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 3

MAIN REPORT (FEASIBILITY STUDY)

AUGUST 1998

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

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 3

MAIN REPORT (FEASIBILITY STUDY)

AUGUST 1998

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

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,

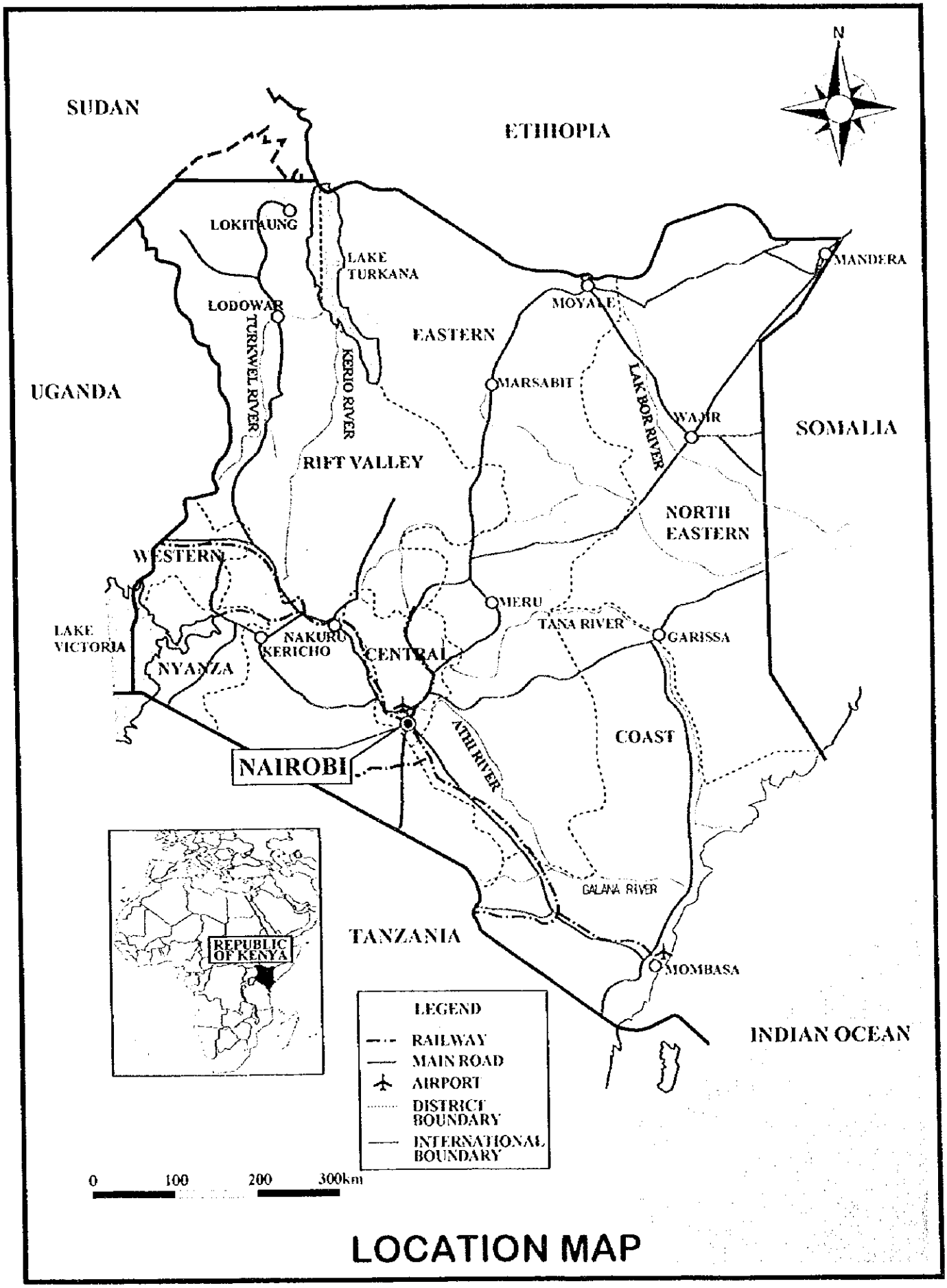
We are pleased to submit herewith the Final Report on the Study on Solid Waste Management in Nairobi City in the Republic of Kenya. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and the Japan International Cooperation Agency (JICA), as well as 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.

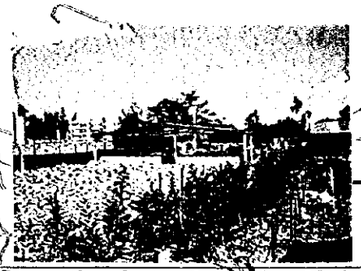
Very truly yours,

Takao Yoshida
Team Leader
JICA Study Team



LOCATION MAP

Collection operation by NCC in the middle income area



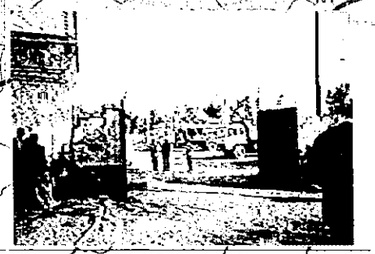
Composting plant at the Hawkers Market

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

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

FINAL REPORT

MAIN REPORT (FEASIBILITY STUDY)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 General

This report describes the results of the Feasibility Study for priority projects which were selected from the Master Plan. The Feasibility Study was carried out for solid waste management with technical and financial optimality as well as urgency of issues taken into consideration.

1.2 Considerations for the Feasibility Study

Institutional/financial and technical aspects were considered for the Feasibility Study, as follows:

(1) Institutional and Financial Aspects

(a) Institutional Restructuring and Financial Reform

Organisations related to solid waste management (SWM) in Nairobi are to be restructured, taking into consideration the minimum requirements for waste collection and transportation services, future waste recycling, and waste reduction. At the same time, a special account for SWM is to be established and the budgetary system reformed. On the other hand, collection charge is to be increased to 100 Kshs/month for households with a continuing billing system where waste collection charge is billed together with water charge at present. Rate increase will be made from the year 2000 accordingly.

(b) Promotion of Private Sector Involvement (PSI)

Solid waste collection services in Ngara which is located next to the Central Business District (CBD) and where a contract-out has already been started by the NCC is proposed to be commissioned to private companies.

(2) Technical Aspect

(a) Construction of a New Final Disposal Site

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

(b) Improvement of Collection and Transportation System

Basically, NCC is to provide a minimum level of service equally throughout Nairobi City. From the viewpoint of technical and financial optimality, a container type of collection with side loaders and dump

trucks is to be implemented to achieve a 60% collection rate including those of private collection services.

CHAPTER 2

INSTITUTIONAL RESTRUCTURING PLAN AND CAPACITY BUILDING ASSISTANCE PROGRAM

CHAPTER 2

INSTITUTIONAL RESTRUCTURING PLAN AND CAPACITY BUILDING ASSISTANCE PROGRAM

2.1 Institutional and Restructuring Plan

2.1.1 New Organisational Structure for the Department of the Environment

The proposed organisational structure of the DoE which is based on the recommendations in **Supporting Report Section B**, is presented in **Figure 2.1-1**. The proposed structural changes can be summarised from the top down as follows:

(1) Reorganise the DoE into four (4) Divisions; namely, SWM Division, Environmental Planning and Management Division, Administration Division and Parks Division, and appoint four (4) Deputy Directors to manage each of them.

(2) In restructuring the Cleansing Section into the new SWM Division, (a) create a new Community Development Section and a new Contract Management Section within the Division; (b) separate disposal from collection and street cleansing, set up a new Disposal Section within the Division and appoint a Disposal Manager for the new Section; (c) appoint an Operations Manager for the Collection and Street Cleansing Section; (d) separate the daily management of collection from street cleansing; and, (e) reduce the number of vertical levels in the Division.

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

(4) The new Environmental Planning and Management Division is to be organised into three (3) Sections: Environmental Planning Section, Environmental Management Section, and Environmental Impact Assessment Section.

(5) Deputy Directors on Scale 3 are to head Divisions, Managers on Scale 4 are to head Sections, and Assistant Managers on Scale 5, generally, are to head Units.

The restructuring will also include clearly defining and assigning functional responsibilities throughout the new organisation to all Divisions, Sections, Units and Sub-Units in the DoE. Currently these responsibilities are not clearly assigned.

Likewise, staff responsibilities are to be defined and assigned to all staff positions, i.e., job descriptions are to be prepared for each staff position. Job descriptions are essential to clarify responsibilities, set accountabilities and for use as a basis to assess an individual's performance.

The DoE will have to make these preliminary structural changes including the creation of new positions and appointment of staff between 1998 and 1999 as Preparatory Actions for the Capacity Building Assistance Program (CBAP). The essential organisational development is to be implemented under the CBAP from 1999 to 2000.

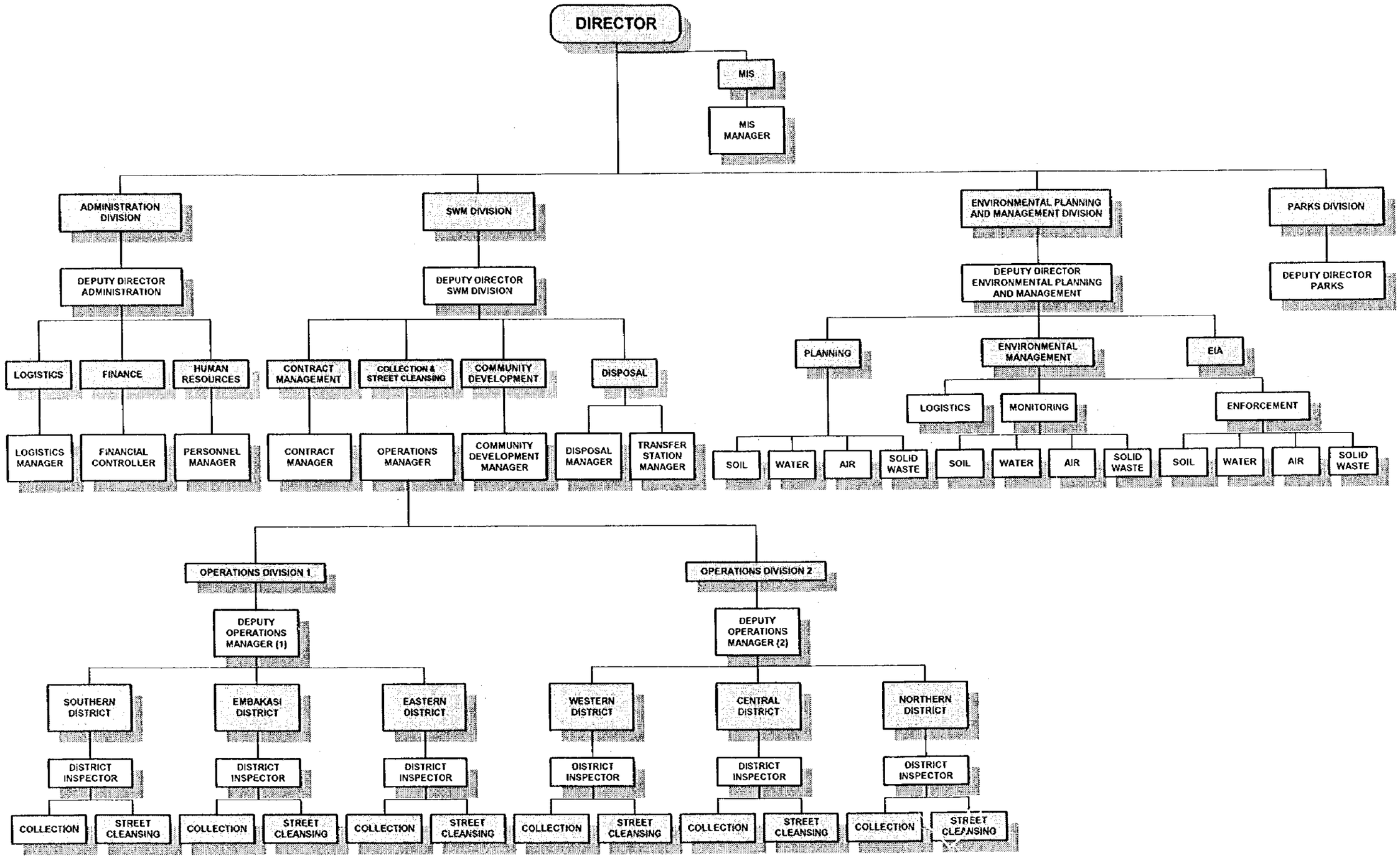


Figure 2.1-1 The Proposed Organisational Structure of the DoE

2.1.2 Phased Implementation of the Institutional Restructuring Plan

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.

The IRP's main actions and tasks can be grouped into three (3) major areas; namely:

(1) Organisational restructuring of the DoE;
(2) Establishing new organisational functions; and
(3) Developing of key management capabilities.

Some of these actions can be implemented by NCC as Preparatory Actions, but most of them will require assisted implementation under the CBAP. The CBAP will critically support the implementation of the IRP. It is recommended that the CBAP is to start in April 1999 and continue until May 2000 on a total time of 14 months. The IRP's actions and tasks are therefore phased in the following way:

(1) Preparatory Actions – 1998/1999

Preparatory Actions must be substantively implemented between 1998 and 1999 to enable the CBAP to start. The components of these Actions are given below. They cover the major areas of:

(a) Organisational restructuring of the DoE; and
(b) Establishing new organisational functions.

(2) Strengthening under the CBAP - 1999/2000

The IRP's actions to be implemented under the Capacity Building Assistance Program (CBAP) shall cover the major areas of:

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

(b) development of key management capabilities.

A description of the CBAP is presented in **Section 2.2** below.

