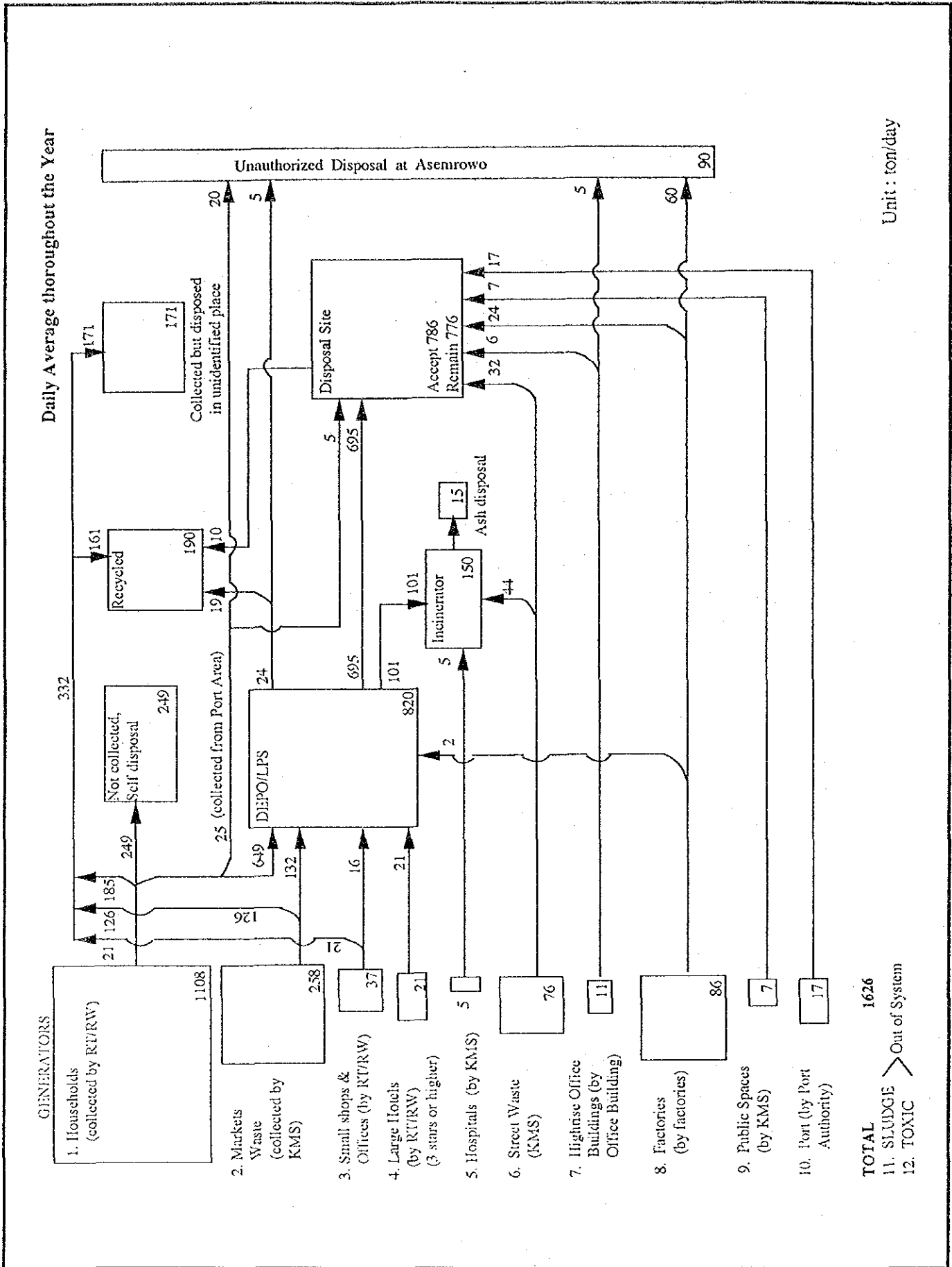


FIG. 1.3-2

BALANCE OF WASTE GENERATION AND DISPOSAL (DAILY AVERAGE THROUGHOUT YEAR)

