



ATHI WATER SERVICES BOARD

CONSULTANCY SERVICES FOR PRELIMINARY AND DETAILED DESIGN AND TENDER DOCUMENTATION FOR THE NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NaRSIP) PHASE II

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

FRAME Consultants Ltd

Consulting Civil, Structural & Geotechnical
Engineers

Pension Towers, Loita Street

P.O. Box 58624-00200 Nairobi, Kenya

Tel: 020 2213744/2251505

Fax: 020 2213990

E-mail: info@frameconsultants.com

Website: www.frameconsultants.com

Athi Water Services Board

Africa Re-Centre 3rd Flr, Hospital Rd

P.O Box 45283-00100 Nairobi, Kenya

Tel: 254 020 2724292/3

Fax: 254 020 2724295

Email: info@awsboard.go.ke

Website: www.awsboard.go.ke

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NEMA REPORT SUBMISSION DETAILS

Completed By:

SignedDate.....

Frame Consultants Limited

LEAD EXPERT NEMA REG NO. 1711

PROPONENT

SignedDate.....

Name.....

ATHI WATER SERVICES BOARD (AWSB)

HEAD PLANNING AND ENGINEERING SERVICES DEPARTMENT

Disclaimer:

This Environmental Impact Assessment Study Report is based on literature review, preliminary feasibility and design reports and findings from field assessment. It is strictly confidential and any materials thereof should strictly be used in accordance with agreement from the management of Athi Water Services Board (AWSB). It is however, subject to conditions in the Environmental Management and Coordination Act 1999, Environmental (Impact Assessment and Audit) Regulations, 2003 and African Development Bank Operation Safeguards Policies 1,2,3,4,&5.

LIST OF ACRONYMS

AFDB	African Development Bank
AWSB	Athi Water Services Board
BOD	Biological Oxygen Demand
EA	Environmental Assessment
EHS	Environment Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMMP	Environment and Social Management & Monitoring Plan
EMCA	Environmental Management and Coordination Act
KFS	Kenya Forest Service
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Services
NARSIP	Nairobi Rivers Sewerage Improvement Project
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NCWSC	Nairobi City Water and Sewerage Company
OS	Operation Safeguards
PAPs	Project Affected Persons
PPP	Private Public Participation
RAP	Resettlement Action Plan
SDGs	Sustainable Development Goals
WRMA	Water Resources Management Authority
WWTP	Waste Water Treatment Plant
WSPs	Waste Stabilization Ponds

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EXECUTIVE SUMMARY

Introduction:

The Nairobi Master Plan for Sewer, Sanitation and Drainage Study, carried out under the Third Nairobi Water Supply Project, was undertaken to provide a complete record of existing sewerage and drainage facilities and to identify and propose a phased development schedule for sewerage and drainage systems up to the year 2020.

The Master Plan for sewerage expansion in Nairobi was first developed in 1973 and reviewed and updated in 1998. AWSB conducted a study geared towards determining whether the feasibility and design propositions given in the 1998 Master Plan still hold while taking into account future demand within the project area.

To validate the master plan, AWSB used various reports and studies carried out in the year 2005 and 2007, on water demand, sewer flow estimates, demographics, socio-economic status and current state of infrastructure. AWSB also used a report on Hydraulic Modeling, prepared in 2007, that modeled the existing trunk sewers in order to check their suitability in coping with the current sewage flows.

The information gathered by AWSB was used to project sewage generation up to the year 2030 used to prepare and recommend immediate works to be implemented.

Following these studies, the Government of Kenya through AWSB is implementing the Nairobi Rivers Sewerage Improvement Project (NARSIP I) which was to be completed in June 2016. Despite implementation of NARSIP I, the sewerage coverage remains significantly low resulting in highly polluted rivers within Nairobi City. To scale up works under NARSIP I and increase sanitation coverage to about 70% it is now proposed that Nairobi Rivers Sewerage Improvement Project Phase 2 (NARSIP-II) be undertaken.

The Government of Kenya (GoK), recognizing the magnitude of the problem has requested the AFDB Bank for support to develop wastewater facilities in order to enhance the sustainable management of the Nairobi urban environment. The Nairobi Rivers Service Improvement Project (NARSIP II) is one of the bank financed projects

This Project Report gives the findings of the Environmental and Social Impact Assessment Study undertaken as an integral part of the design process. The Project highlights salient social and environmental issues associated with the design, construction and operational aspects of the NARSIP (II) project.

Scope of the project report:

The study has been conducted to evaluate the potential and foreseeable impacts of the proposed NARSIP phase 11 project. The physical scope is limited to the proposed sites and the immediate environment as may be affected by or may affect the proposed project. Any potential impacts are also evaluated as guided by EMCA 2015, Environmental (Impact assessment and Audit) Regulations 2003 and AFDB Group's Integrated Safeguards System (Policy statement and Operational safeguards).

Study Methodology:

The systematic investigative and reporting methodology specified for conduct of Project Report Studies (Legal Notice 101 of EMCA) was adopted in this Study. Baseline data on project design was generated through discussion with the client and review of project documentation. Opinions formed were revalidated through field work entailing site investigations and interviews with potentially affected people and secondary stakeholders.

To identify, predict, analyze and evaluate potential impacts that may emanate from the project, diverse study methods and tools including use of checklists, expert opinions, field visits and public participation were employed. An Environmental and Social Management Plan comprising of an impact mitigation plan and modalities for monitoring and evaluation were then developed to guide environmental management during all phases of project development.

The Study Team:

This Project Report Study was undertaken by a team of experts from Frame Consultants Limited, all registered by NEMA under the Lead Expert category.

Policy, Legal and Regulatory Framework:

This Project Report has been developed to ensure that the proposed project is in conformity with National policy aspirations towards securing sustainable development. Specifically, this Report has been developed to ensure compliance with requirements of the Environmental Management and Coordination Act (EMCA) 2015-Kenya's supreme environmental law and the National Constitution. Section 58 of EMCA requires that all development proposed in Kenya to be subjected to environmental assessment to be conducted in line with the Second Schedule (of EMCA) and the Legal Notice 101 (Regulations for Environmental Assessment and Audit) of June 2003. The entire Study process has been designed to conform to the regulatory framework stipulated by the National Environmental Management Authority (NEMA)-the body that will review this report and make decisions on grant of an environmental license to the development.

Project Description:

The project is owned by the Republic of Kenya through the implementing agency, Athi Water Services Board (AWSB), and is being financed by the African Development Bank.

AWSB intends to implement the Second Stage of the NaRSIP Programme, with extension and duplication of the existing sewerage system and construction of lateral sewers within Nairobi. The priority areas of implementation based on the level of development is as follows:

1. Construction of 81 Km trunk sewers. This will include:
 - Duplication of Dandora box culvert from Gatharaini Junction to Njiru Junction - 3 km.
 - Reconstruction/Upgrading of Uhuru Highway Trunk Sewer to Mater Hospital - 2km.
 - Duplication of Mombasa Road Enterprise Trunk Sewer - 3km.
 - Extension of Mombasa Road Enterprise Trunk Sewer – 2km.
 - Reconstruction of Kirichwa Kubwa trunk sewer - 4km.
 - Duplication of Nairobi River/ Eastleigh Trunk Sewer from Eastleigh to Kariobangi and extend to the confluence of Gitathuru and Nairobi River- 10km.
 - Duplication of parklands trunk sewers - 4km.
 - Extension of Parklands Trunk Sewers - 2km.
 - Extension of Karen Trunk sewer - 8km.
 - Gitathuru TS extension/duplication to Kitsuru - 4km.
 - Ruiruaka River TS extension to Ruaka - 3.5km.
 - Old Airport Road (Utawala Area) trunk sewer extension -5km.
 - Upgrading Milimani Chiromo Trunk Sewers - 8km.
 - Extension of Umoja TS from Umoja to Saika -5km.
 - Riruta South Trunk sewer Extension - 3km.
 - Mathare River Trunk sewer extension - 3Km.
 - Extension of south Nairobi Dam trunk sewer – 2km.
 - Ngara Trunk Sewers – 10km
2. Construction of 190 Km lateral and reticulation sewers. This will include:
 - Karen Reticulation - 10km.
 - Dagoretti - 5km.
 - Embakasi reticulation - 10km.
 - Mihango Reticulation - 10km.
 - Embakasi reticulation - 20km.
 - Mihango reticulation -10km.
 - Kilimani reticulation – 10km.
 - Kileleshwa reticulation – 10km.
 - Upper hill – 10km
 - Westlands sewer upgrade – 10km
 - Eastleigh sewer upgrade – 10km
 - Tassia 1 & 2 reticulation – 10km
 - Umoja Innercore reticulation – 10km
 - Kariobangi South – Umoja III – 10km
 - Kangemi reticulation – 5km
 - Mathare North and Huruma reticulation – 10km

- Thome / Garden Estate- 10km
 - Babadogo / Lucky Summer – 10km
 - Maili Saba – 10km
 - Marurui – 10km
 - Mountain View – 5km
 - Marura – Kariobangi North – 10km
 - Satelite reticulation – 5km
3. Construction of anaerobic, facultative and maturation ponds at DESTP site to convert Kiu River pumping system to Ponds

PPC and Stakeholder Consultation:

Diverse approaches were applied in stakeholder engagement as follows: - Consultative forums, administration of questionnaires, discussions with the client and public meetings

Findings of the Study:**(i) Potential positive impacts anticipated:**

The core observation of this Study is that the proposed project is aimed at improving sewerage connectivity within Nairobi area. As such, the project in itself is already an activity in mitigation of an existing concern and this is the prime justification of the proposed investment.

Other positive implications of the project will accrue from its potential to create short-term business and employment opportunities to both professional staff and workers during the design phase while, at construction phase, traders will benefit from opportunities to supply construction material while locals will be employed in works. Upon commissioning, the project will improve the sanitation conditions in the area leading to improved ground water quality, upgrade in real estate value and economic benefits by saving healthcare expenses among other benefits.

(ii) Potential Negative impacts:

Some people who are mostly farmers along the riparian area are likely to be displaced by the project as the Trunk lines will be laid in the riparian areas. To mitigate displacement impacts, adequate notices will be done before the project starts. A RAP Report is being prepared to guide in implementing the mitigation measures.

The construction activities will also introduce nuisances such as traffic diversion, dust, noise, vibrations and fumes. Social vices associated with influx of job seekers can disturb the social order and even lay the ground for escalation of HIV/AIDS cases whose impacts are likely to be prolonged in prevalence. These negative impacts however can be effectively managed through the use of the ESMMP that has been developed in this Project Report.

The ESMMP:

An ESMMP has been developed whose pursuit can greatly improve the overall net effect of the project. This Report observes that the bulk of adverse impacts will manifest at the Construction stage in which case, the core effort in mitigation will be concentrated in the contract for construction. This Report therefore requires that the ESMMP be integrated into the Design Report with appropriate allocation of funds in the Bills of Quantities. The contract for construction should bear clauses binding the contractor to implement impact mitigation as part of the civil works.

Total Cost of the Project:

KSHs. 9,667,463,367.00

Time Frame:

The implementation of Nairobi Sewerage Improvement Programme Phase II is expected to take about 5 years.

Recommendations of this Project Report:

In the view of this study, the project as currently proposed is environmentally sound. An ESMMP has been outlined to guide resolution of potential adverse impacts while enhancing the positive ones, the recommendation is for this project to be granted environmental licensing to pave the way for implementation.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

The Nairobi Master Plan for Sewer, Sanitation and Drainage Study, carried out under the Third Nairobi Water Supply Project, was undertaken to provide a complete record of existing sewerage and drainage facilities and to identify and propose a phased development schedule for sewerage and drainage systems up to the year 2020.

The Master Plan for sewerage expansion in Nairobi was first developed in 1973 and reviewed and updated in 1998. AWSB conducted a study geared towards determining whether the feasibility and design propositions given in the 1998 Master Plan still hold while taking into account future demand within the project area.

To validate the master plan, AWSB used various reports and studies carried out in the year 2005 and 2007, on water demand, sewer flow estimates, demographics, socio-economic status and current state of infrastructure. AWSB also used a report on Hydraulic Modeling, prepared in 2007, that modeled the existing trunk sewers in order to check their suitability in coping with the current sewage flows.

The information gathered by AWSB was used to project sewage generation up to the year 2030 used to prepare and recommend immediate works to be implemented.

Following these studies, the Government of Kenya through AWSB is implementing the Nairobi Rivers Sewerage Improvement Project (NARSIP I) which was to be completed in June 2016. Despite implementation of NARSIP I, the sewerage coverage remains significantly low resulting in highly polluted rivers within Nairobi City. To scale up works under NARSIP I and increase sanitation coverage to about 70% it is now proposed that Nairobi Rivers Sewerage Improvement Project Phase 2 (NARSIP-II) be undertaken.

The growth of Nairobi city has surpassed the rate at which infrastructure is developed to meet the needs of the growing population. Urbanization, population growth, and industrialization are putting enormous pressure on the Nairobi Rivers – Mathare, Ngong, Athi and Kiu – the main source of water supply for the city. The rivers are heavily polluted from both domestic and industrial waste which is discharged directly into the rivers without being treated and adversely impacting its ecology. The existing sewer network infrastructure covers an approximate area of 208km² which is 30% of total coverage in the city. The Government of Kenya (GoK), recognizing the magnitude of the problem has requested the AFDB Bank for support to develop wastewater facilities in order to enhance the sustainable management of the Nairobi urban environment. The Nairobi Rivers Service Improvement Project (NARSIP) is one of the bank financed projects

Legal requirements contained in the Environmental Management and Coordination Act, EMCA 1999 Environmental (Impact Assessment and Audit) Regulations 2003 requires that an ESIA for the proposed project to be carried out. This is an effort to find out the likely negative impacts of the proposed development to the environment and resources thereof.

1.2 PROJECT PROPONENT

The project is being implemented by the Athi Water Services Board herein referred to as the Proponent.

Athi Water is one of the eight Water Boards under the Ministry of Environment, Water and Natural Resources created to bring about efficiency, economy and sustainability in the provision of water and sewerage services in Kenya. AWSB is created under Section 51 of the Water Act 2002 serving a population of over 4.5 million.

The Board ensures the provision of quality and affordable water and sewerage services in its area of jurisdiction through its twelve (12 No.) appointed Water Services Providers (WSPs) namely:

- Nairobi Water and Sewerage Company
- Thika Water and Sanitation Company
- Limuru Water and Sewerage Company
- Ruiru-Juja Water and Sanitation Company
- Runda Water Ltd
- Kikuyu Water Company
- Karuri Water and Sanitation Company
- Gatundu Water and Sewerage Company
- Githunguri Water and Sewerage Company
- Gatanga Community Water Scheme
- Kiambu Water and Sanitation Company
- Karimenu Community Water and Sanitation Company

The Proponent is a product of the reforms initiated in the Water Sector after enactment of Water Act 2002 to provide for the enabling legal and institutional framework for more effective management, conservation, use and control of water resources. The National Water Policy has four broad objectives: -

- To preserve, conserve and protect available water resources and allocate them in a sustainable rational and economic way,
- To supply water of good quality and in sufficient quantities to meet the various water needs,
- To establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector, and
- To develop a sound and sustainable financing mechanism for effective water resources management.

1.3 PROJECT JUSTIFICATION

- Nairobi city has a population presently estimated at 3.6 million people with a population growth rate of 2.7% p.a. Most of these people live in the formal peri urban areas which despite having good housing and yard water connections have no water borne sewer network.
- There's need to ease or reduce pressure on the already installed sewerage network such as in Kilimani, Kileleshwa, Karen and Lavington where re-development is currently taking place.
- The project will enhance progress towards achieving the Sustainable Development Goals (SDGs) on sanitation and environment.
- Despite the implementation of NARSIP I further reduction of pollution from domestic waste effluent to Athi river basin water system is required.
- Exploit the synergy that exists between water, sanitation and health aspects in socio-economic development.
- There is existing un-utilized waste water treatment capacity of 50,000m³/day that needs to be optimized.
- Nairobi soils are not suitable for onsite sanitation facilities leading to flows of raw sewage to rivers and open drains.
- With sewerage projects being requiring huge initial capital outlays, and with the historical perspective of sanitation being considered as a secondary priority to water issues, sewerage infrastructure development for Nairobi have greatly lagged behind development of water infrastructure.
- Development of an effective sewerage system for Nairobi city will reduce pollution and ensure that the vital Athi river basin remains sustainable as a water source to communities downstream and urban centers up to the Indian Ocean.
- An effective sewerage system for Nairobi will assure the city place as an international social, administrative, cultural and economic center amongst other great cities of the world.

1.4 SCOPE OF THE ESIA STUDY

The study has been conducted to evaluate the potential and foreseeable impacts of the proposed NARSIP phase II project. The physical scope is limited to the proposed sites and the immediate environment as may be affected by or may affect the proposed project. Any potential impacts are also evaluated as guided by EMCA 2015, Environmental (Impact assessment and Audit) Regulations 2003 and AFDB Group's Integrated Safeguards System (Policy statement and Operational safeguards). This report includes an assessment of impacts of the proposed site and its environs with reference to the following:

- A review of policy, legal and administrative framework
- Description of the proposed project
- Review of the baseline information
- Assessment of the potential environmental impacts
- Proposition of project alternatives including no project option
- Development of mitigation measures
- Public consultations
- Environmental and Social Management and Monitoring Plan for project construction and implementation.

1.5 STUDY METHODOLOGY

The ESIA activities consisted of desk studies, fieldwork, interviews, questionnaires and Public Participation among others. The following activities were carried out

▪ Literature Review

Desk studies were carried out to review the available reports, development plans and maps in order to get relevant information about the study area.

Documents reviewed include:

- Feasibility Study Reports and Preliminary Designs of the Proposed Project Components
- National Environmental Acts and Regulations (EMCA 2015 and EIA/EA Regulations 2003) and
- African Development Bank (AfDB) Operational Safeguards Policies.

▪ Field visits

Field visits were conducted in the study area in order to collect and evaluate information on the bio physical and socio economic environment and to cross check the secondary data that were compiled during the desktop studies. Environmental data were recorded and potential impacts identified.

Baseline data on project design was generated through discussion with the client and review of project documentation. Opinions formed were revalidated through field work entailing site investigations and interviews with potentially affected people and key stakeholders.

▪ Questionnaires

Stakeholder comment sheets were prepared and administered to the project affected persons and to the neighbours of the proposed project.

To identify, predict, analyze and evaluate potential impacts that may emanate from the project, diverse study methods and tools including use of checklists, matrices, expert opinions and observations were employed.

▪ **Public Participation**

The assessment involved consultations with relevant stakeholders in the project area. The aim of stakeholder consultations was to give a platform for information sharing and opinion gathering in relation to the proposed project; consultations were done in form of public meetings and key informant interviews. The issues were then analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project.

1.6 PRESENTATION OF THE REPORT

The ESIA study as proposed above culminated with production of this Project Report designed to ensure that the proposed development complies with the Environmental Management and Coordination Act (EMCA, 2015). The report is organized in chapters as outlined below: -

Chapter 1: Background Information to the Study

Chapter 2: Project Description

Chapter 3: Policy, Legal and Regulatory Framework Policy, Legal, Institutional and Administrative Framework

Chapter 4: Baseline Information of the Study Area

Chapter 5: Public Participation and Responses

Chapter 6: Alternatives to the Project

Chapter 7: Identification of Potential Impacts and Mitigation measures

Chapter 8: Environmental and Social Management and Monitoring Plan (ESMMP)

Chapter 9: Conclusion and Recommendations

CHAPTER TWO: PROJECT DESCRIPTION

2.1 OWNERSHIP

The project is owned by the Republic of Kenya through the implementing agency, Athi Water Services Board (AWSB), and is being financed by the African Development Bank.

2.2 LOCATION

The Nairobi area is split into regions that are easier managed by the Nairobi City Water and Sewerage Company. These regions are further split into zones. The regions and zones are summarized below:

a. Nairobi Southern Region

The Nairobi Southern Region covers the following zones and areas:

- Zone 1 – Kilimani, Kileleshwa, Lavington, Hurlingham, Riverside, Ngong Road
- Zone 2 – Kibera, Woodley, Jamuhuri, Golf course, Magiwa, Highview
- Zone 3 – Karen, Langata

b. Nairobi Central Region

The Nairobi Central Region covers the following zones and areas:

- Zone 1 – Upperhill, CBD, Ngara
- Zone 2 – South C and surrounding estates
- Zone 3 – Industrial Area, Nairobi West, Plainsview, South B, Diamond Park

c. Nairobi Eastern Region

The Nairobi Eastern Region covers the following zones and areas:

- Zone 1 – Kayole
- Zone 2 – Komarock
- Zone 3 – Umoja
- Zone 4 – Industrial Area
- Zone 5 – Embakasi
- Zone 6 – Donholm

d. Nairobi Northern Region

e. Nairobi North-Eastern Region

The Nairobi Northeastern Region covers the following zones and areas:

- Zone 1 – Kangundo Road
- Zone 2 – Babandogo/Dandora
- Zone 3 – Jogoo Road
- Zone 4 – Buruburu

- Zone 5 – Eastleigh

f. Nairobi Western Region

The Nairobi Western Region covers the following zones and areas:

- Zone 1 – Parklands, Westlands
- Zone 2 – Spring Valley, Kangemi, Raphta Road, Gigiri, Kyuna, Loresho, Ruaka, Uthiru
- Zone 3 – Lavington, Kawangware, Dagoretti, Kinoo

2.3 SCOPE OF WORKS

AWSB intends to implement the Second Stage of the NaRSIP Programme, with extension and duplication of the existing sewerage system and construction of lateral sewers within Nairobi.

The priority areas of implementation based on the level of development is as follows:

4. Construction of 81 Km trunk sewers
5. Construction of 190 Km lateral and reticulation sewers
6. Construction of anaerobic, facultative and maturation ponds at DESTP site to convert Kiu River pumping system to Ponds

Below is an outline of the sewerage components making up the Nairobi Rivers sewerage Improvement Project Phase II (NaRSIP II). The basis of this plan is the previous studies carried out in Nairobi region as outlined in the sewerage master plan which was later validated by AWSB and complemented by information from NCWSC. The consultant will carry out preliminary design, detailed design, and tender documentation of the sewer services outlined below.

- a. Construction of 81 Km trunk sewers.
 - Duplication of Dandora box culvert from Gatharaini Junction to Njiru Junction - 3 km.
 - Reconstruction/Upgrading of Uhuru Highway Trunk Sewer to Mater Hospital - 2km.
 - Duplication of Mombasa Road Enterprise Trunk Sewer - 3km.
 - Extension of Mombasa Road Enterprise Trunk Sewer – 2km.
 - Reconstruction of Kirichwa Kubwa trunk sewer - 4km.
 - Duplication of Nairobi River/ Eastleigh Trunk Sewer from Eastleigh to Kariobangi and extend to the confluence of Gitathuru and Nairobi River- 10km.
 - Duplication of parklands trunk sewers - 4km.
 - Extension of Parklands Trunk Sewers - 2km.
 - Extension of Karen Trunk sewer - 8km.
 - Gitathuru TS extension/duplication to Kitsuru - 4km.
 - Ruiruaka River TS extension to Ruaka - 3.5km.
 - Old Airport Road (Utawala Area) trunk sewer extension -5km.

- Upgrading Milimani Chiromo Trunk Sewers - 8km.
 - Extension of Umoja TS from Umoja to Saika -5km.
 - Riruta South Trunk sewer Extension - 3km.
 - Mathare River Trunk sewer extension - 3Km.
 - Extension of south Nairobi Dam trunk sewer – 2km.
 - Ngara Trunk Sewers – 10km
- b. Construction of 190km lateral and reticulation sewers.
- Karen Reticulation - 10km.
 - Dagoretti - 5km.
 - Embakasi reticulation - 10km.
 - Mihango Reticulation - 10km.
 - Embakasi reticulation - 20km.
 - Mihango reticulation -10km.
 - Kilimani reticulation – 10km.
 - Kileleshwa reticulation – 10km.
 - Upper hill – 10km
 - Westlands sewer upgrade – 10km
 - Eastleigh sewer upgrade – 10km
 - Tassia 1 & 2 reticulation – 10km
 - Umoja Innercore reticulation – 10km
 - Kariobangi South – Umoja III – 10km
 - Kangemi reticulation – 5km
 - Mathare North and Huruma reticulation – 10km
 - Thome / Garden Estate- 10km
 - Babadogo / Lucky Summer – 10km
 - Maili Saba – 10km
 - Marurui – 10km
 - Mountain View – 5km
 - Marura – Kariobangi North – 10km
 - Satellite reticulation – 5km
- c. Construction of anaerobic, facultative and maturation ponds at the DESTW site to convert Kiu River pumping system to Ponds.

2.4 PROJECT ACTIVITIES AND COST

The location of the Waste Stabilization Ponds is recommended to be next to the Series 8 ponds for the existing DESTW WSP. This is land that has been designated for sewerage purposes. The main form of land use here is residential where squatters have built permanent houses. These will be given a notice to vacate before construction starts and will not be

allowed to come back in any of the project phases. The proposed STW area will be located at least 400m away from the nearest residential area.

This ESIA suggests that a buffer area of trees and other vegetation is retained generally around the perimeter of the development site which will serve as natural wind breakers to reduce the level of dispersion of dust particles generated during the construction phase of the development.

It also suggests provision of adequate buffer area, such as trees, or fences, between processing areas and potential receptors during the operational phase of the project to reduce odour from the WSP.