(3) Institutional Strengthening after the CBAP - 2000 to 2008

The CBAP will consider and, if appropriate, recommend further capacity building assistance to be implemented after its completion. Typically this would fall in the remainder of 2000 and 2001. The assistance would cover the further development of the DoE's new functions and key management capabilities.

The phasing of the three (3) major areas of the IRP is illustrated in **Figure 2.1-2** below.

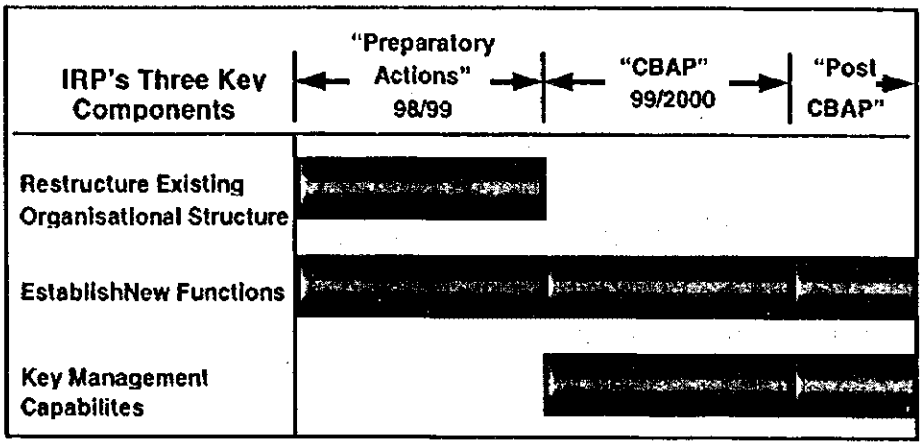


Figure 2.1-2 Phased Implementation of the IRP

Table 2.1-1 below shows the phasing of the major actions and tasks of the Institutional Restructuring Plan and the related costs of the CBAP which total Kshs. 47,773,000. Before **Table 2.1-1** is presented, however, the Preparatory Actions including urgent actions are described in more detail, as follows:

(1) Preparatory Actions

The Preparatory Actions cover:

(a) restructuring the DoE's existing organisational structure; and

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

Among these are a number of Urgent Actions which are described below.

(a) Restructuring the DoE's Existing Organisational Structure

The DoE's existing organisational structure needs to be restructured in the following way:

(i) Reorganise the DoE into four Divisions - SWM, Environmental Planning and Management, Administration and Parks each headed by a Deputy Director. Establish a Management Team comprising the Director and the new Deputy Directors;

(ii) Reduce the number of vertical levels in senior and middle management in the SWM Division and appoint one (1) Operations Manager and two (2) Deputy Operations Managers to head the Collection and Street Cleansing Section of the Division;

(iii) Separate disposal from collection and street cleansing and establish a Disposal Section in the SWM Division to be headed by a Disposal Manager; and

(iv) Separate the daily management of collection services from street cleansing. This will require the appointment of an additional four (4) Senior Foremen.

Since the process of formally approving these actions will take time, a number of Urgent Actions are required to temporarily establish functions and assign staff in an acting capacity while awaiting their formal approval. The process of formal approval will be initiated in parallel with the urgent actions. These Urgent Actions are as presented in **Box 2.1-1** below.

Box 2.1-1 Urgent Actions for Restructuring the DoE

1. The DoE and the Heads of Departments finalise proposals for changes to the existing organisational structure by the end of 1998;
2. Disposal: A temporary Disposal Section is established and the DoE temporarily assigns a member of its staff to manage the Section awaiting its formal creation. All actions are implemented by the end of 1998; and
3. Separation of collection from street cleansing: Set up separate operational units for collection and street cleansing while awaiting their formal creation. Temporarily assign four additional Senior Foremen among the new units. All actions are implemented by the end of 1998.

(b) Establishing New Functions

The new functions which need to be established are:

(i) a new Community Development Section (CDS) in the SWM Division;

(ii) a new Contract Management Section (CMS) in the SWM Division;

(iii) a new Environmental Planning and Management Division which will be responsible for the environmental regulation of solid wastes and other media; and

(iv) a new Administration Division to manage the DoE's Human Resources, Finance and Logistics sections.

At this stage these functions would be partially established, i.e., Divisions, Sections and positions would be created, new managers and senior staff appointed and objectives and simple tasks defined and implemented.

Full implementation of these functions will require assistance under the CBAP.

Box 2.1-2 Urgent Actions for Establishing New Functions

1. The DoE and the Heads of Department finalise proposals for establishing new functions by the end of 1998;
2. Finance Section: a temporary Finance Section is established. The DoE temporarily assigns a member of the City Treasurer's staff to manage the Section while awaiting its formal creation. All actions are implemented by the middle of 1998.

(2) Formal Approval of New Functions/Positions and Staff

The process of obtaining formal approval for establishing new functions, creating new positions and appointing staff is as follows:

(a) Approval by NCC's Heads of Departments, relevant NCC Committees and the Full Council possibly by the end of 1998.

(b) MOLG approves Full Council resolution possibly by the end of 1998;

(c) Formulation of further adjustments, e.g., as a result of discussions with the Local Government Workers Union and the Federation of Kenya Employees and obtain final approval from MOLG possibly by the end of 1998; and

(d) Recruitment and appointment of staff to new positions possibly by the end of 1999.

The schedule is very indicative - in principle, NCC and MOLG will undertake to obtain approvals as soon as possible.

Table 2.1-1 Phased Implementation of the Institutional Restructuring Plan

Main Implementing Actions	Preparatory Actions by DoE	Phasing Over Master Planning Period				CBAP Costs (Kshs.)
	1998/1999	1999	2000	2001-2004	2004-2008	
1. Organisational Restructuring of DoE						
1. Reorganise the DoE into four Divisions	SWM, Environmental, Admin & Parks Divisions set up. Appoint four new Deputy Directors	International consultants review new organisational structure and functions under CBAP				
2. Reduce the number of vertical levels in the SWM Division. Create new manager positions	DoE removes old positions, creates new positions & appoints six new managers in the SWM Division, including an Operations Manager & 2 Deputy Operations Managers					
3. Separate disposal from collection and street cleansing	DoE sets up Disposal Section and appoints Disposal Manager. Collection and Street Cleansing is organised as a Section					
4. Separate daily management of collection from street cleansing	DoE appoints 4 more Senior Forman to enable collection to be separately managed from street cleansing in the Collection and Street Cleansing Section					
5. Assign responsibilities throughout the DoE's Divisions	DoE defines and assigns responsibilities to Divisions, Sections and Units and to all staff positions.	International consultants review organisational responsibilities under CBAP				

Table 2.1-1 Phased Implementation of the Institutional Restructuring Plan (Cont'd.)

Main Implementing Actions	Preparatory Actions by DoE	Phasing Over Master Planning Period				CBAP Costs (Kshs.)
	1998/1999	1999	2000	2001-2004	2004-2008	
2. Establish New Functions						
1. Establish Community Development Section in SWM Division	DoE appoints Community Development Manager and staffs up Section	Social Analyst assists in establishing the Section's functions under CBAP	Social Analyst completes assistance in early 2000 and reviews for further capacity building assistance requirements			9,850,000
2. Establish Contract Management Section in SWM Division	DoE appoints Contract Manager and staffs up Section	Contracting Consultant assists to establish Section's functions under CBAP	As of 1999. Reviews for further CBA requirements			3,500,000
3. Establish Environmental Planning and Management Division	DoE appoints Deputy Director Environmental Regulation and staffs up the Division	Regulation Consultant assists to establish Division's functions under CBAP.	As of 1999. Reviews for further CBA requirements			5,750,000
4. Establish Finance Section in Administration Division	DoE appoints Finance Controller and staffs up Section.	Finance Consultant assists to establish Section's functions under CBAP. Assists implementation of computerised financial system.	As of 1999. Reviews for further CBA requirements			5,750,000
5. Establish Human Resources Section in Administration Division	DoE appoints Human Resources Manager and staffs up Section.	Human Resource Consultant assists in establishing the Section's functions under CBAP.	As of 1999. Reviews for further CBA requirements			3,500,000
6. Establish MIS Section under the Director of Environment	DoE appoints MIS Manager and staffs up Section.	Organisational & Management Consultant assists in designing, implementing and training for MIS	As of 1999. Reviews for further CBA requirements			
7. Establish Logistics Section in Administration Division	DoE appoints Logistics Manager and staffs up Section.					

Table 2.1-1 Phased Implementation of the Institutional Restructuring Plan (Cont'd.)

Main Implementing Actions	Preparatory Actions by DoE	Phasing Over Master Planning Period				CBAP Costs (Kshs.)
	1998/1999	1999	2000	2001-2004	2004-2008	
3. Developing Key Management Capabilities						
A number of key management functions are developed under the CBAP		Organisational and Management Consultant (OMC) develops key management capabilities under CBAP OMC oversees the CBAP	OMC completes assistance in early 2000 & makes recommendations for further organisational changes and capacity building assistance			10,500,000
1. Establish a Management Team	DoE establishes Management Team	OMC trains Management Team				
2. Establish a planning capability		OMC assists in preparation of Cleansing Section's first annual plan, setting up planning procedures and providing training	OMC makes recommendations for future planning capability. DoE appoints planning coordinator and other planning personnel if appropriate			
3. Establish procedures for objective setting and performance measurement		OMC assists establish arrangements for Objective Setting and Performance Measurement				
4. Improving Managers Effectiveness		OMC prepares, designs and delivers a management training program for the Cleansing & Administration Section's senior and middle managers				

Table 2.1-1 Phased Implementation of the Institutional Restructuring Plan (Cont'd.)

Main Implementing Actions	Preparatory Actions by DoE	Phasing Over Master Planning Period				CBAP Costs (Kshs.)
	1998/1999	1999	2000	2001-2004	2004-2008	
5. Preparation of a Departmental Regulation Manual		OMC assists preparation of Departmental Regulations Manual				
4. Training		Training Program delivered under CBAP to support organisational restructuring. Program managed by the OMC Individual Program components delivered by each international consultant	CBAP training completed early 2000. Future Training Program formulated under the CBAP and implemented in 2000 possibly under donor agency program	DoE Training Program	DoE Training Program	
Total Cost*						**38,850,000**

* This total cost does not include cost for development of technical capabilities.

2.2 The Capacity Building Assistance Program (CBAP)

The Capacity Building Assistance Program (CBAP) will comprise a mixture of direct implementation assistance combined with training provided in classes or workshops, covering eight (8) organisational components. It is recommended that the CBAP will start in April 1999 and shall continue for 14 months up to May 2000. It is intended that the IRP's recommendations will be fully implemented under the CBAP by May 2000.

(1) Development of Key Management Capabilities

(a) Policy Planning

Recommended Implementation and Capacity Building Assistance: The Organisational and Management Consultant will assist the DoE in preparing the First Annual Plan and in setting up the annual planning procedures. In this role he would act as the planning coordinator and would provide assistance to:

(i) formulate the structure of the Plan;

(ii) set objectives and goals;

(iii) prepare action plans for the SWM Division's and the Environmental Planning and Management Division's operational, regulatory and other activities;

(iv) prepare a Manpower plan in conjunction with the Human Resource Consultant;

(v) prepare a financial plan including a simple financing plan in conjunction with the Finance Consultant. This will be the Departmental budget;

(vi) formulate the appropriate planning procedures to establish a planning cycle; and

(vii) define what and how Managers report their Sections' and Units' performance to the Management Team.

The consultant will initially provide training in classes and workshops for the Management Team and other staff involved in planning. This would cover the planning cycle.

The consultant will also recommend the best arrangements for coordinating and managing the preparation of the plan in the following year. For example this might involve appointing a planning coordinator in the Administration Division. More detailed operational planning may require the appointment of a planning staff.

(b) **Objective Setting**

Capacity Building Assistance: The Organisational and Management Consultant will assist the DoE in establishing the arrangements for Objective Setting and Performance Measurement.

(c) **Improving Managers Effectiveness**

Capacity Building Assistance: The Organisational and Management Consultant will prepare, design and manage a management training program for the Cleansing Section.

Most of the courses will be delivered by the Organisational and Management Consultant. However, it is herein strongly recommended that where appropriate some of the management training will be delivered by local Kenyan trainers. There are a number of good Kenyan management training organisations in Nairobi. The DoE and the consultant will decide what can be locally provided.

(d) **Management Information Systems Capability**

Implementation and Capacity Building Assistance: The DoE will need assistance from the Organisational and Management Consultant to design and implement the Management Information System (MIS). This will involve defining the Performance Indicators (Pis) and designing simple data capture and data analysis systems.

The consultant will also provide training for the SWM Division's staff covering MIS systems and monitoring methodologies.

(2) **Community Development**

Recommended Implementation and Capacity Building Assistance: The DoE should appoint the Community Development Manager and staff, define objectives and implement simple tasks between 1998 and 1999. Capacity building assistance under the CBAP will then be required to fully establish the CDS's functions. The earliest capacity building assistance can be provided is in April 1999.

The assistance will be provided by a Social Analyst. The appointment would be for one year, in which the Analyst would help to:

(a) establish and manage the CDS; and
(b) establish relationships between NCC and relevant NGOs/CBOs.

The assistance would be conditional upon the creation and appropriate staffing of the CDS. The estimated Social Analyst's fee for five (5) months is Kshs. 9,850,000 (including Kshs. 1,100,000 for equipment and materials).

(3) Financial

Recommended Implementation and Capacity Building Assistance: the DoE should appoint the Financial Controller and staff between 1998 and 1999. The DoE will then need capacity building assistance under the CBAP to establish the Finance Section's functions and to properly set it up. The earliest capacity building assistance can be provided is April 1999.

The assistance will be provided by a Financial Consultant who will be required for three (3) months over a total elapsed period of six (6) months, i.e., one year budget cycle, during 1999-2000.

