

**ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT
FOR THE
PROPOSED CONSTRUCTION OF HABITAT HEIGHTS
RESIDENTIAL APARTMENTS DEVELOPMENT ON PLOT L.R. NO:
7815/10, LUKENYA LOCATION, ATHI RIVER WARD, MAVOKO
CONSTITUENCY, MACHAKOS COUNTY.**



This Environmental Impact Assessment (EIA) Project Report is submitted to the National Environment Management Authority (NEMA) in conformity with the requirements of the Environmental Management and Coordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003.

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REPORT SUBMITTED TO

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

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EXECUTIVE SUMMARY

This is an environmental impact assessment study report, which provides relevant information and an environmental consideration on **Singapura Developers Limited & Housing Habitat Cooperative Society Limited** forming a joint venture company to manage the project is known as **Habitat Heights Limited P. O. Box 64803-00620 Nairobi Kenya** (here in referred to as the proponent) intention to seek approval from National Environment Management Authority (NEMA); for the **proposed construction of 8,888 residential apartments development units for 30 blocks each 14 floors (story building)** of one bedroom, two bedroom and three bedroom houses on Plot L.R. No. 7815/10 at Lukenya location within Athi river ward in Mavoko Constituency, Machakos County. The proposed construction development will comprise of 30 blocks, each 14 floors apartment building total to 8,888 of one bedroom, two bedroom and three bedroom units with amenities such as educational center, auditoriums, car parking facilities, basketball courts, football courts, natural green spaces, commercial center, court yards, walkways, driveways, medical centre (clinic), fire station, police station, sewerage treatment ponds, other associated facilities and amenities as per the approved master plan and architectural drawings in line with the governments' housing policy. In conformity with the Environmental Management and Coordination Act 2015 and the Environmental (Impact Assessment and Audit) regulations, 2003 contained in the Kenya gazette supplement No. 56, legislative supplement No. 31 Legal notice No. 101 of 13th June, 2003, the project proponent has appointed NEMA Certified consultants to carry out an Environmental Impact Assessment of the project and prepare a related project study report.

The purpose of the Environmental and Social Impact Assessment (ESIA) is to identify potential positive and negative environmental and social impacts associated with the proposed project and make recommendations on how to take advantage of the positive impacts on one hand and how to mitigate the negative environmental impacts on the other.

The ESIA team carried out the project assessment using a combination of methods, which include; literature reviews, desktop and ground surveys, public consultation barazas, questionnaires and interviews with the key stakeholders, opinion leaders and neighbours. The project approved designs,

drawings, layout plans and bill of quantities were reviewed to provide an in depth understanding and evaluation of its extent and anticipated impacts. Also existing literature on statutory and other requirements on similar projects of such magnitude were reviewed. The potential environmental impacts identified are classified into the following categories:

Impacts on: land resources, air resources, water resources, ecological resources, biodiversity, existing infrastructure & services, and socio-economic issues.

The following potential impacts are included in the E.I.A study report:

- ✦ Loss of biodiversity
- ✦ Waste water management and disposal
- ✦ Increased water demand
- ✦ Solid waste management
- ✦ Oil spills during construction
- ✦ Dust emissions
- ✦ Visual intrusion
- ✦ Accessibility to the existing road network
- ✦ Soil compaction, erosion and pollution
- ✦ Safety concern during demolition and construction
- ✦ Noise and vibrations
- ✦ Population density
- ✦ Increased traffic along the main roads
- ✦ Air pollution during construction
- ✦ Health and safety of workers during construction phase
- ✦ Optimal use of land
- ✦ Improved security
- ✦ Creation of job opportunities
- ✦ Increase in quality residential apartments/ houses in the area and Nairobi Metropolis in general
- ✦ Increased revenue for the Government
- ✦ Improving growth of the economy

✦ Provision of market supply for goods and services

It is evident from this study that the construction and operation of the proposed residential apartments will bring positive effects in the study area including creation of employment, increase quality living space, boost the local economy and increase income generation, increased revenue generation to the national and county governments, and improved infrastructure & services among others.

However, it is also clear that the project will come with negative impacts especially in the implementation phase. The potential negative impacts attached to this project include: Solid/liquid waste generation; increased pressure on infrastructure; air pollution; noise & vibration; water pollution; traffic disruption; visual intrusion; social evils & crime and degradation of biodiversity among others.

Mitigation measures have been developed in respect of the significant negative environmental and social impacts which when adopted, will make the proposed project environmentally sustainable. In addition, the EIA team has developed an environmental and social management plan, which should be adopted and implemented fully, in order to ensure that the mitigation process is successful.

Having considered the data collected, analysed and collated information that is available, it is the experts considered opinion that:

1. The project, even though of a big scale, has in its design and proposed implementation strategies employed adequate measures to address effectively all potential negative environmental and social impacts that may arise. It therefore **DOES NOT** pose any major negative impact to the environment or the community within its vicinity, both in the implementation and operational phases.
2. The positive impacts of the project far outweigh the negative ones, which will be adequately contained by following the prescribed environmental management and social impact management plans. This is in addition to the well laid implementation and operation strategies adopted by the proponent for this project.

The EIA experts note that the proposed project is well conceived and is in line with the proponent's sustainability strategy in adhering to Millennium Development Goals (MDGs), the Government's Big Four Agenda and Vision 2030. Accordingly, as per part 11 section 10 (2) of the Legal Notice No. 101

on the Environmental (Impact Assessment and Audit) Regulations, 2003, we recommend that the project be granted an EIA license.

ACRONYMS

EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act
EMP	Environmental Management Plan
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
Ha	Hectare
KM	Kilometre
KP	Kenya Power
LR	Land Reference
NEAPC	National Environment Action Plan Committee
NEC	National Environment Council
NEMA	National Environmental Management Authority
NO _x	Nitrogen Oxides
OHS	Occupational Health and Safety
PCC	Public Complaints Committee
PPE	Personal Protective Equipment
PV	Permanent Ventilation
RC	Reinforced Concrete
SEM	Sustainable Environmental Management
SERC	Standard and Enforcement Review Committee
SO _x	Sulphur Oxides
TOR	Terms of Reference
VOC	Volatile organic compounds
WCC	Waste Collection Centre
Φ	Diameter

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CHAPTER ONE

1. INTRODUCTION

1.1. General overview and rationale for EIA study report

Singapura Developers Limited & Housing Habitat Cooperative Society Limited formed a joint venture in managing the proposed project as **Habitat Heights Limited P. O. Box 64803-00620 Nairobi Kenya**, who is hereinafter referred to as the proponent has proposed to develop 30 blocks each 14 floors apartment in total 8,888 residential units comprising of one bedroom, two bedroom and three bedroom houses on Plot L.R. No. 7815/10 at Lukenya location within Athi river ward in Mavoko Constituency, Machakos County. The proposed development will comprise of a total of 8,888 units together with amenities such as educational center, auditoriums, car parking facilities, basketball courts, football courts, natural green spaces, commercial center, court yards, walkways, driveways, medical centre (clinic), fire station, police station, sewerage treatment ponds, other associated facilities and amenities as per the approved master plan and architectural drawings in line with the governments' housing policy. The project is necessitated by the need to create more quiet and comfortable living space for the burgeoning population in Nairobi and its environments.

The proposed project is to be located on Plot LR. No 7815/10 at Lukenya location, of approximately 42 hectares see attached title deed. The area on which the proposed project is situated has been zoned for residential purposes, and the proponent has acquired a change user for that purpose. The proposed project is therefore in line with the existing planning policy. It neighbours other similar residential estates, farmlands and undeveloped plots.

The proposed development will optimize the use of the designated land, hence increasing its utility. The project will provide employment during both construction and operation phases. It will create market for goods, services, and especially construction inputs, which include raw materials such as building stones and blocks, sand, ballast, timber, steel etc.

and construction machinery. Many secondary businesses are also likely to spring up during the construction phase especially those providing foods and beverages to the construction workers.

More recently in development, spurred on by regulators in Kenya and indeed globally, has recognized the need for change in order to safeguard the environment. In relation to this, Environmental concerns have now been integrated in the planning and implementation processes of any proposed projects in Kenya. The key objective is to mitigate conflicts with the environment at the vicinity; during implementation and operational phases. In addition, it is now mandatory for the proponents of such projects to carry out Environmental Impact Assessments (EIAs), to enhance *Sustainable Environmental Management* as well as controlling and revitalizing the much-degraded *environment*. The National Environmental Management Authority (NEMA) in Kenya regulates the environmental management.

Pursuant to the prevailing legal requirements as envisaged in the EMCA and to ensure sustainable environmental management, the proponent undertook this EIA study for the proposed project; and incorporated substantial environmental aspects as advised by NEMA. This EIA study report thus provides relevant information and environmental considerations on the project proponent's intention to seek approval from NEMA for the development of the proposed project. The EIA was conducted by a team comprising of NEMA registered Environmental Experts, sociologists, waste management experts, engineers, planners and architects among others.

1.2. Objectives

The main objective of this EIA was to establish the baseline conditions of the proposed site; evaluate the existing and the anticipated impacts and propose measures to enhance the positive impacts and measures to mitigate and reduce on the effects of the negative impacts. The key goal is to enhance cleaner and sustainable environment during implementation and operation phases of the proposed project.

1.3. Scope

The study was conducted to ensure that significant impacts on the environment and socio-economic aspects are taken into consideration at all times during project implementation and operation phases. The scope of the study was mainly in the subject project and the immediate environs; and to some extent on the possible far-reaching effects of the proposed activities. The following was therefore covered:

- Description of the proposed project
- Design and proposed Construction Materials and Methodology
- Evaluation of the location, Land ownership and use
- Baseline information; biophysical and socio-economic
- A review of the policy, legal and administrative framework
- Potential environmental impacts during project implementation and operation phases
- Potential mitigation measures and future monitoring plans.
- Social Impact Assessment; involvement of neighbours/general public in the area.
- Environmental Management and Monitoring plans.

1.4. Terms of Reference

The terms of reference were but not limited to:

- Assessment of the ecological effects.
- Social implications of the proposed project within the locality and general region.
- Determination of the effects on Landscape and land use
- Evaluation of Effects of the development on current demands on infrastructures and services as well as possible implications.
- Proposition of mitigation measures to be undertaken during and after implementation of the project; and development of an environmental management plan with mechanisms for monitoring and evaluating the compliance and environmental performance.
- Such other matters as NEMA may require.

The study is also aimed at ensuring that the proposed project/building would be constructed based on applicable building standards of Kenya and other international building codes i.e. British standards (*BS 8110*, *BS 5950*, etc). In addition, the construction should incorporate environmental guidelines, health and safety measures.

1.5. Responsibilities

While the environmental expert provided the technical understanding on the baseline environmental status, potential impacts, management options and legal framework, the client was expected to provide the following:

- Site map(s) showing roads, service lines, buildings layout and the actual size of the site including the architectural and structural drawings.
- Full details of proposed operations and activities, input materials, site operational outline, products and by-products and any wastes to be generated,
- Measures to be put in place for handling wastes and hazardous materials on the site,
- Land ownership documents and site history.

The output from the EIA Experts was an EIA study report comprising of an executive summary, study approach, baseline conditions, existing and anticipated impacts and potential mitigation measures for anticipated negative impacts and a comprehensive environmental and social management plan (ESMP).

1.6. Methodology

The methodology of the process, which culminated to the assessment and the subsequent EIA project report, included the following:-

- **Preliminary assessment** of the site; where the experts visited the site to know the location.
- **Screening:** This is the initial phase of any EIA process. It involves the determination of whether or not an EIA study is required for a particular development activity. Determination in the proposed project depended on the following aspects but not limited to:
 - The sensitivity of the area likely to be affected;
 - Public health and safety;

- The possibility of uncertain, unique or unknown risks;
- The possibility of having individually insignificant but cumulatively significant impacts;
- Whether the proposed activity affects protected areas, endangered or threatened species and habitats;

From the above, the proposed project was seen to require an Environmental Impact Assessment study since construction activities of such magnitude are expected to give forth both negative and positive effects to the environment and ultimately contribute to an increased waste generation both in the construction and occupational phases. This stage also involved activities such as:

- a) Getting a comprehensive site description that includes: Location of the proposed project, the soils and geology of the proposed site, water resources available on site, drainage system evident on site, climatic conditions of the proposed location and its vicinity, vegetation on site, land use systems on site and its vicinity, population characteristics of the region holding the proposed site, infrastructure at the site and justification for selection of the site
- b) Getting detailed information on: The nature of the proposed construction activities, the materials to be used in the construction activities on site and the expected project outputs including waste generation
 - **Collection of Baseline Data:** Data collection involved activities such as desktop study and discussion with the proponent, observation, detailed physical inspection of the proposed site and the surrounding areas to determine the present and anticipated impacts of the proposed project, study of the approved structural and technical drawings for the proposed residential home.

The data obtained was used to assess potential impacts on health, safety, environment and the community surrounding the proposed site location. From the obtained data, environmental, health, safety and social concerns were identified in relation to the proposed project location and mitigation measures proposed for the negative impacts, while enhancement measures proposed for the positive impact.

- **Data Analysis and Evaluation of Alternatives:** Use of checklists and the threshold limits were used in data analysis; while the proposed site location, technologies to be employed, scale of construction, potential environmental impacts, capital and operating costs, suitability under local conditions, and institutional, training, and monitoring requirements were considered in the evaluation of alternatives.
- **Consultation and Public Participation:** Here, stakeholders, who include the neighbours to the proposed site, interested parties and representatives from relevant lead agencies were invited into a public baraza on 17th April 2019, interviewed and asked to fill in questionnaires, in order to get their views, expectations, projected environmental, economic and social effects regarding the proposed project activities and location. These findings were then analyzed and incorporated in this study report.
- **Preparation of the Project Report:** This Environmental Impact Assessment project report was then prepared by approved and registered (by NEMA) EIA experts, who are familiar with the provisions of the Environmental Management and Coordination Act (EMCA), 1999 and other relevant regulations and laws of Kenya as indicated in the Legal frame
- **Submission of the Study Report:** This report will then be submitted to National Environment Management Authority (NEMA) in copies of ten and a soft copy for review.

CHAPTER TWO

2.0 PROJECT DESCRIPTION

2.1.1 Introduction

The proposed project is a (real estate) residential development within Lukenya area , Athi River Ward, and Mavoko Constituency in Machakos County on plot L.R. No 7815/10. The residential development is a facility that promotes accommodation and housing for the people of Kenya. The project site lies approximately 6.47 from Athi River Town and the project involves the construction of 30 blocks each 14 floors apartment in total 8,888 units that comprises of apartments that have one bedroom, two bedroom and three bedroom houses that promote the medium and low density residential living, it also has amenities such as proposed educational and commercial centres, recreational and natural green spaces for landscaping such as basketball court, football pitch, ponds, relaxation areas, fitness and exercise area among others and public utilities such as police post, roads, fire station and health facility to serve the residents of the area and the community at large.

2.1.2 Project location

The proposed project site is on plot LR.No. L.R. No 7815/10 approximately 42.00Ha piece of land within Lukenya area , Athi River Ward, Mavoko Constituency, Machakos County.The proposed site is accessible via a service line connecting to Mombasa Road.



Figure 2: A satellite view of the proposed site

GPS Coordinates for the proposed project that will cover the 42.00 Ha piece of land

GPS Coordinates for different points within the plot LR.no7815/10
37M 0281310 UTM 9836991
37M 0281498 UTM 9837209
37M 0282059 UTM 9837795
37M 0282224 UTM 9837932
37M 0281946 UTM 9837471

N/B Towards east side there is scarcity development mostly residential homes approximately 100-500m away from the proposed project and west part of the project is near tarmac road Mombasa –Nairobi highway

On south – North side there is wide empty space fence plot of roughly 50Ha

2.2 Project Design Considerations

The design considerations incorporate aspects of modern architecture, the current local government building policy guidelines and the latest standards developed by Kenya Bureau of Standards including:

1. **Ventilation:** The design caters for natural ventilation with features that encourage natural air circulation (including use of permanent air vents above all doors and windows).
2. **Lighting:** The design caters for various types of energy efficient luminaries including fluorescent lamps and natural lighting through glass windows and doors as appropriate for both security and lighting
3. **Sanitary Accommodation:** The number of toilets and wash hand basins has been selected according to guidelines in BS 6465.
4. **Sustainable resource use:** The design of the development incorporates landscaped gardens which will be planted with suitable species of trees / shrubs and grass to prevent ecological deterioration and improve aesthetic value of the site. Part of the excavated soil will be used for landscaping therefore reducing the amount of soil to be transported away from the site.
5. **Solid waste management:** The proponent will be required to manage solid waste effectively, this may require the proponent to contract waste handler for proper waste management.
6. **Fire protections:** The design of the proposed developments incorporates firefighting equipment to be installed in the building and the provision of a fire station.

7. **Plumbing and drainage;** Sewage to be discharged to the ponds then is pumped to the reservoirs and directed to the treatment plant. Water supply and reticulation to be done using galvanized steel piping to BS and or PPRC piping.

2.3 Project Output and Layout

The output of the proposed development will be a (real estate) multi-units residential development. The layout and construction specifications for the proposed developments are as shown on the architectural drawings annexed herein in this report.

2.3.1 Infrastructure

The development will have a comprehensive and robust infrastructure including access roads, parking areas, courtyards, sewerage system plant, commercial centres, educational facility, public electricity distribution, recreational facilities and waste disposal system among other public utilities

There is an existing Kenya Power main electricity supply line, which the proponent will acquire regal connections, and will be used tom provide power in all phases of the project. The necessary guidelines and precautionary measures relating to the use of electricity shall be adhered to.



The proposed project site is currently unoccupied, with isolated homesteads in the peripheries



Mombasa – Nairobi highway in front of the proposed project site

2.3.2 Water Reticulation System and Sewerage Management

The water used at the site and its environs is obtained from the existing County water system. The area is covered by a public sewer line, in to which the resultant development will be connected. All sanitary work will be in accordance with the ministry of health (MOH) rules and regulations and the Machakos County Government requirements.

2.3.3 Landscaping

The site will be landscaped after construction, using plant species available locally. This will include establishment grass lawns to improve the visual quality of the site where pavements will not have taken space. This will be done by the contractor but any other form of landscaping will be done by management.