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



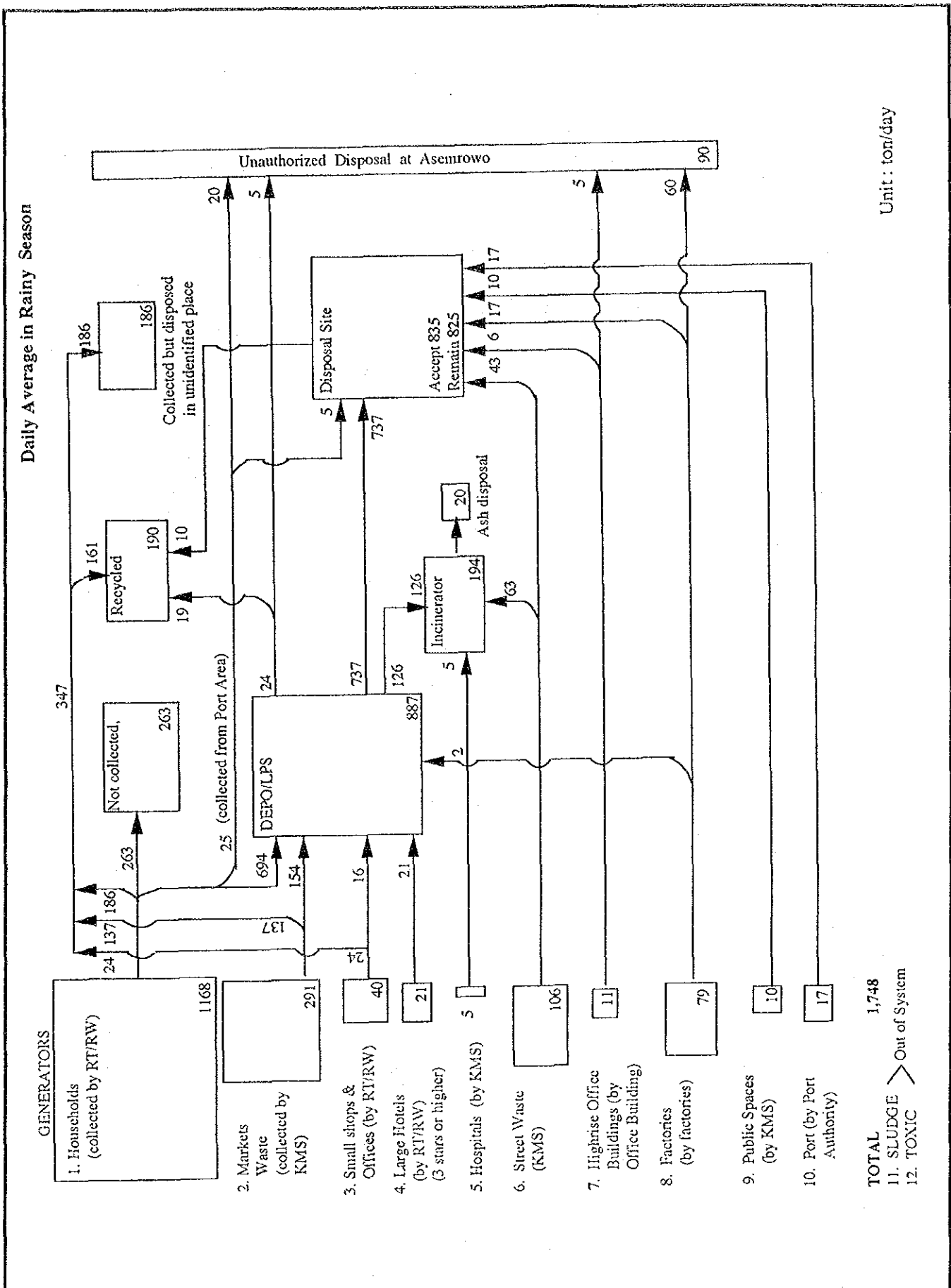


FIG. 1.3-3

BALANCE OF WASTE GENERATION AND DISPOSAL (DAILY AVERAGE IN RAINY SEASON)