Along the trunk sewers the main land use is crop farming and structures erected on the riparian. These include masonry walls and semi – permanent and permanent buildings. These will be compensated for before the project commences.

Project phase determines the activities in question. Phases of the proposed project are:

a. Pre-construction.

Specific activities in this phase include:

- Confirmation of Trunk Sewer Routes through Surveying.
- Pegging of trunk sewer route.
- Site clearance.
- Securing the site through fencing
- Erection of site office and contractors camp.
- Compensation of and resettlement of PAPs whose land is taken by the proposed project.
- Mapping of underground infrastructure.
- Relocation of underground infrastructure where necessary.

b. Construction phase

- Excavation of the WSP site.
- Excavation of trenches for trunk sewers.
- Laying foundation of the WSPs.
- Masonry works on the WSPs
- Procurement and stockpiling of materials on the site.
- Laying of pipes along the TS.
- Backfilling.
- Blasting.
- Ballast crushing.

Table 1: Project Cost Estimates

DESCRIPTION	LOT I (KES)	LOT II (KES)	LOT III (KES)	TOTAL (KES)
Preliminaries and General Items	83,270,000	73,450,000	70,850,000	227,570,000
Trunk Sewers	627,889,107	1,592,622,225	869,060,108	3,089,571,439
Reticulation Sewers	664,046,163	667,972,220	787,881,752	2,119,900,135
Sewage Treatment Works	2,139,340,375	-	-	2,139,340,375
Sub-total (1)	3,514,545,645	2,334,044,445	1,727,791,859	7,576,381,949
10% for Contingencies	351,454,564	233,404,444	172,779,186	757,638,195
Sub-total (2)	3,866,000,209	2,567,448,889	1,900,571,045	8,334,020,144
16% VAT	618,560,033.49	410,791,822	304,091,367	1,333,443,223
GRAND TOTAL	4,484,560,243	2,978,240,712	2,204,662,412	9,667,463,367

2.5 LAND REQUIREMENT AND OWNERSHIP

The proposed land for the construction of the STW is 45 Hectares. Consultations with the local administration revealed that the land is owned by the government of Kenya. Currently the land has been occupied by squatters who are constructing permanent buildings for residential purposes. The local chief (Ruai) informed the ESIA team that there is no mother title for the land.

The Trunk and the reticulation sewers are passing through the riparian and road reserves which are government owned therefore no need of acquisition.

2.6 CONSTRUCTION MATERIALS

The pipe materials have been selected taking into consideration availability, durability and cost. Circular pipes have been adopted in this design. UPVC pipes are recommended for sewers with more less or equal to 300mm. Precast Concrete pipes have been adopted for the sewers greater than 300mm. Steel pipes are recommended for all river aerial crossings, Class A and B road crossings, rail crossing and deep sewers. Different pipe bedding types have been used depending on the nature of the ground. These have been classified as bedding type A, B, C, and D.

i. Concrete Pipes

Spun Concrete Pipes to relevant Kenyan and British Standards are manufactured locally by a number of Companies. They form the most common choice for Sewer Pipes. Spigot and

socket jointed pipes are manufactured in sizes ranging from 100mm to 915mm diameter, and ogee jointed pipes are available in sizes from 100mm to 1525 mm diameter.

Rubber ring, flexibly jointed pipes are manufactured in sizes ranging from 150mm to 975mm diameter and strength classes M and H, or reinforced. Pipes are vertically cast in vibrated moulds and supplied and supplied moulds and supplied with rubber rings. Rigid jointed pipes require jointing with tarred hessian and cement mortar.

ii. UPVC Pipes

Un-plasticised PVC pipes are manufactured in Kenya in metric sizes up to 450mm diameter. A number of firms are involved in production, including Polypipes Ltd and Eslon.

iii. Glass Fiber Reinforced Polyester (GRP) Pipes & Fittings

Glass fibre reinforced polyester pipes are imported and sizes range between nominal diameters 250mm to 4,000mm. They are lighter, corrosion resistant and are much easier to install when compared to Steel and Concrete pipes. The considerably higher costs associated with importation make them infeasible for long trunk lines and reticulation but will be explored for use in inter-pond connections.

A Comparison of costs for GRP, Steel and Concrete is summarized below:-

Table 2: Comparison of costs for GRP, Steel and Concrete

	GRP	STEEL	CONCRETE
Weight	Light	Heavy	Heavy
Service Life	70 years	35 years	50 years
Nested Transport			
Installation	Easy	Tough	Tough
Maintenance	Minimal	Minimal	Minimal
Corrosion Resistance	Good	Needs additional internal layer	Poor
Availability(Locally)	Not available	Available	Available

Source:-Superlit Pipe industries Inc.

iv. Steel Pipes

Steel pipes are manufactured locally. They are generally used in locations where sewers are exposed or in situations such as river crossings. Protection against corrosion is required internally and externally. Bitumen sheathing is normally used, the external sheathing generally being reinforced with glass fiber windings.

2.7 TIME FRAME

The implementation of Nairobi Sewerage Improvement Programme Phase II is expected to take about 5 years.

CHAPTER THREE: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This chapter outlines the policy, legal, regulatory and institutional framework for Environmental Management in Kenya which calls for compliance by all development Projects.

3.1 ENVIRONMENTAL POLICY FRAMEWORK

3.1.1 Constitution of Kenya

Article 42 of Bill of Rights of the Kenyan Constitution provides that every Kenyan has a right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislation and other measures.

Part II of Chapter 5 of the Constitution (Environment and Natural Resources), (I) the State clearly undertakes to carry out the following:

- Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment; Protect genetic resources and biological diversity;
- Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
- Eliminate processes and activities that are likely to endanger the environment;
-

Part (II) “Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Chapter 5 on Land and Environment emphasizes on the following:

- Land use and management shall by law benefit local communities
- Community land is protected from encroachment by State.
- Law shall protect Rivers, forests and water bodies.
- Equitable access to land.
- All lawful land rights are secured; only someone who has stolen land needs to worry.
- County governments will manage land in trust of the people according to the

constitution.

Relevance

The constitution of Kenya provides for sound management and sustainable development of all of Kenya's projects, both public and private investments. It also calls for the duty given to the Project proponent to cooperate with State organs and other persons to protect and conserve the environment as mentioned in Part II.

3.1.2 The National Environmental Action Plan (NEAP) 1994

According to this plan, it's recognized that the development projects on the environment i.e. industrial, economic and social development programs that do not take care of environmental considerations in their operations are not sustainable. Under the NEAP process, ESIA was introduced and among the key targets recognized were the industrialists, business community and local authorities.

Relevance

The Project shall implement the Environmental and Social Management and Monitoring Plan (ESMMP) to mitigate the impacts of the resulting impacts during the construction and operational phases of the project; this will ensure that the sensitive ecosystems are not destabilized by the subsequent Project activities

3.1.3 The National Water Resources Management Policy (1999)

It enhances the systematic development of water resources for all the sectors in promotion of the country's socio-economic development. It also recognizes the by-products of these developments as wastewater and therefore calls for development of appropriate sanitation systems to protect the people's health and water resources from institutional pollution. It is therefore imperative that these activities be accompanied by appropriate waste management plans. The policy also recommends that all such developments should undergo comprehensive EIA that will provide measures to protect environment and people's health in the neighbourhood of the project including the downwind communities. As its predecessor, the EMCA (1999) calls for annual Environmental Audits (EA) to ensure continuous implementation of Environmental Management Plans (EMP) proposed in the EIA and any other recommendations and issues arising. The policy requires that those who pollute water bodies must pay the full cost of remediation of the contaminated water; in tandem with the "Polluter Pays Principle."

3.1.4 Sessional paper No. 6 (1999)

Policy guidelines on environment and development – the key policy objectives of this paper includes:

- Ensuring that all development projects at the inception stage and programs, as well as policies consider environmental considerations.

- Ensuring that an EIA report is prepared for any undertaking or development project before implementation.
- Coming up with effluent treatment standards that will conform with acceptable health guidelines.
- It's important to note that issues of waste water management and human settlements are given prominence and therefore, the policy recommends re-use and recycling of residues i.e. waste water, use of low waste generation technologies and increasing public awareness on benefits of a clean environment. It also recognizes the role of stakeholders in all these initiatives within their localities.
- The paper encourages better planning in rural and urban areas in provision of needs i.e. water, drainage system, waste disposal facilities et al.

3.2 OVERVIEW OF RELEVANT LEGISLATION

The ESIA for this project is conducted in accordance with the requirements of the Environmental Management and Co-ordination Act, No. 8 of 2015 and the Environmental (Impact Assessment and Audit Regulations, 2003) Legal Notice No.101. In addition, the study takes into account other legislation related to the project. These include: the Water Act 2002, the Public Health Act Cap 242, the Physical Planning Act, the local Government Act Cap 265, the Forest Act (2005), the Agriculture Act, the Irrigation Act, and the AFDB safeguards.

For a long time, legal provisions touching various aspects of environmental protection and management were scattered in 77 different statutes. This set up did not offer adequate protection of the environment mainly due to weak legal and institutional framework and conflicts between the various Statutes and sectors. In (1999), a Bill to provide for the establishment of a comprehensive legal and institutional framework for the management and protection of the environment was enacted into law as the Environmental Management and Co-ordination Act, 1999 and received Presidential assent on 6th January, 2000. This Act has addressed the shortcomings of the previous legislation in that it has instituted controls and set up effective institutions.

3.2.1 The Environmental Management and Co-ordination Act, 2015

The main objective of EMCA (2015) and the related Regulations is to provide for the establishment of an appropriate legal and institutional framework including procedures for the management of the environment in Kenya. The Act further aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. In addition Act seeks to harmonize all the 77 sector specific legislation touching on the environment in a manner designed to ensure protection of the environment. This is in line with national objectives and sustainable development goals enunciated in Agenda 21 of the Earth Summit. As such, in

terms of environmental management, EMCA (1999) provides a comprehensive and an appropriately harmonized legal and institutional framework for the handling of all environmental issues in Kenya and supersedes all sectoral laws.

Part VI of EMCA (2015) makes provision for the carrying out of ESIA. It is mandatory for any person being a proponent of a project, to submit a project report to the NEMA in a prescribed format. After perusing the proponent report, and the NEMA is satisfied that the proposed project is likely to have significant negative impacts in the environment, it will direct the proponent of the project to undertake at his or her own expense an environmental impact assessment study and prepare a report. The NEMA shall publish such a report and invite comments thereon from the public before deciding to issue an environmental impact license. The NEMA, at any time after issuing the environmental impact assessment license, may direct the proponent to submit a fresh environmental impact study where there is substantial change in the project or where environmental threats, not earlier foreseen, have emerged.

Some key Sections of the Act relevant to the proposed project are:

Section 3 – Entitlement to Clean and Healthy Environment.

The Sewerage Project shall be entitled to maintain a clean and healthy environment and has a duty to safeguard and enhance environmental management in accordance with sub-sections 1, 2, 3, 4, and 5.

Section 50 – Biological Diversity

The proposed Sewerage project shall ensure that at the operation phases, conservation of biological diversity shall be observed as prescribed in (a) to (g) of this section

Section 51 & 52 – Biological resources

The project shall enforce all measures to ensure conservation of biological resources both in situ and ex situ to ensure species threatened with extinction are protected.

Section 78 – Air quality

The proponent shall enforce air quality standards and be maintained as per NEMA's Standard and Enforcement Review Committee requirements.

Section 87 – Handling and Disposal of Wastes

The proponent shall adhere to the disposal of wastes requirement in such a manner as not to cause pollution to the environment or ill health.

Section 102 – Excess Noise

Noise during operation of the project especially from the water pumps is prohibited and shall be maintained to the desirable levels as is also pointed out in Cap 394.

3.2.2 The Environmental Impact Assessment and Audit Regulations 2003(Legal Notice No. 101)

Regulation 24 – EIA licence: - Environmental Impact License shall be issued after the authority approves the study report under regulations 23, and shall be issued in form and accompanied by the prescribed fee of 0.1% of the total cost of the project.

Regulation 28 – false or incorrect information: -Substantial change or modification and when project poses an environmental threat or revelation that information or data given by the license were false, incorrect or intended to mislead.

Regulation 24 – Annual Environmental Audit: - Annual environmental auditing after presentation of an EIA study report shall be undertaken by the licensee to ensure the implementation of environmental management plan is audited on regular basis, an audit report submitted to NEMA annually and ensuring that the criteria to audit is based on environmental management plan developed during the EIA process or after the initial audit.

Regulation 40 - Monitoring changes after project implementation

Monitoring by NEMA and Lead Agencies shall be done to establish any possible changes in the environment and their possible impacts, immediate and long term effects of its operations, identify and determine parameters and measurable indicators and conduct changes that occurred after implementation.

The proposed project must have an ESIA license before implementation. Proponent has commissioned this ESIA study since the proposed project is listed in Second Schedule of EMCA, 1999.

3.2.3 Water Act, 2002

The Government of Kenya formulated the National Policy on water Resources management in 1999. This was on realizing that the arrangement then on water supply was inappropriate.

The National Policy on Water eventually gave birth to the Water Act 2002 whose main focus is: a. Provisions for involvement of the private sector in water services

b. Setting up a Water Regulator and Water Boards to ensure that water will be adequately distributed to all parts of the country

c. Provision to allow communities to run water projects.

Water Act 2002, is to provide for the management, conservation use and control of water resources and for the acquisition and regulation of rights to use water; provide for the regulation and management of water supply and sewerage services; to repeal the Water Act (Cap 372) and certain provisions of the Local Government Act; and for related purposes.

In Kenya water is regarded as a national resource and therefore owned by the state for and on behalf of the people (Section 3). Thus the Minister in charge of water is empowered under

the Act to control, plan and regulate the use of water. Further the Minister is vested with the duty to promote investigations, conservation and proper use of water.

The Act has set up subsidiary bodies with power to operate and regulate functions assigned to them by the Act such bodies include National water conservation and pipeline corporation and water resources management authority. The Act further gives conditions relating to construction of works in its Second Schedule. As such, the Client shall observe these conditions which are in line with the spirit of ESIA.

Relevance

This Act shall be relevant during both construction and operation phases of the Project whereby the contractor and proponent shall ensure that all relevant water resources are not polluted from both liquid and solid wastes.

The Proponent will work closely with WRMA and apply for discharge licenses after submitting an Effluent Discharge Control Plan. They will also seek authority for construction works crossing rivers.

3.2.4 The Public Health Act (Cap 242)

The Public Health Act is the principle instrument for ensuring the health and safety of the people. Its core function is the prevention of disease, treatment and care of the sick (curative services) and control of nuisance. The Act therefore makes regulations and lays standards for a healthy living environment. Part XI Section 129 of the Act places the responsibility of protecting water supplies on the local authorities.

The Ministry of Health is in charge of administration of the Act with the Director of medical services as the Principal Officer. However, where a municipality is capable of discharging responsibilities under the Act, such a municipality is designated as a local health authority in such a situation the relevant powers under the Act are delegated to the municipality but the Director of Medical Services may take over if the Authority is in default.

During the execution of the proposed project, this Act is relevant in various ways:

Section 115 during construction, a nuisance is prohibited especially for all conditions liable to be injurious or dangerous to health.

Section 118 Outlines nuisance liable to be dealt with i.e. accumulation or deposit of refuse, offal, manure or any other which is offensive or injurious or dangerous to health and an accumulation of stone, timber or other machine likely to harbour rats or rodents.

Section 126 rule 62 – Drainage & latrine rules. It is a statutory requirement that drainage, latrines, septic and conservancy tanks and any other pre- treatment methods of sewerage effluents seek written permission or/and approval from the local authority and be built in conformity to provisions of sub-rules (a) to (e) of this section.

Section 127 buildings for foodstuffs. In case a proposed project indicates the premises shall have a staff canteen, the proponent must consider using materials recommended by a medical officer of health and complemented by sub-sections (1) to (3) in these areas.

Sections 136 – 143 Breeding places of mosquitoes .The civil and building contractors will ensure that during construction, breeding places of mosquitoes and nuisance yards are kept free from bottles, whole or broken. The project area shall not be overgrown by grass, the wells etc to be covered together with the less pits. The gutters may be perforated; larva destroyed to eradicate mosquitoes completely as mere presence of mosquito larvae is an offence.

Section 163 – Powers of entry and inspection. It should be noted that a medical officer, health inspector or a police officer above the role of an inspector shall enforce compliance and offences are punishable by law.

Relevance

During construction, the Contractor will ensure acceptable health conditions are maintained in the camp site as per this Act. Proponent will operate and maintain the STW and sewers during operations to ensure they do not become a threat to public health.

3.2.5 Forest Act, 2005

The Forest Act, 2005 was enacted in November 2005 to repeal the Forest Act, Cap 385 and awaits the Minister to gazette the commencement date. The Act provides for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the social-economic development of the country, recognizing that forests play a vital role in the stabilization of soils, ground water, protecting water catchments, moderating climate by absorbing green house gases, provide the main locus of Kenya's biological diversity and a major habitat for wildlife. Its provisions apply to all forests and woodlands on state, local authority and private land of the country declared as provisional forest by the Minister. The administration of forests is headed by the established Kenya Forest Service managed by a board, regional forest conservation committees work under and community participation is integrated through forest community associations and forest user associations. The Act also establishes the forest management and conservation fund headed by a finance committee. The Act requires formulation of forest management plans for use in management of state, local and provisional forests, joint management of forests is allowed but governed by management agreement with the forest service. Indigenous forests and woodlands shall be managed on a sustainable basis and presidential decree for protection of trees can be issued. Variation of forest boundaries or revocation of state or local authority forests and state forest concession are subject to an independent EIA and public consultation. Mining and quarrying operations in the forest require board consent and has a re- vegetation condition on completion of activity. Director of KFS is required to maintain register of all licenses issued under the Act. Provisions of part VI and part XII of

EMCA'99 shall apply *mutatis mutandis* to and in respect of a license under this Act and any EIA as well as reference to the National Environment Tribunal required under this Act. The provisions of EMCA'99 regarding reference to the Tribunal established under that Act shall apply to the settlement of disputes arising under Forest Act, 2005. Offences under the Act are punishable under the law and citizens can petition High court for a declaration of contravention of the Act provisions. Thus the Act directs, regulates and harmonizes development and use of forests in the country. In addition, the Act provides a vital link with the Environment Management and Co-ordination Act.

Relevance

The proponent shall liaise with the KFS whereby the sewer line cuts across a forest. This will be for purposes of way leave and licensing before accessing the forest.

3.2.6 The Physical Planning Act, 1996

The Physical Planning Act, 1996 commenced operation in 1998 after its revision. The Act provides for the preparation and implementation of physical development plans and other related purposes. Its provisions apply to all parts of the country except those areas as the Minister may specify. Thus the Act directs, regulates and harmonizes development and use of land over the country. In addition, the Act provides a vital link with the Environment Management and Co-ordination Act. For example, Section 36 of the Act states that "In connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant will be required to submit together with the application an environmental impact assessment report". This reinforces EIA requirements under EMCA (1999).

The Act creates the office of the Director of Physical Planning who is an appointee of the Public Service Commission. The Director is the chief advisor to the government on all matters relating to the physical planning and in addition performs such functions as are conferred upon him by or under the Act.

However the Director at his discretion may delegate in writing any of his functions without diverting himself of such functions.

Under the act the director is assigned the responsibility of preparation of development plans. However, the control of development is vested in the respective local authorities. In the preparation of development plans, the act provides for the participation of the communities affected by such plans.

The Act establishes Physical Planning Liaison Committee at four levels namely; National, City of Nairobi, District and Municipality. The National Physical Planning Committee has the role of determining appeals lodged by aggrieved parties resolving matters referred to it

and generally advising the Minister. The other committees deal with complaints against the Directors, arbitration on claims, development applications and appeals by aggrieved parties against the Director or local authorities. The property owners therefore are accorded the right of appeal against adverse decisions of planning authorities.

Relevance

The proponent has sited the STW in an area designated for that purpose. This is in line with this Act.

3.2.7 The Malaria Prevention Act Cap 246**Section 5 – Drainage System**

No operations shall obstruct flow of water into or out of any drainage. The management shall be required to maintain the drainage system within the area of the project for removal of water from any land around the project to prevent larvae breeding.

Relevance

Proponent to operate and maintain the STW to ensure that there is no mosquito breeding.

3.2.8 The Penal Code Cap. 63**Section 191 – Fouling water**

The management shall ensure that no foul water of any public spring or reservoir is rendered unfit for the purpose for which it was ordinarily used for by the community.

Section 192 – Dwellings and Neighborhood

The operation phases of the project shall ensure that health of persons in general dwellings or carrying on business in the neighborhood or passing along a public facility are protected.

Section 193 - Offensive Trade

The proponent shall control loud noises or offensive and un wholesome smells so as not to interfere with the common rights of the people within the surrounding. This offence is punishable for common nuisance.

3.2.9 Occupational Health and Safety Act

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act.

Subsection 17 - Drainage of floors.

Where any process is carried on which renders the floor liable to be wet to such an extent that the wet is capable of being removed by drainage, effective means shall be provided and maintained for draining off the wet.

Subsection 18 - Sanitary conveniences.

Sufficient and suitable sanitary conveniences for persons employed in the factory/ work places shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences and where persons of both sexes are, such conveniences shall afford proper separate accommodation for persons of each sex.

Subsection 21 – Prime movers

Every flywheel directly connected to any prime mover and every moving part of any prime mover, shall be securely fenced, whether the flywheel or prime mover is to be situated in an engine –house or not .

Head and tailrace of every water wheel and of every water turbine shall be securely fenced. Every part of electric generators, motors and rotary converters and every flywheel directly connected thereto shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises as it would be if securely fenced.

Subsection 22 -Transmission Machinery

(1) Every part of transmission machinery shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises, as it would be if securely fenced.

(2) Efficient devices or appliances shall be provided and maintained in every room or place where work is carried on by which the power can promptly be cut-off from transmission machinery in that room or place.

(3) Every machine intended to be driven by mechanical power shall be provided with an efficient starting and stopping appliance, the control of which shall be in such a position as to be readily and conveniently operated by the person operating the machine.

Subsection 25 - Construction and maintenance of fencing

All fencing or other safeguards provided in pursuance of the a foregoing provisions shall be of substantial construction, constantly maintained, and kept in position while the parts required to be fenced or safe guarded are in motion or in use except when any such parts are necessarily exposed for examination and for any lubrication or adjustments shown by such examination to be immediately necessary.

Subsection 13 – Cleanliness

Every factory/work place shall be kept in a clean state and free from effluent arising from any drain, sanitary convenience or nuisance.

Subsection 14 – Overcrowding

A factory/ work place shall not while work is carried on be so overcrowded as to cause risk of injury to the health of the persons employed therein. Standard cubic space allowed for every person in a workroom should not be less than three hundred and fifty cubic feet.

Section 51 Air pollution

Preventive measures shall be put in place during operation of the project to prevent fumes and exhaust gases from entering into the atmosphere.

Relevance

The Proponent to ensure that provisions of the Act are adhered to as the ESMMP indicates.

3.2.10 Land Act, 2012

The Land Act 29(“LA”) is the Kenya’s framework legislation regulating compulsory acquisition of land (i.e. land, houses, easements etc.). The LA was adopted on 2nd May 2012 and provides for sustainable administration and management of land and land based resources including compulsory acquisition. The land Acquisition Process as spelt out in the Land Act involves the following steps: a. Proof that compulsory possession is for public good It is very explicit in the Land Act, 2012, Section 107, that whenever the national or county government is satisfied that it may be necessary to acquire some particular land under section 110 of Land Act 2012, the possession of the land must be necessary for public purpose or public interest, such as, in the interests of public defence, public safety, public order, public morality, public health, urban and planning, or the development or utilization of any property in such manner as to promote the public benefit. Irrigation and drainage are explicitly identified as qualifying for land acquisition as public utility and the necessity therefore is such as to afford reasonable justification for the causing of any hardship that may result to any person having right over the property, and so certifies in writing, possession of such land may be taken.

b. Respective Government agency or cabinet must seek approval of NLC.

The respective Cabinet Secretary or Government agency or the County Executive Committee

Member must submit a request for acquisition of private land to the NLC to acquire the land on its behalf. The Commission will prescribe a criteria and guidelines to be adhered to by the acquiring authorities in the acquisition of land. It is important to note that if the NLC is constituted prior to conclusion of land acquisition, it could prescribe criteria and guidelines necessitating variations or revisions to the current RAP. Similar, the Commission has powers to reject a request of an acquiring authority, to undertake an acquisition if it establishes that the request does not meet the requirements prescribed.

c. Inspection of Land to be acquired NLC may physically ascertain or satisfy itself whether the intended land is suitable for the public purpose, which the applying authority intends to use as specified. If it certifies that indeed the land is required for public purpose, it shall

express the satisfaction in writing and serve necessary notices to land owners and or approve the request made by acquiring authority intending to acquire land.

d. Publication of notice of intention to acquire Upon approval, NLC shall publish a notice of intention to acquire the land in the Kenya Gazette and County Gazette.³⁰ It will then serve a copy of the notice to every person interested in the land and deposit the same copy to the Registrar³¹ The courts have strictly interpreted this provision, requiring that the notice include the description of the land, indicate the public purpose for which the land is being acquired and state the name of the acquiring public body.³² NLC shall ensure that the provisions are included in her notice.