2.3.4 Building and Construction

The buildings will be constructed as per respective building plan appended to this report. Basically, the building structures will consist of concrete appropriately reinforced with steel and iron metal. The building will be provided with a well-designed concrete staircase with rails for access to each upper floor.

The building will be provided with facilities for drainage of storm from the roof through guttering drainage system channeled through ponds. The building will have adequate natural ventilation through provision of permanent vents in all habitable rooms, adequate natural and artificial light, piped water stored in a tank.

2.4 Description of Proposed Project Activities

2.4.1 Pre-construction phase

2.4.1.1 Site support structures

The support structures needed before commencement of construction phase include construction of water reservoirs and fencing and hoarding the site.

2.4.2 Construction phase

2.4.2.1. Excavation works

Excavation work involves digging of foundation and storm water channels. Human labor will be employed to do the excavation work. The materials out of excavation will be piled and compacted to avoid soil erosion and to preserve it for the purpose of using later in landscaping.

2.4.2.2. Sourcing and transportation of building materials

Building materials will be transported to the project site from their extraction, manufacture, or storage sites using transport trucks. The building materials to be used in construction will be sourced within Machakos County to minimize ecological footprints, supplemented by onsite materials developed in line with the new technologies been adopted in the proposed project. Greater emphasis will be laid on procurement of building materials from within the local area, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel by the materials transport vehicles as well as promoting local dealers of those products.

2.4.2.3. Storage of materials

Building materials such as rough stones, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities of materials on site, the contractor will order bulky materials such as sand, gravel and stones at construction pace. Materials such as cement, paints and glasses among others will be stored in temporary storage structures constructed during pre-commission phase, which will be constructed within the project site for this purpose.

2.4.2.4. Masonry, concrete work and related activities

Masonry and related activities will include stone cutting into required sizes and shaping as desired, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces. These activities are known

to be labor intensive and will be supplemented by machinery such as concrete mixers and power floaters.

2.4.2.5. Structural steel and roofing works

The buildings shall be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection. Roofing activities will include raising and fastening the roofing materials.

2.4.2.6. Electrical work

Electrical work during construction of the project will include installation of electric pumps and gadgets and appliances including electrical cables, lighting apparatus, sockets, power meters, etc. In addition, there will be other activities involving the use of electricity such as welding and metal cutting.

2.4.2.7. Winding up construction

To improve on the aesthetic value or visual quality of the site after completion of construction, the contractor will carry out collection and removal of debris and remaining building materials from the site.

2.4.3. Operation phase

This phase involves the owner opening up the dwelling units and possible interested parties occupying the residential houses. The apartments will serve people from within the area.

2.4.3.1. Emission and waste management

The operation phase is expected to generate waste. The project wastes are packaging materials, sewage, storm/rooftop water, solid waste, among others. The proponent is responsible for the management of waste and will provide facilities for handling solid waste generated within the new project. The waste to be generated will be handled and managed as follows:

1) The proponent to provide refuse storage chambers for temporarily holding waste before final collection and disposal in compost pit or by a NEMA licensed contractor;

- 2) Sewage generated from the premise will be discharged into sewerage waste water treatment plant (s);
- 3) The rooftop water can be harvested for use or channeled as part of storm water.
- 4) The storm water from the project area will be channeled into the existing ponds
- 5) The building will also be cleaned regularly by the occupants and will involve sweeping, waste collection, and mopping among others.

2.4.3.2. Repairs and maintenance

The buildings will be maintained regularly during the operation and will include activities such as repair of buildings walls and floors, repair of electrical gadgets such as lighting apparatus and equipment, repairs of leaking water pipes, blocked sewage system, painting, among others.

2.4.4 Construction material handling

Most construction works take in considerable amounts of artificial and natural material. The materials to be used have to conform to KEBS requirements for quality. Some building materials such as building blocks, sand and ballast will be kept outdoors at the site while others such as cement, nails and paints will be kept in indoors in lockable stores to be established at the site since they are easily destroyed by rains or direct sunshine and are vulnerable to theft because they can easily be carried away. A store will be made of iron sheet walling and roof. The iron sheets will be supported on wooden posts. Handling of all hazardous chemicals will be done in accordance with their manufacturers' instructions as outlined on their material safety data sheets. Usage of materials has both beneficial and adverse impacts on the environment. Both on-site and off-site impacts are also anticipated from extraction and usage material. The most common of these impacts are income circulation in the economy, creation of employment opportunities, off-site depletion of materials, land degradation, pollution, excessive demand on materials and health hazards. Sources of construction materials depend on the contractual agreements between the proponent and the contractors, their availability and the priorities of the person sourcing the material. Provisional sources of construction material and their uses have been given (Table 4.1)

Table 2.1: Summary of the main construction material input into the proposed project

Materials	Sources	Uses	Impacts	Mitigation
Sand	Suppliers near the proposed site	Preparation of concrete for joining masonry stone and aggregate	Off-site depletion of raw materials and land degradation especially destruction of the river beds	Re-evaluation of the project to ensure that the design optimizes the use of sand A detailed material plan should be prepared as part of the initial design review
Stones	Suppliers near the proposed site	Reinforcement of the floor	Off-site land degradation Resultant solid wastes Excessive consumption of raw materials	Re-evaluation of the project to ensure that the design optimizes the use of blocks
Building stones	Suppliers near the proposed site	External walling works	Off-site land degradation Resultant solid wastes Excessive consumption of raw materials	Re-evaluation of the project to ensure that the design optimizes the use of blocks
Soil	From site after excavations	Levelling, refilling and landscaping works	Resultant solid wastes and dust pollution	Careful planning landscaping programme Spraying dusty areas with water

Materials	Sources	Uses	Impacts	Mitigation
Cement	Hardware shops near the proposed site	Preparation of concrete for joinery purpose and making ballast for reinforcement concrete	Excessive consumption of cement Off-site depletion of limestone Land degradation Air pollution	Re-evaluation of the project to ensure that the design optimizes the use of cement A detailed material plan should be prepared as part of the initial design review Careful use of cement to avoid unnecessary spills
Ballast and/or hard-core	Suppliers near the proposed site	Preparation of aggregate for making slabs and reinforcement concrete		
Timber	Timber yards near the proposed site	Roofing and making doors	Off-site deforestation and resultant soil erosion	Reforestation Programme Re-evaluation of the project to ensure that the design optimizes the use of timber A detailed material plan should be prepared as part of the initial design review

Materials	Sources	Uses	Impacts	Mitigation
Poles	Timber yards near the proposed site	Supporting structural works	Off-site deforestation and Resultant soil erosion	Reforestation Programme Re-evaluation of the project to ensure that the design optimizes the use of poles A detailed material plan should be prepared as part of the initial design review
Murram	Suppliers near the proposed site	Backfilling of excavated sections		
Steel bars	Hardware shops near the proposed site	Reinforcement and casement	Health hazard Excessive demand on steel	Re-evaluation of the project to ensure that the design optimizes the use of steel bars Re-using and recycling of waste metals Practice effective occupational health and safety practices. Careful handling of glass
Glass	Hardware shops near the proposed site	For glazing windows	Health hazard Heavy demand of glass Resultant solid wastes	Re-evaluation of the project to ensure that the design optimizes the use of glass

Materials	Sources	Uses	Impacts	Mitigation
				A detailed material plan should be prepared as part of the initial design review
PVC material such as pipes	Hardware shops near the proposed site	For water and waste water piping systems	Non-biodegradable solid wastes and resultant breeding grounds for rats and disease vectors such as mosquitoes	Re-using and recycling of wastes Proper handling of wastes
Nails	Hardware shops near the proposed site	For joinery and roofing purposes	Cause injuries to the workers if not stored in an enclosed room	Use of the nails careful to avoid accidents and injuries
Gravel	Quarries within Machakos and its environs	Preparation of aggregate for making ballast	Off-site depletion of gravel land degradation	Re-evaluation of the project to ensure that the design optimizes the use of gravel A detailed material plan should be prepared as part of the initial design review
Paint	Hardware shops near the proposed site	For colourful external and internal finishes	Health hazard Excessive use of paint Resultant pollution	Careful use of paint to avoid unnecessary spills

Materials	Sources	Uses	Impacts	Mitigation
				Re-evaluation of the project to ensure that the design optimizes the use of paint Practice effective occupational health and safety
Paving blocks	Will be made on site	Making pavements	Excessive use of cement, sand and gravel Solid waste from broken blocks	Re-evaluation of the project to ensure that the design optimizes the use of paving blocks Re-using wasted blocks to fill road potholes or other hollow area

Water	Borehole at the site and MACHAWASCO water supply	Input in the construction works for dust suppression and preparation of concrete and aggregate and cleaning	Excessive consumption in of water Waste water and pollution Conflicts with other water users in the area	Regular maintenance of pipes and taps to fix leakages Maximization on other sources of water such as rainwater harvesting and storage in larger tanks
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2.4.5 Cost of proposed project

As provided under section 58 (1) of EMCA, 1999, the project proponent is required to submit an EIA study report to the Authority, in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee. The estimated cost of the proposed project will be determined by an evaluation done by a registered quantity surveyor

The project proposed budget

The proponent has approximate cost of the proposed construction of 30 blocks,14 floors apartment each total to 8,888 residential units as stated below

- Preconstruction
- Foundation
- Framing
- Exterior finishes
- Mechanicals
- Electrical
- Interior finishes
- Overheads
- Amenities

The total cost of the development is estimated to be **Fifty Billion (Kshs 50,000,000,000)**

2.5 Consistency with adopted plans and policies

The County Government of Machakos, Director of Physical Planning, The Commissioner of Lands and Land Register has reviewed the submitted drawings and plan of the proposed project and accepted/authorized as the envisaged project would not conflict with any of the applicable policies of the County Plans as emphasis are made to implement those policies relevant to these type of projects.

Transportation Element

The proposed project would result to minimum significant traffic impacts and mitigation measures have been put in place appropriately such as:

Traffic management plan

A site-specific Traffic Management Plan for construction activities that will describe the deliveries traffic path, pedestrian path, internal traffic path will be issued prior to commencing construction. The Traffic Management Plan will include information on the following: Overview plan for the site, Traffic Management inside the Construction Site, Traffic Management for construction delivery, Traffic Management for pedestrian and any effect on existing neighbouring property traffic or access roads

Site fencing / Hoardings

The construction site will be fenced off with temporary fencing to all surrounds. Site fencing will prevent any entry only

Construction site entry

The construction vehicle site entry will be along Mombasa road leading to acces road to the site as per Machakos County planning department which will allow driveway access then flowing across a vacant allotment to an existing bitumen paved parking area. This makes use of the of the existing site conditions and reduces the impact to the adjoining facilities. All of the construction deliveries and access will be via this entry. Clear signage will be erected outlining the construction entry. Construction pedestrian / workers access will be separated from vehicle access by way of separate pedestrian entry from adjoining footpath. Workers will have a direct footpath access to site amenities from pedestrian entry gate.

Deliveries & Traffic Management

A delivery area will be located within the site compound - All material deliveries for the works will be made via the entry/entry via along Mombasa Road Highway . Vehicular movements around the building will be managed by trained traffic management operatives and all vehicles will enter and exit the construction site in forward facing direction

Tower Crane

Tower crane will generally be used to unload heavy material and equipment directly from the truck. They are to be lifted to the designated location or on to loading platform. Traffic control during loading and unloading inside the construction site will be carried out by contractor's representative.

Man Materials hoist

A man and materials hoist will be used to provide safe access on the floors and the movement of smaller materials. A safe pedestrian access will be provided to the hoist location.

Forklift

A forklift will be available on site for materials handling purpose. Materials will generally unloaded from the truck using forklift and move to a suitable location.

Noise Element

The proposed project would comply with all applicable rules and regulation set by Machakos County and National Environment Management Authority regarding to noise- pollution. However, it is anticipated that the project's proximity to the residences near the project site, would result in temporary significant unavoidable noise and vibration impacts during construction. Control measures have been put in place to reduce operational noise.

Air Quality Element

During construction phase of the proposed project; particulate emissions may be generated (e.g. dust from grinding). Mitigation measures such as the use of masks by construction workers and watering of the ground to avoid rising of dust particles will be put in place.

Security Element

The project site is located in an area near other residential house. The site is secure and the proponent will put in place boundary wall to enhance the security.

2.6 Activities that shall be undertaken during the construction according to operation phases.

The development will be constructed based on applicable building standards of Kenya including the building code and incorporating all the necessary environmental, health and safety measures. The following activities are expected to be undertaken for each particular house.

1. Excavation and earthwork for the foundations	2 – 6 weeks
2. Laying of the foundations	4 – 8 weeks
3. Concrete for each floor	2 week
4. Walls and Isolation/partitioning	4 – 8 weeks
5. Installation of water pipes	4 – 6 weeks
6. Plaster	6 – 8 weeks
7. Electrical and mechanical installation.	6 – 8 weeks
8. Doors and windows	2 weeks
9. Floors	6 – 8 weeks
10. Painting	6– 8 weeks
11. Finishing	4– 6 weeks.
12. Transportation of building materials to the site.	28 weeks
13. Maintenance of building equipment's and trucks.	28 weeks
14. Clearing the site after completion of construction.	4 – 8 weeks
15. Landscaping.	4 – 8 weeks

N/B: The construction duration for the project will approximately takes 4 years

2.7 Design of the proposed project

The proponent has contracted experienced engineer/architect to provide the architectural designs for the proposed development.

Notes on design of the project

1. General:-

- All measurements are shown in millimeters, and should not be scaled off the drawing
- The contractor must check and verify all dimensions before commencing any work. Any discrepancy must be notified to the architect.

- All sections should be read as per the floor plan and all drawings must be read in context with each other. Any discrepancies must be notified immediately to the designer and clarified by consulting the respective consultants' drawings.

2. Construction:-

- Damp proof coat must be provided under the external walls at grade. DPC to be minimum 150 mm above ground level.
- All slab at ground to be poured on 1000 gauge polythene on 50mm stone dust blinding on compact hardcore.
- All soils under slab and around external foundation to be treated for termite control.
- Window seals must be finished before internal plastering.

3. Civil:-

- All soils on cut embankment to be stabilized. The slope is not to exceed the natural angle of repose of the soil.

4. Structural:-

- All RC works to Structural Engineer's details.
- Depth of foundation to be determined on the site to SE approval.
- All walls less than 200mm thick to be reinforced with hoop iron at every alternative course.
-

5. Mechanical:-

- All plumbing and drainage to comply with relevant approving local authority's specifications.
- All service ducts to be accessible from all floors.
- Deep seal or anti-vac to all fittings connected to the SVP's or waste pipes. All bends and junctions to have inspection plates.
- SVP to be provided at the head of the drainage.

- Drain pipes passing beneath buildings and drive ways to be encased in 150mm concrete surround.
- All underground foul and waste drain pipes shall be UPVC and comply with BSS 4514 and 5255.
- All inspection chamber covers and frames shall be cast iron to comply with BSS 497 table 6 grades C except ones in the driveway which shall comply with BSS 556.
- Storm water drain shall comply with BSS 556.
- Minimum slopes to drain shall be 1%.
- No chasing will be allowed in the slabs for pipes. Sleeves will be allowed in the slabs with the written approval of the SE.
- All testing of pipes must be completed before plastering.
- All mechanical works must be coordinated with electrical works. Any conflicts must be clarified before work begins.

6. Electrical:-

- All conduits must be laid before plastering.
- All electrical work must be coordinated with mechanical works. Any conflicts must be clarified before work begins.

All materials will be sourced from reliable sources and dangerous or hazardous materials will not be used in the construction.

Note; See attached Machakos County government has approved the plans for the proposed project

CHAPTER THREE

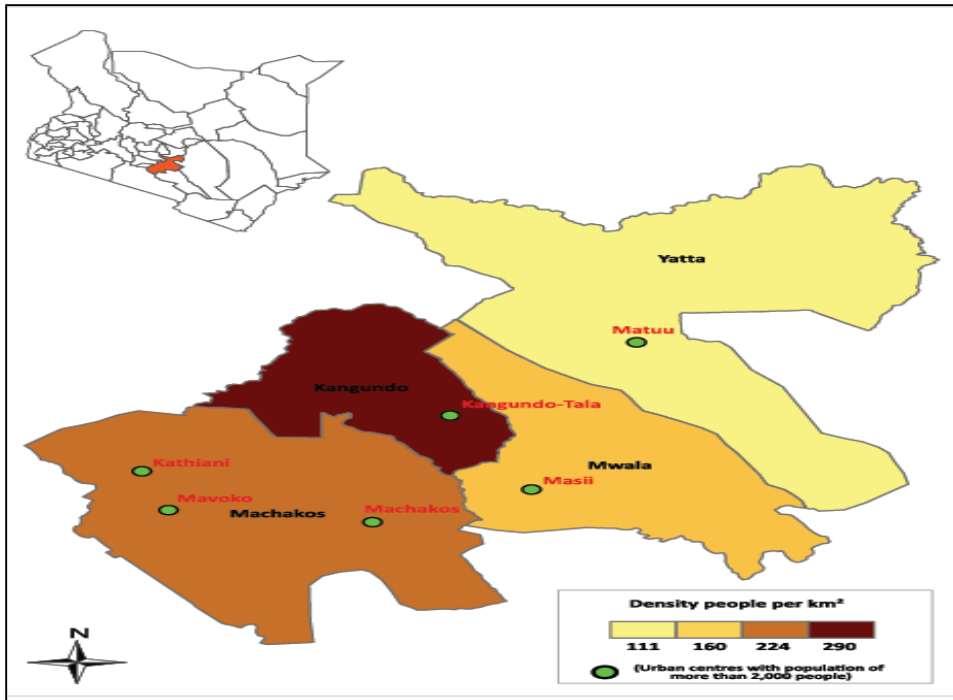
3.0 BASELINE INFORMATION OF THE LOCATION

This Section describes the existing climate, water and geological characteristics, biological, socio-economic environment, aesthetics and cultural resources at the proposed project location. The description provides the baseline against which impacts of the project is to be determined.