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



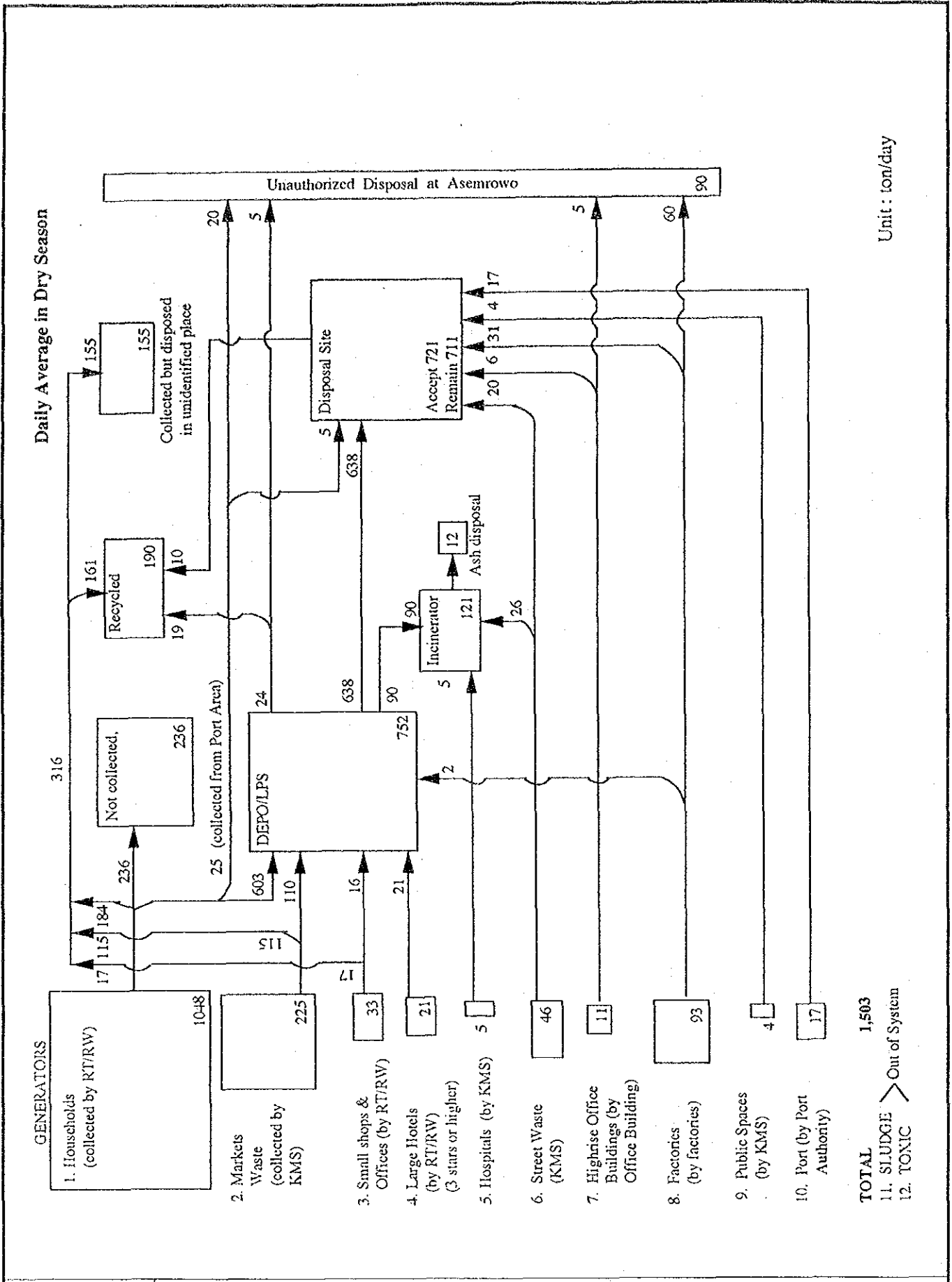


FIG. 1.3-4

BALANCE OF WASTE GENERATION AND DISPOSAL (DAILY AVERAGE IN DRY SEASON)

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

3.2.2 Waste Quality

1) Waste Quality Survey

The following waste items of waste quality were studied in the survey.

