PREPARATORY SURVEY
FOR
INTEGRATED SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN
THE REPUBLIC OF KENYA

FINAL REPORT

VOLUME 3

SUPPORTING REPORT

SECTION G

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

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SECTION G
ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

1. INTRODUCTION

This Supporting Report Section G presents the environmental and social considerations for the SWM in Nairobi City. **Chapter 2** presents the results of the survey on the current condition of environmental quality of Nairobi City and the identification of main problems. On the other hand, **Chapter 3** presents the execution of the Initial Environmental Examination (IEE) for the candidate sites for transfer station and landfill. As for the future arrangements on environmental aspects, it is presented in **Chapter 4**, and finally **Chapter 5** presents the draft TOR of EIA.

2. DESCRIPTION AND EVALUATION OF CURRENT CONDITION

2.1 Environmental Quality in Nairobi City

2.1.1 General

Nairobi City is the capital of Kenya and is divided into eight (8) administrative divisions, namely; Embakasi, Makadara, Pumwani, Central, Kasarani, Westlands, Kibera and Dagoreti. The city is at altitude 1,670 m above sea level and has an area of 696 square kilometres.

Analysed in the following subsections are the current situation of environment and social aspects related to the solid waste management in Nairobi City. The current condition of four components of the environment that are considered relevant to SWM, namely; water, sewage, air quality and solid waste, have been studied utilising available information in the institutions of the sector and through field observations.

2.1.2 Water

The Water Act of 2002 provides the framework for the management of water resources and the provision of water and sewerage services in Kenya. It proposes reform that separates water management and service provisions. The Ministry of Water and Irrigation is in charge of the formulation of policies and provide oversight within the sector; the Water Resources Management Authority (WRMA) is in charge of water resources management and development at the national level; and the Water Services Regulatory Board (WSRB) is in charge of regulation at the national level. At the regional level exists the Water Services Board responsible for regulation and planning of water and sewerage services and the Catchment Advisory Board.

With regard to Nairobi City, the Nairobi Catchment Advisory Board is responsible for advising on water allocation, source protection and conservation, water quality management and pollution control in the city. Other agencies concerned in catchment management are the National Environment Management Agency (NEMA) and the Department of Environment of City Council of Nairobi[1]. (Note: *Figure affixed at the end of a word or a sentence refers to the source listed at the end of this supporting report.*)

(1) Surface Water

The City of Nairobi is traversed by three (3) main rivers that compose the Nairobi River Basin, namely; Nairobi River, Ngong River and Mathare River. These rivers join east of Nairobi to discharge finally into the Athi River.

The rivers are highly polluted by domestic and industrial wastewaters and solid waste. In 2008, it was detected that about 56 percent of the city residents live in 46 slums[2] along the banks of rivers in Nairobi without having proper sanitary facilities, occasioning great pollution to these rivers. Slums are informal settlements, with Kibera, Mathare and Kawangware as the biggest ones. The estimated density in the slums of 300,000 people per square kilometer and the lack of proper sanitation facilities put the slums in an uncompromising situation as the major sources of water pollution[3].

The Motoine River flows into the Nairobi Dam and leaves as the Ngong River, passing through the Industrial Area where it receives industrial wastewater before its confluence with Nairobi River near the Njiru Shopping Centre [4]. The Motoine River receives agrochemical pollutants from its water head at Dagoreti area and, as it flows eastwards, receives uncollected wastes and untreated sewage from the Kibera slum before entering the Nairobi Dam. The Ngong River after the Nairobi Dam receives discharges of industrial wastewater as it passes through the industrial area and raw sewage and uncollected solid waste as it passes through the other informal settlements of Embakasi, Kayole, Kibarage, and Soweto before its confluence with the Nairobi River near the Njiru Shopping Centre. The Ngong River also receives raw sewage from blocked, broken or overloaded sewers. The water analysis conducted by the Ministry of Environment and Mineral Resources and CCN on Motoine River, Nairobi Dam and Ngong River, had revealed very high concentrations of coliform and other pollutants that are hazardous to human health.

Most of the people living in the informal settlement areas use the water of Ngong River for irrigation of crops for subsistence and for sale, such as sugarcane, maize, arrowroots, bananas, Napier grass, beans, cassava, sweet potatoes, and vegetables like tomatoes, cabbages and carrots[5].

In the Nairobi River Basin Programme, Phase II, water monitoring and laboratory analysis were conducted in 20 locations at the Ngong River, as shown in **Figure G.2.1**. This study was conducted to assess the water quality of the river in wet and dry season and the results are given in **Table G.2.1**. The results for Ngong River show that many of the parameters of water quality do not meet the surface water quality standards for water supply under the Kenyan and Japanese standards, if the river is to be used as the source of domestic water, indicating that water quality has deteriorated due mainly to the untreated domestic and industrial wastes.

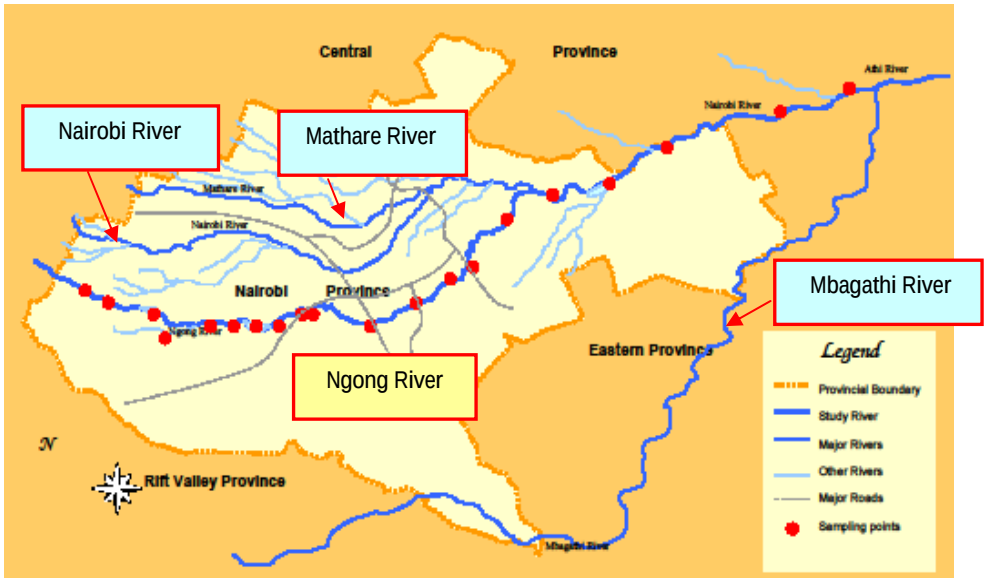


Figure G.2.1 Water Analysis of Ngong River

Source: UNEP, *Nairobi River Basin Programme – Phase II* (University of Nairobi/UNEP project Feb-Nov. 2003) Final Report.

Table G.2.1 Water Quality of Ngong River (November 2003)

Water Quality Parameters	Rainy Season		Dry Season		Standard Value Kenya[*1]/Japan[*2]
	Averaged Max.	Averaged Min.	Averaged Max.	Averaged Min.	
BOD_5	50 mg/l	8 mg/l	640 mg/l	58 mg/l	–/< 3 mg/l
COD	319 mg/l	42 mg/l	1317 mg/l	160 mg/l	–
DO	0.60 – 2.70 mg/l		0.09 – 4.42 mg/l		/ >5 mg/l
pH	6.7 – 8.3		7.2 – 8.2		6.5–8.5/6.5–8.5
PO_4	13.53 – 319.37 µg/l		102.04 – 2693.30 µg/l		–
NO_2	0.02 – 0.15 mg/l		0.00 – 0.27 mg/l		3/– mg/l
NH_3	0.40 – 17.60 mg/l		0.80 – 46.00 mg/l		0.5 / – mg/l
F^-	0.00 – 1.20 mg/l		0.32 – 1.72 mg/l		1.5 /– mg/l
Cl^-	34.00 – 118.00 mg/l		19.00 – 1242.00 mg/l		–
Fe	2.39 –19.83 mg/l		1.25 – 36.92 mg/l		–
Cu	0.00 – 0.09 mg/l		0.01 – 0.76 mg/l		0.05/ – mg/l
Cr	0.00 – 7.84 mg/l		0.00 – 0.32 mg/l		–
Cd	0.00 – 0.02 mg/l		0.00 – 0.01 mg/l		0.01/<0.01[*3] mg/l
Mn	0.21 – 2.13 mg/l		0.23 – 3.68 mg/l		–
Zn	0.03 – 0.20 mg/l		0.08 – 0.68 mg/l		–

Source: UNEP, *Nairobi River Basin Programme – Phase II* University of Nairobi/UNEP Project, Feb-Nov. 2003) Final Report.

Note: [*1] Kenyan Standard applied for sources of domestic water, Environmental Management and Coordination (Water Quality) Regulations, 2006.
[*2] Japanese Standard Category B applied for rivers to be used for water supply, fishery, industrial, agriculture and conservation of the environment, except Cd that is regulated by the Standard to protection of public health.

The other study[6] on Ngong River made by UN-Habitat conjointly with CCN had concluded that the river is grossly polluted by:

(a) Raw domestic sewage coming from broken or overloaded sewers along the river;

(b) Solid waste from informal settlements along the river;

(c) Human faeces deposited into the river from latrines of informal settlements located along the river; and

(d) Untreated industrial effluent entering the river directly or through broken sewers.

Finally, in the previous MP conducted by JICA, the water quality of the rivers in Nairobi City was analysed. **Table G.2.2** presents the test results at some locations where highest pollution levels were noted. Based on the above studies and analyses, it can be concluded that most of the rivers in Nairobi City are suffering from pollution, mainly, by organic substances originating from uncollected solid wastes, industrial effluent and domestic wastewater.

Table G.2.2 Water Quality of Rivers in Nairobi City (MP 1998)

Parameter	Githaturu River	Ngong River	Mathare River	Nairobi River	Standard Value Kenya[*1]/Japan[*2]
GPS	S 1,14,303 E 36,53,471	S 1,19,186 E 36,51,455	S 1,14,928 E 36,49,174	S 1,17,421 E 36,52,152	
DO (mg/l)	1.0	1.0	4.3	0.9	/ >5 mg/l
pH	8.8	7.6	7.5	7.3	6.5–8.5/6.5–8.5
SS (mg/l)	85.0	70.1	70.5	210	30/< 25

Source: Source: JICA MP Study (1998)

Note: [*1] Kenyan Standard applied for sources of domestic water, Environmental Management and Coordination (Water Quality) Regulations, 2006.
[*2] Japanese Standard Category B applied for rivers to be used for water supply, fishery, industrial, agriculture and conservation of the environment, except Cd that is regulated by the Standard to protection of public health.

In the second field survey of the present JICA survey from February 2010, additional water quality analyses were carried out to examine the present water condition. **Table G.2.3** presents the results of the additional survey.

Table G.2.3 Results of Additional Survey on Water Quality of Nairobi River (February 2010)

Parameter	Nairobi River				Standard Value Kenya[*1]/Japan[*2]
GPS	N -1,14,29.02 E 36,55,14.71	N -1,15,9.58 E 36,53,36.15	N -1,14,40.94 E 36,53,46.38	N -1,12,48.02 E 37,2,31.98	
Location	Kariobangi South	Before Dandora	After Dandora	Candidate site for disposal	
pH	7.7	7.3	7.7	7.6	6.5–8.5/6.5–8.5
Temp. (°C)	21	20.4	20.6	22.4	
Detergents (mg/l)	0.45	0.4	0.75	0.25	
BOD5 (mg/l)	36	150	42	42	/< 3
COD (mg/l)	70	270	110	60	
T-N (mg/l)	10.36	13.82	12.67	4.61	
TDS (mg/l)	290	963.75	395	208	1200
SS (mg/l)	110	686.25	363.75	222.5	30/< 25
Total Coliforms (MPN/100 ml)	> 1,800	> 1,800	> 1,800	> 1,800	/<5000
Phenolic substances as Phenols (mg/l)	0.1	0.2	0.1	0.1	Nil
T-P (mg/l)	0.8	1.5	1.5	0.9	
NH4-N (mg/l)	12.6	16.8	15.4	5.6	0.5
DO (mg/l)	5.0	3.3	4.0	9.9	/ >5 mg/l
Arsenic (mg/l)	ND	ND	ND	ND	0.01
Cadmium (mg/l)	ND	ND	ND	ND	0.01
Chromium (mg/l)	ND	ND	ND	ND	
Lead (mg/l)	ND	ND	ND	ND	0.05
Mercury (mg/l)	ND	ND	ND	ND	
Cyanide (mg/l)	ND	ND	ND	ND	
Colour (Hazen Units)	21.4	19.25	26.1	32.6	
Oil & grease (mg/l)	103	115	94.6	118	
Polychlorinated Biphenyls (mg/l)	0.00045	0.00066	0.00067	0.00013	
Organo-Phosphorus Compounds (mg/l)	ND	ND	ND	0.00004	

Source: The present JICA Survey.
Note: [*1] Kenyan Standard applied for sources of domestic water, Environmental Management and Coordination (Water Quality) Regulations, 2006.
[*2] Japanese Standard Category B applied for rivers to be used for water supply, fishery, industrial, agriculture and conservation of the environment, except Cd that is regulated by the Standard to protection of public health.
ND: Not Detected
Nil: means less than limit of detection using prescribed sampling and analytical methods and equipment as determined by the Authority

Based on the above results, it is further concluded that most of the rivers in Nairobi City are still suffering from pollution mainly by organic substances originating from uncollected solid wastes, industrial effluent and domestic wastewater.

(2) Groundwater

Groundwater in Nairobi is used mainly by industries and hotels to supplement the water supplied by the Nairobi Water and Sewerage Company (NWSC). Besides, some parts of the city such as

Langata and Karen also use the water from wells. The water from wells supplied to the commercial, industrial and residential sectors is metered by NWSC and is the basis for the calculation of wastewater charges applied by this company. The number of water wells in Greater Nairobi increased from 10 in 1940 to 2,250 in 2001 as a result of the drought[7].

In the City of Nairobi, the water drained eastwards accumulates on the low-lying ground between Parklands in the north and the Nairobi South Estate forming an aquifer above the Nairobi Phonolite[8]. The following table presents the average analysis results of groundwater in boreholes drilled in the area of Nairobi.

Table G.2.4 Groundwater Quality in Nairobi Province

Parameters	Unit	Values		Standard[*1]
		1983/84	1985	
pH		7.9	7.7	6.5-8.5
Color		-	9.3 mg Pt/l	15 TCU[*2]
Turbidity	NTU	28.9	6.4	5
Oxygen	mg O2/l	-	6	-
Conductivity	µs/cm	859	506	-
Iron	mg Fe/l	1.48	1	0.3
Manganese	mg Mn/l	0.7	0.12	0.5
Calcium	mg Ca/l	43.3	20	150
Magnesium	mg Mg/l	8.16	2.2	100
Sodium	mg Na/l	164	148	200
Potassium	mg K/l	19.3	20	-
Total Hardness	mg/l	48.4	64	300
Total Alkalinity	mg/l	-	192	-
Chloride	mg Cl/l	72.4	40	250
Fluoride	mg F/l	6.59	3.5	1.5
Sulphate	mg SO4/l	32.3	15	400
TDS	mg/l	521	304	1,000

Source: Ministry of Water and Irrigation
Note: [*1] Kenya Bureau of Standard, Third Edition 2007
[*2] True colour units (TCU) mean 15 hazen units after filtration.

Groundwater quality is generally satisfactory for all domestic purposes from the chemical point of view, except the fluoride content which exceeds the Kenyan Standard for drinking water of 1.5 mg/l. The removal of fluoride is not technically easy and economically feasible representing one of the more intractable problems in relation to groundwater utilisation. The other element that slightly exceeds the Nairobi guidelines for groundwater is iron, which causes undesirable taste at levels of 0.3 mg/l. Although the table gives valuable data, it shows only the physical-chemical characteristics of the water and the portion that corresponds to bacteriological, bio-chemical, nitrogen, pesticides and heavy metal analysis to have a comprehensive water quality data is lacking.

In the period 1997-2002, a total of 290 wells were drilled within Nairobi City with a concentration of fluoride that is increased with depth. Thirty percent (30%) of the drilled wells presented fluoride of about 2 ppm[9].

Other recent studies had detected also high concentrations of fluoride in the groundwater of Nairobi, mostly above the recommended standard of 1.5 ppm[10].

(3) Water Supply

The provision of water services to Nairobi City is realised by the Nairobi Water and Sewerage Company (NWSC). This company is fully owned by the City Council of Nairobi and is licensed to operate by the Athi Water Services Board (AWSB). The privatisation was made to improve the quality of the service.

The NWSC is licensed to provide water and sewerage services to Nairobi (approx. 700 sq km) and its environs mainly in areas of close proximity to Nairobi boundaries, i.e., Kiamumbi, Kahawa Sukari and Githurai Kimbo. The current coverage of water services is over 80%, while it is approx. 40% for sewerage and the consumption per capita in the informal settlements is 40 ltrs/day and it is 300 ltrs/day for the more affluent consumers. The company adopts the WHO standard for drinking water[11].