General Location

The proposed project is located in Lukenya area, which is within Machakos County; whose headquarters is Machakos town where the project is based was Kenya's first administrative headquarters. It has a Total Population of 1,098,584 people, 264,500 Households and covers an area of 6,208 SQ. KM. The Population density is 177 persons perKm¹.

Machakos County borders Nairobi and Kiambu Counties to the West, Embu to the North, Kitui to the East, Makueni to the South, Kajiado to the South West, and Muranga and Kirinyaga to the North West. Subsistence agriculture is mostly practiced with maize and drought-resistant crops such as sorghum and millet being grown due to the areas semi-arid state.



¹<http://www.machakosgovernment.com/MachakosProfile.aspx>

Figure 1: Administrative map of Machakos County (Source: Commission on Revenue Allocation Report, 2012)

3.1 PHYSICAL ENVIRONMENT

3.1.1 Climate and Meteorology

Habitat Housing Cooperative Society Limited (Proponent) and the Singapura Developers Limited (Developers) proposed residential dwelling units (Habitat Heights) is located in Portland area in Lukenya, Athi River ward in Mavoko Constituency, Machakos County. Generally the annual rainfall of the County is unevenly distributed and unreliable. The average rainfall is between 500 mm and 1300 mm. The short rains are expected in October and December while the long rains are expected in March to May. The highland areas within the County such as Mua, Iveti and Kangundo receive an average of 1000mm while the lowland areas receive about 500mm; ideally the rainfall within the County is influence by the latitude. In terms of temperature, July is the coldest month while October and March are the warmest. Temperature varies between 18°C and 29°C throughout the year. Since the County does not experience rain throughout the year it then means that there are months that experience dry spells. These months are mainly February to March and August to September.

3.1.2 Winds

The wind near the ground is very predominantly easterly throughout the year, generally between north-east and east from October to April, and between east and south-east from May to September. The strongest winds occur during the dry season just prior to the "Long Rains" when speeds of 20 to 25 mph are common from mid-morning to early afternoon; at other times of the year winds speeds are usually 10 to 15 mph. During the night the wind is usually light. In the squalls sometimes associated with thunderstorms, short-lived of up to 70 mph. have been known to occur.

3.1.3 Physiographic and Natural Conditions

Machakos County has very unique physical and topographical features. Hills and a small plateau rising to 1800-2100m above sea level constitute the Central part of the County. To the West, the County has a large plateau elevated to about 1700m which is Southeast Machakos County Integrated Development Plan, 2015 6 sloping. The County rises from 790 to 1594 m above sea

level. In the North West the County has stand-alone hills. The soils are well drained shallow, dark red clay soils particularly in the plains. However the vegetation across the entire County depends on the altitude of any given area/location. The rainfall distribution in the County depends on the topography of the areas. Since some areas of the County are arid while others have hills and volcanic soils and other areas are plains, the rainfall is widely distributed. For instance the plains receives less amounts of rainfall as such the dominate vegetation is grasslands and some sparse acacia trees. The areas within the County are predominately plains include Mutituni, Mwala, Mua, Iveti Hills and Kathiani.

3.2 Ecological Environment

3.2.1 Flora

The forests cover an area of 477.617Km² which is 7.6 per cent of the County's total land. The forests are categorized as gazette and un-gazette. The gazette forest covers 606.97 ha while the un-gazette cover 1774 ha. These forests are distributed in various parts of the County.

Promotion of Agro-forestry and Green Economy for:

a) Income Generating Activities including farm forestry Income generating activities in the County in this sector include planting of trees such as, eucalyptus, cypress, gravellie and pine for commercial purposes. Other activities include establishment of tree nurseries for seedlings. Fruit trees are also grown and include mangoes, papaws, avocados, Guavas and oranges for both income generation and consumption. This is particularly common in the agricultural areas such as Mwala, Masii, Yatta and Kathiani

b) Protection of water catchments areas The main water catchment areas in the County are Iveti hills, Muumandu, Kalimanzalu and Kiima Kimwe. To protect these areas, planting of indigenous trees has been undertaken in the identified water catchment sites. The County has also set aside funds to promote the planting of trees as such a tree planting campaign will be launched in the course of the 1st financial year.

c) Prevention of soil erosions. The hilly areas of the County such as Iveti, Kathiani and Muumandu are prone to soil erosion due to the nature of the landscape. Prior to the coming into force of the County government, the national government through the ministry of Agriculture trained farmers on contour farming and terracing of farm lands to curb soil erosion. Sensitization was also carried

to encourage farmers to plant 10 per cent tree cover on their land with fruit trees, fodder trees or any other plantation. The County has also seen the need for the prevention of soil erosion as such the department responsible for agriculture will spear head the prevention of soil erosion under the budgetary provisions.

d) Provision of wood fuel and generation of energy for industries According to the Kenya Integrated Household Budget Survey Population 81.6per cent of households use fuel wood for cooking while 1.2 per cent use the same for lighting. The demand for wood fuel is therefore increasing especially with the frequent increase in fuel and gas prices. To meet this demand, trees have been planted in small portions for provision of wood for home consumption and charcoal burning. The County department in charge of energy and natural resources has prioritized the search for alternative sources of fuel so as to reduce the reliance on wood fuel across the county.

e) Growing of fruit trees for improved nutrition the proximity of the County to Nairobi and JKIA has stimulated the growing of fruit trees in the County. Grafted fruit trees that produce grapes, straw berry, mangoes, and oranges been planted. The County produces enough fruits for domestic use and surplus for export to Nairobi. Fruit farming is practiced in all the constituencies in the County except Mavoko Constituency/Sub County.

3.2.2 Fauna

Urban farming contributes to most of the faunal species in residential areas of Machakos in terms of animals reared as livestock. Some of the animals reared in Machakos include poultry, goats, sheep, cattle, pigs and rabbits (Lee Smith et al, 1994). Most of the faunal species noted from the scoping survey were mainly as a result of urban farming and they included goats, chicken and cattle. According to the 2009 Kenya Population and Housing Census, the number of animals bred in the County was 230,891. These include: 126,608 Sheep, and 629,974 Goats. In addition, there are 862,592 indigenous Poultry, 4,026 Pigs, 21,336 Donkeys, 46,370 beehives and 20 Camels. There is growth in this sub-sector because of various government programmes to develop this sector and the ready market by the Kenya Meat Commission in Athi River. In addition there are two livestock markets found in Masii and Masinga where farmers can sell their livestock. The County has made provisions within the budget to avail day old chicks to farmers. The department responsible for agriculture has given this priority

3.3 Socio- Economic Environment

Kenya's real gross domestic product (GDP) grew by 5.8 per cent in 2005 against a revised growth of 4.9 per cent in 2004 (CBS 2006). The major growth sectors were agriculture and forestry; transport and communications; manufacturing; and wholesale and retail trade.

Machakos is a major contributor to Kenya's economy: it generates over 45 per cent of GDP; employs 25 per cent of Kenyans and 43 per cent of the country's urban workers (UN-Habitat 2006). The paradox is that the financial capacity of the Machakos County is extremely limited, largely because of poor resource management and a weak revenue collection system. As a result, there is a 200 per cent shortfall between the revenue collected per capita (\$7 on average) and per capita expenditure (\$21) (UN Habitat 2006).

3.3.1 Population and Demography

According to the 2009 Kenya Population and Housing census the total population of the County is 1,098,584. It is projected to increase to 1,166,516 in 2012, 1,238,649 in 2015 and 1,315,244 in 2017. This increase suggests that population will be increasing by 2%. The population as reflected below is an indication of the social and public amenities that are necessary in each Sub County to provide sufficiently for the needs of the entire populations. Sub Counties like Machakos that have the highest population requires more social and public amenities than Kangundo Sub County would require. Considering the population growth projections, it is pertinent to note that the social and public amenities must increase concurrently with the population growth.

3.3.2 Land use

Land has aesthetic, cultural and traditional values and is a vital factor of production in the economy. Land in the County is broadly used for Forest, Government Reserve, Townships, Game Reserves, Agriculture, Ranches, Industrialization, mining and livestock keeping. The absence of the national land use policy has led to the proliferation of informal settlement, inadequate infrastructure services, congestion environmental degradation, unplanned urban centres, pressure on agricultural land and conflicts. The land of the proposed project is approximately 77.754ha. The land was an immigration area for animals and also a cattle grazing area then changed to construction of dwelling units for the society

3.4 INFRASTRUCTURE AND SERVICES

3.4.1 Roads and Accessibility

The transport and communication network in the project area is excellent. The project is off the Nairobi-Mombasa way, which is a national highway. The road leading directly into the site will be connected to this highway. The proponent will liaise with the relevant agency (Kenya National Highways Authority – KENHA) for connection of the access roads to this national highway

3.4.2 Water supply

The main water resource is tap water, which is supplied by the Machakos County supply networks. This will form the main source of water both during construction as well as during operation. However, it is important to put into consideration the prevalent water shortage in the country. The proponent has proposed to drill boreholes to supplement the public water supply and avoid increasing pressure on the already strained water supply by the county. In case of any shortage, water may be brought to the site using water bowsers. To take care of any shortages during occupation, the proponent will be expected to install water underground reservoirs as well as storage tanks on the upper floors of the buildings. This is well articulated in the architectural drawings.

3.4.3 Sewer system

The proposed project area will be served with a public sewer trunk system, through which all sewage and wastewater from the project can be disposed. The proponent will install a waste treatment plant to take care of effluent from the estate through pre-treatment and recycling/reuse of some of the waste water. This will be properly articulated in the operation phase of the proposed project by embracing wastewater treatment and recycling technology outlined below;

3.4.3 Surface Drainage

Most of the rainwater will mainly be absorbed into the soil during construction phase. Appropriate drainage systems have been provided for in the designs and will be put in place to handle the run-off/storm water from the site during operation of the project.

3.4.4 Waste Management

The project proponent and the contractor will develop modalities to ensure safe disposal of the generated solid waste. The adoption of *integrated Solid Waste Management System* will be Proposed Multi Units Residential Development on Plot L.R. No: 7815/10 Mavoko sub-county, Machakos County

encouraged during construction and operation phases. In addition, the project's contractor and the proponent will work closely with NEMA for the guidance on the modes and site of the waste disposal.

Some materials may be disposed through the process of incineration. Wastes generated from excavation may be used in back filling of quarry pits. During the operational phase, all wastes will be collected from the site by a licensed contracted waste handler for disposal in the approved dumpsite.

3.4.5 Energy

Construction machinery will require fuel during construction. This will be sourced from legitimate petroleum dealers. Electrical power will come in handy in driving the selected construction machinery. It will also be needed on operation of the completed project. The power (electricity) will be drawn from the power grid lines running at the frontage of the project site. Standby generators or and clean energy (solar) will be required to cater for periods when there are supply interruptions.

3.4.6 Communication

The area is well covered by communication facilities by the main telephone service providers including a Telkom, Safaricom, and Airtel among others. All these will facilitate communication during the implementation and on occupation of the project.

3.4.7 Security

There will be a single gate to the site. This will be manned 24 hours by qualified security personnel. The proposed project site will have a masonry perimeter wall served by a single gate. The proponent should also install security lights to beef up security at the site both during construction and the operational phase of the project.

Note: See attached geotechnical survey for the proposed project and it has confirmed that the location can withstand the total 8,888 residential units of 30 blocks

CHAPTER FOUR

4.0 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

Everyone has a right to clean and healthy environment. The law has provisions for the establishment of the National Environment Management Authority (NEMA), as the supreme regulatory and advisory body on environmental management in Kenya under EMCA CAP 387. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other statutory organs. NEMA also ensures that environmental management is integrated into development policies, programmes, plans and projects. The Environmental Management and Co-ordination Act, CAP 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003 are the legislation governing Environmental Assessments (EIA & EA).

Policies and legislation highlighting the legal and regulatory requirements pertinent for this study are presented below.

4.1 Institutional Framework

4.1.1 National environment management authority (NEMA)

The objective and purpose for which NEMA is established is to exercise general supervisory and co-ordinate over all matters relating to the environment and to be the principal instruments of the government in the implementation of all policies relating to the environment. However, NEMA mandate is designated to work within the following committees:-

a) County Environment Committees

According to EMCA, 1999 No. 8, the Ministry by notice in the gazette appoints Provincial and County Environment Committee of the Authority in respect of every province and County respectively. The Provincial and County Environment Committees are responsible for the proper management of the environment within the County in respect of which they are appointed. They are also to perform such additional functions as are prescribed by the Act or as may, from time to time be assigned by the Minister by Notice in the gazette.

b) Public Complaints Committee

The committee performs the following functions:-

- Investigate any allegations or complaints against any person or against the authority in relation to the condition of the environment in Kenya and on its own motion, any suspected case of environmental degradation and to make a report of its findings together with its recommendations thereon to the Council.
- Prepare and submit to the Council periodic reports of its activities which shall form part of the annual report on the state of the environment under section 9 (3) and
- To perform such other functions and exercise such powers as may be assigned to it by the Council

c) National Environment Action Plan Committee

This committee is responsible for the development of a 5-year Environment Action Plan among other things. The National Environment Action Plan shall:-

- Contain an analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quality over time.
- Contain an analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity.
- Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes;
- Set out operational guidelines for the planning and management of the environment and natural resources;
- Identify actual or likely problem as may affect the natural resources and the broader environmental context in which they exist;
- Identify and appraise trends in the development of urban and rural settlements, their impacts on the environment, and strategies for the amelioration of their negative impacts.
- Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general diverse impacts on the environment

- Prioritize areas of environmental research and outline methods of using such research findings;
- Without prejudice to the foregoing, be reviewed and modified from time to time to incorporate emerging knowledge and realities and
- Be binding on all persons and all government departments, agencies, state Corporation or other organ of government upon adoption by the national assembly.

d) Standard and Enforcement Review Committee

This is a technical committee responsible for environmental standards formulation methods of analysis, inspection, monitoring and technical advice on necessary mitigation measures.

e) National Environmental Tribunal

This tribunal guides the handling of cases related to environmental offences in the republic of Kenya.

f) National Environment Council (NEC)

EMCA 1999 No. 8 part iii section 4 outlines the establishment of the NEC. NEC is responsible for policy formulation and directions for purposes of EMCA; set national goals and objectives and determines policies and priorities for the protection of the environment and promote co-operation among public department, local authorities, private sector, non-governmental organizations and such other organizations engaged in environmental protection programmes.

4.2 Policies

4.2.1 Constitution of Kenya 2010

Article 42 of the Bill of Rights of the Kenyan Constitution provides that „every Kenyan has the 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 legislative and other measures“. Under Chapter 5 (land and Environment), Part 1 is devoted to land. It requires that land be used and managed in „a manner that is equitable, efficient, productive and sustainable, and in accordance with the following principles;

a) Equitable access to land

- b) Security of land rights
- c) Sustainable and productive management of land resources
- d) Transparent and cost effective administration of land
- e) Sound conservation and protection of ecologically sensitive areas.

Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides that the state shall;

I. Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits.

II. Work to achieve and maintain tree cover of at least ten per cent of the land area of Kenya.

III. Encourage public participation in the management of, protection and conservation of the environment.

IV. Protect genetic resources and biological diversity.

V. Establish systems of environmental impact assessment, environmental audit and monitoring of the environment.

VI. Eliminate processes and activities that are likely to endanger the environment.

VII. Utilize the environment and natural resources for the benefit of the people of Kenya.

Further, Article 70 states that if a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress. The sub-project should ensure compliance with the constitution in so far as equitable sharing of the resources, between the stakeholders. Further, the project should ensure the sustainability of livelihoods and biological resources within the project areas are protected. Any development proposals should also be cognizant of the increased powers under the Constitution given to communities and individuals to enforce their rights through legal redress.

4.2.2 The Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy

for Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped to between 1.7% and 1.8% in 2008 and 2009 respectively. The objective of the vision 2030 is to transform Kenya into a middle income country with a consistent annual growth of 10 % by the year 2030". The 2030 goal for urban areas is to achieve "a well-housed population living in an environmentally-secure urban environment." This will be achieved by bringing basic infrastructure and services namely roads, street lights, water and sanitation facilities, storm water drains, footpaths, and others. One of the aims of the vision is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar. Improving pollution and waste management through the application of the right economic incentives in development initiatives is critical. The current land use practices in the country are incongruent with the ecological zones. For instance, large portions of land in high potential areas have been subdivided into uneconomic parcels, while some parts of land in the medium and low potential areas are rapidly being converted into agriculture, despite the fragile environment they are located in.

4.2.3 National Environment Action Plan (NEAP)

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from economic and social development programmes that disregarded environmental sustainability. In this regard, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process, EIA was introduced and among the key participants identified were the District Development Committees.

4.2.4 National Policy on Water Resources Management and Development

The National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999) was established with an objective to preserve, conserve and protect available water resources and allocate it in a sustainable rational and economic way. It also desires to supply water of good quality and in sufficient quantities to meet the various water needs while ensuring safe disposal of wastewater and environmental protection.

The policy focuses on streamlining provision of water for domestic use, agriculture, livestock development and industrial utilization with a view to realizing the goals of the Millennium Development Goals (MDGs) as well as Vision 2030. To achieve these goals, water supply (through increased household connections and developing other sources) and improved sanitation is required in addition to interventions in capacity building and institutional reforms. While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the byproducts of this process as waste water. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution. Development projects, therefore, should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating there from. The same policy requires that such projects should also undergo comprehensive EIAs that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighborhood and further downstream are not negatively impacted by the emissions. In addition, the policy provides for charging levies on waste water on quantity and quality (similar to polluter-pays-principle) in which case those contaminating water are required to meet the appropriate cost on remediation, though the necessary mechanisms for the implementation of this principle have not been fully established under the relevant Acts. However, the policy provides for establishment of standards to protect the water bodies receiving wastewater, a process that is ongoing.

4.2.5 Sessional Paper No. 6 of 1999 on Environment and Sustainable Development

Among the key objectives of the Sessional Paper No. 6 of 1999 on Environment and Sustainable Development (1993) are;

- a. To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
- b. To ensure that an independent environmental impact assessment (EIA) report is prepared for any development before implementation,
- c. To ensure that effluent treatment standards which will conform to acceptable health standards.

