JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NAIROBI CITY COUNCIL
MINISTRY OF LOCAL AUTHORITIES
THE REPUBLIC OF KENYA

THE STUDY ON SOLID WASTE MANAGEMENT IN NAIROBI CITY IN THE REPUBLIC OF KENYA

FINAL REPORT

VOLUME 1

EXECUTIVE SUMMARY

AUGUST 1998

CTI ENGINEERING CO., LTD.
ENVIRONMENTAL TECHNOLOGY CONSULTANTS CO., LTD.

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All the Kenyan shilling amounts including the project costs shown in this report are indicated in 1997 price unless otherwise indicated. Those amount are estimated partly based on the foreign prices by applying mean 1997 currency exchange rates; namely, US$1 = Kshs. 58.8 = 121.76 Japanese Yen.

PREFACE

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct a development "Study on Solid Waste Management in Nairobi City in the Republic of Kenya" and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kenya a study team headed by Mr. Takao Yoshida, CTI Engineering Co., Ltd., and composed of staff members of Environmental Technology Consultants Co., Ltd., between March 1997 and August 1998.

The team held discussions with officials concerned of the Government of Kenya, 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 Republic of Kenya for their close cooperation extended to the team.

August 1998

Kimio Fujita
President
Japan International Cooperation Agency

August 1998

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

LETTER OF TRANSMITTAL

Dear Sir,

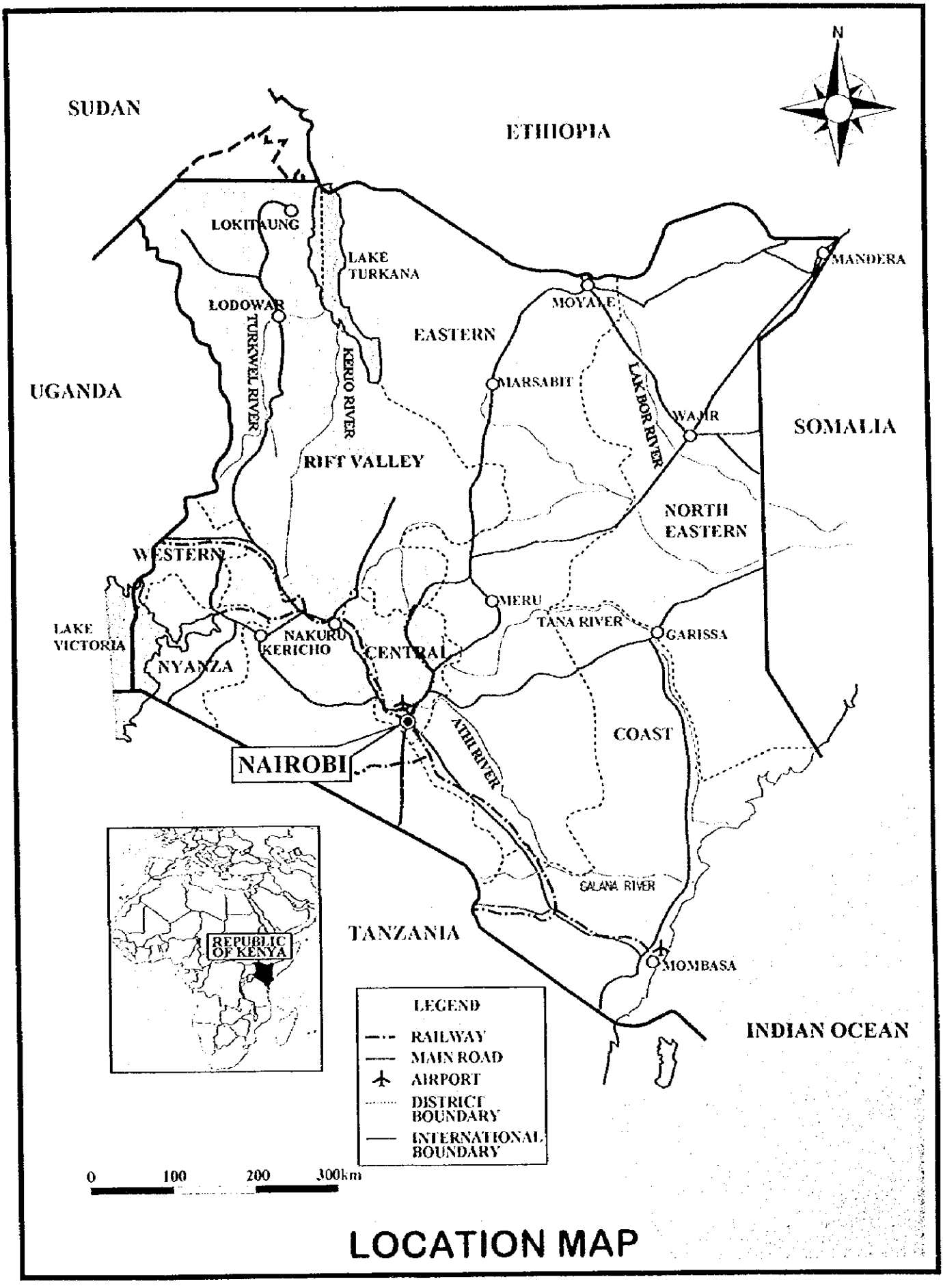
We are pleased to submit herewith the Final Report on the Study on Solid Waste Management in Nairobi City in the Republic of Kenya. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and the Japan International Cooperation Agency (JICA), as well as the formulation of the above mentioned project. Also included are comments made by the authorities concerned of the Government of the Republic of Kenya during the technical discussions on the Draft Final Report.

The Final Report presents the Master Plan of the Solid Waste Management in Nairobi City and the Feasibility Study of the priority projects. In view of the urgency and necessity to improve public cleanliness and public health and protect the environment, the priority projects were selected and technical viability and financial affordability were identified. We recommend that the Government of the Republic of Kenya and the Nairobi City Council who is an executing agency of the projects should promote all priority projects to the next stage of project implementation at the earliest possible time.

Finally, we wish to take this opportunity to express our sincere gratitude to the Government of Japan, particularly, JICA, the Ministry of Foreign Affairs, the Ministry of Health and Welfare, Osaka City Government and other offices concerned. We also wish to express our deep appreciation to the Ministry of Local Authorities, the Nairobi City Council and other authorities concerned of the Government of the Republic of Kenya for the close cooperation and assistance extended to the JICA Study Team during the study.

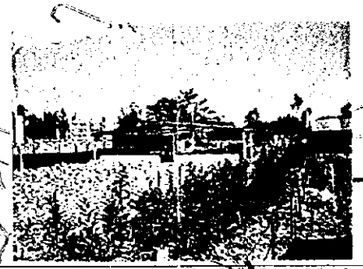
Very truly yours,

Takao Yoshida
Team Leader
JICA Study Team



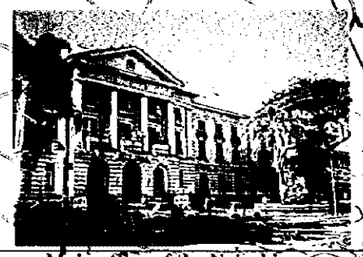
LOCATION MAP

Collection operation by NCC in the middle income area



Composting plant at the Hawkers Market

Existing final disposal site at Dandora



Main office of the Nairobi City Council (NCC)

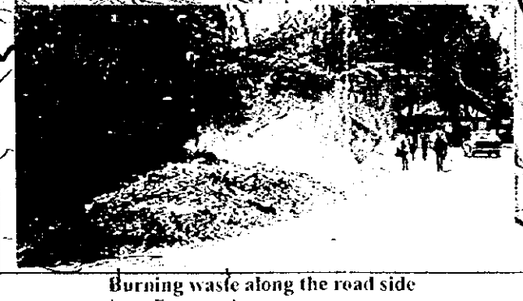
Remaining heap of garbage in the city centre

Containers on the road

Kaloleni Cleasing Depot

NCC Workshop

Kibera Slum, one of the largest slum in the city



Burning waste along the road side

Existing Conditions of Solid Waste Management in Nairobi City

COMPOSITION OF FINAL REPORT

Volume 1:	Executive Summary
Volume 2:	Main Report (Master Plan Study)
Volume 3:	Main Report (Feasibility Study)
Volume 4:	Supporting Report
Section A:	Waste Generation and Compsition Analysis
Section B:	Institutional and Organisational Study
Section C:	Legal Study
Section D:	Private Sector Involvement in Solid Waste Management
Section E:	Collection and Transportation Study
Section F:	Environmental Considerations
Section G:	Waste Reduction, Recycling and Intermediate Treatment
Section H:	Final Disposal
Section I:	Environmental Impact Assessment
Section J:	Economic and Financial Aspect
Section K:	Public Eduation and Social Considerations
Volume 5:	Data Book (1)
Volume 6:	Data Book (2)
Volume 7:	Drawings

OUTLINE OF THE STUDY

1. GENERAL

1.1 Objectives of the Study

The objectives of the Study are:

(1) to formulate a master plan for the improvement of solid waste management (SWM) in Nairobi City with emphasis on operational, institutional and administrative aspects for the target year 2008;

(2) to conduct a feasibility study on the priority project(s) to be selected from the master plan; and

(3) to transfer technology on solid waste management to counterpart personnel in the course of the Study.

1.2 Study Area

The Study Area is the area under the jurisdiction of the Nairobi City Council (NCC).

1.3 Types of Solid Waste

Types of solid waste studied were limited to household waste, market waste, commercial waste, street sweeping waste and office waste. The study on industrial and medical wastes was confined to only policy suggestions and recommendations in the master plan study.

2. IDENTIFICATION OF KEY ISSUES AND PROBLEMS

There are many causes preventing NCC from conducting better SWM services. The major problems, which were considered to be the key issues for the Master Plan formulation, are as enumerated below.

(1) Low level of waste collection rate;

(2) Lack of spare parts and long procedure for procurement of parts;

(3) Non-involvement of NCC on waste reduction and resource recovery;

(4) Illegal and uncontrolled disposal of waste;

(5) Open dumping and no ample space available at the Dandora disposal site;

(6) No comprehensive national law on SWM;

(7) Inefficient institutional and organisational arrangements of NCC;

(8) Uncontrolled private sector involvement on waste collection services;

(9) Lack of financial sources for investment and operation;

(10) Improper budgetary system failing to secure financially sound operation; and

(11) Lack of public awareness about SWM problems facing the city.

3. FRAMEWORK OF THE MASTER PLAN

3.1 The Responsibility of Each Party Concerned

In order to determine the policy on SWM, the responsibility of each party concerned has been clarified. These responsibilities are:

(1) The government shall be responsible for the provision of financial sources, technology development and legislative setup;

(2) The local authority shall be responsible for the provision of sufficient facilities and regulations for SWM services; and,

(3) The beneficiaries shall be responsible for cooperating with the local authority on the discharge of waste and on bearing the charges.

The responsibility of the local authority is the most important to establish an efficient municipal solid waste management system for Nairobi City. Its duty is defined in the following statement:

"NCC has the primary duty of care for SWM in Nairobi City through regulation and services."

3.2 Primary Objectives of Solid Waste Management

The primary objectives of the solid waste management by NCC are proposed to be applied commonly to every municipality so as to achieve the goals of better living environment such as the following three items:

(1) Improvement of Public Cleanliness;

(2) Improvement of Public Health; and

(3) Protection of the Environment.

3.3 Planning Directions of the Master Plan

The Master Plan for the improvement of SWM in Nairobi City is formulated in three (3) stages of action plans; namely, the First Implementation Stage (ended in the 2nd to 3rd year), the Second Implementation Stage (ended in the 5th year), and the Third Implementation Stage (ended in the target year, i.e., the 10th year). The action plans are formulated through two approaches: (1) technical approach, and (2) institutional and financial approach. The major planning items of the Master Plan are as summarised below.

(1) Technical Approach for the Master Plan

(a) Collection and Transportation Plan

(b) Waste Reduction, Recycling and Intermediate Treatment Plan

(c) Final Disposal Plan

(2) Institutional and Financial Approach for the Master Plan

(a) Institutional Restructuring Plan

(b) Legal Restructuring Plan

(c) Private Sector Involvement Plan

(d) Financial Improvement Plan

(e) Public Education and Awareness Plan

4. BASELINE PROJECTION OF POPULATION AND SOLID WASTE GENERATION

The population projection shows a growth rate of 4.70% per annum from 1998 to 2008. Solid waste generation by the year 2008 have been estimated based on this population projection and the field survey results as shown below.

Baseline Projection of Population and Solid Waste Generation

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Nairobi Population ('000)	2,294	2,397	2,500	2,616	2,737	2,867	3,012	3,148	3,300	3,461	3,630
Waste Generation (ton/day)	1,509	1,595	1,684	1,785	1,893	2,009	2,141	2,269	2,413	2,566	2,730

5. Formulation of the Master Plan

5.1 Main Goals and Project Components

Main goals and project components of the Master Plan are tabulated below.

Main Goals and Project Components of the Master Plan

Action Plan	Main Goals	Project Components
Technical Approach		
Collection and Transportation	• 100% of collection coverage rate • More private participation in collection services	• Introduction of container system, combining side loaders, dump trucks (tippers), wheel loaders, etc. • Construction of a transfer station • Construction of a new small workshop and parking lot • Community Waste Management Project (CWMP)
Waste Reduction, Recycling and Intermediate Treatment	• Reduction of waste by 5% at generation source • Resource recovery of 5%	• Establishment of a special task team under the Community Development Section in DoE • Public campaign and education
Final Disposal	• Operation of an effective sanitary landfill • Preparation of post-closure plan • Minimisation of secondary pollution	• Closure of the existing dumpsite at Dandora • Construction of a new final disposal site at Ruai
Institutional and Financial Approach		
Institutional Restructuring	• Establishment of an effective organisation structure • Formulation and implementation of effective policy/planning • Development of good human resources	• Preparation of a comprehensive national strategy and plan for SWM by MENR • Reorganisation of the DoE • Restructuring the Cleansing Section • Development of key management capabilities by Capacity Building Assistance Program (CBAP)
Legal Restructuring	• Enactment of a new SWM By-law	• Establishment of a new Environmental Planning and Management Division • Formatting and drafting of By-laws

Main Goals and Project Components of the Master Plan (Cont'd.)		
Action Plan	Main Goals	Project Components
Private Sector Involvement	• 20% of collection coverage rate including contracts • Encouragement and assistance to recycling companies	• Establishment of a new Contract Management Section • Set up of each contract and contracting process by the Contract Team
Financial Improvement	• Attain financial autonomy • Increase revenue from solid waste charges • Increase solid waste tariff to an appropriate level • Maintain viability of budgeting	• Establishment of a new waste charge system • Improvement of the budgeting/accounting system • Seeking new financial sources including government subsidies and foreign aids
Public Education and Awareness	• Continuous public campaign and education • Regular education at schools/churches	• Establishment of a new Community Development Section in the DoE

5.2 Step-by-Step Implementation and Target Waste Collection Rate

Since the current waste collection rate, i.e., the proportion of amount of waste collected to the total amount of waste generated, is very low at approximately 25%, a stepwise increase in waste collection rate is to be made in each stage to attain the goal of 100%. In the initial stage of the project, the collection rate is proposed at more than half of the generated waste, i.e., 60% to realise visible improvement of the environmental condition. The collection rate will accordingly go up to 80% in the second stage in 2004, and 100% by the year 2008.

5.3 Financial Evaluation

5.3.1 Total Capital Cost in Years 1999 to 2008

The total capital cost in the years 1999 to 2008 is summarised below.

Total Capital Cost, 1999-2008		
(1)	CBAP	Kshs 48 million
(2)	Final Disposal (Ruai, 40ha)	Kshs 1,969 million
(3)	Collection and Transportation	Kshs 4,282 million
	Total	Kshs 6,297 million (US$107 million)
Note: Required number of vehicles in 2008: 139 Container trucks (8m^3), 3,143 containers, 40 trailer trucks (20m^3), 67 side loaders, 32 dump trucks, 32 wheel loaders, 5 water tankers, 22 inspection vehicles and 2 tow truck)		

5.3.2 Requirements for the Collection of Waste Charge

Based on the above capital costs, three kinds of financing are considered to calculate the waste charge: loan 100%, grant aid 50% and loan 50%, and grant aid 100%. The required waste charge for households is the same whatever is the financing source since the household charge compensate for O&M costs and depreciation for each year. The required charges and balance (negative figures in the balance indicate the required amount of subsidy) are estimated as follows:

Three Financial Sources to Calculate Waste Charge					
Kind of Finance		2000	2004	2008	Average/Sum
Loan 100%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	599	867	1,117	804
	Tipping (Kshs/ton)	84	114	106	106
	Balance (Kshs million)	-141	-549	-834	-4,241
Grant 50% and Loan 50%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	469	688	891	638
	Tipping (Kshs/ton)	58	102	93	93
	Balance (Kshs million)	0	-152	-450	-1,367
Grant 100%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	469	589	757	561
	Tipping (Kshs/ton)	58	91	83	83
	Balance (Kshs million)	0	0	0	0

Another study case has been prepared on the condition that the collection coverage rate is reduced from 60% to 40% in 2000, 80% to 50% in 2004 and 100% to 60% in 2008. This reduced level of services will require collection of the waste charges of Kshs 165 to 211 per household per month from 2000 to 2007 and Kshs 266 in 2008. The capital costs will be Kshs 4,901 million (US$83 million) in total in the period 1999-2008 in this case.