1. Physical composition
2. Chemical composition
3. Variation by the type of generation sources
4. Variation by seasons

The survey is conducted both in rainy and dry seasons by selecting some sample points that represent typical land uses in Surabaya City.

2) Physical Composition of Waste

The results of the physical composition analysis are summarized in Table 1.3-8. The content of combustible is measured to be 96% and 93% for rainy and dry seasons respectively on wet basis (non-processed condition). It is revealed that the most part of waste consists of combustibles and its seasonal fluctuation does not exceed three (3) % in average.

Table 1.3-8 Average Physical Composition of Waste (Wet Basis)

(unit: weight %)

Classification	Rainy Season	Dry Season
(Combustible)		
Paper	13.54	11.37
Textile	1.85	2.03
Garbage	52.93	55.89
Wood/Grass	19.15	15.72
Plastics	7.7	7.51
Leather/Rubber	0.45	0.63
Others	0.13	0.06
Sub-total	95.75	93.21
(Noncombustible)		
Metal (Ferrous)	0.82	0.74
Metal (Nonferrous)	0.08	0.16
Glass	1.12	0.68
Stone/Ceramics	1.61	4.46
Bones	0.62	0.74
Others	0.0	0.01
Sub-total	4.25	6.79
Total	100	100

The market waste shows a special characteristics among other generation sources, of which garbage share is as high as 80%. Papers are dominant in the wastes of the commercial area. The waste from incinerator seems to have the similar composition to the household wastes, and the waste from road sweeping has the largest share of wood/grass and stone/ceramics which may derive from the maintenance of road side trees and streets.

3) Apparent Density

The average apparent density is estimated to be 0.34 Kg/liter. The highest density is observed in incinerator and the lowest in high residential area. In residential area, there is a tendency that the higher the income level, the lower the density. Seasonal change is such that there is a decrease of density in dry season by 5% in average.

4) Moisture Content

Overall average moisture contents are estimated to be 67% and 56% in rainy and dry seasons respectively, which shows about 10% decrease in dry season from rainy season in average moisture content. Among the various generation sources, the market generates the waste with the highest moisture content, higher than the average by about 10% as shown in Fig. 1.3-5. Among the 13 kinds of waste components, garbage has the highest moisture content, higher than the average by 8% to 10%. At the same time, the garbage is recognized to contribute to raise the moisture content of the whole waste due to its largest share in physical composition. It is found that the waste kept for three days in the pit has smaller moisture content than that of fresh waste by about 5%. This shows that the three day storing of waste in the pit has an effect of moisture reduction, in other word, an effect of increase of calorific value.