Under this paper, broad categories of development issues have been covered that require sustainable approach. These issues include the waste management and human settlement sectors.

The policy recommends the need for enhanced reuse/ recycling of residues including wastewater and increased public awareness raising and appreciation of clean environment as well as the participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others for decent housing of every family.

4.3 Legal Framework

Applications of national statutes and regulations on environmental conservation suggest that the proponent will have a legal duty and social responsibilities to ensure the proposed project development is carried out without compromising the status of the natural resources in the area, environment resources, social and cultural setting as well as the economic potential of the local communities health and safety. This position enhances the importance of this environmental impact assessment for the proposed site to provide a benchmark for its sustainable operation. The key national laws that govern the management of environmental resources in the country have been briefly discussed below. It is noteworthy that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act, CAP 387 prevails.

4.3.1 The Environment Management and Co-ordination Act, CAP 387

Part II of the Environment Management & Coordination Act, CAP 387 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. In order to partly ensure this is achieved, the Act directs that this category of project should undergo environmental impact assessment and a report prepared for submission to the National Environmental Management Authority (NEMA), who in turn may issue a license as appropriate. The second schedule of the same Act lists water programmes and sewage disposal works among the key activities that must undergo environmental assessments. Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources be discharged only into the existing sewerage system upon issuance of

prescribed permit from the local authorities or from the licensee. Finally, section 75 requires that parties operating a sewerage system obtain a discharge license from NEMA to discharge any effluent or pollutant into the environment. Section 87 sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste, shall apply to the NEMA for a license. Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides. Finally the environmental impact assessment guidelines require that study be conducted in accordance with the issues and general guidelines spelt out in the second and third schedules of the regulations. These include coverage of the issues on schedule 2 (ecological, social, landscape, land use and water considerations) and general guidelines on schedule 3 (impacts and their sources, project details, national legislation, mitigation measures, a management plan and environmental auditing schedules and procedures.

4.3.2 EMCA Regulations

4.3.2.1 The Environmental (Impact Assessment and Audit) Regulations, 2003

These Regulations, made under section 147 of the Environmental Management and Co-ordination Act, contain rules relative to content and procedures of an environmental impact assessment. In the sense of section 58 of the Act, contain rules relative to environmental impact audit and monitoring and strategic environmental assessment and regulate some other matters such as appeal and registration of information regarding environmental impact assessment.

4.3.2.2 Water Quality Management Regulations, 2006 (Legal Notice No. 120)

These regulations were drawn under section 147 of the Environmental Management and Coordination Act, CAP 387. In accordance with the regulations, every person shall refrain from acts that could directly or indirectly cause immediate or subsequent water pollution and no one should throw or cause to flow into water resources any materials such as to contaminate the

water. The regulation also provides for protection of springs, streams and other water sources from pollution.

No river pollution is expected however measures will be taken to ensure no pollution of river e.g. by not dumping liquid or solid waste to any river or storm drain hence no river passing near project location and water for construction will be from Mavoko Water and Sewerage Services Company.

4.3.2.3 Waste Management Regulations, 2006 (Legal Notice No. 121)

The regulations are formed under sections 92 and 147 of the Environmental Management and Coordination Act, CAP 387. Under the regulations, a waste generator is defined as any person whose activities produces waste while waste management is the administration or operation used in handling, packaging, treatment, conditioning, storage and disposal of waste. The regulations requires a waste generator to collect, segregate and dispose each category of waste in such manners and facilities as provided by relevant authorities. Regarding transportation, licensed persons shall operate transportation vehicles approved by NEMA and will collect waste from designated areas and deliver to designated disposal sites.

The primary intend to manage the solid waste generated as a result of construction and installations is to conserve resources by minimizing the amount of materials to be disposed off in landfills. The solid waste generation shall be reduced by reuse of the waste on the project or offer these materials for reuse or resale to others. Recycling construction waste to be encouraged to reduce the amount of waste destined for the landfill from the sites for appropriate disposal and there is appropriate septic tank with high set standards within the site.

4.3.2.4 Noise and Excessive Vibration Pollution Control Regulations, 2009

Part II section 3(1) of these Regulations states that: no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment and section 3(2) states that in determining whether noise is loud, unreasonable, unnecessary or unusual. Part II Section 4 also states that: except as otherwise provided in these Regulations, no person shall (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations

which exceed 0.5 centimeters per second beyond any source property boundary or 30m from any moving source. Part III, Section 11(1) states that any person wishing to (a) operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device; or (b) engage in any commercial or industrial activity, which is likely to emit noise or excessive vibrations shall carry out the activity or activities within the relevant levels prescribed in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence. Section 13(1) states that no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations. These purposes include emergencies, those of a domestic nature and /or public utility construction. Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying sites, and states that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding (a) machinery that may be used, and (b) the permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations. It further states that the relevant lead agency shall ensure that mines and quarries where explosives and machinery used are located in designated areas and not less than two kilometers away from human settlements and any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

4.3.2.5 Air Quality Regulations

Under the general prohibitions (Part II), section 5 states that no person shall act in a way that directly or indirectly causes immediate or subsequent air pollution. Among the prohibitions are priority air pollutants (as listed under schedule 2 of the regulations) that include general pollutants, mobile sources and greenhouse gases.

Odors are also prohibited under section 9 of the regulations (offensive emissions). Emissions into controlled areas such as schools, hospitals, residential areas and populated urban centers are also prohibited. Part VII on occupational air quality limits in section 29 states that an occupier of

premises shall ensure that exposure of indoor air pollutants does not exceed the limits stipulated under the Factories and Other Places of Work rules or under any other law. Other sources are recognized at sections 32 and 33 are those arising from construction equipment and materials as well as particulate matter from demolitions of structures and buildings as well as stockpiled dry materials.

4.3.2.6 Biodiversity Regulations

Part II of Regulations, section 4 states that no person shall engage in any activity that may have adverse impacts on ecosystems, lead to introduction of exotic species or lead to unsustainable use of natural resources without an EIA license. The regulation puts in place measures to control and regulate access and utilization of biological diversity that include among others banning and restricting access to threatened species for regeneration purposes. It also provides for protection of land, sea, lake or river declared to be a protected natural environmental system in accordance to section 54 of EMCA, CAP 387.

4.3.3 The Water Act, 2016

The purpose of this Act is to provide for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. It provides for the established the Water Resources Authority. The Cabinet Secretary, the Water Resources Authority, the Regulatory Board, county governments and any person administering or applying this Act shall be guided by the principles and values set out in Articles 10, 43, 60 and 232 of the Constitution. It states that every water resource is vested in and held by the national government in trust for the people of Kenya. The Water Resources Authority established shall serve as an agent of the national government and regulate the management and use of water resources. Upon the commencement of this Act, no conveyance, lease or other instrument shall convey, assure, demise, transfer or vest in any person any property, rig

4.3.4 County Governments Act, 2012

This is an Act of Parliament to give effect to Chapter Eleven of the Constitution; to provide for county governments powers, functions and responsibilities to deliver services and for connected purposes and shall come into operation upon the final announcement of the results of the first elections under the Constitution. It states that a county government shall be responsible for any

function assigned to it under the Constitution or by an Act of Parliament. Under this Act, a county government shall be responsible for:

- a) County legislation in accordance with Article 185 of the Constitution;
- b) Exercising executive functions in accordance with Article 183 of the Constitution;
- c) Functions provided for in Article 186 and assigned in the Fourth Schedule of the Constitution;
- d) Any other function that may be transferred to county governments from the national government under Article 187 of the Constitution;
- e) Any functions agreed upon with other county governments under Article 189 (2) of the Constitution; and
- f) Establishment and staffing of its public service as contemplated under Article 235 of the Constitution.

Under this act the objectives of county planning shall be to:

- a) Ensure harmony between national, county and sub-county spatial planning requirements;
- b) Facilitate the development of a well-balanced system of settlements and ensure productive use of scarce land, water and other resources for economic, social, ecological and other functions across a county;
- c) Maintain a viable system of green and open spaces for a functioning eco-system;
- d) Harmonize the development of county communication system, infrastructure and related services;
- e) Develop urban and rural areas as integrated areas of economic and social activity;
- f) Provide the preconditions for integrating under-developed and marginalized areas to bring them to the level generally enjoyed by the rest of the county;
- g) Protect the historical and cultural heritage, artifacts and sites within the county; and
- h) Make reservations for public security and other critical national infrastructure and other utilities and services;
- i) Work towards the achievement and maintenance of a tree cover of at least ten per cent of the land area of Kenya as provided in Article 69 of the Constitution; and
- j) Develop the human resource capacity of the county.

4.3.5 Land Act, 2012.

This is Act of Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes. This Act shall apply to all land declared as:

- a) Public land under Article 62 of the Constitution;
- b) Private land under Article 64 of the Constitution; and
- c) Community land under Article 63 of the Constitution and any other written law relating to community land.

4.3.6 Public Health Act, CAP. 242 and Health Act, 2017

This is an Act of Parliament to establish a unified health system, to coordinate the inter-relationship between the national government and county government health systems, to provide for regulation of health care service and health care service providers, health products and health technologies and for connected purposes, interest or privilege in respect of any water resource except as may be prescribed under this Act. Section 68 (2) states that the national health system shall ensure that measures for managing environmental risk factors to curtail occurrence and distribution of diseases are put in place and implemented. In particular such measures shall target factors like the reduction of disease burden arising from poor environmental hygiene, sanitation, occupational exposure and environmental pollution; among other factors stated in the Act. Section 69 (1) states that Pursuant to meeting the objects set out in section 68, the national government department of health shall formulate national strategic and operation policies that shall provide for measures that include ensuring houses, institutions, hospitals and other public places maintain environment to the highest level of sanitation attainable to prevent, reduce or eliminate environmental health risks among other factors stated in the Act.

4.3.7 The Forest Act, 2005

The Forest Act No7 of 2005 consolidates all forests under the act, and prescribes heavy penalties for damage to forests and trees. Charcoal burning in a forests or farmlands without a license or permit is an offence. Section 52(1) deals with felling, cutting, burning, injuring or removing of any forest produce only cover state, local authority or provisional forest. It sets heavy penalties for damaging trees. This will assist farmers in maximizing benefits from growing trees. Section 40(1)

of the act sets to ensure that the forest areas under her management are maintained for biodiversity, cultural or recreational use. In addition it protects the concession area from destruction and encroachment by other persons. Section 41(1) says that all indigenous forests and woodlands shall be managed on a sustainable basis for purposes of, Conservation of water, soil and biodiversity, River line and shoreline protection. The Act puts emphasis on the need to strengthen community-based institutions by creation of Community Forest Associations, which gives the public a greater participatory role to the community in the forest conservation.

4.3.8 Physical Planning Act

It is a requirement under the Physical planning act that such a project be subjected to the local county government policy requirements as regards to waste water disposal, proximity to the sewer lines etc. Section 24 of the Physical Planning Act gives provision for the development of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of a city, municipal, town or urban council or with reference to any trading or marketing center and for specific control of the use and development of land. The plan shows the manner in which the land in the area may be used. Section 29 of the physical Planning Act gives the county councils power to prohibit and control the use of land, building, and subdivision of land, in the interest of proper and orderly development of its area. The same section also allows them to approve all development applications and grant development permissions as well as to ensure the proper execution and implications of approved physical development plans. On zoning, the act empowers them to formulate by-laws in respect of use and density of development. Section 30 states that any person who carries out development within an area of a local authority without development permission shall be guilty of an offence and the development shall be invalid. The act also gives the local authority power to compel the developer to restore the land on which such development has taken place to its original conditions within a period of ninety days. If no action is taken, then the council will restore the land and recover the cost incurred thereto from the developer.

In addition, the same section also states that no person shall carry out development within the area of a local authority without development permission granted by the local authority. At the same time, sub-section 5, re-enforce it further that, no licensing authority shall grant under any written law, a license for commercial use for which no development permission had been granted

by the respective local authority. Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA, CAP 387. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to its original conditions.

4.3.9 Occupational safety and health Act, 2007 OSHA

This is an act of parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. This Act applies to all workplaces where any person is at work, whether temporary or permanently. Part II (1) states that; every occupier shall ensure the safety, health and welfare at work of all persons in his workplace. Part II (2) (a) provides the duties of an occupier as; arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances. Part V of the Act states that before any person occupies or uses any premises as a workplace, he shall apply for the registration of the premises by sending to the Director a written notice containing the particulars set out in the Fourth Schedule. The Act further states that; every workplace shall be kept in clean state, and free from effluvia arising from any drain, sanitary convenience or nuisance.

An occupier shall ensure that his workplace shall not, while work is carried on, be so overcrowded as to cause risk of injury to the health of the persons employed therein. An occupier shall ensure that effective and sustainable provision is made for securing and maintaining, by the circulation of fresh air in each workroom, adequate ventilation of the room. An occupier shall ensure that effective provision is made for securing and maintaining sufficient and suitable lighting, whether natural or artificial, in every part of his workplace in which persons are working or passing. Sufficient and suitable sanitary conveniences for the persons employed in the workplace shall be provided, maintained and kept clean, and effective provision shall be lighting the conveniences; and, where persons of both sexes are or are intended to be employed (except in the case of

workplaces where the only persons employed are members of the family dwelling there), such conveniences shall afford proper accommodation for persons of each sex. Other important provisions in the act include:

a) Registration of workplaces

Before any person occupies or uses any premise as a workplace, he shall apply for the registration of the premises by sending to the Director a written notice containing the particulars set out in the Fourth Schedule. All workplaces which were registered under the Factories and Other Places of Work Act (now repealed) shall be deemed to have been registered under this Act.

b) Cleanliness

Each workplace shall be kept in a clean state and free from effluvia arising from any drain, sanitary convenience or nuisance, and, without prejudice to the generality of subsection.

c) Lighting

An occupier shall ensure that effective provision is made for securing and maintaining sufficient and suitable lighting, whether natural or artificial, in every part of this workplace in which persons are working or passing. All glazed windows and skylights used for the lighting of workrooms shall, so far as practicable be kept clean on both the inner and outer surface and free from obstruction. Provided that this subsection shall not affect the white-washing or shading of windows and skylights for the purpose of mitigating heat or glare. An occupier who contravenes the provisions of this commits an offence.

d) Sanitary convenience

Sufficient and suitable conveniences for the persons employed in the workplace shall be provided, maintained and kept clean, and effective provision shall be made for the lighting the conveniences; and where persons of both sexes are or are intended to be employed (except in the case of workplaces where the only persons employed are members of the same family dwelling there) such convenience shall afford proper separate accommodation for persons of each sex.

e) Ventilation

An occupier shall ensure that effective and suitable provision is made for securing and maintaining, by the circulation of fresh air in each workroom, the adequate ventilation of the room.

f) Overcrowding

Without prejudice to the generality of subsection (1) a workplace shall be of sufficient size for work to be carried out with ease and shall further have free spacer and , having regard to the nature of the work, an adequate amount of air for each employee, the minimum permissible being cubic metres per person.

g) 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.

4.3.10 Way-leaves Act (Cap. 192)

According to the Way-leaves Act Cap. 292, Section 2, private land does not include any land sold or leased under any act dealing with government lands. Section 3 of the act states that the government may carry any sewer, drain or pipeline into, through, over or under any lands whatsoever, but may not in so doing interfere with any existing building.

Section 8 further states that any person who, without the consent of the Permanent Secretary to the Ministry responsible for works (which consent shall not be unreasonably withheld), causes any building to be newly erected over any sewer, drain or pipeline or on property of the government shall be guilty of an offence and liable to a fine of one hundred and fifty Kenya shillings, and a further fine of sixty shillings for every day during which the offence is continued after written notice in that behalf from the Permanent Secretary; and the Permanent Secretary may cause any building erected in contravention of this section to be altered, demolished or otherwise dealt with as he may think fit, and recover any expense incurred by the government in so doing from the offender.

4.3.11 National Construction Authority Act 2014

The National Construction Authority (NCA), which was constituted under the Act No. 41 of 2011, was enacted in December 2011 in a bid to regulate and bring sanity in the Kenyan construction industry.

NCA is placed under the Ministry of Lands, Housing and Urban Development.

The Authority is managed to oversee the construction industry – including registering (and de-registering) contractors after rigorous scrutiny to ensure only competent contractors are allowed to carry out any construction work in the country.

Section 15 of the Act states that no contractor shall conduct the business of a contractor without a clearance certificate from the Authority.

The section also sets a fine of Sh1 million or three years imprisonment or both for contractors who breach this provision

4.3.12 THE ENERGY (SOLAR WATER HEATING) REGULATIONS, 2012

Installation and use of solar water heating systems.

3. (1) All premises within the jurisdiction of a local authority with hot water requirements of a capacity exceeding one hundred litres per day shall install and use solar heating systems.

(2) Within a period of five years from the date of coming into force of these Regulations, all existing premises with hot water requirements of a capacity exceeding one hundred litres per day shall install and use solar heating systems.

(3) A person who contravenes the provisions of this regulation commits an offence and shall, on conviction, be liable to a fine not exceeding one million shillings, or to imprisonment for a term not exceeding one year, or to both.

Exemptions.

4. (1) The Commission may exempt from these Regulations—

- (a) premises with technical limitations;
- (b) premises incapable of incorporating solar heating systems due to their special circumstances;
- (c) premises supplied with hot water from a cogeneration plant in or proximate to the premises;
- (d) premises utilizing electricity generated from renewable energy and the excess is used to heat

water as a dump load; or
(e) such other premises as the Commission may determine.

(2) An application for an exemption under sub-regulation (1) shall be made to the Commission, in Form 1 set out in the First Schedule, before the submission of the building plans for approval to the relevant local authority.

(3) The Commission shall process an application for an exemption within forty five days of receipt thereof, and inform the applicant and the relevant local authority of its decision, in writing.

(4) The Commission shall, where it refuses to grant an exemption, give the applicant reasons for the refusal.

Demand calculation and minimum hot water demand.

5. (1) All premises shall have a minimum annual solar contribution of sixty per cent to the premises' hot water demand.

(2) The daily hot water demand shall be calculated using the specific hot water demand values specified in Part A of the Second Schedule.