The consultant will assist the DoE staff in setting up the Finance Section, including the budgeting systems, implement the computing systems and train the Section's staff in their use. He will also provide financial training for the staff covering accounting principles and concepts, budget setting and monitoring, financial forecasting, tariff setting, etc. The assistance would be conditional upon the creation and appropriate staffing of the Finance Section.

The estimated Financial Consultant's fee for three (3) months is Kshs. 5,250,000. The estimated cost of the computing hardware and software is Kshs. 500,000. This is an indicative estimate.

(4) Environmental Regulation

Recommended Implementation and Capacity Building Assistance: the DoE should set up the Environmental and Management Division, appoint the Deputy Director and his staff and establish and define basic tasks between 1998 and 1999. The DoE will then need the capacity building assistance under the CBAP to establish the Division's functions and to properly set it up. The capacity building assistance will be implemented in 1999 and 2000.

The assistance will be provided by an Environmental Regulation and Legal Consultant who will help to establish the Division's functions, formulate regulatory methodologies and implement regulatory systems. The consultant will also advise on the appointment of the Division's staff and provide training to them covering regulatory policies and practices, waste monitoring methodologies and systems.

The Consultant will be required for three (3) months during 1999-2000. The assistance would be conditional upon the creation and appropriate staffing of the Division.

The estimated Environmental Regulation and Legal Consultant's fee for three (3) months is Kshs. 5,250,000.

(5) Formatting and Drafting of SWM By-laws

Recommended Implementation and Capacity Building Assistance: It is recommended that a capacity building assistance (CBA) should be provided to

assist the NCC in the formulation of the draft of a new SWM By-laws. This assistance should be provided as soon as possible. The earliest it can be provided is from April 1999.

The CBA should also include a seminar(s) on the best practice in international environmental legislation for solid wastes for the DoE's senior managers, its environmental regulatory staff and relevant officers from NCC's Town Clerk's Department.

The assistance will be provided by an Environmental Regulation and Legal Consultant who will be the same person assigned for the Environmental Regulation in **Item (4)** above.

The estimated Environmental and Legal Consultant's fee is included in **Item (4)** above.

(6) Contract Management

Recommended Implementation and Capacity Building Assistance: The CMS should be firstly set up - the Contract Manager (CM) and some staff appointed and simple tasks defined - as a Preparatory Action. After this the DoE will need capacity building assistance under the CBAP to properly establish the Section and the system of contract management.

The assistance will be provided by a Contract Management Consultant. The Contract Manager and staff from the Section would work closely with the Consultant. The Consultant would assist in two fundamental aspects:

(a) setting up appropriate systems and procedures; and
(b) developing the contract management skills of the Section's staff.

The CBA will cover all aspects of the contract management process for both pre- and post-contract awards. The assistance would be primarily focused on the Section but it would also consider procedures and needs of the Contract Team and the Town Clerk's Department as appropriate.

The Consultant will be required for two (2) months during 1999-2000. The assistance would be conditional upon the creation and appropriate staffing of the Division.

The estimated Contract Management Consultant's fee for two (2) months is Kshs. 3,500,000.

(7) Human Resource Management

Recommended Implementation and Capacity Building Assistance: the DoE should appoint the Manager and staff between 1998 and 1999. The DoE will then need capacity building assistance under the CBAP to establish the Human Resource Section's functions and to properly set it up. The earliest capacity building assistance can be provided is 1999.

The assistance will be provided by a Human Resource Consultant. The Consultant will also provide training for the Section's staff covering human resource policies, practices, methodologies and systems. The Consultant will be required for two (2) months during 1999-2000. The assistance would be conditional upon the creation and appropriate staffing of the Human Resource Section.

The estimated Human Resource Consultant's fee for two (2) months is Kshs. 3,500,000.

(8) Development of Technical Capabilities

(a) Collection and Transportation

Recommended Implementation and Capacity Building Assistance: The DoE should appoint the new Operations Manager between 1998 and 1999. The new Collection and Street Cleansing Section will then need development of technical capabilities under the CBAP. The CBAP will consist of two fields; one is development of planning capability and the second is development of vehicle maintenance capabilities in 1999. The estimated cost of the first planning portion including fees, per diems and travel (2 trips) for one (1) month is Kshs. 2,270,000. The second portion regarding vehicle maintenance is estimated at Kshs. 4,893,000.

(b) Final Disposal

Recommended Implementation and Capacity Building Assistance: The DoE should appoint the new Disposal Manager between 1998 and 1999. The new Disposal Section will then need development of technical capabilities under the CBAP. The CBAP will be composed of two phases; the first is the development of planning capability in 1999, and the second is development of landfill operation capabilities at the sanitary landfill in 2000. The estimated Final Disposal Expert's fee, per diems and travel (2 trips) for one (1) month is Kshs. 2,760,000.

Each of these components will be prepared and managed by one consultant in consideration of the fields of expertise. The entire Program will be overseen and managed by the Organisational and Management Consultant. The majority of the training will be delivered by international consultants but some may be provided by Kenyan resources. The detailed components of the training are given in **Section 2.3** below.

Table 2.2-1 below shows the phasing of the Capacity Building Assistance Program (CBAP) from April 1999 to May 2000, giving its main components and the required inputs of each consultant. These inputs will cover both implementation assistance as well as training. The timing of inputs is indicative and will be decided by the individual consultants.

Each consultant will assess the effectiveness of his capacity building and training and review the DoE's further needs after the CBAP's completion. They will then

formulate a future capacity building program and recommend how it could be financed. This might be through a donor agency, by the DoE itself, or a mixture of both.

The total CBAP cost of Kshs. 47,773,000 includes consulting costs, information hardware and software costs and training costs, i.e., materials and venue costs. These costs are indicative only.

Table 2.2-1 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 2.2-1 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					
-Planning, Scheduling, Staffing & Vehicle Management					2,270,000
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					
-Planning, Scheduling, Staffing & Maintenance	Disposal Consultant	■	■	The Disposal Consultant reviews the need for further assistance the DoE may require on Disposal Planning, Scheduling Management	2,760,000
Assists in developing operations management staff's planning, operating and reviewing systems.					
Total Cost					47,773,000

2.3 The Training Program for the DoE

The DoE's SWM, Environmental and Administration divisions need training to support their organisational restructuring. The approach is to firstly provide a substantial training program delivered through classes and workshops under the CBAP covering key organisational and management areas.

The CBAP training will be provided in 1999 and 2000 and will be managed by the Organisational and Management Consultant. Individual components will be delivered by each consultant for his specialist area. The major aspect of the training will be to train trainers wherever it is appropriate. Trainers will be identified and given short courses on training skills.

Some training may also be provided by Kenyan training organisations. The DoE and the consultants will decide what local resources can be used. Examples are the University of Nairobi's Industrial Resource Unit (successfully used for the Water Department's training program under the World Bank Nairobi Third Water Supply Engineering Project) and the Kenya Institute of Management (KIM).

After the CBAP is completed, the DoE will inevitably require further training. The Organisational and Management Consultant and the Human Resource Consultant will assess the impact and effectiveness of the training provided under the CBAP. Based on this assessment, they will review the DoE's further training needs, prepare a future training program and recommend how it could be financed. This might be through a donor agency, by the DoE itself, or a mixture of both.

Table 2.3-1 below summarises the Training Program for the DoE under the CBAP with indicative suggestions for training after the CBAP. The course descriptions are indicative only. The consultants will be responsible for preparing their training programs and deciding on their timing and duration.

Table 2.3-1 Training Program for the DoE

Main Training Components	CBAP Training Program - 1999				Suggestions for Training after Completion of CBAP
	Course Description	Who Receives Training	Who Delivers Training	Type of Training	
Organisational and Management	1. Principles, process and functions of organisations & their management 2. The planning cycle - strategic and operational planning 3. Objective setting and performance measurement 4. Management Information Systems (MIS) 5. Improving managers skills and effectiveness: - problem solving & decision making - leadership - communication & staff motivation - time management - delegating - presentation & meeting skills.	Management Team members: The Director Deputy Directors All Managers Other staff: Human Resources Management Section Financial Controller Deputy Operations Managers MIS Manager Logistics Manager District Inspectors	Organisational and Management Consultant	Workshops and Training Classes Scope of training will be different for senior managers and middle managers -they will be separately trained.	Managers will inevitably require further training particularly to improve their management skills. Organisational and Management Consultant will formulate training needs
Financial Management	1. Accounting concepts and principles 2. Budget setting and monitoring 3. Simple financial forecasting and tariff setting 4. Basic cost accounting 5. Billing and collection Basic economic analysis of projects	Deputy Director Administration Financial Controller All financial staff in the Finance Section	Financial Consultant	Workshops and Training Classes	The Finance staff will need further training to improve their financial skills The Financial Consultant will formulate training needs
Finance for Non Financial Managers	1. Accounting concepts and principles 2. Budget setting and monitoring 3. Simple financial forecasting and tariff setting	The Director Deputy Directors All Non-Financial Managers District Inspectors	Financial Consultant	Training Classes	Non financial staff will need further financial training The Financial Consultant will formulate training needs
Regulation of SWM	1. Regulatory policies and practices, monitoring methodologies and systems 2. Procedures for the safe handling of industrial, hazardous and clinical wastes	The Director Deputy Directors Staff in the Environment Division Operations Manager Deputy Operations Manager Disposal Manager Logistics Manager	Regulation Consultant	Workshops and Training Classes	The Regulation Consultant will formulate training needs

Table 2.3-1 Training Program for the DoE (Cont'd.)

Main Training Components	CBAP Training Program - 1999				Suggestions for Training after Completion of CBAP
	Course Description	Who Receives Training	Who Delivers Training	Type of Training	
Contract Management	1. Pre contract award procedures. ·2709 - Specification preparation. Contract, planning, design & pricing. ·2709 - Prequalification, setting tender evaluation criteria, the tendering process, post tender negotiation and contract award. 2. Post contract award procedures. ·2709 - Monitoring service delivery & compliance with contract terms and conditions. ·2709 - Procedures to manage change to contract requirements & terms and conditions. ·2709 - Carrying out VFM assessment of contracts.	The Director Deputy Directors Contract Manager Staff from the Contract Management Section Appropriate staff from the Town Clerk's Department	Contract Management consultant	Workshops and Training classes	The Contract Management will formulate training needs
Human Resource Management and Development	1. Human resource policies, methodologies and systems - personnel functions of recruitment, promotion and staff appraisal 2. Human resource planning 3. Improving employee performance 4. Occupational health arrangements	Deputy Directors Human Resources Management Manager Staff from the Human Resources Management Section	Human Resource Consultant	Training Classes and Workshops	The Human Resource Consultant will formulate training needs
Collection and Transportation	1. Planning Courses: - Operation and management - Planning methodologies - Scheduling, staffing and reviewing system 2. Maintenance skills	The Director Deputy Directors Staff in the SWM Division Operations Manager Deputy Operations Manager Logistics Manager	Planning, Scheduling, Staffing & Vehicle Management Consultant	Training Classes and Workshops	The Planning, Scheduling, Staffing & Vehicle Management Consultant will formulate training needs
Final Disposal	1. Planning Courses: - Operation and management - Planning methodologies - Scheduling, staffing and reviewing system 2. Operation Capabilities - Methodologies of sanitary landfill system - Monitoring system	New Disposal Section Manager and engineers	Disposal Consultant	Training Classes and Workshops	The Disposal Consultant will formulate training needs
Training the Trainers	Training skills course: 1. Designing courses 2. Training techniques 3. Presentation skills	Selected DoE staff	Organisational and Management Consultant	Training Classes	

CHAPTER 3

FINANCIAL IMPROVEMENT PLAN

CHAPTER 3

FINANCIAL IMPROVEMENT PLAN

3.1 General

The objectives of the financial improvement plan are to improve and strengthen the financial condition of SWM services and to support sound or sustainable operations. These objectives are expected to be attained by (1) securing enough revenue; (2) enhancing cost effectiveness of management and operation; and (3) improving financial planning. These policies are involved in the Financial Improvement Plan. Policies and concrete measures in the plan are summarised below:

Table 3.1-1 Summary of Policies and Measures in the Financial Improvement Plan

Policies	Measures
(1) securing enough revenues	• increasing charge revenues • establishing financial autonomy
(2) bettering cost effectiveness of management and operation	• promoting private sector involvement
(2) improving financial planning	• reforming budgetary process

3.2 Increasing Charge Revenues

Creating a new tax or charge is expected to be very difficult or time-consuming because it needs tedious co-ordination among other departments in NCC. In consideration of urgency, the plan aims to increase and extend the existing revenue base, i.e., SWM charges by establishing rules of setting and charging.

3.2.1 General Principles on Charges

Charging policies are needed to be established for each of the revenue sources.

(1) Waste Charge for Households

The waste charge will be the largest source of revenue. A number of policies are needed to be established.

Firstly, revenue from waste charge should be used to recover the operating costs of collection, haulage and disposal proportioned to households or commercial entities. "Proportion" means here the share of waste production by household entities.

Secondly, different charges should be set for different income groups of households. For the low income group the waste charge should be set at a lower level. For middle and high income groups higher charges should be set.

Thirdly, households paying for services provided by private companies not contracted by NCC should bear the cost of dumpsite operation. This cost should be collected through the tipping fees of such private companies.

Fourthly, concerning households in the informal settlements which are currently not charged, a waste charge should be set at a different rate considering their living standard. Charges should be collected through the administrators of water kiosks from the viewpoint of collection cost and efficiency.

(2) Waste Charge for Commercial Establishments

Basically the same principle as for households can be devised for commercial establishments except the following:

(a) Commercial establishments share the cost of capital investment as well as O&M and depreciation costs. (See **Section 4.9.2, General Principles of SWM Finance** of the **Main Report - Master Plan Study** for details.)

(b) The same charge rate is applied to all users since it is difficult to catch their income. However, appropriateness of the cost is examined from the viewpoint of the Regional Gross Domestic Products (RGDP). (See **Section 9.1, Financial Evaluation** for details.