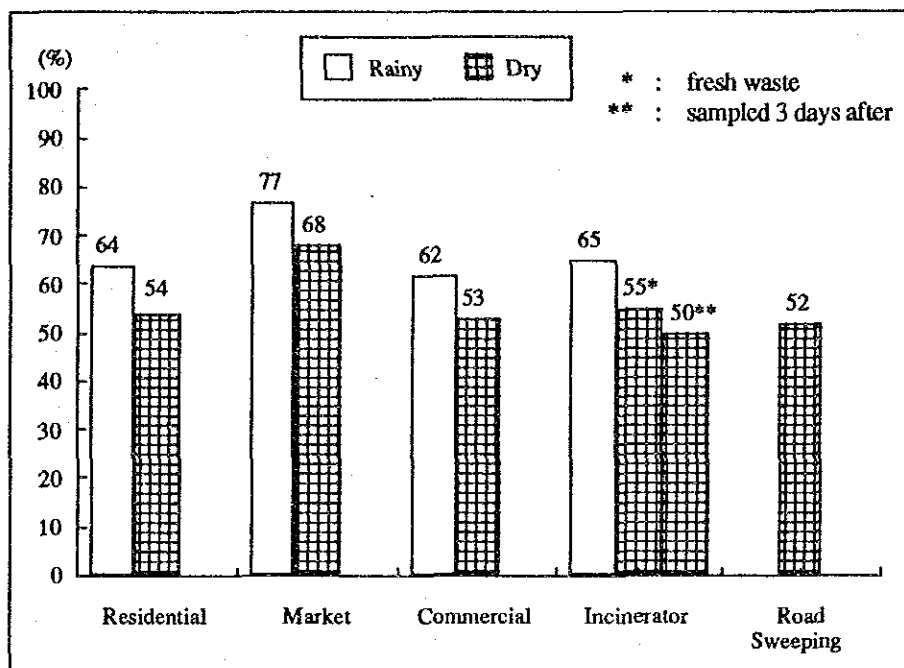


Fig. 1.3-5 Comparison of Moisture Content

5) Chemical Analysis

Four major components are summarized in Table 1.3-9. Among the four major components moisture is a dominant one and shares about 2/3 in average. Proportions of ash and combustible component including plastics is 1 to 2.

Table 1.3-9 Summary of Major Components

Component	Content (wt.%)	
	Rainy Season	Dry Season
Moisture	67.1	55.6
Ash	9.9	15.1
Combustible	23.0	29.3
Plastics	3.9	4.2
Others	19.1	25.1
Total	100	100

6) Elemental Composition

The content of six major elements of the combustibles is summarized below. Based on this table, fuel index of both seasons are calculated at almost 1.2.

Table 1.3-10 Summary of Elemental Composition of Waste

(unit: wt.%, wet basis)

	C	H	N	S	Cl	O	Total
Rainy Season	13.28	1.70	0.31	0.02	0.05	7.66	23.02
Dry Season	17.20	2.36	0.44	0.02	0.06	9.21	29.29

7) Calorific Value

The calorific values of the waste from various sources are summarized as shown in Table 1.3-11. The average values excluding market waste are almost same as that of household waste varying from 1,050 Kcal/kg for rainy season to 1,300 Kcal/kg for dry season. The difference between rainy and dry seasons is proved large, and the value in dry season is larger than that in rainy season with about 24% in average. Among various sources, markets generate such wastes that have remarkably low calorific value, which is considered insufficient to sustain spontaneous combustion. Such remarkably low calorific value is considered to be brought about by the large moisture content mainly held by dominant garbage content.

Table 1.3-11 Calorific Value

Source Season	Household (Income Level)			Market	Commercial	Incinerator	Road Sweeping	Weighted Average
	(High) Darum o Permai	(Middle) Sawahana	(Low) Tambak Sari	Wono- kromo	Bungran			
Rainy Season	880	970	1,050	300	1,150	1,250	-	1,050
Dry Season	1,480	1,450	1,210	450	1,550	1,390	1,180	1,300

Note: Average value excludes market wastes.

3.3 Laws and Regulations regarding SWM

3.3.1 Introduction

There are about 18 valid laws and regulations that concern both directly and indirectly the solid waste management in Surabaya Municipality. Among the 18, there are the following five (5) laws and regulations which are considered as basic and important in the execution of solid waste management in the city of Surabaya.

- 1) Surabaya Municipal Regulation No.4/1980,
- 2) Surabaya Municipal Regulation No.6/1986,
- 3) Surabaya Municipal Regulation No.2/1990,
- 4) Decision of Mayor of Surabaya Municipality No.251/1987, and
- 5) Decision of Mayor of Surabaya Municipality No.77/1988.

The first (1st) regulation deals with the responsibility of the Cleansing Department, its main points are shown in Section 3.4.1 and 3.4.3. The fourth (4th) and fifth (5th) regulations stipulate responsibilities of chiefs of Kecamatan, Kelurahan, RT/RW and procedures of the sanitary retribution., and their outlines are shown in Volume 3 Section 3.3. This section explain the second (2nd) and third (3rd) regulations.