The Land Registrar shall then make entry in the master register on the intention to acquire as the office responsible for survey, at both national and county level, geo- references the land intended for acquisition.

e. Serve the notice of inquiry Thirty days after the publication of the Notice of Intention to Acquire, NLC will schedule a hearing for public inquiry. NLC must publish notice of this meeting in the Kenya Gazette and County gazette 15 days before the inquiry meeting and serve the notice on every person interested in the land to be acquired. Such notice must instruct owner of land to deliver to the NLC, no later than the date of the inquiry, a written claim for compensation.

f. Holding of a public hearing

NLC then convenes a public hearing not earlier than 30 days after publication of the Notice of Intention to Acquire. On the date of the hearing, NLC must conduct a full inquiry to determine the number of individuals who have legitimate claims on the land, the land value and the amount of compensation payable to each legitimate claimant. Besides, at the hearing, the Commission shall— make full inquiry into and determine who are the persons interested in the land; and receive written claims of compensation from those interested in the land. For the purposes of an inquiry, the Commission shall have all the powers of the Court to summon and examine witnesses, including the persons interested in the land, to administer oaths and affirmations and to compel the production and delivery to the Commission (NLC) of documents of title to the land.

The public body for whose purposes the land is being acquired, and every person interested in the land, is entitled to be heard, to produce evidence and to call and to question witnesses at an inquiry. It will also provide opportunity to land owners to hear the justification of the public authority in laying claims to acquire the land.

g. Valuation of the land

Part III of the Land Act 2012, section 113 (2a) states that “the Commission shall determine the value of land with conclusive evidence of (i) the size of land to be acquired; (ii) the value,

in the opinion of the Commission, of the land; (iii) the amount of compensation payable, whether the owners of land have or have not appeared at the inquiry.” This can be interpreted that NLC must determine the value of the land accordingly and pay appropriate just compensation in accordance with the principles and formulae that it will develop. Nonetheless, just compensation could also be interpreted as market rate. The final award on the value of the land shall be determined by NLC and shall not be invalidated by reason of discrepancy, which may be found to exist in the area.

h. Matters to be considered in determining compensation: The market value of the property, which is determined at the date of the publication of the acquisition notice must be considered. Determination of the value has to take into consideration the conditions of the title and the regulations that classify the land use e.g. agricultural, residential, commercial or industrial.

Increased market value is disregarded when:

- It is accrued by improvements made within two years before the date of the publication of the acquisition notice, unless it is proved that such improvement was made in good faith and not in contemplation of the proceedings for compulsory acquisition.
- It is accrued by land use contrary to the law or detrimental to the health of the occupiers of the premises or public health.
- Any damages sustained or likely to be sustained by reason of severing such land from other land owned by the claimant.
- Any damage sustained or likely to be sustained if the acquisition of the land had negative effects on other property owned by the claimant.
- Reasonable expenses, if as a consequence of the acquisition, the claimant was compelled to change his residence or place of business (i.e., compensation for disruption to the claimant’s life).
- Any damage from loss of profits over the land occurring between the date of the publication of the acquisition notice and the date the NLC takes possession of the land.

Matters not to be considered in determining compensation:

- The degree of urgency, which has led to the acquisition.
- Any disinclination of the person’s interest to part with the land.
- Damages sustained by the claimant, which will not represent a good cause of action.
- Damages, which are likely to be caused to the land after the publication of the acquisition notice or as a consequence of the future, land use.
- Increased land value accrued by its future use.
- Any development at the time of acquisition notice, unless these improvements were necessary for maintaining the land.

Relevance

This project follows a designated public reserve and has no issues of acquiring private land.

3.3 AFDB ENVIRONMENTAL AND SOCIAL OPERATIONAL SAFEGUARDS

- **Operational Safeguard 1: Environmental and social assessment**

This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.

- **Operational Safeguard 2: Involuntary resettlement, Land acquisition, population displacement and Compensation.**

This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and incorporates a number of refinements designed to improve the operational effectiveness of those requirements.

- **Operational Safeguard 3: Biodiversity and ecosystem services**

This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.

- **Operational Safeguard 4: Pollution prevention and control, hazardous materials and resource efficiency.**

This safeguard covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.

- **Operational Safeguard 5: Labour conditions, health and safety**

This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development

Relevance

The Project is being financed by AfDB, was therefore checked against the above listed operation safeguards and how the project activities are likely to trigger each.

Table 3: Project Activities Triggering AFDB Operational Safeguards

Policy	Criteria	Discussions
OS 1: Environmental and Social Assessment.	Yes	The Project components will trigger EA safeguards and is Category B due to the interaction with the physical, biological and social setting within the immediate surroundings
OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.	Yes	The Project shall be constructed within existing public land, road reserves and river riparian, however, isolated cases on encroachment to public land was indentified which implies that RAP has to be prepared as part of this assessment.
OS 3: Biodiversity and Ecosystem Services.	No	Project activities have no direct linkage to biological diversity and ecosystem services OS 1 shall be applied in isolated minor cases of biodiversity and ecosystem services.
OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.	Yes	<p>The Projects shall utilize raw materials both during construction and operation phase that could result to pollution of biophysical environment if not handled appropriately.</p> <p>Project activities shall not result to significant amount of green house gases, ESMMP has proposed measures of ensuring that methane gas generated from the anaerobic ponds is collected and flared appropriately sewer flows through the distribution lines by gravity hence reducing the need for pumping.</p>
OS 5: Labour Conditions, Health and Safety.	Yes	The Project shall involve workers both during construction and operation phases of the project. This policy read together with OSHA 2007 and IFC Performance Standards 2 on Labour and Working Conditions shall form integral instruments to be used in ensuring that health, safety and working conditions of both workers and community is maintained.

CHAPTER FOUR: BASELINE INFORMATION

4.1 INTRODUCTION

Baseline conditions entail the sum-total of all biophysical and geo-physical condition of the project area. Gathering of baseline data is necessary to meet the following objectives:

- To *understand* key social, cultural, economic, and political conditions in areas potentially affected by the proposed project;
- To *provide data* to predict, explain and substantiate possible impacts;
- To *understand* the expectations and concerns of a range of stakeholders on the proposed development ;
- To *inform* the development of mitigation measures; and
- To *benchmark* future socio-economic changes/impacts and assess the effectiveness of mitigation measures.

Most importantly, project activities interaction with the baseline conditions is what produces environmental impacts. Thus the need to understand it more concisely.

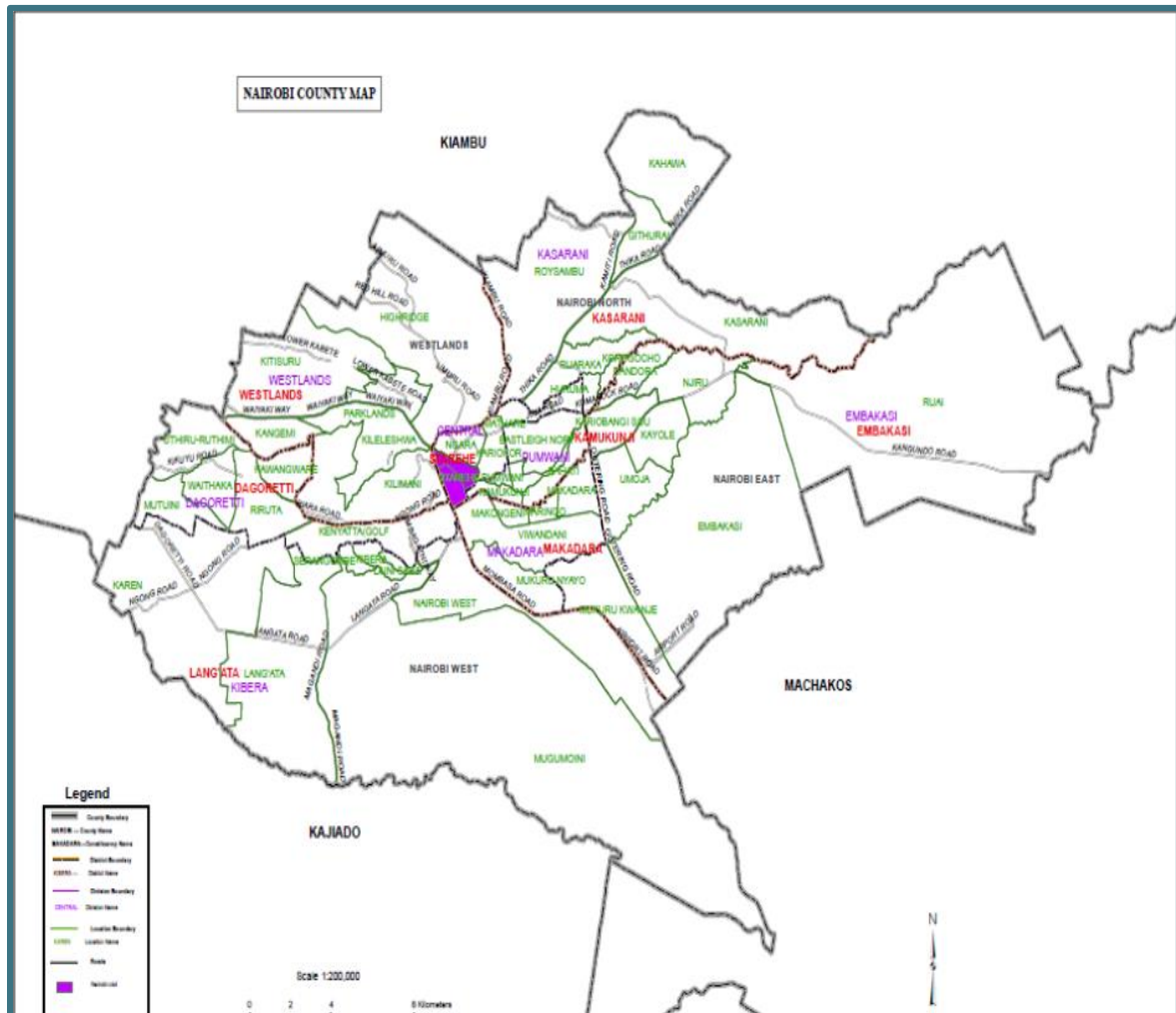
4.2 GEOGRAPHICAL CHARACTERISTICS OF PROJECT AREA

4.2.1 Location

The project location is Nairobi city, the administrative and commercial capital of the Republic of Kenya and seat of the government.

The city lies on the Nairobi River in the southern part of the country. It is located at latitude 1°17' south and longitude 36°49' east and occupies around 696 km².. The city has an elevation of 1660 meters (5,450ft) above sea level.

Nairobi borders Thika and Kiambu to the north, Machakos to the east and Kajiado to the South. It is situated between the cities of Kampala and Mombasa. It is close to the Rift valley. The Ngong hills are towards the west, Mount Kenya is towards the North and Mount Kilimanjaro is towards south – East.



Source: Kenya National Bureau of Statistics 2010

Figure 1: Nairobi County Map

4.2.2 Climate

Under the Koppen Climate Classification, Nairobi has a Subtropical Highland Climate. Evenings may be cool, especially in the June/July season, when the temperature can drop to 10 °C (50 °F). The sunniest and warmest part of the year is from December to March, when temperatures average the mid-twenties during the day. The mean maximum temperature for this period is 24 °C (75 °F).

There are two rainy seasons, but rainfall can be moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. As Nairobi is situated close to the equator, the differences between the seasons are minimal. The seasons are referred to as the wet and the dry season. The timing of sunrise and sunset varies little throughout the year for the same reason.

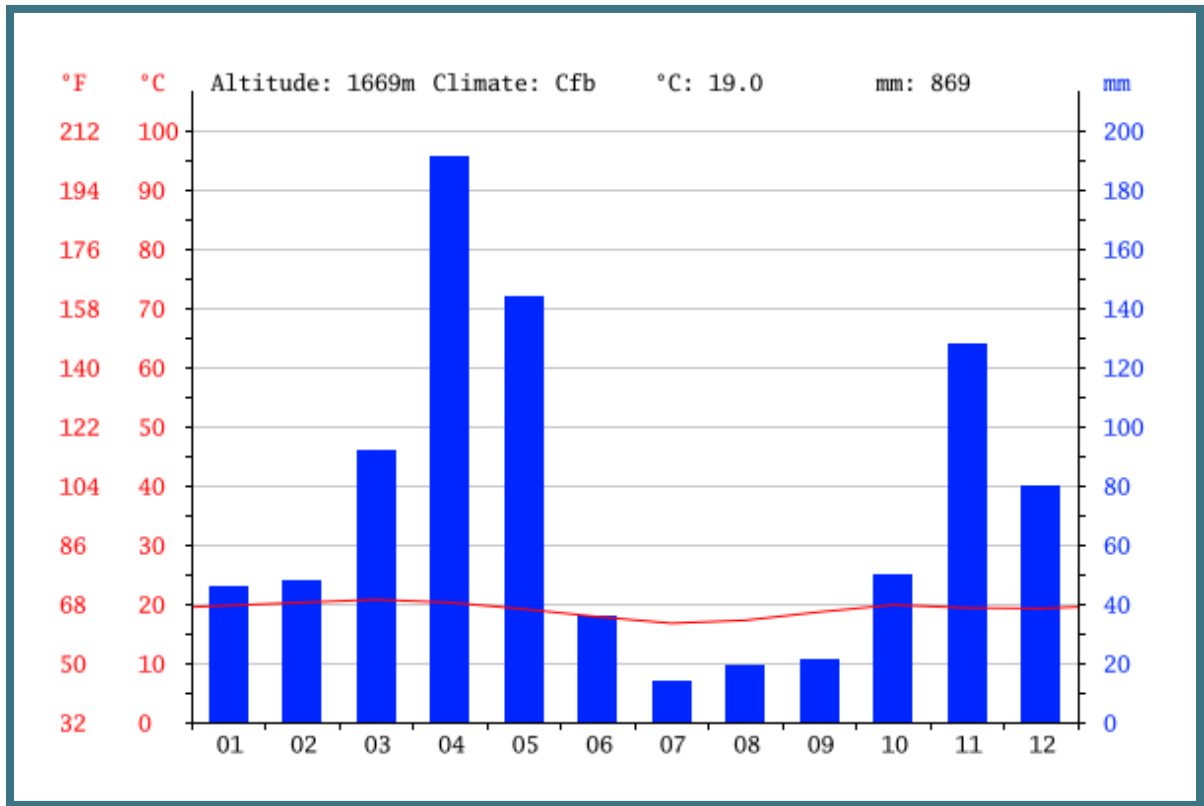


Figure 2 : Climate Graph for Nairobi

4.2.3 Topography

The city is characterized by undulating hilly topography with elevation in a range of 1,460 m to 1,920 m. Lowest elevation occurs at the Athi River at the eastern boundary of the city and highest at the western rim of the city.

The terrain in the eastern side of the County is gently rolling but divided by steep valleys towards the City boundaries. To the north, there is the Karura forest which is characterized by steep sided valleys. The Karen - Langata area is characterized by plains surrounded by Nairobi National Park on the east and Ngong Forest on the south.

Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong River and Kabuthi River.

4.2.4 Drainage

The three major rivers traversing Nairobi include the Nairobi River, Ngong River and Mathare River. The city is drained mainly by the Nairobi River and the Mokoyeti River, both of which are the tributaries of the Athi River. The former have four (4) main tributaries such as the Rui Ruaka, Mathare Nairobi, and Ngong rivers and the latter mainly drains the area of Nairobi National Park.

Nairobi's main drainage follows the regional slope of the volcanic rocks towards the east, while subsidiary internal drainage into the Rift region is confined to the western part. The lava plains east of the line Ruiru-Nairobi-Ngong are underlain by a succession of lava flows alternating with lakebeds, streams deposits, tuffs and volcanic ash. These plains, comprising mainly the Athi plains and the northern section of the Kapiti plain, extend westwards, rising from

4900 feet (1493 m) at the Athi River to 6000 feet (1829m) in the faulted region near Ngong. The lava plains are crisscrossed with steep-walled gullies and canyon-like gorges, such as those along the Mbagathi valley. Further east this valley widens slightly where soft material is being actively eroded (Saggerson, 1991). Water draining eastward from the hill area accumulates on the low-lying ground between Parklands in the north and Nairobi South estate, forming a perched water table above the Nairobi phonolite. The Kerichwa Valley Tuffs lying to the east of the highway function like a sponge and the contact between them and the underlying impermeable phonolite thus forms a perfect aquifer, so much so that a number of channels containing water occur beneath Nairobi.

4.2.5 Geology and Soils

The rocks in the Nairobi area mainly comprise a succession of lavas and Pyroclastics of the Cainozoic age and overlying the foundation of folded Precambrian schist's and gneisses of the Mozambique belt (Saggerson, 1991). The crystalline rocks are rarely exposed but occasionally fragments are found as agglomerates derived from former Ngong volcano. The soils of the Nairobi area are products of weathering of mainly volcanic rocks. Weathering has produced red soils that reach more than 50 feet (15m) in thickness (Saggerson, 1991). A number of subdivisions are recognized in the Nairobi area according to drainage, climatic regions and slopes, and other categories have been introduced for lithosols and regosols.

4.2.6 Ecological Conditions

The County is predominantly a terrestrial habitat that supports a diverse web of biodiversity ecosystems. It is home to about 100 species of mammals, 527 bird species and a variety of plant species. Nairobi National Park has got a variety of Africa's best known animals such as giraffes, zebras, ostriches, lions, baboons, cheetahs and endangered species of black rhinos and white rhinos.

Although it is endowed with some permanent rivers, the aquatic ecosystems are largely choked by the effects of pollution from different sources. Currently, efforts are underway to ensure a sustainable clean Nairobi River Basin.

4.2.7 Physical Structures and Infrastructure

This section describes the various infrastructural facilities and their access in the Nairobi County. They include: the road network, rail network, airports, posts and telecommunication services.

Road, Railway network and Airports

The current road network in the County is inadequate in terms of coverage to meet current and future demands as envisaged in the Vision 2030. There is heavy congestion on most of the City roads especially during the morning and evening peak hours. There has been increasing number of vehicles; in 2012 Kenya had 1.4 million registered vehicles and 400,000 motorcycles with a greater number of 60% being used in Nairobi (KNHR, 2013). The total road network covers 553.7 Km: 423Km are of bitumen standard while 54Km and 76.7 Km are gravel and earth roads respectively. The current poor state of road network is a great impediment to socio-economic growth leading to high production costs and low productivity. The completion of Thika Super highway, by-passes and missing links within the County will help in reducing traffic congestion.

Nairobi County hosts Jomo Kenyatta International Airport (JKIA) which is the biggest Airport in East and Central Africa, and is the focal point for major aviation activity in the region. Its importance as an aviation Centre makes it the pacesetter for other airports in the region. JKIA, located 18 kilometers to the East of Nairobi City centre, is served by 49 scheduled airlines. JKIA has direct flight connections to Europe, the Middle East, Far East and the rest of Africa. JKIA has five cargo facilities with a capacity to handle 200,000 tonnes of cargo annually, and an animal holding facility which occupies 4,318.95 square feet. The Airport has a runway measuring 4,117m long and 45m wide on 4,472.2ha of land.

The County has a railway network of 298Km and a total of 10 functional railway stations which are: Embakasi, Makadara, and Nairobi main terminal, Dandora, Githurai, Kahawa, Kibera, Dagoretti, JKIA and Syokimau. The establishment of Makadara and Imara Daima railway stations and expansion of Nairobi platform will help to improve public transportation in Nairobi for socio-economic development.

Posts and Telecommunication

Posts and telecommunication sub-sector has experienced mixed growth in the recent past. While the County has 35 post office branches, the growth of postal services has rather been declining due to increase in mobile telephony. Mobile telephony has the highest coverage in Nairobi compared to other parts of the country with over 95 per cent of the inhabitants having access to mobile communication. The players engaged in mobile telecommunication include: Safaricom, Orange, Airtel and YU while those in mailing services include Kenya Postal Corporation, Group 4 Securities (G4S), Direct Handling Limited (DHL), Wells Fargo among others.

4.3 SOCIO ECONOMIC PROFILE

4.3.1 Population and Settlement

The population of Nairobi grew from 8,000 in 1901 to 118,579 in 1948 (Rakodi 1997). By 1962, the City had a population of 343,500 people, although some of this could be attributed to extension of the City's Boundaries. Between the 1948 and 1962 censuses, the population grew at an average rate of 5.9 percent per annum, compared with 7.6 per cent in the previous 12-year period. Taking the 2009 census figures as a baseline, it is projected that the City's population will be 3.8 million by 2015 (CBS 2001). This increase will put even more pressure on the available resources. Although it covers only 0.1 per cent of Kenya's total surface area, Nairobi already has about 8 per cent of the country's total population (CBS 2001) and 25 per cent of Kenya's urban population (UN-Habitat 2001). In 1962, there were over twice as many adult males as females.

With a population of 3.36 million in 2011, Nairobi is the second-largest city by population in the African Great Lakes region after Dar es Salaam Tanzania. According to the 2009 census, in the administrative area of Nairobi, 3,138,295 inhabitants lived within 696 km² (269 sq mi). Nairobi is the 14th largest city in Africa, including the population of its suburbs.

Nairobi has experienced one of the highest growth rates of any city in Africa since its foundation in 1899. The growth rate of Nairobi is currently 4.1%. It is estimated that Nairobi's population will reach 5 million in 2025.

Table 4: Demographic details of Administrative areas within the project area

Region/Unit	Population			Households	Area (km ²)	Density
	Male	Female	Total			
Nairobi West	352,227	332,538	684,765	212,295	261.8	2,616
Nairobi East	582,554	561,862	1,144,416	369,866	226.7	5,048
Nairobi North	545,701	561,385	1,062,086	327,428	109.3	9,721
Westlands	124,748	122,354	247,102	75,427	97.4	2,538
Total	1,605,230	1,533,139	3,138,369	958,016	695.1	4,515

4.3.2 Housing

There is wide variety regarding standards of living in Nairobi. Most wealthy Kenyans live in Nairobi, but the majority of Nairobians are average and poor. Half of the population have been estimated to live in slums which cover just 5% of the city area. The growth of these slums is a result of urbanisation, poor town planning, and the unavailability of loans for low income earners.

Kibera is one of the largest slums in Africa, and is situated to the west of Nairobi. The slums cover two square kilometres and are on government land. Other notable slums include Mathare and Korogocho. Altogether, 66 areas are counted as slums within Nairobi.

Many Nairobi non-slum-dwellers live in relatively good housing conditions. Large houses can be found in many of the upmarket neighbourhoods, especially to the west of Nairobi. This includes Gigiri, Muthaiga, Langata and Karen. Other middle and high income estates include Parklands, Westlands, Hurlingham, Kilimani, Milimani, Spring Valley, Lavington, Rosslyn, Kitisuru, and Nairobi Hill. To accommodate the growing middle class, many new apartments and housing developments are being built in and around the city. Eastlands also houses most of the city's middle class and includes South C, South B, Embakasi, Buru Buru, Komarock, Donholm, Umoja, and various others.

In regard to housing, an approximate of 557 households will be affected. It was noted that in the upmarket neighbourhoods, most of the PAPs have masonry walls built on the riparian for security reasons. This will be affected during construction but compensation will be done to restore the PAPs to their original state.

4.3.3 Land tenure and ownership

Most land in Nairobi, including the central business district (CBD), is publicly owned and leased for 99 year periods to private owners (Ondiege 1989 in Rakodi 1997). Government leasehold covers most of the legalized residential areas, and corporate ownership of land in these areas is becoming more common. Freehold land is privately owned either by individuals or by groups of individuals and can be sold without limits to the period of ownership. This covers a small portion of land mainly to the west and north-west of Nairobi and includes suburbs such as Dagoretti, Mwimuto, Runda, Gigiri and part of the Kahawa area in the north. Over 50 per cent of Nairobi is estimated to be under private ownership (Karuga 1993 in Rakodi 1997).

The land needed for the proposed STW at DESTW is government owned therefore there are no issues of acquisition. The trunk sewers will be laid along the riparian reserves while the reticulation sewers will be laid along the road reserves. The PAPs already know that these reserves are government owned.

4.3.4 Land and natural resources use

In 2012 the projected housing land requirement was estimated to be 250 Km². Land meant for urban agriculture has been on the decline as more of it is turned to residential use with the City relying on other counties for supply of food items. The industrial areas are largely concentrated in Industrial Area, Kariobangi South and Baba-Dogo. Industrial and commercial land has dwindled in the last decade and most industries have been looking for land in Athi river part of Machakos County.

The project area is characterized by various forms of land use. There are small scale farmers along the riparian areas. The main crops include vegetables that are used for both commercial and domestic purposes. It was also noted that in some places people have erected temporal structures along the riparian area.

The main economic activity for the population is Business oriented activities ranging from small scale businesses to Large-scale businesses depending with the socio economic background of the PAPs which was at 38%. 10% are farming along the river beds / riparian areas and agricultural lands in the project area while the rest of the 17% are either employed in the formal or informal sectors, 35% of the PAPS reported to have been doing combination of business, farming, casual employment and employment.

The social economic status of the people is likely to be slightly disrupted during the construction period.



Source: ESIA Assessment October 2016

Figure 3 : Crop farming along Nairobi River



Source: ESIA Assessment October 2016

Figure 4 : Structures along the Riparian area in the proposed project area.