Only 42 percent of households in Nairobi City have proper water connection and water losses exceed 50 percent due to leakage and illegal connection[12].

The residents of slums suffer most due to the lack of piped water supply in these areas. According to the Study on Ngong River, 85% of the households of Kibera slum get water from kiosks located at approximately 40 meters on average at an average price of 2Kshs per 20 litres[13].

The NWSC operates the following facilities for water supply: 4 dams (Thika Dam Capacity: 70M m^3, Sasumua Dam Capacity: 17M m^3, Ruiru Dam Capacity: 2.9M m^3 and Kikuyu Springs Capacity: 24,000 m^3); and 3 water treatment plants (Ngethu Treatment Works: 440,000m^3/d, Sasumua Treatment Works: 59,000m^3/d and Kabete Treatment Works: 11,000m^3/d). As for the water from Kikuyu Springs, it is treated onsite[14].

The NWSC is rehabilitating the Sasumua Dam so that it can realise its design capacity of 16 million cubic meters. In addition, many alternative water projects are to be executed and all of them aim to satisfy the water demand of Nairobi City[15].

Water consumption in Nairobi City is about 350,000 m^3/day and the production is 392,000 m^3/day, although the optimum production capacity is 592,000 m^3/day. The per capita consumption varies according to socio-economic group. The national standard per capita consumption is 50 ltrs/day. In some informal settlements such as Mali Saba, the per capita consumption ranges from 1.7 to 30 ltrs/day[16] and in Kibera slum the consumption ranges from 16 to 20 ltrs/day[17]. The per capita usage varies according to the poverty level.

The quality of water supplied to Nairobi City in 1984 is shown in **Table G.2.5**. Although the table gives valuable data, it is necessary to know the portion that corresponds to bacteriological quality to evaluate the potability of water supplied to Nairobi's residents.

Table G.2.5 Water Quality of Nairobi Water Supply System

Parameter	Monitoring Places						Standard[*1]
	Unit	Kangemi	Dandora	Univ. of Nairobi	Pangani	Kibera	
Colour	Hazen	5	5	5	5	5	15 TCU[*2]
Taste & Odour	-	-	-	-	-	-	Not offensive/ Odourless
Turbidity	NTU	0.75	0.75	1	1	0.5	5
Total alkalinity	mg/l	30	25	24	27	28	-
pH	-	7.6	7.4	7.8	7.8	7.7	6.5-8.5
Total hardness	mg/l	30	280	40	39	38	300
Calcium hardness	mg/l	16	120	20	20	15	-
Resid. chlorine	mg/l	0.3	0.3	0.3	0.3	0.1	-
Iron	mg/l	0.3	0.3	0.3	0.3	0.3	0.3
Chloride	mg/l	30	14	25	15	15	250
Bacteria (coliform)	MPN/ 100ml	-	-	-	-	-	Not detectable

Source: Nairobi Master Plan for Sewer, Sanitation &Drainage, July, 1996

Note: [*1] Kenya Bureau of Standard, Third Edition 2007; [*2] True colour units (TCU) mean 15 hazen units after filtration.

(4) Waterborne Diseases

At the national level in 1999, 4.7% of all outpatients reported cases of diarrheal diseases which were more prevalent in Nairobi, Rift Valley, Nyanza and the western provinces[18]. Diarrheal diseases may be attributable to poor or inadequate sanitary facilities and hygienic practices. In Nairobi City, the population living in informal settlements is the most vulnerable group to waterborne diseases due to the poor sanitary condition of these places.

The Study on Ngong River revealed through interview with some residents of informal settlements the high prevalence of environmentally related diseases such as malaria, diarrhea, eye diseases and typhoid. According to this Study, in 2000, between 85% and 95% of all new patients that visited Langata Clinic (mainly serving Kibera residents) suffered from environmentally related diseases like malaria, diarrhea, intestinal worms, diseases of the respiratory system, diseases of the skin and eye infections[19].

Water pollution due to municipal, industrial, mining and agricultural sources continues deteriorating the water supply causing waterborne diseases[20].

(5) Water Pollution Control

The rivers in Nairobi City are polluted mainly by domestic wastewater, industrial wastewater and solid waste. The Department of Water Resource Management of the Ministry of Water and Irrigation is in charge of the protection, conservation and management of water resources, control and apportionment, as well as water quality and pollution control; whereas, the National Environmental Management Authority (NEMA) is in charge of implementing programs for controlling pollution of the environment. NEMA is the institution in charge of EIA studies. On the other hand, the Nairobi Water and Sewerage Company Limited also have the responsibility of monitoring industrial effluents before discharge into the sewers.

(6) Standards

(a) Drinking Water

With respect to drinking water quality, the Kenyan Bureau of Standard had developed the respective standards given in **Section G of Volume 4, Data Book**.

(b) Regulation on Effluent Discharge into the Environment

The Environmental Management and Coordination (Water Quality) Regulations of 2006 in its Third Schedule present the characteristics that all effluent must fulfill for their disposal into the environment. The Standard is presented in **Section G of Volume 4, Data Book.**

(c) Standard for Effluent Discharge into the Public Sewers

The Environmental Management and Coordination (Water Quality) Regulations of 2006 in its Fifth Schedule present the characteristics that all effluent must fulfill for their disposal into the public sewers. The Standard is presented in **Section G of Volume 4, Data Book.**

2.1.3 Sewage

The sewerage system of Nairobi City is of combined type where sewers receive both storm water and sewage. The sewerage service is provided by the Nairobi Water and Sewerage Company Limited.

Sewer sizes range between 225mm diameter and 2m diameter lines with manholes provided at intervals for inspection purposes. The sewerage network in the city is not sufficient, permitting illegal discharges of sewage into the rivers[21].

Besides, many parts of the network are old and blocked or broken and need maintenance or replacement. The Nairobi Water and Sewerage Company and the Athi Water Services Board are jointly rehabilitating the sewer network to contain effluent discharge into the Nairobi River as a part of initiatives being implemented under the Nairobi River Basin Programme. The following trunk sewers are to be rehabilitated: Mathare River, Dandora Community Phase One, Kipande Road Sewer and Dandora Treatment Plant[22]. According to officials of the Nairobi Water and Sewerage Company Limited, many people block or puncture the sewers to get sewage for urban agriculture[23].

The Study on Ngong River revealed that among the places where the sewers are blocked or punctured are Lucky Summer, Kayole (Matopeni), KCC Village, Dandora and the southern end of Kibera. The Study on Ngong River also showed that farming activities using sewage for irrigation are extensive and represent considerable socio-economic benefit of many people that depend on the activities for their livelihood[24].

As for sanitation in the informal settlements, the Kibera slum area was surveyed in the Study on Ngong River showing that between 50% and 94% of the households do not have access to adequate sanitation. It was revealed that close to 150 people share one latrine and due to this inadequate sanitation other methods are used for excreta disposal such as the use of polythene bags popularly known as flying toilets, or directing the excreta into the drainage channels or into the rivers[25].

The current coverage of sewerage is approx. 40%, and the sewage is treated in the following wastewater treatment facilities: (a) Kariobangi Treatment Works, composed of digestion incubators situated about 5km west of the City Centre; (b) Dandora Treatment Works, composed of Stabilisation Lagoons located in Ruai, 30km east of the City Centre; and (c) a number of stabilisation Lagoons located in Kahawa West. In each of the treatment facilities there is a quality assurance laboratory which carries out regular monitoring of the treatment process[26].

2.1.4 Air Quality

The previous study carried out for Nairobi City shows that the levels of particulates in most parts of the city are above the levels recommended by WHO (mean value: 90 μg/m^3). The most affected parts of the city with the highest concentration of particulates are the residential areas located in the eastern zone and the city centre[27].

During the present JICA survey, it was observed that burning of waste is very common at the collection points and disposal sites. According to the CBOs or waste pickers, they burn the waste at the collection points to reduce the amount of waste at the site, since the collection service is very irregular. At the disposal site, the burning of waste could happen intentionally by waste pickers or naturally due to the decomposition of waste and not the existence of gas treatment system.

On the other hand, it was noted during the survey that many mal-maintained vehicles in the daily traffic pollute the air of Nairobi City. In addition, NEMA also reported that industries also are responsible for air pollution[28].

2.1.5 Solid Waste

(1) General

The JICA Survey Team had decided to carry out a field observation conjointly with the Kenyan counterparts on the following sites: (a) Dandora designated disposal site and Kayole Orbit temporary disposal site; (b) major illegal disposal sites (large and medium/small scales); (c) some collection points operated by CBOs/CCN; and (d) some collection points operated by CCN.

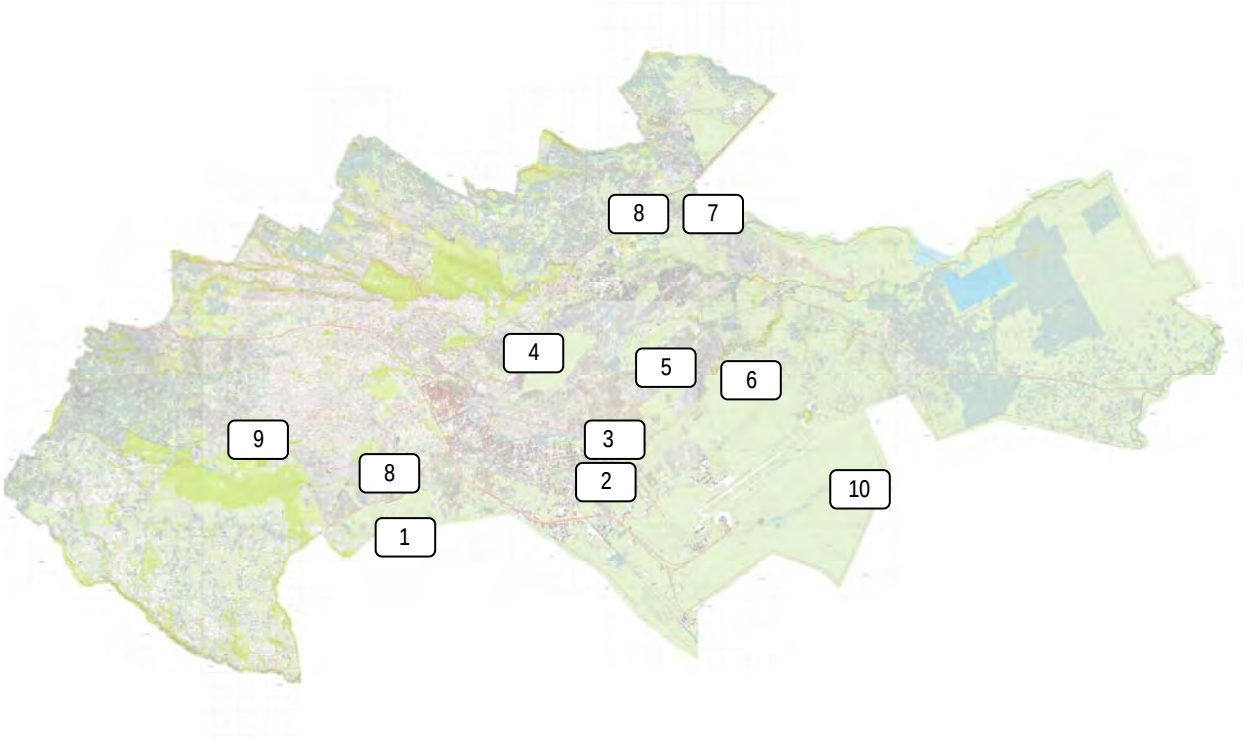
(2) Objective of the Field Observation

The field observation was conducted to identify the current impacts of the solid waste disposal sites on the natural and social environment in Nairobi City.

(3) Procedure of the Field Observation

The survey was conducted through the analysis of existing information, in-situ observation of the sites, and interview with CBO members, waste pickers and residents living in the vicinity. To ensure the transfer of technology from the JICA Survey Team to the Kenyan side, 3 counterparts were assigned to the survey. Before conducting the field observation, the 3 counterparts were trained on the components of the environment that they must observe during the survey and the reasons for choosing those components.

Locations of the observed sites are as indicated in **Figure G.2.2.**



(1) South land Kijiji; (2) Burma market; (3) Eastleigh airforce fence; (4) Limuru road hawkers market; (5) Mathare North Primary, (6) Dandora Dumpsite; (7) Zimmerman; (8) Githurai 44; (8) Kibera slum; (9) Gathundeki; (10) Kayole Orbit

Figure G.2.2 Location Map of Surveyed Dumping Sites and Collection Points

(4) Overview of Major Findings during the Field Observation

(a) Disposal Sites

(i) Designated and Temporary Disposal Sites in Nairobi

Currently, the Dandora Dumpsite is the only disposal site designated in Nairobi City. The CCN had to wait for the result of the present JICA survey before taking a decision on the closure of the Dandora Dumpsite and the construction of a new one in the Ruai Area. However, until the construction is implemented, a temporary disposal site is needed, and this could be Dandora or the Kayole Orbit Quarry.

(ii) Illegal Disposal Sites

It was estimated roughly that in Nairobi City there are three (3) sizes of illegal disposal sites, namely; the large scale (used mainly by private contractors) and the medium and small scale ones located along the roads or riverbanks where mainly residents dispose their solid wastes.

It is opportune to mention that many institutions including the CCN and MEMR are participating in the current Nairobi River Basin Rehabilitation and Restoration Programme under the auspices of UNEP. The program among other activities includes the removal of illegal disposal sites along the rivers and the removal of garbage from the rivers. Under this programme, a demo-stretch of 2.5 km in the Nairobi River (from Museum Hill roundabout to Race Course) was already implemented by clearing one of the illegal disposal sites (i.e., Gikomba market area along the river) and the removal of garbage from the main course of the river. To maintain cleanliness in this stretch, MEMR hired 20 workers (15 to clean the river course and plant trees in the riparian zone, and 5 inspectors to stop people from disposing waste at the site).

Large Scale Illegal Disposal Sites:

Identified in the present survey were 4 major sites in Nairobi City: (a) Gathundeki; (b) Zimerman; (c) Eastleigh Air Force; and (d) Mathare North.

Medium/Small Scale Illegal Disposal Sites (River bank/Roads):

There are still many remaining illegal disposal sites mainly located along the roads or rivers in Nairobi City where the people discharge their wastes contributing to the degradation of the environment. These sites can be seen in the low income and slum areas.

(b) Designated Collection Points

There are many collection points designated by CCN where the residents are allowed to bring their waste by themselves.

On the other hand, the CBOs are providing services of garbage collection to households specially those located in the low income and slums areas. The CBOs also are allowed to bring their collected waste to the designated collection points where they usually separate valuables and the remaining waste is left for CCN to collect and transport to the Dandora Dumpsite.

(5) Findings on Environmental Pollution by Solid Waste at Designated Disposal Site (Dandora)

The Dandora Dumpsite is one of the areas currently designated by CCN for final domestic solid waste disposal. Currently the place is not operated in a sanitary way, putting risk on the environment and on the health of waste pickers and people living in the vicinity. The JICA Survey Team visited the site on November 24, 2009, and the major findings are as described below.

(a) Water Pollution

It was confirmed that Nairobi River is still receiving leachate from the Dandora Dumpsite leading to water pollution.

(b) Air Pollution

Scattering of dust, smoke from combustion of waste, and exhaust gas from collection vehicles and tractors working in the place were observed as the main factors that pollute the air.

(c) Offensive Odour

Noted was the existence of offensive odour in the dump and in the vicinity.

(d) Soil Contamination

By 1998, the JICA Study Team already detected the presence of some elements that lead to soil contamination, especially heavy metals. The main sources of these elements are industrial wastes that could have been disposed in the site. Since no remedial actions were taken to restore the place up to the present, it is assumed that the soil is still contaminated with some heavy metals. In 2006, UNEP made a research on soil contamination at the site, comparing the results with samples taken from other sites considered uncontaminated in Nairobi, and found that 42% of the soil samples from the Dandora Dumpsite recorded high levels of lead.

(e) Landscape

Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences in the site. According to CCN, the land with a surface area of

26 hectares is owned by the Government of Kenya. However, this land is surrounded by private lands.

(f) Social Condition

The communities surrounding the dump are the Dandora, Kariobangi, Korogocho and Lucky Summer estates. Also noted was the existence of a primary school adjacent to the dumpsite.

There is no official record on the number of waste pickers working at the site although the number of waste pickers at the Dumpsite is estimated from 1,200 to 1,500; however, some officials of CCN had estimated that about 600 are active at the site and composed of men and women collecting valuable materials from incoming wastes such as paper, glass, metal, plastics, etc. The recovered valuables are sold to dealers who finally bring them to the recycling plants. The list of waste pickers is given in **Section G of Volume 4, Data Book.**

On the other hand, noted was the presence of insects and animals including pigs and birds which feed on the waste, coexisting with the waste pickers and the operators of CCN.