5.4 Preparatory Actions by NCC

The JICA Study Team strongly recommends that the Nairobi City Council (NCC) should take the following actions which are thought to be self-endeavouring actions without a large capital investment in order to facilitate the proposed projects in the Master Plan.

(1) Organisational Strengthening of the Department of Environment (DoE)

  (a) implementing changes to the existing organisational structure.

  (b) setting up of a number of new sections and functions, and appointing new managers and staff.

(1) Establishment of Financial Autonomy

(2) Promotion of Private Sector Involvement (PSI)

(3) Improvement of the Dandora Dumpsite

(4) Improvement of Collection and Transportation Operations

5.5 Urgent Improvement Plan

Due to rapid urbanisation including population increase in Nairobi, the present capacity for waste collection and disposal could not cope with the increase of waste generated in the near future. To at least maintain the current situation, the urgent improvement projects are required to be carried out as quickly as possible since the actual increase of collection ratio will arise from the year 2000 due to the arrangement and preparation of financial resources. The urgent improvement projects comprise the following:

(1) Augmentation of Existing Collection Vehicles

Fifteen (15) dump trucks that are the same as the average available number of vehicles are recommended to be procured. The specification of trucks is also the same as those purchased in 1997.

(2) Improvement Work for the Dandora Dumpsite

DoE has to maintain the repaired bulldozer very well and also to permanently operate a reasonable number of heavy equipment at the site. The reasonable number of heavy equipment for daily management is three (3) bulldozers and one (1) excavator.

The Plan could commence from the year 1999, and the capital cost for the Plan is estimated at Kshs 82.6 million and the operation and maintenance (O&M) cost is Kshs 100.9 million. The total project cost of the Plan is Kshs 183.5 million.

Assuming that waste charge is collected at Kshs 100 per month per household and commercial establishment through each of the existing water account, revenue is estimated at Kshs 183.8 million which could fully cover the cost of the Plan.

6. FEASIBILITY STUDY FOR PRIORITY PROJECTS

6.1 Selection of Priority Projects

Based on the results of the Master Plan Study, the following four (4) plans are selected as priority projects of SWM with technical and financial optimality as well as urgency of issues taken into consideration. The priority projects shall be carried out in the First Implementation Stage, i.e., from 1999 to 2003.

(1) Institutional Restructuring and Financial Reform

(a) Implementation of Institutional Restructuring Plan and Capacity Building Assistance Program (CBAP)

(b) Collection of waste charge by using the present water charging system

(2) Promotion of Private Sector Involvement

(a) Continuation of the current CBD PSI Contract

(b) Implementation of the next PSI Contract in the Ngara area

(3) Construction of a New Final Disposal Site

(a) Construction of a new sanitary landfill site at Ruai

(b) Closure work of the existing dumpsite at Dandora

(4) Improvement of the Collection and Transportation System

(a) Introduction of container system with side loaders, dump trucks, etc.

(b) Construction of a transfer station

(c) Construction of a new small workshop at Kaloleni

(d) Implementation of the Community Waste Management Project

6.2 Project Evaluation

(1) Project Cost

(a) Capital Cost (including Engineering)

(1)	CBAP	Kshs 48 million
(2)	Final Disposal	Kshs 1,822 million
(3)	Collection and Transportation	Kshs 1,984 million
	Total	**Kshs.3,854 million (US$66 million)**
Note:	Required number of vehicles in 2000: 47 Container trucks ($8m^3$), 1008 containers, 11 trailer trucks ($20m^3$), 22 side loaders, 10 dump trucks, 10 wheel loaders, 2 water tankers, 22 inspection vehicles and 1 tow truck	

(b) Waste Charge

Household	Kshs 211/month (average, 1997 price, 3 classes depending on water consumption)
Commercial	Kshs 437/month (average, 1997 price)
Tipping	Kshs 89/ton (average, 1997 price) (All charges are subject to the case of grant aid 100%)

(2) Consideration of Service Level and Initial Investment Reduction

Even if the residents are agreeable to the payment of Kshs 100 in accordance with the new NCC's By-laws, the above waste charge would still be higher than this level. Therefore, the following is alternatively considered.

Firstly, reduction of service level is considered not only from the viewpoint of revenue but on how the new system can be started without difficulty. Thus, the target levels are decided as 40% in 2000-2003, as mentioned in the Master Plan Study.

Secondly, reduction of the initial investment is introduced as follows:

(a) the construction of transfer station is delayed to the Second Implementation Stage and direct transportation system is employed in the First Implementation Stage; and

(b) the sanitary level of landfill system for the new disposal site is reduced to Level 2+.

As a result, Kshs 48 million for CBAP, Kshs 522 million for PSI contract and Kshs 12 million for CWMP are not changed. The new final disposal site requires Kshs 64 million for O&M, Kshs 33 million for depreciation, and Kshs 1,383 million for initial investment. The collection/transportation system requires Kshs 1,161 million for O&M, Kshs 199 million for

depreciation, and Kshs 539 million for initial investment. (Required number of vehicles in 2000: 23 container trucks ($8m^3$), 507 containers, 6 trailer trucks ($20m^3$), 11 side loaders, 5 dump trucks, 5 wheel loaders, 1 water tanker, 22 inspection vehicles and 1 tow truck). The total capital cost is Kshs 2,059 million (US$35 million). The waste charge from households is Kshs 135/month (average, 1997 price, 3 classes depending on the water consumption) and the commercials and tipping are Kshs 279/month and Kshs 88/ton, respectively, for the case of grant aid 100%.

(3) Consideration of the Project Implementation

It is recommendable that the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out all the priority projects in the First Implemenation Stage, i.e., from 1999 to 2003. However, in case that the revenue necessary to implement the projects is not enough because of financial constraints, some of the projects may have to be deferred to the next implementation stage.

In considearion of the possibility of securing special funds from the central governments and/or grant aid from other governments, the priority projects as considered in this Study may be divided into smaller project units which can be executed as independent projects as shown below.

Priority	Project	Prerequisite	Required Capital Cost (million Kshs)
1	Institutional Restructuring and Financial Reform under the Capacity Building Assistance Program (CBAP)	Implementation of Preparatory Actions by NCC	47.8
2	Construction of a new small workshop at Kaloleni	-ditto-	88.2
3	Introduction of container system with side loaders, dump trucks, etc.	Implementation of Preparatory Actions by NCC; and After start-up or in parallel with the above CBAP	447.2
4	Construction of a new sanitary landfill site at Ruai (First Stage)	Implementation of Preparatory Actions by NCC and the Urgent Improvement Plan; and After start-up or in parallel with the above CBAP	455.4
5	Procurement of heavy equipment for the new landfill site	-ditto-	89.1
6	Closure work of the existing dumpsite at Dandora	-ditto-	227.0
7	Implementation of the Community Waste Management Project (CWMP)	Implementation of Preparatory Actions by NCC	12.0 (for 5 years)
8	Construction of a transfer station	Implementation of Preparatory Actions by NCC and the Urgent Improvement Plan; and After start-up or in parallel with the above CBAP	945.0

7. CONCLUSION

To improve public health and sanitation and to protect the environment, the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out the priority projects in the First Implementation Stage, i.e., from 1999 to 2003.

8. RECOMMENDATION

The JICA Study Team recommends that the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out the priority projects in the First Implementation Stage, i.e., the years 1999 to 2003. The priority projects should be followed by the Preparatory Actions and Urgent Improvement Plan.

With regard to project implementation, the following actions are recommended to be carried out with dedication and dispatch:

(1) Drafting of a new SWM By-laws.

(2) Restructuring the organisation and financial system of the Department of Environment, Nairobi City Council.

(3) Making arrangements with the central government and donor countries or agencies in order to secure financing for the implementation of the projects.

THE STUDY ON SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN THE REPUBLIC OF KENYA

FINAL REPORT

EXECUTIVE SUMMARY

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ABBREVIATIONS AND ACRONYMS

ASG	Apparent Specific Gravity
BOD	Biochemical Oxygen Demand
BOOT	Build, Own, Operate and Transfer
CBAP	Capacity Building Assistance Program
CBD	Central Business District
CBO	Community-Based (Voluntary) Organisation
CBP	Capacity Building Program
CDP	Communal Disposal Point
CDS	Community Development Section
CED	City Engineer's Department
CGT	Clean and Green Towns
CI	City Inspectorate
CME	Chief Mechanical Engineer
CMS	Contract Management Section
COD	Chemical Oxygen Demand
DI	District Inspectors
DoE	Department of Environment
DoPH	Department of Public Health
DSO	Deputy Superintendent Operations
EIA	Environmental Impact Assessment
EPM	Environmental Planning and Management Division
FIDIC	Federation Internationale Des Ingeneurs Counsels
FIRR	Financial Internal Rate of Return
FSDA	Foundation of Sustainable Development in Africa
GDP	Gross Domestic Product
GEMS	Global Environmental Monitoring System
GOK	Government of Kenya
GPT	Graduated Personal Tax
GTZ	Deutsche Gesellschaft Techniche Zusammenarbeit
HCDP	Horticultural Crops Development Authority
HIS	Health Inspectorate Section
HRMU	Human Resource Management Unit
HRP	Human Resource Plan
IEE	Initial Environmental Examination
IPC	Investment Promotion Centre
IRP	Institutional Restructuring Plan
JICA	Japan International Cooperation Agency
KBS	Kenya Broadcasting System
KCPC	Kenya Certificate of Primary Education
KIM	Kenya Institute of Management
LRP	Legal Restructuring Plan
MENR	Ministry of Environment and Natural Resources
MIS	Management Information System
MOH	Ministry of Health
MOIC	Ministry of Industry and Commerce
MOLG	Ministry of Local Government

MOWD	Ministry of Water Development
MSW	Municipal Solid Waste
MYSA	Mathare Youth Sports Organisation
NCC	Nairobi City Council
NEAP	National Environmental Action Plan
NES	National Environmental Secretariat
NGO	Non-Governmental Organisation
NICs	Newly Industrialized Countries
NYS	National Youth Service
PHO	Public Health Officer
PHT	Public Health Technician
PIs	Performance Indicators
PRS	Public Relations Section
PSC	Public Service Commission
PSI	Private Sector Involvement
PSIA	Programme Support Implementation Arrangement
RDF	Refuse Derived Fuel
SAL	Social Affordable Limit
SDO	Social Development Officer
SPEK	Society for Protection of the Environment in Kenya
SPHO	Senior Public Health Officer
SPHT	Senior Public Health Technician
SPM	Suspended Particular Matter
SWM	Solid Waste Management
TA	Technical Assistance
TO	Transport Officer
TOR	Terms of Reference
UAP	Urban Agriculture Project
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UWASM	Urban Water and Sanitation Management
VAT	Value Added Tax
VFM	Value for Money
WHO	World Health Organisation
WSD	Water and Sewerage Department

EXECUTIVE SUMMARY

1. GENERAL

1.1 Background of the Study

The City of Nairobi is the capital of the Republic of Kenya and the largest administrative, commercial and industrial centre of the country. Nairobi City is experiencing a rapid population growth largely due to rural-urban migration and natural rate of increase. The present population of Nairobi City is estimated at 2.2 million and is growing at the rate of 4 to 5% per annum.

As a result of population increase, the generation rate of solid waste which is now about 1,500 ton/day, is increasing. The present capacity of refuse collection and disposal cannot now cope with this situation, resulting in a large volume of waste uncollected, or dumped along streets, side ditches and other areas inside the city.

The condition is creating hygienic, environmental, as well as aesthetic problems. Since the final disposal site is an open dumping type landfill at approximately 8 km southeast of the city centre, it also has a detrimental effect on the surrounding environment, due not only to the generation of offensive odour and gases but also to the associated problem of insects and animal pests.

To improve the City's environmental and sanitary conditions, the Nairobi City Council (the authority concerned in the City of Nairobi, hereinafter referred to as "NCC") has recognised the necessity of a solid waste management master plan, including institutional and administrative strengthening strategies. The Government of Kenya (hereinafter referred to as "GOK"), therefore, requested the Government of Japan (hereinafter referred to as "GOJ"), in 1993, to provide technical assistance for this ***Study on Solid Waste Management in Nairobi City in the Republic of Kenya*** (hereinafter referred to as "the Study").

In response to the request of the GOK, the GOJ decided to conduct the Study in accordance with the relevant laws and regulations of Japan. The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the agency responsible for the implementation of technical cooperation programs of the GOJ, made a preparatory survey, and the implementing arrangement for the technical assistance was agreed upon among the Ministry of Finance of GOK, Ministry of Local Government of GOK, NCC of GOK, and JICA of GOJ in October, 1996.

1.2 Objectives of the Study

The objectives of the Study are:

(a) to formulate a master plan for the improvement of solid waste management (hereinafter referred to as "SWM") in Nairobi City with emphasis on operational, institutional and administrative aspects at the target year 2008;

(b) to conduct a feasibility study on the priority project(s) to be selected from the master plan; and

(c) to transfer technology on solid waste management to counterpart personnel in the course of the Study.

1.3 Study Area

The Study Area is the area under the jurisdiction of the Nairobi City Council (NCC). In cases where a proposed landfill site is out of Nairobi City, the site is included in the study area.

1.4 Types of Solid Waste

Types of solid waste to be studied are limited to household waste, market waste, commercial waste, street sweeping waste and office waste. The study on industrial and medical wastes was confined to only policy suggestions and recommendations in the master plan study.

1.5 Study Schedule and Staff

The Study, in principle, was to be carried out through field studies in Kenya and home office studies in Japan from March 1997 to June 1998. The total duration of the Study is approximately 15 months. Six (6) kinds of report were to be prepared and submitted; i.e., Inception Report, Progress Report (1), Interim Report, Progress Report (2), Draft Final Report, and Final Report. Workshops for technical transfer were held thrice in the second field studies in Kenya.

The organisation for the Study is composed of the JICA Advisory Committee and the JICA Study Team with Kenyan counterparts. The function of the JICA Advisory Committee is to give necessary advices on the Study to JICA.

2. IDENTIFICATION OF KEY ISSUES AND PROBLEMS

2.1 Institutional, Organisational and Legal Issues

2.1.1 National Level

The Ministry of Environment and National Resources (MENR) and the Ministry of Local Government (MOLG) are responsible for solid waste management (SWM) in the national level. Efforts to cope with the issues related to SWM have, however, become deficient due to the rapid increase of urbanisation as mentioned before. The following are pointed out as examples:

(1) A comprehensive national law on SWM is not available at present and there is no specific agency designated to issue permits and licenses to solid waste operators; and

(2) There is little coordination and linkage between institutions involved inSWM.

2.1.2 Nairobi City Council

The Department of Environment (DoE) under the Nairobi City Council (NCC) is making all efforts to provide adequate SWM services. Such efforts have however become deficient due to accumulation of waste as an offshoot of the rapid urbanisation in Nairobi. Some of such deficiencies are as follows:

(1) Deficient organisation, management and financing for SWM;

(2) Insufficient funds to sustain the efficient operation of vehicles, equipment and manpower; and

(3) Unclear environmental regulations and monitoring, human resource management, financial management, and public awareness and educational program on SWM.

2.2 Private Sector Involvement in SWM

NCC estimates that there are about 60 private collection companies operating in Nairobi. NCC had contracted waste collection and street cleansing services in the Central Business District (CBD) of Nairobi to a private contractor, Kenya Refuse Handlers Ltd., which is presently providing satisfactory collection services to mostly commercial establishments. The physical monitoring arrangements for the CBD contract are sufficient but need appropriate development.

2.3 Collection and Transportation System

The remarkable increase of waste generated in the city has resulted in insufficient waste collection services due mainly to rapid urbanisation. The average amount of solid waste carried by collection vehicles is approximately 370 tons per day. NCC collects about 22% of the total amount, and privates collect 32%. The contract in the Central Business District (CBD) has the largest part of waste amount collected in the city, i.e., 46%. The collection coverage ratio, i.e., proportion of the amount of waste collected to the total amount of waste generated is very low at about 25%.