3.3.2 Surabaya Municipal Regulation No.6/1986 concerning "Sanitary Management in Surabaya Municipality"

This Regulation regulates the responsibilities of Surabaya Municipal Government and the people in sanitary management, and the sanitary retribution charge as shown below.

Responsibilities of Surabaya Municipal Government:

- to keep clean the public roads/streets, spaces, and drainage,
- to arrange and determine temporal & final waste disposal sites,
- to haul wastes from temporal disposal sites to final ones, and
- to eliminate and utilize wastes with proper ways.

Responsibilities of the Residents:

- to keep clean pathways and individual drainage with the coordination of RT/RW;

- to keep clean buildings, yards, and the surroundings.

The Regulation also obliges entrepreneurs, industries, or workshops that generate hazardous wastes (solid, liquid, or gas) to have containers or tanks or filters in such a way that they will not pollute the environment. As there are also quite a few street vendors and hawkers in Surabaya, they are obliged to have their own waste containers for the waste they generate.

The Regulation also requires those who generate waste as much as 2.5 m³ or more each day to haul the waste to final disposal sites by themselves unless they request Cleansing Department to do so.

According to the Regulation, it is forbidden to:

- burn wastes in the yards or other places that may cause fire or disturb the surroundings.
- discharge wastes into rivers, ditches, drains, public roads/streets, pathways, other public places.
- discharge glasses, chemical substances or other hazardous materials, feces, or bad smell wastes into improper places.

The Regulation requires the citizens to pay the sanitary retribution charge at stipulated rates as shown in the table below:

Table 1.3-12 Tariff of Sanitary Retribution Charge by KMS

No.	Type of Charge Payer	Monthly Tariff (Rp)
	<i>A. Residential/Commercial:</i>	
1	Housing A	1,000
2	Housing B	500
3	Small Industry	2,500
4	Large Industry	15,000
5	Small Enterprise	4,000
6	Big Enterprise:	
	a. Shop, Retailer, Wholesaler, Travel Bureau, Private Office, and the likes	5,000
	b. Restaurant	10,000
	c. Hotel	20,000

7	Foreign Diplomatic Office	5,000
8	Governmental Office	3,000
9	Particular Social Institution	500
10	General Social Institution	1,000
	B. Market:	
11	Municipal Market	1,000/m ³
12	Private Market, Shopping Center, Supermarket, Department Store	2,000/m ³

The Regulation also requires that the following retribution be paid:

- Rp 50.-/day upon street vendor/hawker.
- Rp 500.-/m³ upon those who dispose waste directly to final disposal sites.

All revenues from the retribution charge will be the Local Original Revenue and shall go to the Municipal Treasury.

3.3.3 Surabaya Municipal Regulation No.2/1990 concerning "First Amendment against the Surabaya Municipal Regulation No.6/1986 on Sanitary Management in Surabaya Municipality"

This Regulation determines the following significant items:

- a. Industries, factories, or workshops disposing hazardous wastes at final disposal sites should neutralize the wastes before hauling them to the disposal sites so that they will not cause pollution.
- b. It is forbidden to:
 - excrete feces and urinate on streets, green lanes, parks and other public places.
 - discharge night soil into rivers, ditches, and other public places except to the final night soil disposal site prepared by the Municipal Government.
- c. Those who dispose night soil to the night soil final disposal site shall pay the retribution charge as much as Rp 1,000.-/m³.
- d. Delay in the payment of the retribution charge is fined 10% from the charge.

3.4 Organization and Responsibility of Cleansing Department

The organization and responsibility of Cleansing Department are stipulated by a municipal regulation, i.e. Surabaya Municipal Regulation No.4/1980 concerning "Organization of Cleansing Department in Surabaya Municipality".