(g) Conclusion

Currently the place is not operated in a sanitary way putting risk on the environment and on the health of waste pickers and people living in the vicinity. It is necessary to conduct a detailed study on waste pickers in the feasibility stage in order to incorporate them in the re-structural plan.

(6) Findings on Environmental Pollution by Solid Waste at Temporary Disposal Site (Kayole Orbit)

The JICA Survey Team was informed that in the area exist three (3) ex-quarries that are being used as temporary disposal sites for solid waste. The JICA Survey Team confirmed that only one ex-quarry is used currently as final disposal site of solid waste and the other two are being filled with soil by the private sector.

Consequently, only the site being used as final disposal site was investigated to analyse its current condition. The JICA Survey Team visited the site on November 26, 2009, and the major findings are as described below.

(a) Water Pollution

The existing basement of the ex-quarry is about 30m from the top surface. The basement soil is rocky and no underground water pollution is expected. This preliminary assessment rests on the assumption that the basement is solid and no fissure exists at present. These preliminary findings need to be confirmed during the EIA process.

(b) Air Pollution

Scattering of dust, smoke from combustion of waste, and exhaust gas from collection vehicles and tractors working in the place were observed as the main factors that pollute the air.

(c) Offensive Odour

Noted was the existence of offensive odour in the dumpsite.

(d) Soil Contamination

Since only domestic solid waste is allowed in the place, there is a low possibility of soil contamination by chemicals or heavy metals.

(e) Landscape

Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site.

According to CCN, the land is owned by the Government of Kenya. It was rented to the private sector for exploitation as a quarry, but then abandoned due to complaints of the surrounding communities on the noise level produced at the site. The depth of the ex-quarry is about 30 meters.

(f) Social Condition

The communities surrounding the dumpsite contain permanent houses. Working in the dumpsite are about 50 waste pickers including men, women and children collecting valuable materials from the incoming wastes such as paper, glass, metal, plastics, etc. The recovered valuables are sold to dealers who finally bring them to the recycling plants.

On the other hand, about 500 people work as small stone miners in the dumpsite. They use rudimentary tools to extract the stones and to break them into pieces (ballast) and finally sell them to the dealers at the base cost of 8Ksh/10 ltrs.

On the other hand, noted in the dumpsite was the presence of insects and animals including pigs, goats, cattle and birds which feed on the waste, coexisting with the waste pickers and the operators of CCN.

(g) Conclusion

Currently the place is not operated in a sanitary way putting risk on the environment and on the health of waste pickers, small stone miners and people living in the vicinity.

(7) Findings on Environmental Pollution by Solid Waste at Illegal Disposal Sites

(a) Large-Scale Illegal Disposal Sites

(i) Gathundeki

- *General:* The visited site is an ex-quarry of approximately 6 hectares that has been filled with waste from 1980 to 2009 mainly by private contractors. The operation was stopped by the intervention and prohibition of the Ministry of Environment and Mineral Resources due to the strong complaints received from the people living in front of the disposal site. The disposed garbage at the site was covered partially with soil, but a large area of garbage still remains needing a lot of intervention for the site's final closure.
- *Water Pollution:* The generation of leachate that reaches the Nairobi River was observed.
- *Air Pollution:* Since operation at the site was stopped, no dust or burning of waste was observed. However, the production of gas from waste was noted.
- *Offensive odour:* The existence of offensive odour was noted at the site.
- *Landscape*: Scattering of wastes and presence of waste pickers, domestic animals and birds were noted at the site. The place is located along the road.
- *Social condition:* Next to the site lives a population of low income families, while in front of it is a residential complex building of permanent structure. According to some waste pickers that still live around the site, before the operation was stopped, there were about 3,000 waste pickers working at the site, and a few has remained requesting to open the site again because they are jobless at present. Some of the remaining waste pickers plant maize in the area that was covered with soil. At the site many children use the place as playground. The river in the

area is used for the irrigation of vegetables including arrowroots, sugarcane and others. Also observed in the river was the presence of fish (mudfish) that is taken by the residents for consumption.

- *Conclusion:* The disposal of waste at the site has been stopped. It is necessary to complete the closure of the dump taking into account the mitigation measures necessary for environmental restoration and conservation. As for the social aspect, when a new disposal site is to be constructed it is necessary to consider those people that lost their jobs in this disposal site.

(ii) Zimerman

- *General:* The visited place of approximately 10 hectares is an ex-quarry area owned by the private sector. The site used to receive solid waste brought by private contractors. Up to the present, however, the entrance of vehicles to the site is prohibited creating concern among the waste pickers that work at the site. Currently some waste pickers collect waste from the households using handcarts and bring them to the site.
- Water *Pollution:* It is assumed that Kasarini River which flows near the site is being polluted by leachate.
- *Air Pollution*: Noted was the generation of smoke from the combustion of waste at the site.
- *Offensive odour*: Noted was the existence of offensive odour at the site.
- *Landscape*: Noted were the scattering of wastes and degradation of the place.
- *Social condition:* The site is located near a residential area. Few waste pickers work at the site at present. The presence of insects and domestic animals including cattle, goats and birds that feed on the waste was noted.
- *Conclusion:* The site was left in an unsanitary condition that may affect the environment and the health of the population living in the vicinity. The issue of waste pickers must be analysed carefully during the formulation of the MP.

(iii) Eastleigh Air Force

- *General:* The visited place is an open dumping site owned by the Government, where the solid waste is disposed mainly by individuals using handcarts. The JICA Survey Team was advised by the counterparts not to enter the place for security reasons.
- *Water Pollution:* The collection of waste from this site has not been made for a long time. Due to this fact, it is assumed that leachates are being generated and may reach the nearest watercourses.
- *Air Pollution*: Noted were the generation of dust and smoke from the combustion of waste at the site and exhaust gas from the heavy traffic in the area.
- *Offensive odour:* Noted was the existence of offensive odour at the site.
- *Landscape:* Scattering of wastes and presence of waste pickers, domestic animals and birds were noted at the site. The place is located along the road. In front of the site is the airport managed by the Air Force of Kenya.
- *Social condition:* The site is located inside the city, surrounded by residential building complexes. A waste picker working at the site was interviewed with the following results: at the site works approximately 2,000 waste pickers; waste pickers also provide garbage collection services to the households charging 20 KSh/house each time the collection is made. The interviewed waste picker also mentioned that he collects garbage daily from one hotel, receiving 150 KSh/day plus food.

- *Conclusion:* The site is operating in an unsanitary condition. As for the social aspect, the issue on waste pickers must be analysed carefully during the formulation of the Master Plan.

(iv) Mathare North

- *General:* The visited collection point is located inside of the community adjacent to Mathare River. The CBO named "One Love Group" is operating at the site. Residents also bring their waste to this site by themselves. The collection point has become a large disposal site because CCN had not collected the waste since many years ago.
- *Water Pollution:* The generation of leachates that reach the Mathare River was observed. Additionally noted was the discharge of raw sewage directly to the river by residents and by the broken sewage pipes. Also noted was the blockage of drainage channels by solid waste which rush out to the river in the rainy season.
- *Air Pollution*: Scattering of dust and smoke from combustion of waste were observed as the main factors that pollute the air in the place.
- *Offensive odour*: Noted was the existence of offensive odour at the site.
- *Landscape:* Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site. The place is located inside of the community, presenting an unhealthy landscape.
- *Social condition:* The site is surrounded by a dense population with houses of temporary and permanent types. Very near to the site, also noted was the existence of a primary school. In fact, the site is usually used by many children for playing. Besides, there are many people that cross through the site to reach their houses. The CBO that operates in this collection point is composed of 35 members (30 men, 5 women) and provides the collection services for approximately 500 households allocated to them, two times a week (Wednesday and Sunday). Each household is charged 40 KSh/month. The CBO also sells water to the households that request water provision services. On the other hand, noted was the presence of insects and animals including pigs, goats and birds which feed on the waste.
- *Conclusion:* Currently the place is not operated in a sanitary way putting risk on the environment and on the health of CBO members, children playing at the site and people living in the vicinity.

(b) Medium/Small Scale Illegal Disposal Sites (Riverbanks/Roads)

In the city could be observed a high number of medium/small illegal disposal sites along the roads and rivers. These sites are located especially in the low income/slum areas and open market areas where the residents throw their waste or burn them. An example of this case is as presented below.

(i) Nairobi West

- *General:* The visited point is located at the bank of Ngong River next to the bridge. The point had become a disposal site where residents leave their waste in uncontrolled manner.
- *Water pollution:* The Ngong River receives the leachate generated at the point. Also noted were blockages of drainage channels by solid waste at the site.
- *Air pollution:* Scattering of dust and waste were observed as the main factors that pollute the air in the place.
- *Offensive odour:* Noted was the existence of offensive odour at the site.

- *Landscape:* Noted were the scattering of wastes and pedestrians walking across the place.
- *Social condition:* The visited point is surrounded by a dense population with permanent house structures. The traffic level is also high in the place. On the other hand, noted was the presence of insects at the site.
- *Conclusion:* The site is unhealthy and this condition may affect the environment and people's health.

(8) Findings on Environmental Pollution by Solid Waste at Designated Solid Waste Collection Points

(a) Collection Point Operated by CBOs/CCN

CCN is operating many collection points conjointly with CBOs. The procedure is as follows: the CBOs are encouraged to bring wastes using mainly handcarts (mkokoteni) to the collection points where they either segregate the valuable materials or not. Then, the remaining wastes are collected and transported by the CCN collectors to the final disposal site. This kind of joint operation is seen mainly in slums and low income areas. As of December 2009, CCN had registered and licensed 140 CBOs which are performing solid waste collection activities.

The CBOs pay to CCN a collection and transportation charge that ranges between Ksh 500 and Ksh 5,000 each time the collection is provided. However, it is necessary to develop criteria to charge CBOs according to the amount of waste collected.

On the other hand, the already developed CBOs have their own trucks to transport wastes from the collection points to the disposal site.

The JICA Survey Team had visited some collection points managed by CBOs and CCN to obtain the baseline condition of the environment at these places. The observed places were the Kibera slum and Githurai 44 Area, and the major findings are as described below.

(i) Kibera Slum

- *General:* This slum is considered as one of the biggest in Nairobi City. The visited collection point is located along the road where the CBO named "The Kibera Zulu Youth Group" operates. Residents also bring their waste to that site by themselves. The collection point had become a small disposal site because CCN does not collect the waste on a regular basis.
- *Water pollution:* After the CBO members recover the valuables from the collected solid waste, the remaining waste is left on the ground for a long time because CCN does not collect the waste on a regular basis. This fact brings about the generation of leachate that could go to the open channels connecting with the Nairobi River. Also noted was the blockage of drainage channels by solid waste which rush out to the river in the rainy season.
- *Air pollution:* Scattering of dust, smoke from the combustion of waste and exhaust gas from vehicles were observed as the main factors that pollute the air in the place. The members of the CBO explained to the JICA Survey Team that they usually burn the waste for amount reduction purposes since the collection frequency provided by CCN is very irregular.
- *Offensive odour:* Noted was the existence of offensive odour at the site.
- *Landscape:* Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds is a common occurrence at the site. The place is located along the road, presenting an unhealthy landscape.
- *Social condition:* The CBO that operates in this collection point is composed of 17 members and provides collection services for each household allocated to

them, two times a week (Wednesday and Sunday). Each household is charged 20 KSh each time that collection is provided. There was an initiative of the government to construct new houses to resettle the people of Kibera Slum. However, the people are reluctant to be resettled due to the cost associated with living in the new houses. On the other hand, noted was the presence of insects and animals including pigs, goats and birds which feed on the waste.

- *Conclusion:* Currently the place is not operated in a sanitary way putting risk on the environment, the health of CBO members and the people living in the vicinity.

(ii) Githurai 44 Area

- *General:* The visited collecting point is located inside of the community. The CBO named "Mowgano Group" is operating at the site. Residents also bring their waste to the site by themselves. The collection point had become a small disposal site because CCN does not collect the waste on a regular basis.
- *Water pollution:* It was noted that solid wastes brought to the site have not been collected for a long time. This fact brings about the generation of leachates that could go to open channels and finally to the Kasarini River. Also noted was the blockage of drainage channels by solid waste which rush out to the river in the rainy season. On the other hand, observed was the direct discharge of sewage on the drains that finally pollutes the Kasarini River.
- *Air pollution:* Scattering of dust and smoke from the combustion of waste were observed as the main factors that pollute the air in the place.
- *Offensive odour:* Noted was the existence of offensive odour at the site.
- *Landscape:* Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site. The place is located inside of the community, presenting an unhealthy landscape.
- *Social condition:* The site is surrounded by a dense population with houses of mainly permanent structure. The site is usually used by many children as playground. Besides, there are many people that cross through the site to reach their houses. The CBO that operates in this collection point is composed of 20 members (12 men, 8 women) and provides collection services for approximately 3,000 households allocated to them, once a week (every Tuesday). Each household is charged KSh 30 each time the collection is provided. On the other hand, noted was the presence of insects and animals including pigs, goats, chicken and birds which feed on the waste.
- *Conclusion:* Currently the place is not operated in a sanitary way putting risk on the environment and the health of CBO members, children that play at the site and the people living in the vicinity.

(b) Collection Point Operated by CBOs/CCN

The JICA Survey Team had visited some collection points operated by CBOs and CCN to obtain the basic condition of environment at these places. The observed places were Burna Market, Limuru Hawkers Market and South Land Kijiji, and the major findings are as described below.

(i) BurnaMarket

- *General:* The visited collection point is located in front of the Burna Market where the marketers bring their waste, mainly food waste. This market is operated as a wholesale market from where distributors buy the goods to be sold

in the communities. The collection point had become a small disposal site because CCN does not collect the waste on a regular basis.

- *Water pollution:* The solid waste produced is left on the ground for a long time, permitting the generation of leachates that could lead to water pollution of the nearest watercourses. Also noted were blockages of drainage channels by solid waste at the site.
- *Air pollution:* Scattering of dust and smoke from combustion of waste were observed as the main factors that pollute the air in the place.
- *Offensive Odour:* Noted was the existence of a strong offensive odour at the site.
- *Landscape*: Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site. The place is located along the road, presenting an unhealthy landscape.
- *Social condition:* The site is surrounded by the market and a dense population with houses of mainly permanent type. Next to the site is a car parking area where a lot of people coexist with the waste. On the other hand, noted was the presence of insects and animals such as pigs, goats, chicken and birds which feed on the waste.
- *Conclusion:* Currently the place is not operated in a sanitary way putting risk in the environment and the health of people that frequently come to the site and those living in the vicinity.

(ii) Limuru Hawkers Market

- *General:* The visited collecting point is located next to the Limuru Hawkers Market where the marketers bring their waste, mainly food waste. In the market work small traders that offer fruit, vegetables and food to customers. The collection point had become a small disposal site because CCN does not collect the waste on a regular basis.
- *Water pollution:* The solid waste produced is left on the ground for a long time, permitting the generation of leachates that could lead to water pollution of the nearest watercourses. Also noted were blockages of drainage channels by solid waste at the site.
- *Air pollution:* Scattering of dust and smoke from combustion of waste were observed as the main factors that pollute the air in the place.
- *Offensive odour:* At the time of site visit, operators of CCN were removing the waste to be taken to the disposal site. Noted was the existence of a strong offensive odour at the site.
- *Landscape:* Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site. The land where the collection point and the market are located is owned by CCN. The collection point is located next to the market, presenting an unhealthy landscape.
- *Social condition:* The collection point is next to the market where approximately more than 4,000 people work, and it is surrounded by a dense population with houses of permanent structure. Near the site are the Aga Khon Hospital and the University Primary School. Next to the collection point is a facility where a group of women make compost for selling at a price of 300 KSh for every 20 kg. According to the interviewed person, the process of making compost takes about one month and the amount produced currently is more than 50 bags of 20 kg each. On the other hand, noted was the presence of insects and animals including pigs, goats, chicken and birds which feed on the waste.
- *Conclusion:* Officials of CCN manifested that the frequency of collecting waste from the site is once in every 2 months. Currently the place is not operated in an

unsanitary way putting risk on the environment and the health of people working in the market, customers of the market and people living in the vicinity.

(iii) South Land Kijiji

- *General:* The visited collection point is located inside of the community. The collection point had become a small disposal site because CCN does not collect the waste on a regular basis.
- *Water pollution:* The solid waste produced is left on the ground for a long time, permitting the generation of leachate that could lead to water pollution of the nearest watercourses. Also noted were blockages of drainage channels by solid waste at the site. Besides, observed was sewage running along the main entrance street to the community.
- *Air pollution:* Scattering of dust and smoke from combustion of waste were observed as the main factors that pollute the air in the place.
- *Offensive odour:* Noted was the existence of an offensive odour at the site.
- *Landscape:* Scattering of wastes, burning of waste and presence of waste pickers, domestic animals and birds are common occurrences at the site. The land is privately owned and the collection point presents an unhealthy landscape due to the uncollected waste. It was observed that many children use the place as playground.
- *Social condition:* The visited collection point is inside of the community where approximately 35,000 people live with houses of permanent and temporary structure. There is no CBOs operating in the place and households dispose their waste by themselves. Some women were interviewed regarding the main problem they currently have. Some of them manifested that the biggest problem they are facing is the lack of jobs and hence many women had become sex workers. Other respondents said that they would appreciate receiving education regarding the environment to raise the awareness of people on having a better, cleaner and healthy place to live in. On the other hand, noted was the presence of insects and animals including chicken and birds which feed on the waste.
- *Conclusion:* The site is unhealthy and this condition may affect the environment and the health of people, especially the many children that coexist with the waste due to the shortage of waste collection activities. Also, it is concluded that another big problem at the site is the lack of jobs. This fact should be analysed carefully in the formulation of the MP especially for providing collection services in the slum areas.