Since a few number of commercial entities have no water meters, there is another idea that charges are added to business license fees for which NCC has the authority in order to improve fairness and revenues.

(3) Tipping Fees

Tipping fees are set at a level which could recover the cost of NCC's final disposal facilities apportioned to the dumping amounts of non-contract-out users. Fees are collected on the basis of waste tonnage from the companies.

(4) License Fees

License fees are set at a level which could recover the costs of licensing and monitoring.

3.2.2 Cost Sharing

Cost is allocated to users in each category. The estimated cost sharing in 2000-2003, where the collection rate is 60%, is shown in **Table 3.2-1**.

Table 3.2-1 Cost Sharing

	2000	2001	2002	2003
Coll/Trans				
Domestic	92.90%	92.98%	93.09%	93.20%
Commercial	7.10%	7.02%	6.91%	6.80%
Total	100.00%	100.00%	100.00%	100.00%
Final Disposal				
NCC and Contract PSI				
Domestic	74.31%	77.93%	77.77%	77.57%
Commercial	5.68%	5.88%	5.78%	5.66%
Non-Contract PSI				
Domestic	18.59%	15.05%	15.31%	15.64%
Commercial	1.42%	1.14%	1.14%	1.14%
Total	100.00%	100.00%	100.00%	100.00%

3.2.3 Setting-up New Tariff System for Households

(1) Households in Formal Area

New tariff system should be enforced after the implementation of new collection and transportation system. The system will utilise the water billing system.

The new tariff will employ 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 the household in each income group.

If the excess water consumption of a high income household exceeds the low level water consumption, an extra charge is added to its high income charge in accordance with the excess. (See **Figure 3.2-1.**)

For example, a household consumes (I + II + III + IV), where IV is less than I its charge is c. If a household consumes (I + II + III + IV + V), where (IV + V) is more than I and less than (I + II), its charge is (a + c).

If a household consumes (I + II + III + IV + V + VI), where (IV + V + VI) is more than (I +II) and less than (I +II + III), its charge is (b + c).

If a household consumes (I + II + III + IV + V + VI + VII), where (IV + V + VI + VII) is more than (I +II + III) and less than (I +II + III + IV), its charge is (c + c = 2 x c).

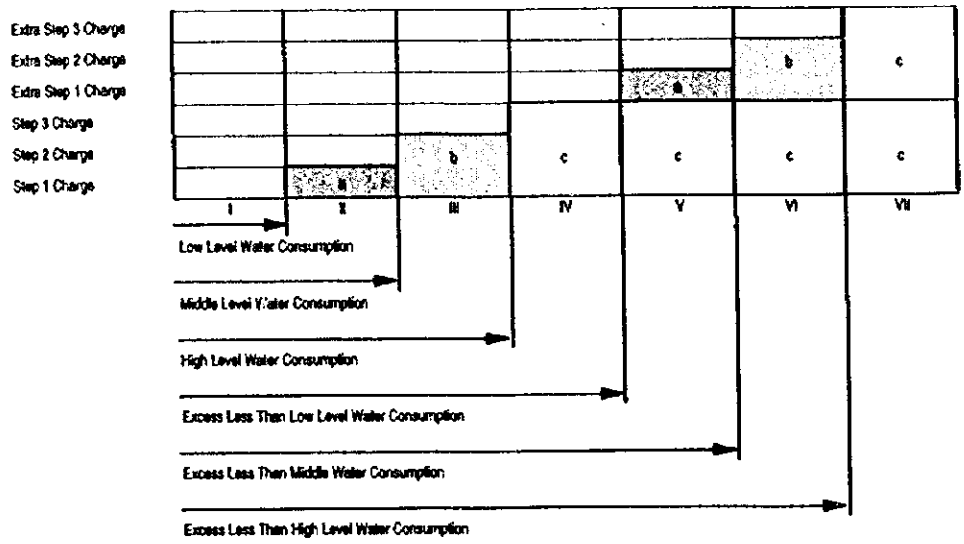


Figure 3.2-1 Step-up System of Waste Charge for Households

Some low income families share one water meter. If the rule mentioned above is applied to this case, the charge may be higher on per family basis due charge level setting. In this case, NCC will accept the claim from the administrator of the water meter, register the number of families sharing the same meter and then apply the rule to the average consumption of each family.

3.2.4 Households in Informal Settlement Area

Charge is set at 5 Kshs/month for one person. Considering that waste charge is added to the water charge, the waste charge should be less than 10% of the expense for water. Since it is estimated that the average water expense for one person in one month is Kshs 60, the waste charge should be less than Kshs 6. Since the average number of family members is 5, the average charge for one family should be less than 30 Kshs/month. The charge of 25 Kshs/month per household was assumed for the financial analysis.

3.2.5 Estimation of Water Consumption for Each Income Level

Charge rate for households changes according to the income level. Since it is assumed that the water consumption of a household increases in accordance with its income level, waste charge rates are in turn increased in accordance with the water consumption. Here, the water consumption level of each income level has been estimated in order to estimate the household's affordability for SWM services at each water consumption. (See **Table 3.2-2.**)

Table 3.2-2 Estimated Water Consumption for Household Income Levels

Unit: m^3/month

	2000	2001	2002	2003
Average	2.53	2.60	267	2.75
Low (Top 45% Level)	1.75	1.80	1.85	1.90
Middle (Top 30% Level)	2.27	2.33	2.40	2.47
High (Top 15% Level)	2.79	2.87	2.95	3.03

3.2.6 Model Charge Rates for Households

Combining the affordability of each income class and its water consumption estimation, the model charge rate which is expected to make a **maximum** revenue, is as shown in **Table 3.2-3**. Actual charge may be less than the case where revenue is enough.

Table 3.2-3 Model Charge Rate for Households at 1997 Price

Charge Level	Water Consumption	Charge
Year 2000		
Informal Settlement	-	25 Kshs/month
First Step	0 - 2.27 m^3/month	155 Kshs/month
Second Step	2.27 - 2.79 m^3/month	202 Kshs/month
Third Step	2.79 - 4.54 m^3/month	248 Kshs/month
Year 2001		
Informal Settlement	-	25 Kshs/month
First Step	0 - 2.33 m^3/month	160 Kshs/month
Second Step	2.33 - 2.87 m^3/month	207 Kshs/month
Third Step	2.87 - 4.67 m^3/month	255 Kshs/month
Year 2002		
Informal Settlement	-	25 Kshs/month
First Step	0 - 2.40 m^3/month	164 Kshs/month
Second Step	2.40 - 2.95 m^3/month	213 Kshs/month
Third Step	2.95 - 4.80m^3/month	262 Kshs/month
Year 2003		
Informal Settlement	-	25 Kshs/month
First Step	0 - 2.47 m^3/month	169 Kshs/month
Second Step	2.47 - 3.03 m^3/month	219 Kshs/month
Third Step	3.03 - 4.93 m^3/month	269 Kshs/month

3.2.7 Model Charge Rates for Commercials and Tipping

Charge rates for commercial establishments and tipping fees are decided in proportion to their waste production and dumping amounts. Calculation results are shown in **Table 3.2-4**.

Table 3.2-4 Model Charge Rate for Commercial Establishments and Tipping Fees

	2000	2001	2002	2003
Commercial (Kshs/month)	426	461	438	418
Tipping (Kshs/ton)	103	89	87	85

As mentioned above, appropriateness of these rates are examined in **Section 9.1, Financial Evaluation.**

3.2.8 Comparison of Revenues between Current System and New System

The current tariff system charges the same rate to all water accounts while the new system levies different rates on the families as well as those in informal settlements in accordance with water consumption. Here, it is examined how much the new system would increase the household charge revenue. It is assumed that the current system collects Kshs. 100 from households in accordance with the recent approval of charge increase. It is also estimated that the new system collects the maximum amount of household affordability as well as Kshs. 5 from informal settlements. **Table 3.2-5** shows a comparison of the revenues of the two systems from households. Here, high means the household whose income is ranked at top 15% or above, middle top at 30% or above and low at 45% or above. Revenue is estimated to increase to 3.8 times larger at the maximum in the new system.

Table 3.2-5 Comparison of Estimated Revenues

Unit: Kshs million; 1997 price

	2000	2001	2002	2003	Total
Current System	183.5	192.0	200.9	210.4	786.7
New System					
High	241.6	259.4	278.9	300.4	1,080.3
Middle	196.4	210.9	226.8	244.2	878.3
Low	151.2	162.4	174.6	188.1	676.3
Informal	82.5	86.3	90.3	94.6	353.8
New System Total	**671.7**	**719.1**	**770.7**	**827.3**	**2,988.7**

3.3 Establishing Financial Autonomy of SWM Services

Since the generation of general tax revenue by NCC is severely constrained and is likely to remain so for a considerable time, the Department of Environment (DoE) must secure revenue for SWM services to improve the financial condition. The new SWM Section in the DoE needs financial autonomy of SWM services.

Services by the SWM Section need to be financially "ring fenced" by establishing an special account in 2000 when the new system starts in order to ensure that revenues are controlled and spent by the Section for SWM services only and are not used to finance other services in NCC.

Additionally, funds for replacement of equipment and facilities should be accumulated as depreciation in the operation of system in order to sustain the operation after the equipment and facilities initially introduced have exhausted their useful life.

When charge revenues are increased and secured to cover yearly O&M costs and depreciation, the sound operation of SWM services is expected to be established to a larger extent.

3.4 Promoting Private Sector Involvement

Increasing percentages of collection and transfer services are planned to be contracted out to private companies from 2001 in Ngara area in addition to the Central Business District (CBD) area where contacting-out has started in 1997. Contracting cost is estimated at 2,155 Kshs/ton. Since the cost done by NCC is 2,291 Kshs/ton, the cost efficiency of operation would be improved as the rate of contracting-out increases. The rate is planned to increase from 8.19% in 2000 to 10.35% in 2000. Contracting out share is shown in **Table 3.4-1**.

Table 3.4-1 Contracting-out Share

	2000	2001	2002	2003
NCC Collection	39.00%	38.50%	38.00%	37.50%
Contract PSI	8.19%	10.53%	10.46%	10.35%
Non-Contract PSI	11.81%	9.47%	9.54%	9.65%
Reduction	1.00%	1.50%	2.00%	2.50%
Total	**60.00%**	**60.00%**	**60.00%**	**60.00%**

Details of effects of PSI promotion is examined in **Chapter 4, Private Sector Involvement Plan.**

3.5 Reforming the Budgetary Process

NCC's budgeting system has several problems. The budgeting system of SWM services' special account should be arranged to avoid such problems. The World Bank already proposed reforms of local government finance in 1992. Some of them are still applicable to the budgeting of the special accounts with some minor adjustments. Reformation of the budgetary process include the following:

(1) Revenue should not accrue in the budget and the general revenue funds. Only cash receipts should be credited to the special account.

(2) Revenue estimates should be based on the previous calendar year's actual cash collection, i.e., the 1998/99 estimate should represent actual collection in the calendar year 1997. Any increase appropriated to meet current expenditures should be based solely on an approved increase in charges.

(3) In the case of fluctuating revenue, estimates should be based on the average of three previous years' actual collections.

(4) Recurrent expenditure should be estimated within revenue estimates based on the previous calendar year's actual revenue plus any approved charge increase. Expenditure ceilings should be established at the beginning of the budget process.

(5) Revenue in excess of the estimates should be appropriated to capital expenditure. It should not be released until the revenue has been realised.

The new budgetary process will start in 2000 when the special account is established and a new financial section is organised in the Administrative Division of the new DoE.

Reformed budgetary process controls yearly revenues and expenses properly and in turn can make adequate financial plan for the future.

CHAPTER 4

PRIVATE SECTOR INVOLVEMENT PLAN

CHAPTER 4

PRIVATE SECTOR INVOLVEMENT PLAN

4.1 Contracting Arrangements by New Contract Management Section

Responsibilities for managing solid waste contracts are recommended to be arranged among a new Contract Management Section (CMS), a proposed Contract Team (CT) and the Council's existing Tendering Committee (TC). The arrangements are primarily focused at waste collection and street cleansing contracts.

The CMS would be a Section within the SWM Division, headed by a Contract Manager, who reports directly to the Deputy Director of the Division. The appointee will need contracting expertise. Detailed recommendations are given in **Subsection 4.1.2** below.

The timing of setting up these arrangements will depend on when the DoE intends to contract out more services. At the moment only the Central Business District (CBD) is contracted out. Further contracting may start after reviewing this current performance of the CBD contract.

4.1.1 Description of Contract Management Arrangements

By contract management is meant the system of controlling and managing contracts from their very inception, namely the identification of the contract requirements, to their final completion when the contractors cease to provide services.

Contract management falls into two distinctive types of activity; those activities before a contract is awarded, i.e., "pre-contract award", and those activities after a contract is awarded, i.e., "post-contract award". **Figure 4.1-1** below summarises the Contract Management process in its entirety.

The Contract Management Process

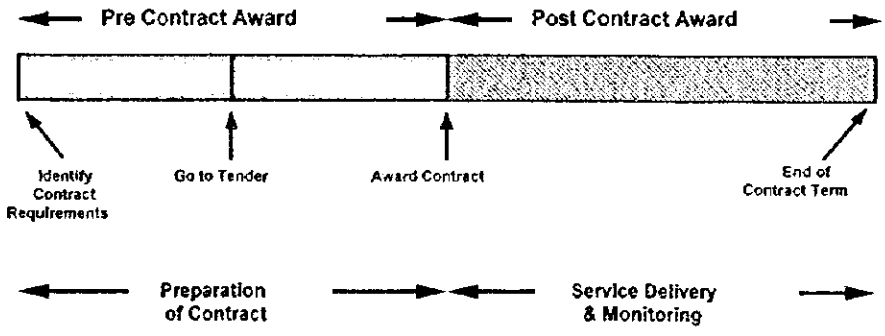


Figure 4.1-1 The Contract Management Process

(1) The Pre-Contract Award Arrangements

The main stages of the pre-contract award process include identifying the contract requirements, preparation of the contract specification, formulating the contract strategy, setting tender evaluation criteria, pre-qualification, the invitation to tender, i.e., from preparation to issuing the tender documentation, tender evaluation and selection, and post-tender contract negotiation and award of the contract.