The NCC collection method depends primarily on the station type of collection which seems to be deficient in covering all the city due to the extremely insufficient number of collection vehicles, i.e., only 10 to 15 vehicles are operating. In addition, daily operation totally depends on manual loading of waste. Besides, the DoE seems to be unable to deal autonomously with the procurement of spare parts and other materials, and procurement of spare parts usually takes a long procedure resulting in the low vehicle availability for solid waste operations.

2.4 Waste Reduction, Recycling and Intermediate Treatment

NCC has been dumping municipal solid waste at the Dandora dumpsite without intermediate treatment. Solid waste recycling or resource recovery is carried out by community based self-help groups and recycling industries. The involvement of NCC in the activities of the community groups, scavengers and recycling industries is essential to improve and develop waste reduction, recyling and so on more effectively and efficiently.

2.5 Final Disposal System

There is only one landfill site, i.e., the Dandora, which is 7.5 km to the southeast of the centre of Nairobi. The site is filled with approximately 1.3 million m^3 waste at present. Due to insufficient funds, proper landfill operations to prevent secondary pollution seems to be deficient. There is a high risk of environmental pollution which may affect the health of scavengers and neighbouring residents.

2.6 Environmental Problems Due to Solid Waste

2.6.1 Water Pollution

A long time delay in waste collection generates a foul smelling black liquid called leachate which is considered as a high polluter when it reaches watercourses due to its high BOD, COD and chemical concentration.

2.6.2 Air Pollution

The physical reduction of the amount of waste by means of burning has been established as a common practice in Nairobi City. This practice, which causes air pollution, can be attributable mainly to the inadequate collection service given to the residents.

2.6.3 Landscape

Actually, in the urban area of the city, solid waste can be found everywhere having a high negative impact on the environment.

2.6.4 Public Health

The uncollected solid waste causes not only bad sanitary condition but also health risks to the residents. Most severely affected are those located in the low income areas and slums where uncollected solid wastes contribute to the high rate of disease incidence. Around the Dandora disposal site, interviewed people had mentioned cases of respiratory and stomach problems among children and adults due to the smoke and smell coming from the site.

2.7 Economic and Financial Aspect

Concerning the balance sheet of NCC for the last four years, the most noticeable point is the extremely high level of debtors. It reached K£129,069,523 as of 30th June, 1995, which is an increase by K£12,725 over the previous year (K£1 = Kshs 20). Running expenses of refuse vehicles were not realised fully until 1993/94 and a major part of supplies, services and equipment were not also realised. This may be due to expenditure estimates compiled with inadequate revenue estimate. Solid waste collection services offered by NCC are charged on the same bills of water related tariffs. Water charge, sewerage charge, other water related charges and solid waste (dust bin) charge collected are pooled in the Water Fund. The total billing amount is Kshs 100-120 million per month. About 10% is dust bin charges. New computer billing system will start in June, 1998 with the assistance of the World Bank. This new system will continue the billing of waste collection.

2.8 Public Education and Social Considerations

Strict resource constraints currently prevent NCC or DoE from taking the initiative with respect to the promotion of SWM education and public awareness. A number of groups are actively involved in the process of improving public awareness of SWM and related issues. A public education and awareness programme in co-operation with these groups, however, is still to be introduced.

3. FRAMEWORK OF THE MASTER PLAN

3.1 Principles and Guidelines for Establishment of SWM Framework

(1) Categories of Waste

Solid waste to be managed is categorised into municipal waste and non-municipal waste. Municipal waste is defined as solid waste that may be collected and disposed of by ordinary methods, which is the responsibility of the local government. In Nairobi, NCC is responsible for the management of municipal waste.

The types of municipal waste are as enumerated below.

(a) Household waste

(b) Business waste of small amount (less than 50 kg)

(c) Waste generated from public institutions such as schools

(d) Market waste

(e) Hospital waste that does not require any treatment

(f) Dead animals excluding domesticated animals (cattle and swine)

(g) Street waste excluding demolition waste dumped on streets

(h) Other wastes accepted by NCC as municipal waste

Non-municipal waste is waste designated to be not under NCC's responsibility but the responsibility of waste generators.

Waste categories and management responsibilities are summarised in **Table S3.1 1** below.

Table S3.1-1 Waste Category and Management Responsibility

Category of Waste	Management Responsibility	Remarks
1. Municipal waste	NCC	NCC collects bulky waste upon receipt of requests from citizens by charging a special tariff.
2. Non-municipal waste 2-1 Non-hazardous industrial and commercial waste of large amount 2-2 Demolition waste 2-3 Discarded vehicles 2-4 Hazardous waste including infectious hospital waste	Generators of waste (NCC should monitor generators' management of non-municipal waste until they establish a proper management system for these waste.)	NCC may accept waste 2-1 and 2-2 at its disposal site on full cost recovery basis. The central government should establish hazardous waste management (treatment) facilities.

(2) Responsibilities of the Central Government, NCC, Business Waste Generators and Residents

NCC must have the authority and responsibility for implementing solid waste management. As listed below, the other organisations involved in solid waste management are:

(a) the Central Government;

(b) the NCC;

(c) Contractors;

(d) Business (Industrial and Commercial) Waste Generators; and

(e) the Residents.

The proposed principal responsibilities of the respective organisations are as summarised in **Table S3.1-2** below.

Table S3.1-2 Parties Involved in Solid Waste Management and their Responsibilities

Parties Involved	Responsibilities
1. Central Government	(1) to formulate a national policy with respect to waste reduction, recycling and solid waste management. (2) to enact a national SWM law. (3) to set technical standards. (4) to research on solid waste management. (5) to ensure that laws and regulations are applied. (6) to provide guidance to local governments.
2. Nairobi City Council	(1) to formulate a local policy and prepare local strategies and plans (short and long term). (2) to finance SWM. (3) to levy waste tax. (4) to formulate regulations. (5) to formulate guidelines with respect to: (a) methods of discharging waste (types of containers to be used); (b) the waste reporting requirements of business waste generators; and, (c) recycling (types of waste to be recycled).
3. Contractors	(1) to provide waste collection, haulage and street sweeping services under contractual arrangements.
4. Business (Industrial and Commercial) Waste Generators	(1) to manage (collection, treatment and disposal) their waste except those accepted by the local government as municipal waste. (2) to submit reports on their waste (types, quantity, pretreatment and other information) as required by the municipal regulations.
5. Residents	(1) to reduce generation of waste. (2) to recycle waste. (3) to comply with the local government's waste collection procedure. (4) not to scatter waste. (5) to dispose of discarded vehicles by using commercial enterprises.

3.2 Formulation of SWM Policy

(1) The Responsibility of Each Party Concerned

In order to determine the policy on SWM, the responsibilities of each party concerned have to be clarified. Such responsibilities may be as follows:

(a) The government shall be responsible for the provision of financial sources, technology development and legislative set up;

(b) The local authority shall be responsible for the provision of sufficient facilities and regulations of SWM services; and,

(c) The beneficiaries shall be responsible for co-operating with the local authority on the discharge of waste and on bearing the charges.

The responsibility of the local authority is the most important to establish an efficient municipal solid waste management system for Nairobi City. It is defined in the following statement:

"NCC has the primary duty of care for SWM in Nairobi City through regulation and services."

(2) Primary Objectives of Solid Waste Management

The primary objectives of the solid waste management are proposed to be applied commonly by NCC in every municipality to achieve the goals of better living environment such as the following three items:

(a) Improvement of Public Cleanliness;

(b) Improvement of Public Health; and

(c) Protection of the Environment.

3.3 Planning Strategy

To achieve the primary objectives, the strategic approach to formulate the SWM Master Plan for NCC are proposed with the following six (6) items in consideration of solving the implicated constraints of the city towards improvement of technical and institutional deficiencies:

(1) Financial strengthening of SWM;

(2) Institutional capacity building;

(3) Improvement of SWM operational capacity;

(4) Private sector involvement (PSI) in SWM;

(5) Public awareness and participation of communities and NGOs; and

(6) Promotion of waste reduction at source and resource recovery.

3.4 Planning Directions of the Master Plan

The Master Plan for improvement of SWM in Nairobi is formulated in three stages of action plans; namely, the First Implementation Stage (ended in the 2nd to 3rd year), the Second Implementation Stage (ended in the 5th year), and the Third Implementation Stage (ended in the target year, i.e., the 10th year). The action plans are formulated through two approaches: (1) technical approach, and (2) institutional and financial approach. The major planning items of the Master Plan are summarised below.

(1) Technical Approach for the Master Plan

(a) Collection and Transportation Plan

(b) Waste Reduction, Recycling and Intermediate Treatment Plan

(c) Final Disposal Plan

(2) Institutional and Financial Approach for the Master Plan

(a) Institutional Restructuring Plan

(b) Legal Restructuring Plan

(c) Private Sector Involvement Plan

(d) Financial Improvement Plan

(e) Public Education and Awareness Plan

The interrelation of objectives, strategies and planning directions is as illustrated in **Figure S3.4-1**.

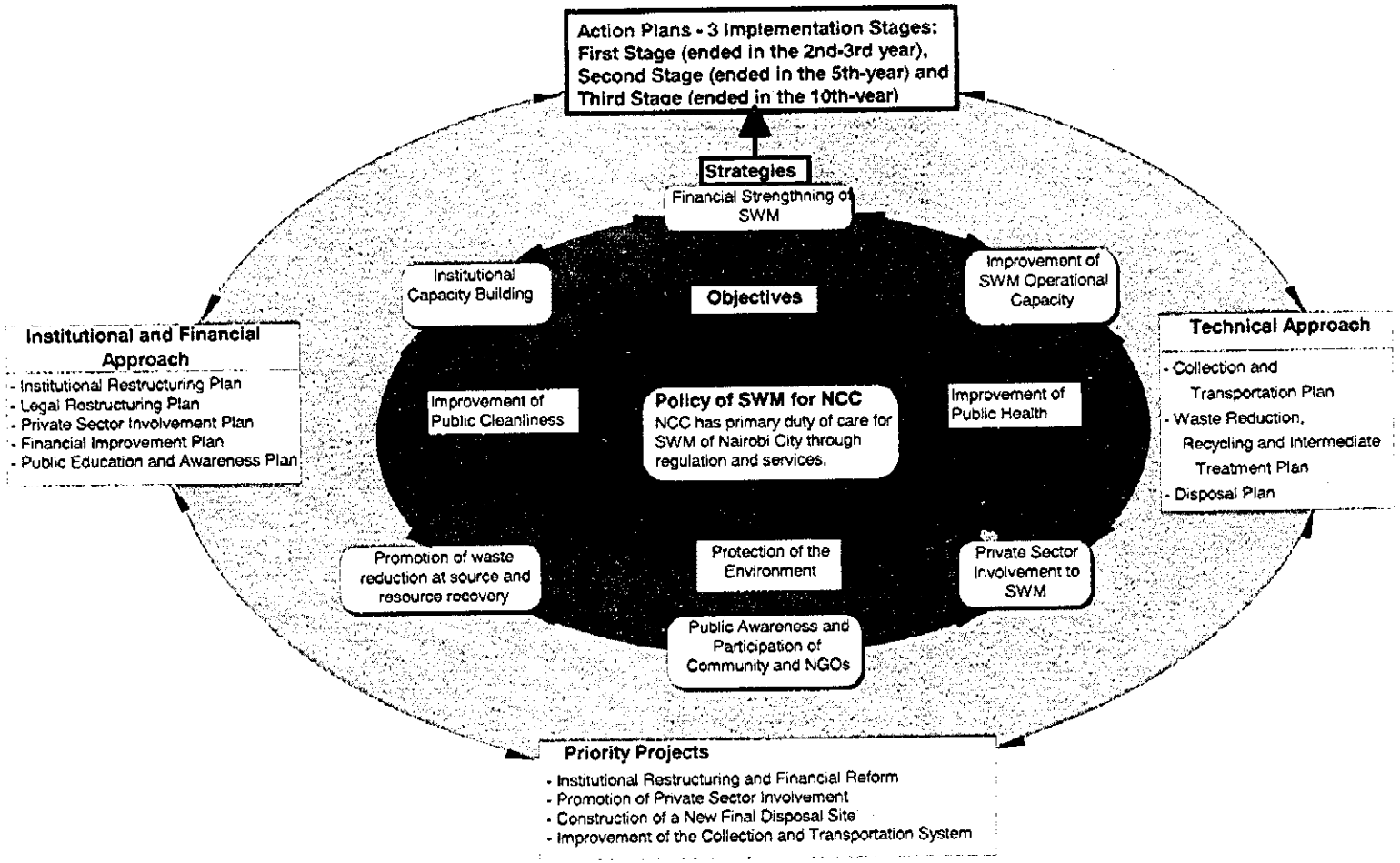

Figure S3.4-1 Framework of the Solid Waste Management Master Plan for Nairobi City

4. BASELINE PROJECTION OF POPULATION AND SOLID WASTE GENERATION

4.1 Population Projection

The population projection shows a growth rate of 4.70% per annum from 1998 to 2008.

Table S4.1-1 Population Projection in Nairobi City

(Unit: 1,000)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Kenya	29,010	29,746	30,473	31,189	31,896	32,588	33,264	33,922	34,561	36,178	35,773	36,344
Nairobi	2,191	2,294	2,397	2,500	2,616	2,737	2,867	3,012	3,148	3,300	3,461	3,630
Share	7.55%	7.71%	7.87%	8.02%	8.20%	8.40%	8.62%	8.88%	9.11%	9.12%	9.67%	9.99%

Source: *MOLG; Economic Survey 1996, and the JICA Study Team*

4.2 Projection of Waste Generation

Future solid waste generation by the year 2008 have been estimated based on the field survey results.

Table S4.2-1 Projection of Waste Generation in Nairobi City

Unit: ton/day

	1997	1998	2000	2004	2008
Household	1181.1	1251.1	1398.9	1784.1	2283.3
Commerce	93.5	97.9	106.7	128.5	154.9
Market	82.5	86.3	94.1	113.4	136.6
Road	69.0	73.9	84.8	114.4	155.3
Total	1,426	1509	1,684	2,140	2,730

5. FORMULATION OF THE MASTER PLAN

5.1 Collection and Transportation Plan

(1) Objective

The primary objective of the Collection and Transportation Plan is to increase the collection service coverage in order to maintain public health and cleanliness, and to protect the City's environment.

(2) Planning Policy

The NCC is firstly to provide a minimum level of service throughout Nairobi. Minimum level of service is defined as collection service to be conducted once a week from communal collection points.

(3) Strategy

(a) A collection and transportation system which is the most economical and efficient as well as the least socially and environmentally harmful, shall

be adopted, in comparison with possible technical options such as station type and door-to-door type collection as well as direct and indirect transport methods.

(b) Apart from contracting areas of collection to private companies, NCC shall provide collection services equally to residents.

(c) NCC shall promote and make the greatest use of private sector involvement (PSI) in terms of collection services with full management control by the private sector.

(d) Community based waste management in the informal settlements shall be considered to enhance collection and transportation operations by using communal collection points.

(e) Improvement of the existing vehicle operation and maintenance system in the Department of Environment of NCC shall be carried out to increase the availability of collection vehicles.

(4) Goal

(a) To increase the collection efficiency and capacity with the collection ratio targeted at 100% for NCC and private companies at the ratio of 80% and 20%, respectively.

(b) To encourage more participation of private companies in the collection services.

(c) To attain full control of collection services by NCC.

(5) Recommendation

(a) Container system should be introduced with supplementary use of side loaders, dump trucks (tippers) and wheel loaders. Also, the appropriate number of staff is required to operate and maintain this system. The required number of the vehicles, equipment and manpower is shown below.

Table S5.1-1 Required Vehicles, Equipment and Manpower for Collection and Transportation Plan

No	Items	Quantity								
		2000	2001	2002	2003	2004	2005	2006	2007	2008
1	Detachable-container truck	45	47	49	51	83	87	92	97	139
2	Container	1008	1055	1104	1156	1873	1968	2074	2186	3143
3	Side loader	22	23	24	25	40	42	45	47	67
4	Dump truck	10	11	11	12	19	20	21	22	32
5	Wheel loader	10	11	11	12	19	20	21	22	32
6	Water sprinkler	2	2	2	2	3	3	3	4	5
7	Driver	128	133	137	143	214	223	233	244	339
8	Loader	224	235	246	258	418	439	463	489	703
9	Sweeper	672	704	738	774	1253	1318	1390	1466	2110
10	Supervisor	100	104	109	114	183	192	203	213	306
11	Headman	45	47	49	52	84	88	93	98	141

(b) Transfer station should be constructed to improve the efficiency of collection and transportation operation by reducing the transportation

time. However, the site and timing of construction will require further survey and analysis.