Table G.2.6 Environmental Pollution at Disposal Sites and Designated Collection Points

Name of the site / Environ Checklist	Disposal Sites							Designated Collection Points					%
	Design-ated	Tem-porary	Illegal Disposal site				Medium/ Small (River& Roads)	CBOs/CCN		CCN			
			Large-Scale Illegal Disposal Sites										
	Dan-dora	Kayo-le	Gath-undeki	Zimer-man	Eastleigh Air Force	Mathare North	Nairobi West	Kibera Slum	Githurai 44 Area	Burnat Market	Limuru Hawkers Market	South-land Kijiji	
General Information													
Scattering of waste	A	A	A	A	A	A	A	A	A	A	A	A	100
Frequency of collection	-	-	-	-	-	-	-	I	I	I	I	I	100
Blockage of channel by waste	A	C	B	B	A	D	D	A	A	A	A	A	58
Air Pollution													
Scattering of dust	A	A	B	B	B	A	B	A	A	A	A	A	67
Gas from waste	A	A	A	A	A	A	A	A	A	A	A	A	100
Smoke from combustion	A	A	B	B	A	A	B	A	A	A	A	A	75
Exhausting gas from vehicles& equipment	A	A	B	B	B	A	A	A	A	A	A	A	75
Water Pollution													
Leachate production	A	A	A	A	A	A	A	A	A	A	A	A	100
River pollution by leachate	A	B	A	A	A	A	A	A	A	A	A	B	83
Ground water pollution by leachate	A	A	A	A	A	A	A	A	A	A	A	A	100
Offensive Odour													
Kitchen waste	A	A	B	B	A	A	A	A	A	A	A	A	83
Leachate	A	A	A	A	A	A	A	A	A	A	A	A	100
Gas from waste	A	A	A	A	A	A	A	A	A	A	A	A	100
Noise													
From collection vehicles & equipment	A	A	C	C	C	C	C	C	C	C	A	C	25
From traffic	B	B	B	B	B	A	A	A	B	A	A	B	42
Health and Sanitation													
Insects	A	A	A	A	A	A	A	A	A	A	A	A	100
sewage on the road	A	A	B	B	A	A	B	A	A	A	A	A	75
Presence of animals	A	A	A	A	A	A	B	A	A	A	A	A	92
Presence of waste picker	A	A	A	A	A	A	B	A	A	A	A	A	92
Landscape													
Degradation due to waste	A	A	A	A	A	A	A	A	A	A	A	A	100

Legend:
A: high significance, B: low significance, C: no significance, D: unknown
R: regular, I: irregular, N: no collection provided , %: percentage of selected sites for the survey with problems of high significance

2.1.6 Laws and Regulations related to Environment in Kenya

The table below shows the main legislations in Kenya that relate to environment.

Table G.2.7 Laws and Regulations on Environment in Kenya

Legislation	Main Content
Legislation for Conservation of Natural Resources:	
The Water Act, Chaption 372	Contains provisions for the conservation and controlled use of water resources.
The Forest Act, Caption 385	Contains provisions for the establishment, control and regulation of forests.
The Agriculture Act, Caption 318	Contains provisions for promoting agricultural development.
Wildlife (Conservation and Management) Act, Caption 376	Contains provisions for the preservation and control of wild fauna and flora.
The Fish Industry Act, Caption 324	Contains provisions for control of fishing activities.
Kenya Tourist Development Authority, Caption 382	
The Local Authority Government Act, Caption 265	Contains provisions for local councils to construct and maintain sewage, drainage and water supply systems. It has also provisions to prevent pollution in urban areas.
Land Planning Act, Caption 303	Contains provisions for planning the use and development of land.
Town Planning Act, Caption 134	Contains provisions for the proper planning of urban and rural centres.
Environmental Management and Co-ordination Act, 1999	Contains the Regulation on Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing.
Legislation related to Environmental Management:	
The Physical planning Act, Caption 286	Contains provisions for the preparation and implementation of physical development plan
The Government Land Act, Caption 280	Contains provisions for the administration of government lands
The Land Acquisition Act, Caption 295	Contains provisions for the compulsory acquisition of land for public benefit
Trust Land Act, Caption 288	Contains provisions for Trust land
Registered Land Act, Caption 300	Contains provisions for the registration of title to land, and for the regulation of dealings in land so registered, and for purposes connected therewith
Land Consolidation Act, Caption 283	Contains provisions for the ascertainment of rights and interests in, and for the consolidation of, land in the special areas; for the registration of title to, and of transactions and devolutions affecting, such land and other land in the special areas; and for purposes connected therewith and incidental thereto
Land (Group Representatives) Act, Caption 287	Contains provisions for the incorporation of representatives of groups who have been recorded as owners of land under the Land Adjudication Act, and for purposes connected therewith and purposes incidental thereto
Registration of Titles Act, Caption 281	Contains provisions for the transfer of land by registration of titles
Land Adjudication Act Caption 284	Contains provisions for the ascertainment and recording of rights and interests in Trust land, and for purposes connected therewith and purposes incidental thereto
Legislation for Pollution Control	
The Water Act, Caption 372	Contains provisions against the pollution of water resources
The Public Health Act, Caption 242	Contains provisions on water supply source protection
The Factories and Other Places of Work Act , Caption 514	Contains provision for the health, safety and welfare of persons employed in factories and other places of work
The Factories and Other Places of Work (Noise prevention and control) Rules, 2005	Contains provision on permissible noise levels, noise prevention programme and noise measurements and records
Radiation Protection Act, Caption 243	
Traffic Act, Caption 403	Contains provisions to controlling the traffic and vehicles including those assigned to public services. Subsidiary regulations relate to the control of smoke emission
Penal Code, Caption 63	Contains provisions on issues considered as offenses to health and environment
The Use of Poisonous Substances Act, Caption 247	Contains provisions for the protection of persons against risks of poisoning by certain substances
Environmental Management and Co-ordination Act, 1999	Contains regulations to: (a) EIA and Audit; (b) Waste Management; (c) Water Quality; (d) Controlled Substances; (e) Noise and Excessive Vibration Pollution Control; (f) Wetlands, Riverbanks, Lakeshore and Seashore Management; (g) Fossil Fuel Emission Control; (h) Prevention of Pollution in Coastal Zone and Other Segments of the Environment
Kenya Bureau of Standards, KS 1515	Provides the standard for emission of mobile sources
Kenya Bureau of Standards, KS 459-1	Provides the standard for drinking water

The Environmental Management and Coordination Act of 1999 is considered as one of the most important advances in Kenyan legislation aiming to coordinate the activities of various agencies tasked to regulate the various sectors of environment including those related to SWM.

2.1.7 Organisations Responsible for Environmental Control and Solid Waste Management in Nairobi City

The following table gives as list of organisations related to environmental control and SWM in the City of Nairobi and their main responsibilities.

Table G.2.8 Institutions related to Environmental Control and SWM in Nairobi City

Institutions	Main Responsibilities
Ministry of Environment and Mineral Resources	To formulate the policies and regulations or standards for environmental control and management at national level.
National Environmental Management Authority (NEMA)	To implement programs for controlling the pollution of environment. NEMA is the institution in charge of EIA studies.
Ministry of Water and Irrigation	To formulate sustainable conservation, management and development of available water and land resources and facilitate their planned exploitation.
Ministry of Public Health and Sanitation	To formulate the health and sanitation policies, regulations and actions for the health protection of the population.
Ministry of Nairobi Metropolitan Development	To carry out the Development of Integrated Nairobi Metropolitan Areas Growth and Development Strategy covering among others: (a) Development and enforcement of Planning and Zoning Regulations, (b) Development and enforcement of Planning and Zoning Regulations, and (c) Efficient Water Supply and Waste Management infrastructure.
Ministry of Local Government	- To formulate and implement policies including urban development policies for the local authority sector; - To support local authorities to provide physical and social infrastructure and services; - To support capacity building for local authorities; - To administer the Local Authorities Transfer Fund*; - To provide development support to the local authorities including the development of environmental management programmes; and - To provide technical assistance to local authorities in infrastructure, project planning and management.
City Council of Nairobi, Department of Environment	CCN through its Department of Environment provides the services of garbage collection, transportation and disposal.

Note: * The Local Authorities Transfer Fund, established in 1999, receives the transference of 5% of the national income tax to be used by the local authorities to improve and expand their services delivery to citizens and to improve their financial management among others.

2.2 Identification of Major Problems on Environmental and Social Conditions

2.2.1 General Condition

(1) Water

It is concluded that the quality of rivers in Nairobi is being deteriorated by pollutants from the domestic sector (sewage and solid waste), agricultural sector (agrochemicals) and industrial sector (wastewater). Using sewage for irrigation of agriculture is the most serious and unhealthy practice that needs attention because it involves hazard to human health. This practice was observed in the vicinity of Kariobangi South where the sewage running through open channels is diverted by individuals to irrigate maize and other crops.

(2) Sewage

The main problem affecting public health is the lack of proper sewage disposal because the area of Nairobi is partially served by sewer lines leading to increased river pollution because domestic

water is channeled nearby. It was noted in the slum areas that sewage is diverted to open channels, finally reaching the watercourses and deteriorating river water quality.

(3) Air Quality

Main sources of air pollution that affect the City of Nairobi are the vehicles, industries, emissions from the use of charcoal or firewood, open burning of waste, and the unsanitary waste disposal sites.

Previous studies indicate that the level of particulates in the air of Nairobi City exceeds the WHO standard of 90 ug/m^3. The areas most affected by this pollutant are the eastern residential areas and the city centre.

2.2.2 Environmental Problems due to Solid Waste

(1) Water Pollution

It was observed by the JICA Survey Team that wastes are not collected regularly at many collection points. Delays in waste collection for a long time generate the smell of a black liquid called leachate which is considered as a high polluter when it reaches watercourses due to its high concentration in BOD, COD and chemicals. It was noted that leachates generated in these collection points and in the illegal disposal sites pollute the rivers of Nairobi.

It was observed also that solid wastes are dumped intentionally along the roads or riverbanks by the residents. This fact brings as a consequence the transfer of uncollected wastes to rivers, drains, streams and lowland areas when Nairobi experiences intensive rains. It was observed also that the rivers are polluted by the existing disposal sites.

(2) Air Pollution

From the results of the survey, it is concluded that the air quality of Nairobi City is also being deteriorated from the current practice of burning waste. Besides, the existing unsanitary disposal sites (legal or illegal) cause the emission of offensive gases hazardous to the health of people living in the vicinities.

Actually the sources of air pollution in Nairobi City are vehicular emission, factory emission and the haphazard generalised burning of wastes.

(3) Landscape

In the City of Nairobi could be observed the proliferation of illegal disposal sites along the roads, beside the rivers and in open spaces. This fact brings about the degradation of city environment, presenting an unhealthy landscape to residents and visitors alike.

(4) Soil Contamination

The designated disposal site at Dandora had received in the past not only domestic waste but also dangerous waste due to the lack of control of the public sector. By 1998, the JICA Study Team already had detected the presence of some elements that lead to soil contamination, especially heavy metals. Since up to the present there are no remedial actions to restore the place, it is assumed that the soil still is contaminated with some heavy metals.

2.2.3 Social Problems due to Solid Waste

(1) Situation of Waste Pickers

Waste pickers interviewed by the JICA Survey Team pointed out that their daily income depends on what they obtain from waste, because they have no other option or opportunity to earn money for subsistence.

Generally, waste pickers work at the disposal sites without using any kind of equipment and materials to protect them from the unsanitary condition of the site. In addition, these people live next to the disposal site, so that they are vulnerable to diseases due to the unhealthy environmental conditions.

(2) Public Health

Many of the observed solid waste collection points in the city became open temporary disposal sites, because CCN do not provide regular collection services. Besides, Nairobi City does not have a sanitary disposal site for solid waste.

Noted during the survey in most of the solid waste collection points and disposal sites is the presence of offensive odour, smoke and disease vectors such as cockroaches, rats, flies and mosquitoes that have negative impacts on public health. In the MP study in 1998, the people interviewed mentioned cases of respiratory and stomach problems among children and adults due to the smoke and smell coming from the Dandora Dumpsite. At present, the Dandora Dumpsite still presents the same unsanitary condition and it is assumed that the health of operators, waste pickers and people living in the vicinity are still affected by the wastes dumped at the site. According to officials of CCN, residents living in and around the dumpsite would like to receive relief from air pollution due to the burning of wastes.

3. INITIAL ENVIRONMENTAL EXAMINATION (IEE)

3.1 General

The Initial Environmental Examination (IEE) is the first field recognisance of the environment where a project is planned to be executed. The IEE is conducted during the Master Plan (MP) Study using for the analysis existing information. As for the EIA, it is conducted during the Feasibility Study (F/S). The Terms of Reference (TOR) for EIA must be prepared in the F/S stage taking into consideration the results of the IEE and in consultation with NEMA.

3.2 Objectives of the IEE

The IEE has the following objectives:

(1) To understand the present condition of the environment at the initial stage of a project; and

(2) To identify or predict potential impacts that could be generated by the project utilising available information.

3.3 Targeted Projects for IEE

The present MP involves the study for the construction of the following components: (1) Final Landfill Site for Solid Waste; and (2) Transfer Station for Solid Waste. In this connection, the Initial Environmental Examination shall be realised on the Candidate Sites for Final Landfill and Transfer Station for Solid Waste.

3.4 Procedure of the Examination

The IEE includes the analysis of the following components:

- Natural and environmental-social conditions of each candidate site;
- Project justification;
- Project description; and
- Prediction of potential impacts, assessment and mitigation measures.

The Terms of Reference (TOR) for IEE was prepared in accordance with:

(1) JICA Environmental Guidelines for Environmental and Social Considerations; and

(2) JBIC Handbook Volume 1.

This TOR was agreed with the Kenyan counterparts and it is presented in **Section G of Volume 4, Data Book.**

The assessment of impacts, its significance and its sources was made in preliminary form taking the existing regulations related to environment in Kenya and international standards into account.

3.5 Execution of IEE for Final Landfill Candidate Sites

3.5.1 Natural and Social-Environmental Condition

(1) Ruai Candidate Site

(a) Natural Environmental Condition

(i) General Information

The site is located in Embakasi Division at about 30 km east of Nairobi City on flat land adjacent to the Nairobi River. The place available for disposal site is grassland of about 80 hectares owned by CCN and currently used for the pasture of livestock. There are no trees in the site except the riverine vegetation (forests) on the left bank of the Nairobi River. At the entrance to the site, there is the Dandora Estate Sewage Treatment Works operated by the Nairobi Water and Sewerage Company. The presence of many varieties of birds which feed on the insects and fishes from the ponds of the sewage works has been observed.

(ii) Water

The only existing river in the area is the Nairobi River which is located adjacent to the site. During this JICA Survey, water sampling was conducted after a rainy day on the Nairobi River upstream of the candidate site and noted the presence of solid waste in both river banks brought by the river during the rain. The results indicate that the river is loaded with organic substances from sewage and solid waste. According to some people living in the surrounding areas, the water of Nairobi River is used for animal consumption and even for domestic use.

Table G.3.1 Water Quality of Nairobi River at Ruai Landfill Candidate Site

Parameters	Unit	Measured Values	Standard Value	
			Kenya Standard*1	Japan Standard*2
GPS		N -1,12,48.02 E 37,2,31.98		
pH		7.6	6.5–8.5	6.5–8.5
BOD5	mg/l	42		< 3
TDS	mg/l	208	1200	
SS	mg/l	222.5	30	< 25
Total Coliforms	MPN/100 ml	> 1,800		< 5000
Phenolic substances as Phenols	mg/l	0.1	Nil	
NH4-N	mg/l	5.6	0.5	
DO	mg/l	9.9		> 5
Arsenic	mg/l	ND	0.01	< 0.05
Cadmium	mg/l	ND	0.01	< 0.01
Chromium	mg/l	ND		< 0.05
Lead	mg/l	ND	0.05	< 0.1
Mercury	mg/l	ND		ND
Cyanide	mg/l	ND		ND
Organo-Phosphorus Compounds	mg/l	0.00004		ND

Source: The present JICA Survey
Note: *1Kenyan Standard applied for sources of domestic water, Environmental Management and Coordination (Water Quality) Regulations, 2006
*2Japanese Standard Category B applied for rivers to be used for water supply, fishery, industrial, agricultural and conservation of environment
ND: Not Detected
Nil: means less than limit of detection using prescribed sampling and analytical methods and equipment as determined by the Authority

(iii) Flora and Fauna

The site is open grassland with some shrubs especially in the riverine zone. The grassland is used for the pasture of animals like cattle, goat and sheep. Livestock was the main animal activity observed. A few birds were observed especially in the riverine community. According to the local people, crocodiles and hippopotamus can be found in the Nairobi River at the site.