Table 5: Land use in Nairobi County

Land Use	Area (km ²)	Cover (Per cent)
Residential	175.6	25.22
Industrial / Commercial	31.8	4.57
Infrastructure	15.9	2.28
Recreational	12	1.72
Water bodies and Riverine	11.8	1.69
Urban Agriculture	96.8	13.9
Open lands	198.8	28.55
Others (Including protected areas)	153.6	22.06
Total	696.3	100

Source: GoK/UNEP 2007

4.3.5 Social Infrastructure

Education Institutions

The County is very vibrant on the education front. This is demonstrated by high concentration of tertiary and university level institutions with science and technology institutions being 237 as at 2012. It hosts the oldest public university in the country; The University of Nairobi, and 16 university colleges and campuses.

Whereas the County has a high concentration of national schools, it experiences huge challenges on accessing secondary education due to high competition for available vacancies both from within and without the County. Access to basic education at primary and secondary levels remains a major challenge to the urban poor especially in the informal settlements. Civil society organizations continue to play a key role in ensuring that pupils from non-formal settlements access basic education. The requirement for land in registration of public primary schools has been a big barrier to education accessibility since schools operating as community based organizations do not benefit from free primary education.

There are 1,235 functional primary schools with a total population of 429,280 while the total number of secondary schools is 319 with a population of 49,728 students.

Some of these institutions will benefit from being connected to the sewer line. There will be slight disruption from noise during construction though this is a short term impact.

Health Access

Kenyatta National Hospital is the major referral hospital in the County. There are 16 sub-County hospitals, 9 mission, 32 private, 15 nursing homes, 38 public health centres as well as 45 private health centres. The County has 30 public dispensaries, Private dispensaries, 84 private clinics and 22 public clinics. Kenyatta National Hospital has a total bed capacity of 1,800. Level 5 hospitals in the County have a bed capacity of 750. The doctor patient ratio stands at 1:7,816.

Some of these institutions will benefit from being connected to the sewer line. There will be slight disruption from noise during construction though this is a short term impact.



Figure 5 : Mama Lucy Kibaki Hospital

4.3.6 Water Services

The pipe water supply in the city is critical now. A number of studies so far have been conducted and a couple of the projects have been implemented mainly under support of the World Bank which has been supporting this sector since 1977.

As part of reform program in Kenya, Nairobi Water Supply and Sewerage Company was established in 2005 and operate and manage the water and sewerage in the city. The said company is under umbrella of the Athi River Water Service Board who holds and leases the assets to the company.

More than 71% of the population has been served the pipe water by the company either through house connection and public taps. There are four sources of water supply: Kikuyu Springs, Ruiru reservoir on the Ruiru River, Sasumua Reservoir on the Chania River, and Thika Dam (Ndakaini). Water from Ruiru Dam and Kikuyu Springs is treated at the Kabete Treatment plant. The thika dam contributes the bulk of water at 84%, followed by the Sasumua at 11% while Ruiru Dam and Kikuyu Springs contribute 3% and 2% respectively. The total installed water production capacity from these sources is about 520,000 cubic metres per day.

4.3.7 Existing Sewer services

The existing sewer network on the other hand comprises a trunk sewer system that has a total length of about 162.7 km and covers an area of about 208 km² which essentially covers only 40% of the city area served with water. The main problems identified in the system are non-functional sewers due to washed away sections, accidental breakages or deliberate vandalism of manhole covers, blockages due to deliberate dumping of solid waste or accidental entry of stones and boulders into open manholes and also blockage of sewer lines by urban farmers to catch sewage for irrigation and overflowing of sewers due to insufficient capacity.

There are 24 Sewage Treatment Plants in Nairobi, the main ones being the Dandora and Kariobangi Sewage Treatment Plants. The Dandora Plant has design capacity of 120,000m³/day and handles an average flow of 76,000m³/day while the Kariobangi plant has design capacity of 32,000m³/day and handles an average flow of 11,000m³/day.

Recent surveys indicate that most of the sewage treatment plants are operating at very low efficiency despite the fact that they receive flows below their design capacity. It has been suggested that this may be attributed to poor maintenance, high organic loading and influence of industrial discharges.



Source: ESIA Assessment October 2016

Figure 6 : Karen Sewerage Treatment Plant

A survey was carried out to determine the nature and extent of pollution of the major rivers in Nairobi thus Nairobi, Mathare and Ngong rivers. The surveys indicate that the rivers are highly polluted and concrete mitigation measures need to be taken.

NARSIP II will ensure that more people are connected to the sewer system and also increase capacity of flows relieving the already overstretched existing sewer systems in Nairobi County.

4.3.8 Solid waste management

Waste management is a growing problem in Nairobi. Increasing urbanization, rural-urban migration, rising standards of living, and rapid development associated with population growth have resulted in increased solid waste generation by industrial, domestic, and other activities. This increase has not been accompanied by an equivalent growth in the capacity to address the problem. In 1992, from 800 to 1 000 tonnes of solid waste was generated in Nairobi every day, of which less than ten per cent was collected; by 2002, the amount had grown to 1 530 tonnes per day of which 40 per cent was either uncollected, or disposed of by burning or illegal dumping (Syagga 1992, CCN 2007). The proper management of waste has thus become one of the most pressing and challenging environmental problems in the city. Waste in Nairobi comes from a variety of household, service, and industrial processes in the following proportions: domestic sources: 68 per cent; industrial: 14 per cent; roads: 8 per cent; hospitals: 2 per cent; markets: 1 per cent; and 7 per cent from other sources (NEMA 2003). Food waste, plastic, and paper are the most dominant forms of solid waste in Nairobi. One of the most ubiquitous forms of visible waste is the plastic bag.

The proposed project project area is characterized by lots of solid waste dumping along the rivers and open spaces. This majorly applies to the slums especially in Maasai village, Deep Sea and Kibagare. The intervention will lead to decreased pollution in the rivers leading to a clean environment and reduction of diseases like cholera and Typhoid.



Figure 7 : Dumping of solid waste along Nairobi River

CHAPTER FIVE: PUBLIC PARTICIPATION AND RESPONSES

5.1 INTRODUCTION

Stakeholders are ‘all those people and institutions who have an interest in the successful design, implementation and sustainability of the project. This includes those positively and negatively affected by the project. Stakeholder participation involves processes whereby all those with a stake in the outcome of a project can actively participate in decisions on planning and management. They share information and knowledge, and may contribute to the project, so as to enhance the success of the project and hence ultimately their own interests’. Different types of stakeholders can contribute to the ESIA process in different ways and, in most cases; inputs from a broad variety of stakeholders will complement the ESIA process. Stakeholder interests exist at different levels. For example, at the local project level, they might include land or water access rights, pollution or market opportunities.

Kenya has entered the era of participatory development in all matters of national life. Participation in this case is not just through elected representatives but also through direct action. The Environmental Management and Coordination Act (EMCA, 2015) and its subsequent Environmental (Impact Assessment and Audit) Regulations, 2003 underscore the need for stakeholder participation in the ESIA process. Neighbours of a proposed project have to live with the project if implemented. They have the most to gain if the project impacts are beneficial to them. Conversely, they have the most at stake if the project goes awry. Not just neighbours but for projects whose impacts have a wide geographical spread, distant communities need to be involved. Stakeholder input is thus vital at the earliest stage possible in project development and should continue throughout the project cycle.

Public consultation in this project was carried out with the following aims:

- To inform the local people, leaders and other stakeholders about the proposed project and its objectives.
- To seek views, concerns and opinions of people in the area concerning the project.
- To establish if the local people foresee any positive or negative environmental impacts from the project and if so how the impacts can be addressed.

STAKEHOLDER IDENTIFICATION

Like in all civil works projects, the core stakeholders comprise people to be directly served by the sewerage system and the residents along the riparian reserves. Motorists, businessmen and other service providers who rely on the road reserves where reticulation sewers will be laid will also be affected. This is the group that is likely to benefit or be affected by the proposed development hence the primary stakeholders.

This study also identified a second category of stakeholders comprised of GoK officers and institutions in charge of diverse sectors (like Nairobi County Council and NCWSC among others), which are likely to be impacted by the proposed project. This category was also consulted as key informants on sectoral policy and to advise this ESIA study on mitigation measures to be put in place so as to minimize adverse impacts in respective sectors.

Roles of stakeholders

- They act as a source of information concerning various issues in relation to the project
- They help to identify, predict, analyze and evaluate potential impacts that may emanate from the project
- Project ownership. When the stakeholders are engaged in the matters pertaining to the project, they also feel a part of the project thus supporting the development.
- The Secondary stakeholders often help provide aid to the primary stakeholders.

Each category of stakeholders called for a different approach to consultation.

5.2 CONSULTATION METHODOLOGY

There is no single ‘public’; instead there are a number of publics some of whom may emerge at any time during the process depending on their particular concerns and the issues involved. Strategies for involvement must be appropriate to the individual, the community or the region potentially being affected. A successful public involvement process must take the characteristics of the potential publics and their changing views of contentious issues into consideration. The public could be:

- i. Experienced in public involvement.
- ii. Informed or uninformed about the issues.
- iii. Hostile or apathetic.
- iv. United or divided.

MODALITIES FOR STAKEHOLDER CONSULTATION

The following techniques and instruments were used for public participation and consultation;

➤ Photography and direct observation

Photography was particularly useful as it captured the real situation on the ground that was relevant to the study. Direct observation involved site viewing of the proposed project location to see the extent of development on it and the condition of the sewerage system.

➤ Site checklists

Checklists were used to assess the suitability of the site where the proposed project is to be located and the negative impacts it might have on the environment.

➤ **Public meetings (barazas)**

This involved scheduled meetings with the public who are directly affected by or will benefit directly from the proposed project. The aim was to get their views concerning the proposed project; how it will affect them and the environment.

➤ **Questionnaires**

Consultations with Secondary Stakeholders

Under this category, a cross section of stakeholders were met and these included; civil servants, local government officials and the local residents. Consultations took place in respective offices and in the field where possible. Consultations were made either with individual officers or in Focus Group Discussions involving several officers in a group. Discussions started with the consultant team explaining the project to the target officer following which, they were asked to identify their fundamental concerns on the same.

Public consultation was extensively carried out in the entire project area to elicit concerns and compliments from the PAPs. The proposed project spans a fairly large administrative area with a mix of socio-economic characteristics. Consequently, this meant “diverse publics”. Consultation meetings were convened in public areas to enable maximum attendance. These were organised in collaboration with respective area Chiefs and Assistant Chiefs.

Public Consultations is a continuous process through all the phases of the project.

5.3 CONSULTATION OUTCOMES

A wide range of public was consulted on the proposed project. These people gave a candid view of the proposal. The views reflect different interests and positions in the community. They expressed appreciation to the proponent for the proposal.

The following is the summary of issues emerging from consultations:

Positive impacts

i. **Employment**

This is a key benefit of any project that host communities can gain from a proposed project. They thus expressed the need for the proponent to observe the following with regard to employment.

- Those responsible for project implementation ensure that youth from the area are given priority in recruiting labour force. They were emphatic especially on the recruitment of manual labour.
- Notices to be done through the Chief’s Offices at the start of Construction so as the village elders can hold a meeting with the Contractor and ask for job opportunities.

- While recruiting employees during the operation phase there is need to consider local population skilled in various issues.
- ii. Participation in the life of the community
The proponent has become part and parcel of the local community. There is thus need to fully participate in the life of the local community in improving the life of the people.
- iii. Connection to the Sewer
Given the immense benefits that the proposed project will produce, the community members urged the proponent to hasten so that the community can start benefitting from it. Those living in towns are especially very keen on the sanitation aspect.
- iv. Open communication
To avert unnecessary conflicts, there is need for prompt communication to all stakeholders. This could be through the use of the local administration and other such fora. Any information or clarification about stakeholders' position on project need to be promptly availed to any interested party.
- v. Elimination of Septic Tanks
Most of the consulted PAPs indicated that they use septic tanks at their homes. This project will benefit them as they will be connected to the sewer line and therefore no more use of septic tanks and the associated costs.
- vi. Project acceptance and support
There was support for the proposed project. This was as a result of clear explanation of what is proposed and the way forward in the implementation process. The community understood that the project is feasible in all aspects. In addition, the project will spur growth in the area. The local administration indicated that it and the entire community would support the project as long as it promoted development in the area. The community has no objections for the project since there are similar projects in other parts of the country that have benefitted the residents. In addition, the fact that access to water and decent sanitation is aright enshrined in Constitution of Kenya increases support for the proposal. The community thus embraces the project which will go a long way in making this right a reality.

Negative Impacts

The community also expressed concerns related to undesirable impacts from the proposal. These varied from location to location and were greatly a function of the socio-economic characteristics of the location.

- i. Loss of livelihood

Most of the PAPs along Nairobi River expressed their concerns concerning their source of livelihood. The main form of encroachment is crop farming and they feared that this will be cut off by the proposed intervention.

It was noted that compensation will be done for the crops that have been planted along the riparian areas. This is meant to compensate the loss of livelihood. There will be no compensation of land as riparian reserves belong to the government.

ii. Pollution

This includes noise pollution; air pollution and pollution of surface water for those who do not have piped water and rely on streams, wells and rivers in the area.

The client will source for a competent Contractor to do the work and an Engineer's office to supervise the work of the Contractor. This will ensure that all the mitigation measures proposed in the ESMMP are put into place accordingly to protect the environment and the community at large.

iii. Displacement

This concern was aired in Ruai. The concern is that laying trunk sewers may displace some of the residents from their plots for them that have small plots.

It was indicated that there will be no physical displacement because the proposed project will pass through public land, this includes, river riparians and road reserves. In any case where private land will be needed, the owner of the land will be given room to negotiate with the Client for easement rights.

iv. Interference with the existing Infrastructure

This includes the water supply pipes, data cables among others. The following mitigation measures will be applied:

- Get maps of the underground infrastructure from the relevant institutions.
- Sensitize workers carrying out excavations so that they exercise caution to minimize chances of underground infrastructure damage.
- Work closely with the responsible institutions so that in case of damage, the services are restored within the shortest time.

v. Insecurity

Land owners in the up market residential areas like Muthaiga and Ridgeways areas expressed their fears due to having strangers hang around their homes during survey and construction phase.

It was indicated that notices will be given prior any activity that will be carried out, thus no stranger will access their property without their knowledge. They were informed also that there will be compensation of their masonry walls that will be affected during construction.

The ESIA Team explained the proposed mitigation measures to their concerns among other potential negative impacts. This allayed fear from the community.



Source: ESIA Assessment October 2016

Figure 8 : Consultation meeting at Njiru Chief's Office

Table 6: Schedule of public consultations held with the local Administration

No	Local Administration Representative	Designation	Location	Date of Visit
1.	Ayiecha Joseph	Chief	Kariobangi South	26/9/2016
2.	Patrick Weru	Chief	Kilimani	26/9/2016
3.	Senior Chief Ngamia	Chief	Highridge	26/9/2016
4.	Chief Mbithi	Chief	Karen	27/9/2016
5.	Chief Kingori	Chief	Dandora Phase 1 & 2	27/9/2016
6.	James Ndichu	Senior Chief	Riruta	27/9/2016
7.	Geoffrey Moni	Chief	Ngando	27/9/2016
8.	Rev. Njenga	Chairman	Karen Plains Residents Association	29/9/2016
9.	Mukeki	Chief	City Carton (Uhuru Location)	18/9/2016
10.	Kithinji	Assistant Chief	City Carton(Uhuru Location)	18/9/2016
	Alexander Waweru	Village Elder	City Cartoon	
11.	Mukatha	Chief	Njiru	18/9/2016
12.	Ngunye	Chief	Ruai	18/9/2016
13.	Mowlem Obinchu	Village Elder	Mowlem	26/9/2016
14.	Humphrey Mbayi	Chief	Roysambu(Ruiruaka TS and Marurui	26/9/2016
15.	Micheal	Representative and Member	Garden Ridgeways Resident Association	26/9/2016
16.	Kiarie	Umoja 111 Village Elder	Umoja 111	26/9/2016
17.	Chief David	Assistant Chief Mugumoini	Langata	5/10/2016 17/10/2016
18.	Chief Jackie	Assistant Chief	Highridge - Muthaiga	5/10/2016
19.	Chief Maina	Assistant Chief	Spring Valley Location	25/10/2016
20.	Chief Momanyi	Chief and Assistant Chief	Lucky Summer	1/11/2016
	Chief Joylene			
21.	Chief Damaris Muchiri	Senior Chief	Mihango	28/11/2016
22.	Chief Leah Mburu	Assistant Chief	Kitusuru	29/11/2016
	Chief George	Assistant Chief		

Others Consulted include but not limited to;

- ✓ Nairobi City County Department of Water, Sanitation and Environment, Lands and County Executive Committees
- ✓ Nairobi Provincial Commissioner through a courtesy letter
- ✓ Kenya Forest Service (Karura Forest) through a letter
- ✓ The Waterfront Mall in Karen Road were notified on 17/10/2016 through their clerk of works (David and Property Owner)

- ✓ Jacaranda Brooks on Kiambu road informed on 18/10/2016
- ✓ Muthaiga Golf Club notified on 25/10/2016
- ✓ Oshwal Center Management 28/11/2016
- ✓ Ukay Center Management 28/11/2016

CHAPTER SIX: ANALYSIS OF PROJECT ALTERNATIVES

6.1 INTRODUCTION

The project area is at different stages of development and it is therefore prudent to stage the development of the sewerage systems to follow suit. Provision of a sewerage system will require the construction of a reticulation system to serve areas that are either already developed or are in the process of development.

“The main criteria adopted in selecting alternative sewer routes and sewage treatment works sites have considered the amount of sewage generated, available land and recent development in sewage treatment. The identified alternatives have been subjected to technical, financial and economical, social and environmental evaluation. The proposed routes for sewers and sewage treatment works sites has ensured that there is least amount of disruption to existing features and services e.g. roads, railways, rivers etc. Sewage treatment technologies, construction materials and techniques has been proposed from best practice in Kenya ensuring safety.”

6.2 ANALYSIS OF ALTERNATIVE FOR THE TRUNK SEWERS

The natural drainage system has been used as a basis of design of the trunk sewer system. The trunk sewers have been located at the lower drainage boundaries as much as permissible so as to maximize sewage collection from feeder lines. Some trunk sewers drain into treatment works whilst some drain to other larger trunk sewers.

The sewer routes as were identified during the survey by the consultant have been adopted in the design. Proposed sewers have been routed on rivers riparian, road reserves and utility way-leaves as much as possible. Main sewers have been provided for areas currently served with piped water and those with the potential of being served with piped water soon, as identified.

6.3 ALTERNATIVE FOR THE SEWAGE TREATMENT WORKS SITES

Three alternative locations for the Sewage Treatment Works were evaluated as follows;

STW OPTION 1: Construction of WSP on space allocated for Constructed Wetlands at DESTW:

In this option, it is proposed to construct the Sewage Treatment Work on the space between the existing Waste Stabilization Ponds and the Nairobi River. This location is nearer to the existing Inlet Works.

The available space is adequate for construction of additional sewage treatment works.

The Main Advantages for using this site are:

- i. Shortest length of trunk Sewer extension from inlet works to STW,
- ii. Shortest length of outfall sewer after treatment to the river,

The Disadvantages for using this site are:

- i. The space has been allocated for construction of wetland for the existing DESTW,
- ii. Private individuals have already sub-divided the plots and some have put up temporary structures,
- iii. The nearby Nairobi River is prone to bursting its banks and flooding the area,
- iv. If implemented, the existing 3No. outfall sewers for the WSP will require relocation since they pass through the available land.

STW OPTION 2: Construction of WSP on space next to the DESTW:

In this option, it is proposed to construct the Sewage Treatment Work on the space next to the existing DESTW WSP immediately after the Series 8 ponds.

The Main Advantages for using this site are:

- i. The system can also serve excess flows from the DESTW WSP by extending the Inlet channel,
- ii. This site had been identified by the Nairobi Masterplan for Sewers (1997) for construction of WSP for the Gathara-ini Sewerage System,
- iii. Minimal excavation for levels required

The Disadvantages for using this site are:

- i. Acquisition and/or repossession of the land is required,
- ii. A few private individuals have already sub-divided the plots and some have put up structures,
- iii. The extended trunk sewer will longer than in Option 1 above (4.5km),
- iv. STW may require additional excavation to attain desirable levels.

STW OPTION 3: Construction of WSP at the confluence of Athi and Nairobi Rivers:

In this option, it is proposed to construct the Sewage Treatment Work at the confluence of the Athi River and Nairobi River.

Advantages for using this site are:

- i. The area is not habited and therefore cheap to acquire,
- ii. The site can serve a bigger area, including sewage origination from the Athi River basin,

The Disadvantages for using this site are:

- i. The land is privately owned,
- ii. The extended trunk sewer will be longest compared to the other Option 1 &2 above (17km). This will be very expensive to implement,

- iii. A new Inlet works will require to be built,

Least cost Analysis of the above options is as summarized in the following table;

Table 7: Cost of Alternative STW Locations

Project Component	Amount (KES)
1 <u>STW near the Pumping Station:</u>	
i. Extension of Trunk Sewer (1.9km)	66,500,000.00
ii. Construction of WSP	1,050,000,000.00
iii. Construction of Outfall Sewer (200m)	7,000,000.00
iv. Relocation of existing Outfall Sewers	25,000,000.00
v. Land Acquisition/Repossession (85Ha)	172,720,000.00
	1,321,220,000.00
2 <u>STW next to existing Series 8 Ponds:</u>	
i. Extension of Trunk Sewer (4.5km)	157,500,000.00
ii. Construction of WSP	1,050,000,000.00
iii. Construction of Outfall Sewer (250m)	8,750,000.00
iv. Land Acquisition/Repossession (85Ha)	215,900,000.00
	1,432,150,000.00
3 <u>STW at Athi River Confluence:</u>	
i. Extension of Trunk Sewer (17km)	765,000,000.00
ii. Construction of an Inlet Works	25,000,000.00
iii. Construction of WSP	945,000,000.00
iv. Construction of Outfall Sewer (200m)	31,500,000.00
v. Compensations for sewer Wayleaves	25,500,000.00
iv. Land Acquisition (90Ha)	155,448,000.00
	1,947,448,000.00

6.4 ANALYSIS OF THE ALTERNATIVE SEWAGE TREATMENT PROCESSES

The Terms of Reference had specifically requested that the feasibility for conversion of the Kiu River Sewerage Pumping System to a Waste Stabilization Ponds System. However the table below gives a description of different technologies and designs used for sewage treatment.

Table 8: Description and Comparison of Alternative Sewage Treatment Processes

Treatment process	Brief Description	Advantages	Disadvantages
Waste stabilization ponds	<ul style="list-style-type: none"> Are open flow through lagoons Generally the most suitable method of wastewater treatment in hot climates Generally sub-divided into anaerobic ponds, facultative ponds and maturation ponds. 	<ul style="list-style-type: none"> No power requirements Very low O&M requirements No mechanical installations Very simple method of treatment 	<ul style="list-style-type: none"> Land required for the Kiu River System is high. Odour nuisance, particularly from the anaerobic ponds Sensitive to temperature variations
Aerated	<ul style="list-style-type: none"> A more intensive system 	<ul style="list-style-type: none"> Detention time less 	<ul style="list-style-type: none"> The Operation and

Treatment process	Brief Description	Advantages	Disadvantages
lagoons	<p>of treatment resulting in greater removal of organics per unit volume of treated wastewater than in WSPs.</p> <ul style="list-style-type: none"> ▪ Oxygen is supplied to wastewater by aerators floating or fixed in the lagoons. 	<p>than in waste stabilization ponds</p> <ul style="list-style-type: none"> ▪ Less land requirement as compared to WSP 	<p>Maintenance cost will be very high.</p>
Oxidation ditches	<ul style="list-style-type: none"> ▪ An extended aeration plant best suited to small communities. ▪ The aeration tank is in the form of a long continuous channel, oval in plan and with rotor suspended over the channel for aeration, mixed liquor propulsion and prevention of suspended particles from settling out. 	<ul style="list-style-type: none"> ▪ Relatively low land requirement and suitable where land is at a premium price. 	<ul style="list-style-type: none"> ▪ High O&M requirements ▪ Not effective in removing Faecal Coli form.
Percolating/Trickling filters	<ul style="list-style-type: none"> ▪ A permeable bed of media, graded natural stone or inert synthetic material, where sewage flows. ▪ Sewage is evenly distributed on the surface and effluent collected through under drains that also help in aeration. ▪ The units are preceded by settling tanks to collect the settleable organic 	<ul style="list-style-type: none"> ▪ Durability in all weather conditions and in the presence of corrosive effluents ▪ Does not upset for variation of hydraulic or organic loading 	<ul style="list-style-type: none"> ▪ Limitation in volumetric loading ▪ Significant loss of head ▪ Nuisance due to flies ▪ Medium O&M cost

Treatment process	Brief Description	Advantages	Disadvantages
	solids delivered from the filters.		

6.5 ANALYSIS OF ALTERNATIVE MATERIALS

The pipe materials have been selected taking into consideration availability, durability and cost. Circular pipes have been adopted in this design. U-PVC pipes are recommended for sewers with bore less or equal to 300mm. Precast Concrete pipes have been adopted for the sewers greater than 300mm. Steel pipes are recommended for all river aerial crossings, Class A and B road crossings, rail crossing and deep sewers. Different pipe bedding types have been used depending on the nature of the ground. These have been classified as bedding type A, B, C, and D.

i) Concrete Pipes

Spun Concrete Pipes to relevant Kenyan and British Standards are manufactured locally by a number of Companies. They form the most common choice for Sewer Pipes. Spigot and socket jointed pipes are manufactured in sizes ranging from 100mm to 915mm diameter, and ogee jointed pipes are available in sizes from 100mm to 1525 mm diameter.