(c) The Department of Environment should have its own workshop for daily preventive maintenance of its collection vehicles. The new workshop is not necessarily comprehensive, but equipped with minimum level of tools and facilities. In addition, the increase in number of vehicles requires much more space for parking in the city.

(d) The Community Waste Management Project (CWMP) is proposed to increase the capacity of community based organisations in slum areas in order to effectively carry out collection and transportation of waste.

5.2 Waste Reduction, Recycling and Intermediate Treatment Plan

(1) Objective

The objective of the Waste Reduction Plan is to lighten the cost burden to NCC through reduction of solid waste amount for collection and disposal.

The objective of the Recycling Plan is to save finite resources and minimise landfill space as a result.

The objective of the Intermediate Treatment Plan is stabilisation and reduction of residuals in addition to resource recovery through waste conversion.

(2) Planning Policy

(a) The Waste Reduction Plan shall be formulated with a clear definition of responsibilities and functions of each party concerned, i.e., the central government, the local authority and the beneficiaries.

(b) Solid waste recycling shall make use of the existing functions of the community based organisations and the recycling industries to the maximum extent.

(c) The Intermediate Treatment Plan shall be formulated with the efficient use of technology applicable to Kenya so as not to cause a financial burden on SWM.

(3) Strategy

(a) Waste reduction shall be carried out for domestic, commercial and other business wastes.

(b) Formulation of the Waste Reduction Plan shall take public participation into consideration.

(c) NCC shall have the primary responsibility for promotion, guidance and assistance to the community groups, enterprises, recycling companies, etc., for organising the recycling groups and operations.

(d) Initial solid waste recycling shall be carried out mainly by materials recovery by the generators at sources and by the scavengers at the disposal site(s).

(c) Intermediate treatment or waste conversion through composting shall be introduced in the future.

(4) Goal

(a) To reduce waste by 5% at generation sources.

(b) To encourage participation of the central government, NCC, residents and enterprises.

(c) To attain resource recovery of 5% through participation of community based groups and NGOs.

(d) To attain resource recovery of 5-10% by scavengers.

(e) To encourage promotion, control and assistance by NCC on resource recovery activities.

(f) To encourage promotion, encouragement and assistance to recycling companies.

(g) To prepare a development plan for a pilot scale compost plant with the capacity of 50 tons per day for materials recycling and biological conversion processes.

(5) Recommendation

(a) Waste Reduction

For the implementation of a trial program called "waste generation source management", the more practical and promising methods are proposed so as to carry out the plan by means of programmes, as follows:

(i) Control of waste generation, including production control, distribution/sale control, consumer control, waste charge control and business waste control; and

(ii) Discharge control, including promotion of self-disposal/recovery.

The Community Development Section (CDS) shall execute public campaign and education with the most effective measures to encourage the people to change their present unsatisfactory practice of waste generation, discharge and recycling and to promote the participation of the public.

(b) Recycling and Resource Recovery

The CDS officials dispatched to the six collection district offices shall implement the waste reduction and recycling activities. The CDS shall initiate the programs to establish the system for waste separation, collection, transportation, sale routes through the educational campaign, installation of buy-back centres and co-operation by the recycling industries.

The public campaign, guidance and assistance shall be made continuously to develop the recycling activities.

5.3 Final Disposal Plan

(1) Objective

In the concept of final process of solid waste management (SWM) system, the objective of the Final Disposal Plan is to have the solid waste stabilised and be hygienic to prevent secondary pollution.

(2) Planning Policy

The sanitary landfill is evaluated to be the most appropriate disposal method from both economic and environmental viewpoints. Therefore, the final disposal plan shall be formulated for the construction and operation of a sanitary landfill.

(3) Strategy

The scale of sanitary landfill facilities and their operation shall take financial availability into consideration. Although it is preferable to provide two disposal sites for Nairobi City, considering the size of collection area and efficiency, the design should be examined also from the environmental and social points of view. Due to financial constraints concerning SWM financing, a phased construction of the disposal site shall also be considered.

(4) Goal

(a) To operate an effective sanitary landfill.

(b) To prepare a post-closure plan.

(c) To minimise secondary pollution.

(5) Recommendation

(a) The existing dumpsite at Dandora should be closed as soon as possible in consideration of the post-closure land use plan.

(b) A new final disposal site in the Ruai area is more recommendable than the Ngong Road Forest area as a result of the Environmental Impact Assessment.

(c) Sanitary landfill system should be introduced in the new final disposal site at Ruai.

(d) Proper operation and maintenance work should be required in the new final disposal site on a daily basis.

5.4 Institutional Restructuring Plan

(1) Objective

The Institutional Restructuring Plan (IRP) has three (3) objectives, as follows:

(a) To strengthen NCC's Department of Environment (DoE) so that it can effectively and efficiently manage its SWM responsibilities and services.

(b) To strengthen the Department of Environment so that it has the institutional capacity to manage and sustain the priority SWM projects proposed under the Master Plan.

(c) To propose a strategy for the future role and structure of the DoE as a whole.

(2) Planning Policy

(a) Some portions of the IRP shall be implemented fully or partially by NCC itself (Preparatory Actions).

(b) The IRP's actions are to be implemented under the Capacity Building Assistance Program (CBAP).

(c) The CBAP will comprise a mixture of direct implementation assistance combined with training provided in classes or workshops, covering a number of organisational areas.

(3) Strategy

(a) The IRP shall be made based on restructuring the existing organisational structure of the DoE's SWM functions.

(b) The IRP will establish a number of new functions, including the appointment of new managers and staff.

(c) The IRP will develop key management capabilities.

(4) Goal

(a) To establish an effective organisation structure.

(b) To formulate and implement an effective policy and planning.

(c) To develop good human resources.

(d) To appoint effective managers and supervisors.

(5) Recommendation

(a) The Ministry of the Environment and Natural Resources (MENR) should prepare a comprehensive national strategy and plan for solid waste management.

(b) The proposed organisational structure of the DoE is as shown in **Figure S5.4-1.** The structural changes can be summarised from the top down as follows:

(i) reorganise the DoE into four Divisions - SWM, Environmental Planning and Management, Administration, and Parks, and appoint four Deputy Directors to manage each of them.

(ii) in restructuring the Cleansing Section into the new SWM Division:

- create a new Community Development Section (CDS) and a new Contract Management Section (CMS) in the SWM Division;
- separate disposal from collection and street cleansing, set up a new Disposal Section in the Division and appoint a Disposal Manager for the Section;
- appoint an Operations Manager for the Collection and Street Cleansing Section;
- separate the daily management of collection from street cleansing; and
- reduce the number of vertical levels in the Division.

(iii) the new Administration Division will manage the DoE's Human Resources, Finance and Logistics which are each organised into a Section.

(iv) the new Environmental Planning and Management Division is organised into three Sections - Environmental Planning, Environmental Management, and Environmental Impact Assessment.

(c) DoE needs to develop a number of key management capabilities. It is recommended that the DoE should receive capacity building assistance from an Organisational and Management Consultant to assist DoE in developing these capabilities. These key capabilities are:

(i) effective senior management;

(ii) effective policy and planning;

(iii) setting objectives and measuring performance;

(iv) management information systems (MIS); and

(v) improving managers skills and effectiveness.

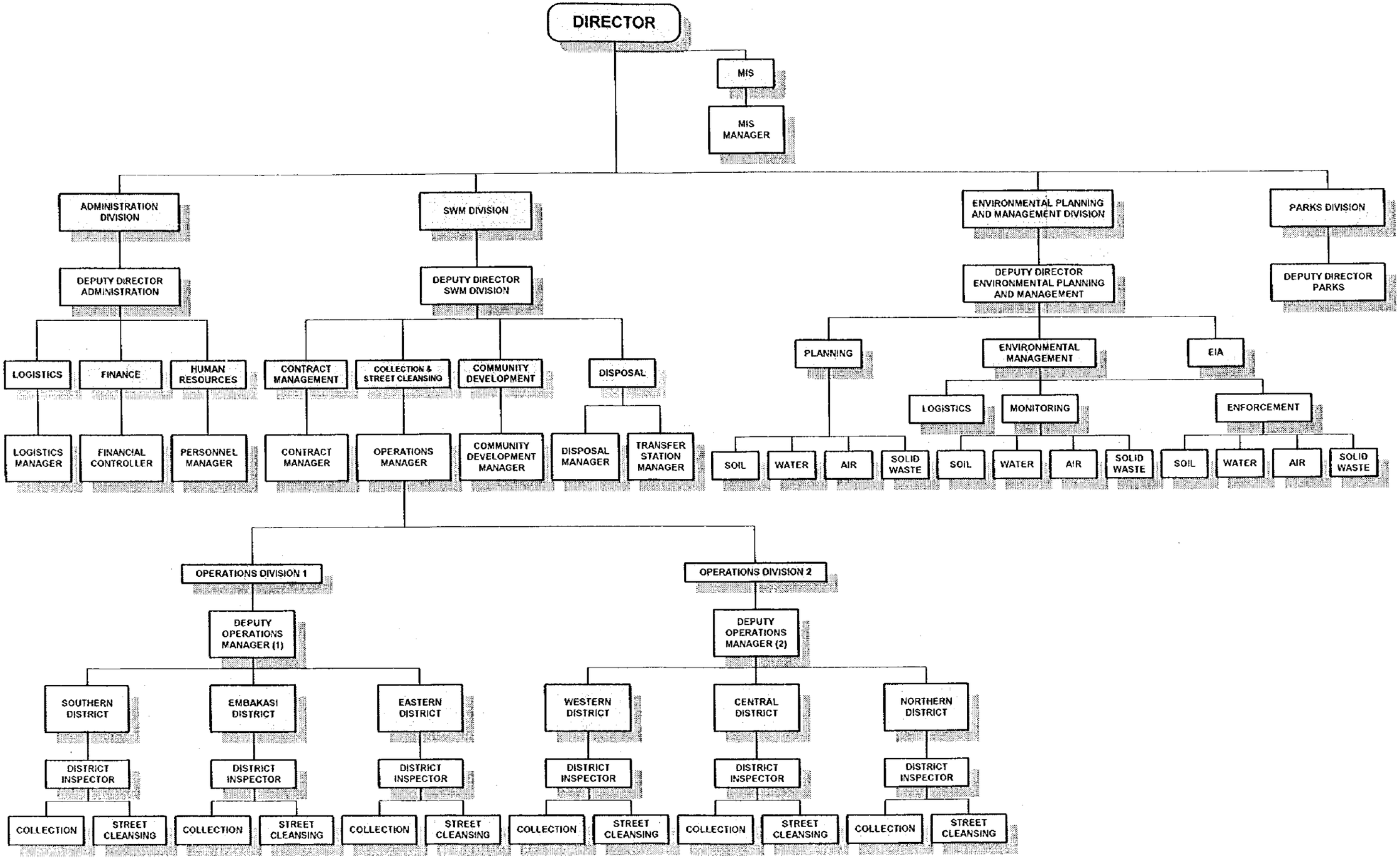

Figure S5.4-1 The Proposed Organisational Structure of the DoE



5.5 Legal Restructuring Plan

(1) Objective

The objective of the Legal Restructuring Plan (LRP) is to propose the most suitable legal arrangements which will enable NCC to effectively and efficiently regulate solid waste management activities in Nairobi City.

(2) Planning Policy

(a) NCC should move quickly to enact a new SWM By-laws.

(b) The SWM By-laws should be formulated in consideration of other international SWM legislations to ensure that Kenya complies with the international standards.

(3) Strategy

(a) A new Environmental Planning and Management Division is to be established in the DoE which, in conjunction with the Town Clerks Department, will formulate the new SWM By-laws.

(b) NCC will receive assistance from a Legal Consultant to format and draft the SWM By-laws.

(4) Goal

To enact the SWM By-laws.

(5) Recommendation

(a) The Government of Kenya (GOK) through the MENR should enact a comprehensive SWM law either as an National Act or National Regulation. This should cover all types of solid waste and set out responsibilities and conditions for their management and control. A more comprehensive national law is required rather than the Environmental Management and Coordination Bill formulated by the Ministry of Environment and Natural Resources (MENR).

(b) NCC should enact the new SWM By-laws between 1999 and 2000. The By-laws would become a model legislation for other local authorities in Kenya.

(c) The Environmental Planning and Management Division (EPM) will cooperate and coordinate with the Town Clerks Department for formulating the new SWM By-laws.

(d) The Consultant will formulate the By-laws in consideration of other international SWM legislation to ensure that Kenya complies with the international standards.

5.6 Private Sector Involvement Plan

(1) Objective

The objective of the Private Sector Involvement (PSI) Plan is to improve the quality of NCC's SWM services in a manner to increase efficiency and effectiveness and reduce the cost of the services through capital investment by private sectors.

(2) Planning Policy

(a) Implementation of PSI shall be regulated properly to have efficient contract management in addition to encouraging participation of the private sector in cleansing services.

(b) PSI in SWM services shall be initiated with collection and transportation services of municipal wastes by means of contracting out the service areas.

(c) PSI shall be practised positively taking into consideration the financial affordability of NCC for the cleansing services.

(3) Strategy

(a) Every existing private sector involved in waste collection should be licensed, levied/charged, monitored and controlled by NCC.

(b) Services provided by the contractor(s) shall be firstly limited to operation of collection/transportation and street cleansing, including street sweeping, litter picking, gully cleaning, dustbin emptying, dumping removal and grass cutting.

(c) In addition to the existing contracted-out area, i.e., the Central Business District (CBD), NCC shall implement the plan to expand the privatisation area(s) without delay to improve the services.

(d) The privatisation area(s) shall be expanded gradually based on the priority made principally by distance from the city centre, residents' income level and financial affordability of NCC.

(e) The private contractor(s) shall have the sole and exclusive right to provide services in a designated area on the condition that he(they) will bear the responsibility for collecting and transporting of all municipal wastes to maintain cleanliness of the area.

(f) The waste charge rate in the privatised area(s) shall be determined by the level of services and the financial affordability of the beneficiaries and NCC.

(4) Goal

(a) To increase the amount of solid waste collected by private companies.

(b) To encourage and provide assistance to recycling companies.

(5) Recommendation

(a) The new Contract Management Section (CMS) is to be responsible for each stage of the preparation and award of the contract. In this capacity the CMS acts as the Secretariat of the Contract Team (CT).

(b) The CMS should review the current contract in the Central Business District and start to promote the next contract for the other areas.

(c) The CMS will be responsible for monitoring the contractor's performance and managing or "running" the contract, i.e., monitoring for compliance of the contract terms and conditions.

(d) The DoE should use a mixture of continuous monitoring for problematic areas, e.g., high density commercial areas, random or sample monitoring in residential areas and both to be augmented by "self-monitoring" by the contractor.

(e) A Contract Team (CT) should be set up for each contract to oversee the contracting process up to award.

(f) Members of the CT would be drawn from the DoE, the Administration and Legal Sections of the Town Clerk's Office and the City Treasurer's Department. The member from the Administration Section would head the CT. The life of CT would only be for the period of contract preparation. The CT would cease on the execution of the contract.

5.7 Financial Improvement Plan

(1) Objective

The objective of the Financial Improvement Plan is to improve and strengthen the financial condition of SWM services and to support a sound or sustainable operations.

(2) Planning Policy

(a) Enough revenue should be secured for the proper operation of SWM services.

(b) Cost effectiveness should be improved in the operation of SWM services.

(c) Financial planning for SWM services should be improved.

(3) Strategy

(a) Establishing Financial Autonomy of SWM

Since the generation of general tax revenue by NCC is severely constrained and is likely to remain as such for a considerable length of time, the Department of Environment must secure its own revenue for the operation of SWM services by establishing a special account whose revenue is restricted to expenditures for SWM activities only.

(b) Increasing Revenue through Charges

The existing billing system which utilises the water billing system should be continued. In addition, a step-up tariff system which changes rate in accordance with household income should be introduced for increasing revenue.

(c) Improving the Budgetary System

Simplifying the budgeting process and clarifying the accounting procedure will help to grasp the financial conditions accurately and to make a proper financial planning of SWM services.

(d) Private Sector Involvement

Contracting a part of SWM services to private companies is expected to improve cost efficiency of the services as a whole.

(4) Goal

(a) To attain financial autonomy.

(b) To increase revenue from solid waste charges.

(c) To increase solid waste tariff to an appropriate level.

(d) To maintain viability of budgeting.

(5) Recommendation

(a) The existing charge system should be continued and enhanced to be a main financial resource with some improvement.

(b) The DoE needs to be financially "ring fenced" by establishing a special account to ensure that these revenues are controlled and spent by the SWM Division for SWM services only and are not used to finance other services in NCC.