(iv) Landscape

The place is located on a huge flat land adjacent to the right bank of the Nairobi River. The cover soil of the site comprises surface black cotton soil developed over poorly drained flat surface of the land.

(v) Air and Noise

During the survey at the site, no air pollution or generation of noise were noted.

(b) Socio-Environmental Condition

(i) Socio-economy

There is no population living near the site although it is important to mention that the Ruai area corresponds mainly to the low income area of subsistence cultivators, pasture keepers and small-scale traders. Far away from the site were observed some houses where

displaced people live after the Kenya election in 2007, and the Maasai population mostly living in temporary houses and dedicated to goat and cattle-breeding. Most of the problems they mentioned were the lack of water, educational and health facilities near their places of abode.

(ii) Sanitation

No water supply exists at the site. People who live nearest to the site buy water at 1 ksh/litre for their consumption. Pit latrine is used for excreta disposal and garbage is disposed by burying or burning.

(iii) Health Condition

Malaria is the most common disease in the area.

(c) Conclusion

The site could be used for developing the new sanitary landfill site with the necessary mitigations. The site is one of the most suitable due to the limited settlements in the vicinity and its large area. In addition, there are no significant socioeconomic activities at the site.

(2) Juja Candidate Site

(a) Natural Environmental Condition

(i) General Information

The site is located within the jurisdiction of Thika County Council, in the north-eastern side of Nairobi City, at 39 km from the Nairobi Central Business District. The site is composed of many quarries, some of them still active, located at the right side of Ndarugu River. The area available for the landfill site is about 40 hectares. Next to the site is found the railway that could be used for solid waste transportation from Nairobi City. The vast land belongs to one owner who is willing to participate as a partner in the project.

(ii) Water

The site is located at the right bank of Ndarugu River, which is the water source for water supply to Juja town, for irrigation of coffee plantations, and for the coffee industry located near the site. The water intake for water supply is located upstream of the candidate site.

(iii) Flora and Fauna

O Only a few shrubs were noted especially in the riverside area. A few cattle grazing around the site were observed. A vast plantation of coffee located between the quarries and the railway track was also observed.

(iv) Landscape

The site is a vast, disturbed land composed by quarries of different depths ranging from 5m to 30m, some of them abandoned and some still active.

(v) Air and Noise

Noise and dust are produced from the operation of the active quarries.

(b) Socio-Environmental Condition

(i) Socio-economy

About 100 people work at the active quarries which provide much of machine-cut stones for Nairobi's building industry. Around the quarries also exist plantations of coffee and horticulture in minor scale. A flower plant garden could be observed also in the vicinity.

(ii) Sanitation

At the upstream of the site, the river water is treated and pumped to Juja Town located at about 5 km from the site. The Ruiru-Juja Water and Sewerage Company Ltd. is in-charge of the water supply service, but it does not provide sewerage services so that septic tanks are used commonly for sewage disposal. The company also operates two bore holes of 150 feet in depth, but the production of water is very low and the fluoride content is high. In Juja area some houses own shallow wells 20-30 m in depth to supplement the water supply from the treatment plant; however, these shallow wells already present signs of pollution especially by sewage according to the local consultants. Around the site were observed very few houses occupied mainly by workers at the quarries. Opposite to the site was observed the Thika Road Girls High School with 93 students. As for garbage, people dispose them by burying or burning.

(iii) Health Condition

The main diseases in the area are malaria, diarrheal diseases, typhoid, and intestinal worms/amoebiasis, some of them attributable to the consumption of polluted water.

(c) Conclusion

The site could be used for waste disposal taking into account mitigation measures. The proximity of the site to Nairobi City and Thika County Council means that the site could be used by both urban centres with a view to sharing the costs.

(3) Mavoko Candidate Site

(a) Natural Environmental Condition

(i) General Information

The site is located within the jurisdiction of the Municipality of Mavoko, in the south-eastern direction from the city centre toward Mombasa. The total area of about 4000 ha which include the proposed site, belong to the East African Portland Cement Co., Ltd. which is a parastatal organisation (major shareholder is the Government of Kenya).

The proposed site is a vast, open grassland area and near to it could be observed the railway, which could be used for the transportation of solid waste from Nairobi City.

(ii) Water

Two seasonal water courses exist at the site, the River Stonyathi and its tributary which join downstream.

(iii) Flora and Fauna

The site is typical savannah vegetation mainly inhabited by wild animals. Currently the plains have huge savannah grass due to the rains. At the site could be observed wild animals such as giraffe, ostrich, zebra and antelope living in the natural habitation. However, these animals keep moving all the time.

(iv) Landscape

The site has a gentle slope towards a seasonal stream. The cover soil is black cotton to depths of 0.5m to 2 m; further depths may present gypsum or laterite soils. The railway track that connects Nairobi to Mombasa runs next to the site.

(v) Air and Noise

No noise or air pollution was noted at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

The site has little economic activity. Some parts are leased by the Kenya Meat Commission for cattle grazing. Before entrance to the site is an industrial zone where some firms are located, such as the Kenya Meat Association, the Steel Mills Ltd., etc. In the vicinity is the Athi River EPZ (Export Processing Zone).

(ii) Sanitation

The nearest community named Kitengela is located behind the railway track. This place is being developed and the houses are of permanent and temporary types. Some houses are supplied with water from the Athi River Company and others buy it from tankers. It was observed during the survey that a borehole is being constructed to serve a new condominium site composed by many high class houses. Available information shows that some boreholes constructed in the Kitengela area present a high degree of alkaline and fluoride. Excreta are disposed in septic tanks. Garbage is disposed by burning or burying; other residents contract private collectors.

(iii) Health Condition

Main diseases in the Kitengela area are malaria, influenza, and chest problems.

(c) Conclusion

The site could be used for developing the sanitary landfill site with the necessary mitigations. The site is one of the most suitable due to its large area and its far location from human settlements. The site could be shared by CCN and Mavoko Municipality.

3.5.2 Project Justification

The existing Dandora Dumpsite which is categorised as an open dumping type has a detrimental effect on public health and the environment of the surrounding area due to not only air and water pollution but also to the associated problem of insects and animal pests. For this reason the construction of a new sanitary landfill is highly recommendable to improve the environmental quality of the city and the level of public health of the population.

3.5.3 Project Description

The sanitary landfill shall mainly consist of the following components:

(1) Fence
(2) Building
(3) Truck scale
(4) Roads
(5) Ramps

(6) Drainage
(7) Gas and leachate control system
(8) Wells for groundwater monitoring
(9) Structures for solid waste retention

3.5.4 Prediction of Potential Impacts, Assessment and Mitigation Measures

Impact prediction is based on all activities relating to project implementation. The improvement of solid waste management in Nairobi City will contribute in a positive way to the improvement of the environment and the health of Nairobi's residents. However, some adverse impacts may be predicted and proper mitigation measures should be taken to protect or minimise such negative effects, accordingly. In the IEE, potential impacts were predicted and their significance was also assessed during the four phases of the project; i.e., the Construction Phase, the Operation Phase, the Closure Phase, and the Post-Closure Phase.

The significance of environmental impacts determined on the basis of non-negligible environmental changes induced by the project implementation are shown in three levels, namely; high impact, moderate impact and low impact. The environmental impact results are assessed by comparing them with values specified in standards used as assessment targets. The standards used in this study, which are presented in the **Section G of Volume 4, Data Book**, include the following:

(1) Kenya Standard for Drinking Water Quality
(2) Kenya Standard for Effluent Discharge into the Environment
(3) Kenya Standard for Effluent Discharge into Public Sewers
(4) The Factories and Other Places of Work (Noise Prevention and Control) Rules
(5) Kenya Water Quality Standard for Sources of Domestic Water
(6) Japanese Water Quality Standards

(1) Ruai Candidate Site

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

With regard to groundwater pollution, the nearest existing well to the candidate site is more than five (5) km to the south-east and no impact has been predicted on this well.

Impacts of low significance are predicted on the groundwater quality of adjacent areas, especially downstream of the candidate site, considering the geological properties of the soils of the site. The implementation of lechate collection and treatment shall be applied as a mitigation measure.

The survey on water quality of Nairobi River was conducted after a rainy day; therefore, pollutant concentrations had been significantly diluted. Water pollution of Nairobi River is assessed as negative impact although it is determined to be low in significance because according to secondary data the water quality is already degraded. The adverse impact shall be controllable with a proper management of the construction and the provision of drains with sediment traps, as well as the proper operation of the proposed leachate collection/treatment.

As for smoke, low impact is predicted when the sanitary landfill method is implemented in which daily soil covering of the disposed garbage is practiced and the installation of gas control system is provided. However, dust and exhaust fumes from vehicles and equipment are predicted impacts of moderate significance on the workers at the site and the community at the access road. Exhaust fumes from vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of

vehicles/equipment shall be implemented and watering may be required for access road and operational places during the construction, operation and closure stages, especially in the dry season. During operation, a medical checkup programme shall be established. During the construction, operation and closure stages, it is also important to cover soil materials transported to the disposal site.

Soil contamination is considered to be of low significance, due to the nature of solid waste to be disposed of at the landfill site. The contamination shall be minimised by the prohibition of entering of toxic waste to the disposal site.

Noise will be generated in the construction, operational and closure stages of the disposal site. It is expected that vehicles will generate an impact of moderate significance especially in the access road; therefore, proper measures should be taken to avoid any inconvenience to the residents. Public consensus is absolutely necessary about the project prior to the construction, and for the noise control, the work schedule should be arranged in such a way that the operation of heavy equipment is limited to the daytime only. On the other hand, for the workers involved in the construction and operation, the impact will be of moderate significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

Gas migration has low impact due to the absence of buildings in the surrounding area and this condition should be kept to minimise this impact.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Migration of waste pickers to the new disposal site is highly predictable. If CCN decides to allow them to work in the facility, the provision of specific working rules should be enacted to control their activities without disturbing the smooth operation of the site. Waste pickers should not be allowed to live at the site.

A poor operation of the disposal site can adversely impact the social environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the landfill site. These impacts considered to be of high significance shall be minimised by means of daily soil covering of the disposed garbage, the installation of a gas control system and a regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.

Predictable negative impacts, assessment and mitigation measures for the Ruai Candidate Site are summarised in **Table G.3.2.**

Table G.3.2 Predictable Negative Impacts, Assessment and Mitigation Measures for Ruai Landfill Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O, PCL	Low	• Collection and leachate treatment
Offensive Odour	O	High	• Daily soil covering of disposed garbage • Implementation of medical check-up program • Installation of gas control system
Harmful Insects Generation	O	High	• Daily soil covering of disposed garbage • Implementation of medical check-up program
Water Pollution of Nairobi River	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of leachate treatment facilities
	PCL	Low	• Maintenance of ring-drain operation after closure stage • Continued use of leachate treatment facilities for a long time depending on production/quality of leachate
Smoke from Garbage	O	Low	• Daily soil covering of disposed garbage • Installation of gas control system
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of access road and operational places • Soil materials should be covered with sheet • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment
Soil Contamination	O	Low	• Landfill site should receive solid domestic waste only
Noise	C, O, CL	Moderate	• Public Information on work schedule • Limitation of operation of heavy equipment to daytime only • Adequate maintenance of equipment and trucks which must have exhaust mufflers
Gas Migration	O, PCL	Low	• Land use regulation to surrounding area, avoiding building construction
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation
Waste pickers	O	High	• Enactment of specific working rules for waste pickers if allowed to work in the landfill site

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

(2) Juja Area

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

With regard to groundwater pollution, no borehole or well was identified in the vicinity of the site.

Impacts of low significance are predicted on the groundwater quality of adjacent areas especially downstream of the candidate site considering the geological properties of the soils of the site. The implementation of lechate collection and treatment shall be applied as a mitigation measure.

Water pollution of the Ndarugu River is assessed as a negative impact of moderate significance due to the existing water use in the area. The adverse impact shall be controllable with a proper management of the construction and the provision of drains with sediment traps, as well as the proper operation of the proposed leachate collection/treatment.

As for smoke, low impact is predicted when the sanitary landfill method is implemented in which daily soil covering of the disposed garbage is practiced and a gas control system is provided. However, dust and exhaust fumes from vehicles and equipment are predicted

impacts of moderate significance on the workers at the site and on the access road. Exhaust fumes from vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of vehicles/equipment shall be implemented and watering may be required for the operational places and access road during the construction, operation and closure stages, especially in the dry season. During operation a medical checkup programme shall be established. During the construction, operation and closure stages, it is also important to cover soil materials transported to the disposal site.

Soil contamination is considered to be of low significance due to the nature of solid waste to be disposed at the landfill site. The contamination shall be minimised by the prohibition of entering of toxic waste to the disposal site.

Noise will be generated in the construction, operational and closure stages of the disposal site. It is expected that vehicles will generate an impact of moderate significance in the access road; therefore, vehicles and equipment should be well-maintained to minimise noise emission and the work schedule should be arranged in such a way that the operation of heavy equipment is limited to the daytime only. On the other hand, for the workers involved in the construction and operation, the impact will be of moderate significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

Gas migration has low impact due to the absence of buildings in the surrounding area and this condition should be kept to minimise this impact.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Migration of waste pickers to the new disposal site is highly predictable. If CCN decides to allow them to work in the facility, the provision of specific working rules should be enacted to control their activities without disturbing the smooth operation of the site. Waste pickers should not be allowed to live at the site.

A poor operation of the disposal site can adversely impact the environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the landfill site. These impacts considered to be of high significance shall be minimised by means of daily soil covering of the disposed garbage, the installation of a gas control system and a regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.

Predictable negative impacts, assessment and mitigation measures for the Juja Candidate Site are summarised in **Table G.3.3.**

Table G.3.3 Predictable Negative Impacts, Assessment and Mitigation Measures for Juja Landfill Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O, PCL	Low	• Collection and leachate treatment
Offensive Odour	O	High	• Daily soil covering of disposed garbage • Implementation of medical check-up program • Installation of gas control system
Harmful Insects Generation	O	High	• Daily soil covering of disposed garbage • Implementation of medical check-up program
Water Pollution of Ndarugu River	C, CL	Moderate	• Provision of drains with sediment traps • Proper management of the construction
	O	Moderate	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of leachate treatment facilities
	PCL	Moderate	• Maintenance of ring-drain operation after closure stage • Continued use of leachate treatment facilities for a long time depending on production/quality of leachate
Smoke from Garbage	O	Low	• Daily soil covering of disposed garbage • Installation of gas control system
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of operational places and access road • Soil materials should be covered with sheet • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment
Soil Contamination	O	Low	• Landfill site should receive solid domestic waste only
Noise	C, O, CL	Moderate	• Adequate maintenance of equipment and trucks which must have exhaust mufflers
Gas Migration	O, PCL	Low	• Land use regulation to surrounding area, avoiding building construction
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation
Waste pickers	O	High	• Enactment of specific working rules for waste pickers if allowed to work in the landfill site

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

(3) Mavoko Candidate Site

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

With regard to groundwater pollution, no borehole or well was identified near the site.

Impacts of low significance are predicted on the groundwater quality of adjacent areas especially downstream of the candidate site considering the geological properties of the soils of the site. The implementation of lechate collection and treatment shall be applied as a mitigation measure.

Water pollution of the Stonyathi River is assessed as negative impact although it is determined to be low in significance especially considering that this river is seasonal. The adverse impact shall be controllable with the proper management of construction and the provision of drains with sediment traps, as well as the proper operation of the proposed leachate collection/treatment.

Another potential impact expected is the existence of wild animals at the site. This impact is considered to be low in significance considering the large area of the site and to the fact that these animals keep moving and their migration takes place yearly. Mitigation could include the provision of a buffer zone around the facility to avoid interference with the wild animals at the site.

As for smoke, low impact is predicted when sanitary landfill method is implemented in which daily soil covering of the disposed garbage is practiced and a gas control system is provided. However, dust and exhaust fumes from vehicles and equipment are predicted impacts of moderate significance on the workers at the site. Exhaust fumes from vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of vehicles/equipment shall be implemented and watering may be required for the operational places during the construction, operation and closure stages, especially in the dry season. During operation a medical checkup programme shall be established. During the construction, operation and closure stages, it is also important to cover soil materials transported to the disposal site.

Soil contamination is considered to be of low significance due to the nature of solid waste to be disposed at the landfill site. The contamination shall be minimised by the prohibition of entering of toxic waste to the disposal site.