Rubber ring, flexibly jointed pipes are manufactured in sizes ranging from 150mm to 975mm diameter and strength classes M and H, or reinforced. Pipes are vertically cast in vibrated moulds and supplied and supplied moulds and supplied with rubber rings. Rigid jointed pipes require jointing with tarred hessian and cement mortar.

ii) uPVC Pipes

Un-plasticised PVC pipes are manufactured in Kenya in metric sizes up to 450mm diameter. A number of firms are involved in production, including Polypipes Ltd and Eslon.

iii) Glass Fibre Reinforced Polyester (GRP) Pipes and Fittings

Glass fibre reinforced polyester pipes are imported and sizes range between nominal diameters 250mm to 4,000mm. They are lighter, corrosion resistant and are much easier to install when compared to Steel and Concrete pipes. They however have considerably higher costs associated with importation.

iv) Steel Pipes

Steel pipes are manufactured locally. They are generally used in locations where sewers are exposed or in situations such as river crossings. Protection against corrosion is required internally and externally. Bitumen sheathing is normally used, the external sheathing generally being reinforced with glass fibre windings.

6.6 NO PROJECT ALTERNATIVE

This “alternative” implies maintenance of the status quo. That is, the proposed project is put on

hold and mechanisms currently being used for disposal of sewage be maintained. This would have far reaching negative implications on the environment in its totality including among others:

- Loss of economic benefits from the construction and operation of the proposed project.
- Continued pollution of ground due to reliance on pit latrines.
- Pollution of surface waters by raw sewage being washed into these bodies.
- Population will continue to be affected by water borne and other diseases associated with exposure to raw sewage.
- Access to proper sanitation is a human right. If this option is adopted, the population will be denied this right.

This being the case then, “No Project Alternative” is discarded in favour of the Preferred Alternative which will lead to realisation of the project objectives which are for the good of the greatest majority.

6.7 RECOMMENDED SEWAGE TREATMENT SYSTEM

A waste stabilisation ponds (WSP) system is recommended for sewage treatment due to its low operation and maintenance, and effectiveness in the local climate. The capital cost of buying land required for WSPs by far outweighs the operational and maintenance cost of the other alternatives.

The location of the Waste Stabilization Ponds is recommended to be next to the Series 8 ponds for the existing DESTW WSP.

The recommended scope of work for the Kiu River Sewerage System is as follows;

- i. Extending the Kiu River Trunk Sewer from the Inlet Works to the Proposed Anaerobic Ponds for a length of 4.5km;
- ii. Construction of a 41,700m³/d Waste Stabilization Ponds System;
- iii. Connection of new ponds outlets to the existing Outfall channel;
- iv. Decommissioning of the Pumping Station.

Table 9: Description of the proposed Waste Stabilization Ponds

Description of Pond	No. per Series	Dimensions at TWL (m)	Retention Time	Influent BoD	Effluent BoD
Anaerobic Ponds	2	80 X 120	1.67 days	400.00	184
Facultative Ponds	1	300 X 700	days	184.00	54.55
Maturation Ponds 1	1	300 X 150	days	54.55	40.91
Maturation Ponds 2	1	300 X 150	days	40.91	30.68
Maturation Ponds 3	1	300 X 150	days	30.68	23.01

6.7.1 Manhole Spacing and Manhole Diameter

Manhole sizes and spacing are generally in accordance with NCC standards. Manholes are provided on sewers at all changes of direction, sewer level, at every junction and throughout the systems at intervals sufficiently close to simplify sewer cleaning.

The maximum distances at which manholes should be spaced and the minimum sizes of manholes are given in Table 10 and Table 11 respectively. The maximum spacing of manholes is from WHO report No. 9.

Table 10: Maximum spacing of manholes

Sewer Pipe Diameter (mm)	Maximum Spacing (m)
450 or less	60
525 – 825	90
900 and above	120

Table 11: Minimum sizes of manholes

Diameter of Largest Sewer (mm)	Diameter of Manhole Rings (mm)
225 to 300	1050
375 to 600	1200
675 to 900	1500

Treatment of wastewater by stabilization ponds is an appropriate method of wastewater treatment in developing countries with tropical warm climates; provided adequate inexpensive land is available. This treatment method makes use of sunlight, wind, temperature, bacteria and algae to produce a high quality of re-usable final effluent.

Construction of the ponds is simple and straightforward which mainly comprises of earthmoving and minor concrete and pipe works, which can be executed easily.

Wastewater stabilization ponds (WSP) are highly efficient in removal of BOD (up to 70%) and pathogens (up to 99.99%) in wastewater.

Inlet Works

The proposed inlet works comprise the following main components:

- (i) Screening
- (ii) By-pass channel
- (iii) Grit collection channels
- (iv) Flow control facilities (flumes)
- (v) Overflow chamber

Influent BOD Loading

For the estimation of the BOD, the following equation has been used;

$$L_i = \frac{1000B}{q}$$

Where; L_i = Waste Water BOD
 B = BOD contribution (g/capita/day)
 q = Wastewater flow (L/capita/day)

Waste Stabilization Ponds

i. Anaerobic Ponds

The anaerobic ponds have been designed based on volumetric BOD loading. An effective Depth of the pond to top water level (TWL) of 4m, a Length: Breadth Ratio of 3:1 and a side slope ratio of 1:3. A meter high freeboard has also been provided.

For permissible volumetric loading, the following table shows the design criteria adopted.

Table 12: Permissible Volumetric Loading and Percentage Removal of BOD

Temperature (°C)	BOD ₅ Loading (g/m ³ /d)	Percentage BOD ₅ Removal (%)
<10	100	40
10-20	20T – 100	2T + 20
20-25	10T + 100	2T + 20
>25	350	70

ii. Facultative Ponds

Facultative ponds have been designed on the surface loading basis. The following formula has been adopted for sizing the mid-depth area.

$$A = \frac{10QL_i}{\lambda_s}$$

Where; λ_s = Design BOD₅ loading (kg/ha/day)
 Q = Average flow in the pond (m³/day)
 L_i = Influent BOD₅ loading from anaerobic pond (mg/lit)

The permissible surface loading rate value increases with temperature, T (°C). The global permissible value of the surface-loading rate to be used in design will be estimated from the following equation:

$$\lambda_s = 350 (1.107 - 0.002T)^{(T-20)}$$

An effective depth of 1.75m has been used as recommended by Mara, *Sewage Treatment in Hot Climate*. (1986). A Length: Breadth Ratio of 3:1 and side slope ratio of 1:3 has been adopted. A meter high freeboard has also been provided.

The effects of seepage and evaporation have been assumed to be negligible and hence not taken into account.

iii. Maturation Ponds

Maturation ponds are designed on basis of faecal coliform (FC) removal by use of first order kinetics as recommended by D. Mara (1986). The equation for the design is as follows:

$$N_e = \frac{N_i}{(1 + k_T \phi)}$$

Where; N_e = Effluent number of coliform per 100ml
 N_i = Influent number of coliform per 100ml
 k_T = First order rate constant for FC removal (d^{-1})
 ϕ = Retention time (d)

Where a, f and m refer to anaerobic, facultative and maturation ponds, and n is the number of maturation ponds assuming equal sized ponds.

The value of the rate constant k_T is given as follows depending on the design temperature of the area;

$$K_T = 2.6 (1.19)^{T-20}$$

A check will also be made on the BOD₅ of the first maturation pond, which must be lower than that of the last facultative pond. The maximum loading is taken as 75% of that on the last facultative pond.

The area of the maturation pond is then calculated from the equation:

$$A_m = \frac{Q\phi_m}{D}$$

Effects of seepage and evaporation are assumed to be minimal hence ignored.

They are wholly aerobic thus the effective depth to be adopted should be 1.2m and a length to breadth ratio 3:1.

Sludge Handling

Grit Removal

The grit will be removed manually in to trash rack for disposal. A truck will be used in transport of the grit in to solid waste disposal site or to a landfill.

Sludge Removal

The quantities of sludge expected to be produced in the anaerobic ponds has been estimated using the following criteria;

- i. Amount of solids is 55grams/capita-day,
- ii. Water content in the sludge is 90%
- iii. Density of sludge has been estimated at 1,050kg/m³.

Sludge Collection and Disposal

The following assumptions have been made for collection and disposal of sludge

- All sludge from the waste stabilisation ponds, together with any additional sludge that will be delivered directly to the treatment plant, will undergo treatment by drying in sludge drying beds before disposal.
- Additional sludge from outside the treatment works will be transported to the treatment plant using the vacuum truck used for transportation of wastewater
- Industrial and other hazardous sludge will require on-site treatment before transportation to the treatment site.
- Sludge disposal options to be considered include incineration, land filling, land application and/or distribution to farmers. The Consultant does not consider incineration as a good option as it has a high pollution potential and yet equipment for pollution control is expensive. Land filling and land application are viable for a start because of the availability of land for purchase in the vicinity of the project area. Distribution of the sludge, for free or by sale, to farmers is considered a good option but only as long it's chemical composition is within acceptable levels if to be used for food crop production.

Sludge Drying Beds

The sludge drying bed has been designed on the basis of loadings of beds as dry solids per year. The criterion used has assumed that the loading of the beds as dry solids per year is 175Kg/m²/year.

CHAPTER SEVEN: POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

7.1 INTRODUCTION

A study of potential environmental impacts as a result of the proposed project was carried out. From field observations and discussions held with stakeholders, various aspects affecting the natural, physical, economic and social environment were noted. These observations are also intended as useful pointers during the design stage of this project.

Once potential impacts of the proposed project were identified, the team went further to predict the nature of the impacts. Predictions are normally based on explicit assumptions about environmental processes, professional judgment and different value judgments expressed by various stakeholders during consultations. Determination of the significance of the potential impacts was based on the three broad categories of determining impact significance. These are:

- Legal: The importance of environmental conservation is acknowledged in existing policies, laws and plans.
- Public: segment of the public recognize the importance of environmental conservation. This recognition takes place in the form of support and sometimes conflict and opposition.
- Technical: the importance of an environmental resource is based on the scientific knowledge of the critical resource characteristics.

Environmental impacts manifest at all stages of a project. This is because of the different project activities that inform particular actions which in turn act on environmental factors. The significance of these impacts is also varied.

The proposed project will have positive impacts during its life span. These include:

- Improvement in groundwater quality through preventing infiltration of sewerage from porous cesspits and pit latrines.
- Improve living conditions for targeted residents through achieving the above environmental benefits, upgrade their real estate values and contribute in alleviating poverty conditions through work opportunities in construction and operation of the project
- Achieve economic benefit by saving some healthcare expenses, improving people's productivity and improving water resources management.
- Strengthen community participation in environmental protection through involving community based organizations in project operation and mobilization activities.
- Employment of some community members as skilled, semi-skilled and unskilled workers.
- Growth of secondary businesses in the project area.
- Increased revenues for the service providers.

- Guaranteeing the right to decent sanitation.

7.2 CONSTRUCTION PHASE ENVIRONMENTAL IMPACTS

The chosen location of the treatment works is ideal in many respects. The water pollution control federation, manual of practice, sewage treatment plant design specifies that ponds are to be located at a reasonable distance from the community and at least 400m from the nearest residence. This criterion is met in this case.

7.2.1 Air Emissions and Ambient Air Quality

a) Gaseous Emissions

Associated with combustion of fuel from the construction vehicles and equipment. These emissions may be in the form of oxides of nitrogen as well as volatile organic carbons. Similar to other combustion processes, emissions from vehicles include CO, NO_x, SO₂, and VOCs. Emissions from the construction vehicles should comply with national or international standards.

Mitigation measures

- Regardless of the size or type of vehicle, operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Contractors should consider additional ways to reduce potential impacts including implementing a regular vehicle maintenance and repair program.
- Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic.
- Ensure that all vehicles involved in the transport of construction material and staff, and machinery involved in the construction is properly maintained and serviced.
- Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions.

b) Particulate Matter

The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads.

Mitigation measures

- Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a bag house or cyclone for material handling sources,

such as conveyors and bins;

- Ensure that all material (sand and aggregate) stockpiled on the site to be used in construction activities are regularly sprayed to reduce the effects of wind whipping.
- Ensure that all trucks carrying aggregate and sand are covered during delivery to the site.
- Care must be taken in the unloading construction materials (aggregate, sand and cement) to prevent spillage. If a spill occurs, this should be cleaned up as soon as possible thereafter.
- Extra care must be taken to reduce dust in periods when wind speed is greatest and the rainfall amounts are lowest. This will involve extra wetting of the construction area to suppress dust particles.
- Retain a buffer area of trees and other vegetation generally around the perimeter of the development site which will serve as a natural windbreaks which may reduce the level of dispersion of dust particles generated during this phases of the development.
- All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic.
- All waste must be transported off-site for processing, not burnt or stored for any longer than is absolutely necessary.

7.2.2 Water quality

The activities involved in this phase of the development may cause a major negative long-term impact on the surface and ground water quality within the area. The surface water likely to be affected includes the rivers as the sewer lines will be laid along the riparian reserves. This will be as a result of many of the activities which are slated to take place in these phases which includes the possible storage of hazardous substances on the site such as diesel and motor oil for the operation of machinery and stand-by generators, and the storage of raw material for the construction of buildings and roads *inter alia*.

Mitigation Measures:

- If diesel and motor oil are to be stored on site, ensure that they are properly contained in a bunded area. This area must have signs indicating the storage of these substances erected.
- Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per toilet.
- Store all raw materials away from the vicinity of water bodies located on the property to avoid contamination in these areas.
- General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site.
- Clearance of vegetation must be avoided in periods of heavy rainfall

7.2.3 Soil erosion and contamination

The activities involved in the site preparation and construction phase of the development may have a major negative short - term impact on soil. This is due to the removal of vegetation from the area which will leave considerable areas of soil exposed to the elements which may result in soil erosion. This is particular area of concern since the soil cover in the area is already poor.

Heavy machinery will be traversing the site due to the construction activities this may lead to soil compaction and erosion of the soil. Hazardous substances such as diesel used for the operation of machinery and stand-by generators, may be stored on the property. This may have a significant negative long-term impact on soil quality in the area.

Mitigation Measures:

- Only remove vegetation from areas for the STW/sewers construction
- Install appropriate drainage systems to direct water away from slopes;
- Avoid as far as possible the traversing of bare soil by vehicles to reduce soil compaction;
- Designate a main access route for heavy machinery;
- Avoid site Preparation in period when wind velocities are highest.

7.2.4 Noise & vibration

The site preparation and construction phases of the development may likely have the most negative impact to the ambient noise and vibration in the development area. A number of measures may be undertaken by the Contractors to reduce the impact of noise on the existing and potential residents as well as the workers involved in the project. This is temporary, however, and the aim at this point is to make the increase in noise small as possible until this phase is complete. The cumulative impact of the construction activities occurring simultaneously may increase the noise and vibration levels in the area significantly.

Mitigation Measures:

- Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. These roads should be sited in such a way that the noise from this movement affects as few of the existing residents as possible.
- Where possible silenced machinery and instruments should be employed to reduce the impact of noise on the existing residents and workers.
- Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact. These pieces of equipment such as drills, graders and cement mixers should also be used when the least number of residents can be expected to be affected, for example during periods where most residents are at work or school.
- Temporary barriers such as earth berms, zinc fencing and sound dampening fencing such as acoustic screens should be employed to reduce the impact of noise to the existing residents;
- Ensure that construction activities for the development of the project are staggered to

decrease the levels of noise and vibration in the area;

- Construction hours should be limited to the hours of 8:00 a.m. and 6:00 p.m. daily.
- The delivery of raw materials must be limited to 8:00 a.m. and 6:00 p.m daily.

7.2.5 Flora and fauna loss.

It is worth noting that the potential significant impact on flora in the area will be short term and reversible. For instance the proposed STW has already treatment works going on. Thus there is minimal vegetation to be affected. The trunk sewers will run along the river course which is currently under crop cultivation. These areas will thus be restored immediately the sewer lines have been laid. No rare, threatened, critically endangered or endemic plant or animal species were observed. However it is important to reduce vegetation loss on the STW site as much as possible.

Mitigation Measures:

- Only clear vegetation that is absolutely necessary for the construction activities;
- Retain all mature trees (> 25 cm diameter at breast height (DBH)) during this phase of the development if possible;
- Avoid the use of Invasive Alien Species in the landscaping activities
- Determine access roads which are to be used by machinery used in the construction and site clearance phase of the development to avoid the unnecessary trampling of vegetation that will be maintained within the development area.
- Ensure that ‘green belts’ which have been proposed for the STW are large as possible as small patches may not be able to support viable populations of some species and these small patches tend to more susceptible to edge effect. It possible position these green belts in adjacent to existing vegetated areas. In addition species richness tends to increase with area, which would be the desired outcome of the incorporation of green belts.

7.2.6 Accidents

Use of heavy machinery in site clearing presents safety hazards. Vehicular movements can cause accidents resulting in injuries and probably death. Use of explosives in the preparation of the STW is a high risk activity which can cause fatal accidents.

Mitigation Measures:

- Ensuring that the drivers and machine operators hired to work on the site are qualified.
- Workers on site must be provided with appropriate PPE.
- Appropriate signs must be erected on the site to warn workers and visitors.
- There should be safety policy clearly displayed on the site.
- Machines should be properly maintained.
- A first aid kit should be provided and a trained first aider should always be on site.
- Fire extinguishers should be provided.

- Proper scheduling of activities to avoid workers being overworked.
- Machines/equipment for the intended purpose.
- No worker should be allowed on site while under the influence of alcohol or other inebriating substances.
- Only the Blaster licensed by the Mines and Geology should carry out blasting on the site.
- Blasting should only be carried out as per the provisions of the blasting license away from house and power lines.
- All charged holes must be covered with appropriate medium to arrest fly rocks.

7.2.7 Disturbance of traffic and difficulty of access

The main impact on roads traffic will be during possible laying of transmission mains along, or across main roads. Longitudinal excavation will cause narrowing of the road for relatively long periods, while lateral crossing of roads may cause blocking of the road but for a relatively short period, probably few hours.

Excavation in residential areas will cause access problems to pedestrians, and possibly to riders of bicycles and motorcycles. This access difficulty will have more impact on elderly people, handicapped and children, who may accidentally fall in open trenches or make tedious long cycles before they reach their targeted locations.

Mitigation measures

- Provide diversion routes where possible.
- Give a construction itinerary in advance so that the potentially affected population can use alternative routes and start early to get to their destinations on time.
- Erect warning signs of on-going works.
- Expedite construction works so as to reduce the times where roads are blocked.
- Traffic department should approve crossing plan prior to construction, and should approve obstruction times during construction.
- Access of residents should be facilitated by installing appropriate temporary bridges over the pipeline trenches.
- Suitable warning signs should be placed at near locations and should be visible at night.
- A guard should be available 24 hours to help people access across pipeline trenches.
- Alternatives access ways should be communicated to the community.

7.2.8 Risks of damaging underground infrastructure

During excavation for laying the sewerage pipes there are risks of damaging underground potable water pipes, telecommunication or power lines. This will be associated with cutting water, communication or power services and in excavation trenches.

Mitigation measures

- Get maps of the underground infrastructure from the relevant institutions.
- Sensitize workers carrying out excavations so that they exercise caution to minimize

chances of underground infrastructure damage.

- Work closely with the responsible institutions so that in case of damage, the services are restored within the shortest time.

7.2.9 Effects on structural integrity

During excavations of trenches, vibrations from excavators may affect the stability of the buildings. Affected buildings may crack and thus impact on their safety.

Mitigation Measures

- The geotechnical report should include suitable measures for confining vibrations within project sites. These measures should be tailored according to the proximity of buildings to the project sites and earthwork program.
- These recommendations identified in the geotechnical report (such as secant piling or sheet piling or establish cut-off walls) should be implemented by the contractor and supervised by EHS Advisor.
- Blasting should not be done near houses or power lines.

7.2.10 Construction wastes

Various wastes both liquid and solid are generated in the course of construction. The wastes range from general to hazardous categories. This impact is short term. However the disposal mechanism of the wastes can have long term consequences.

Mitigation measures

- All solid waste will be collected at a central location at each site and will be stored temporarily until removal to an appropriately permitted disposal site in the vicinity of the site.
- No dumping within the surrounding area is to be permitted. Where potentially hazardous substances are being disposed of, a chain of custody document should be kept with the environmental register as proof of final disposal.
- Waste generated at the site should be categorized by the contractor and disposed of in a suitable manner into different waste streams (including general and hazardous waste). Wherever possible recycling should be carried out.

7.2.11 Fire outbreak

Fire outbreak in the construction camp or in the machinery being used is always a risk. This is because there are flammable substances in use. Depending on the severity, fire can cause loss of life, disability or property damage. Thus precautions are necessary.

Mitigation measures

- Label all inflammable materials and store them appropriately
- Provision of adequate fire fighting equipment capable of fighting all classes of fire
- Put – No Smoking Signs in areas where inflammables are stored
- Train workers on the use of fire fighting equipment

- Display a list of emergency contact numbers prominently.
- Provide a fire assembly point in the Contractors camp.

7.2.12 Contractors camp sanitation

Improper handling of human wastes at the camp can have far reaching health implications on the workers and the host population. This is an impact that can be experienced far from the camp site.

Mitigation measures:

- Provision shall be made for employee facilities including shelter, toilets and washing facilities.
- Toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 30 workers (preferred 1:8).
- The exact location of the toilets shall be approved by the Public Health Department prior to establishment.
- Sanitation facilities shall be located within 100m from any point of work, but not closer than 50 m to any water body.
- All temporary/portable toilets shall be secured to the ground to prevent them toppling due to wind or any other cause.
- The contractor shall ensure that the entrances to toilets are adequately screened from public view.
- Only approved portable toilets should be used.
- These facilities shall be maintained in a hygienic state and serviced regularly. Toilet paper shall be provided.
- The contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from site to an approved disposal site.
- Discharge of waste from toilets into the environment and burying of waste is strictly prohibited.
- Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas, which include groundwater, are not polluted.

7.2.13 Spread of HIV and AIDS

Large projects like the proposed sewerage system do attract migrant workers. These men and women away from their partners can get into sexual liaisons with people from the host community. Thus being exposed to HIV/AIDS or infecting others.

Mitigation measures:

- Sensitize the migrant workers on risky sexual behaviour.
- Have VCT services on site and encourage workers to undergo the same.
- Provision of protective devices such as condoms.
- Maximize hiring skilled and unskilled workers from the host community.

7.2.14 Social conflicts

These emerge mainly due to:

- Acts of omission or commission by project Proponent or Contractor for example delay in honouring agreements.
- Misunderstanding amongst stakeholders.

Mitigation measures

Immediate action undertaken as soon as possible and within 24 hours of receipt of a complaint.

Investigations completed within seven days of receipt of complaint.

- All corrective actions implemented by due date
- All incidents or complaints about either environmental or social issues will be managed in accordance to the existing procedure in line with the legal framework.

All incidents and complaints will be recorded in the contractor's incident reporting system

- Additional environmental awareness training of the workforce with respect to procedures to be followed for environmental incidents or complaints
- Sensitize workforce on cultural sensitivities

7.2.15 Displacement

Implementation of the proposed project will lead to displacement of sections of the population. The displacements include:

- i. Physical displacement: land is taken for the project especially for the STW.

The STW will be located on public land. This will be next to the existing STW at DESTW. In this case then there will be no compensation. Consultations with the local administration revealed that the land is owned by the government of Kenya. Currently the land has been occupied by squatters who are constructing permanent buildings for residential purposes. These will be offered a notice to vacate as they are aware that they do not own the land. Therefore there will be no relocation of the PAPs.

Trunk sewers will run along road and riparian reserves to minimize displacement. Where this cannot be avoided or the reserves have been encroached, compensation as per the law will be made.

- ii. Economic displacement: Loss of income for the time the project is being implemented in the affected sections. This is mainly for those farming along the riparian zone, those who have structures on the riparian and site of the proposed STW.

The total number of households to be affected is 557 which translates to 2,228 number of Project Affected Persons. The total no of structures is envisaged to be 462. This includes masonry walls, pit latrines, kiosks, galvanized iron sheets structures and other storage facilities. Compensation

will only be done for the crops and structures. There will be no compensation for land, however where a private property will be affected, the client will negotiate with the owner for easement rights. Refer to RAP Report for details.

An independent Resettlement Action Plan (RAP) has been prepared to address these impacts. However the following key mitigation measures will be implemented. The RAP has to be fully implemented prior to commencement of construction works.

Mitigation measures

- Avoid displacement as much as possible.
- Prompt and fair compensation of all the PAPs before beginning of construction works
- Pre and post resettlement counselling's support.
- Financial education for the recipients of compensation funds.
- Establishment and regular use of locally based Grievance Redress Mechanism.

7.3 POTENTIAL IMPACTS ASSOCIATED WITH OPERATIONS

The most significant potential environmental impacts associated with operation and maintenance of sewerage system and sewerage treatment plants arise from:

7.3.1 Pollution of water and soil from leaks and overflows

Leaks and overflows from the sewerage system can cause contamination of soil, groundwater, and surface water. Depending on the elevation of groundwater, leaks in gravity mains may also allow groundwater into the sewer system, increasing the volume of wastewater requiring treatment and potentially causing flooding and treatment bypass. Overflows occur when the collection system cannot manage the volume of wastewater, for example due to high flows during rain events or as the result of power loss, equipment malfunctions, or blockages. The excess flows may contain raw sewage, industrial wastewater, and polluted runoff.