(c) Funds for replacement of equipment and facility should be accumulated as depreciation in the operation of system in order to sustain operations after the equipment and facility initially introduced are finished.

(d) Financial autonomy should not exclude the continued subsidisation of the DoE's SWM services by NCC's general taxation or the central government.

5.8 Public Education and Awareness Plan

(1) Objective

The objective of the Public Education and Awareness Plan is to raise the awareness of residents to obtain their cooperation in solid waste management.

(2) Planning Policy

The Plan shall be formulated to promote a better understanding of residents through public and school education by establishing a workable implementation system within NCC.

(3) Strategy

(a) Raising Awareness within the NCC

The NCC's own awareness of the requirements of a new solid waste management strategy is to be raised through a programme of seminars and workshops directed at council officials. This should be made prior to a public announcement by NCC on the implementation of the new strategy.

(b) Communications Strategy

Following its decision to implement the new strategy, the NCC has to inform the public of the measures it proposes taking to improve SWM services in the city and of its proposals to increase the existing charge levels to pay for the services. A properly structured communications strategy is to be proposed.

(c) Public Education

A public education and awareness programme should accompany the NCC's announcement of the new strategy. Any attempt to introduce such a programme before the NCC has spelt out the steps it is to take to improve solid waste management condition in the city would be futile.

(d) School Education

A children's charter is proposed to make school children more aware of solid waste issues. It involves a commitment by the NCC to provide high quality collection services to all schools and children to keep their school compounds free from waste. It is to be reflected in a signed Charter prominently displayed in all schools.

A highly visible public commitment such as this will heighten children's awareness of the issues involved and place a duty on the NCC to meet its publicly stated obligations.

(4) Goal

(a) To continue public awareness campaign and educational programme through the media.

(b) To implement regular education on SWM for students at schools.

(c) To implement regular education on SWM for adults at churches.

(d) To increase public awareness on the reduction and recovery of solid waste.

(5) Recommendation

(a) The NCC's own awareness of the requirements of a new solid waste management strategy is proposed to be enhanced through a programme of seminars and workshops directed at council officers prior to a public announcement on the implementation of the new strategy.

(b) NCC has to inform the public of the measures it proposes taking to improve SWM services and of how it proposes to fund these by increasing the existing low level of charges. A properly structured communications strategy is needed.

(c) A public education and awareness programme should accompany the NCC's announcement of the new strategy. Any attempt to introduce it before the NCC has spelt out the steps it is to take to improve solid waste management conditions in the city would be futile.

(d) A "children's charter" is proposed to make school children more aware of solid waste issues. It involves a commitment by the NCC to provide high quality collection services to all schools and by children to keep their school compounds free from waste.

(e) That a programme of workshops and seminars be prepared, with accompanying fact sheets, to improve the general awareness of NCC's officials of the issues involved in the delivery of appropriate SWM services to the people of Nairobi.

(f) That a communications strategy be prepared to inform the public of the measures NCC proposes taking to improve SWM services and of how these are to be funded by increasing existing charge levels.

(g) Technical assistance by a communications specialist is required to educate council officers and assist the Department of City Education.

5.9 Preparatory Actions by the NCC

The JICA Study Team strongly recommends that the Nairobi City Council (NCC) should take the following actions which are thought to be self-endeavouring actions without a large capital investment in order to facilitate the proposed projects in the Master Plan. Details of each action are presented in **Volume 2, Section 4.11** of the **Main Report - Master Plan Study**.

(1) Organisational Strengthening of the Department of Environment (DoE)

(a) implementing changes to the existing organisational structure.

(b) setting up a number of new sections and functions, and appointing new managers and staff.

(2) Establishment of Financial Autonomy

(3) Promotion of Private Sector Involvement (PSI)

(4) Improvement of the Dandora Dumpsite

(a) Improve and Sustain the Condition of Dandora site.

(b) Strengthen the Operational Management of Dandora.

(c) Preparation Work for New Disposal Site(s).

(5) Improvement of Collection and Transportation Operations

5.10 Urgent Improvement Plan

Due to rapid urbanisation including migration in Nairobi, the present capacity of waste collection and disposal could not cope with the increase of waste amount in the near future even if the above Preparatory Actions by NCC are done completely. To maintain at least the current situation, the Urgent Improvement Plan is required to be carried out as quickly as possible since the actual increase of collection ratio will arise from the year 2000 due to arrangement and preparation of financial resources. The Urgent Improvement Plan comprises the following two projects:

(1) Augmentation of the Existing Collection Vehicles

Fifteen (15) dump trucks that are the same as the average available number of vehicles are recommended to be procured. The specification of trucks is also the same as those which were purchased in 1997.

(2) Improvement Work for the Dandora Dumpsite

DoE has to maintain the repaired bulldozer very well and also to permanently operate a reasonable number of heavy equipment at the site. The reasonable number of heavy equipment for daily management is three (3) bulldozers and one (1) excavator. NCC has to keep an annual budget to hire or purchase two bulldozers and one excavator.

The scope of the Urgent Improvement Plan is to be defined in consideration of the existing human and financial resources of NCC. The Plan therefore does not require a number of additional manpower and operating cost greater than the current ones.

The Plan could commence from the year 1999, and the capital cost for the Plan is estimated at Kshs 82.6 million and the operation and maintenance (O&M) cost is Kshs 100.9 million. The total project cost of the Plan is Kshs 183.5 million as summarised in **Table S5.10-1** below.

Assuming that waste charge is collected at Kshs 100 per month per household and commercial establishment through the existing water account, revenue is estimated at Kshs 183.8 million which could fully cover the cost of the Plan.

Table S5.10-1 Summary of Cost for the Urgent Improvement Plan

(million Kshs)

Project	Capital cost	O&M cost*	Total cost
Renewal of the existing collection vehicles	48.8	93.2	142.0
Improvement work for the Dandora dump site	33.8	7.7	41.5
Total	82.6	100.9	183.5

* Operation and maintenance (O&M) cost means costs of personnel, fuel and oil for operating vehicles and equipment and purchasing spare parts and consumables only.

5.11 Phased Implementation Plan

(1) Step-by-Step Implementation and Target Waste Collection Rate

The Master Plan is divided into three (3) implementation stages; in other words, the new system is expected to start in 2000, the second step starts in 2004 and the third or final step starts in 2008 or the target year.

Since the current waste collection rate is very low at approximately 25%, a stepwise increase in waste collection rate is to be made in each stage to attain the goal of 100%. In the initial stage of the project, the collection rate is to be proposed at more than half of the generated waste, i.e., 60% to realise visible improvement of the environmental condition. The collection rate will accordingly go up to 80% in the second stage of 2004 and 100% by the year of 2008.

(2) Required Number of Vehicles and Equipment

Based on the above stepwise increase of the waste collection rate, i.e., 60% in 2000, 80% in 2004 and 100% in 2008, the required number of collection vehicles and equipment is presented in **Table S5.11-1** (the numbers in the years 1998 and 1999 are shown as reference and include the required numbers for the Urgent Improvement Plan).

Table S5.11-1 Vehicles and Equipment Required for the Phased Implementation (Waste Collection Rate: 1998-2003; 60%, 2004-2007; 80%, 2008; 100%)

No	Items	Quantity										
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Collection/Transport.												
1	Detachable-container truck	41	43	45	47	49	51	83	87	92	97	139
2	Container	927	967	1008	1055	1104	1156	1873	1968	2074	2186	3143
3	Trailer truck	14	15	15	16	17	18	25	27	28	30	40
4	Side loader	20	21	22	23	24	25	40	42	45	47	67
5	Dump truck	9	10	10	11	11	12	19	20	21	22	32
6	Wheel loader	9	10	10	11	11	12	19	20	21	22	32
7	Water sprinkler	2	2	2	2	2	2	3	3	3	4	5
8	Inspection car	22	22	22	22	22	22	22	22	22	22	22
9	Tow truck	1	1	1	1	1	1	2	2	2	2	2
10	Parking lots	6	6	6	6	6	6	6	6	6	6	6
Final Disposal												
11	Bulldozer	3	3	3	7	7	7	12	12	12	12	12
12	Excavator	1	1	1	1	1	1	1	1	1	1	1
13	Dump truck	0	0	0	2	2	2	3	3	3	3	3
14	Jeep	0	0	0	1	1	1	1	1	1	1	1

(3) Project Cost and Schedule

The project cost of the Master Plan and the cost of each stage presented above are summarised in **Table S5.11-2** below. The total project cost of the Master Plan is Kshs. 17,310 million and the capital cost is Kshs. 6,297 million (US$107 million). **Figure S5.11-1** shows the schedule of the Master Plan.

Table S5.11-2 Project Cost of the Master Plan

Unit: Kshs. million

Item	1st Stage 1999 - 2003	2nd Stage 2003 - 2007	3rd Stage 2007 - 2008	Total 1999 - 2008
CBAP	47.8	0.0	0.0	47.8
PSI Contract	575.8	1,136.6	429.5	2,141.8
Final Disposal				
Operation	96.4	153.5	53.2	303.2
Depreciation	44.4	98.4	32.5	175.3
Initial Investment	1,756.5	78.3	63.2	1,898.0
Engineering	65.3	2.9	2.3	70.5
Total	1,962.6	333.2	151.3	2,447.0
Collection/Transportation				
Operation	1,972.8	3,270.9	1,269.9	6,513.5
Depreciation	563.3	962.2	353.2	1,878.6
Initial Investment	1,878.3	1,118.3	1,052.0	4,048.5
Engineering	93.9	56.4	52.6	202.9
Sub-total	4,508.2	5,407.7	2,727.6	12,643.6
CWMP	12.0	13.6	4.0	29.6
Total	4,520.2	5,421.3	2,731.6	12,673.2
Total Cost*	7,106.4	6,891.1	3,312.3	17,309.8

* Total cost may not be the same as indicated due to rounding.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Future Goals
Target Collection Rate	25%	30%	[illegible]	[illegible]	[illegible]	[illegible]	60%	80%	80%	80%	100%	
Financial and Institutional Aspect	1st Implementation Stage						2nd Implementation Stage				3rd Implementation Stage	
(1) Institutional Restructuring Plan	Preparatory Actions by NCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Further Capacity Building Program, If Necessary					Full Responsible for SWM by NCC
(2) Legal Restructuring Plan		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Further Capacity Building Program, If Necessary					Full Responsible for SWM by NCC
(3) Private Sector Involvement Plan	Preparatory Actions by NCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Contract-out of Ngara				Ngara	Full Privatisation (Contract out)
		[illegible]	[illegible]	[illegible]	[illegible]	Review of Performance of Ngara	Contract-out of Kenyatta/Golf Cource				Kenyatta/Golf Cource	
								Review of Performance of Kenyatta/Golf Course	Contract-out of Parklands		Parklands	
										Review of Performance of Parklands	Contract-out of Kilimani	
(4) Financial Improvement Plan	Preparatory Actions by NCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Further Capacity Building Program, If Necessary					Full Financial Autonomy for SWM by NCC
		Collection Rate 100	[illegible]	[illegible]	[illegible]	[illegible]	Increase of Tariff Rates (2)				Increase of Tariff Rates (3)	
(5) Public Education and Awareness Plan		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Public Campaign/Education Focusing on Business Establishments/Recycling Industries					Establishment of SWM Culture
			[illegible]									
			[illegible]									
Technical Aspect												
(1) Collection and Transportation Plan	Preparatory Actions by NCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	CWMP (2)				CWMP (3)	Full Privatisation (Contract-out) Introduction of Separate Collection System
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
	Design/Procurement for the Urgent Improvement Plan	Urgent Improvement Plan	[illegible]			Design/Procurement (2)	Additional Collection/Transportation System					
										Design/Procurement (3)	Additional Collection/ Transportation System	
(2) Waste Reduction, Recycling and Intermediate Treatment plan		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Public Campaign/Education Focusing on Business Establishments/Recycling Industries					Treatment of Waste in Combination of Composting, Incinerator etc.
							[illegible]ery (Target : 5% in 2008)					
(3) Final Disposal Plan	Preparatory Actions by NCC	Design (1)	[illegible]	[illegible]	[illegible]	[illegible]						Operation of Complete Sanitary Landfill Reuse of Closed Landfill Site(s)
			[illegible]			Design/Procurement (2)				Design/Procurement (3)		
	Design/Procurement for the Urgent Improvement Plan	Urgent Improvement Plan										

Note : Procurement (excluding replacement and including the Urgent Improvement Plan in the Procurement (1))

	Container Trucks	Side Loaders	Dump Truck (Tippers)	Trailers	Containers	Wheel Loaders	Sprinklers	Inspection Vehicle	Recovery Trucks	Parking Lots
(1)	51	25	12	18	1156	12	2	22	1	6
(2)	45	22	10	12	1030	10	2	0	1	0
(3)	42	20	10	10	957	10	1	0	0	0

Bulldozer	Excavator	Dump Truck	Jeep
7	1	2	1
5	0	1	0
4	1	0	0

Figure S5.11-1 The Master Plan Schedule (1998-2008)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Future Goals
Target Collection Rate	25%	30%	60%	60%	60%	60%	60%	80%	80%	80%	80%	100%	
Financial and Institutional Aspect	1st Implementation Stage							2nd Implementation Stage				3rd Implementation Stage	
(1) Institutional Restructuring Plan	Preparatory Actions by NCC	Capacity Building Assistance Program (CBAP)		Review of CBAP				Further Capacity Building Program if Necessary					Full Responsible for SWM by NCC
(2) Legal Restructuring Plan		Enactment of SWM By-law under the CBAP Establishment of Environmental Plan & Management Section under the CBAP		Review of CBAP				Further Capacity Building Program if Necessary					Full Responsible for SWM by NCC
(3) Private Sector Involvement Plan	Preparatory Actions by NCC	Establishment of Contract Management Section under the CBAP Regulation of Private Collectors		Contract-out of Ngara				Contract-out of Ngara				Ngara	Full Privatisation (Contract-out)
						Review of Performance of Ngara		Contract-out of Kenyatta Golf Course				Kenyatta Golf Course	
										Review of Performance of Kenyatta Golf Course	Contract-out of Parklands	Parklands	
											Review of Performance of Parklands	Contract-out of Kilimani	
(4) Financial Improvement Plan	Preparatory Actions by NCC	Financial Reform under the CBAP Establishment of Financial Autonomy		Review of CBAP				Further Capacity Building Program if Necessary					Full Financial Autonomy for SWM by NCC
		Collection of Tariff of Kshs 100	Increase of Tariff Rates in accordance with the Increase of Service Level (1)					Increase of Tariff Rates (2)				Increase of Tariff Rates (3)	
(5) Public Education and Awareness Plan		Establishment of Community Development section under the CBAP	Public Campaign/Education					Public Campaign/Education Focusing on Business Establishments Recycling Industries					Establishment of SWM Culture
		Raising Awareness of NCC Communications Strategy											
Technical Aspect													
(1) Collection and Transportation Plan	Preparatory Actions by NCC	Community Waste Management Project (CWMP) (1)						CAMP 2				CAMP 3	Full Privatisation Combination of Modern and Collection System
		Design (1)	Procurement (1)	New Collection/Transportation System									
		Design Procurement for the Urgent Improvement Plan	Urgent Improvement Plan	Construction of Transfer Station, Workshop Parking Lots				Design Procurement (2)	Additional Collection Transportation System				
											Design Procurement (3)	Additional Collection Transportation System	
(2) Waste Reduction Recycling and Intermediate Treatment plan		Establishment of Community Development Section Under the CBAP		Public Campaign/Education				Public Campaign/Education Focusing on Business Establishments Recycling Industries					Treatment of Kitchen Combination of Composting Incineration etc
				Resource Recovery Target 5% in 2006									
(3) Final Disposal Plan	Preparatory Actions by NCC	Design (1)	Construction (1)	Construction (2)	Construction (3)								Location of Controlled Sanitary Landfill Reuse of Closed Landfill Sites
			Procurement of Heavy Machine (1)					Design Procurement (2)			Design Procurement (3)		
		Design Procurement for the Urgent Improvement Plan	Urgent Improvement Plan										

Figure S5.11-1 The Master Plan Schedule (1998-2008)

(4) Requirements for the Collection of Waste Charge

Based on the above capital costs, three kinds of financing are considered to calculate the waste charge: loan 100%, grant aid 50% and loan 50%, and grant aid 100%. The required waste charge for households is the same whatever is the finance source since the household charge compensate for O&M costs and depreciation for each year. The required charges and balance (negative figures in the balance indicate the required amount of subsidy) are estimated as follows:

Table S5.11-3 Required Waste Charges and Balance

Financing Source		2000	2004	2008	Ave./Sum
Loan 100%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	599	867	1,117	804
	Tipping (Kshs/ton)	84	114	106	106
	Balance (Kshs million)	-141	-549	-834	-4,241
Grant 50% and Loan 50%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	469	688	891	638
	Tipping (Kshs/ton)	58	102	93	93
	Balance (Kshs million)	0	-152	-450	-1,367
Grant 100%	Household (Kshs/month)	216	296	446	295
	Commercial (Kshs/month)	469	589	757	561
	Tipping (Kshs/ton)	58	91	83	83
	Balance (Kshs million)	0	0	0	0

(5) Examination of Service Level

In case that the revenue necessary to achieve a 100% waste collection rate in 2008 is not attained, the reduction of service level may be taken into consideration. Different service levels or project scales are thus examined.