Noise will be generated in the construction, operational and closure stages of the disposal site. It is expected that vehicles will generate an impact of low significance in the access road, due to the almost absence of houses. On the other hand, for the workers involved in the construction and operation, the impact will be of moderate significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

Gas migration has low impact due to almost absence of buildings in the surrounding area and this condition should be kept to minimise this impact.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Migration of waste pickers to the new disposal site is highly predictable. If CCN decides to allow them to work in the facility, the provision of specific working rules should be enacted to control their activities without disturbing the smooth operation of the site. Waste pickers should not be allowed to live at the site.

A poor operation of the disposal site can adversely impact the social environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the landfill site. These impacts considered to be of high significance shall be minimised by means of daily soil covering of the disposed garbage, the installation of a gas control system and the regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.

Predictable negative impacts, assessment and mitigation measures for the Mavoko Candidate Site are summarised in **Table G.3.4.**

Table G.3.4 Predictable Negative Impacts, Assessment and Mitigation Measures for Mavoko Landfill Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O, PCL	Low	• Collection and leachate treatment
Offensive Odour	O	High	• Daily soil covering of disposed garbage • Implementation of medical checkup program • Installation of gas control system
Harmful Insects Generation	O	High	• Daily soil covering of disposed garbage • Implementation of medical checkup program
Water Pollution of Stonyathi River	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of leachate treatment facilities
	PCL	Low	• Maintenance of ring-drain operation after closure stage • Continued use of leachate treatment facilities for a long time depending on production/quality of leachate
Fauna	C, O	Low	• Provision of a buffer around the facility to avoid interference with the wild animals at the site
Smoke from Garbage	O	Low	• Daily soil covering of disposed garbage • Installation of gas control system
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of operational places • Soil materials should be covered with sheet • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment
Soil Contamination	O	Low	• Landfill site should receive solid domestic waste only
Noise	C, O, CL	Moderate	• Adequate maintenance of equipment and trucks which must have exhaust mufflers
Gas Migration	O, PCL	Low	• Land use regulation to surrounding area, avoiding building construction
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation
Waste pickers	O	High	• Enactment of specific working rules for waste pickers if allowed to work in the landfill site

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

3.6 Execution of IEE for Transfer Station Candidate Sites

3.6.1 Natural and Social-Environmental Condition

(1) Dandora Candidate Site

(a) Natural Environmental Condition

(i) General Information

The site with an area of about twenty-six (26) ha is located in the Embakasi Division. It was a quarry along the Nairobi River, used for stone extraction for the building industry in Nairobi City. The site is used currently for garbage disposal, operated by CCN and owned by CCN and private individuals.

(ii) Water

The only existing river in the area is the Nairobi River which is located adjacent to the site. During this JICA Survey, water sampling was conducted in the Nairobi River upstream and downstream of the candidate site. The results indicate that the river is loaded with organic substances and not suitable as the source of domestic water. It was

confirmed that Nairobi River receives leachate without any treatment from the Dandora Dumpsite, leading to water pollution.

Table G.3.5 Water Quality of Nairobi River at Dandora Transfer Station Candidate Site

Parameter	Unit	Sampling Locations		Standard Value
		Before the Site	After the Site	Kenya[*1]/Japan[*2]
GPS		N -1,15,9.58 E 36,53,36.15	N -1,14,40.94 E 36,53,46.38	
pH		7.3	7.7	6.5–8.5/6.5–8.5
BOD5	mg/l	150	42	/< 3
TDS	mg/l	963.75	395	1200/
SS	mg/l	686.25	363.75	30/< 25
Total Coliforms	MPN/100 ml	> 1,800	> 1,800	/< 5000
Phenolic substances as Phenols	mg/l	0.2	0.1	Nil/
NH4-N	mg/l	16.8	15.4	0.5/
DO	mg/l	3.3	4.0	/ >5
Arsenic	mg/l	ND	ND	0.01/< 0.05
Cadmium	mg/l	ND	ND	0.01/
Chromium	mg/l	ND	ND	/< 0.05
Lead	mg/l	ND	ND	0.05/< 0.1
Mercury	mg/l	ND	ND	/ND
Cyanide	mg/l	ND	ND	/ND
Organo-Phosphorus Compounds	mg/l	ND	ND	/ND

Source: The present JICA Survey
Note: [*1]Kenyan Standard applied for sources of domestic water, Environmental Management and Coordination (Water Quality) Regulations, 2006
[*2]Japanese Standard Category B applied for rivers to be used for water supply, fishery, industrial, agricultural and conservation of environment
ND: Not Detected
Nil: means less than the limit of detection using prescribed sampling and analytical methods and equipment as determined by the Authority

(iii) Flora and Fauna

At the site could be observed the presence of animal scavengers such as pigs, birds, goats, sheep and cattle that feed on the waste. Few shrubs could be observed especially in the riverine vegetation.

(iv) Landscape

The site is an ex-quarry filled with waste. It slopes steeply before reaching the Nairobi River.

(v) Air and Noise

Smoke, dust and exhaust gases pollute the air at the place. Offensive odour also could be noted due to the unsanitary condition of the place. Offensive odour and smoke are the major complaints of people living around the site. Noise production also could be noted due to the machines and vehicles operating at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

The Dandora Dumpsite is surrounded by populated villages such as Kogorocho Slum, Lucky Summer, the Kariobangi and Dandora estates, and by a number of educational and religious facilities such as the Dandora Secondary School, the Jiran Education Centre, the Tortola Rescue and Educational Centre, and the Monica Church.

Many waste pickers from the surrounding villages work at the place for material recovery or recycling. No official record exists on the number of waste pickers at the site; however, it was estimated to be about six hundred (600) by the CCN officials.

During the survey, the presence of one group identified as the Mukuru Recycling Centre was noted, performing paper recycling with its own equipment. Other people of the surrounding villages are the stone miners working near the site.

(ii) Sanitation

The surrounding population is provided with piped water and excreta disposal is made through sewers in some cases or pit latrines. As for garbage disposal, some are carried by collectors and some are burned.

(iii) Health Condition

The place is an open dumping site where solid waste poses a risk from the sanitary point of view, which could affect the operators of the landfill site, the waste pickers and the residents living around the site directly. The site constitutes a breeding ground for different organisms which are carriers of diseases such as malaria, typhoid, dysentery, etc. Interviewed persons expressed that the main diseases in the area are upper respiratory tract infections, gastro-intestinal diseases, allergies, tetanus, chest infections, etc.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station and recovery facilities after the sanitary closure of the existing disposal site. The public health of a vast population living around the site will be improved through closing the existing disposal site.

(2) Langata Candidate Site

(a) Natural Environmental Condition

(i) General Information

The site is located next to the Langata Cemetery limiting with the Langata Road with an area of approximately eight (8) hectares that form part of the Ngong Road Forest. The site is located in-front of the National Nairobi Park at approximately ten (10) km south-west from the city centre. The land is owned by the private sector.

(ii) Water

The Mokoyeti stream is in the lowest part of the land. It goes through the Nairobi National Park and is currently polluted by leakage of sewers that pass through the site. A newly constructed bore hole was identified at the Wildlife Clubs of Kenya; however, it is not operated yet and no data was available about the water quality and other features.

(iii) Flora and Fauna

Presence of some birds was noted. Shrubs are dominant while few species of trees were observed at the site.

(iv) Landscape

The site has a gentle slope towards the stream. The cover soil is red soil that goes down until approximately 50 cm. Under this soil, a rocky layer is found.

(v) Air and Noise

No significant noise or air pollution was noted at the site. The existing ones come from the traffic on Langata Road.

(b) Socio-Environmental Condition

(i) Socio-economy

No residential area was found in the vicinity, but next to the site is the Wildlife Clubs of Kenya which promotes environmental education and tourism courses. Next to this facility exists the Bomas of Kenya Limited, a government corporation with many facilities for tourists, entertainment, and social activity.

(ii) Sanitation

Water supply in the area of Langata is provided by CCN in some parts and the other parts use bore holes. Sewage is disposed by sewage or septic tanks. In front of the candidate site is a sewerage pipeline. The garbage is usually collected by private collectors.

(iii) Health Condition

Main diseases in the area are respiratory diseases and malaria.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station. The site is a sensitive area due to its proximity to tourist areas and recreational facilities; therefore, strict monitoring of the operation should be implemented to avoid any negative impact.

(3) Kibera Area (Railway Station)

(a) Natural Environmental Condition

(i) General Information

The site is about six (6) km south-west from the Nairobi centre, next to the railway track and in-front of the Kibera Station. The site is owned by the Kenya Railways Corporation (a parastatal institution).

(ii) Water

There is a stream in the vicinity originating in springs. The stream feeds 3 dams which supply water for the population of Kibera and for livestock consumption.

(iii) Flora and Fauna

Grass, shrubs, maize and vegetable plantation could be observed at the site. The presence of animals could be noted.

(iv) Landscape

The site has a steep slope towards the access road to the site. The cover soil is red soil and rock.

(v) Air and Noise

No noise or air pollution was noted at the site.

(b) Socio-Environmental Condition

(i) Socio-economy

In front of the site could be observed the Unga Farm Care (EA) Limited, a parastatal institution with an area of 109 hectares where the exhibition of Kenyan products (including livestock, agricultural and commercial) is organised every year. Also noted were the three (3) schools located very near to the site and in the land belonging to the Kenya Railways Corporation.

(ii) Sanitation

Some houses have piped water from CCN. Others buy it at 4 Ksh for each container of 20 litres. Sewage is disposed using pit latrines or septic tanks. As for garbage, the common system used is burning, composting or dumping anywhere.

(iii) Health Condition

Interviewed persons informed that the main diseases in the area are influenza, coughs and malaria.

(c) Conclusion

The site could be used with mitigation measures for developing the transfer station. The health of the vast population living in Kibera could be improved through the improvement of collection and transportation of garbage from the area using the transfer station. An additional area of land needs to be acquired to meet the requirement of the proposed transfer station.

3.6.2 Project Justification

The traffic condition in Nairobi City is too congested especially in the main roads. Under this circumstance, it is recommendable to use a transfer station in strategic places where collectors' trucks bring the waste to large container trucks or train wagons which will take it finally to the landfill site.

3.6.3 Project Description

The transfer station shall consist mainly of the following components:

(1) Roads
(2) Fence
(3) Gate
(4) Ramps
(5) Retaining Wall
(6) Weighing Building
(7) Refuse Transfer Building

(8) Workshop Building

(9) Wastewater Treatment Building

(10) Car Washing Building

(11) Landscaping

(12) Pavement

(13) Drainage

(14) Material Recovery Facility

3.6.4 Prediction of Potential Impacts, Assessment and Mitigation Measures

Impact prediction is based on all activities relating to the project implementation. Considering that the solid waste management in Nairobi City will be improved, impact prediction will contribute in a positive way to the improvement of the environment and the health of Nairobi's residents. Nevertheless some adverse impacts could also be predicted and proper mitigation measures should be taken to protect or minimise the negative effects, accordingly. In the IEE, potential impacts were predicted and their significance was also assessed during the four phases of the project; i.e., Construction Phase, Operation Phase, Closure Phase and Post-Closure Phase.

The significance of environmental impacts determined on the basis of non-negligible environmental changes induced by the project implementation are shown in three levels, namely; high impact, moderate impact and low impact.

The environmental impact results could be assessed by comparing them with values specified in the standards used as assessment targets. The standards used in this study, which are presented in **Section G** of **Volume 4, Data Book,** include the following:

(1) Kenya Standard for Drinking Water Quality

(2) Kenya Standard for Effluent Discharge into the Environment

(3) Kenya Standard for Effluent Discharge into Public Sewers

(4) The Factories and Other Places of Work (Noise Prevention and Control) Rules

(5) Kenya Water Quality Standard for Sources of Domestic Water

(6) Japanese Water Quality Standards

(1) Dandora Candidate Site

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

It has been assessed that the groundwater quality of adjacent areas especially downstream of the candidate site is already polluted by the existing dumping site. On the other hand, the generation of leachate at the transfer station is not expected but wastewater from cleaning of the facility is predicted. Consequently, impact of low significance is predicted on the groundwater quality, and wastewater treatment shall be applied as a mitigation measure.

Water pollution of Nairobi River has been assessed as a negative impact of low significance, due to the existing level of pollution of the river. The adverse impact shall be controllable with proper management of the construction and the provision of drains with sediment traps, as well as the proper operation of the proposed wastewater treatment.

Dust and exhaust fumes from vehicles and equipment are predicted impacts of moderate significance on the workers at the site and the surrounding community. Exhaust fumes from

vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of vehicles/equipment shall be implemented and watering may be required for the operational places during the construction, operation and closure stages, especially in the dry season. During operation, a medical checkup programme shall be established. During the construction stage it is also important to cover soil materials transported to the site.

Noise will be generated in the construction, operational and closure stages of the site. It is expected that vehicles will generate an impact of moderate significance in the access road due to the existing settlements; therefore, proper measure should be taken to avoid any inconvenience to the residents. Public consensus is absolutely necessary about the project prior to the construction, and for the noise control, the work schedule should be arranged in such a way that the operation of heavy equipment is limited to the daytime only. On the other hand, for the workers involved in the construction and operation, the impact will be of moderate significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Waste pickers will lose their jobs when the Dandora Dumpsite is closed in order to construct the transfer station. However, a materials recovery facility (MRF) is proposed to be constructed at the site, which could accommodate about 60 waste pickers. For the other waste pickers working currently at the site, a detailed study shall be carried out on them in order to propose a joint-work among CBOs and waste pickers for material recovery at the collection points operated currently by CBOs and CCN. The enactment of specific working rules for waste pickers will be necessary to allow them to work in the MRF and with the CBOs. Waste pickers should not be allowed to live at the site.

Poor operation of the transfer station can adversely impact the environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the site. These impacts considered to be of moderate significance shall be minimised by means of proper sanitary management of the transfer station and a regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.
- Residents around the site will be happy on the closure of the Dandora Dumpsite.

Predictable negative impacts, assessment and mitigation measures for the Dandora Transfer Station Candidate Site are summarised in **Table G.3.6.**

Table G.3.6 Predictable Negative Impacts, Assessment and Mitigation Measures for Dandora Transfer Station Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O	Low	• Wastewater treatment
Offensive Odour	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup program
Harmful Insects Generation	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup program
Water Pollution of Nairobi River	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of wastewater treatment facilities
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of operational places. Soil materials should be covered with sheet • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment • Implementation of medical checkup program
Noise	C, O, CL	Moderate	• Adequate maintenance of equipment and trucks which must have exhaust mufflers
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation
Waste Pickers	O	High	• About 60 waste pickers will be accommodated in the MRF to be constructed at the site. For the other waste pickers, a detailed study shall be conducted on them in order to propose their incorporation with the CBOs for material recovery at the garbage collection points operated by CBO/CCN • Enactment of specific working rules for waste pickers will be necessary to allow them to work in the MRF and with CBOs

Legend: C: Construction Phase; O : Operation Phase; CL: Closure Phase

(2) Langata Candidate Site

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

Generation of leachate at the transfer station is not expected, but wastewater from cleaning of the facility is predicted. Impact of low significance is predicted on the groundwater quality considering the geological condition at the site. Mitigation measures are proposed such as the construction of a wastewater treatment facility.

Water pollution of Mokoyeti stream has been assessed as a negative impact of low significance since it is receiving sewage discharge which affects its quality negatively. The adverse impact shall be controllable with proper management of the construction and the provision of drains with sediment traps, as well as the proper operation of the proposed wastewater treatment.

Dust and exhaust fumes from vehicles and equipment are predicted impacts of moderate significance on the workers at the site. Exhaust fumes from vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of vehicles/equipment shall be implemented and watering may be required for the operational places during the construction, operation and closure stages, especially in the dry season. During operation, a medical checkup programme shall be established. During the construction stage it is also important to cover soil materials transported to the site.

Noise will be generated in the construction, operational and closure stages of the site. For the workers involved in the construction and operation, the impact will be of moderate

significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Poor operation of the transfer station can adversely impact the environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the site composed mainly by recreational and tourist facilities that could be very sensitive to the implementation of the project. These impacts considered to be of moderate significance shall be minimised by means of proper sanitary management of the transfer station and a regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.

Predictable negative impacts, assessment and mitigation measures for the Langata Candidate Site are summarised in **Table G.3.7.**

Table G.3.7 Predictable Negative Impacts, Assessment and Mitigation Measures for Langata Transfer Station Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O	Low	• Wastewater treatment
Offensive Odour	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup programme
Harmful Insects Generation	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup programme
Water Pollution of Mokoyeti Stream	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of wastewater treatment facilities
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of operational places • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment • Implementation of medical checkup programme
Noise	C, O, CL	Moderate	• Adequate maintenance of equipment and trucks which must have exhaust mufflers
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation

Legend: C: Construction Phase; O : Operation Phase; CL: Closure Phase

(3) Kibera Candidate Site

(a) Predictable Negative Impacts on Natural Environment, Assessment and Mitigation Measures

Generation of leachate at the transfer station is not expected but wastewater from cleaning of the facility is predicted. Impact of low significance is predicted on the groundwater quality considering the geological condition at the site. Mitigation measures are proposed such as the construction of a wastewater treatment facility.