Mitigation measures

- Consider the installation of separate sewer systems for domestic wastewater and storm water runoff in the overall planning and design of new sewerage systems;
- When on-site sanitation systems where excreta are mixed with water predominate, consider use of small-diameter sewerage system to collect water effluent from septic systems or interceptor tanks;
- Limit the sewer depth where possible (e.g., by avoiding routes under streets with heavy traffic). For shallower sewers, small inspection chambers can be used in lieu of manholes;
- Use appropriate locally available materials for sewer construction. Spun concrete pipes can be appropriate in some circumstances but can suffer corrosion from hydrogen sulphide if there are blockages and/or insufficient slope;
- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation;

- Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system;
- Equip pumping stations with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages, and conduct regular maintenance to minimize service interruptions. Consider redundant pump capacity in critical areas;

7.3.2 Accidents and Injuries

Work at water and sanitation facilities is often physically demanding and may involve hazards such as open water, trenches, and slippery walkways, working at heights, energized circuits, and heavy equipment. Work at water and sanitation facilities may also involve entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions. Drowning is also a risk associated with water works.

Mitigation measures

- Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available;
- Use PFDs when working near waterways;
- Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards.
- Valves to process tanks should be locked to prevent accidental flooding during maintenance;
- Use fall protection equipment when working at heights;
- Maintain work areas to minimize slipping and tripping hazards;
- Use proper techniques for trenching and shoring;
- Implement fire and explosion prevention measures in accordance with internationally accepted standards;
- When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as:
 - i. Establishment of work zones so as to separate workers from traffic and from equipment as much as possible
 - ii. Reduction of allowed vehicle speeds in work zones;
 - iii. Use of high-visibility safety apparel for workers in the vicinity of traffic
 - iv. For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists
- i. Locate all underground utilities before digging.

7.3.3 Chemical Exposure

Water in the sewerage system may contain radioactive substances and heavy metals, which typically accumulate in the water treatment sludge. Potential sources of exposure to radionuclides include: pumps and piping where mineral scales accumulate; lagoons, and flocculation and sedimentation tanks where residual sludges accumulate; filters, pumping stations, and storage tanks where scales and sludges accumulate; facilities where filter backwash, brines, or other contaminated water accumulates; facilities that are enclosed (radon); residuals processing or handling areas; and land disposal or application areas where residuals are shovelled, transported, or disposed.

Wastewater may contain potentially hazardous chemicals depending on the source water quality, drinking water treatment processes, and industries discharging to the sewer, including chlorinated organic solvents and pesticides, PCBs, Polycyclic aromatics, petroleum, hydrocarbons, flame retardants, nitrosamines, Heavy metals, asbestos, dioxins, and radioactive materials. In addition, workers may be exposed to hydrogen sulphide, methane, carbonmonoxide, chloroform, and other chemicals generated during wastewater treatment.

Mitigation measures

- Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures;
- Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance.
- Prepare escape plans from areas where there might be a chlorine or ammonia emission;
- Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used;
- If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices);
- Conduct radiation surveys at least annually, especially in areas where radionuclides are removed;
- Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyse incoming raw wastewater to identify hazardous constituents;
- Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. Use personal gas detection equipment while working in a wastewater facility;
- Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency);
- Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted

standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping;

- Prohibit eating, smoking, and drinking except in designated areas;
- Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.

7.3.4 Liquid Effluents

Effluents for the Dandora STW will be discharged to Kiu River. Alternatively, treated wastewater (liquid effluents) may be reused for irrigation or other purposes or disposed subject to regulatory oversight. Due care should be taken to ensure that the effluents meet the quality standards that do not jeopardize the health of ecosystems.

Mitigation measures

- Minimize bypass of the treatment system by using separate storm water and wastewater systems, if possible, and providing capacity sufficient to treat peak flows;
- Implement an industrial source control program which includes monitoring and effective regulatory enforcement;
- Collaborate with public officials to select appropriate treatment technologies, considering factors such as the quality and quantity of raw wastewater and its variability; available land area for the treatment facility; and resources for capital expenditures, operation, maintenance, and repair; availability of skilled operators, operator training, maintenance personnel, treatment chemicals, and replacement parts;
- Design, construct, operate, and maintain wastewater treatment facilities and achieve effluent water quality consistent with applicable national requirements or internationally accepted standards and consistent with effluent water quality goals based on the assimilative capacity and the most sensitive end use of the receiving water;
- Consider discharge of treated wastewater to natural or constructed wetlands, which can buffer the impact from discharge on the aquatic environment, unless the wetland itself would be degraded by the discharge;
- Treat grey water, if collected separately from sewage, to remove organic pollutants and reduce the levels of suspended solids, pathogenic organisms and other problematic substances to acceptable levels based on applicable national and local regulations. Grey water lines and point of use stations should be clearly marked to prevent accidental use for potable water quality applications;
- Based on an assessment of risks to human health and the environment, consider re-use of treated effluent, especially in areas with limited raw water supplies. Treated wastewater quality for land application or other uses should be consistent with the

relevant public health-based guidance from the World Health Organization (WHO) and applicable national requirements.

7.3.5 Solid Waste

Solids removed from wastewater collection and treatment systems may include sludge and solids from cleaning of drainage and sewer collection systems (including seepage systems), screening solids, and sludge from various unit operations used for wastewater treatment.

Mitigation measures

- Select appropriate sludge treatment technologies, considering, for example, the quantity and sources of sludge; available resources for capital expenditures, training, operations and maintenance; availability of skilled operators, maintenance personnel, etc.; and the desired disposal methods or end uses of the treated solids;
- Land application or other beneficial re-use of wastewater treatment plant residuals should be considered but only based on an assessment of risks to human health and the environment. Quality of residuals for land application should be consistent with the relevant public health-based guidance from the World Health Organization (WHO) and applicable national requirements;
- Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable National requirements or, in their absence, internationally accepted guidance and standards.

7.3.6 Offensive Odours

Air emissions from wastewater treatment operations may include hydrogen sulphide, methane, ozone (in the case of ozone disinfection), volatile organic compounds (such as from industrial discharges), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bio-aerosols. Odours from treatment facilities can also be a nuisance to workers and the surrounding community

Mitigation measures

- Commissioning should start with the facultative ponds to avoid odour release when anaerobic pond effluent discharges into an empty facultative pond. It's recommended the facultative and maturation pond be filled with freshwater so as to allow gradual development of algae.
- If sewage is weak or its flow low, it is best to by-pass the anaerobic ponds until the sewage strength is achieved.
- Maintain the pond pH above 7.5 to permit the development of bacteria and ensure that most of the sulphide remains as the odourless bisulphide ion.
- The anaerobic ponds allow sludge to settle at the bottom of the pond.
- Desludging when the sludge occupies about 1/3 of the anaerobic ponds.
- Airtight vandal proof manhole covers.

- Removal of scum from facultative and maturation ponds (to maximize aeration and photosynthesis)
- WSPs have a high capacity to handle shock loads.
- Avoid siting facilities near densely populated neighbourhoods' and installations with potentially sensitive receptors, such as hospitals and schools. Site facilities down-wind from potential receptors, if possible.
- Cover emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and channels), and vent emissions to control systems (e.g., compost beds, bio-filters, chemical scrubbers, etc.) as needed to reduce odours and otherwise meet applicable national requirements and internationally accepted guidelines;
- Where necessary, consider alternate aeration technologies or process configurations to reduce volatilization.
- Provide adequate buffer area, such as trees, or fences, between processing areas and potential receptors;
- The physical and process designs have been carefully done and will significantly affect treatment efficiency.

7.3.7 Hazardous Chemicals

Wastewater treatment often includes the use of hazardous chemicals, such as strong acids and bases for pH control, chlorine or other compounds used for disinfection, etc.

Mitigation measures

- Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
- Use vacuum trucks or tugs for removal of faecal sludge instead of manual methods;
- Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
- Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure;
- Encourage workers at wastewater facilities to wash hands frequently;
- Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations
- Avoid handling screenings by hand to prevent needle stick injuries;
- Maintain good housekeeping in sewage processing and storage areas;

- Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, especially composting facilities, facility because of their greater risk of infection
- Reduce aerosol formation and distribution, for example by:
 - i. Planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles
 - ii. Using diffused aeration rather than mechanical aeration and using finer bubbles for aeration
 - iii. Reducing aeration rate, if possible
 - iv. Use of floating covers on the mixed liquor of the aeration basin
 - v. Suppression of droplets just above the surface, (e.g. by installing a screen or mesh above the basin);
 - vi. Disinfection of airborne particles (e.g., by using ultraviolet lights)
 - viii. Use of submerged effluent collector (such as pipes with orifices) rather than weirs

7.3.8 Public health risks associated with land application of sludge

Use of treated wastewater in agriculture can pose public health risks. Hazards associated with crops irrigated with treated wastewater include excreta-related pathogens and toxic chemicals that may be present in the wastewater.

Mitigation measures

- Avoid use of spray irrigation of treated wastewater, if possible;
- Provide field workers with personal protective equipment, such as rubber gloves and waterproof shoes;
- Provide access to safe drinking water and sanitation (including hand washing) facilities;
- Provide worker health monitoring, including regular physical examinations;
- Control vectors and intermediate hosts of disease-causing micro-organisms.
- Treat wastewater and sludge used for land application in a manner consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Grey water and applicable national requirements;
- Stop irrigation with treated wastewater two weeks prior to harvesting;
- Limit irrigation with treated wastewater to crops that are cooked before eating;
- Restrict public access to hydraulic structures carrying wastewater and to fields irrigated with treated wastewater.
- Consider use of drip irrigation of treated wastewater, which minimizes worker exposure and the amount of water needed

7.3.9 Physical Hazards such as drowning

Visitors and trespassers at wastewater treatment facilities may be subject to many of the hazards for site workers.

Mitigation measures

Recommended measures to prevent, minimize, and control physical hazards to the community include:

- Restrict access to waste management facilities by implementing security procedures, such as:
 - i. Perimeter fencing of adequate height and suitable material, with lockable site access gate.
 - ii. Security cameras at key access points, and security alarms fitted to buildings and storage areas; and
 - iii. Use of a site visitor register.
- Light the site where necessary. As this may cause light nuisance to neighbours, the lighting installations should be selected to minimize ambient light pollution.

7.3.10 Risks of wildlife and rodents attractions to the site

The sewerage treatment plant can attract wildlife like hyenas, Hippos, Crocodile, wild dogs and scavenger birds. These can pose high risk to the human population while precipitating human- wildlife conflicts.

Mitigation measures

- Proper fencing of the Plant to keep off wildlife is recommended
- Maintaining high standards of hygiene at the site throughout the operation phase of the facility
- Constant consultations with KWS in event that wildlife is spotted in the area.
- The inlet works should be enclosed in a building to avoid exposure to birds
- Daily burying of the wastes in appropriate solid Waste disposal section covering with soil, this reduces the tonnage of wastes on site and exposing the wastes to scavenging birds.

7.4 ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

The following action will be taken to safeguard the health and safety of workers and visitors in the site throughout the project lifecycle. These are in line with OSHA, 2007.

- **Personal Protective Equipment (PPE)**

Provision of appropriate protective clothing such as ear muffs, safety boots dust masks, gloves, helmets and safety goggles to workers during construction. The supervisors will ensure that workers comply by wearing these protective clothing.

- **Employees' pro-active safety attitudes**

Regular training on pro-active safety attitudes for employees would instil a sense of responsibility upon the employees, and in this way, increase employee's efforts towards avoiding occurrence of accidents due to negligence, ignorance or carelessness.

- **Training in Occupational Health and Safety**

This is most important and should be regular. It will encompass ergonomic issues to avert life threatening conditions.

- **First Aid**

There will be trained First Aiders and continuous training for staff is recommended. First aid kits will also be provided.

- **Sanitary provision**

These should be provided. Toilets should always be clean and drinking water should be free of pathogens. They shall be adequate and separate for male and female.

- **Control of health hazards**

There should be adequate medical supervision of all personnel comprising pre-hiring clinical screening, periodic medical examination and rehabilitative care for any affected workers.

- **Ergonomics**

All personnel should be trained on the basic ergonomic principles. This should cover the correct lifting, carrying and setting down techniques to prevent incidences of hernias, sprains, strains, back injuries and other muscular-skeletal disorders due to improper handling of heavy objects.

- **Health Safety Policy**

It is hereby recommended that the firm undertakes a Health and Safety Survey. This activity culminates in the preparation of the health and safety management plan. The health and safety management plan is accomplished following a risk assessment. The risk assessment provides a systematic process that can highlight projected activities within the operations of the lodge that demand the highest degree of observation. An overall register of all projected firm activities has then to be prepared, each hazard identified and its risk assessed.

The management needs to work to initiate a special emphasis program to demonstrate a positive interest and commitment in addressing and/or eliminating the potential hazard exposures in the workplace and ensuring that the workplace complies with the relevant Legislation and Applicable codes of Practice as a minimum to add to employees 'sense of well-being.

7.5 CLOSURE AND DECOMMISSIONING

Decommissioning of a facility and property includes: the removal of hazardous materials and wastes, cleaning and removal of equipment, decontamination, rehabilitation and remediation and the termination of the operational permits and licenses.

Although the decommissioning of this project is probably the last thing at this point, it's prudent to develop a project with its eventual demise. By viewing the project over its lifecycle, the designers put in place the impacts of the design and were assisted with the perspective that sees the project as part of the ecosystem, rather than a construction without the consequences of its eventual demise.

Therefore with this in mind the decommissioning phase of this project will probably include these:

- i. Building decommissioning entails:
 - Environmental remediation,
 - Equipment dismantling
 - Building demolition
 - Removal of equipment
 - Decontamination of the building
- ii. Adaptive reuse
 - Once the structures of the project have been decommissioned, the search for recycling and reuse will begin.
 - If the structures will be completely demolished, the remaining property will be suited for new construction or rehabilitated as green space.
 - If the shell the original remains it will be ready for modifications /restoration to prepare it for its new intended use.
 - The debris will be used as hardcore for forming the foundation of the new facility
 - There will be proper landscaping which will involve (has already involved the planting of indigenous tree species, grassing the facility with local grass, establishing a water pond or basically an animal pond with the remaining materials.
- iii. Rehabilitation
 - Prior to the decommissioning of the project, the following steps will be undertaken.
 - The current conditions, areas of concern and alternatives for future action will be put into consideration.
 - An environmental assessment will be performed to identify and determine the nature and extent of any hazardous building materials or environmental contaminants.
 - An equipment inventory will be undertaken, as it is important to determine the equipment and materials present inside a building before it can be decommissioned.
 - The project inspection will be done to provide valuable information for deciding on alternative for future use. There will be an inspection of the facility design, materials of

construction and current condition. The structural integrity of the facility will be used to evaluate whether the building should be reused or demolished.

From this assessment the decommissioning will include:

Hazardous materials are found, will be dismantled and the contaminated building materials sent to an appropriate landfill in lieu of clean-up or decontamination of these materials.

Equipment: equipment that cannot be used at the facility will be cleaned and taken to another facility of the same nature of business or sold. This will include components to water and wastewater pre-treatment systems, process piping and industry specialized equipment. Decontamination will involve removal, purging and proper disposal of liquids, solids and gases contained in equipment, and rinsing or high pressure washing with water and detergent. Chemical analysis of wipe samples taken from washed equipment surfaces will be performed to document that residual hazardous substances have been removed.

Decontamination and remediation: building surfaces will be identified (floors, walls, ceiling and equipment that stays) that may be contaminated and require decontamination. This will typically include maintenance rooms, chemical storage rooms, hazardous waste storage rooms, storage rooms, production area and other locations that had been subject to spills and processes. Generally, concrete surfaces subject to chemical, processes spills and wastewater spills will be easily decontaminated by high-pressure washing. Finished surfaces damaged by spills or process materials will require replacement. Wipe or chip samples will be collected and chemically tested to verify that sufficient cleaning has been performed.

While there is no reason to presume that the facility would need to be decommissioned, or abandoned in the future, assuming proper maintenance, the result of needing to abandon or remove the facility are considered to be minor. Nevertheless, the facility remnants would not create any long term threat to the environment; as the concrete slabs could be broken up and disposed off and the septic tanks could be filled up, if warranted.

Table 13: Assessment Criteria for significant Impacts

Key	Type of Impact	Key	Type of Impact
++	Major Positive	+	Minor positive
--	Major Negative	-	Minor negative
0	Negligible/Zero	Nc	No change
Sp	Specific / Localized	W	Widespread
R	Reversible	Ir	Irreversible
Sh	Short term	L	Long term
T	Temporary	P	Permanent

Table 14: Potential Environmental Impacts

Impacts on or due to	Construction	Operation	Remarks
Air pollution	-	-	During construction, dust and exhaust emission from the construction activities and machinery, may Pollute the ambient air. Not a major issue in operation phase
Water pollution	-	-	Petroleum oils and grease used in vehicles and construction machinery may spill or leak on/into the ground hence into the soil or water system within the neighbourhood Oil waste will not be a major issue during operation phase of the project.
Soil erosion	-T	0	Earth works during project construction usually influence soil erosion. By incorporating appropriate soil conservation measures and proper drainage facilities both during construction and operation phases of the project, soil erosion will be completely minimized
Solid waste	Sh	-	Various wastes both liquid and solid are generated in the course of construction. Waste generated at the site should be categorized by the contractor and disposed of in a suitable manner into different waste streams (including general and hazardous waste). Wherever possible recycling should be carried out. This applies to all phases
Noise / Vibrations	-	0	During construction, hooting of construction vehicles and communication from workers may generate noise and vibration that may have negative effect to the neighborhood. This will however be very minimal and will be restricted to the construction stage of the project.
Disturbance of traffic / Difficult in access	T	0	The main impact on roads traffic will be during possible laying of transmission mains along, or across main roads. A construction itinerary should be given in advance so that the potentially affected population can use alternative routes and start early to get to their destinations on time. The effects only apply during construction

Damage of underground Infrastructure	Sh	0	During excavation for laying the sewerage pipes there are risks of damaging underground potable water pipes, telecommunication or power lines. Get maps of the underground infrastructure from the relevant institutions
Structural stability	Sp	0	During excavations vibrations may affect the stability of the buildings. The geotechnical report should include suitable measures for confining vibrations within project sites.
Public Health	-	-	During the construction process, there will be health threats to workers on site. During operation phase, public health threats will be from blocked Sewerage system that may pollute the environment
Sanitation at the Contractor's camp	-	-	Improper handling of human wastes at the camp can have far reaching health implications on the workers Provision shall be made for employee facilities including shelter, toilets and washing facilities.
Fire outbreak	--	-	Fire outbreak in the construction camp or in the machinery being used is always a risk. This is because there are flammable substances in use Provision of adequate firefighting equipment capable of fighting all classes of fire
Social conflicts	Sh	-	Acts of omission or commission by project Proponent or Contractor Immediate action undertaken as soon as possible and within 24 hours of receipt of a complaint.
Spread of HIV / AIDs	L	P	Large projects like the proposed sewerage system do attract migrant workers. These men and women away from their partners can get into sexual liaisons with people from the host community. Sensitize the migrant workers on risky sexual behavior.
Physical Displacement of people	Ir	P	Implementation of the proposed project will lead to physical displacement of squatters that have encroached the STW

CHAPTER EIGHT: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 INTRODUCTION

The purpose of the following Environmental and Social Management Plan (ESMMP) for the proposed project is to initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. The EMP identifies certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring. The objectives of the ESMMP are:

- To provide evidence of practical and achievable plans for the management of the proposed project.
- To provide the Proponent and the relevant Lead Agencies with a framework to confirm compliance with relevant laws and regulations.
- To provide community with evidence of the management of the project in an environmentally acceptable manner.

Conversely, Environmental monitoring provides feedback about the actual environmental impacts of a project. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes. A monitoring program, backed up by powers to ensure corrective action when the monitoring results show it necessary, is a proven way to ensure effective implementation of mitigation measures. By tracking a project's actual impacts, monitoring reduces the environmental risks associated with that project, and allows for project modifications to be made where required.

This ESMMP is prepared for the three project stages where potential significant negative impacts manifest. These are:

- i. Construction Phase ESMMP
- ii. Operation Phase ESMMP and
- iv. Decommissioning Phase ESMMP.

8.2 CONSTRUCTION ENVIRONMENTAL, SOCIAL, MANAGEMENT AND MONITORING PLAN

The construction Contractor will be responsible for the implementation of the construction phase ESMMP. The Contractor will identify responsibilities and organization required to implement the accountabilities of the construction phase ESMMP. The construction phase ESMP will apply to the Principal Contractor and all Sub-contractors.

The Contractor will also be responsible for developing and implementing a site specific induction for all construction workers. This induction will include all EHS hazards and their control measure. The Contractor will ensure that all construction workers are trained and competent and hold the appropriate certification for the tasks that they will be undertaking.

A preliminary environmental management and monitoring outline has been developed for the project works. Responsibility for the incorporation of mitigation measures for the proposed project lies with the Proponent, who must ensure specified mitigation measures are implemented and monitored.

The table below summarizes the environmental management plan for the proposed project. They describe parameters that can be monitored, and suggest how monitoring should be done, how frequently, and who should be responsible for implementation and monitoring. The estimated costs for the various mitigation measures have been provided where possible. It will be noted that most of these measures will be part of the project's operational costs

Construction Phase ESMMP**Table 15: Construction Phase ESMMP**

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
1. Air pollution	<ul style="list-style-type: none"> Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits; Contractors should consider additional ways to reduce potential impacts including implementing a regular vehicle maintenance and repair program. Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic. Ensure that all vehicles involved in the transport of construction material and staff, and machinery 	<ul style="list-style-type: none"> Contractor Project Manager 	Throughout the construction period	Contractor / AWSB	Cases of Respiratory complications in the nearby Health Centre	3,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>involved in the construction is properly maintained and serviced.</p> <ul style="list-style-type: none"> ▪ Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions. ▪ Use of dust control methods, such as covers water suppression ▪ Ensure that all trucks carrying aggregate and sand are covered during delivery to the site. ▪ Ensure that all material (sand and aggregate) stockpiled on the site to be used in construction activities are regularly sprayed to reduce the effects of wind whipping ▪ Care must be taken in the unloading construction materials (aggregate, sand 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>and cement) to prevent spillage. If a spill occurs, this should be cleaned up as soon as possible thereafter.</p> <ul style="list-style-type: none"> ▪ Extra care must be taken to reduce dust in periods when wind speed is greatest and the rainfall amounts are lowest. This will involve extra wetting of the construction area to suppress dust particles. ▪ Retain a buffer area of trees and other vegetation generally around the perimeter of the development site which will serve as a natural windbreaks which may reduce the level of dispersion of dust particles generated during this phases of the development. ▪ All raw materials must be sourced as close as possible to the construction site thus 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>reducing the emissions from vehicular traffic.</p> <ul style="list-style-type: none"> All waste must be transported off-site for processing, not burnt or stored for any longer than is absolutely necessary. 					
2. Water Pollution	<ul style="list-style-type: none"> If diesel and motor oil are stored on site, ensure that they are properly contained in a bunded area (With capacity to contain 1½ times the amount of substances stored). This area must have signs indicating the storage of these substances erected. Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be fifteen (15) workers per toilet. Store all raw materials away from the vicinity of water bodies located on the property to avoid 	Contractor	Throughout the construction period	Contractor/AWSB	No complaints from community not happy with the Contractor	2,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>contamination in these areas.</p> <ul style="list-style-type: none"> General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site. Clearance of vegetation must be avoided in periods of heavy rainfall 					
3. Soil erosion and contamination	<ul style="list-style-type: none"> Only remove vegetation from areas for the STW/sewers construction ; Install appropriate drainage systems to direct water away from slopes; Avoid as far as possible the traversing of bare soil by vehicles to reduce soil compaction; Designate a main access route for heavy machinery; Avoid site preparation in period 	Civil Engineer and Contractor	Throughout the construction period	AWSB / Nairobi County	Soil erosion extent and intensity on site	1500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>when wind velocities are highest.</p> <ul style="list-style-type: none"> Areas storing hazardous substances such as diesel must be properly contained in a bunded area (With capacity to contain 1 ½ times the amount of substances stored. This area must be situated away from project activities and signs indicating the storage of these substances erected. Care must be taken when handling these hazardous substances to avoid spills. In the event of an oil spill the contaminated soil must be removed and disposed off 					
4. Solid wastes	<ul style="list-style-type: none"> Use an integrated wastes management system observing the following hierarchy of options: Reduction at source Recycling Reuse Combustion 	Contractor	Throughout the construction period	Contractor / AWSB / NEMA	No complaints from the community not happy with solid waste disposal	1,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>Land filling.</p> <ul style="list-style-type: none"> ▪ Incorporation of waste management commitments contained in the Waste Management Guidelines ▪ Agreement with suppliers to accept the return of unused materials. ▪ Agreement with and license details of companies to be used for the off-site transport of wastes ▪ Workforce training programs in waste minimization practices ▪ Where practical any excess materials will be returned to the supplier ▪ Waste oil will be collected for transport and off-site disposal Littering, specifically of the natural areas, should be prevented. Adequate containers for litter removal should be supplied on site. These containers should be emptied on a regular basis and the contents removed to an appropriate and 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>licensed waste disposal site.</p> <ul style="list-style-type: none"> The Contractor shall set up a solid waste control and removal system. Bins shall be emptied on a daily basis. Waste and litter shall be disposed of into scavenger – and weather proof bins. The contractor shall then remove the refuse collected from the working areas, from site at least once a week. 					
5. Noise and Vibration	<ul style="list-style-type: none"> Best available work practices will be employed on-site to minimize occupational noise levels. All construction equipment will be regularly inspected and maintained in good working condition. Combine noisy operations so that they occur at the same time. The total noise level will not be significantly louder than 	Contractor	Throughout construction phase	Contractor / AWSB / NEMA	Reported no of complaints from neighbors and nearby institutions	200,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>the level produced if the operations were to be undertaken separately.</p> <ul style="list-style-type: none"> Noisy operations will be carried out strictly during the day time. Switch off engines when not in use. Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. These roads should be sited in such a way that the noise from this movement affects as few of the existing residents as possible. Where possible silenced machinery and instruments should be employed to reduce the impact of noise on the existing residents and workers. Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact. 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>These pieces of equipment such as drills, graders and cement mixers should also be used when the least number of residents can be expected to be affected, for example during periods where most residents are at work or school.</p> <ul style="list-style-type: none"> Temporary barriers such as earth berms, zinc fencing and sound dampening fencing such as acoustic screens should be employed to reduce the impact of noise to the existing residents; Ensure that construction activities for the development of the project are staggered to decrease the levels of noise and vibration in the area; Construction hours should be limited to the hours of 8:00 a.m. and 6:00 p.m. 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>daily.</p> <ul style="list-style-type: none"> The delivery of raw materials must be limited to 8:00 a.m. and 6:00 p.m daily. 					
6.Biodiversity loss	<ul style="list-style-type: none"> Only clear vegetation absolutely necessary for the construction activities; Avoid the use of Invasive Alien Species in the landscaping activities Determine Access roads which are to be used by machinery used in the construction and site clearance phase development to avoid the unnecessary trampling of vegetation that will be maintained within the development area. Ensure that green belts' which have been proposed for the STW are large as possible as small 	Contractor	Throughout construction phase	Contractor/AWSB	Soil erosion extent and intensity on site	1,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>patches may not be able to support viable populations of some species and these small patches tend to more susceptible to edge effect. It possible position these green belts in adjacent to existing vegetated areas. In addition species richness tends to increase with area, which would be the desired outcome of the incorporation of green belts.</p>					
7. Disturbance of traffic and difficulty of access	<ul style="list-style-type: none"> ▪ Provide diversion routes where possible. ▪ Give a construction itinerary in advance ▪ Erect warning signs of ongoing works. ▪ Expedite construction works so as to reduce the times where roads are blocked. <ul style="list-style-type: none"> ▪ Traffic department should approve crossing plan prior to construction, and should 	Contractor	Throughout the construction phase	Contractor / AWSB	No complaints from the community due to lack of certain services	3,500,000.00