Figure 4.1-2 below shows the typical stages of the pre-contract award process.

The Pre Contract Award Process

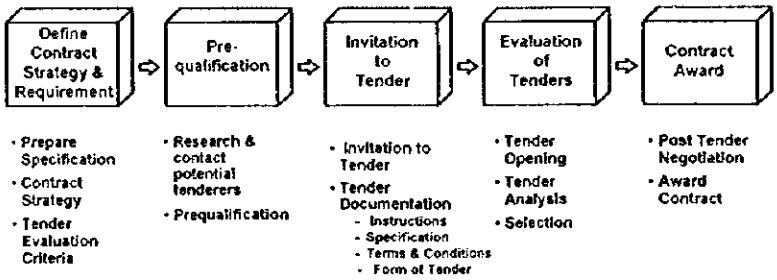


Figure 4.1-2 The Pre-Contract Award Process

(2) The Post-Contract Award Arrangements

Post-contract award arrangements are the systems of contract control and monitoring which ensure that after the contract is awarded, it is executed and carried out to the required performance, standard and quality specified in the contract, and to the contract's terms and conditions.

These arrangements include procedures to monitor service delivery, to monitor for compliance with contract terms and conditions, to manage change to contract requirements and/or terms and conditions, to maintain documentation, to deal with failures to perform, default and contract termination, to provide a workable structure to resolve disputes and to carry out a "Value For Money (VFM)" assessment.

Figure 4.1-3 below shows the typical components of the post-contract award process.

Good contract management ensures that the most suitable contractor is selected, the contract is carried out efficiently and effectively, that both parties fulfill their contractual obligations, and that the contract provides best Value For Money (VFM).

The Post Contract Award Process

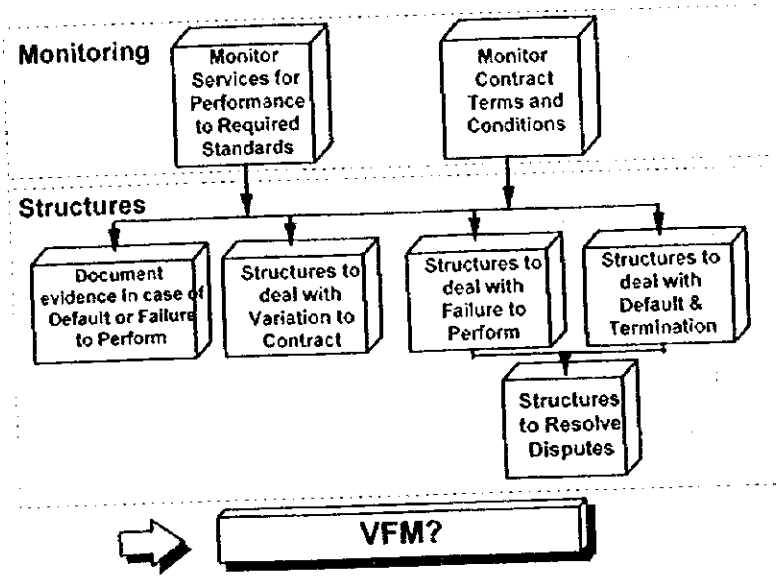


Figure 4.1-3 The Post-Contract Award Process

4.1.2 The Recommended Organisational Responsibilities and Roles

The responsibilities for the new Contract Management Section (CMS), the proposed Contract Team (CT) and the Council's existing Tendering Committee (TC) are:

The Contract Management Section is 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.

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. "Complaints based monitoring" is recommended when it is possible for the DoE to resource it.

A Contract Team is set up for each contract and oversees 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.

The detailed stages of the pre-award process are recommended as follows:

(1) The DoE through the CMS prepares the contract specification, formulates a contract strategy and prepares a contracting plan including a tendering plan. The CT gives advice.

(2) The CT approves the specification, strategy and plan.

(3) If appropriate the CMS carries out prequalification, short lists the bidders and prepares a prequalification report. The CT reviews the report and approves the short list.

(4) The CMS with the assistance of the Legal Section prepares the Tender Documentation. The CT approves the Tender Documentation and the CMS then invites tenderers to bid.

(5) Bids are received and evaluated by the CMS which co-opts assistance as necessary from the Internal Audit Section of the City Treasurer's Department and the Legal Section. The CMS selects the preferred bid and prepares a Bid Evaluation Report. The CT reviews and approves the Bid Evaluation Report.

(6) The DoE passes the Bid Evaluation Report to the Tendering Committee.

(7) The Tendering Committee assesses the bids and formally selects the winning tender. Full Council approval is obtained in the usual way.

(8) The CMS then prepares the Contract Documentation. The CT reviews and approves the Contract which is then formally executed.

Figure 4.1-4 below illustrates the proposed organisational structure of the pre-contract award process within NCC.

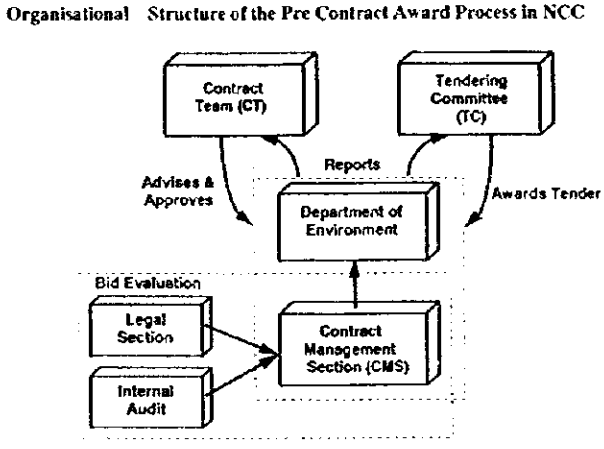


Figure 4.1-4 Organisational Structure of the Pre-Contract Award Process

4.2 The Private Sector Involvement (PSI) Promotion Plan

4.2.1 Collaboration with the Private Sector and Existing PSI Promotion by NCC

Target collection service coverage or waste collection rate is defined as the proportion of collected amount of solid waste to the total generated amount of waste. Target service coverage includes private sector involvement (PSI) and existing PSI program by NCC in a cooperative way. This collaboration is expected to result in visible improvement of environmental condition in the city compared with the existing approximately 25% of collection service coverage. However, it should be justified from the viewpoint of financial considerations on NCC.

As far as NCC collection is concerned, the collection service is assumed to be delivered at least once a week in the collection and transportation plan while there is no periodical service provided for almost all districts.

On the other hand, waste collection services by private companies are not controlled or monitored by NCC. It is required to regulate private companies by NCC with the least level of service standard in order to promote PSI through improving reliability of PSI services by the people.

4.2.2 The Collection Service Area of the Private Sector

(1) Demarcation of the Service Area

The collection service area in the Master Plan was determined based on the present location boundaries. Nairobi City is administratively divided into eight (8) divisions; namely, Dagoretti, Kibera, Central, Parklands/Westlands, Pumwani, Makadara, Embakasi and Kasarani. These divisions are also composed of several locations and the total number of locations are 29. Based on the population projection in each location, solid waste generation can also be estimated on an area-wise basis.

In addition, daily collection and transportation work as well as street cleansing work is now carried out based on district-wise operations by NCC; in other words, NCC's SWM service area is divided into six districts and each district has its own assigned staff, equipment and a office and depot. Boundaries of these districts are mostly traced on part of the location boundaries. Therefore, it seems to make the daily operation and management of collection work much easier and smoother if the boundary of service area is almost equal to the location boundary. The relationship between the locations and districts is shown in **Table 4.2-1**.

Table 4.2-1 Relationship between the Locations and Districts

No.	Location	District	Remarks
1.	Makadara	Eastern	
2.	Kaloleni/Makongeni		
3.	Maringo/Mibotela		
4.	Bahati		
5.	Pumwani		
6.	Eastleigh		
7.	Kamukunji*		* Some portions are in Central
8.	Ngara*	Central	* Some portions are in Northern
9.	Starehe*		* Some portions are in Eastern and Northern
10.	Viwanda*	Southern	* Some portions are in Central
11.	Mugumoini*		* Some portions are in Western
12.	Embakasi*	Embakasi	* Some portions are in Southern
13.	Nijiru*		* Some portions are in Southern
14.	Kasarani*		* Some portions are in Northern
15.	Dandora		
16.	Kariobangi*		* Some portions are in Northern
17.	Kibera/Woodley	Western	
18.	Waithaka		
19.	Kangemi		
20.	Riruta		
21.	Kawangware		
22.	Mutuini		
23.	Kenyatta/Golf Cource		
24.	Karen/Langata		
25.	Kilimani		
26.	Mathare	Northern	
27.	Kahara		
28.	Roysambu		
29.	Parklands		

Source: JICA Study Team

(2) Selection of the Possible Contract-out Area

The collection service area by PSI is to be selected in accordance with the following criteria:

(a) High density and near the city center areas will be given higher priority because of their higher demand for improvement and efficiency of the services.

(b) High, middle income or other residential areas will be required because people who live in these areas have already had a chance to be provided with private collection services and, therefore, the collection service by the same sector will be easily acceptable.

NCC has started to contract out services for the Central Business District (CBD) whose portion mostly overlaps with Starehe. Ngara is located next to Starehe and also has business and commercial areas.

According to a Study, *"A Strategic Health Plan for the Nairobi Area,"* (Development Solutions for Africa, Ltd., 1992), high income area includes the

following five locations: Karen/Langata, Kenyatta/Golf Course, Parklands, Kilimani and Roysambu.

Considering the above, the area to be contracted out will be selected among Ngara, Karen/Langata, Kenyatta/Golf Course, Parklands, Kilimani and Roysambu.

(3) Order of the Contract-out

As a result of discussions with the Kenyan counterparts and the following considerations, the draft schedule of contract-out has been prepared:

(a) Similar conditions to the present CBD contract-out area
(b) Closeness to the city center
(c) Equalisation of waste collection in an area
(d) Enough intervals for the preparation of the next area

Table 4.2-2 shows the contract-out schedule of planned areas. Shaded numbers are waste amounts which are planned to be collected by private companies. The contract-out area is also shown in **Figure 4.2-1**.

This schedule should be reviewed after evaluating performance in the next contract-out at Ngara by the new Contract Management Section (CMS) under the SWM Division. Responsibilities and roles of the CMS are described in the preceding **Subsection 4.1.2**.

Table 4.2-2 Schedule of Contract-out Area in the Master Plan

(Unit: ton/day)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Waste Generation	1,509	1,595	1,684	1,785	1,893	2,009	2,141	2,269	2,413	2,566	2,730
Location											
Starehe	129	134	138	145	152	159	167	174	183	192	202
Ngara	39	40	41	43	46	49	52	55	58	62	66
Kenyatta/Golf Course	13	13	14	15	16	17	18	19	20	21	22
Parklands (excl. Muthaiga)	126	133	139	148	158	168	180	192	205	219	234
Kilimani	35	35	36	39	41	44	47	50	53	57	61
Total PSI	129	134	138	188	198	208	237	248	466	494	585
PSI ratio by Contract-out (%)	8	8	8	10	10	10	11	11	19	19	21
Designed Total PSI ratio(%)	20	20	20	20	20	20	20	20	20	20	20