Reduction of service level is considered not only from the viewpoint of revenue but on how the new system can be started without difficulty. Thus, the target levels are assumed to be as follows: 40% in 2000, 50% in 2004 and 60% in 2008 which include services contracted to private companies.

The capital costs will be Kshs. 4,901 million (US$83 million) in total between 1999 and 2008 in this case, and the required waste charges and balance (negative figures in the balance indicate the required amount of subsidy) are estimated as follows:

Table S5.11-4 Required Waste Charges and Balance under the Reduced Service Level

Financing Source		2000	2004	2008	Ave./Sum
Loan 100%	Household (Kshs/month)	165	181	266	191
	Commercial (Kshs/month)	406	577	778	558
	Tipping (Kshs/ton)	79	126	119	119
	Balance (Kshs million)	-118	-450	-659	-3,514
Grant 50% and Loan 50%	Household (Kshs/month)	165	181	266	191
	Commercial (Kshs/month)	359	432	588	423
	Tipping (Kshs/ton)	38	109	98	98
	Balance (Kshs million)	0	-125	-336	-1,113
Grant 100%	Household (Kshs/month)	165	181	266	191
	Commercial (Kshs/month)	359	361	452	363
	Tipping (Kshs/ton)	38	91	83	83
	Balance (Kshs million)	0	0	0	0

6. FEASIBILITY STUDY OF PRIORITY PROJECTS

6.1 Selection of Priority Projects

Based on the results of the Master Plan Study, the following plans are selected as priority projects of SWM with technical and financial optimality as well as urgency of issues taken into consideration.

(1) Institutional and Financial Aspect

(a) Institutional Restructuring and Financial Reform

Organisations related to SWM shall be rearranged, taking into consideration of providing the minimum requirements of collection and transport services, future waste recycling and reduction. At the same time, a special account for SWM shall be established and the budgetary system be reformed. On the other hand, collection charge shall be increased to 100 Kshs/month for households with continuing billing system, where collection charges are billed with water charges. An increase of the charge rate will be made accordingly from year 2000.

(b) Promotion of Private Sector Involvement

Solid waste collection services shall be contracted to private companies in the area of Ngara which is located in the next to the Central Business District (CBD) where a PSI contract has already been started by the NCC.

(2) Technical Aspect

(a) Construction of a New Final Disposal Site

The existing Dandora site shall be closed and a new disposal site shall be constructed in the Ruai Area.

(b) Improvement of Collection and Transportation System

Basically, the NCC shall provide a minimum level of service equally throughout Nairobi City. From the viewpoint of technical and financial optimality, a container type collection with side loaders and dump trucks shall be implemented for achieving 60% collection including private collection services.

6.2 Outline of the Priority Projects

(1) Institutional Restructuring and Financial Reform

(a) Institutional Restructuring Plan

Objective

The Institutional Restructuring Plan (IRP) delineates the actions and tasks for restructuring and strengthening the DoE. The central focus of the IRP is the strengthening of the Department's SWM Division.

Project Outline

The IRP's main actions and tasks can be grouped into three key areas:

(i) organisational restructuring of the DoE;

(ii) establishing new organisational functions; and

(iii) developing of key management capabilities.

Preparatory Actions must be substantively implemented by NCC between 1998and 1999 to enable the Capacity Building Assistance Program (CBAP) to begin. They cover the key areas of:

(i) organisational restructuring of the DoE; and

(ii) establishing new organisational functions.

The IRP's actions to be implemented under the Capacity Building Assistance Program (1999/2000) cover the key areas of:

(i) full development and implementation of the new organisational functions; and

(ii) development of key management capabilities.

Project Impacts

The priority project will strengthen NCC's Department of Environment so that it can effectively and efficiently manage its SWM responsibilities and services.

Cost and Schedule

Figure S6.2-1 illustrates the phasing of the three key areas of the IRP.

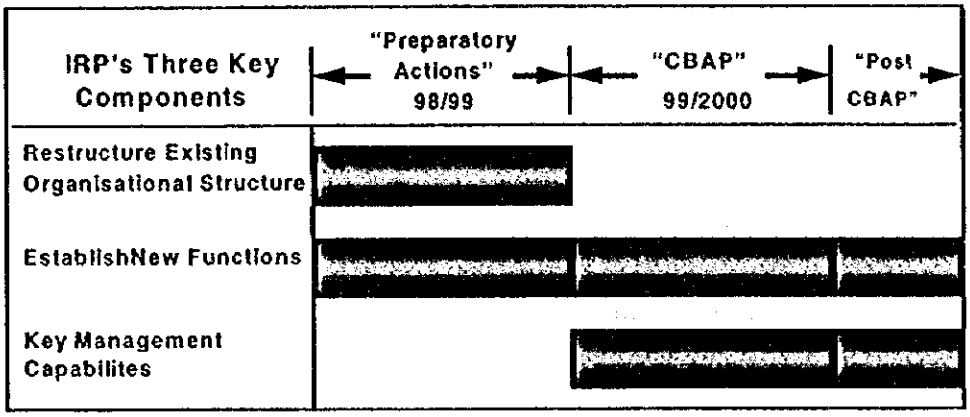

Figure S6.2-1 Phased Implementation of the IRP

The cost of the Institutional Restructuring Plan is calculated in the Capacity Building Assistance Program (CBAP).

(b) Capacity Building Assistance Program

Objective

Most of the Institutional Restructuring Plan (IRP) will require assisted implementation to be provided by consultants under the Capacity Building Assistance Program (CBAP).

Project Outline

The Capacity Building Assistance Program comprises a mixture of direct implementation assistance combined with training provided in classes or workshops, covering six organisational components. The components of the Capacity Building Assistance Program are as follows:

(i) Development of Key Management Capabilities;

(ii) Community Development;

(iii) Financial;

(iv) Environmental Regulation;

(v) Formatting and Drafting the SWM By-law;

(vi) Contract Management;

(vii) Human Resource Management; and

(viii) Development of Technical Capability.

Project Impacts

The Capacity Building Assistance Program will critically support the implementation of the Institutional Restructure Plan (IRP).

Cost and Schedule

Table S6.2-1 below shows the phasing of the Capacity Building Assistance Program from April 1999 to May 2000, giving its main components and the required inputs of each consultant. These inputs cover both implementation assistance as well as training. The timing of inputs is indicative and will be decided by the individual consultants.

The total costs of the CBAP of Kshs. 47,773,000 (US$812,500) include consulting costs, information hardware and software costs and training costs, i.e., materials and venue costs. These costs are indicative only.

Table S6.2-1 Phased Implementation of the Capacity Building Assistance Program

Main Components of CBAP	Consultant Responsible	1999	2000	2001 - 2008	Costs of CBAP (Kshs.)
Development of Key Management Capabilities Assistance in establishing Management Team, planning capability, procedures for objective setting and performance measurement, MIS setup and improving managers' effectiveness	Organisational and Management Consultant			The Organisational and Management Consultant reviews for further capacity building assistance on management	10,500,000
Community Development Assistance in establishing the Community Development Section	Social Analyst			The Social Analyst reviews the need for further assistance on Community Development	9,850,000
Financial Assistance in establishing financial systems in the Finance Section including implementation of computerised financial system	Financial Consultant			The Financial Consultant reviews for further capacity building assistance the DoE may require for Finance	5,250,000
Environmental Regulation Assistance in establishing Environmental Division's monitoring methodologies and systems and procedures for handling non-municipal wastes	Regulation/Legal Consultant			The Regulation/Legal Consultant reviews for further assistance the DoE may require for Environmental Regulation	5,250,000
Formatting and Drafting SWM By-laws Assistance in the formatting, drafting and enactment of SWM By-laws	-ditto-			The Regulation/Legal Consultant reviews for further assistance the DoE may require for SWM By-law	including the above
Contract Management Assistance in establishing Contract Management Section's functions and procedures for both pre-contract award and post-contract award	Contract Management Consultant			The Contract Management Consultant reviews the need for further assistance the DoE may require on Contract Management	3,500,000
Human Resource Management and Development Assistance in establishing Human Resource Section's functions covering personnel functions, HR planning, improving employee performance and occupational health	Human Resource Consultant			The Human Resource Consultant reviews the need for further assistance the DoE may require on Human Resource Management	3,500,000

Table S6.2-1 Phased Implementation of the Capacity Building Assistance Program (Cont'd.)

Main Components of CBAP	Consultant Responsible	1999	2000	2001 - 2008	Costs of CBAP (Kshs.)
Development of Technical Capability					
Collection and Transportation					2,270,000
-Planning, Scheduling, Staffing & Vehicle Management					
Assists in establishing operations management staff's planning methodologies and functions covering arrangement, routing for collection, scheduling, staffing and reviewing systems. Also, assists in establishing Vehicle Management subunit's functions covering procurement of spare parts and tools, store methods and inventory management.	Planning, Scheduling, Staffing & Vehicle Management Consultant			The Planning, Scheduling, Staffing & Vehicle Management Consultant reviews the need for further assistance the DoE may require on Vehicle and Planning Management	
-Maintenance					4,893,000
Assists in establishing Maintenance subunit's functions focusing on improvement of craftsman's skills based on the job training.	Maintenance Consultant (mechanical and electrical)			The Maintenance Consultant reviews the need for further assistance the DoE may require on Vehicle Maintenance.	
Final Disposal					2,760,000
-Planning, Scheduling, Staffing & Maintenance	Disposal Consultant			The Disposal Consultant reviews the need for further assistance the DoE may require on Disposal Planning, Scheduling Management	
Assists in developing operations management staff's planning, operating and reviewing systems.					
Total Cost					47,773,000

(c) Financial Improvement Plan

Objective

The objective of this project is to secure a proper operation of solid waste management services by enhancing revenues and reforming the budgeting system.

Project Outline

(i) Enhancing Revenue Resources

Creating a new tax or charges is expected to be very difficult or time-consuming since it needs tedious co-ordination among other departments in NCC. Thus, the existing charge system should be continued and enhanced to be a main financial resource by establishing a new charging policy.

The new tariff employs a step-up rate system. Household charge rate increases in three steps in accordance with the water consumption of the household on the assumption that income and water consumption are closely related. Charge rate in each step should not exceed the affordability of households in each income group.

Charge rates for commercial establishments and tipping are decided in proportion to their waste collection and dumping amounts.

(ii) Establishment of Financial Autonomy of SWM Services

A special account is planned to be established in the DoE in 2000 when the new system starts. Revenues are controlled and spent by the SWM Division for SWM services only and are not used to finance other services in NCC.

Additionally, funds for replacement of equipment and facility should be accumulated as depreciation in the operation of system in order to sustain the operation after the equipment and facility initially introduced are finished.

However, financial autonomy should not necessarily exclude the subsidisation by NCC's general taxation or the central government.

(iii) Promotion of Private Sector Involvement (PSI)

Increasing percentages of collection services are planned to be contracted to private companies from 2001 in Ngara area in addition to the CBD area where a PSI contract started in 1997. See **Item (2), Promotion of Private Sector Involvement** for details.

(iv) Reform of Budgeting Process for SWM Services

- Revenues should not accrue in the budget. Only cash receipts should be credited to the account;
- Revenue estimates should be based on the previous calendar year's actual cash collections;
- Recurrent expenditure should be estimated within revenue estimates based on the previous calendar year's actual revenue plus any approved charge increases. Expenditure ceilings should be established at the beginning of the budget process; and
- Revenue in excess of the estimates should be appropriated to capital expenditure. It should not be released until the revenue has been realised.

Project Impact

Once the SWM services by NCC has improved, it will encourage people's confidence on the services and in turn it would further improve the services.

Cost and Schedule

This plan should be carried out by incorporating it with other plans such as the Institutional Restructuring Plan and other UNDP's assistance programs. Budgetary reforms should be finished before the start of new system operations.

(2) Promotion of Private Sector Involvement (PSI)

Objective

The objective of this project is to start the next PSI contract for the Ngara area based on the review of current performance in the Central Business District.

Project Outline

DoE should organise the new section, i.e., Contract Management Section (CMS), for the promotion of private sector involvement. The proposed Contract Team (CT) and the Council's existing Tendering Committee (TC) will work under the CMS. The responsibilities for these are:

The Contract Management Section is responsible for each stage of the preparation and award of the contract. In this capacity it acts as the Secretariat of the Contract Team.

After award the CMS will also be responsible for monitoring the contractor's performance and managing or "running" the contract, i.e., monitoring for compliance of the contract terms and conditions.

The DoE should use a mixture of continuous monitoring for problematic areas, e.g., high density commercial areas, random or sample monitoring in residential areas, and both to be augmented by "self-monitoring" by the contractor(s). "Complaints based monitoring" is recommended when it is possible for the DoE to resource it.

A Contract Team is set up for each contract to oversee the contracting process up to award. The CT's role is (1) to advise and approve the Contract Management Section's activities at each stage of the contracting process and (2) to ensure that the preparation and award of the contract complies with Local Government legislation, NCC's policy, rules and regulations.

Membership of the CT would be drawn from the DoE, the Administration and Legal Sections of the Town Clerk's Office and the City Treasurer's Department. The member from the Administration Section would head the CT. The life of CT would only be for the period of contract preparation. The CT would cease on the execution of the contract.

The role of the **Tendering Committee** is to formally evaluate and select the winning tender on behalf of the Council.

Project Impacts

The promotion of private sector involvement (PSI) will result in improving the quality of NCC's SWM services in a manner to increase efficiency and effectiveness and reduce the cost of the services through capital investment by the private sector.

Cost and Schedule

Table S6.2-2 below shows the contracting schedule of planned areas. Shaded numbers are waste amounts which are planned to be collected by private companies. The total cost of the contract is estimated at Kshs. 521.5 million.

Table S6.2-2 PSI Contract Schedule and Cost

(Unit: ton/day)

Year	1998	1999	2000	2001	2002	2003
Total Waste Generation	1,509	1,595	1,684	1,785	1,893	2,009
Location						
Starehe	129	134	138	145	152	159
Ngara	39	40	41	43	46	49
Kenyatta/Golf Course	13	13	14	15	16	17
Parklands	126	133	139	148	158	168
Kilimani	35	35	36	39	41	44
Total PSI	129	134	138	188	198	208
PSI ratio (%)	8	8	8	10	10	10
Total PSI ratio (%)	20	20	20	20	20	20
Cost of Contract (1000 Kshs.)			54,300	147,900	155,700	163,600

Note: Highlighted areas above indicate target waste amount by contracted private collector.

(3) Construction of a New Final Disposal Site

Objective

To improve the current condition at the Dandora dump site, closure of the site should be carried out as soon as possible. The construction of a new sanitary landfill site, therefore, has to be a high priority for NCC's SWM.

Project Outline

The Master Plan is divided into three implementation stages according to the target of total SWM system. Major activities in the First Implementation Stage are shown in **Table S6.2-3.**

Table S6.2-3 Major Activities in the First Implementation Stage (1999~2003)

Year	Activities
1999	• Basic Design, Detail Design
2000	• Construction of new Disposal Site(s) 1st Area
2001	• Construction of new Disposal Site(s) 2nd Area • Land-filling at 1st Area • Closure Work of Existing Dandora Dumpsite
2002 ~ 2003	• Construction of new Disposal Site(s) 3rd Area) • Well maintenance and operation of new landfill site(s)

Project Impacts

The new sanitary landfill structure and daily cover soil will prevent secondary pollution at and around the final disposal site. Therefore, the introduction of sanitary landfill would contribute to the improvement of NCC's SWM.

Cost and Schedule

(a) Construction Schedule

The construction schedule is shown in **Figure S6.2-2.** It is possible for the landfill operation to begin in the Second Implementation Stage.

Site	Area	Year			
		1st	2nd	3rd	4th
Ruai	40 ha	1st Stage	2nd Stage	3rd Stage	
			Beginning	Operation	

Figure S6.2-2 Construction Schedule of Final Disposal Site

(b) Construction Cost

The construction cost of each construction stage is shown in **Table S6.2-4.**

(3) Construction of a New Final Disposal Site

Objective

To improve the current condition at the Dandora dump site, closure of the site should be carried out as soon as possible. The construction of a new sanitary landfill site, therefore, has to be a high priority for NCC's SWM.