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>approve obstruction times during construction.</p> <ul style="list-style-type: none"> Access of residents should be facilitated by installing appropriate temporary bridges over the pipeline trenches. Suitable warning signs should be placed at near locations and should be visible at night. A guard should be available 24 hours to help people access across pipeline trenches. Alternatives access ways should be communicated to the community. 					
8. Damage of underground infrastructure	<ul style="list-style-type: none"> Get maps of the underground infrastructure from the relevant institutions. Sensitise workers carrying out Excavations so that they 	Contractor	Throughout the construction phase	Contractor / Nairobi County	No complaints from the community due to lack of certain services	2,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>exercise caution to minimize chances of underground infrastructure damage.</p> <ul style="list-style-type: none"> Work closely with the responsible institutions so that incase of damage, the services are restored within the shortest time. Notify affected parties if service needs to be temporarily relocated or was affected by the project works. 					
9. Structural Stability	<ul style="list-style-type: none"> The geotechnical report should include suitable measures for confining vibrations within project sites. These measures should be tailored according to the proximity of buildings to the project sites and earthwork program. These recommendations identified in the geotechnical report (such as secant piling or sheet piling or establish 	Contractor	Throughout the construction phase	Contractor / AWSB		3,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>cut-off walls) should be implemented by the contractor and supervised by EHS Advisor.</p> <ul style="list-style-type: none"> ▪ Blasting should not be done near houses or power lines. 					
10. Occupational Accidents	<ul style="list-style-type: none"> ▪ Ensuring that the drivers and machine operators hired to work on the site are qualified. ▪ Workers on site must be provided with appropriate PPE. ▪ Appropriate signs must be erected on the site to warn workers and visitors. ▪ There should be safety policy clearly displayed on the site. ▪ Machines should be properly maintained. ▪ A first aid kit should be provided and a trained first aider should 	Contractor	Throughout construction phase	Contractor / AWSB	Accidents occurrences / incidences	500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>always be on site.</p> <ul style="list-style-type: none"> Fire extinguishers should be provided. Proper scheduling of activities to avoid workers being overworked. Machines/equipment for the intended purpose. No worker should be allowed on site while under the influence of alcohol or other inebriating substances. Only the Blaster licensed by the Mines and Geology should carry out blasting on the site. Blasting should only be carried out as per the 					
	<p>provisions of the blasting license away from house and power lines.</p> <ul style="list-style-type: none"> All charged holes must be covered with 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>appropriate medium to arrest fly rocks.</p> <ul style="list-style-type: none"> ▪ Inspection of workers to ensure they are using the PPE at all times when necessary. ▪ Provide a fully stocked First Aid box on the site ▪ Display at prominent places occupational health and safety rules. ▪ Test and approve equipment such as ladders before use. ▪ Training workers on how to use various PPE and proper use of machinery. ▪ Have a trained First Aider on the site. ▪ Registration of the premises as required by Law. ▪ Appropriate insurance should be acquired as required by law ▪ Medical examination of all workers before engagement and after the project is over. ▪ Display emergency evacuation procedures 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> Moving parts of machines should be guarded to protect workers from injuries. Should an accident occur: <ul style="list-style-type: none"> The injured worker should be given first aid and immediately taken to the hospital. An investigation should be initiated immediately to ascertain the cause of the accident and preliminary findings released within 12 hours. 					
11. Sanitation at Contractor's camp	<ul style="list-style-type: none"> Provision shall be made for employee facilities including shelter, toilets and washing facilities. <ul style="list-style-type: none"> Toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 30 workers (preferred 1:15). The exact location of the toilets shall be approved by the Public Health Department prior to establishment. Sanitation facilities shall be located within 100m 	Contractor	Throughout construction phase	Contractor / AWSB	No of cases of water related diseases among the work force	1,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>from any point of work, but not closer than 50 m to any water body.</p> <ul style="list-style-type: none"> ▪ Temporary/portable toilets shall be secured to the ground to prevent them toppling due to wind or any other cause. ▪ The contractor shall ensure that the entrances to toilets are adequately screened from public view. ▪ Only approved portable toilets should be used. ▪ These facilities shall be maintained in a hygienic state and serviced regularly. Toilet paper shall be provided. ▪ The contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from site to an approved disposal site. 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> Discharge of waste from toilets into the environment and burying of waste is strictly prohibited. Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas, which include groundwater, are not polluted. 					
12. Fire outbreak	<ul style="list-style-type: none"> Label all inflammable materials and store them appropriately Provision of adequate fire fighting equipment capable of fighting all classes of fire <ul style="list-style-type: none"> Put - No Smoking Signs in areas where inflammables are stored Train workers on the use of fire fighting equipment Label fire exits and keep them clear. Display a list of emergency contact numbers prominently Inspecting fire fighting equipment once they are due. Conducting regular fire drills to enhance fire preparedness 	<ul style="list-style-type: none"> Contractor Project Manager Workers 	Throughout construction phase	Contractor	Incidences of reported fuel leaks and fire accidents	550,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> All fire incidents will be recorded and reported Should a fire incident occur: <ul style="list-style-type: none"> Fight the fire with the available equipment Raise fire alarm. Assemble at the designated fire assembly points for roll calls to account for all those on site. 					
13. Social Conflicts	<ul style="list-style-type: none"> Immediate action undertaken as soon as possible and within 24 hours of receipt of a complaint Investigations completed within seven days of receipt of complaint. All corrective actions implemented by due date All incidents or complaints about either environmental or social issues will be managed in accordance to the existing procedure in line with the legal framework. All incidents and complaints will be recorded in the contractors incident reporting system Additional environmental 	<ul style="list-style-type: none"> Contractor 	Throughout construction phase	Contractor / AWSB	No complaints from the community and neighbouring institutions	450,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>awareness training of the workforce with respect to procedures to be followed for environmental incidents or complaints</p> <ul style="list-style-type: none"> ▪ Sensitize workforce on cultural sensitivities 					
14. Spread of HIV and AIDS	<ul style="list-style-type: none"> ▪ Sensitize the migrant workers on dangers of risky sexual behaviour. ▪ Have VCT services on site and encourage workers to Undergo the same. ▪ Uptake of VCT by project workers and the host community. ▪ Provision of condoms to the workers. ▪ Preference for hiring workers from local community to minimize influx of migrant workers. 	<ul style="list-style-type: none"> ▪ Contractor 	Throughout construction phase	AWSB	No of trainings held Availability of training reports including list of participants	1,500,000
15. Displacement of people	<ul style="list-style-type: none"> ▪ Avoid displacement as much as possible. ▪ Prompt and fair compensation of all the PAPs in full prior to beginning of construction works at the site. ▪ Pre and post resettlement counseling's support. 	Contractor and Project Manager	Throughout construction phase	AWSB	<p>List of PAPs that have been compensated</p> <p>No of grievances forwarded by the community</p>	

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none">Financial education for the recipients of compensation funds.Identification and full resettlement assistance for vulnerable PAPs.					

Operational phase ESMMP**Table 16: Operational Phase ESMMP**

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
Water and soil pollution from leaks and sewage overflow and leaks	<ul style="list-style-type: none"> Consider the installation of Separate sewer systems for domestic wastewater and storm water runoff in the overall planning and design of new sewerage systems; When on-site sanitation systems where excreta are mixed with water predominate, consider use of small-diameter sewerage system to collect water effluent from septic systems or interceptor tanks; Limit the sewer depth where possible (e.g., by avoiding routes under streets with heavy traffic). For shallower sewers, small inspection chambers can be used in lieu of manholes; 	NCWSC	Throughout the operation phase	NCWSC	No of blockage cases along the sewer line	O&M Budget

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> ▪ Use appropriate locally available materials for sewer construction. Spun concrete pipes can be appropriate in some circumstances but can suffer corrosion from hydrogen sulphide if there are blockages and/or insufficient slope; ▪ Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation; ▪ Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize entry of garbage and silt into the system; ▪ Equip pumping stations 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages, and conduct regular maintenance to minimize service interruptions. Consider redundant pump capacity in critical areas;</p> <ul style="list-style-type: none"> ▪ Development of an inventory of system components, with information including age, construction materials, drainage areas served, elevations, etc ▪ Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas. ▪ Inspection of the condition of sanitary sewer structures and 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>identifying areas that need repair or maintenance.</p> <ul style="list-style-type: none"> Monitoring of sewer flow to identify potential inflows and outflows Immediate clearing of blockage or repairs warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow 					
Accidents and injuries	<ul style="list-style-type: none"> Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; Use PFDs when working near waterways; Implement a confined spaces entry program that is consistent with applicable national requirements and 	Contractor, NCWSC	Throughout the operation phase	Contractor / NCWSC	<p>No of reported cases in the nearby Health Centre</p> <p>Accidents report register</p>	2,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>standards.</p> <ul style="list-style-type: none"> ▪ Valves to process tanks should be locked to prevent accidental flooding during maintenance; ▪ Use fall protection equipment when working at heights; ▪ Maintain work areas to minimize slipping and tripping hazards; Use proper techniques for trenching and shoring; ▪ Implement fire and explosion prevention measures in accordance with internationally accepted standards; ▪ When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as: ▪ Establishment of work zones so as to separate workers from traffic and from equipment as much 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	as possible <ul style="list-style-type: none"> Reduction of allowed vehicle speeds in work zones; Use of high-visibility safety apparel for workers in the vicinity of traffic For night work, provision of proper illumination for the work space while controlling glare so as not to blind workers and passing motorists Locate all underground utilities before digging. 					
Exposure to hazardous chemicals	<ul style="list-style-type: none"> Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures; Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use 	NCWSC	Throughout the construction period	NCWSC	No of trainings conducted Results of soil analysis conducted	1,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>and maintenance.</p> <ul style="list-style-type: none"> ▪ Prepare escape plans from areas where there might be a chlorine or ammonia emission; ▪ Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used; ▪ If source water contains radioactive substances locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices); ▪ Conduct radiation surveys at least annually, especially in areas where radionuclides are 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>removed;</p> <ul style="list-style-type: none"> Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). <p>Analyze incoming raw wastewater to identify hazardous constituents;</p> <ul style="list-style-type: none"> Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. Use personal gas detection equipment while working in a wastewater facility; Continuously monitor air quality in work 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency);</p> <ul style="list-style-type: none"> Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping; Prohibit eating, smoking, and drinking except in designated areas; Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials. 					
Liquid effluents	<ul style="list-style-type: none"> Minimize bypass of the treatment system by using separate storm water and 	NCWSC	Throughout The	NCWSC	Monitoring Reports conducted on site	1,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>wastewater systems, if possible, and providing capacity sufficient to treat peak flows;</p> <ul style="list-style-type: none"> Implement an industrial source control program which includes monitoring and effective regulatory enforcement; Collaborate with public officials to select appropriate treatment technologies, considering factors such as the quality and quantity of raw wastewater and its variability; available land area for the treatment facility; and resources for capital expenditures, operation, maintenance, and repair; availability of skilled operators, operator training, maintenance personnel, treatment chemicals, and replacement parts; 		operations			

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> Design, construct, operate, and maintain wastewater treatment facilities and achieve effluent water quality consistent with applicable national requirements or internationally accepted standards and consistent with effluent water quality goals based on the assimilative capacity and the most sensitive end use of the receiving water; Consider discharge of treated wastewater to natural or constructed wetlands, which can buffer the impact from discharge on the aquatic environment, unless the wetland itself would be degraded by the discharge; Treat grey water, if collected separately from sewage, to remove organic pollutants and reduce the levels of suspended solids, 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>pathogenic organisms and other problematic substances to acceptable levels based on applicable national and local regulations. Grey water lines and point of use stations should be clearly marked to prevent accidental use for potable water quality applications;</p> <ul style="list-style-type: none"> Based on an assessment of risks to human health and the environment, consider re-use of treated effluent, especially in areas with limited raw water supplies. <p>Treated wastewater quality for land application or other uses should be consistent with the relevant public health-based guidance from the World Health Organization (WHO) and applicable national</p>					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	requirements.					
Sludge	<ul style="list-style-type: none"> Select appropriate sludge treatment technologies, considering, for example, the quantity and sources of sludge; available resources for capital expenditures, training, operations and maintenance; availability of skilled operators, maintenance personnel, etc.; and the desired disposal methods or end uses of the treated solids; Land application or other beneficial re-use of wastewater treatment plant residuals should be considered but only based on an assessment of risks to human health and the environment. Quality of residuals for land application should be consistent with the relevant public health-based guidance from the World Health 	NCWSC	Throughout operations	NCWSC / Nairobi County		2,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>Organization (WHO) and applicable national requirements;</p> <ul style="list-style-type: none"> Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable National requirements or, in their absence, internationally accepted guidance and standards. 					
Offensive odours	<ul style="list-style-type: none"> Provide adequate buffer area, such as trees, or fences, between processing areas and potential receptors; Avoid siting facilities near densely populated neighbourhoods and installations with potentially sensitive receptors, such as hospitals and schools. Site facilities down-wind from potential receptors, if possible. Cover emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and 	NWSC	Throughout operations	NCWSC	No of complaints from the community	1,500,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	channels), and vent emissions to control systems (e.g., compost beds, bio-filters, chemical scrubbers, etc.) as needed to reduce odours and otherwise meet applicable national requirements and internationally accepted guidelines;					
Public health issues related to irrigation with treated sewage	<ul style="list-style-type: none"> ▪ Consider use of drip irrigation of treated wastewater, which minimizes worker exposure and the amount of water needed. ▪ Avoid use of spray irrigation of treated wastewater, if possible; ▪ Provide field workers with personal protective equipment, such as rubber gloves and waterproof shoes; ▪ Provide access to safe drinking water and sanitation (including hand washing) facilities; ▪ Provide worker 	Farming community	Throughout operations	NCWSC / Nairobi County	No of cases related to Water borne diseases at the nearest Health centers	3,500,000.00

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<p>health monitoring, including regular physical examinations;</p> <ul style="list-style-type: none"> ▪ Control vectors and intermediate hosts of disease-causing micro-organisms. ▪ Treat wastewater and sludge used for land application in a manner consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and applicable national requirements; ▪ Stop irrigation with treated wastewater two weeks prior to harvesting; ▪ Limit irrigation with treated wastewater to crops that are cooked before eating; ▪ Restrict public access to hydraulic structures carrying wastewater and to fields irrigated with 					

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	treated wastewater.					
Physical hazards	<ul style="list-style-type: none"> Restrict access to waste management facilities by implementing security procedures, such as; Perimeter fencing of adequate height and suitable material, with lockable site access gate; Security cameras at key access points, and security alarms fitted to buildings and storage areas; and Use of a site visitor register. Light the site where necessary. 	NCWSC	Throughout the		No of reported accidents / incidences	2,000,000
Scavengers birds and other animals	<ul style="list-style-type: none"> Proper fencing of the Plant to keepoff wildlife is recommended Maintaining high standards of hygiene at the site throughout the operation phase of the facility Constant consultations with KWS in event that wildlife is spotted in the area. 	NWSC and KWS	Throughout the operation phase	NCWSC	Operational manual and facility book records initiatives undertaken to maintain hygiene status to required levels	3,000,000

POTENTIAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	MONITORING INDICATOR	COST ESTIMATE
	<ul style="list-style-type: none"> The inlet works should be enclosed in a building to avoid exposure to birds Daily burying of the wastes in appropriate solid Waste disposal section covering with soil, this reduces the tonnage of wastes on site and exposing the wastes to scavenging birds 					

Decommissioning Phase

The decommissioning phase of a project includes restoring the environment to its original form once all the operational activities of the project have ceased. In addition to the mitigation measures provided above, it is necessary to outline some basic mitigation measures that will require to be undertaken once all operational activities of the project have ceased. The necessary activities, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project are outlined in below.

Table 17: Decommissioning Phase ESMMP

ENVIRONMENTAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	TIME FRAME	MONITORING AUTHORITY	COST ESTIMATE
Sold Waste Generation.	All removed materials that will not be used for other purposes must be removed and recycled/reused as far as possible	Contractor	One-off	Contractor/ AWSB, NEMA	-
	<ul style="list-style-type: none"> Where recycling/reuse of the removed materials and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site or arrangements made with the County Council 	Contractor	One-off	Contractor/ AWSB, Nairobi County Council	80,000
	<ul style="list-style-type: none"> Donate reusable demolition waste to charitable organizations, individuals 	Contractor	One-off	Contractor/ AWSB	-

	and institutions				
Degeneration of vegetation at the construction site	<ul style="list-style-type: none"> Implement an appropriate re-vegetation programme to restore the site to better status 	Contractor	One-off	Contractor/AWSB	30,000
	<ul style="list-style-type: none"> Consider use of indigenous plant species in re-vegetation 	Contractor	One-off	Contractor/AWSB	20,000
	<ul style="list-style-type: none"> Trees should be planted at suitable locations so as to interrupt sight lines (screen planting), between the adjacent residential area and the development. 	Contractor	One-off	Contractor/AWSB	-

CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

The importance of the proposed project to national development and the local community cannot be overemphasized. In addition to following the laid down guidelines, project design has also factored in state of art technology in line with sound environmental management practices.

Several conclusions can be drawn from findings of this ESIA. These touch mainly on the potential impacts of the proposed project. These impacts manifest at the different stages of the proposed project on environment in its totality. That is the biophysical and abiophysical environmental components. The potential positive impacts include:

- Improvement in groundwater quality through preventing infiltration of sewerage from porous cesspits and pit latrines.
- Improve living conditions for targeted residents through achieving the above environmental benefits, upgrade their real estate values and contribute in alleviating poverty conditions through work opportunities in construction and operation of the project
- Achieve economic benefit by saving some healthcare expenses, improving people's productivity and improving water resources management.
- Strengthen community participation in environmental protection through involving community based organizations in project operation and mobilization activities.
- Employment of some community members as skilled, semi-skilled and unskilled workers.
- Growth of secondary businesses in the project area.
- Increased revenues for the service providers.
- Guaranteeing the right to decent sanitation.

The potential negative impacts on the biophysical environment include air and water pollution, offensive odours from the STWs and noise. For these, appropriate mitigation measures have been identified and presented in the ESMMP in Chapter 8.

Conversely, the proposed project will have some negative socio-economic impacts on the host population. The main significant negative impact will be economic displacement. It is worth noting that there is encroachment along the riparian reserves where the trunk sewers are meant to pass. Farming is taking place on these reserves. However all these will be compensated before commencement of works. Cases of relocation are minimal if any at all. Those along the trunks can continue farming after construction works are complete and the trenches have been backfilled. Thus, except in rare cases displacement will be temporary. Detailed RAP has been prepared and sent as a separate document capturing all the affected PAPs and the form of displacement.

On the basis of the above discussions it can be concluded that the proposed project is environmentally, legally, socially and culturally acceptable. The potential significant

environmental impacts can be adequately mitigated by the proposed measures. It is the responsibility of the Proponent and other Actors to see to it that the measures are implemented. This way the environmental threats will be downscaled to acceptable. On that basis, it is recommended that the project be issued with the necessary clearance for the Proponent to commence implementation.

Having considered the information collected, collated and analyzed, it is the Expert's considered opinion that:

- i. The proposed project will lead to livelihood improvement in the area. This will be through direct and indirect employment, reduction in morbidity and increase in property value among others.
- ii. The project is vital for the improvement of health in the project area. Access to proper sanitation is a right for all citizens.
- iii. The project DOES NOT pose any serious environmental concern, other than those that accompany similar development activities.
- iv. The proposed ESMMP is adequate to mitigate the potential negative environmental impacts
- v. The positive environmental impacts far outweigh the negative ones, which can be contained by following the proposed ESMMP.
- vi. The proposed project will not compromise the well-being of the neighbouring community, ecology or any other conditions.
- vii. The project should be allowed to commence and activities be managed within the provided ESMMP. There are various actors with diverse responsibilities depending on the stage of the project.
- viii. The proposed project is a viable venture that should be given due support.
- ix. The Proponent is a responsible corporate citizen committed to good environmental practices. Thus all due care has been in relation to laws and procedures of the country in setting up of the project.

9.2 RECOMMENDATIONS

- The proponent should be given all the available support to implement this noble project.
- The licensing authorities should issue the necessary licenses so that the work can commence.
- Similar projects should be encouraged to promote health while spurring growth and development.
- All the proposed mitigation measures should be implemented to ensure sustainability of the project throughout its lifecycle.
- Where there is displacement, compensation should be prompt and just to ensure that the PAPs are not worse off due to implementation of the proposal. The RAP

should be keen especially to identify Vulnerable Households so as to put in place appropriate safety nets.

REFERENCES

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- ii. Republic of Kenya (2004), *District Environment Profile*, NEMA, Nairobi
- iii. Republic of Kenya, *Environmental Management and Coordination Act (EMCA,1999)*, Government Printer, Nairobi
- iv. Republic of Kenya , *Forest Act (2005)*, Government Printer, Nairobi
- v. Republic of Kenya , *Water Act (2002)*, Government Printer, Nairobi
- vi. Republic of Kenya , *National Water Master Plan: 1980*, MWI, Government Printer, Nairobi
- vii. Republic of Kenya , *Water Supply Design Manual (MWI, 2005)*, Government Printer, Nairobi
- viii. Republic of Kenya, *Public Health Act, Cap 242*, Government Printer, Nairobi.
- ix. Republic of Kenya, *Environmental Impact Assessment/Audit Regulations 2003, (Legal Notice No.101)* Government Printer, Nairobi.
- x. Republic of Kenya, *Legal Notice 31: Factories and Other Work Places (Safety and health committees) Rules, 2004*, Government Printer, Nairobi
- xi. UNEP and ACTS (2001), *Making of Framework Environmental Law in Kenya*, ACTS Press, Nairobi, 2001.
- xii. World Health Organization (WHO, 1993) *Guidelines for Drinking Water Quality. Second Edition. Volume 3. Surveillance and Control of Community Water Supplies*. WHO. Geneva.

ANNEXES

ANNEX 1: FRAME CONSULTANTS LTD PRACTICING LICENSE

FORM 7 (r.15(2))


nema
mchanga petu | ulizi wetu | waziwa wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)
THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/1469
Application Reference No: NEMA/EIA/EL/2653

M/S **Frame Consultants Ltd**
(individual or firm) of address
P.O. Box 58624-00200 Nairobi

is licensed to practice in the
capacity of a (Lead Expert/Associate Expert/Firm of Experts) **FIRM**
registration number **1711**
in accordance with the provision of the Environmental Management and Coordination Act, 1999.

Issued Date: 2/17/2015 Expiry Date: 12/31/2015


Signature.....
(Seal)
Director General
The National Environment Management
Authority

P. T. O.

ISO 9001 : 2008 Certified

ANNEX 2: PUBLIC CONSULTATION RECORDS

Public Consultation Meeting held at Triad House, Muthaiga Estate for Muthaiga Residents Association on 11th October 2016

Members Present

Stakeholders as per attached attendance list

1. Introduction

This consultation meeting took place at Triad House in Muthaiga Estate. It was attended by the Executive Board of the Muthaiga Residents Association, the assistant chief of Highridge area and the consultants from FRAME CONSULTANT LTD.