Water pollution of the stream located at the lower part is assessed as a negative impact of low significance, since it showed signs of pollution at the time of the observation. The adverse impact shall be controllable with proper management of the construction and the provision of drains with sediment traps, as well as the proper operation of the proposed wastewater treatment.

Dust and exhaust fumes from vehicles and equipment are predicted impacts of moderate significance on the workers at the site and the surrounding community. Exhaust fumes from vehicles shall be controlled with the proper maintenance of trucks and equipment. For the dust control, control on the number or speed of vehicles/equipment shall be implemented, and watering may be required for the operational places and the access road during the construction, operation and closure stages, especially in the dry season. During operation, a medical checkup programme shall be established. During the construction stage it is also important to cover soil materials transported to the site.

Noise will be generated in the construction, operational and closure stages of the site. It is expected that vehicles and equipment will generate an impact of moderate significance in the access road to the site; therefore, vehicles and equipment should be well maintained. To minimise noise emission, the work schedule should be arranged in such a way that the operation of heavy equipment is limited to the daytime only. For the workers involved in the construction and operation, the impact will be of moderate significance due to the high noise levels emitted by the equipment. In this regard, the level of 90 dB(A)-8 hr should not be exceeded at the working place.

(b) Predictable Impacts on the Social Environment, Assessment and Mitigation Measures

(i) Negative Impacts

Poor operation of the transfer station can adversely impact the environment, such as the breeding of harmful insects and the generation of offensive odour which could affect the health of workers and the neighbourhood of the site composed mainly of schools and exhibition campus facilities. These impacts considered to be of moderate significance shall be minimised by means of proper sanitary management of the transfer station and regular medical check-up for workers.

(ii) Positive Impacts

The following are the positive impacts:

- The project will improve the health condition in the city.
- The project will create several jobs directly in various aspects of construction, transportation and operation of the SWM system.

Predictable negative impacts, assessment and mitigation measures for the Kibera Candidate Site are summarised in **Table G.3.8.**

Table G.3.8 Predictable Negative Impacts, Assessment and Mitigation Measures for Kibera Transfer Station Candidate Site

Predictable Impacts	Impact Stage	Significance	Mitigation Measures
Groundwater	O	Low	• Wastewater treatment
Offensive Odour	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup programme
Harmful Insects Generation	O	Moderate	• Proper sanitary management of the transfer station • Implementation of medical checkup programme
Water Pollution of stream in the lower part of the site	C, CL	Low	• Provision of drains with sediment traps • Proper management of the construction
	O	Low	• Maintenance of ring-drain outside the landfill site enclosing dike • Provision of wastewater treatment facilities
Dust, Exhaust Fumes from Vehicles and Equipment	C, O, CL	Moderate	• Watering of operational places and access road • Proper maintenance of vehicles • Control on the number or speed of vehicles/equipment • Implementation of medical checkup programme
Noise	C, O, CL	Moderate	• Adequate maintenance of equipment and trucks which must have exhaust mufflers
Landscape	C	Low	• Project implementation in an aesthetic development scene with landscape harmonisation

Legend: C: Construction Phase; O : Operation Phase; CL: Closure Phase

3.7 Procedure of Land Acquisition for Candidate Sites

3.7.1 Introduction

Concern about land tenure and its impact on land use as well as the management of natural resources is not a recent phenomenon in Kenya and indeed in the whole of Africa. Prior to and after independence, radical changes have been deliberately initiated in tenure arrangements. These have been justified mainly on the basis of the expected improvements in productivity, land use planning and decision making they would generate.

3.7.2 Land Tenure System in Kenya

Interests in land broadly fall into two groups: rights that are held through traditional African systems and rights derived from the English system introduced and maintained through laws enacted by colonial and then by the national parliament. The former is loosely known as customary tenure bound through traditional rules (customary law). The latter body of laws is referred to as statutory tenure, secured and expressed through national law, in various Acts of Parliament as shown in the table below.

Table G.3.9 Laws related to Land Tenure System in Kenya

Laws	Provisions
Land Acquisitions Act 295	An Act of Parliament to make provision for the compulsory acquisition of land for the public benefit
Government Lands Act, Caption (Cap.) 280	An Act of Parliament to make further and better provision for regulating the leasing and other disposal of Government lands, and for other purposes
Trust Land Act, Cap. 288	An Act of Parliament to make provision for Trust land
Registered Land Act, Cap. 300	An Act of Parliament to make further and better provision for the registration of title to land, and for the regulation of dealings in land so registered, and for purposes connected therewith
Land Consolidation Act, Cap. 283	An Act of Parliament to provide for the ascertainment of rights and interests in, and for the consolidation of, land in the special areas; for the registration of title to, and of transactions and devolutions affecting, such land and other land in the special areas; and for purposes connected therewith and incidental thereto
Land (Group Representatives) Act, Cap. 287	An Act of Parliament to provide for the incorporation of representatives of groups who have been recorded as owners of land under the Land Adjudication Act, and for purposes connected therewith and purposes incidental thereto
Registration of Titles Act, Cap. 281	An Act of Parliament to provide for the transfer of land by registration of titles
Land Adjudication Act Cap. 284	An Act of Parliament to provide for the ascertainment and recording of rights and interests in Trust land, and for purposes connected therewith and purposes incidental thereto

3.7.3 Applicable Law and Estimated Timing of Land Acquisition for Candidate Sites

The applicable laws and estimated timing for the negotiation and acquisition of candidate sites by CCN are summarised in the table below.

Table G.3.10 Applicable Law and Estimated Timing of Land Acquisition for Candidate Sites

Candidate Sites for Landfill and Transfer Station Sites	Applicable Laws	Duration of Negotiation and Acquisition (Month)
Ruai (LF)	Already CCN land	
Juja Site (LF)	Registered Land Act; Registration of Titles Act	3 months
Mavoko Site (LF)	Registered Land Act; Registration of Titles Act; Government Land Act	4 months
Dandora (TS)	Registered Land Act; Registration of Titles Act	Difficult to Estimate since ownership is shared by CCN and many individuals
Langata (TS)	Registered Land Act; Registration of Titles Act	3 months
Kibera (TS)*	Registered Land Act; Registration of Titles Act; Government Land Act	4 months

Note: LF: landfill; TS: transfer station; *the site is available only for leasing

4. FUTURE ARRANGEMENTS ON ENVIRONMENTAL ASPECTS

4.1 Procedures of EIA in Kenya

The projects to be subjected to EIA are specified in the Second Schedule of the Environmental Management and Coordination Act (1999). According to the Second Schedule, a waste disposal project is subject to EIA. NEMA is responsible for the coordination of the EIA process with the leading agencies, the approval of the Terms of Reference (TOR) for EIA, examination of EIA reports, and issuing, varying or cancelling EIA licenses.

The legal requirements for conducting EIA in Kenya are described in the Environmental (Impact Assessment and Audit) Regulations, 2003, Legal Notice No. 101. A simplified flowchart of the EIA process is presented below:

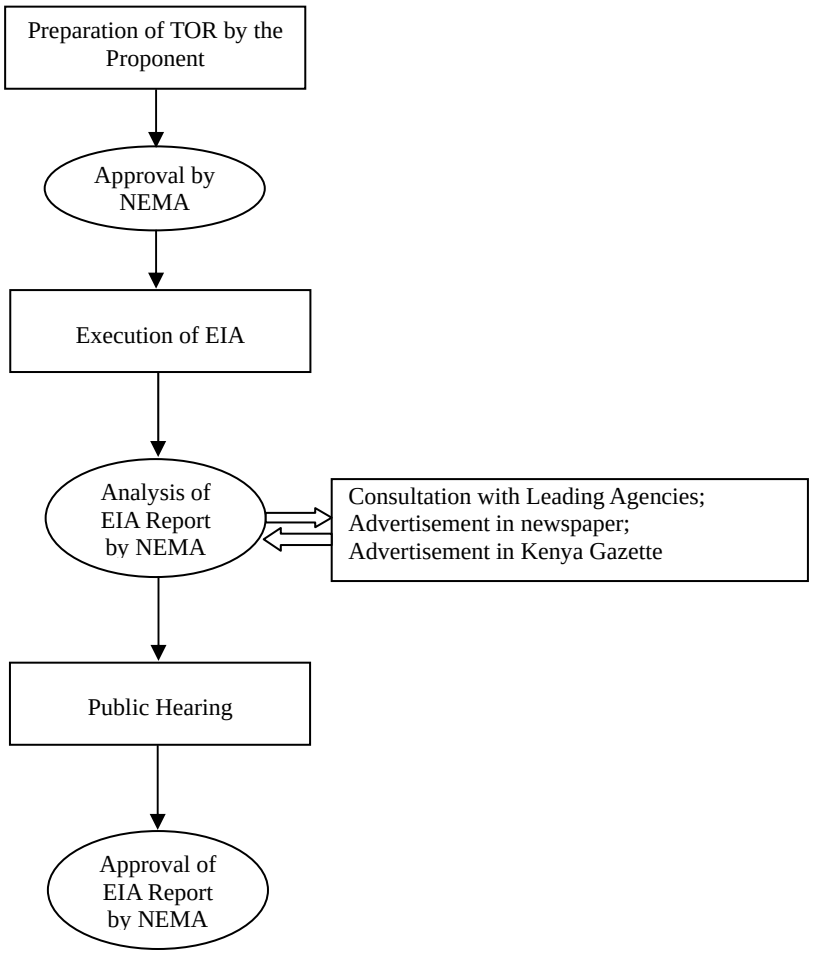


Figure G.4.1 Flowchart of the EIA Process in Kenya

The estimated time schedule for the EIA process is shown in **Table G.4.1** below.

Table G.4.1 Schedule of EIA Process for Solid Waste Management Project in Kenya

Months		1				2				3				4				5				6				7			
Weeks		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Nº	Activities																												
1	Preparation of TOR in consultation with NEMA																												
2	Approval of TOR by NEMA																												
3	Execution of EIA																												
4	Submission of EIA Report to NEMA																												
5	Advertisment in newspaper																												
6	Advertisment in Kenya Gazzette																												
7	Comments from stakeholders																												
8	Analysis of EIA Report by NEMA																												
9	Public hearing prepared by NEMA																												
10	Approval of EIA Report by NEMA																												

4.2 Terms of Reference and General Guidelines for EIA in Kenya

4.2.1 Terms of Reference

According to the Environmental (Impact Assessment and Audit) Regulations, 2003, Legal Notice No. 101, the EIA must be conducted in accordance with the Terms of Reference (TOR) developed by the project proponent and approved by NEMA. The regulation also stipulates that the TOR must include matters required to be considered in the EIA as contained in the Second Schedule of the Regulations and such other matters as the Director General may require in writing.

Table G.4.2 Second Schedule of the Regulation on Issues that may be considered in EIA

Ecological consideration	Biological diversity; Sustainability; Ecosystem maintenance
Social consideration	Economic impacts; social cohesion or disruption; effect on human health; immigration or migration; communication; effects on culture and objects of culture value
Landscape	Views opened up or closed; visual impacts; compatibility with surrounding area; amenity opened up or closed
Land use	Effects of proposal on current land use and land use potential in the project area; possibility of multiple use; effects of proposal on surrounding land use and land use potential
Water	Water sources (quantity and quality), drainage patterns/drainage systems

Source: Environmental (Impact Assessment and Audit) Regulations, 2003, Legal Notice No. 101

4.2.2 General Guidelines for Carrying Out an EIA Study

According to the Environmental (Impact Assessment and Audit) Regulations, 2003, Legal Notice No. 101, an EIA study shall include the following:

(1) Sources of Impact

(2) Project Inputs

(3) Project Activities

(4) Areas of Impact on the Natural and Human Environment

(5) Environmental Impacts (General Impacts on the Natural and Human Environment)

(6) Environmental Guidelines and Standards (National Legislation, International guidelines, International Conventions and Treaties)

(7) Mitigation Measures

(8) Environmental Management Plan

(9) Environmental Monitoring Plan

4.3 Draft TOR for EIA Study on Candidate Sites

The draft TOR for EIA for: (a) Construction of Landfill at Ruai Candidate Site; (b) Closure of Dandora Dumpsite and construction of MRF at the site, has been prepared taking into consideration the findings in the Initial Environmental Examination (IEE). The said draft TOR is given in the following **Chapter 5**. The final version of the TOR shall be prepared in the feasibility study stage in consultation with NEMA taking into account the Kenyan Regulation and the new JICA Guidelines.

5. TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT (DRAFT)

5.1 Introduction

5.1.1 Background and Objectives of the Study

As in many cities in the world, the solid waste management in Nairobi City is facing several problems of great importance that can directly affect the environment and the health of the population. Among the problems can be mentioned the unsanitary condition of the disposal site favoring the reproduction of sickness vectors, pollution of surface and ground water, smell and dust production with reduction of the aesthetic condition of the city. Besides, the waste collection is inefficient because the number of collection trucks is inadequate and those existing are old and suffer constant breakdowns, resulting in a low coverage of the service, favoring the illegal dumping anywhere, representing a potential impact on public health and the environment.

Under these circumstances, the Government of Kenya had requested technical cooperation from Japan to update the Master Plan (MP) formulated in 1998. The updated MP of solid master management in Nairobi City has thus been formulated to upgrade the environmental quality of the city and the health condition of its residents.

5.1.2 Objectives of the Environmental Impact Assessment

The Environmental Impact Assessment (EIA) is required as a part of the feasibility study to define the characteristics of the Project and the potential natural and social impacts resulting from project implementation. It also proposes the suitable approach to identify significant impacts and impact sources, and suggests proper measures to mitigate the adverse effects.

5.1.3 Project Selected for EIA

The projects chosen from the Master Plan and subject to EIA are:

(1) The Project for the Construction of a New Final Landfill Site at Ruai; and

(2) The Project for the Closure of Dandora Dumpsite and the Construction of a Material Reduction Facility (MRF) at the Site

For these projects, Initial Environmental Examination (IEE) has been conducted for the candidate sites, and a detailed EIA shall be executed in the feasibility study (F/S) for the same candidate sites, aiming at the prevention or mitigation of possible negative effects on the environment that may emerge from project implementation.

5.1.4 Project Justification

The Dandora Dumpsite, categorised as an open dumping type, has a detrimental effect on public health and the environment of the surrounding area due not only to air and water pollution, but also to the associated problem on insects and animal pests, and, for this reason, its closure and the construction of a new landfill site to improve the environmental quality of the city and the level of public health of the population is highly recommendable.

On the other hand, the construction of a material reduction facility (MRF) is proposed to promote the recovery activities and to relocate the waste pickers currently working at the Dandora Dumpsite.

5.1.5 Project Description

(1) Construction of New Landfill

The proposed project is the construction of a new sanitary landfill for domestic waste to serve the whole urban area of Nairobi City.

Mainly, the new landfill shall consist of the following components:

- Fence
- Building
- Truck scale
- Roads
- Ramps
- Drainage
- Gas and leachate control system
- Wells for ground water monitoring
- Structures for solid waste retention

(2) Closure of Dandora Dumpsite and Construction of MRF at the Site

Decommissioning of the Dandora Dumpsite and land reclamation are the first activities to be done prior to the construction of the material recovery facility (MRF) at the site.

Mainly, the MRF shall consist of the following components:

- Roads
- Fence
- Gate
- Landscaping
- Pavement
- Drainage
- Material Recovery System

5.2 Scope of Work

5.2.1 General

This Terms of Reference for Environmental Impact Assessment (EIA) has been prepared taking into account the findings of the Initial Environmental Examination (IEE) conducted during the Master Plan Study Phase.

The EIA is to be carried out by a local consultant under the supervision of the JICA Study Team on two candidate sites based on this Terms of Reference, taking into account the National Environmental Management Authority (NEMA) Guidelines, the provisions of the Environmental Management and Coordination Act of 1999 and Legal Notice 121, the Waste Management Regulations of 2006, and any other existing relevant laws and regulations related to environment and social conditions in Kenya and the international standards.

The EIA report shall include all results of the analysis compiled, as follows:

(1) Introduction

   (a) Background of the Project
   (b) Brief explanation of the site and a location map
   (c) Description of the Project

(2) Legal framework of the project components (waste collection, transportation, transfer station, recycling and landfill site)

(3) Present Environmental Condition

   (a) Natural environmental conditions
   (b) Social environmental aspects

(4) Public awareness

(5) Public consultation

(6) Analysis of alternatives (design, location, technology, etc.)