Project Outline

The Master Plan is divided into three implementation stages according to the target of total SWM system. Major activities in the First Implementation Stage are shown in **Table S6.2-3**.

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Year	Activities
1999	• Basic Design, Detail Design
2000	• Construction of new Disposal Site(s) 1st Area
2001	• Construction of new Disposal Site(s) 2nd Area • Land-filling at 1st Area • Closure Work of Existing Dandora Dumpsite
2002 ~ 2003	• Construction of new Disposal Site(s) 3rd Area) • Well maintenance and operation of new landfill site(s)

Project Impacts

The new sanitary landfill structure and daily cover soil will prevent secondary pollution at and around the final disposal site. Therefore, the introduction of sanitary landfill would contribute to the improvement of NCC's SWM.

Cost and Schedule

(a) Construction Schedule

The construction schedule is shown in **Figure S6.2-2**. It is possible for the landfill operation to begin in the Second Implementation Stage.

Site	Area	Year			
		1st	2nd	3rd	4th
Ruai	40 ha	1st Stage	2nd Stage	3rd Stage	
			Beginning	Operation	

Figure S6.2-2 Construction Schedule of Final Disposal Site

(b) Construction Cost

The construction cost of each construction stage is shown in **Table S6.2-4**.

Table S6.2-4 Construction Cost of Final Disposal Site

(1000 Kshs)

Site	Area	Construction Cost			
		1st year	2nd year	3rd year	Total
Ruai	40 ha	667,857	338,007	405,100	1,410,964

(c) Annual Disposal Expenditure

Annual disposal expenditure is composed of design cost, heavy equipment purchase cost, construction cost and O&M cost (engineering cost, fuel, electricity, water, spear parts, etc.), and estimated as shown in **Table S6.2-5** below.

Table S6.2-5 Annual Disposal Expenditures of Final Disposal Site

Year	Waste Amount	Cost ($x10^3$ Kshs)				
		Design*	Construction	Heavy Equipment	O&M Cost	Total Cost
1999		70,548				70,548
2000			667,857	118,500		786,357
2001	385,075		338,007 (227,000)		22,950	360,957 (227,000)
2002	406,245		405,100		24,212	429,312
2003	428,875			78,300	25,561	103,861
Total	**1,220,195**	**70,548**	**1,410,964** **(227,000)**	**196,800**	**72,723**	**1,751,035** **(227,000)**

* Design cost is 5% of construction cost.
( ) is closure work of Dandora site.

Examination of Service Level

In case that the revenue necessary to achieve 60% waste collection ratio is not attained, reduction of service level may be taken into consideration. The target levels are decided as 40% in the First Implementation Stage from 2000 to 2003. Also, a case of Sanitary Level 2+ will be examined to reduce the initial investment cost.

The construction schedule is the same as the above case. However, the construction cost of each construction stage and annual expenditures are as shown in **Tables S6.2-6, S6.2-7 and S6.2-8,** respectively.

Table S6.2-6 Construction Cost of Disposal Site under the Reduced Service Level

(1000 Kshs)

Site	Area	Sanitary Level	Construction Cost			
			1st year	2nd year	3rd year	Total
Ruai	40 ha	4	667,549	337,263	404,544	1,409,356
Ruai	40 ha	2+	402,090	296,010	368,960	1,067,060

Table S6.2-7 Annual Disposal Expenditures under the Reduced Service Level (Sanitary Level 4)

Year	Waste Amount	Cost ($x10^3$ Kshs)				
		Design*	Construction	Heavy Equipment	O&M Cost	Total Cost
1999		70,468				70,468
2000			667,549	89,100		756,649
2001	256,595		337,263 (227,000)		16,756	354,019 (227,000)
2002	270,830		404,544		17,685	422,229
2003	286,160			29,400	18,686	48,086
Total	**813,585**	**70,468**	**1,409,356 (227,000)**	**118,500**	**53,127**	**1,651,451 (227,000)**

* Design cost is 5% of construction cost. Figure in parenthesis ( ) is closure work at Dandora site.

Table S6.2-8 Annual Disposal Expenditures under the Reduced Service Level (Sanitary Level 2+)

Year	Waste Amount	Cost ($x10^3$ Kshs)				
		Design*	Construction	Heavy Equipment	O&M Cost	Total Cost
1999		53,353				53,353
2000			402,090	89,100		491,190
2001	256,595		296,010 (227,000)		16,756	312,766 (227,000)
2002	270,830		368,960		17,685	386,645
2003	286,160			29,400	18,686	48,086
Total	**813,585**	**53,353**	**1,067,060 (227,000)**	**118,500**	**53,127**	**1,292,040 (227,000)**

* Design cost is 5% of construction cost. Figure in parenthesis ( ) is closure work at Dandora site.

(4) Improvement of the Collection and Transportation System

Objective

The objective of this project is to increase the collection ratio to improve the public health and environmental conditions of the city.

Project Outline

The project is composed of the following four (4) sub-projects.

(a) Procurement and Operation of Vehicles and Equipment for the Improvement of Collection and Transportation

The required number of vehicles and equipment is shown below.

Table S6.2-9 The Required Number of Vehicles and Equipment for the Improvement of Collection and Transportation System in the First Implementation Stage

Item	Year				
	1999	2000	2001	2002	2003
Detachable-container truck	-	47	2	2	-
Container	-	1008	47	49	-
Trailer truck	-	11	0	1	-
Side loader	-	22	1	1	-
Dump truck	-	10	1	0	-
Wheel loader	-	10	1	0	-
Water sprinkler	-	2	0	0	-
Inspection car	-	22	0	0	-
Recovery truck	-	1	0	0	-

Note: Figures indicate the number of vehicles and equipment required to be procured in the fiscal year.

(b) Construction of a New Transfer Station

The transfer station is to be constructed near city centre areas such as Madaraka or Kariobangi. The transfer station is equipped with hoppers and the station area is proposed to be 5 hectares.

(c) Construction of a New Small Workshop and the Rehabilitation of Existing Depots

A small-scale workshop is to be constructed in the Kaloleni Cleansing Depot for daily preventive maintenance of their collection vehicles. The new workshop is not necessarily comprehensive but equipped with minimum level of tools and facilities. In addition, the increase of the number of vehicles requires much more space for parking in the city.

(d) Introduction of Community Based Waste Management for Informal Settlements (Community Waste Management Project or CWMP)

The Community Waste Management Project (CWMP) is proposed to increase the capacity of community based organisations in slum areas in order to effectively carry out collection and transportation of waste.

Project Impacts

The project will improve the efficiency and effectiveness of the collection and transportation operation and increase the collection rate accordingly.

Cost and Schedule

The cost and schedule of the project are as shown in **Table S6.2-10**.

Table S6.2-10 Project Cost and Schedule for the Improvement of Collection and Transportation System in the First Implementation Stage

Year	1999	2000	2001	2002	2003
Schedule					
Vehicles					
Design/plan					
Contract					
Procurement					
O&M					
Transfer Station					
Design/plan					
Contract					
Construction					
O&M					
Workshop, parking					
Design/plan					
Contract					
Construction					
O&M					
CWMP					
Capital Cost					
Vehicles	44,700	823,500	30,000	40,800	-
Transfer Station	45,000	900,000	-	-	-
Workshop, parking	4,200	84,000	-	-	-
CWMP	2,400	2,400	2,400	2,400	2,400
Sub-total	96,300	1,809,900	32,400	43,200	2,400
O&M Cost	-	250,200	492,700	489,500	490,200
Depreciation	-	66,800	138,900	142,700	148,200
Total Cost	**96,300**	**2,126,900**	**664,000**	**675,400**	**640,800**

Examination of Service Level

Assuming that the level of services, in other words, waste collection rate is reduced from 60% to 40% in the First Implementation Stage, the project component would be the same as the previous case except the required number of vehicles and equipment, as presented in **Table S6.2-11** and **S6.2-12**.

The schedule of the project is also the same as the previous one and the project cost is as shown in **Table S6.2-13** and **S6.2-14**.

Table S6.2-11 The Required Number of Vehicles and Equipment for the Improvement of Collection and Transportation System in the First Implementation Stage under the Reduced Service Level (With Transfer Station)

Item	Year				
	1999	2000	2001	2002	2003
Required Number of Vehicles					
Detachable-container truck	-	23	0	1	-
Container	-	507	16	17	-
Trailer truck	-	6	0	0	-
Side loader	-	11	0	1	-
Dump truck	-	5	0	0	-
Wheel loader	-	5	0	0	-
Water sprinkler	-	1	0	0	-
Inspection car	-	22	0	0	-
Recovery truck	-	1	0	0	-

Note: Figures indicate the number of vehicles and equipment required to be procured in the fiscal year.

Table S6.2-12 The Required Number of Vehicles and Equipment for the Improvement of Collection and Transportation System in the First Implementation Stage under the Reduced Service Level (Without Transfer Station)

Item	Year				
	1999	2000	2001	2002	2003
Required Number of Vehicles					
Detachable-container truck	-	27	1	1	-
Container	-	507	16	17	-
Trailer truck	-	0	0	0	-
Side loader	-	14	0	1	-
Dump truck	-	6	0	1	-
Wheel loader	-	6	0	1	-
Water sprinkler	-	1	0	0	-
Inspection car	-	22	0	0	-
Recovery truck	-	1	0	0	-

Note: Figures indicate the number of vehicles and equipment required to be procured in the fiscal year.

Table S6.2-13 Project Cost for the Improvement of Collection and Transportation System in the First Implementation Stage under the Reduced Service Level (With Transfer Station)

Year	1999	2000	2001	2002	2003
Capital Cost					
Vehicles	22,000	423,300	4,000	12,000	-
Transfer Station	45,000	900,000	-	-	-
Workshop, parking	4,200	84,000	-	-	-
CWMP	2,400	2,400	2,400	2,400	2,400
Sub-total	73,600	1,409,700	6,400	14,400	2,400
O&M Cost	-	200,100	382,800	367,800	354,300
Depreciation	-	42,700	86,400	86,900	88,400
Total Cost	74,600	1,652,500	389,300	469,100	445,100

Table S6.2-14 Project Cost for the Improvement of Collection and Transportation System in the First Implementation Stage under the Reduced Service Level (Without Transfer Station)

Year	1999	2000	2001	2002	2003
Capital Cost					
Vehicles	22,700	424,500	8,000	22,000	-
Workshop, parking	4,200	84,000	-	-	-
CWMP	2,400	2,400	2,400	2,400	2,400
Sub-total	29,300	510,900	10,400	24,400	2,400
O&M Cost	-	178,700	341,500	326,800	314,400
Depreciation	-	27,000	55,500	56,500	59,700
Total Cost	**29,300**	**716,600**	**407,400**	**407,700**	**376,500**

7. ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Construction of Final Disposal Site at the Ngong Road Forest Area

(1) Predictable Negative Impacts, Assessment and Mitigation Measures

Table S7.1-1 below summarises the results of the environmental study for the Ngong Road Forest Area.

Table S7.1-1 Predictable Negative Impacts, Assessment and Mitigation Measures for Ngong Forest Area

Predictable Impacts	Impact Stage	Significance	Mitigation Measure
Flora & Fauna	C	High	• Plantation of 1.4 ha of indigenous species • Expansion of the nursery to produce more tree seedlings • Plantation of 15 ha of mixed indigenous species around the candidate site
	O	High	• Plantation of a fuelwood buffering zone • Inspection of vehicles and patrols of the forest • Expansion of the nursery • Increase of areas with plantation of indigenous forest of various species to maintain the diversity of plants. However a high rate poaching can not be solved in this way. • Fencing off the indigenous and riverine communities • Activities of scavengers should be eliminated. However, this measure is not practicable in Nairobi City
	CL	Moderate	• Inspection of vehicles and patrols of the forest
Groundwater	O	Low	• Collection and Leachate treatment
Offensive odour	O	High	• Daily soil covering of the disposed garbage • Implement medical check-up program • Installation of a gas control system
Harmful insect generation	O	High	• Daily soil covering of the disposed garbage • Implement medical check-up program
Water Pollution of Mutoine River	C, CL	Moderate	• Provision of drains with sediment traps • Proper management of the construction
	O	High	• Maintain a ring-drain outside the landfill site enclosing dike • Provision of leachate treatment facilities • Water supply system for the surrounding communities
	PCL	High	• Maintain the ring-drain in operation after the closure stage • Continue using the leachate treatment facilities for long time depending on the production/quality of the leachate
Smoke from garbage	O	Low	• Daily soil covering of the disposed garbage, install gas control system
Dust, exhaust fumes from vehicles and equipment	C, O, CL	Moderate	• Control on the number or speed of vehicles/ equipment • Watering of access road and operational places. Soil materials should be covered with sheet • Proper maintenance of vehicle
Soil pollution	O, PCL	Low	• The landfill site should receive solid domestic waste only
Noise	C, O, CL	Low	• Trucks shall use exhaust mufflers to maintain the current noise levels • Work schedule should be informed to the public and operation of heavy equipment should be limited to the day time only • Control of number or speed of vehicles/ equipment • Adequate maintenance of equipment and trucks which must have exhaust mufflers
Gas Migration	O, PCL	Low	• Land use regulation should be enforced for surrounding area avoiding building construction
Traffic	C, O, CL	High (Access road)	• Construction of access road of Class C
		High (Main road)	• The road should be upgraded to a dual carriage way
Landscape	C	Low	• The project should be implemented in an aesthetic development scheme with landscape harmonisation
Interference with petroleum pipeline	C, O, CL, PCL	High	• Proper management of construction and operation of the landfill site
Interference with Kenya Forestry Master Plan	C, O, CL, PCL	High	• No mitigation measures can be proposed
Scavengers	O	High	• NCC or the central government should provide alternative sources of jobs

Legend: C: Construction Phase; O: Operation Phase; CL: Closure Phase; PCL: Post-closure Phase

(2) Conclusion

In consideration of the result of the EIA, the JICA Study Team had considered that the construction of the disposal site in the Ngong Road Forest Area is not suitable because it is not compatible with the Kenya Forestry Master Plan which will introduce ecotourism in the area and will use the forest for forestry research and education.

The current level of traffic of Ngong Road is about 2.5 times the road design capacity and this condition will make it insensible for any increase in the number of vehicles or to take the extra volume of vehicles of the project. Upgrading of the road will become necessary which is beyond of the scope of this project.

On the other hand, scavengers are likely to move to the new landfill site after closing of the existing one at Dandora. This fact will contribute to the total destruction of the forest around the candidate site.

7.2 Construction of Final Disposal Site at the Ruai Area

Since the Ngong Road Forest Candidate Site is not suitable for the construction of a new landfill, it is assumed that all the garbage of Nairobi City will be taken to the Ruai Candidate Site using a transfer station whose location is still to be decided by the Kenyan authorities concerned. Based on this assumption, the study on predictable impacts as well as the identification of mitigation measures and assessment was conducted and the results are reflected in the environmental management and environmental monitoring plans.

(1) Predictable Negative Impacts, Assessment and Mitigation Measures

Table S7.2-1 below summarises the results of the environmental study for the Ruai Area

Table S7.2-1 Predictable Negative Impacts, Assessment and Mitigation Measures for Ruai Area

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O, PCL	Low	• Collection and leachate treatment
Offensive Odour	O	High	• Daily soil covering of disposed garbage • Implementation of medical checkup program • Installation of gas control system
Harmful Insects Generation	O	High	• Daily soil covering of disposed garbage • Implementation of medical checkup program
Water Pollution of Nairobi River	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of leachate treatment facilities
	PCL	Low	• Maintenance of ring-drain operation after closure stage • Continued use of leachate treatment facilities for a long time depending on production/quality of leachate
Smoke from Garbage	O	Low	• Daily soil covering of disposed garbage • Installation of gas control system

Table S7.2-1 Predictable Negative Impacts, Assessment and Mitigation Measures for Ruai Area (Cont'd.)

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of access road and operational places. Soil materials should be covered with sheet • Provision of mask and protective clothing to operators • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment
Soil Pollution	O, PCL	Low	• Landfill site should receive solid domestic waste only
Noise	C, O, CL	Low	• Public Information on on work schedule • Limitation of operation of heavy equipment to daytime only • Adequate maintenance of equipment and trucks which must have exhaust mufflers
Gas Migration	O, PCL	Low	• Land use regulation to surrounding area, avoiding building construction
Traffic	C, CL	Low	• Adequate working hours to minimise traffic congestion • Selection of nearest source for necessary materials
	O	High (Access road)	• Upgrading of access road to Class C to accept the additional number of vehicles
		Low (Kangundo road)	• Adequate routing and collection hours to minimise traffic congestion • Selection of the nearest source for necessary materials • Proper maintenance of the road
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation
Scavengers	O	High	• Enactment of specific working rules for scavengers if allowed to work in the landfill site

Legend: C: Construction Phase; O: Operation Phase; CL: Closure Phase; PCL: Post-closure Phase

7.3 Environmental Management Plan for the Ruai Area

Predictable impacts and mitigation measures must be considered in preparing the environmental management plan for the landfill site at Ruai, as shown in **Table S7.3-1** below. The post construction phase is composed of operation, closure and post-closure stages.