The consultants and MRA officials then introduced themselves thereafter the Chairman of MRA (Muthaiga Residents Association) gave the consultant time to inform the other members of the proposed NaRSIP 2 project.

The consultant Engineer explained to the participants that the proposed project was derived from the Nairobi Sewerage Master plan of 1998. The proposed project will entail approximately 90Km of Trunk Sewers and 190 Km of Lateral sewers within Nairobi County. In Muthaiga Area, there will be two trunk lines on both sides of the estate for Getathuru River and Mathare River. They were informed all the proposed project components are in the design stage and this goes hand in hand with preparation of the Resettlement Action Plan and ESIA exercise.

Discussions

The community members present were urged to give their views on the project, which they did, a summary of the consultative exercise is tabled below;

Comments and Issues	Response
Most of the Members have fenced up to the river for security reasons. What will happen	The Members were informed that the trunk sewer being a liner infrastructure will be laid along the riparian reserve hence those who have encroached the area there will be assessment of their masonry fences and compensation will be made, also the restoration will be done as per to the original status .
Communication and Notification before the surveyor and other teams gets into the ground for security reasons and also have Tag IDs	The members were informed prior notice will be given to them before the consultants team comes to the ground for whatever reason either being valuation, surveyor
What will happen if the Proposed line does not follow the riparian reserve	The members were informed in cases where private property will be needed for the sewer line the Client will seek Easement rights rather than compulsory acquisition where they will negotiate with the plot owner. Crops and Trees will also be compensated according to the current market rates and land restored to its original state.

Conclusion

The meeting ended at 6:00pm, The MRA board indicated that they will discuss with their members and communicate the way forward.

**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: MUTHAIGA..... DATE: 11/10/2016

LIST OF ATTENDANCE

MUTHAIGA RESIDENTS ASSOCIATION

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
1	Duncan Kamau	FRAME CONSULTANTS LTD	22593413	0720104815	<i>[Signature]</i>
2	PATRICK MURIGI	FRAME CONSULTANTS LTD	29723362	0720847137	<i>[Signature]</i>
3	PETER KUGURU	Sofa Boli Coln	4538711	0722713280	<i>[Signature]</i>
4	JACQUELYNE DNGILI	ASSISTANT CHIEF MUTHAIGA	21824576	0722174999	<i>[Signature]</i>
5	Raieke Ruretti	Muthaiga Res Assoc	35249627	0722 511137	<i>[Signature]</i>
6	Rose Muya	"	1272840	0722-204-609	<i>[Signature]</i>
7	Ann DAGAMIA ROSE	"	66100353	0722-609854	<i>[Signature]</i>
8	Shared Rao	"	4423947	0733744729	<i>[Signature]</i>
9.	Y.A. SHRETTA	"	1520658	0722 703127	<i>[Signature]</i>
10.	Irene.N.wanjigi	"	14697577	0715511665	<i>[Signature]</i>

FRAME Consultants limited

ESIA and RAP Consultation Meeting






CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NaRSIP) PHASE II

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NaRSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: MUTHIGA..... DATE: 11/12/2016..

LIST OF ATTENDANCE

MUTHIGA RESIDENTS ASSOCIATION

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
11.	CAROL STEMP	MUTHIGA RES ASSOC	355761	0736447921	
12.	Vijay Savellun	"	12762918	0733937157	
13.	Tabitha Njeri	"	26097599	0728912072	
14.	Idah Mueheni	Home Land Centre Study	2088426	0721791218	
15.	Ann Kariu	Environmental EIA	26665445	0711304514	

FRAME Consultants limited

ESIA and RAP Consultation Meeting

Consultation records with PAPs whose land will be affected by the trunk sewer in City Carton on 4th November 2016 at the Chief's Office.

Members Present

Stakeholders as per attached attendance list

1. Introduction

The meeting was opened with a word of prayer by one of the Community members at 10.30am. After self-introduction, the Consultant's team from Frame Consultants Ltd took over to drive the agenda.

The consultant team explained to the participants that the proposed project was derived from the Nairobi Sewerage Master plan of 1998. The proposed project will entail approximately 81 Km of Trunk Sewers and 190 Km of Lateral sewers within Nairobi County. In City Carton the Trunk will be laid along Nairobi River. The PAPs were informed that all the proposed project components are in the design stage and this goes hand in hand with preparation of the Resettlement Action Plan and ESIA exercise.

Discussions

The community members present were urged to give their views on the project, which they did, a summary of the consultative exercise is tabled below;

Comments and Issues	Response
Compensation	<p>The PAPs sought to know if they will be compensated for the structures along the riparian.</p> <p>They were informed that compensation will be done to the owner of the structure and not the tenant. This will be done at a replacement cost whereby it is illegal for one to come back and construct after the completion of the project.</p>
Easement	<p>The PAPs enquired on what happens if the works go beyond the riparian area into someone's property.</p> <p>In cases where private property will be needed for the sewer line the Client will seek Easement rights rather than compulsory acquisition where they will negotiate with the plot owner.</p>

The Extent of the Riparian	<p>The PAPs enquired on what methodology would be used to determine the extent of riparian.</p> <p>It was noted that the riparian is a distance of 30m from the centre of the river on both sides. The PAPs were also informed that it is the responsibility of WRMA to mark the riparian and thus they will be engaged for the same purpose before the works commence.</p>
Grievance Redress Committee	<p>The PAPs wanted to know how the committee will be formed.</p> <p>They were told that there will be a representative from every village and if there is an existing committee already, that will be used instead of forming a new one.</p>
Some people have been allocated land in the Riparian area.	<p>The Community members were informed that riparian is government's land and therefore no compensation will be done for land.</p>

Conclusion

The meeting ended with a word of prayer from one of the PAPs at 11:20am

**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION
MEETINGS.

LOCATION: City Carbon

DATE: 4/11/2018

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
1.	Nicholas Naingi	NGAO	13337052	0723825959	
2.	Nashon Okeke Wambaka	NGAO	20451969	0723138114	
3.	John Nyaga Kithingiri	NGAO	9252161	0721998877	
4.	Alexander Waweru	Bura-bura R. Side	0966120	0719672524	
5.	Ann Njogu	"	22627726	0729904312	
6.	Peter Mwaruli	"	10228021	0720286159	
7.	Hudson Chege	"	1125298	0723640206	
8.	Julius Nohinga	"	0964139	0704260144	
9.	Anthony Waweru	"	8633500	0721429043	
10.	JAMES KIRO	"	14653825	0721497853	

FRAME Consultants limited

ESIA and RAP Consultation Meeting

CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: ...City Center...

DATE: ...4/11/2016...

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
11	JOHNSTONE KABUCHI M.	V.C. Buruburu R.S.	115202859	0722629450	JK
12	Ole Margaret Evans	Redeemed Gospel - Kiambo (Church)	25294511	0726229329	ME
13	JEREMIAH WACHALI	Redeemed Gospel Church (Umuu)	30994742	0713163605	JD
14	Lucy Wangiri	V.C. Buruburu	27744906	0705807852	LB
15	CELESTINE MUENI	V.C. Buruburu	22793640	0716061229	CM

FRAME Consultants limited

ESIA and RAP Consultation Meeting

Public Participation and Consultation Meeting for the Duplication of Eastleigh TS with PAPS in Dandora held on 22 November 2016 at the Chief's Office.

Members Present

Members present as per attached attendance list

1. Introduction

The meeting was opened with a word of prayer by one of the Community members at 10.45am. After self-introduction, the chief welcomed the community members who were present and briefed them on the various agenda of the meeting. Frame Consultants Ltd took over to drive the objectives of the proposed NARSIP 11 project.

The consultant team explained to the participants that the proposed project was derived from the Nairobi Sewerage Master plan of 1998. The proposed project will entail approximately 81 Km of Trunk Sewers and 190 Km of Lateral sewers within Nairobi County. In Dandora Estate the trunk line will be duplicated along the exiting line along Nairobi River. The PAPs were informed that all the proposed project components are in the design stage and this goes hand in hand with preparation of the Resettlement Action Plan and ESIA exercise.

Discussions

The community members present were urged to give their views on the project, which they did, a summary of the consultative exercise is tabled below;

Comments and Issues	Response
The Extent of the Riparian	<p>The PAPs enquired on what methodology would be used to determine the extent of riparian.</p> <p>It was noted that the riparian is a distance of 30m from the centre of the river on both sides. The PAPs were also informed that it is the responsibility of WRMA to mark the riparian and thus they will be engaged for the same purpose before the works commence</p>
Compensation	<p>The PAPs sought to know if they will be compensated for the structures along the riparian.</p> <p>They were informed that compensation will be done to the owner of the structure and not the tenant. This will be done at a replacement cost whereby it is illegal for one to come back and construct after the completion of the project.</p>
Easement	<p>The PAPs enquired on what happens if the works go beyond the riparian area into</p>

	<p>someone's property.</p> <p>In cases where private property will be needed for the sewer line the Client will seek Easement rights rather than compulsory acquisition where they will negotiate with the plot owner.</p> <p>Some PAPs raised the issue that they have allocation letters/ documents for land within the riparian hence this issue might bring tension in the community when the issue of relocation arises.</p>
Grievance Redress Committee	<p>The PAPs wanted to know how the committee will be formed.</p> <p>They were told that there will be a representative from every village and if there is an existing committee already, that will be used instead of forming a new one.</p>

Conclusion

The meeting ended with a word of prayer from one of the PAPs at 12.00pm

CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: KANSONDA.....

DATE: 22/11/2016.....

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
1	Cecilia Mwangi Kairara	Darbara	—	—	—
2	TERESIA WANGARI NISERU	Darbara	0619293	0722981860	—
3	Alice Wanjiku Njeri	Darbara	1336738	0723762005	—
4	MARY NYAMBURA MURUGI	Darbara	3597445	0706047148	—
5	Lucy WANGARI	Darbara	8728614	0722 458634	—
6	JOHN OOKO	Darbara	13633270	0723681701	—
7	DONALD MABESHE MOE	TOTAL	13633270	0723681701	—
8	CHARLES MUSAU	KADUNA	0954868	0715608036	—
9	LIDIA KAGWIRIA	KADUNA	8350484	0716309060	—
10	NATWANA				

FRAME Consultant's limited

ESIA and RAP Consultation Meeting

CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: ...*SANABODA*.....

DATE: ...*22.11.2016*...

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
	<i>Ms Ephraim Nyaga</i>	<i>KAG</i>	<i>072099073</i>	<i>15 0720132</i>	<i>[Signature]</i>
	<i>ADAM MACHARIA</i>	<i>m</i>	<i>0723985714</i>	<i>15 26348371</i>	<i>[Signature]</i>
	<i>SIMON KARUICI</i>	<i>Wambani</i>	<i>0719726362</i>	<i>15 1105929</i>	<i>[Signature]</i>
	<i>HELEN KAIRIMA</i>	<i>KWAMBUE</i>	<i>0722294183</i>	<i>15 11033527</i>	<i>[Signature]</i>
	<i>JOHN OOKO OMBURUA</i>	<i>Kambura</i>			
	<i>FESTO ONINGO</i>	<i>Kwa mbao</i>	<i>0722491803</i>	<i>15 NO 27491850</i>	<i>[Signature]</i>
	<i>JENIPHER A' NAMATE</i>		<i>0721251946</i>	<i>15 0979034</i>	<i>[Signature]</i>
	<i>LUBIA W. KALUKI</i>	<i>K</i>	<i>0722671117</i>	<i>14675076</i>	
	<i>SIMPLE NZINGO</i>	<i>KAYOLE</i>	<i>0701948445</i>	<i>15 17563</i>	<i>[Signature]</i>
	<i>MAURICE STEPHEN</i>	<i>WATER SANBODA 1</i>	<i>070050509</i>	<i>15 2000165</i>	<i>[Signature]</i>

FRAME Consultant's limited

ESIA and RAP Consultation Meeting

Consultation records with PAPs whose land will be affected by the trunk sewer in Riruta on 28th October 2016 at the Chief's Office.

Members Present

Stakeholders as per attached attendance list

1. Introduction

The meeting was opened with a word of prayer by one of the Community members. After self-introduction, the Consultant's team from Frame Consultants Ltd took over to drive the agenda.

The consultant team explained to the participants that the proposed project was derived from the Nairobi Sewerage Master plan of 1998. The proposed project will entail approximately 81 Km of Trunk Sewers and 190 Km of Lateral sewers within Nairobi County. In Riruta, the trunk line will be laid along the Duke river the one that separates Riruta from Ng'ando. The PAPs were informed that all the proposed project components are in the design stage and this goes hand in hand with preparation of the Resettlement Action Plan and ESIA exercise.

Discussions

The community members present were urged to give their views on the project, which they did, a summary of the consultative exercise is tabled below;

Comments and Issues	Response
Compensation	<p>The members raised a concern that there was a similar project in the area where no one was compensated for the affected assets.</p> <p>They were informed that compensation cases are dealt with at an individual level. It was emphasized that compensation will be done only on crops that will be affected within the working area. Crops and Trees will be compensated according to the current market rates and land restored to its original state.</p>
Easement Cases	<p>The members were informed in cases where private property will be needed for the sewer line the Client will seek Easement rights rather than compulsory acquisition where they will negotiate with the land owner.</p>
The Extent of the Riparian	<p>The PAPs enquired on what methodology would be used to determine the extent of riparian.</p> <p>It was noted that the riparian is a distance of 30m from the centre of the river on both sides, though for this specific river 6m will be considered for it is a small river. They were also informed that it is the responsibility of WRMA to do so and thus they will be engaged for the same purpose.</p>
The Exact location of the sewer line	<p>The PAPs wanted to be sure on which side of the river will the sewer line be located; Ng'ando or Riruta side.</p> <p>They were informed that those details will be given after survey is done and that consultations are still ongoing. More meetings will be scheduled for</p>

	further discussions.
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Conclusion

The meeting ended with a word of prayer from one of the PAPs at 11:15am

**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: RIRUTA.....

DATE: 28/10/2016.....

LIST OF ATTENDANCE

NO	NAME	ORGANISATION/ LOCATION/VILLAGE	ID NUMBER	PHONE NUMBER	SIGN
1	LEAHY W. KAMUYU	SATERELITE	3110088	0721 423756	<i>Leahy</i>
2	KAMUYU KIMUTU		7423745	0723 343572	<i>Kamuyu</i>
3	KIMANI KIMUTU	"	12652043	0729 369910	<i>Kimani</i>
4	Peter Ngega	"	5455288	0724 353578	<i>Peter</i>
5	JOHN GITHUNGI JOHN GITHUNGI	"	744007 28524060	0722 859235 0724 255277	<i>John</i>
6	HANNAH WANJAKI		24936194	0719139287	<i>Hannah</i>
7	NICHOLAS ACHARA	<i>Consulancy Team</i>		0720 821 034	<i>Nicholas</i>
8	MARTIN WAINAINA	"	4242787	0723718575	<i>Martin</i>
9	Jeremiah Kitihi	"	20599675	0722 484466	<i>Jeremiah</i>
10	MWANGA KARUKU	"	22214673	0790223515	<i>Mwangi</i>

FRAME Consultants limited

ESIA and RAP Consultation Meeting

**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION MEETINGS.

LOCATION: RIRUTA..... DATE: 28/10/2016

LIST OF ATTENDANCE

NO	NAME	ORGANISATION/ LOCATION/VILLAGE	ID NUMBER	PHONE NUMBER	SIGN
	Mutisia Jeyo	RIRUTA	1689691	0722-782572	<i>[Signature]</i>
	Stephen Njiru	RIRUTA	95-74975-	0714235789	<i>[Signature]</i>
	Mwenja Kamuyu	RIRUTA		—	<i>[Signature]</i>
	Stanley Mungu Kimulu	RIRUTA	190371	072121318	<i>[Signature]</i>
	Mary Chege	RIRUTA		0716 074419	<i>[Signature]</i>
	Hannah Wangari	RIRUTA		0714 368166	<i>[Signature]</i>
	John M. GITHINDI	RIRUTA	5182959	0729044780	<i>[Signature]</i>
	Catherine Kimani	RIRUTA	7980989	0714918374	<i>[Signature]</i>

FRAME Consultants limited

ESIA and RAP Consultation Meeting

Consultation records with PAPs whose land will be affected by the trunk sewer in Njiru Location on 26th September 2016 at the Chief's Office.

PRESENT

- 1 Charles Mwatha (Chief – Njiru)
- 2 Iddah Muchena (Frame Consultants Limited)
- 3 Anne Kawira (Frame Consultants Limited)
- 4 See the attached PAPs attendance sheet

AGENDA

- Prayers and introduction
- Sensitization of the project and its impacts
- PAPs Expectations
- AOB

ITEM NO	AGENDA	DELIBERATIONS
1	<p>Prayer and Introduction</p> <ul style="list-style-type: none"> • The meeting convened at 11.25am, chaired by one of the village elders. • It was opened with a word of prayer by one of the Community members. • After self-introduction, the Chief handed over the meeting to the RAP / ESIA team to drive the agenda 	
2.	<p>Sensitization of the project and its impacts:</p> <p>An overview of the project was done and the possible impacts pointed out. Some of the impacts noted include but not limited to: Employment, reduced pollution and improved health, impacts on crops and land, noise and air pollution. Measures will be taken to mitigate the negative impacts. The project is for the good of the community and thus the need to embrace it.</p>	
3	<p>PAPs Expectations:</p> <p>The PAPS stated some of the following as their concerns:</p> <ul style="list-style-type: none"> • Employment of the locals 	<p>The PAPs stated that they have no objection to the project thus the locals should be given job opportunities once the works begin especially the young people.</p> <p>They requested to be notified when the project starts so that they can have a meeting with the Contractor and ask for job opportunities.</p> <p>They were informed that notices will be done through the Chief's Office.</p>

	<ul style="list-style-type: none"> • Riparian Reserve 	<p>The PAPs enquired on what methodology would be used to determine the extent of riparian.</p> <p>It was noted that the riparian is a distance of 30m from the centre of the river on both sides, though it is the responsibility of WRMA to do so and thus they will be engaged for the same purpose.</p>
	<ul style="list-style-type: none"> • Compensation 	<p>The PAPs expressed their concerns on the structures and the crops that have been done on the riparian.</p> <p>They were informed that such cases will be dealt with at an individual level. It was emphasized that compensation will be done only on crops within the working area.</p>
	<ul style="list-style-type: none"> • Connection to the sewer 	<p>The residents indicated that there is no sewer in Njiru and whether all of them will be connected to the sewer line.</p> <p>They were informed that there will be reticulation lines within Njiru so as to allow different households to connect to the main trunk. NCWSC will be in charge of the connections.</p> <p>They suggested having sewer lines on both rivers, that is, Nairobi and Ngong River so as to serve a large number of</p>

		people
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**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION
MEETINGS.

LOCATION: Nairobi DATE: 26/9/2016

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
1.	GEORGE O. NJIRU	VILLAGE CHAIRMAN NJIRU	14429309	0722 905272	<i>[Signature]</i>
2.	FRANCIS KARIUKI	VILLAGE CHAIRMAN NJIRU	14429309	0722 905272	<i>[Signature]</i>
3.	NANCY NGHENYA	VILLAGE ELDER NJIRU	9522935	0720478061	<i>[Signature]</i>
4.	ALEX MURUKU	VILLAGE ELDER NJIRU	7794081	0721908345	<i>[Signature]</i>
5.	GRACE NJIRU	VILLAGE ELDER NJIRU	887750	0722-919044	<i>[Signature]</i>
6.	STANLEY NJIRU	NJIRU FARMERS SH.C	12533775	0721622770	<i>[Signature]</i>
7.	GERALD KOBWA	VILLAGE ELDER NJIRU	3146323	0721144716	<i>[Signature]</i>
8.	DANIEL NJIRU	VILLAGE ELDER NJIRU	1125748	0713-654-480	<i>[Signature]</i>
9.	NAOMI NGANGA	FARMER	1187977	0710361051	<i>[Signature]</i>
10.	MARY WATIRI	FARMER	1187977	0710361051	<i>[Signature]</i>

FRAME Consultants limited

ESIA and RAP Consultation Meeting

**CONSULTANCY SERVICES FOR PRELIMINARY & DETAILED DESIGN AND TENDER DOCUMENTATION
FOR NAIROBI RIVERS SEWERAGE IMPROVEMENT PROJECT (NARSIP) PHASE II**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR NARSIP (PHASE II) PUBLIC CONSULTATION
MEETINGS.

LOCATION: Ngiru DATE: 26/9/2016

LIST OF ATTENDANCE

NO	NAME	ORGANISATION	ID NUMBER	PHONE NUMBER	SIGN
11	MUTHIA WILIAMU RAGINA MUNGUTI	FARMER	1876424	0710266100	kg.
12	PAUL Ngega	FARMER	5359163	0724646006	Paul Ngega
13	Iddah Mubone	FCH (KINOGIET)	—		Iddah Mubone
14	ANNE ODUGA	FCH	26665445		ANNE ODUGA
15	CHARLES MWAHA	CHIEF	5506540	0722903198	CHARLES MWAHA

FRAME Consultant's limited

ESIA and RAP Consultation Meeting

Public Consultation Meeting held in Karen for Karen Plains Residents Association on 24th November 2016

Members Present

Members did not give their names citing security issues

1. Introduction

This consultation meeting took place at one of the members' house in Karen Plains Estate. It was attended by the Executive Board of the Karen Plains Residents Association, and the consultants from FRAME CONSULTANT LTD.

The consultants and the members then introduced themselves thereafter the Chairman gave the consultant time to inform the other members of the proposed NaRSIP II project.

The consultant Engineer explained to the participants that the proposed project was derived from the Nairobi Sewerage Master plan of 1998. The proposed project will entail approximately 90Km of Trunk Sewers and 190 Km of Lateral sewers within Nairobi County.

In Karen, It is proposed to construct a DN525mm sewer line for the entire 8.4km length. The Sewer will start at the last manhole to the Karen STW; follow the mokoyeti drainage Channel until when it reaches the Karen Road. From this point, the sewer will follow the Karen Road, Plains Road road, the road network within Karen "C" area, the southern bypass and finally into Kibera-Ayany Road underpass to connect to the new constructed Kibera Trunk Sewer at Raila Village. They were informed all the proposed project components are in the design stage and this goes hand in hand with preparation of the Resettlement Action Plan and ESIA exercise.

Discussions

The members present were urged to give their views on the project, which they did, a summary of the consultative exercise is tabled below;

Comments and Issues	Response
Who will be connected to the sewer line	The Members were informed that all the residents of Karen plains will be beneficiaries of the project. They were also informed that after the Construction of the Trunk Sewer, NCWSC are the service providers who will be in charge of household connections.
Water Project	Members wanted to know if there can be a water supply project hand in hand with NARSIP II. They were informed that, that is not within the scope of the proposed project. The Chairman of the Association picked up the issue with the Client.
Damages incurred	The Members were informed that the trunk sewer being a liner infrastructure will be laid along the road reserve hence those who have encroached the area there will be assessment of their masonry fences and compensation will be made, also the restoration will be done as per to the original status .
Mitigation measures	Members sought to know if there are any mitigation measures laid for the potential negative impacts during construction.

	They were informed that an ESIA Report is being prepared and they will be given a platform to give their comments as the Report will be presented to the public for the same purpose
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Conclusion

The members expressed their gratitude and indicated that they support the development. The meeting ended at 8:30pm

ANNEX 3: FIELD QUESTIONNAIRE

This questionnaire is intended to ensure there is adequate Public Participation & Consultation before implementation of the said project – **Nairobi Rivers Sewerage Improvement Project (NARSIP)**. It is proposed this questionnaire is filled and signed by members of the surrounding community and institutions in the area of the said project, as required by the National Environment Management Authority, NEMA and AFDB.

Project Proponent: Athi Water Services Board

Date: September 2016

1. Are you aware of the construction of this project and do you know its exact location?

Yes ☒

No ☐

2. What is the form of land ownership in this area

- Leasehold ☒
- Freehold

3. Are there historical or cultural heritage that would be affected by this project? If so, state them.

None

4. Do you think there will be any wastes generated during this project and how do you propose that is handled?

Construction Phase: Mounds of soil, these should be either flattened or removed from site.
Operations Phase: Leaking sewage, there should be a contact number to call

5. What are the expected POSITIVE impacts of the project from construction phase through to commissioning and operations phases?

Construction Phase: None Commissioning Phase: None
Operations Phase: No need to call honey sucker services anymore

6. What are the expected NEGATIVE impacts of the project from construction phase through to commissioning and operations phases?

Construction Phase: Interference with water supply, strangers hanging around
Operations Phase: If NOT well maintained sewer stench can affect air quality

7. What suggestions would you make to mitigate any adverse environmental impacts during the project construction, commissioning and operations?

- i) Ensure the sewer has access hatches/man holes for service maintenance
- ii) Plant trees/vegetation where they have been removed

8. In your conclusion, do you welcome the project in the said area?

1 | Page

Yes - But on condition the project is delivered on schedule and well planned.

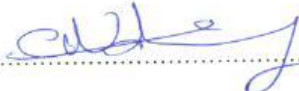
9. Any relevant observations, recommendations or comments on this project.

It is running adjacent a river, Caution MUST be exercised not to pollute the water and riparian areas

Name (Optional): Edward Muriuki

ID Number (Optional):

Telephone (Optional):

Signature: (With Company Stamp if Institution) 

ANNEX 4: PROPOSED PROJECT AREA LAYOUTS