(7) Identification of potential impact and impact sources

(8) Assessment of environmental impacts

(9) Description of preventive or mitigation measures against adverse effects

(10) Environmental management plan

(11) Environmental monitoring plan

(12) Drafting of EIA

(13) Conclusion and recommendations

(14) Bibliography

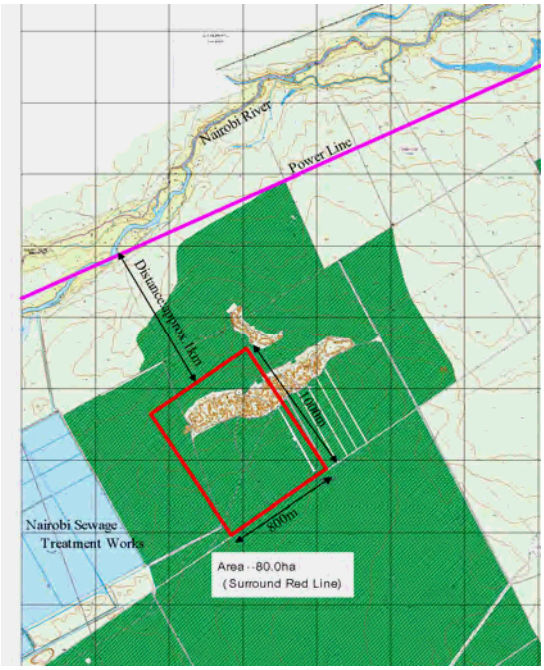
(15) Appendices

The Report shall be duly prepared and submitted to the National Environmental Management Authority (NEMA) for approval.

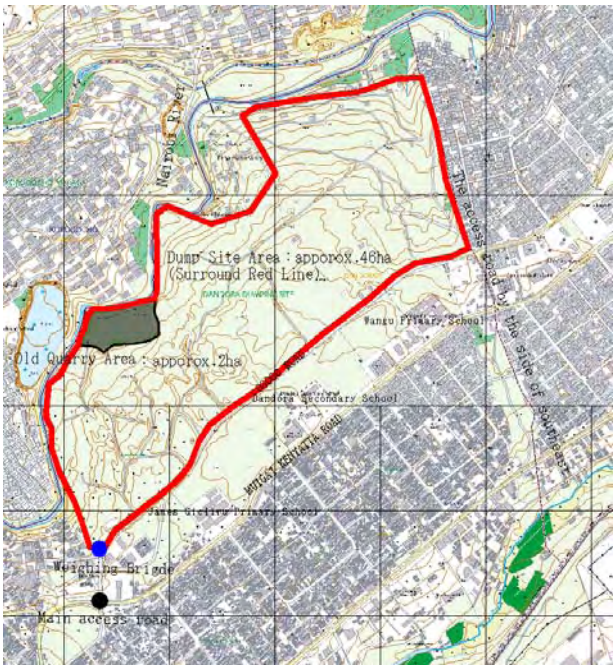
5.2.2 Work Items and Contents

The Environmental Impact Assessment shall be carried out in accordance with this Terms of Reference and as instructed by the JICA Study Team.

The location of the two candidate sites, the Ruai Area and the Dandora Area, are as indicated in **Figure G.5.1** below.



Candidate Site for Landfill at Ruai



Candidate Site for MRF at Dandora after Closure

Figure G.5.1 Location of Candidate Sites

The items and contents of the required work to be executed for each candidate site are as given below.

(1) Ruai Area

(a) Present Environmental Condition

(i) Natural Environmental Condition

Water Quality

For the water quality survey, the following items are required:

Table G.5.1 Items Required for the Water Quality Survey at Ruai

Components	Parameters	Number of Samples	
		Water	Sediment*
Surface Water (Nairobi River: study point to be specified by the Engineer)	pH, SS, Nitrate-NO_3, Ammonia-NH_3, Nitrite-NO_2, TN, TDS, E. coli, Flouride, Phenols, As, Cd, Pb, Se, Cu, Zn, Cr^{+6}, total mercury, Fe, Mn, Cyanide, Alkyl	2 samples/river × 1 river × 2 times = 4 samples Samples shall be taken from Nairobi River, one from up stream and one from down stream of the	1 sample/river x 1 river x 2 times = 2 samples. Samples shall be taken from Nairobi River bottom, just in front of the proposed site. The first sampling

Components	Parameters	Number of Samples	
		Water	Sediment*
	mercury, Alkyl benzyl sulphonates, Permanganate value, DO, BOD, COD, Total Coliform, Pesticides	proposed site. The first sampling should be conducted on a dry day while the second one, after a rainy day.	should be conducted on a dry day while the second one after a rainy day.
Groundwater (Existing well and well to be constructed by the JICA Study Team for hydro-geological survey)	pH, Colour, EC, Turbidity, Total Coliform, E. Coli, Chloride, Sulphate, Total Hardness, TDS, Permanganate, Nitrate, Nitrite, NH3, TN, Fluoride, Pb, Cr^{+6}, Cu, Fe, Mn, Ca, Mg, Na, Zn, Total Hg, As, Pesticides	1 sample/well × 2 wells × 2 times = 4 samples One sample shall be taken from an existing well at the entrance to the site and the other one from the well to be constructed by the JICA Study Team. The first sampling should be conducted on a dry day while the second one, after a rainy day.	
Drinking Water (Existing pipeline or distribution system)	pH, Colour, EC, Turbidity, Total Coliform, E. Coli, Chloride, Sulphate, Total Hardness, TDS, Permanganate, Nitrate, Nitrite, NH3, TN, Fluoride, Pb, Cr^{+6}, Cu, Fe, Mn, Ca, Mg, Na, Zn, Total Hg, As, Pesticides	1 sample/point × 2 points × 2 times = 4 samples The first sampling should be conducted on a dry day while the second one, after a rainy day.	

Note: * Only heavy metals will be analysed in sediment.

Fauna and Flora

Existing species, endangered or not, habitat, etc., in the proposed area.

Landscape

Topography, geology, land use, etc.

Soil Contamination

For the soil contamination survey, the following items are required:

Table G.5.2 Items Required for the Soil Contamination Survey at Ruai

Component	Parameters	Number of Samples
Soil	Pb, Cr^{+6}, Cu, Fe, Mn, Zn, Total Hg, As	1 sample/point × 2 points = 2 samples One sample shall be taken from the center of the proposed site and the other from the Nairobi River Bank. Samples shall be taken from a depth of 50 cm.

Noise

2 sites × 1 time/hour × 24 hours = 48 samples

Locations of sites shall be the same as those selected for the traffic survey.

Offensive Odour

H_2S:

2 sites × 2 times = 4 samples

NH_3:

2 sites × 2 times = 4 samples

Samples shall be taken from the centre of the proposed site and the other from the Nairobi River Bank. One sampling should be conducted on a dry day while the other sampling, after a rainy day.

(ii) Socio-Environmental Aspects

Analysis of Population Affected by the Project

Manner of Subsistence

Income Level, Education Level

Population and Composition

Housing

Health Condition and Sanitation

Main diseases in the project area

Number of patients due to respiratory diseases, waterborne, and other communicable diseases

Water supply method and coverage

Sewage disposal method and coverage

Garbage disposal methods and coverage

Custom, Religion

Necessity of resettlements

Traffic Survey

2 sites × 1 time/hour × 24 hours = 48 samples

One site survey shall be located on the main road and the other site, on the road entering the proposed area.

(b) Public Consultation

The contractor shall conduct city-wide consultations with the affected groups and ensure public participation consistent with Kenyan legal requirements. Besides, city-wide stakeholder consultations shall be conducted to allow their participation in the process.

(c) Analysis of Alternatives (Design, Location, Technology, etc.)

The contractor shall identify the alternative technologies and processes available and present the reasons for preferring the project sites, designs and technologies.

(d) Identification of Potential Impact and Impact Sources

The contractor shall identify the negative and positive environmental impacts on the natural and social environment (people affected either directly or indirectly by the construction and the operation of project facilities) in close consultation with all relevant stakeholders.

(e) Assessment of Environmental Impacts

(f) Description of Preventive or Mitigation Measures against Adverse Effects

The contractor shall consider both policies and procedures in identified mitigation measures for the natural and social environment and specify necessary training, human resource requirements, and emergency protocols to avoid pollution of the environment. Besides, the contractor shall propose measures to prevent health and safety hazards and ensure security in the working environment of employees and residents, and for management in case of emergencies. The cost analysis of related mitigation measures shall be submitted.

(g) Environmental Management Plan

The contractor shall submit his environmental management plan for the mitigation of identified and predicted environmental impacts throughout the project cycle.

(h) Environmental Monitoring Plan

The contractor shall submit his environmental monitoring plan for the whole cycle of the project.

(i) Draft of EIA

(2) Dandora Dumpsite Area

(a) Present Environmental Conditions

(i) Natural Environmental Conditions

Water Quality

For the water quality survey, the following items are required:

Table G.5.3 Items Required for the Water Quality Survey at Dandora

Components	Parameters	Number of Samples	
		Water	Sediment*
Surface Water (Nairobi River, study point to be specified by the Engineer)	pH, SS, Nitrate-NO_3, Ammonia-NH_3, Nitrite-NO_2, TN, TDS, E.coli, Flouride, Phenols, As, Cd, Pb, Se, Cu, Zn, Cr^{+6}, total mercury, Fe, Mn, Cyanide, Alkyl mercury, Alkyl benzyl sulphonates, Permanganate value, DO, BOD, COD, Total Coliform, Pesticides	2 samples/river × 1 river × 2 times = 4 samples Samples shall be taken from Nairobi River, one from up stream and one from down stream of the proposed site. The first sampling should be conducted on a dry day while the second one after a rainy day.	1 sample/river x 1 river x 2 times = 2 samples. Samples shall be taken from Nairobi River bottom, just in front of the proposed site. The first sampling should be conducted on a dry day while the second one after a rainy day.
Groundwater (Existing well and well to be constructed by the JICA Study Team for the hydrogeological survey)	pH, Colour, EC, Turbidity, Total Coliform, E. Coli, Chloride, Sulphate, Total Hardness, TDS, Permanganate, Nitrate, Nitrite, NH3, TN, Fluoride, Pb, Cr^{+6}, Cu, Fe, Mn, Ca, Mg, Na, Zn, Total Hg, As, Pesticides	1 sample/well × 2 wells × 2 times = 4 samples One sample shall be taken from an existing well at the entrance to the site and the other one from the well to be constructed by the JICA Study Team. The first sampling should be conducted on a dry day while the second one after a rainy day.	

Components	Parameters	Number of Samples	
		Water	Sediment*
Drinking Water (Existing pipeline or distribution system)	pH, Colour, EC, Turbidity, Total Coliform, E. Coli, , Chloride, Sulphate, Total Hardness, TDS, Permanganate, Nitrate, Nitrite, NH3, TN, Fluoride, Pb, Cr^{+6}, Cu, Fe, Mn, Ca, Mg, Na, Zn, Total Hg, As, Pesticides	1 sample/point × 2 points × 2 times = 4 samples The first sampling should be conducted on a dry day while the second one after a rainy day.	

Note: * Only heavy metals will be analysed in sediment.

Fauna and Flora

Existing species, endangered or not, habitat, etc., in the proposed area.

Landscape

Topography, geology, land use, etc.

Soil Contamination

For the soil contamination survey, the following items are required:

Table G.5.4 Items Required for the Soil Contamination Survey at Dandora

Component	Parameter	Number of Samples
Soil	Pb, Cr^{+6}, Cu, Fe, Mn, Zn, Total Hg, As	1 sample/point × 2 points = 2 samples One sample shall be taken from the center of the proposed site and the other from the Nairobi River Bank. Samples shall be taken from a depth of 50 cm.

Noise

2 sites × 1 time/hour × 24 hours = 48 samples

Site location shall be the same as those selected for the traffic survey.

Offensive Odour

H_2S:

2 sites × 2 times = 4 samples

NH_3:

2 sites × 2 times = 4 samples

Samples shall be taken from the centre of proposed site and the other from the Nairobi River Bank. One sampling should be conducted on a dry day while the other sampling, after a rainy day.

(ii) Social Environmental Aspects

Analysis of Population Affected by the Project

Manner of Subsistence

Income Level, Education Level

Population and Composition

Housing

Health Condition and Sanitation

Custom, Religion

Necessity of Resettlements

Traffic Survey

2 sites × 1 time/hour × 24 hours = 48 samples

One survey site shall be located on the main road and the other site on the road entering the proposed area.

(b) Public Consultation

The contractor shall conduct city-wide consultations with the affected groups and ensure public participation consistent with the Kenyan legal requirements. Besides, city-wide stakeholder consultations shall be conducted to allow their participation in the process.

(c) Analysis of Alternatives (Design, Location, Technology, etc.)

The contractor shall identify the alternative technologies and processes available and reasons for preferring the project sites, designs and technologies.

(d) Identification of Potential Impact and Impact Sources

The contractor shall identify the negative and positive environmental impacts on the natural and social environments (people affected either directly or indirectly) of the activities of decommissioning the Dandora Dumpsite and the construction and operation of project facilities in close consultation with all relevant stakeholders

(e) Assessment of Environmental Impacts

(f) Description of Preventive or Mitigation Measures against Adverse Effects

The contractor shall consider both policies and procedures in identified mitigation measures for the natural and social environment and specify the necessary training, human resource requirements, and emergency protocols to avoid pollution of the environment. Besides, the contractor shall propose measures to prevent health and safety hazards and ensure security in the working environment of employees, residents and the management in case of emergencies. The cost analysis for related mitigation measures shall be submitted.

(g) Environmental Management Plan

The contractor shall submit his environmental management plan for the mitigation of identified and predicted environmental impacts of the decommissioning activities of the Dandora Dumpsite and for the project cycle of the MRF.

(h) Environmental Monitoring Plan

The contractor shall submit his environmental monitoring plan for the whole cycle of the project

(i) Draft of EIA

(3) Public Awareness Survey (for both sites)

The public awareness survey shall include:

(a) Necessity of new disposal site, closure of the Dandora Dumpsite, and construction of MRF.

(b) Environmental degradation of Nairobi City due to waste.

(c) Importance of sanitary improvement.

(d) Willingness to participate in the SWM improvement of Nairobi City.

This survey shall be conducted through interview with people who will be benefited and/or affected by the Project. The number of families to be interviewed by income group and by division shall be as follows:

Table G.5.5 Number of Families Proposed for the Public Awareness Survey

Item No.	Division	Income Group	Number of Families
1	Central	High income	6
		Middle income	6
		Low income	12
		Slum	15
2	Dagoretti	High income	6
		Middle income	6
		Low income	12
		Slum	15
3	Embakasi	High income	6
		Middle income	6
		Low income	12
		Slum	15
4	Kasarani	High income	6
		Middle income	6
		Low income	12
		Slum	15
5	Kibera	High income	6
		Middle income	6
		Low income	12
		Slum	15
6	Makadara	High income	6
		Middle income	6
		Low income	12
		Slum	15
7	Pumwani	High income	6
		Middle income	6
		Low income	12
		Slum	15
8	Westlands	High income	6
		Middle income	6
		Low income	12
		Slum	15
9	Communities surrounding of candidate sites (Ruai and Dandora)		150
		Total	**462**

Note: Locations shall be as agreed with the Kenyan counterpart.

5.3 Methodology

5.3.1 Data Collection and Analysis Methods

Execution of the EIA will start with the collection of existing data and information on natural and social environment in and around the candidate sites. These data, called primary data, which may be available in relevant institutions or agencies, will be used for further analysis work on the environmental components of the Study. In addition, information on specific items shall be obtained through field investigation and measurement.

Kenyan Standards shall be used for analysing the environmental components described in the scope of work. Presently, however, some standards are still in the process of formulation and, in these special cases, international standards shall be used.

5.3.2 Methods for Identification of Impacts and Determination of Significant Impacts

(1) Identification of Impacts and Impact Sources

Environmental impacts and impact sources shall be predicted for each phase of project implementation, i.e., construction, operation and closure of the disposal site, and should be generally made with the use of quantitative data. If such data is difficult to obtain, qualitative prediction procedures shall be used.

(2) Significant Impacts

The significance of environmental impacts shall be shown in three levels; i.e., high, moderate and low, in accordance with the magnitude of impact in each phase. Significant impacts shall be determined on the basis of non-negligible environmental changes induced by project implementation.

5.3.3 Method of Assessment of Environmental Impacts

The forecasting results shall be assessed by comparing them with the values specified in the standards used as assessment targets and also with analogous precedents.

5.4 EIA Study Team

A professional EIA multi-disciplinary team shall undertake the work through the leadership of a NEMA registered and licensed EIA firm with experiences on domestic solid waste management and similar projects. The Team shall include, at least, an environmental engineer, environmental scientists and a socio-economist.

5.5 EIA Schedule

The EIA shall be completed within two (2) calendar months for field works including report compilation and submission to NEMA.

5.6 Report

The Environmental Impact Assessment shall be completed on schedule. One (1) set of the Completion Report shall be submitted to NEMA for approval, and one (1) set shall be submitted to the JICA Study Team. The contractor will be responsible for organising and facilitating public hearings for the purpose of obtaining the EIA license.

The contractor shall take the necessary follow-up actions until the final approval of the Report by the Government of Kenya is issued.

5.7 JICA Guidelines

The contractor, aside from the Kenyan laws and regulations, shall take into account for the execution of the EIA the JICA Guidelines for Environmental and Social Considerations, the JICA Operational Procedures for Finance, and the other international finance corporation performance standards as may be applicable.

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