Responsibility for compliance.

6. (1) A developer of a housing estate, a promoter of the construction, an owner of the premises or an Architect or an Engineer engaged in the design or construction of premises shall comply with these Regulations.

(2) An owner of premises, Architect and an Engineer engaged in the design, construction, extension or alteration of premises shall incorporate solar water heating systems in all new premises designs and extensions or alterations to existing premises.

(3) An owner or occupier of premises that has a solar water heating system shall use and carry out the necessary operational maintenance and repairs required to keep the installation in good and efficient working condition.

(4) An electric power distributor or supplier shall not provide electricity supply to premises where a solar water heating system has not been installed in accordance with these Regulations.

(5) An owner or occupier to whom these Regulations apply may investigate the inclusion of the relevant solar water heating system into a project to be registered under any carbon finance mechanism that may be established from time to time including the Clean Development

Mechanism (CDM).

(6) A person who contravenes the provisions of this regulation commits an offence and shall be liable, on conviction, to a fine not exceeding one million shillings, or imprisonment for a term not exceeding one year, or to both.

4.3.13 RADIATION PROTECTION ACT CHAPTER 243

Notwithstanding subsection (1), a person who contravenes any of the provision of this **Act** relating to or in connection with the importation, possession, transportation, use or disposal of irradiating devices, radioactive materials or any other sources of ionizing **radiation** without being in possession of a valid license ...

(1) The Chief Radiation Protection Officer or any person appointed as a radiation protection officer may— (a) enter, inspect and examine any premises or any part thereof, booth, motor vehicle, vessel, aircraft or any other vehicle in or upon which he has reasonable cause to believe that an irradiating device, radioactive material or any other source of ionizing radiation is stored, used, transported or disposed of; (b) require the production of a license authorizing the use of any irradiating device, radioactive material or any other source of ionizing radiation, or a register or document kept under this Act, and inspect, examine or take copies thereof; (c) make such examinations and enquiries as may be necessary to ascertain whether the provisions of this Act are being complied with; (d) exercise such other powers as may be necessary for carrying out the provisions of this Act or regulations made thereunder. (2) Every radiation protection officer shall be furnished with a certificate of his appointment signed by the Minister and when visiting a place to which the provisions of this Act apply, shall, if so required, produce that certificate to the occupier or person holding a responsible position of management or control of the facility at the premises in which an irradiating device, radioactive material or other source of ionizing radiation are believed to be present or to exist.

4.4 The International Framework

This EIA is based on internationally accepted and respected procedure recommended by the international standards organization (ISO 9001) which provides for the relevant sectoral guidelines. This EIA is intended to meet the expectation of international supporters through the government of Kenya. Kenya is a signatory to some international legislation. Some of these are relevant to this project and were reviewed for the purpose of writing this report.

4.4.1 The World Commission on Environment and Development

The commission commonly referred to as 'the Brundtland Commission focuses on the environmental aspects of development, in particular, the emphasis on suitable development that produces no lasting damage to biosphere and to particular ecosystem. In addition, environmental sustainability is the economic and social sustainability. Economic sustainability development is development for which progress towards environment and social sustainability occurs within available financial resources. Social sustainable development maintains the cohesion of a society and its ability to help its members work together to achieve common goals ,while at the same time meeting individual needs for health and well-being , adequate nutrition, and shelter, cultural expression and political involvement.

4.4.2 The Rio Declaration on Environment and Development

Agenda 21-a Programme of action for sustainable development worldwide in the Rio Declaration on Environment and Development was adopted by more than 178 government at the united nations conference on environment development (UNICED),known as the earth summit, held in Rio de Janeiro, Brazil from 3rd to 14th June 1992. Kenya is a third world country and therefore its plans falls into the agenda 21 whereby the government, local authorities, donors and other stakeholders have committed large amounts of resources to facilitate sustainable developments. Principle no. 10 of the declaration underscored that environment issues are best handled with participation of all concerned citizens at all concerned citizens at all relevant levels. At the national level, each individual shall have appropriate access to information that is concerning environment that is held by public authorities. The states shall encourage and facilitate public participation by making information widely available

4.5 Compliance with Existing Legislation

By carrying out this Environmental Impact Assessment, the proponent has already complied with the Environmental Management and Coordination (amendment) Act, 2015 (EMCA) and the Environmental Management and Co-ordination (Water quality) Regulations which require that an EIA must be carried out for a project of such magnitude.

The project proponents have also applied for authorization permit from the Water Resources Management Authority (WRMA) in fulfillment of the Water Act and Physical Planning Act and has agreed to dump the waste in NEMA approved sites in regards to the Public Health Act, Local Government Act and the Councils By-Laws.

The project proponent will observe strict adherence to the provisions of the various Acts and regulations cited above in order to avoid any non-compliance/conflicts and assure sustainability, both in the implementation and operational phases of the project.

CHAPTER FIVE

5.0 PREDICTED ENVIRONMENTAL, HEALTH AND SOCIAL-ECONOMIC IMPACTS

5.1 EXISTING IMPACTS

There were no notable negative environmental impacts on site, at the time of assessment.

5.2 ANTICIPATED IMPACTS

Impacts can be positive or negative, direct or indirect. The magnitude of each impact is described in terms of being significant, minor or negligible, temporary or permanent, long-term or short-term, specific (localized) or widespread, reversible or irreversible. Some impact mitigation has already been addressed in the proactive design and other mitigations can only be guaranteed through active, responsible management, helped by following the guidelines in the project Environmental Management Plan.

These qualities are indicated in the assessment tables as follows:

Table 1: Impacts assessment scale

Key	Type of Impact	Key	Type of Impact
++	Major positive impact	+	Minor positive impact
--	Major negative impact	-	Minor negative impact
0	Negligible/ zero impact	NC	No change
Sp	Specific/ localized	w	Widespread
R	Reversible	ir	Irreversible
Sh	Short term	L	Long term
T	Temporary	p	Permanent

On the basis of information gathered during the field study, potential environmental impacts of the project are tabulated below.

Table 2: Anticipated Environmental Impacts

Impacts on or due to the implementation of the project.	Construction	Occupation	Remarks
Changes in hydrology	-/0	0	<p>No major effect to the hydrology of the area.</p> <p>There will be no obstruction to the flow of both surface and ground water resources, which is so because the soil in the area is not predominated with clay hence presence of surface and ground water is not notable. Water conservation measures will however be required on operation of the project to minimise water usage.</p>
Pollution: Air/ dust Noise	- t ir - t ir	-/0 -	<p>During construction: dust and exhaust emissions from involved machinery will affect air quality; construction activities, hooting of the involved vehicles and workers will generate noise and (vibration) which may have effect to the immediate neighbourhoods.</p>
Site drainage	-/0	+/0	<p>Run-off will result from the increased impervious surfaces of the proposed project.</p> <p>Due consideration should be taken on the surface drainage systems of the entire project and roof catchments installed.</p>
Soil erosion	- L sp	0	<p>Earthworks during construction will have an impact on soil erosion. During operation phase, soil erosion will not be a problem.</p>

			Incorporating appropriate soil conservation measures and proper drainage facilities during construction would mitigate the impacts.
Water resources	- sh	+	Water for construction purposes will be obtained from existing county water pipe lines. To take care of any shortages, the proponent will be expected to install water reservoirs on the roof of the building.
Vegetation/ Flora	- L, sp ir	+	There is no significant vegetation on site Landscaping will be done within the site to improve site appearance. During operation, any impact on vegetation/ flora will be negligible.
Health and Safety	- t ir	NC	During construction, increased dust, noise and air pollution levels could impact on health and safety, particularly in the direct impact zone. During the operation of the project no major health and safety effects will be expected.
Disturbance of the public	- t ir sp	-	Disturbance to the public/neighbours would occur due to noise and dust during construction and traffic movement. After construction, noise levels compared to the current situation will be negligible.
Visual intrusion	- t/p	+/- p	During construction, visual intrusion is attributed to construction works including construction traffic.

			<p>After construction of the project, the situation will be permanent. In line with this, the proposed project should be blend in a way to merge with the existing environment and approvals by the local council.</p> <p>Visual impacts can be mitigated through controlling the operating hours of construction traffic, clearing debris after construction and landscaping the site.</p>
Construction materials	-	0	<p>Building stones, sand and ballast will be required for the construction of the project. Other materials will include steel, cement, timber, plumbing materials etc. All these should be sourced from credible commercial suppliers who are sensitive to the general environment.</p> <p>Undesirable, hazardous or unauthorized materials will not be used</p>
Construction waste	- sh sp	0	<p>Construction waste will be minimal. Proper disposal of wastes generated is necessary; the waste should be disposed into the approved dumpsites, by licensed waste handlers.</p>
Clean on completion	- sp	0	<p>The contractor should ensure that when works are completed, the site is left clean and tidy.</p>
Positive impacts	++, t	++, L	<p>Construction activities will create jobs for skilled and non-skilled workers.</p> <p>Job opportunities for skilled and non-skilled personnel during operation phase i.e. more engineers, masons and technicians and others who will be working on the project</p>

5.2 .1 Direct and Indirect Effects

Employment and Income

The facility will create employment opportunities both during construction and operation phases, thus generating wealth and livelihoods. Besides the direct employment, other forms of

employment are likely to result from the multiplier effects, such as increased urbanization, local markets for providing goods and services during both the implementation and operational phases.

Impacts of Construction Activities

During the construction phase, sources of negative environmental impacts will emanate from the site preparation activities including excavation of soils, and other geological formations, levelling of landscape and the subsequent construction activities.

The above activities will have varying negative impacts on the biophysical environment. Immediate negative impacts will include the subsequent disturbance of the exposed topsoil, which could lead to soil erosion and siltation. The combined effect of site preparation and construction activities on the site can lead to potential soil erosion problems. Development on the transformed site may lead to continued soil loss especially during construction period when the ground is exposed. Soil wash out by the rains can lead to considerable ecological consequences. This is however not expected at the site.

In addition, there may be negative impacts related to visual intrusion, pollution, and negative socio-economic effects (including safety and health hazards) among other negative impacts if safe construction procedures are not followed.

5.2.2 Economic effects: Short-Term and Long –Term Effects

Utility of the site

The proposed development shall increase the value of the plot in which the project will be situated because it will entail construction of the operation space for the plot and hence exercising the full value of the area.

5.2.3 Products, By-Products and Waste generated by the Project

Products, By-products and Waste generated during Project Construction

During the construction phase of the project, it is envisaged that the following products, by-products and waste will be generated:

- Dust emissions arising from excavation works of the proposed project site as well as emissions arising out of various construction activities, for example, VOCs from construction machinery and equipment,
- Timber, polythene sheeting and nails arising from the formwork that will be used to contain various concreting activities, empty cement bags, wet gunny bags (used for curing concrete) etc.
- Fugitive oil spills arising out of improperly serviced trucks and construction equipment.
- Human effluent emanating from construction workers on the proposed site.

Products, By-Products and Waste generated during Operations.

Once the site is operational; products, by-products and waste generated shall mainly be household wastes that will be produced from the operations of the various houses. Approved waste handlers will be collecting the household wastes regularly for appropriate disposal in the approved dumpsites.

CHAPTER SIX

6.0 ISSUES OF CONCERN AND MITIGATION MEASURES

This part includes impacts during implementation/construction phase, operation phase and decommissioning phase on the following issues: *soil degradation; air quality; noise; oil wastes; water resources; solid and liquid waste management; drainage, terrestrial ecology, visual and landscape; traffic; public comfort; occupational health and safety (OHS); and energy*. Most of these key issues were identified during the scoping exercise and are clearly elaborated as follow:

6.1 Noise and Vibration

Noise is unwanted/undesirable sound that can affect job performance, safety, and health. Psychological effects of noise include annoyance and disruption of concentration. Physical effects include loss of hearing, pain, nausea, and interference with communications when the exposure is severe.

Relatively high noise levels are expected in the area during the construction phase. Noise control measures should be implemented in the construction area if the noise levels exceed 90dB (A) for a continuous 8 hours exposure as per the requirements of the Noise Prevention Control and Prevention Rules, 2005 a subsidiary legislation to the Occupational Safety & Health Act, 2007. In addition, protection against the effect of the noise exposure among the workers should be effected.

The noise produced by the construction works may be a nuisance to the neighbours. This will however not have serious effects as the construction works will be done during the day when most of the neighbours are not in their houses.

Potential Mitigation Measures

- Construction work should be carried out during the specified time i.e. from 0730 hrs. to 1700hrs; noise generated during the day is not quite disturbing as compared to it being generated at night hours
- Sensitize construction vehicles' drivers and machinery operators to switch off engines of vehicles when not in use.

- Workers should be provided with relevant Personal Protective Equipment (PPE)/ materials such as earmuffs and earplugs; when operating noisy machinery and when in noisy environment. These provide a physical barrier that reduces inner ear noise levels and prevent hearing loss from occurring
- Installing Suppressors or silencers (acoustic cladding) on equipment or noise shields; for instance, corrugated iron sheet structures should be put around the proposed project site (acoustic fencing).
- Machinery should be maintained regularly to reduce noise resulting from friction.
- Provision of billboards at the construction site notifying of the construction activity and timings.
- Manual labour is recommended in the construction phase where applicable, to reduce the noise emitted by construction machinery.

6.2 Soil Erosion

Soil movement is common in construction projects. This mostly happens during the laying of foundations (earthworks) for the projects and site clearing. Most top loose material is excavated and transported elsewhere. There will be some soil disturbance which would expose and set the soils loose to the agents of soil erosion. The excavated soil may be used for backfilling of quarry pits. Comprehensive soil erosion measures are thus important during the construction and operation phases:

Potential Mitigation Measures

- Provision of soil conservation structures on erosion prone areas to control occurrence of soil movement.
- Avoid unnecessary movement of soil materials from the site.
- Good management of the runoff/storm water to reduce its impact on loose soil
- Control construction activities especially during rainy / wet conditions
- Landscaping: Re-surface open areas on completion of the project and introduce appropriate vegetation where applicable.
- Provide appropriate drainage systems to manage surface runoff.

6.3 Increased Water Demand

Water is a universal resource and whose demand in the urban areas is high. The increase in demand for water will occur during the construction phase as well as during operation since some of the activities will require use of large quantities of water. The area is served with public water supply networks, from the Machakos county government. In addition the proponent has proposed to drill boreholes to supplement the county water supply. This will form the main source of water during both the construction and operation phases of the project.

Potential Mitigation Measures

- Encourage water reuse/recycling mostly during construction phase and for the long run during occupation phase.
- Ensure additional water conservation measures including rain water harvesting, storage, and reuse/recycling
- Provide notices and information signs i.e. 'keep/leave the tap closed', etc. This will awaken the civic consciousness with regard to water usage and management
- Install water-conserving taps that turn-off automatically when water is not in use.

6.4 Air Quality

The construction activities on the site will result to increased dust and gaseous pollutants emissions. Construction machinery and trucks generate hazardous exhaust fumes such as Carbon Oxides (CO_x), Sulphur Oxides (SO_x), Nitrogen Oxides (NO_x) and Volatile Organic compounds (VOCs). Particulate matter (dust) would be generated by such activities as concrete mixing, grading, excavation and the movement of construction vehicles. It is not possible to accurately estimate the particulate concentration that might occur at the site because it is dependent on meteorological conditions and soil moisture.

Vehicular/ equipment engine exhaust emissions and particulate matter generation will be temporary during construction. The project will generate significant vehicle trips to the area, especially private cars, during project occupation phase. Therefore, it is expected to have a minor incremental/cumulative impact locally and regionally.

Potential Mitigation Measures

- Provide Personal Protective Equipment (PPEs) such as nose masks, goggles, overalls etc. to the affected workers on site during construction phase

- Regular and prompt maintenance of construction machinery and equipment. This will minimize generation of noxious gases and other suspended particulate matter
- Control over areas with exposed soil surfaces. Such areas should be regularly cleaned or sprinkled with water, preferably twice each day during dry weather to reduce dust generation. The areas can be enclosed to mitigate effects of wind blowing the loose soil and hence dust generation.
- Vehicle speeds in the construction area will be limited to minimize dust generation in the area.
- Discourage idling of vehicles i.e. vehicle and equipment will be turned off when not in direct use to reduce exhaust emissions.
- The management will sensitize the employees on sound environmental management
- Workers should be trained to understand the hazards that may be generated in such work environments

6.5 Oil Leaks and Spills

Oil/grease spills are noted to be prevalent in construction sites; and in most areas that make use of petroleum products. Such products contain detrimental elements to the environment since they contain traces of heavy metals such as mercury, lead and sulphur among others. Though this may not be common at the site, it is wise to control and observe the little that could occur especially during maintenance of the involved machinery.

Potential Mitigation Measures

- All construction machinery should be keenly observed not to leak oils on the ground. This can be done through regular maintenance of the machinery.
- Any maintenance work should be carried out in a designated area (protected service bays) and where oils spills are completely restrained from reaching the ground. Such areas should be covered to avoid storm water from carrying away oils into the soil.
- Car wash areas and other places handling oil activities within the site should be well managed and the drains from these areas controlled. Oil interceptors should be installed along the drainage channels leading from such areas.
- Develop a spill prevention and control plan to counter and manage emergencies that may occur/arise in the event of accidental spills

6.6 Waste Management

6.1 Wastewater management during construction and operational phase

Wastewater from washrooms, washings should be channelled to wastewater treatment and recycling plant before final discharge to public sewer by strictly following water quality regulation 2006, 5th schedule. Hence proponent will acquire technologies illustrated below.

Process flow of domestic wastewater treatment plant

The latest art of Technology by Nature Systems Kenya Limited is based on a patented submerged fixed-film aeration system – a proven technology over the last 40 years – that ensures COD reduction, de-nitrification and removal of pathogens from the effluent. The Plant is designed to be simple and automated – the only moving parts are the pumps ensuring low maintenance and ease of operation. All materials used are non-corrosive – being reinforced PVC / PLASTIC and Stainless Steel. The Plant produces low noise levels.

The source of raw sewage will come from 8,888 residential units and it will be design to cater for population of exceeding of 20,000 persons.

The WWTP consist of:

i. SEPTIC TANK.