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

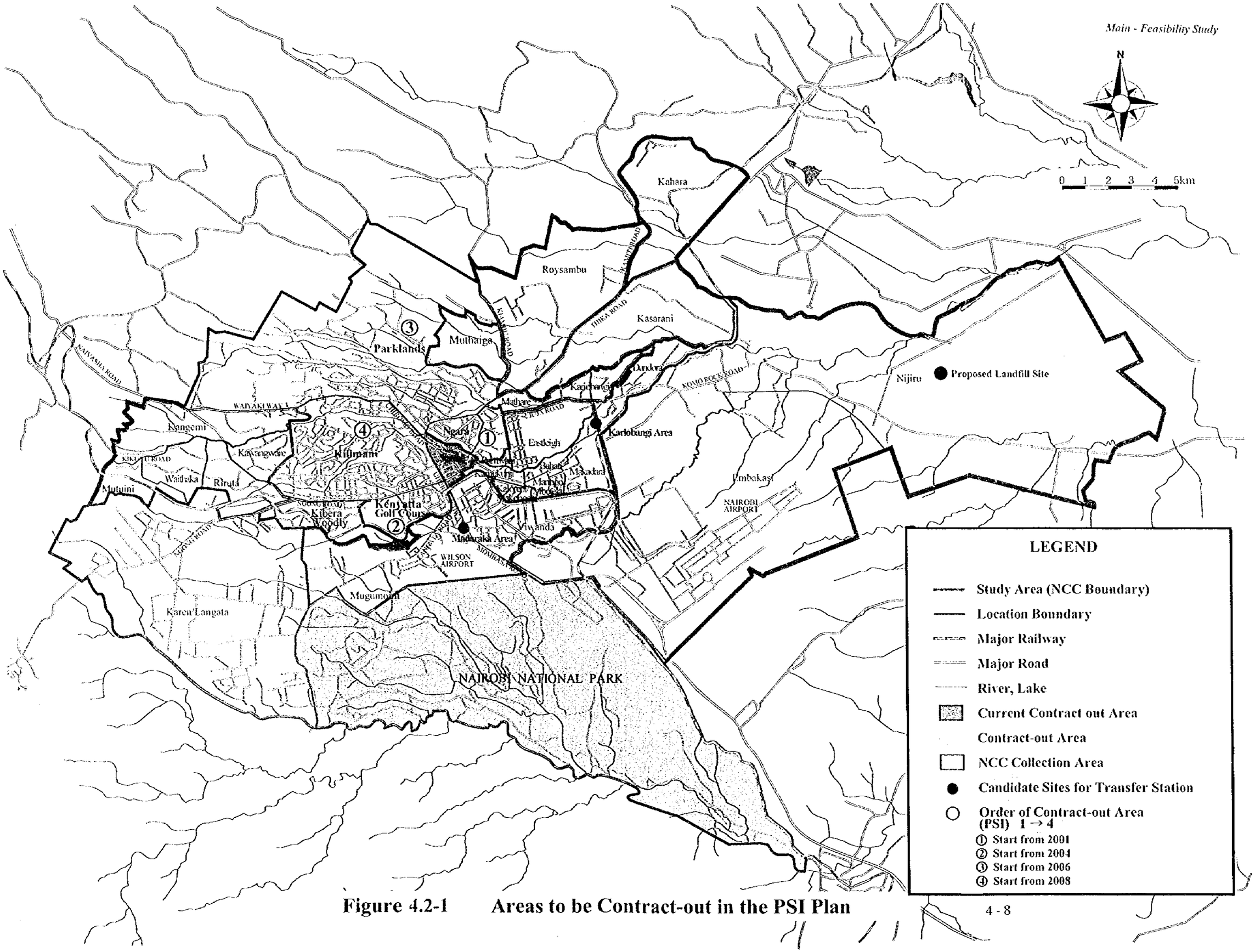


Figure 4.2-1 Areas to be Contract-out in the PSI Plan

4.3 Cost and Financing of Contract-out Services

4.3.1 Estimated Cost of Contract-out Services

Cost of SWM services contracted out by NCC to private companies is estimated at Kshs 2,155 or US$ 36.66 per ton of waste (see **Table 4.3-1**). Services include waste collection and street cleansing in the contracted area. According to the contract-out schedule, the total cost of the services is estimated at Kshs 2,142 million for 2000-2008 (see **Table 4.3-1**).

Table 4.3-1 Breakdown of Estimated PSI Cost

Unit: Kshs/ton

(1) Operating Cost	
Fuel/Oil	395
Maintenance	43
Waste Bags	214
Wages	485
Overhead	645
Depreciation	178
Sub-Total of (1)	1,959
(2) Financial Cost	196
Total of (1) + (2)	**2,155**

Table 4.3-2 Total Cost of Contracted PSI Services

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Waste Amount by PSI Contract (ton/day)	138	188	198	208	237	248	466	494	546	2,723
Cost (Kshs million)	109	148	156	164	186	195	367	389	430	2,142

4.3.2 Financing for Contract-out Services

Cost of contact-out services is combined with the operating cost of all other areas, and revenue charged from all area users including households and commercial entities are used to finance the total cost. When the charged revenue is not enough, funds from the general account or subsidies from the central government are expected to finance the shortage.

The same billing system, namely the water charge billing system should be employed. Even if contracted-out areas are enjoying higher quality of services than other areas, the same tariff system should be applied to both areas in view of the following reasons:

(1) Contracting-out is planned to be implemented in the high income areas where higher charges are expected to be applied by the new tariff system.

(2) If two kinds of tariff system is employed, it would be complicated to enforce the system. In addition, since contracted-out areas are planned to increase in every two or three years, charging system has to be adjusted frequently.

Since water charge areas do not necessarily coincide with the administrative areas where the contracting-out schedule is based, problems may ensue if the water billing system is modified.

4.3.3 SWM Operation by Contractors

The Ngara area is planned to be contracted out from 2001 in the First Implementation Stage. In terms of SWM, Ngara is featured with such conditions as waste collection, number of households and number of commercial establishments. Projections of these features of Ngara are shown in **Table 4.3-3.**

Table 4.3-3 Features of Ngara

	2001	2002	2003
Waste Collection (ton/day)			
Domestic	35.7	38.2	40.7
Commercial	2.7	2.9	3.1
Market	2.4	2.5	2.7
Road	2.2	2.3	2.5
total	43.0	46.0	49.0
No. of Households	14,700	15,500	16,200
No. of Commercials	1,300	1,400	1,500
Total Users	16,000	16,900	17,700

Source: JICA Study Team

Vehicles and personnel required by contractors in the First Implementation Stage are estimated by employing the same model used for the financial analysis on private collectors. The details of financial model analysis for private collectors are given in **Subsection 3.1.3 of Supporting Report Section D.** Results are shown in **Table 4.3-4.**

Table 4.3-4 Vehicles and Personnel Required in the First Implementation Stage

	2001	2002	2003
Vehicles	11	12	13
Personnel			
Office Workers	8	9	10
Drivers	10	11	12
Loaders	30	33	36
Sweepers	40	44	48
Total Personnel	88	97	106

Source: JICA Study Team

According to the present condition of business by private companies obtained from the survey conducted by the JICA Study Team, the top two largest companies employ 65 and 62 employees, hold 15 and 11 vehicles, and keep 4,351 and 5,034 contracts, respectively. The third and fourth largest companies employ 20 and 14 employees, hold 5 and 2 vehicles, and keep 1,155 and 365 contracts, respectively. When the Ngara area is contracted out, it is expected that one of the two largest companies will be involved. Alternatively, some of the large companies will jointly operate the services, or the area will be divided into several parts and each part is operated by one company.

CHAPTER 5

FINAL DISPOSAL PLAN

CHAPTER 5

FINAL DISPOSAL PLAN

5.1 General

5.1.1 The Present Condition of Final Disposal System

In Nairobi, there is, at present, only one landfill site, which is located in Dandora. It is 7.5 km to southeast of the centre of Nairobi. The site is filled with approximately 1.3 million m^3 of waste at present. Adjacent to the Dandora site is the Dandora Housing Estate where no facility has been provided to prevent secondary pollution. There is thus a high risk of environmental pollution which may affect the health of residents.

Environmental and management conditions of the existing dumping site, which is considered as the final disposal system of NCC, are in a very critical situation. NCC should improve the existing site conditions and also make efforts to ensure the construction of a new sanitary landfill site(s).

The following actions are required:

(1) To take steps to acquire land for the disposal site(s); and,

(2) To obtain the consent of neighboring residents for the construction of a new disposal site(s), subject to Environmental Impact Assessment (EIA).

5.1.2 The Introduction of Sanitary Landfill

In view of the final process of solid waste management (SWM), the objective of final disposal is to have solid waste stabilised and rendered hygienic to prevent secondary pollution. Although open dumping as currently practiced by NCC is the cheapest method of disposal, it causes environmental pollution and can potentially affect the health of local residents living near a disposal site. Therefore, it is necessary for Nairobi City to adopt the sanitary landfill. Sanitary landfill of the highest environmental standard is still much more economical than other intermediate treatments.

The primary target of the construction of a new landfill site should be Sanitary Level 3 plus simple leachate treatment ponds, according to the result of EIA. Major facilities of the new sanitary landfill are shown in **Table 5.3-2.**

5.2 Outline of the Area Selected as Disposal Site

Selection and evaluation of disposal site(s) had been carried out based on nine (9) candidate final disposal sites [refer to **Data Book (1), Section 8.3, Selection Criteria of Final Disposal Site**]. Every site has been checked as to necessity of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). The results suggest that every site needs IEE and EIA prior to project implementation. The

detailed process of evaluation of the 9 candidate sites is shown in **Supporting Report Section H** in compliance with the selection criteria of landfill sites.

The evaluation results indicate that four (4) sites have higher feasibility to be developed as landfill site; namely, Ruai Area, Industrial Area, Ruiru Town, and Athi River Area. NCC has selected the Ruai Area and the Ngong Road Forest Area for the feasibility study, taking into consideration the possibility of land acquisition. The selection of Ruai Area has been given a high evaluation, because ensuring a new landfill site is an urgent matter for NCC's solid waste management. The Ruai Area belongs to NCC, therefore, NCC will be able to start construction of a new final disposal site without long land acquisition proceedings.

The Ngong Road Forest Area has not satisfied the condition for pre-qualification; hence, the Kenyan authorities had strongly recommended the carrying out of Environmental Impact Assessment (EIA) for both sites. The reason why Ngong Road Forest area was selected as a candidate site was not only the high possibility of land acquisition but also the distance to the centre of the city. However, the Ngong Road Forest Area was disqualified through the EIA, especially regarding social impact assessment. Therefore, only the Ruai Area is considered as the final disposal site in this plan. The detailed reason why the Ngong Road Forest Area was not selected is described in **Supporting Report Section H.**

5.3 Design of the Disposal Site

5.3.1 Priority Project

To establish the final disposal system for NCC, the construction of a sanitary landfill site and the introduction of a suitable operation and maintenance system at the site are major targets of the First Implementation Stage. The schedule and major activities are as shown in **Table 5.3-1**.

Table 5.3-1 Priority Project of Final Disposal System

Year	Activities
1999	• Basic design and detail design for the new site
2000	• Construction of the Ruai Disposal Site First Area
2001	• Construction of the Ruai Disposal Site Second Area • Land-filling at First Area • Well maintenance and operation of the new site • Closure Work of the Existing Dandora Dumpsite
2002 ~ 2003	• Well maintenance and operation of the new site • Construction of the Ruai Site Third Area

5.3.2 Site Conditions

(1) Topography

The Ruai Area is located on a relatively low ground at the northern, reaching an elevation of approximately 1,480 m in the Nairobi River catchment area. The site may have been originally flat because the average surface slope from

the southern boundary to the northern boundary along a southeast to northwest line is 1 is to 234, i.e., [(1,482.88m - 1,480.23m)/500m = 0.0043].

The Ngong Road Forest Area is located on a relatively high ground at the western boundary, reaching an elevation of approximately 1,840 m in the Mutoine River catchment area. Surface slopes are in northwest to southeast direction averaging 1 is to 500, i.e., [(1,860m - 1,840m)/1,000m = 0.02].

The results of topographic survey for the above areas are given in **Data Book (1)**.

(2) Geology

Surface soil of the Ruai Area consists of dark grey clay. The depth of this clay was confirmed by the boring test at around 1.0 m at the site. Below this clay, there distribute tuffs with the thickness of more than 30 m. According to the result of laboratory test, the coefficient of permeability distributes in the range from 3.902×10^{-9}m/s to 8.019×10^{-8}m/s. It is described that their soils have impermeability. Groundwater level around the area is low.

Surface soil of the Ngong Road Forest Area consists of brown silty clay. The depth of this clay was confirmed by the boring test at around 3.3 m at the area. Below this clay, there distribute tuffs. According to the result of laboratory test, the coefficient of permeability distributes in the range from 3.392×10^{-6}m/s to 9.78×10^{-10}m/s. Groundwater level around the area is low.

The results of geological survey for the above areas are presented in **Data Book (1)**.

(3) Existing Land Use

The Ruai Area has the following land use/facilities around the planned landfill site. Most of the area is not yet occupied.

(a) Sewerage Treatment Plant (planned site)
(b) High tension line
(c) Livestock production

The Ngong Road Forest Area has the following land use items according to the EIA survey:

(a) Indigenous forest and plantation forest
(b) Bee-keeping
(c) Residential land
(d) Agricultural production of food crops in the settled areas
(e) Livestock production
(f) Water storage for tree nursery at the forest station and irrigation and livestock watering during drought

(g) Communication comprising major roads, railways, power lines, telephone lines and oil pipeline

5.3.3 Design Concepts

Landfilling solid wastes may cause negative impacts. Therefore, the sanitary landfill includes mitigation measures against impacts. The following factors for designing the sanitary landfill were taken into consideration:

(1) Environmental conservation
(2) Construction cost
(3) Landfill capacity
(4) Future land use

The major facility design concepts which take these factors into consideration are as given below:

(1) Prevent dispersion of solid wastes.

(2) Prevent or reduce contamination of public water and underground water by leachate.

(3) Divide the landfill site to separate hospital wastes from general solid wastes.

(4) Utilise excavated soil.

(5) Reduce the leachate by collecting rainwater that has not touched the garbage separately from the leachate and discharged.

(6) Retain sufficient volume of solid wastes to be used as landfill.

(7) Shorten the necessary time for stabilising the layer that results in surface subsidence.