Table S7.3-1 Environmental Management Plan for the Establishment of Landfill Site at Ruai Area

Management Item	Source of Impact	Measuring Standard of Impact	Management Approach	Management Location
Construction Phase				
Water pollution of Nairobi River	• All civil works of project	• No surface runoff and soil erosion from the landfill	• Avoid spill soil into river • Provide ring drain around landfill	• Construction site
Dust, Exhaust fumes from equipment	• Mobilisation of equipment and vehicles • Civil works	• People's complaints	• Cover soil materials with sheet • Road watering • Proper maintenance of vehicles and equipment • Control of number or speed of vehicles/ equipment	• Construction site • Access road
Noise	• Operation of heavy equipment and vehicles	• WHO's Noise Standard	• Working hour of heavy equipment limited to daytime only • Control of number or speed of vehicles/ equipment • Proper maintenance of vehicles and equipment which must have exhaust mufflers	• Access & main road • Construction site

Table S7.3-1 Environmental Management Plan for the Establishment of Landfill Site at Ruai Area (Cont'd.)

Management Item	Source of Impact	Measuring Standard of Impact	Management Approach	Management Location
Traffic	• Mobilisation of vehicles and equipment	• Traffic congestion frequency/ duration	• Effort to avoid traffic jam by selection of nearest source for necessary materials • Adjustment of working time	• Construction site • Access & main road
Landscape	• All civil works of project	• People's perception	• Design of landfill should integrate aesthetic development of area	• Construction site
Post Construction Phase				
Groundwater Pollution	• Leachate	• NCC's criteria and WHO's guidelines for drinking water	• Control of leachate treatment plant	• Landfill site
Offensive Odour	• Decomposition of garbage at landfill site	• Public complaint and reaction	• Daily covering of garbage • Installation of gas control system • Implementation of medical checkup program	• Landfill site
Harmful Insects	• Uncovered garbage	• Public complaint and reaction	• Daily covering of the garbage • Implementation of medical checkup program	• Landfill site
Water pollution of Nairobi River	• Leachate	• Japanese Standard for discharge into Public Water Courses	• Control of leachate treatment plant • Proper maintenance of drains around the landfill	• Landfill site
Smoke from garbage	• Burning of garbage at landfill site	• Public complaint and reaction	• Daily covering of garbage • Installation of gas control system	• Landfill site
Dust, Exhaust fumes from vehicles	• Mobilisation of equipment and vehicles	• Public complaint and reaction	• Cover soil materials with sheet • Road watering • Proper maintenance of vehicles and equipment • Provide mask and protective clothing to operators • Implementation of medical checkup program	• Access & internal roads • Landfill site
Soil Pollution	• Toxic elements illegally entering site	• No toxic waste entering the site	• Control of type of waste introduced at landfill site	• Main gate
Noise	• Operation of heavy equipment and vehicles	• WHO's Noise Standard	• Working hour of heavy equipment limited to daytime only • Proper maintenance of equipment/vehicles which must have exhaust mufflers	• Access & main road • Landfill site
Gas Migration	• Gas generated at landfill site	• Field inspection	• Land use limitation in the surrounding area • Installation of gas control system	• Area surrounding landfill site • Landfill site

Table S7.3-1 Environmental Management Plan for the Establishment of Landfill Site at Ruai Area (Cont'd.)

Management Item	Source of Impact	Measuring Standard of Impact	Management Approach	Management Location
Traffic	• Mobilisation of equipment/ vehicles	• Traffic congestion frequency/duration	• Selection of adequate routing and time for waste transportation • Selection of nearest source for necessary materials • Build access road to main road specification (Class C) • Proper maintenance of road	• Landfill site • Access & main road
Scavengers	• Recycling activities	• Interference with the smooth operation of the landfill	• Provision of rules to control scavengers	• Landfill site

7.4 Environmental Monitoring Plan for the Ruai Area

The matrix of the Environmental Monitoring Plan for the landfill site at Ruai is shown in **Table S7.4-1** below.

Table S7.4-1 Environmental Monitoring Plan for the Ruai Area

Monitoring Items	Location	Monitoring Method	Frequency	Duration
Groundwater	• Groundwater monitoring well	Analysis of water for physic-chemical and bacteriological quality	1/year	Operation and post-closure stages
Offensive Odor	• Landfill site • Surrounding residential area	• Public opinion • Medical checkup	Monthly	Operation stage
Harmful Insects	• Landfill site • Surrounding residential area	• Public opinion • Field inspection • Medical checkup	Monthly	Operation stage
Water Pollution of Nairobi River	• Upstream and downstream of disposal site for water sampling • Inlet and outlet of leachate treatment plant	Analysis of water and leachate for physic-chemical and bacteriological quality	1/year	Operation and post-closure stages
Smoke	• Landfill site • Surrounding residential area	• Field inspection • Public opinion	1/year	Operation stage
Dust and exhaust fumes	• Landfill site • Surrounding residential area	• Public opinion • Field inspection • Medical checkup	Quarterly	Construction, Operation and closure stages
Soil Pollution	• Main gate • Landfill site	• Inspection of type s of waste	1/year	Operation and post-closure stages
Noise	• Landfill site and main & access roads	Field measurement of noise level	1/year	Construction, Operation and closure stages
Gas Migration	• Landfill site • Surrounding area	Field measurement of gas and site inspection	1/year	Operation and post-closure stages
Traffic	• Main & access roads	Field inspection	yearly	Construction, Operation and closure stages
Scavengers	• Landfill site	Field inspection	Monthly	Operation stage

8. PROJECT EVALUATION

8.1 Financial Evaluation

(1) Affordability of the Required Costs and Charges

Waste collection rate would be maintained at 60% in the 2000-2003 period. The initial investment cost including engineering amounts to Kshs. 3,854 million (US$65.5 million), which is assumed to be financed by grant aid. Average charge for households should be collected at 211 Kshs/month in order to cover O&M cost, depreciation and PSI contract cost.

On the other hand, affordability of households in the same period is estimated, as presented in **Table S8.1-1,** and the all year average is 212 Kshs/month.

Table S8.1-1 Estimated Affordability of Households

Unit: Kshs/month

Income Level	2000	2001	2002	2003	All Year Average
Top 45% Level	155	160	164	169	163
Top 30% Level	202	207	213	219	212
Top 15% Level	248	255	262	269	260
Three Level Average	202	207	213	219	212

Theoretically, it is possible to operate the projects at 60% collection by charging 211 Kshs/month in all year average from the viewpoint of households' affordability **during 2000-2003.**

From the viewpoint of macro-economy as well as financing, it is safely assumed that the project is feasible since the required burden on Nairobi is less than 1% of the Gross Regional Domestic Product (GRDP) of Nairobi in 2000-2003.

Finally, if the average charge for households is set at 211 Kshs/month, which is decided in proportion to their waste production and deemed as affordable, the charge for commercial establishments set at 437 Kshs/month and tipping fees set at 89 Kshs/ton, which are also calculated in proportion to their waste production/dumping, would be appropriate from the viewpoints of macro-economy and the Polluter Pay Principle (PPP).

(2) Consideration of Service Level and Initial Investment Reduction

In case that the revenue necessary to achieve 60% waste collection ratio is not attained, reduction of service level and the initial investment may be taken into consideration.

Firstly, reduction of service level is considered not only from the viewpoint of revenue but on how the new system can be started without difficulty. Thus, the target levels are decided as 40% in 2000-2003, as mentioned in the Master Plan Study.

Secondly, reduction of the initial investment is introduced as follows:

(a) the construction of transfer station is delayed to the Second Implementation Stage and direct transportation system is employed in the First Implementation Stage; and

(b) the sanitary level of landfill system for the new disposal site is reduced to Level 2+.

Initial investment cost including engineering amounts to Kshs. 2,059 million (US$35.0 million), which is also assumed to be financed by grant aid. Average charge for households should be collected at 135 Kshs/month covering O&M, depreciation and PSI contract cost. As above, the average affordability in the same period is over 212 Kshs/month. This indicates that the project could be operated by charging 135 Kshs/month in all year average during 2000-2003.

The total of O&M, depreciation and contract-out cost in this case is about Kshs. 1,979 million and it is about 0.6% of GRDP. The proposed project is thus feasible from the viewpoint of macro-economy as well as financing.

In addition, if the average charge for households is set at 135 Kshs/month, the charge for commercial establishments set at 279 Kshs/month and tipping fees set at 88 Kshs/ton would also be appropriate from the viewpoints of macro-economy and the Polluter Pay Principle (PPP).

8.2 Technical Evaluation

(1) Final Disposal

The proposed final disposal site is assumed to be managed under a sanitary landfill system. There would be no technical difficulties for the system if heavy equipment like bulldozers and/or excavators are employed. It should be noted, however, that proper organisational arrangements are essential to sustain the sanitary landfill system.

With an experience of NCC operators in the Experimental Sanitary Landfill and Closure Work implemented as one of the pilot projects in this Study, expertise on the system may not be necessary.

(2) Collection and Transportation

Daily operation and maintenance of the container truck and container itself would not bring any technical constraint because the container system has already been introduced by the Nairobi City Council (NCC) and it is still workable. Construction of a new workshop under the Department of Environment (DoE) will reduce failures caused by inadequate repair or replacement of parts and equipment.

The mechanical system of the container truck is the same as that of the dump truck in terms of hydraulic system. This system could be well maintained and

fully repaired by local staff. As for the transfer station, there is no complicated mechanical system and therefore, no expertise is required on a daily basis except in the introductory stage of the facility which will be covered by technical assistance and/or grant aid.

8.3 Environmental Evaluation

The EIA conducted during the Feasibility Study had focused on the construction of disposal site at either the Ruai Area or the Ngong Road Forest Area. Also focused are the impacts involved due to collection and transportation.

Since the Ngong Road Forest Area is not suitable as a solid waste disposal site, the Ruai Area is selected in which case a transfer station is needed. For this transfer station whose location is still to be decided by the Kenyan authorities concerned, an initial environmental examination and an environmental impact assessment are necessary which could be carried out during the detailed design stage of the overall project.

The components of the priority projects and their environmental implications are summarised in the **Table S8.3-1** below.

Table S8.3-1 Potential Negative Impacts of Priority Projects on the Environment

Priority Project Components	Final Disposal	Collection and Transportation System		
		Storage	Collect/Transport	Transfer Station
Potential impacts				
Groundwater pollution	2	4	4	*
Offensive odour	1	1	3	*
Harmful insects generation	1	1	4	*
Surface water pollution	3	4	4	*
Smoke from garbage	3	4	4	4
Dust, Exhaust fumes	2	4	2	*
Soil pollution	3	4	4	*
Noise	2	4	2	*
Gas migration	3	4	4	4
Traffic	1 (access road)	4	2 (main road)	*
Landscape	3	1	4	*
Scavengers	1	2	4	*

Legend: 1: impact of high significance; 2: impact of moderate significance; 3: impact of low significance; 4: impact of no significance; *: to be evaluated by EIA during the detailed design

Some potential negative impacts are predicted to appear with the proposed projects; however, the implementation of mitigation measures will minimise these impacts.

Since currently the waste collection in the city is very poor and in some places is null, the proposed projects are expected to make a clean city with less disease caused by the poor management of solid waste.

The existing disposal site currently have serious impacts on the surrounding environment. The newly proposed disposal site will be of sanitary landfill type, diminishing in this way possible adverse effects on the surrounding environment.

In conclusion, the proposed projects are considered to be beneficial as a whole from the point of view of their contribution to a better environmental quality of Nairobi City as well as to the improvement of public health.

8.4 Social Evaluation

(1) Public Awareness

The new collection and transportation system depends mainly on a container system. In other words, communal containers will be installed all over the city as much as possible and NCC will collect the waste discharged in the containers. Since the installation of new containers would be conspicuous, the introduction of the container system will result in arousing people's awareness toward the importance of solid waste management. It will accordingly enhance people's cooperation with the new system.

(2) Scavenging

A large number of scavengers is operating in the city and especially sustained by the Dandora dumpsite. Proper collection services will gradually reduce the number of scavengers. The closure of the Dandora site will eliminate scavenging problems such as health and safety. Although the construction of the new final disposal site at Ruai area will create a new venue for scavenging activities, a proper level of management and control in the new site will minimise the scavenging problems and contribute more or less to reuse and recycling of the waste by scavengers.

The construction of a transfer station may bring social tension in the surrounding area because the transfer station is proposed near the residential area. In this respect environmental impact assessment (EIA) as well as social survey should be carried out before the implementation, and construction schedule will be fixed based on the result of EIA.

8.5 Institutional and Organisational Evaluation

The proposed Institutional Restructuring Plan (IRP) and the Capacity Building Assistance Program (CBAP) will end in the year 2000. The new collection and transportation system will start in the middle of 2000, and the new final disposal site will receive collected solid waste from the year 2001. Therefore, these technical approaches could be carried out smoothly and properly under the restructured organisations including the financial system by IRP and CBAP.

8.6 Consideration on Project Implementation

It is recommendable that the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out all the priority projects in the First Implementation Stage, i.e., from 1999 to 2003. However, in case that the revenue necessary to implement the projects is not enough because of financial constraints, some of the projects may have to be deferred to the next implementation stage.

In consideration of the possibility of securing special funds from the central government and/or grant aid from other governments, the priority projects as considered in this Study may be divided into smaller project units which can be

executed as independent projects. The following table shows the prioritisation of project implementation, prerequisites and required project costs.

Table S8.6-1 Prioritisation of Project Implementation, Prerequisites and Project Costs

Priority	Project	Prerequisite	Capital Cost Required (million Kshs)
1	Institutional Restructuring and Financial Reform under the Capacity Building Assistance Program (CBAP)	Implementation of Preparatory Actions by NCC	47.8
2	Construction of a new small workshop at Kaloleni*[1]	-ditto-	88.2
3	Introduction of container system with side loaders, dump trucks, etc.*[2]	Implementation of Preparatory Actions by NCC; and After start-up or in parallel with the above CBAP	447.2
4	Construction of a new sanitary landfill site at Ruai (First Stage)*[3]	Implementation of Preparatory Actions by NCC and the Urgent Improvement Plan; and After start-up or in parallel with the above CBAP	455.4
5	Procurement of heavy equipment for the new landfill site*[4]	-ditto-	89.1
6	Closure work of the existing dumpsite at Dandora	-ditto-	227.0
7	Implementation of the Community Waste Management Project (CWMP)	Implementation of Preparatory Actions by NCC	12.0 (for 5 years)
8	Construction of a transfer station	Implementation of Preparatory Actions by NCC and the Urgent Improvement Plan; and After start-up or in parallel with the above CBAP	945.0

Note: *[1] Including rehabilitation of the existing depots.

*[2] Vehicles and others required are 27 container trucks, 507 containers, 14 side loaders, 6 dump trucks, 6 wheel loaders, 1 water sprinkler, 22 inspection cars and 1 recovery truck.

*[3] The first stage construction excludes excavation, embankment and installation of leachate collection and drain piping and gas exhaust equipment work for the following stage of construction.

*[4] Heavy machinery required are 5 bulldozers, 1 excavator, 2 dump trucks and 1 jeep.

9. CONCLUSION

To improve public cleanliness and public health and protect the environment, the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out the priority projects in the First Implementation Stage, i.e., from 1999 to 2003. The priority projects are composed of: (1) Institutional Restructuring and Financial Reform; (2) Promotion of Private Sector Involvement; (3) Construction of the Final Disposal Site; and (4) Improvement of the Collection and Transportation System.

10. RECOMMENDATION

The JICA Study Team recommends that the Government of the Republic of Kenya and the Nairobi City Council (NCC) should carry out the priority projects in the First Implementation Stage, i.e., the years 1999 to 2003. The priority projects should be followed by the Preparatory Actions and Urgent Improvement Plan.

With regard to project implementation, the following actions are recommended to be carried out with dedication and dispatch:

(1) Drafting of a new SWM By-laws.

(2) Restructuring the organisation and financial system of the Department of Environment, Nairobi City Council.

(3) Making arrangements with the central government and donor countries or agencies in order to secure financing for the implementation of the projects.