Submersible Grinder Pump located in the last chamber of the septic tank, these are operated on an alternate standby / duty operation.

ii. The Bioreactor Process

The Bioreactors are built into concrete or PVC tanks depending on client's need and consist as follows:

- Specialized Fixed Film Media held in a “MATRIX CAGE”
- **Whale Tooth Assemblies'** each with a aeration Pumps

Bioreactor contains specialist Fixed Film Media. This Media provides a large surface area for the attachment of Aerobic Bacteria that digests the biological loading in the effluent coming from the Septic Tank. In each Bioreactor the loading of COD on the Media is calculated as less than 2700mg COD per cubic meter of media. The Bioreactors are serviced by aeration pumps delivering oxygen to the Bioreactor via a Venturi and Whale Tooth Assembly.

iii. Clarifiers and Sludge Removal

At the Discharge Points of the Bioreactors, the now treated effluent flows by high level gravity feed into an Clarifier tank. There is minimal Sludge Production due to the Fixed-Film Treatment Process. However the small quantity of nitrates and dead bacteria that does flow over from the Bioreactors with the treated effluent settles into a sump in the base of the Clarifier. This sludge is returned from this sump to the first chamber of the Balancing Tank System periodically (about once every 24 hours for thirty minute duration) via a desludge Pump operated on an automated timer circuit

iv. Chlorine Disinfection System

After the Clarifier and before the Entry Point of the Contact Tank, the treated effluent flows through a specialist Chlorine Dosage Pump Disinfectant Unit.

v. The Contact Tank

A high level gravity feed delivers the treated effluent from the Clarifier into Clean Water Contact Tanks. The Contact Tanks clean water discharge will feed to the irrigation of lawns , washrooms and final effluent to the public sewer line of Mavoko Sewerage and water company.

4.2 Mains Power Supply to the Nature Systems WWTP

A three Phase power will need to be delivered to the Electrical Distribution Board (DB) at the Nature Systems WWTP to power the plant.

N/B Find attached typical design of waste water treatment plant

6.2 Solid waste

Huge quantities of solid wastes are normally generated from construction activities. Such wastes include stones, wood, broken glasses, containers, rods of metal, pieces of iron sheets etc. There is need for proper management (proper disposal) of the solid wastes expected from the site during construction phase. However, during operation by-products and waste generated shall mainly be household wastes. The proponent will be expected to design and institute appropriate measures for the collection and disposal of the various wastes produced by their operations.

Potential Mitigation Measures

- The contractor or proponent should work hand in hand with private refuse handlers, NEMA and the Machakos County Government to facilitate sound waste handling and disposal from site.
- All solid wastes should be taken for disposal to the approved dumpsites and by licenced waste handlers.
- The wastes should be properly segregated and separated to encourage recycling of some useful waste materials i.e. some demolished and excavated materials will be used as backfills.
- Proper dustbins should be provided and the occupiers of the various houses should make arrangements on proper disposal of wastes during operation.

6.7 Ecological impacts

The proposed site is covered by grass and isolated shrubs. The region is relatively dry hence limited vegetation growth is supported and one has to plant and water the vegetation to promote their growth. The proponent intends to clear this grass to create room for the development. It is however prudent to consider introduction of vegetation (landscaping plants) on site as part of environmental conservation initiative during the operation phase.

Potential Mitigation Measures

- Landscaping: After completion of the project the proponent will rehabilitate the land by planting trees and ornamental flowers on the disturbed areas.
- Project construction will disturb as little area as possible in order to minimize potential impacts to biodiversity: vegetation cover that does not interfere with the sitting of the project will be left intact.
- Plant vegetation in all practical open areas on project completion.
- Manage the introduced vegetation on completion of the development to restore or improve the site.
- During the decommissioning stage the proponent shall rehabilitate the land by removing any unnecessary materials that shall be covering land and protecting the natural biodiversity

6.8 Occupational Health and Safety (OHS)

During construction there will be increased dust, air and noise pollution. These are considered as negative impacts as they significantly lower the quality of environment.

Potential Mitigation Measures

- Capacity building and training of staff/workers with respect to Occupational Health, Safety and Environment. Provide safety measures for personnel, Personal Protective equipment (PPE) – safety gear as per Health and Safety and Welfare – Special Provisions and Rules Regulations; conduct medical examination of workers as required by the Medical Examinations Rules of 2005 under the Occupational Safety and Health Act, 2007, for occupations covered under Schedule II of the act. Construction works fall under this schedule II and therefore all workers should undergo the medical examinations.
- A first aid kit should be provided within the site and should be fully equipped (as per sec. 2 of the First Aid Rules, 1977) at all times and managed by qualified and trained first aider(s).
- The contractor/proponent should initiate and develop effective Emergency Response Plans-ERPs to cater for various eventualities such as fire outbreaks, oil spills and other incidences that are likely to occur.
- Proper documented possible action plans (ERPs) need to be put in place in case of any incidences occurring.
- Where the workforce exceeds 20, the contractor should facilitate formation of a Safety and Health Committee, in accordance with the Safety and Health Committees Rules, 2004. The safety and health committee should be adequately trained on Occupational Safety and Health in line with sec. 12 of the Safety and Health Committee Rules, 2004 and be appraised on their functions as stipulated under sec. 6 of the Safety and Health Committee Rules, 2004.
- The contractor should obtain a certificate of registration of Building or Construction from DOHSS.
- Appropriate abstracts should be displayed at strategic location including, the Workplaces Act, and Building Operations and Works of Engineering Construction, Rules, 1984.

6.9 Public disturbance

Construction disturbances result from noise, lighting etc. Such disturbances result to stress and other body reactions.

There may occur disturbances, which are likely to cause stress and other similar effects mostly during project implementation processes due to continued vibrations and noise generated by heavy trucks and machinery.

Potential Mitigation Measures

- Construction activities should be done only during the day
- Erect billboards on the start of the project to psychologically prepare the people in the vicinity
- The signs should indicate and inform the public when works starts and when it will be completed. Such information should be made clear for the interest of the motorists along the connecting roads

6.10 Security

Security is a necessity for any development since it ensures that all planned activities run smoothly without any loss of construction materials especially during the construction phase. It (security) controls movement within the site especially for the intruders who might be injured by the materials and other hazardous features in the construction site. The area is well covered by communication networks and this to a great extent facilitates security in the area.

Potential Mitigation Measures

- Security should be beefed-up and movement within the site should be controlled
- Provide lighting systems that illuminate the area well. Security alarms should be installed in strategic points all over the site area after completion of the project.
- Contractor should provide adequate security during the construction period when there is no work going on at the site. E.g. during the night and weekends
- Ensure that the access gate is manned (24hrs) by qualified security personnel.

6.11 Fire hazards and Fighting

There are some operations that may pose a risk to fire occurrences at the construction site and even during the operational period. These occurrences may arise during the construction phase

but more in the operation phase since there will be extensive use of electricity in the various houses which are likely to cause Class C Fires. It should therefore be ensured that all operations during construction and operation phases are in tandem with the Fire Risk Reduction Rules, 2007.

Potential Mitigation Measures

- Install an automatic fire alarm system for the entire project mostly on operation.
- Install fire fighting equipment as approved by the County Council.
- All fire control and fighting facilities to be installed as per the requirements stipulated in the approved plans.

In addition to the above, the project management should consider the following:-

- Conduct regular fire drills/simulations to sensitize workers during construction phase.
- Adapt an emergency response plan for the entire project during operational phase.
- Ensure that all fire fighting equipment are strategically positioned, regularly maintained and serviced.
- Provisions of marked fire exits and ensure that all fire exits are unobstructed at all times.
- The proponent to put up a trained fire fighting team in accordance with the sec. 20& 21 of the Fire Risk Reduction Rules, 2007.

6.12 Traffic density

The proposed project will come along with increased (vehicle) traffic along the adjacent road networks and mostly during construction phase.

Potential Mitigation Measures

- Notify the motorists about the proposed development once implementation is started. It is important that warning/informative signs (billboards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed. The signs should be positioned in a way to be easily viewed by the public and mostly motorists.
- The traffic along connecting routes should be controlled especially during construction phase and mostly when large trucks are turning into the site, say for delivery of materials

6.13 CONSTRUCTION SAFETY

Introduction

This section provides general guidelines and procedures for construction safety during project implementation process.

General Construction Guidelines

Construction work can be particularly hazardous. Personal Protective Equipment, fire safety, electrical safety, and other precautions are essential for safe construction work.

Follow these guidelines when visiting or working at construction sites:

- Do not walk, stand, or work under suspended loads. If you raise a load, be sure to crib, block, or otherwise secure the load as soon as possible.
- Avoid placing unusual strain on equipment or materials.
- Be prepared for unexpected hazards. BE ALERT!

Barriers and Guards

Contractors and project managers should use barriers and guards as necessary to protect employees, and visitors from physical hazards. If any person identifies a mechanical hazard that is not sufficiently protected, s/he should notify the attending supervisors, the Health and Safety Advisor or the *DOHSS office* immediately.

NOTE: Barriers, guards, and warning signs are required to ensure safety against existing hazards.

Types of Barriers and Guards

- Physical barriers and solid separators (dust barriers, hazard barriers, temporary walkways, etc.)

NOTE:

- Signs that state DANGER, WARNING, or CAUTION are also important when barriers or guards are necessary.
- Remember to make signs legible, visible, and brief.

Areas that Need Barriers or Guards

Any area that poses a physical threat to workers and/or pedestrians requires barriers or guards.

Areas that typically require permanent or temporary protection include the following:

- Stairways,
- Open Manholes,
- Elevated platforms,
- Areas with moving machinery,

- Excavation sites,
- Construction sites,
- Temporary wall or floor openings,
- Doors opening into construction
- Balcony

6. 14 Summary of Positive Impacts of the Proposed Project

The proposed development will have positive impacts to the society and the environment in general. Some of benefits include the following:

- Through construction of the proposed development, the project will ensure optimal use of the land to the great benefit of the country and its people with land being a scarce resource in Kenya
- Improvement of local and national modern property standards
- Economic-investment for the proponent who will earn some income or save on spent capital from renting the residential units.
- Creation of market for goods and services and especially construction inputs which include raw materials, construction machinery and labor. Secondary businesses are also likely to spring up during the construction phase especially those providing foods and beverages to the construction workers.
- Increase in national housing stock
- Improved security in the area
- Massive job opportunities for Kenyans both during planning, construction and operational phases. They include building contractors, architectures, structural engineers, mechanical engineers, surveyors, environmentalists, security agents, transporters, construction workers, site managers and foremen.
- Increase in revenue for the government; from processing of the building plans to the County council and through annual rates.
- The project will act as flagship towards the fulfillment of vision 2030
- Provision of employment during construction phase and operational phase

6.15 Summary of Negative Impacts of the proposed Project

Against the background of the above positive impacts, there are a few negative drawbacks that are anticipated mostly during the construction of the project. They include the following:

- Loss of biodiversity from the project site which has a some trees and patches of grass
- Waste water management and disposal
- Increased water demand
- Increased power demand
- Solid waste management
- Oil spills during construction
- Dust emissions
- Accessibility to the existing road network
- Soil compaction, erosion and pollution
- Noise and vibrations
- Population density increase
- Increased traffic, both vehicular and human, along the nearby roads
- Air pollution during construction.
- Health and safety for the workers during construction phase

6.16 Summary of the Mitigation Measures

One of the objectives of the environmental assessment has been to identify measures to be taken by the proponent to mitigate environmental impacts. These will include:

- A code of practice to minimize construction noise, vibration dust and disturbance of the site.
- Planting of trees, and wild flowers to supplement the ground cover on the excavated area.
- Application of soil conservation measures to reduce surface runoff during wet seasons and especially during construction phase.
- Recovery of all debris generated and reuse of materials where possible e.g. the stone chippings which can be used as hardcore.
- Recycling and reuse of appropriate materials.
- Provision of security measures to deter intruders and protect them from the risk of injury; and fitting of noise mufflers on generator exhausts.

- Installation of oil/diesel separators on site especially where there is storage of machinery or petroleum products etc. to keep oils from storm runoff.
- Predetermined route to the site, oil spillages will be minimized by using right machinery that are regularly serviced and operators who are qualified following the operations instructions strictly.
- The contractor will ensure management of excavation activities, if any- the activities will be controlled especially if construction will take place during rainy season.
- After construction the proponent shall rehabilitate the land by removing any unnecessary materials that shall be covering the land and preventing natural biodiversity.
- To minimize potential impacts to bio diversity, grass cover that does not interfere with the sitting of the project will be left intact,
- Sensitize drivers of construction machinery on effects of noise; billboards will be suitably erected on the start of the project to psychologically prepare the people in the vicinity.
- Signs must indicate and inform the public when the works start and when it will be completed, construction activities to be restricted to daytime to avoid accidents and possible harm to gears provide barriers such as walls around site boundaries to provide some buffer against noise propagation.
- Vehicle speeds in the construction area will be limited to minimize dust in the area, discourage idling of vehicles i.e. vehicle and equipment engines will be turned off when not in direct use to reduce exhaust emissions.
- Regular maintenance of construction plant and equipment, engage sensitive construction workers.
- Provide personal protective Equipment such as nose masks to the workers on site, the construction contractor will water the site with exposed soil surface twice each day during dry weather.
- All residual waste materials to be recycled sold or disposed in an environmentally friendly manner. Wastes will be properly segregated and separated to encourage recycling of some useful wastes; dustbins will be provided at the construction site.
- A first aid kit will be provided within the site and it will be fully equipped at all times.

- Sanitary facilities will be provided, local individuals preparing food for the workers at the site will be controlled to ensure that food is hygienically prepared
- Construction crew at the site will be sensitized on social issues such as drugs, alcohol, diseases, ensuring proper solid waste disposal and collection facilities, ensure effective waste water management.
- Provision of safe drinking water, contractor to take an insurance cover for workers in case of major accidents on site.
- Unauthorized persons will be restricted from construction site, enforce speed limits for construction vehicles especially along roads leading to the site, provide bill boards at the site/entrance to notify motorists about the development, put up warning signs like “speed limit 10kph”, “heavy vehicles” etc.
- For the prevention of accidents the contractor shall adhere to the guidelines under the factories and other places of work act.

MATERIALS TO BE USED, PRODUCTS AND BY PRODUCTS INCLUDING WASTE TO BE GENERATED BY THE PROJECT AND THE METHOD OF DISPOSAL

A Table for Waste generated and disposal methods

Project phase	Material to be used	Waste/by products generated	Disposal method
Excavation/Earthwork	-Excavating equipments	-Soil -Foliage -Grass -Tree stumps and Roots	-Reused for landscaping and lawns. Excess soil to be disposed at designated areas. -Cut foliage and grass to be composted for garden manure. -Tree stumps and roots to be used as fuel.
Transportation of materials & maintenance of equipments	-Trucks -Fuel -Spare parts and lubricants/oil	-Used oil -Air fumes	-Used oil to be reused for lubricating movable parts of equipments e.g. wheelbarrows. -Minimize air fumes by use of well serviced trucks.
Building works	-Machine cut stones -Steel -Cement -Paving slabs -Timbers -Nails, galvanized iron sheets -Gravel, sand -Tiles -Anodized aluminum windows/doors -Glasses e.t.c	-Building debris -Used timber	-Reused for landscaping & filling. -Timbers reused for firewood or in other construction sites etc. -Other materials like glass and metals to be reused or resold.
Electrical & mechanical installations	-Electrical gadgets (Pipes, switches, electrical wire, lamps etc) -Plumping gadgets, water storage tanks.	-Accidental breakage's and unusable parts	-Contractors to dispose appropriately at their sites.
Occupation	-Household materials	-solid waste (e.g. food	-Contracted licensed refuse handlers.

Project phase	Material to be used	Waste/by products generated	Disposal method
		particles, sweepings, washings).	-will be channel to septic tank
Decommissioning (but not in the near future)	-Demolishing equipments	-Building debris	-Reused on the new site or sold to second hand dealers.

The main materials to be used in this project include machine cut stones, steel, roofing sheet, pavement slabs, timbers, locks, window glasses, pipes, paints etc.

CHAPTER SEVEN

7.0 PUBLIC PARTICIPATION - SOCIAL IMPACT ASSESSMENT

Public participation enables evaluation of the public and neighbours views. It is an important part of the EIA as it helps identify various concerns, which should be addressed at the initial stages of project implementation processes.

For the subject project, a public baraza, questionnaires and interviews were used to collect the views of the various stakeholders and neighbours. Majority of the respondents indicated that they had no problem with the project in the area so long as the proposed works are contained within the designated plot boundaries.

The people consulted generally welcomed the proposed project saying it will provide more job opportunities to the youth both during construction and operational phases of the project.

Occupational health and safety of the workers and the public including the issue of traffic on the access road especially during construction should be keenly observed. They recommended that adequate fire safety, electrical safety, machinery safety, personal protective equipment and general welfare measures be adopted due to the nature of operations and implement within the facility sound solid and liquid wastes management systems.

Neighbours within the projects vicinity welcomed the idea saying that it will multiply customers. Other advantages mentioned include creation of employment (during construction, operation and maintenance activities), and promotion of development in the area.

All the issues raised and many other foreseeable impacts have been adequately addressed in this report and in the EMP.

Attached in the appendices are:

- Minutes and photographic report of the public baraza
- Filled in questionnaires

CHAPTER EIGHT

8.0 PLANS TO ENSURE THE HEALTH AND SAFETY OF WORKERS AND NEIGHBOURING COMMUNITIES

Noise

There will be noise generated during the construction phase but it will be no different from the noise generated on any other typical construction site. Noise will be generated from powered mechanical equipment, concrete mixers, grinders, excavators and the movement of construction vehicles to and from the site.

Mitigation measures:-

- Workers are expected to wear protective gear including earplugs when operating noisy equipment.
- The consultants and contractors are requested to guarantee that the works are carried out in a proper manner and planning so as to minimize the impact of the construction in terms of noise.
- Ensure equipment are well maintained to avoid unnecessary noise.
- Post notices at the construction site gates informing of construction activity.
- No construction activity at night.
- Liaise closely with neighboring communities and resolve any conflict that may arise.