3.4.1 Organization of Cleansing Department

The Headquarters of Cleansing Department comprises one division and five sections as shown below:

- (1) Administration Division:**
 - i. Administrative Affairs Sub-Division
 - ii. Personnel Affairs Sub-Division
 - iii. Financial Affairs Sub-Division
- (2) Planning & Supervision Section:**
 - i. Planning Sub-Section
 - ii. Guiding Sub-Section
 - iii. Supervision Sub-Section
- (3) Construction & Execution Section:**
 - i. Inventory Sub-Section
 - ii. Execution Sub-Section
 - iii. Maintenance Sub-Section
- (4) Evaluation & Report Section:**
 - i. Public Sanitary/Facility Sub-Section
 - ii. Firm & Industry Sanitary Sub-Section
 - iii. Sanitary Laboratory Sub-Section
- (5) Waste Disposal/MCK & Night Soil Section:**
 - i. Waste Disposal & Recycling Sub-Section
 - ii. MCK/Night Soil Sub-Section
- (6) Haulage Section:**
 - i. Haulage Sub-Section
 - ii. Vehicle Sub-Section
 - iii. Vehicle Maintenance & Supervision Sub-Section.

The organizational structure of Cleansing Department is shown in the following figure.

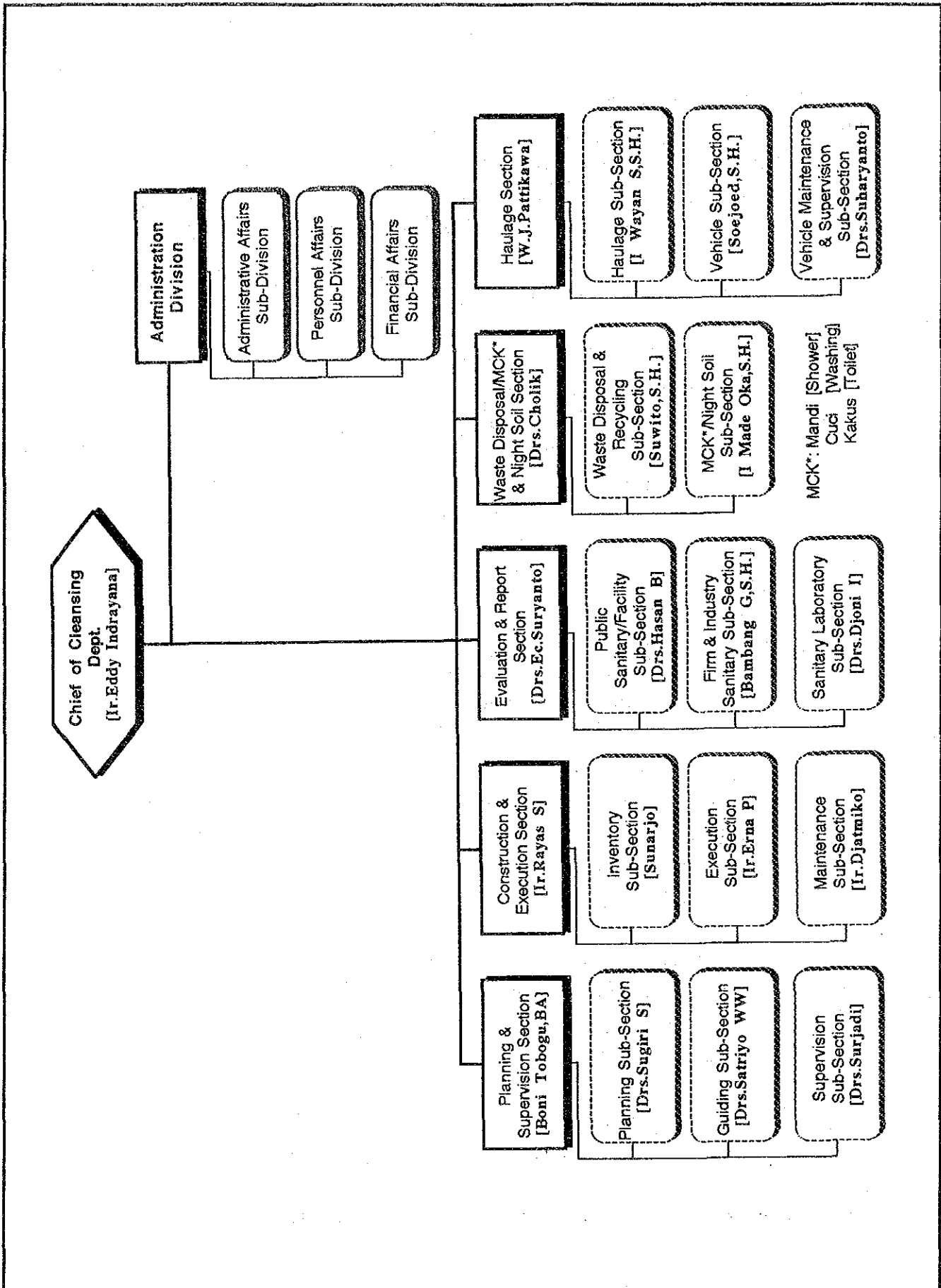
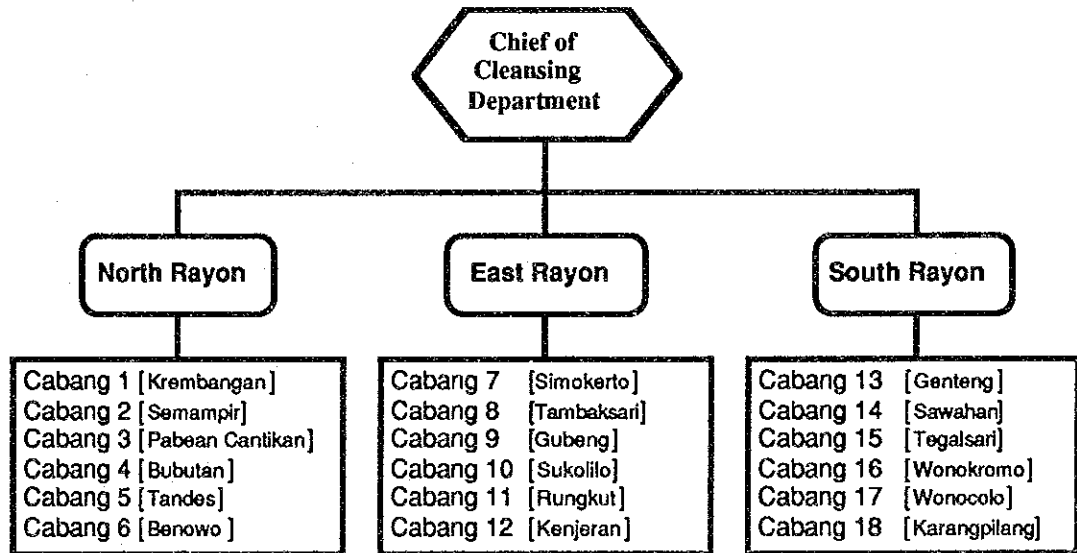


FIG. 1.3-6

Organizational Structure of Cleansing Department

Besides the Headquarters, Cleansing Department has 3 (three) Rayons [working area of each Assistant to the Mayor], and each Rayon covers 6 (six) Cabang [District] as shown in the chart below:

Fig.1.3-7
Organizational Structure of
Rayon & Cabang



Remarks: [] = name of District

Notes:

1. Administratively, there are altogether 5 Rayons and 19 Districts in Surabaya Municipality. So, there is 1 District (in West Rayon) that has no Cabang, i.e. Lakarsantri District. Cabang 5 & 6 which are administratively included in West Rayon are, for the time being, still managed by North Rayon; while Cabang 4, 7, 13 & 15 which are administratively inside Central Rayon are still managed by North Rayon (i.e. Cabang 4), East Rayon (i.e. Cabang 7), and South Rayon (i.e. Cabang 13 & 15).
2. Each Cabang consists of several Units at Kelurahan (Sub-District) level. In terms of sanitary management, there are altogether 58 Units in Surabaya City. Whereas, administratively Surabaya Municipality has 163 Sub-Districts in total. The existing 58 Units cover the sanitary management for the whole 163 Sub-Districts.