5.3.4 Composition and Function of Facilities

Facilities for the sanitary landfill site consist of the components shown in **Table 5.3-2.**

Table 5.3-2 Major Components and Functions of the Sanitary Landfill Site

Component	Function
1. Access Road	a. Connect the site with the existing public road b. Constructed as an essential component of the landfill site
2. Structure for Solid Waste Retention	
2-1 Enclosure Dike	a. Prevent dispersion of solid wastes b. Prevent influx of rainwater from outside c. Limit the range of dumping area d. Placed along the boundary of the site
2-2 Divider Dike	a. Placed on the boundary of the partition to separate hospital wastes from general solid wastes
2-3 Landfill Area	a. Retain sufficient volume of solid wastes to be landfilled b. The place where waste is placed c. Installed with on-site road, underdrain for leachate and gas exhaust equipment according to the progress of landfill operation d. Divide the total landfill area into 2 zones: general solid wastes zone and hospital wastes zone
2-4 Liner Facility	a. Prevent or reduce contamination of public water and underground water by leachate
3. Leachate Collection and Drain	a. Collect rainwater (leachate) through the solid wastes pile b. Supply air into the solid waste layer to facilitate aerobic decomposition which shorten the necessary time for stabilizing the solid waste layer
4. Retention pond	a. Adjust the flow rate of collected leachate to keep the necessary retention time in treatment facility
5. Leachate Treatment Facility	a. Consists of Anaerobic pond, Facultative pond and Maturation pond b. Treat leachate by biological process and discharge
6. Rainwater Drainage	a. Consists of collection facility, discharge facility b. Collection facility has the function to collect rainwater in principle
7. Gas Exhaust Equipment	a. Made of porous material to facilitate the penetration of gaseous substances b. Installed vertically through the solid wastes layer and cover soil and connected with the underdrain c. Discharge gaseous substance generated in the solid waste layer d. Supply air into the solid waste layer to facilitate aerobic decomposition e. Discharge leachate collection by a horizontal underdrain network through the bottom drain network
8. Onsite Road	a. Installed in the structure for solid waste retention b. Connect the landfill area with the access road
9. Maintenance Road	a. Connect the landfill area with the access road b. Placed along the outside of the enclosure dike and several ponds to maintain all the facilities
10. Monitoring Facility	a. Consists of 2 wells b. Monitor groundwater for checking fugitive leachate with comparison between 2 wells
11. Net Fence and Gate	a. Placed along the boundary of the site b. Separate the site from the outside c. Prevent intruding outsiders
12. Administrative Facility	a. Consists of control office, rest house, truck scale, car washing pool, septic tank, garage and parking lot b. Contain the function for occupation of the necessary operation staff c. Limit the landfill activity within the site

5.3.5 Facility Design

(1) Landfill Capacity

It is necessary to prepare the new landfill site with a capacity of more than the volume of landfilling solid wastes from 2001 to 2008 (Minimum landfill capacity). The required landfill capacity is approximately 5.3 million m^3 including 10% cover soil volume based on the Collection and Transportation Plan. The annual disposal amounts are shown in **Table 5.3-3.**

The formation of the landfill site is designed, as illustrated in **Figure 5.3-1.** The estimated capacity of each block is given in **Table 5.3-4.**

Table 5.3-3 Capacity Requirement of Disposal Site

Year	(1) Landfill Waste Amount (t/d)	(2) (1)x60%	(2) Landfill Waste Amount (m^3/d) (2)/*1.0	(3) Landfill Waste Amount (m^3/year) (3)x365	(4) Total Waste Amount (m^3)
1998	1,509	905	905	330,325	330,325
1999	1,587	952	952	347,480	677,805
2000	1,667	1,000	1,000	365,000	1,042,805
2001	1,758	1,055	1,055	385,075	385,075
2002	1,855	1,113	1,113	406,245	791,320
2003	1,959	1,175	1,175	428,875	1,220,195
2004	2,077	1,662	1,662	606,630	1,826,825
2005	2,190	1,752	1,752	639,480	2,466,305
2006	2,316	1,853	1,853	676,345	3,142,650
2007	2,451	1,961	1,961	715,765	3,860,415
2008	2,594	2,594	2,594	946,810	4,807,225
Total	-		-		**5,849,030**

* Bulk density of waste in the site is from 0.7 to 1.4. Therefore, the bulk density of 1.0 was used for the above calculation as the average density.

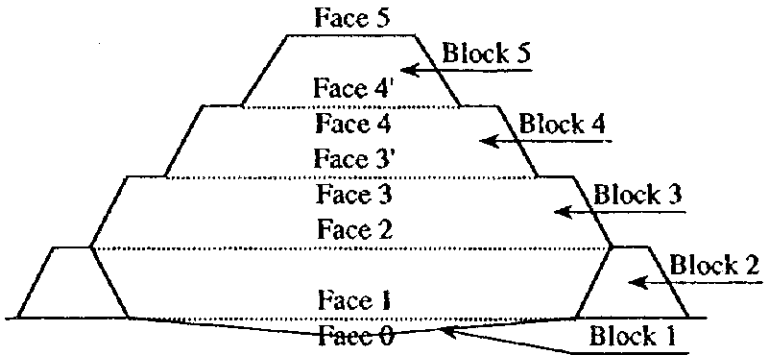


Figure 5.3-1 Design Formation of Landfill Blocks
(Area: 40 ha; Minimum landfill capacity: $5,300 \times 10^3 m^3$)

Table 5.3-4 Computation of Landfill Capacity

Block	Face	Area (ha)	a. Average area (ha)	b. Height (m)	Landfill Capacity (a × b) (10^3 m^3)
1	0	0	15.3	1.0	153
	1	30.6			
2			31.0	2.0	620
	2	31.3			
3	2'	31.6	32.6	5.0	1,630
	3	33.5			
4			32.9	5.0	1,645
	4	32.2			
5	4'	31.0	30.5	4.5	1,373
	5	29.9			
Total	-	-	-	**17.5**	**5,421**

Note: Total capacity: $5,400 \times 10^3$ m^3 > Minimum capacity: $2,700 \times 10^3 m^3$

(2) Standard Structure of Facilities

The standard structure and so on of major facilities of the disposal site are shown in **Table 5.3-5.**

Table 5.3-5 The Standard Structure of Facilities, etc.

Facility		Standard Structure, etc.
1. Access Road		a. Standard Structure : Paved road (Thickness of Surface Course: 50mm; Thickness of Base: 150 mm; Thickness of Subbase: 200mm) b. Width: 6m (excluding gutter)
2. Structure for solid wastes retention	2-1 Enclosure Dike	a. Material: Excavated soil and Bought soil b. Standard structure : Banking soil (Side-slope: 1:1.5; Width of top: 5m; Height: 5m)
	2-2 Divider Dike	a. Material: Bought soil b. Standard Structure: Banking soil (Side-slope: 1:1.5; Width of top: 1m; Height: 2m)
	2-3 Liner Facility	Liner facility is not necessary because soils of the site are impermeable.
3. Leachate Collection and Drain		a. Standard Structure: Porous PVC pipe with sand and excavated stone b. Main pipe: D=400mm × 3 pipes × 3 lines c. Branch pipe: D=300mm × 1 pipe × 38 lines
4. Retention pond		Capacity : 40,000m^3
5. Leachate Treatment Facility		a. Flow rate : 400m^3/day b. Water quality of final effluent: BOD 30mg/l c. Anaerobic ponds: 2,000m^3 × 3 ponds d. Facultative pond: 9,600m^3 e. Maturation ponds: 2,800m^3 × 2 ponds
6. Rainwater Drainage		Standard Structure: Gutter
7. Gas Exhaust Equipment		Standard Structure: Porous PVC pipe (D=200mm) with excavated crushed stone
8. Onsite Road		a. Standard Structure: Crushed stone road b. Width: 6m
9. Maintenance Road		a. Standard Structure : Crushed stone road b. Width of road : 3m
10. Monitoring Facility		Depth: 200m, 2 wells
11. Net Fence and Gate		Height: 2.3m
12. Administration Facility		a. Area of Resthouse and Parking lot: 1,500m^2 b. Area of Control Office, Car washing pool and so on: 2,000m^2

5.4 Construction of the Final Disposal Site

5.4.1 Construction Stage Plan

It is necessary to prepare the new landfill site before the existing landfill site at Dandora is exhausted. It will require at least 3 years to construct all facilities of the sanitary landfill site, but it is not necessary to construct all the facilities before the beginning of landfill operation because leachate collection and drain pipes, gas exhaust equipment and rainwater drains will be extended in accordance with the construction stage. The construction should be continued even after the commencement of landfill operations according to the annual landfill amount expected in the successive years. As shown in the construction stage plan of each case in **Figure 5.4-1**, it is possible for landfill operations to begin in the second stage of construction.

Site	Area	Year			
		First	Second	Third	Fourth
Ruai	40 ha	1st Stage	2nd Stage	3rd Stage	
			Beginning of Operation		

Figure 5.4-1 Construction Stage Plan

5.4.2 Construction Schedule

The construction schedule in relation to the beginning of operation is shown in **Figure 5.4-2** below.

5.4 Construction of the Final Disposal Site

5.4.1 Construction Stage Plan

It is necessary to prepare the new landfill site before the existing landfill site at Dandora is exhausted. It will require at least 3 years to construct all facilities of the sanitary landfill site, but it is not necessary to construct all the facilities before the beginning of landfill operation because leachate collection and drain pipes, gas exhaust equipment and rainwater drains will be extended in accordance with the construction stage. The construction should be continued even after the commencement of landfill operations according to the annual landfill amount expected in the successive years. As shown in the construction stage plan of each case in **Figure 5.4-1**, it is possible for landfill operations to begin in the second stage of construction.

Site	Area	Year			
		First	Second	Third	Fourth
Ruai	40 ha	1st Stage	2nd Stage	3rd Stage	
			Beginning of Operation		

Figure 5.4-1 Construction Stage Plan

5.4.2 Construction Schedule

The construction schedule in relation to the beginning of operation is shown in **Figure 5.4-2** below.

Item	Works	Year (Stage)		
		First	Second	Third
Preparatory Works:				
Access Road	Road Construction			
Structure for Solid Waste Retention	Excavation			
	Embankment			
	Side-slope adjustment			
Retention Pond	Excavation			
	Land adjustment			
	Liner Laying Work			
	Pipe Connection Work			
Leachate Treatment Facility	Excavation			
	Land adjustment			
	Liner Laying Work			
	Pipe Connection Work			
Leachate Collection and Drain	Piping Work			
	Leachate Reservoir			
Gas Exhaust Equipment	Vertical type			
	Part of Side Slope			
Rainwater Drain	Drain Installation			
Onsite Road	Road Construction			
Maintenance Road	Road Construction			
Monitoring System	Well Work			
Net Fence	Net Fence Work			
Gate	Gate Work			
Administratiion	Control Office			
	Resthouse			
	Truck Scale			
	Car Washing Pool			
	Septic Tank			
	Garage			
	Parking Lot			
Operation				

Figure 5.4-2 Construction Schedule of Facilities

5.4.3 Operation and Management of Landfill System

(1) Management of Landfill System

The functions of a landfill system will only be realised if appropriately managed. Therefore, management of the sanitary landfill system must be thoroughly examined.

The detailed information on landfill management is described in **Data Book (1), Section 8.5, Operation and Management Manual of Sanitary Landfill.** In principle, the planning must consider the following points:

(a) Strict adherence to the technical standards set up for maintenance and control of landfill system;

(b) Recording and storing of data on the volume of solid waste dumped, volume of cover material used and the condition of the landfill site in

order to correctly control the volume of solid waste dumped into the site and for the planning of efficient operations;

(c) The arrangement of proper organisation for the site is essential to sustain the sanitary landfill system. The proposed organisation is as shown in **Table 5.4-1.** The number of operators will depend on the transported waste amount.

Table 5.4-1 Operational Organisation of the Final Disposal Site

Staffing	Number	Responsibility
Site Manager	1	- All the responsibilities of handling the site, as well as contact and reporting to NCC
Secretary	1	- Controls and regulates the schedule of the Site Manager, registers income and outlays daily management
Chief of Engineering Section	1	- Responsible for all engineering matters, planning and conduct of the suitable landfill operation method
Truck Scale Engineer	3	- Operates truck scale to measure the waste quantity and quality, and directs trucks to the designated landfill area
Site Inspector	3	- Inspects safety against disaster at the site and illegal dumping
Chief Operator	1	- Controls daily operator's work and directs trucks to the designated landfill area in site
Security Guard	3	- Inspects safety against strangers, robbers and so on at the site
Operator	2001-20 2004-28 2008-36	- Landfills the waste
Total	2001-33 2004-41 2008-49	

(d) Monitoring of the environment during the land-filling process as well as after completion;

(e) Periodical inspection and maintenance of each facility in the landfill system after a heavy downpour or the occurrence of a natural disaster; and

(f) Rational management taking into account the prevailing social atmosphere in the region and the actual condition and technical level of cleansing operators.

(2) Landfill Operation

The detailed landfill operation method is shown in **Data Book (1), Section 8.5, Operation and Management Manual of Sanitary Landfill.**

(a) Application of Cover Soil

Dumped waste should be covered with soil everyday. Daily application of cover soil is required to:

(i) reduce smoke and odour;
(ii) reduce the number of insects and rodents; and
(iii) accelerate waste decomposition.

(b) Bedding and Compaction

Solid waste must be sufficiently compacted to stabilise the landfill foundation and prolong the use period of landfill. A layer of cover soil must be systematically placed after land-filling each layer of solid waste.

The waste is unloaded at the toe of the earth dike and spread and compacted on the slope of the dike in a series of layers that vary in depth from 30 to 60 cm. The recommended slope of these layers is 1 is to 3.

At the end of each day's operation, a 15 cm to 30 cm layer of cover soil is placed over that day's completed fill. This one day's completed fill including the cover soil is required for about 10 to 20% of daily waste quantity. Therefore, the daily cover soil should be prepared and stocked on the next ground by excavation work or selection of suitable construction work.

The cell method is recommended for sanitary landfill in view of the large area of landfill, and uphill method is recommended for bedding and compaction. Daily covering by soil should be done.

(3) Safety and Sanitary Control

A landfill system should be designed to consider safety and sanitary conditions for its workers. Work at a sanitary landfill system is mainly done outdoors. Workers will be affected by dust, odor and gas emission. In addition, they have some contact with chemicals. Working environment requirements then need to be considered.

(a) Safety and Sanitary Control for Workers

In order to ensure health and safety for workers at a landfill site, it is necessary to consider the working conditions and examine the following items:

(i) Dust from landfill operations
(ii) Gas formation
(iii) Use of chemicals
(iv) Accidents such as falls
(v) Vectors and animals
(vi) Others

(b) Welfare Facilities and Health Check

Health care for workers should be one aspect of the overall sanitary landfill system plan. Particular consideration should be given to the following points for safety and ease of work:

(i) Canteen, welfare and rest facilities
(ii) Regular health checks
(iii) Maintenance of first-aid kits

5.4.4 Cost Estimate

(1) Construction Cost

The construction cost is estimated for each construction stage. The detailed results are shown from **Table 8.7-1** to **Table 8.7-15** in **Data Book (1)**. The estimated construction costs are shown in **Table 5.4-2**.