Air Quality

The proposed development is not expected to emit fumes, dust or odors that would affect the current air quality of the area. However fumes (nitrogen oxides {NO_x} and Sulphur oxides {SO_x}) generated from vehicles could be a major source of air pollutants, although it is not likely to cause any significant impact on the local air quality. It is however unlikely that, during the construction phase, both the infrastructure and the building works might induce fumes and dust.

Mitigation measures:-

- Masks to be provided to all personnel in dust generation areas throughout the period of construction.
- The consultants and contractors are requested to guarantee that the works are carried out in a proper manner so as to minimize the impact of the construction on the air quality.
- Any stockpiles of earth should be enclosed, covered or watered during dry or windy conditions to reduce dust emissions.
- Proper maintenance of construction vehicles to minimize on air pollution.
- Use of environmental friendly fuel i.e. low Sulphur diesel/unleaded petrol.

Road Safety

Traffic will need to be controlled during construction especially with heavy vehicles turning and by enforcing speed limits for construction vehicles.

Disturbance to the Public

Noise disturbance to the public would occur during construction works including construction traffic. After construction, the impact of noise will be insignificant.

- Warning/informative signs should be erected when construction works are about to begin.
- Construction activities should not be carried out at night.
- Liaise closely with the neighbouring communities and resolve adequately any issues of concerns that may arise.

Public Health and Occupational Safety

During construction there will be increased dust, noise and air pollution levels, which are considered to be negative impacts, although for the public at large this would be minor. The workforce would be more exposed to these hazards.

- Contractor should provide pre-prepared food to the workmen. There should be no cooking on site.
- Workmen should be provided with suitable protective gear (such as nose masks, ear plugs/muffs, helmets, overalls, industrial boots, etc.), and there should be a fully equipped first aid kit on site.
- The contractor must have workmen's compensation cover. The contractor is required to comply with the Workmen's Compensation Act, as well as other relevant Ordinances, Regulations and Union Agreements.
- There should be provision for make shift toilets to be used by the work force during construction phase.
- The contractor should ensure that the employees have access to safe drinking water.

CHAPTER NINE

9.0 PROJECT ALTERNATIVES

The No Action Alternative

This alternative represents the situation that would result if the project were not implemented. Under this option, the proponent's proposal would not receive the anticipated approval from NEMA and the proponent will not be able to undertake the development.

The socio-economic impacts resulting from the site activities will not be realized. The economic benefits during implementation i.e. market for materials, provision of jobs for skilled and non-skilled workers will not be realized and there will be no generation of income. The anticipated better living space and localized economic development may not be realized.

On the other hand, the anticipated small-scale environmental impacts resulting from construction, and operation activities would not occur.

This option is however not viable for the proponent, the government, and the county authority.

Alternative materials and technology

Several alternatives were considered for this project, based on the need for sustainable and environment friendly implementation and operation of development projects. The project should be developed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental requirements. Equipment that saves energy and water should be given first priority without compromising on cost or availability. A proper landscaping and tree planting system should be adopted to ensure that all vegetation removed and landscapes distorted are restored.

An integrated solid waste management system is recommended. This should give priority to reduction at source of the materials, recycling, reuse and composting of the waste. This will call for separation at source programme to be put in place. The waste should be collected by a NEMA licensed firm.

Comparison of Alternatives

Undertaking the project would provide all the benefits (social, economic and infrastructure development), which is crucial to spur socio-economic development for the County and Kenya at large. This would also provide employment directly and indirectly to the Kenyan population. It would provide jobs for the workers during implementation. After completion, more jobs would be generated for manual workers, such as cleaners, guards and caretakers, technicians and Masons among others.

The use of materials and technologies that promote sound environmental management both for the implementation and operation phases offers the best alternative, and therefore this alternative will be adopted for the project.

The proponent has invested heavily on the use of alternative and environmentally friendly technologies, materials and processes for this project. These include:

- Use of renewal energy (solar) for supply of power during occupational phase of the project;
- Recycling and reuse of waste water, including pre-treatment; this will not only cut on the amount of water used in the project, but will also reduce the amount of wastewater discharged in to the sewer line.
- The proposal to extract ground water through boreholes for the project will reduce on the potential increased demand on the county water supply network. This will mitigate against increased demand for water resources associated with such development projects.

Proposed technologies to be used in construction of the proposed 8,888 residential units

Construction industry includes a wide range of constructions suitable for all classes of society. Commercial construction, domestic construction, industrial construction, heavy or civil constructions are a few examples that are now displaying master pieces of construction technologies. Each of these requires different technological treatments. For domestic construction, simple technological methods are usually preferred and frequently available materials are mostly

used. These are mostly low cost projects and are also short-term. In commercial construction, the basic concern is infrastructure that is responsible for strength and life of project

Proponent should embrace alternative technologies to cut costs and maximize the returns while still maintaining quality standards by applied is the expandable polystyrene system (EPS), which could replace the traditional brick-and-mortar process

An inert material, expandable polystyrene (EPS) does not rot. It has no nutritional benefits to vermin and thus does not attract pests such as rats and termites, making the building more durable. The technology is popular in Italy, United Arab Emirates, Indonesia, Malaysia, Mexico, Iran, Jamaica, Panama, Romania, Venezuela and South Africa, and is being introduced in Kenya by the National Housing Corporation among other firms.

E.g. an example of expandable polystyrene system (EPS) in use (source for internet Google EPS website)



6.8 Materials for proposed 8,888 residential units project construction

a) Styrofoam Panels

Styrofoam panels are actually EPS foam that is sealed between steel sheets for strength and this foam works as thermal resistor. It not only has heat resistance but also has capacity to endure the wind speed up to 140 mph. This makes it favorable in the areas targeted by hurricane. As it laminates the foam in steel sheets that make it safer from termites, as they can't invade steel sheets. The durability and strength of Styrofoam make buildings long lasting and cleaner than buildings constructed with other materials. Use of new technology in construction endows with comfortable buildings for housing sector.

b) Unbounded PT Slabs

These are affordable for constructing modern buildings and are also considered reliable for their quality and strength. Their steel strands are greased well to resist rusting that increase their age. The unbounded PT slabs are light weight and flexible due to small thickness of its unbounded tendon. Due to this reason, unbounded PT slab patterns are able to make best use of complete strength of a concrete slab. These are successfully used at different places such as on roofs, pavements, and even in the round water tanks.

c) Electrical systems and equipment

- AC power plugs and sockets
- Circuit breaker
- Electrical connector
- Electrical wiring

d) Surface finishing

- Plaster & gypsum board
- Cement render
- Ceramic tile, quarry tile, pavers, mosaic
- Dropped ceiling, coffered ceiling
- Flooring – wide plank, terrazzo, carpet
- Marble
- Wall covering, wallpaper, acoustic
- Paint, wood stain, faux finishing
- Staff – a type of artificial stone
- Stucco

e) Other Materials

- Machine cut stones, Steel, Cement, Paving slabs
- Timbers, metals, Nails, galvanized iron sheets

- Gravel, sand ,timber, Tiles,
- Electrical gadgets(Pipes, switches, electrical wire, lamps etc)
- Plumping gadgets, water storage tanks.
- Anodized aluminum windows/doors
- Glasses e.t.c.

Conclusion:

After considering various options, it was evident that it was important to consider interest of proponent and general development for the trade and employment issues. As a result the last option would be construction of the industrial warehouses at the proposed site.

CHAPTER TEN

10.0 ENVIRONMENTAL AND SOCIAL IMPACTS MITIGATION/MANAGEMENT PLAN

10.0 Significance of EMP

EMP involves the protection, conservation and sustainable use of the various elements or components of the environment. The EMP for the proposed project provides all the details of project activities, impacts, mitigation measures, time schedules, costs, responsibilities and commitments proposed to minimize environmental impacts. The main activities include monitoring and evaluation and environmental audits during implementation and decommissioning phases of the project.

10.1 Environmental Monitoring and Audits

Environmental monitoring and audits are essential in projects life span as they are conducted to establish if project implementation has complied with set environmental management standards for Kenya as spelt out in EMCA 1999 and the Environmental Impact Assessment and Audit Regulations 2003. In this project, environmental monitoring and audit will be conducted to ensure that identified potential negative impacts are mitigated during the project's life span.

Table: Environmental Management Plan

Potential Impacts	Mitigation	Responsibility for mitigation	Monitoring plan	Frequency of monitoring
Workforce accidents by unsafe working practices during construction	Develop an EHS plan	Proponent/ Contractor	-Prepare an EHS manual for use during construction -Engage an EHS consultant during project construction	Reference documents
Solid waste during construction and occupancy	Contract a private waste handler	Occupants/ Proponent	Efficient disposal as per the permit/ contract	Daily
Storage of construction wastes and other solid waste materials	-Promote collection and sorting out of wastes -Contract a private waste handler	Project contractor	Compliance with EMCA and Local authority Act	Daily during construction
Physical environment destruction	-Avoid use of heavy machinery	Contractor	EMCA 1999	Daily during construction

	<ul style="list-style-type: none"> - Use water boozers to minimize dust pollution - Control earth works 			
Air, dust and noise pollution	<p>Control speed for vehicles and switching off idle machines</p> <ul style="list-style-type: none"> - Provide ear muffs to workers <p>Working only during daytime</p>	Contractor	Comply with EMCA and Public Health act	Daily during construction
Fire outbreaks	Install and maintain firefighting equipment and machinery	Proponent	Comply with EMCA and Fire inquiry Act - Invite fire safety inspectors	Every two months

Wastewater management during occupancy	-Construct adequate septic tanks. Exhaust regularly to avoid overflow -	Proponent/ Occupants	Comply with EMCA and Local government Act	During construction and occupation
Aesthetics of the site	- Landscaping - Tree planting	Proponent	Compliance with EMCA and NCC regulations	At the end of construction
Flooding Hazard	Construct storm water drainage system	Proponent/ Contractor	EMCA and Building codes	At the end of construction phase

Construction Phase EMP

Table 10.1: Environmental Management Plan during Construction Phase

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
1. Minimize extraction site impacts and ensure efficient use of raw materials in construction				
High Demand of Raw material	1. Source building materials from local suppliers who use environmentally friendly processes in their operations.	Proponent & Contractor	Throughout construction period	100,000,000
	2. Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered.	Proponent & Contractor	Throughout construction period	0
	3. Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.	Proponent & Contractor	Throughout construction period	0

	4. Use at least 5%-10% recycled, refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills	Proponent & Contractor	Throughout construction period	0
2. Reduce storm-water, runoff and soil erosion				
Increased storm water, runoff and soil erosion	1. Surface runoff and roof water shall be harvested and stored in underground reservoir for reuse.	Responsible Architect, and Proponent	2 months	90,000
	2. A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structure will be designed.	Responsible Architect, and Proponent		

3. Minimize solid waste generation and ensure efficient solid waste management during construction				
Increased solid waste generation	1. Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling.	Proponent & Contractor	Throughout construction period	50,000
	2. Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed, rather than cutting them to size, or having large quantities of residual materials.	Proponent & Contractor	One-off	
	3. Ensure that construction materials left over at the end of construction will	Proponent & Contractor	One-off	

	be used in other projects rather than being disposed of.			
	<p>4. Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects</p> <p>5. Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or home owners.</p>	Proponent & Contractor	One-off	
	6. Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time	Proponent & Contractor	Throughout construction period	

	<p>7. Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements</p>	<p>Proponent & Contractor</p>	<p>One-off</p>	
	<p>8. Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste</p>	<p>Proponent & Contractor</p>	<p>Throughout construction period</p>	

4. Reduce dust emissions				
Dust emission	1. Ensure strict enforcement of on-site speed limit regulations	Proponent & Contractor	Throughout construction period	0
	2. Avoid excavation works in extremely dry weathers	Proponent & Contractor	Throughout construction period	50,000 per month
	3. Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles	Proponent & Contractor	Throughout construction period	
	4. Personal Protective equipment to be worn	Proponent	Throughout construction period	
	5. construction materials on site to be covered to prevent to be blown off by wind	contractor	Throughout construction period	
5. Minimization of exhaust emissions				

Exhaust emission	1. Alternatively fuelled construction equipment shall be used where feasible equipment shall be properly tuned and maintained	Proponent & Contractor	Throughout construction period	0
	2. Vehicle idling time shall be minimized	Proponent & Contractor	Throughout construction period	0
	3. Sensitize truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off or keep vehicle engines at these points	Proponent & Contractor	Throughout construction period	0
6. Minimization of Noise and Vibration				
Noise and vibration	1. Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Proponent & Contractor	Throughout construction period	0

	<p>2. Sensitize construction drivers to avoid gunning of vehicle engines or unnecessary hooting especially when passing through sensitive areas such as churches, residential areas and schools</p>	<p>Proponent & Contractor</p>	<p>Throughout construction period</p>	<p>0</p>
	<p>3. Ensure that construction machinery are kept in good condition to reduce noise generation</p>	<p>Proponent & Contractor</p>	<p>Throughout construction period</p>	<p>200,000</p>
	<p>4. Ensure that all generators and heavy duty equipment are insulated or placed in enclosures to minimize ambient noise levels.</p>	<p>Proponent & Contractor</p>	<p>Throughout construction period</p>	<p>45,000</p>
	<p>5. The noisy construction works will entirely be planned to be during day time when most of the neighbors will be at work.</p>	<p>Proponent & all site foreman</p>	<p>Throughout construction period</p>	<p>0</p>
<p>7. Minimization of Energy Consumption</p>				

Increased energy consumption	1.Ensure electrical equipment, appliances and lights are switched off when not being used	Proponent & Contractor	Throughout construction period	0
	2. Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy	Proponent & Contractor	Throughout construction period	50,000
	3. Installation of solar modules for water heating, pumping and security lighting	Proponent & Contractor	Throughout construction period	50,000
8. Minimize water consumption and ensure more efficient and safe water use				
High Water Demand	1. Promptly detect and repair of water pipe and tank leaks	Proponent	Continuous	To be determined
	2. Ensure taps are not running when not in use	Proponent	Continuous	To be determined

	3. Install a discharge meter at water outlets to determine and monitor total water usage	Proponent	One-off	25,000
	4. Proper recycling of water from other uses for watering the flowers and sprinkling dusty pavements	Contractor	Continuous	30,000
9. Minimize occupational health and safety risks				
	<ul style="list-style-type: none"> Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises. 	Proponent	Continuous	60,000 Annually
		Contractor	On commencement	

	<ul style="list-style-type: none"> • Construction of a perimeter wall around the project area 			
Personal Protective Gear (PPG)	<ul style="list-style-type: none"> • Suitable overalls, safety footwear, dust masks, gas masks, respirators, gloves, ear protection equipment etc. should be made available and construction personnel must be trained to use the equipment 	Proponent & Contractor	Once off	80,000
Health and safety impacts	<ul style="list-style-type: none"> • Implement all necessary measures to ensure health and safety of workers and the general public during operation of the housing project as stipulated in OSHA, 2007 	Proponent	Continuous	

First Aid	<ul style="list-style-type: none"> Well stocked first aid box which is easily available and accessible should be provided within the premises 	Proponent & Contractor	One-off	150,000
	<ul style="list-style-type: none"> Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body. 	Proponent & Contractor	One-off	40,000
Fire protection	<ul style="list-style-type: none"> Firefighting equipment such as fire extinguishers should be provided at strategic locations such as stores and construction areas. 	Proponent & Contractor	One-off	50,000
		Proponent & Contractor	Every 3 months	60,000

	<ul style="list-style-type: none"> Regular inspection and servicing of the equipment must be undertaken by a reputable service provider and records of such inspections maintained 			
	<ul style="list-style-type: none"> Fire escape routes and assembly point to be marked 	Proponent & Contractor	Continuous	30,000
	<ul style="list-style-type: none"> Signs such as “NO SMOKING” must be prominently displayed within the premises, especially in parts where inflammable materials are stored 	Proponent & Contractor	One-off	20,000

10.2 Operational Phase EMP

The necessary mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the operational phase of the residential house project are outlined below.

Table 10.2: Environmental Management Plan for the Operation phase

Expected Negative impact	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
Minimization of solid waste generation and ensuring more efficient solid waste management				
Solid waste generation	1. Provide solid waste handling facilities such as waste bins and skips	Proponent/occupants	One-off	50,000
	2. Ensure that solid waste generated from units is regularly disposed of appropriately at authorized dumping sites	Proponent/occupants	Continuous	15,000/month

	3. Ensure that tenants of the rooms manage their waste efficiently through recycling, reuse and proper disposal procedures	Proponent/occupants	Continuous	-
	4. Donate redundant but serviceable equipment to charities and institutions	Proponent/occupants	Continuous	0
2. Minimize risks of sewage release into environment				
Sewage disposal	1. Provide adequate and safe means of handling sewage generated	Proponent & Contractor	One-off	30,000
	2. Conduct regular inspections for drainage pipe blockages or damages and fix appropriately	Proponent & Contractor	Continuous	12,000 per inspection

	<p>3. Ensure regular monitoring of the sewage discharged from the project to ensure that the stipulated sewage/effluent discharge rules and standards are not violated</p>	Proponent/occupants	Continuous	5,000/parameter
<p>3. Minimize energy consumption</p>				
<p>Energy Resource Utilization</p>	<p>1. Switch off electrical equipment, appliances and lights when not being used</p>	Proponent/occupants	Continuous	-
	<p>2. Install occupation sensing lighting at various locations such as storage areas which are not in use all the time</p>	Proponent/occupants	One-off	10-40 % higher than ordinary lighting

	3. Install energy saving fluorescent tubes at all lighting points within the flats instead of bulbs which consume higher electric energy	Proponent/occupants	One-off	10-40 % higher than ordinary lighting
	4. Monitor energy use during the operation of the project and set targets for efficient energy use	Proponent/occupants	Continuous	8,000/month
	5. Sensitize occupants to use energy efficiently	Proponent	Continuous	5,000/month
4. Minimize water consumption and ensure more efficient and safe water use				
Water consumption	1. Promptly detect and repair water pipe and tank leaks	Proponent/occupants	Continuous	5,000/month
	2. Occupant to conserve water e.g. by use water efficient toilet flushing system.	Proponent/occupants	Continuous	6,000/month

	3. Ensure taps are not running when not in use	Proponent/occupants	Continuous	1,000/month
	4. Install water conserving taps that turn-off automatically when water is not being used	Proponent	One-off	10-40 % higher than ordinary taps
	5. Install a discharge meter at water outlets to determine and monitor total water usage	Proponent	One-off	65,000
5. Minimization of health and safety impacts				
	1. Implement all necessary measures to ensure health and safety of the workers and the general public during operation of the residential building project as stipulated in OSHA, 2007	Proponent/occupants	Continuous	-
6. Ensure the general safety and security of the premises and surrounding areas				

	<p>1. Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises</p>	<p>Proponent/occupants</p>	<p>Continuous</p>	<p>250,000/month</p>

10.3 Decommissioning Phase

10.3.1 Introduction

Decommissioning is the last phase of project life. It involves terminating project activities and operations and rehabilitating site to or close to its original state. In construction and building industry, decommissioning of a building which is still under construction can be necessitated if part of the building collapses or is declared unsafe due to various reasons including poor workmanship. On the other hand if a building is already in use and is condemned and declared a safety hazard, then such a building has to be demolished. Further, natural calamities such as earthquakes and tremors may destabilize a building necessitating its demolition.

10.3.2 Components

This decommissioning plan presents a conceptual framework on how the proposed Residential Flat Development can be demolished if need arises and how the site can be rehabilitated to its original state or close to original state. The plan takes consideration on how materials and equipment in the Residential development can be handled, support infrastructure, and land on which the buildings will be standing on.

10.3.3 Disposal/Demolition of Residential house

If by any chance at one time their demolition is necessitated, it will require a lot of expertise to avoid environmental damage (air pollution, noise pollution), occupational hazards and loss of property. In making a decision on how to undertake the demolition the following should be considered: -

- The general public to be informed of demolition exercise well in advance by placing notices in public places concerning the intended demolition at least two weeks in advance;
- The Residential development must be sealed off from public access;
- The firm commissioned to demolish must have enough relevant machines and equipment such as high cranes, fleet of dumpers, dozers that will enable the work be undertaken smoothly and be completed within stipulated time;
- Adequate measures to be put in place to minimize environmental degradation;

- Site supervision from relevant Government Departments and County Government to be in place throughout the exercise;
- Waste materials resulting from demolished must be handled and disposed according to environmental requirements and procedures;
- Care must be taken to avoid destruction of trees and other vegetation on site during the exercise.

10.3.4 Support infrastructure on site

Support infrastructures such as water reservoirs, and sewage facilities should be handled with care.

The following should be taken into consideration: -

- If underground water reservoirs contain water, empty them first before demolition;
- Put temporally potable tanks on site to hold the water which can be used in dust arresting while demolition is on;
- Sewage management system facility must be emptied first; and
- Seek professional advice from on their decommissioning.

10.3.5 Decommissioning Phase

In addition to the mitigation measures provided in the table above, it is necessary to outline some basic mitigation measures that will be required to be undertaken once the building is earmarked for decommissioning. The necessary objectives, 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 residential house project are outlined below.

Recommended Mitigation Measures	Responsible Party	Time Frame
1. Demolition waste management		

<p>1. The building, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible</p>		
<p>2. All foundations must be removed and recycled, reused or disposed of at a licensed disposal site.</p>		<p>One-off</p>
<p>3. Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site</p>	<p>Contractor, Proponent</p>	<p>One-off</p>
<p>4. Donate reusable demolition waste to charitable organizations, individuals and institutions</p>	<p>Contractor, Proponent</p>	<p>One-off</p>
<p>2. Rehabilitation of project site</p>		
<p>1. Implement an appropriate vegetation Programme to restore the site to its original status</p>	<p>Contractor, Proponent</p>	<p>One-off</p>

<p>2. Consider use of indigenous plant species in vegetation</p>	<p>Contractor, Proponent</p>	<p>One-off</p>
<p>3. Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent buildings and the development.</p>	<p>Contractor, Proponent</p>	<p>One-off</p>

CHAPTER ELEVEN: ENVIRONMENT, HEALTH AND SAFETY (EHS)

11.1 EHS Management and Administration

The EHS is a broader and holistic aspect of protecting the worker, the workplace, the tools / equipment and the biotic environment. It is an essential tool in determining the EIA study. The objective of the EHS on the proposed project is to develop rules that will regulate environmentally instigated diseases and occupational safety measures during construction and the operation phases of the proposed project by:

- Avoidance of injuries
- Provision of safe and healthy working environment for workers comfort so as to enhance maximum output.
- Control of losses and damages to plants, machines, equipment and other products.
- Enhance environmental sustainability through developing sound conservation measures.

11.2 The Guiding Principles to Be Adopted By the Contractor

The company will be guided by the following principle: -

- It will be a conscious organization committed to the promotion and maintenance of high standards of health and safety for its employees, the neighboring population and the public at large.
- Ensuring that EHS activities are implemented to protect the environment and prevent pollution.
- Management shall demonstrate commitment and exercise constant vigilance in order to provide employees, neighbors of the project and the environment, with the greatest safeguards relating to EHS.
- Employees will be expected to take personal responsibility for their safety, safety of colleagues and of the general public as it relates to the EHS management plan.

11.3 EHS Management Strategy to Be Adopted By the Contractor

The following strategies will be adopted to achieve the above objectives:

- Create an Environment Health and Safety Management committee and incorporate EHS as an effective structure at various levels and units to manage and oversee EHS programs in all construction and operation phases of the project
- Maintain an effective reporting procedure for all accidents.
- Provide appropriate tools and protective devices for the success of the project.
- Encourage, motivate, reward and support employees to take personal initiatives and commitment on EHS.

11.4 Safety Requirement at the Project Site during Construction and Operation Period

(a) The Contractor

The contractor will ensure that:

- Safe means of entry and exit exist at the proposed project site.
- Ensure adequate briefing of job at hand on the safe system of work before commencement of work
- The EHS coordinator must be in attendance at all times throughout the duration of the project.
- The EHS consultant must maintain constant assessment of the risk involved as the work progresses
- A safety harness must be worn before entry into all confined spaces and while working at height
- An EHS consultant must be posted at the entrance of the project site to monitor progress and safety of the persons working at the construction site.

(b) The Traffic / Drivers

Within the construction premises, the following traffic rules will be observed: -

- Observe speed limits and all other signs and obey traffic rules.
- Use the vehicle for the purpose to which it is intended only.

c) Fire Hazard at the Construction Site

Workers at the site shall ensure that: -

- Oxy-acetylene cylinders are not contaminated with grease or oil.
- Oxy-acetylene cylinders are not subjected to direct sunlight or heat.
- Oxy-acetylene cylinders are not to be used or stored standing in a vertical position.
- When in use, ensure the inclination should never be over 30° from the vertical

11.5 Welding At the Construction Site

It is the responsibility of the contractor during construction to: -

- Ensure that welding clamp is fixed such that no current passes through any moving parts of any machine.
- Ensure that all welding clamps are in good operating condition and conduct current without arcing at the point of contact.
- Ensure that welding clamps are free from any contact with explosive vapors i.e. Oil spillage, Fuel tanks, Coal dusts and miscellaneous combustible material (e.g. Cotton rags filter bags, rubber belting, and wood shavings).
- Ensure that any slag or molten metal arising from welding activities does not start up fires by:
 - ✓ Clearing combustible material to a distance of at least 3 meters away from the working area or covering area with metal or asbestos sheet.
 - ✓ Appropriate fire extinguisher is to be kept available for immediate use at all times

11.6 Emergency Procedures during Construction and Operation

In the event of an emergency during construction, the workers shall:

- Alert other persons exposed to danger.
- Inform the EHS coordinator.
- Do a quick assessment on the nature of emergency.
- Call for ambulance on standby.
- When emergency is over the EHS coordinator shall notify the workers by putting a message:
“ALL CLEAR”

In the event of such an emergency during operation the occupants shall: -

- Alert other persons exposed to danger.
- Ring the nearest police station
- Call for ambulance on standby.

CHAPTER TWELVE: DECOMMISSIONING

Decommissioning is an important phase in the project cycle and comes last to wind up the operational activities of a particular project. It refers to the final disposal of the project and associated materials at the expiry of the project lifespan. If such a stage is reached, the proponent needs to remove all materials resulting from the demolition/ decommissioning from the site. The following should be undertaken to restore the environment.

- Remove all underground facilities from the site
- The site should be well landscaped by flattening the mounds of soil
- All the equipment should be removed from the site
- Fence and signpost unsafe areas until natural stabilization occurs
- Backfill surface openings if practical

**Table 12.1: The table below shows the proposed decommissioning plan.
EMP for Decommissioning**

Expected Negative Impacts	Recommended Measures	Responsible Party	Time Frame	
1. Construction Machinery/Structure & Wastes				

<p>Scraps material and other debris</p>	<ul style="list-style-type: none"> ▪ Use of an integrated solid waste management system i.e. through a hierarchy of options. ▪ Wastes generated as a result of facility decommissioning activities will be characterized in compliance with standard waste management procedures. ▪ The contractor will select disposal locations and the local council based on the properties of the particular waste generated. 	<p>Project Manager & Contractor</p>	<p>During decommissioning</p>	
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	<ul style="list-style-type: none"> ▪ All buildings, machinery, equipment, structures and partitions that will not be used for other purposes should be removed and reused or rather sold/given to scrap material dealers. 	Project Manager & Contractor	During decommissioning	
	Where recycling/reuse of the machinery, equipment, structures and other waste materials is not possible the materials should be taken to designated dumpsites.	Project Manager & Contractor	During decommissioning	
Rehabilitation of project site				
<p>I. Vegetation disturbance</p> <p>II. Land deformation</p>	<ul style="list-style-type: none"> ▪ Implement appropriate re-vegetation programme to 	Project Manager & Contractor	During decommissioning	

<p>soil erosion, drainage problems</p>	<p>restore the site to its original status.</p> <ul style="list-style-type: none"> ▪ During the vegetation period, appropriate surface water runoff controls will be taken to prevent surface erosion; ▪ Monitoring and inspection of the area for indications of erosion will be conducted and appropriate measures taken to correct any occurrences; ▪ Fencing and signs restricting access will be posted to minimize disturbance to 			
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	newly-vegetated areas;			
Social- Economic impacts				
I. Loss of income	<ul style="list-style-type: none"> ▪ The safety of the workers and occupants should surpass all other objectives in the decommissioning project. ▪ Adapt a project – completion policy; identifying key issues to be considered. ▪ Compensate and suitably recommend the workers to help in seeking 	Project Manager & Contractor	During decommissioning	
II. Reduced ability to support dependents.				
III. Loss of quality of life				
IV. Loss of benefits i.e. medical, insurance cover etc.				

	<p>opportunities elsewhere.</p> <ul style="list-style-type: none">▪ Offer advice and counseling on issues such as financial matters			
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CHAPTER THIRTEEN

13.0 CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusion

In accordance with the Environmental Management and Coordination Act 1999 and The Environmental (Impact and Audit) Regulations, 2002, the findings of the environmental impact assessment carried out for this indicate that possible environmental impacts generated during operations and decommissioning phases will be addresses effectively by the proponent as mitigation measures indicated in the matrix above. As per the above analysis of the aspects of both positive and negative environmental impacts of the project's development, we, the experts found no significant negative impacts that could pose adverse effects to the extent of the proposed project not being implemented. However, the minor potential negative impacts of the proposed project could be managed with the suggested environmental and social mitigation management plans.

Having considered the data collected, analysed and collated information that is available, it is the experts considered opinion that:

- i. The project **DOES NOT** pose any serious environmental concern, other than those of minor scale that accompany most development activities.
- ii. The positive impacts of the project far outweigh the negative ones, which will be adequately contained by following the prescribed environmental management and social impact management plans.
- iii. As such the project should be **licensed** to continue, and activities be managed within the provided Environmental Management Plan and sound environmental management practices that are internationally recognised.

13.2 Recommendation

This report recommends that the project be allowed to go ahead provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards

minimizing the occurrence of impacts that would degrade the general environment. This will however be overcome through close follow-up and implementation of the recommended Environmental Management and Monitoring plans (EMPs). We recommend these:

- ✦ The proponent should follow the guidelines as set by the relevant departments to safeguard and envisage environmental management principles during construction and operations/occupation phases of the proposed project.
- ✦ It is important that warning or informative sign (bill boards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed. The signs should be positioned in a way to be easily viewed by the public and mostly motorists.
- ✦ All solid waste materials and debris resulting from construction activities should be disposed off at approved dumpsites.
- ✦ All construction materials and especially pipes, pipe fittings, sand just to mention a-few should be sourced/procured from bonafide /legalized dealers.
- ✦ During construction all loose soils should be compacted to prevent any erosion by water and wind.
- ✦ Other appropriate soil erosion control measures can be adapted. Any stock piles of earth should be enclosed, covered or sprinkled with water during dry or windy conditions to minimize generation of dust particles into the air.
- ✦ Once earthworks have been done, restoration of the worked areas should be carried out immediately by backfilling, landscaping/leveling and planting of suitable tree species.
- ✦ Proper and regular maintenance of construction machinery and equipment will reduce emission of hazardous fumes and noise resulting from friction of metal bodies. Maintenance should be conducted in a designated area and in a manner not to interfere with the environment.
- ✦ A fully equipped first aid kit should be provided within the site
- ✦ Workers should get food that is hygienically prepared. The source of such food should be legalized or closely controlled.

- ✦ The contractor should have workmen's compensation cover and is required to comply with workmen's compensation Act as well as other relevant ordinances, regulations and Union Agreements
- ✦ The contractor should provide adequate security during the construction period.

13.3 Statutory Compliance

The proponent and the contractor shall ensure that they implement statutory provision of the statutes mentioned in Chapter Four. A quarterly environmental monitoring programme should be instituted during the implementation phase; this should be backed up by daily supervision and inspection of the project site activities.

REFERENCES

1. Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act No. 8 of 1999. Government printer, in Nairobi
2. Kenya gazette supplement Acts physical planning Act, 1999. Government printer, in Nairobi.
3. Kenya gazette supplement Acts local authority Act (cap 265). Government printer, Nairobi
4. Exploratory Soil Map and Agro-Climate Zone Map of Kenya, 1980, Scale 1:1 *by Sombroek W. G., Braun H. M. M. And Van der Pouw B. J. A., 1982*
5. The Making of a Framework Environmental Law in Kenya, *by ACTS press, UNEP-ACTS, 2001*
6. Environmental Assessment Sourcebook Volume I (Policies, procedures, and cross-sectoral issues), Volume II (sectoral guidelines) Volume III (guidelines for Environmental assessment of energy and industry projects) *by, World Bank, Washington, 1991*
7. *Dharani N. 2002. Field guide to common Tree & Shrubs of East Africa. Struck Publishers, Cape Town, South Africa*
8. Environmental Management and Coordination Act, 1999.
9. Environmental (Impact Assessment & Audit) Regulations, 2003
10. The Occupational Safety and Health Act, 2007 and its subsidiary legislations
11. Other Relevant government Acts.
12. Sanitation Engineering, *volume I and II*, by R.S. Deshpande
13. GOK (2000). Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act Number 8 of 1999. Government printer, Nairobi
14. GOK (2007). Poverty Reduction Strategy Paper (2003 – 2007). Ministry of Planning and National Development. Government printer, Nairobi

15. GOK (2002). Kenya gazette supplement Acts Water Act, 2002 government printer, Nairobi
16. GOK (2000). Kenya gazette supplement Acts Building Code 2000 government printer, Nairobi
17. Kenya gazette supplement Acts Local Authority Act (cap. 265) government printer, Nairobi
18. Kenya gazette supplement Acts Land Planning Act (cap. 303) government printer, Nairobi
19. Kenya gazette supplement Acts Public Health Act (cap. 242) government printer, Nairobi
20. Kenya gazette supplement Acts Penal Code Act (cap. 63) government printer, Nairobi\
21. Public Health Act (Cap 242). Government Printers
22. United Nations (2006). City of Nairobi Environment Outlook
23. United Nations (2000). Millennium Development Goals
24. World Bank (2002). Making Sustainable Commitment; An Environmental Strategy for the World Bank; Special Issue: The World Bank; Washington D. C. USA. Water Engineering Superintendent Report (2004).
25. World Bank (1996). The Environmental Impact Assessment (EIA) in Africa: A World Bank Commitment. World Bank, Washington D.C. USA.

Annexes and the Terms of Reference of the Assignment (PSR)

Terms of Reference (TOR)

Activities by the Consultant:

The Consultant shall carry out an environmental impact assessment of the proposed development and prepare a project report, which shall incorporate the following details:

- The proposed location of the project
- A concise description of the national environmental legislative and regulatory framework, baseline information and any other relevant information related to the project
- The objective of the project
- The technology, procedures and processes to be used, in the implementation of the project
- The products, by- products and waste generated by the project
- A description of the potentially affected environment
- The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short term and long term effects anticipated
- Alternative technologies and processes available and reasons for preferring the chosen technology and processes
- Analysis of alternatives including project site, design and technologies and the reasons for preferring the proposed site design and technologies
- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, time frame and responsibility to implement the measures
- Provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the course of carrying out activities or major industrial and other development projects
- The measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies

- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information
- An economic and social analysis of the project
- An indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures and
- Such other matters as the authority may require.

Expected Outputs

An Environmental Impact Assessment Project Report

Responsibility of the Client

- Make payments of wide public participation adverts as required by NEMA.
- Pay for any testing that may be demanded by NEMA
- Pay consultancy fees for preparing the Project Study Report.

Appendices

Annex 1. Completed copies of questionnaire

Annex 2. A copy of the land ownership documents and company details

Annex 3. Architectural drawings and approval certificate

ANNEX 1

PROJECT SITE AND PHOTOGRAPHY



Plate 1: The proposed Project site



Plate 2: Mombasa Road



Plate 3: One of the Point identified by the Hydrologist



Plate 4: Scarce Residential Dwelling Neighbouring the site

ANNEX 2

PUBLIC CONSULTATIONS

ANNEX 3

TITLE DEED

ANNEX 4

PROJECT APPROVED DRAWINGS