Table 5.4-2 Summary of Construction Cost

(in 1000 Kshs)

Construction Phase	1st Year	2nd Year	3rd Year	Total
Cost	667,857	338,007	405,100	1,410,964

(2) Annual Disposal Expenditure of Final Disposal Plan

The annual disposal expenditure of the final disposal plan, which consists of design cost, heavy equipment purchase cost, construction cost and O&M cost (engineering cost, fuel, electricity, water, spare parts), is shown in **Table 5.4-3**, and detailed information is attached in **Data Book (1), Section 8.6, Cost Estimation.**

Table 5.4-3 Annual Disposal Expenditure of Final Disposal Plan

Year	Waste Amount	Cost (10^3 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.
Figure in parenthesis ( ) is for closure work of Dandora site.

5.5 Closure Plan of Dandora Dumpsite

5.5.1 Closure Plan

The Dandora Dumpsite should be closed when the new site(s) is constructed. There is a plan that the site will be developed by a private company as a residential area. However, if the area will not be used for any other purpose and left as it is, the site will remain with many environmental problems in the future. Therefore, NCC has to consider the closure plan and another post-closure land-use plan.

The site is an uncontrolled dumping site and it is very difficult to have it restored to its original ground condition very quickly. The following closure work shall be done and it will needed more than ten years for the ground to stabilise:

(1) Scattered waste have to be taken together to the northern part of the site. The work will reduce the waste distributed area and the cleaned-up original ground area in front of the public road can be used for any land-use immediately.

(2) The waste distributed area should be covered with soil material completely. The thickness of cover soil should at least be 50 cm.

(3) Gas-outlet equipment and leachate collection pipes should be installed in the waste distributed area to promote the stabilisation of waste layer.

(4) Rainwater drainage ditch should be constructed around the site.

(5) Periodical monitoring is required to check the progress of stabilisation.

(6) The waste distributed area has to be used as open space area, e.g., football ground or park until the waste layer has stabilised completely.

The closure work of Dandora Dumpsite is as illustrated in **Figure 5.5-1**.

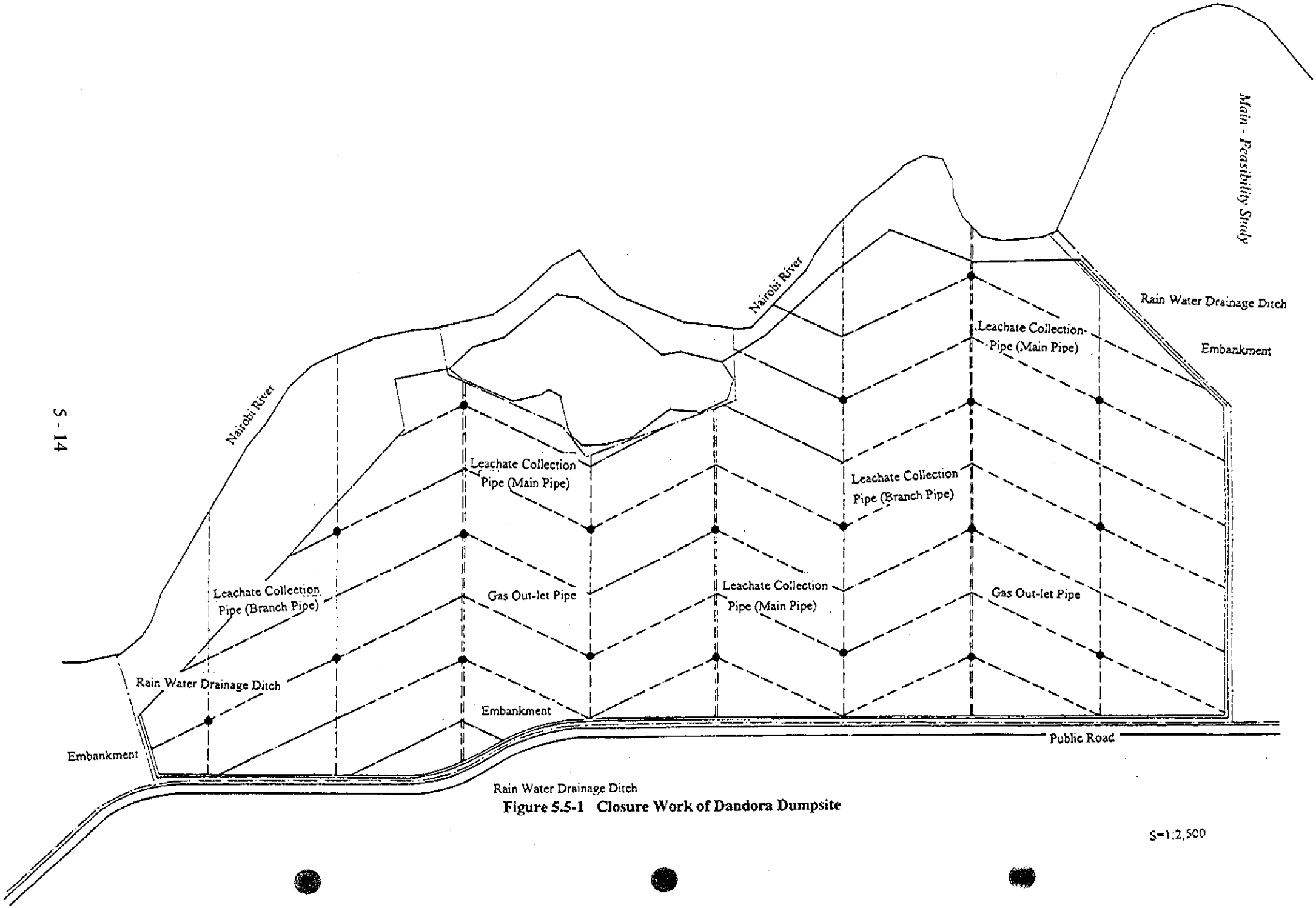


Figure 5.5-1 Closure Work of Dandora Dumpsite

S=1:2,500

5.5.2 Cost Estimate of Closure Work of the Existing Dandora Dumpsite

As stated before, the existing Dandora Dumpsite should be closed when the new site is constructed. The main closure work consists of land reclamation and soil cover work, as shown in **Figure 5.5-1**. The quantity of complete closure work and the cost estimate are given in **Table 5.5-1**. This table shows that the work requires approximately 302 million Kshs and a one year construction period. Even if NCC is unable to ensure enough budget for a complete closure work, it has to carry out the minimum closure work shown in **Table 5.5-2**. The minimum closure work requires approximately 227 million Kshs. and a half year construction period.

Table 5.5-1 Cost Estimate of Complete Closure Work of Dandora Dumpsite

Items	Unit Cost (m^3/Kshs)	Quantity (m^3)	Cost (× 1000 Kshs)	Remarks
1. Land Reclamation	105	90,000	9,450	30.0 ha × 0.3m = 90,000m^3
2. Loading & Compaction	64	123,750	7,920	24.75ha × 0.5m = 123,750m^3
3. Cover Soil Material	1,221	123,750	151,099	Same as above
4. Embankment	1,285	5,260	6,759	1,315m × 4m^3/m
5. Rainwater Drainage Ditch	6,500	1,910	12,415	
6. Leachate Collection Work				
6.1 Material & Installation Work (Main Pipe)	12,182	930	11,329	
6.2 Material & Installation Work (Branch Pipe)	3,441	6,500	22,367	
7. Gas Outlet Equipment	128,600	20	2,572	
Sub-Total	-	-	223,911	-
Overhead Cost	-	-	78,089	Sub-Total × Approx. 35%
Total	-	-	**302,000**	-

Table 5.5-2 Cost Estimate of Minimum Closure Work of Dandora Dumpsite

Items	Unit Cost (m^3/Kshs)	Quantity (m^3)	Cost (× 1000Kshs)	Remarks
1. Land Reclamation	105	90,000	9,450	30 ha × 0.3m = 90,000m^3
2. Loading & Compaction	64	123,750	7,920	24.75ha × 0.5m = 123,750m^3
3. Cover Soil Material	1,221	123,750	151,099	Same as above
Sub-Total	-	-	168,469	-
Overhead Cost	-	-	58,531	Sub-Total × Approx. 35%
Total	-	-	**227,000**	-

5.6 Project Evaluation

The construction of a new disposal site and the introduction of sanitary landfill by NCC is required to establish the new SWM system of NCC. The new final disposal system will improve the site conditions and give a good impression to the residents regarding NCC's SWM. The new final disposal system of NCC is evaluated as a model case of national level standard.

5.7 Examination of Service Level

This section carries out another study with a lower collection ratio (40:50:60%) than the case discussed above (60:80:100%) in order to examine the reduced level of services. Also, a case of Sanitary Level 2+ will be examined to reduce the initial investment cost.

5.7.1 Landfill Capacity (Collection Ratio: 2000~2003=40%, 2004~2007=50%, 2008=60%)

It is necessary to prepare the new landfill site which should have a capacity of more than the volume of land-filling solid waste from 2001 to 2008 (Minimum landfill capacity). The required landfill capacity is approximately 3.3 million m^3 including 10% cover soil volume according to the Collection and Transportation Plan. The annual disposal amounts are as shown in **Table 5.7-1**.

The formation of the landfill site is designed, as illustrated in **Figure 5.7-1**. The estimated landfill capacity of each block is given in **Table 5.7-2**.

Table 5.7-1 Disposal Site Capacity Requirement at Reduced Service Level

Year	(1) Landfill Waste Amount (t/d)	(2) (1)×40% ×50 ×60%	(2) Landfill Waste Amount (m^3/d) (2)/*1.0	(3) Landfill Waste Amount (m^3/year) (3)×365	(4) Total Waste Amount (m^3)
1998	1,509	604	604	220,460	220,460
1999	1,587	635	635	231,775	452,235
2000	1,667	667	667	243,455	695,690
2001	1,758	703	703	256,595	256,595
2002	1,855	742	742	270,830	527,425
2003	1,959	784	784	286,160	813,585
2004	2,077	1,039	1,039	379,235	1,192,820
2005	2,190	1,095	1,095	399,675	1,592,495
2006	2,316	1,158	1,158	422,670	2,015,165
2007	2,451	1,226	1,226	447,490	2,462,655
2008	2,594	1,556	1,556	567,940	3,030,595
Total	-		-		3,726,285

* Bulk density of waste in the site is from 0.7 to 1.4 (average 1.0)

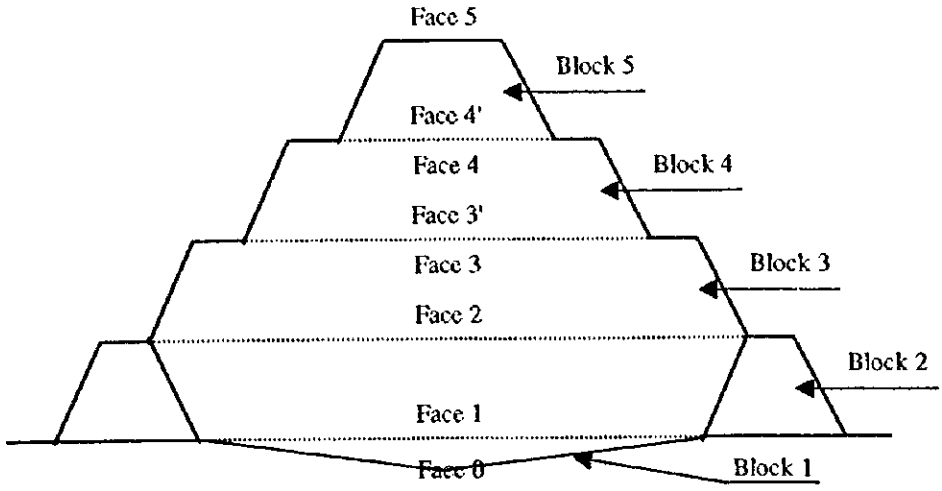


Figure 5.7-1 Design Formation of Landfill Blocks at Reduced Service Level

Table 5.7-2 Computation of Landfill Capacity at Reduced Service Level

Block	Face	Area (ha)	a. Average area (ha)	b. Height (m)	Landfill Capacity (a × b) (10^3 m^3)
1	0	0	15.4	1	154
	1	30.7			
2			31.1	2	622
	2	31.4			
3	2'	31.7	32.7	5	1,635
	3	33.6			
4			33.3	3	999
	4	33.0			
Total	-	-	-	**10**	**3,410**

Note: Total capacity: $3,410 \times 10^3$ m^3 > Minimum capacity: $3,300 \times 10^3 m^3$

5.7.2 Construction Cost

The construction cost is estimated for each case and each construction stage. The detailed results are shown from **Table 8.7-1** to **Table 8.7-15** in **Data Book (1), Section 8.6**. Construction cost estimation cases are shown in **Table 5.7-3** below.

Table 5.7-3 Summary of Construction Cost at the Reduced Service Level

(in 1000 Kshs)

Construction Phase	First Year	Second Year	Third Year	Total
Cost (Level 4)	667,549	337,263	404,544	1,409,356
Cost (Level 2+)	402,090	296,010	368,960	1,067,060

5.7.3 Annual Expenditure of Final Disposal Plan

The annual expenditures of the final disposal plan, which consist of design cost, heavy equipment purchase cost, construction cost and O&M cost (engineering cost, fuel, electricity, water, spare parts) are as shown in **Tables 5.7-4** and **5-7-5**. Detailed information is given in **Data Book (1), Section 8.6, Cost Estimation.**

Table 5.7-4 Annual Disposal Expenditures at the Reduced Service Level (Sanitary Level 4)

Year	Waste Amount	Cost (10^3 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 of Dandora site.

Table 5.7-5 Annual Disposal Expenditures at the Reduced Service Level (Sanitary Level 2+)

Year	Waste Amount	Cost (10^3 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 of Dandora site.