ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED RESIDENTIAL DEVELOPMENT ON PLOT L.R NO. 10426/61 LOCATED IN GIMU AREA, MAVOKO SUB-COUNTY, MACHAKOS COUNTY.

This Environmental and Social Impact Assessment (ESIA) Study Project Report is submitted to Kenya National Environmental Management Authority (NEMA) in conformity with the requirements of the Environmental Management and Coordination Act cap 387 and the Environmental Impact Assessment and Audit Regulations

September 2020

This Environmental and social Impact Assessment project report has been prepared by registered experts in accordance with the Environmental Management and Coordination Act (EMCA) cap 387 and the Environmental (Impact Assessment) and Audit regulations 2003 which requires that every development project must have an ESIA report prepared for submission to the National Environmental Management Authority (NEMA). We the undersigned, certify that the particulars in this report are correct to the best of our knowledge.

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PROJECT LOCATION

-1.440339, 37.008467

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DEFINITION OF ANALYTICAL TERMS

1. **Environmentally Sound Design**: Is the design and implementation of activities and projects such that the environmental harm associated with a particular development objective is kept to a practicable minimum.

2. **Positive Impact**: A change which improves the quality of the environment (for example by increasing species diversity; or improving the reproductive capacity of an ecosystem; or removing nuisances; or improving amenities).

3. **Neutral Impact:** A change which does not affect the quality of the environment.

4. **Negative Impact**: A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or property or by causing nuisance.

5. **Significant impact**: An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

6. **Profound impact**: An impact which obliterates sensitive characteristics.

7. **Do-Nothing Impact**: The environment as it would be in the future should no development of any kind be carried out.

8. **Indeterminable Impact**: When the full consequences of a change in the environment cannot be described.

9. **Irreversible Impact:** When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.

10. **Residual Impact**: The degree of environmental change that will occur after the proposed mitigation measures have taken effect.

11. **Synergistic Impact**: Where the resultant impact is of greater significance than the sum of its constituents.
12. **Worst Case Impact:** The impacts arising from a development in the case where mitigation measures substantially fail.

13. **Cumulative impacts**: Are identified as impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions.

14. **Indirect impacts**: Are defined as impacts on the environment which are not a direct result of the project, possibly produced some distance away from the project or as a result of a complex pathway.

EXECUTIVE SUMMARY

In pursuant to the Environmental Management and Coordination cap 38 and the Environmental Impact Assessment and Audit Regulations, 2003 part II, an ESIA was carried out for the proposed residential development project. The assessment was carried out in order to determine the anticipated environmental impacts of the proposed project and to identify the necessary mitigation measures in order to incorporate sustainable development aspects in the project cycle and at the same time with a view to obtaining the necessary approvals and licenses from NEMA.

Kenya being a developing country is urbanizing very fast and hence experiencing the challenges of urbanization among them being lack of modern and decent housing. This is this evident in Nairobi City County where some of the workers have opted to commute from its outskirts such as Mlolongo, Syokimau, Athiriver among others. FAIRVALLEY HEIGHTS LIMITED (herein referred to as the proponent) has proposed to develop a 229 residential development on a 1.99 hectares plot, L.R. No. 10426/61 in Mavoko Sub-County, Gimu Area, in Machakos County. This is phase 1, with phase 2 coming in future. Phase 2 shall undergo the due process of approval before commencement.

The development comprises of the following:

- **3 blocks which are 8 floors each. The 3 blocks combined contain 102 three (3) bedroom units and 85 two (2) bedroom units.**
- **1 block containing 24 one (1) bedroom units**
- **18 four (4) bedroom villas**
- **A commercial zone with adequate shops to support the development**
- **Ample parking, playground and other social amenities**
- **The site neighbourhood is sewered and the development will be connected to the sewer line for liquid waste disposal**
- **The total number of units is 229, all fitted with associated amenities**

Approved drawings and a change user are annexed in this report

2. Environmental Impacts and Mitigation Measures

The potential negative environmental impacts of the proposed project and possible mitigation measures are outlined below.

Potential Environmental Impacts

The potential negative environmental impacts of the project and possible mitigation measures are summarized in the table below:

ANTICIPATED IMPACTS	PROPOSED MITIGATION
Impacts At The Construction Phase	
1. Site Preparation Impacts ➢ **Deformation of the ground and destruction of the natural site physiography** ➢ **Interference of soil properties (Compacting shall interfere with soil properties)** ➢ **Generation of High Volume of Construction works waste (Excavation shall result in extraction of debris from the ground)** ➢ **Soil erosion**	✓ **Demarcate and delineate areas to be affected by the construction work.** ✓ **Conduct site clearing activities in stages to minimize the area of exposed soil.** ✓ **Control earthworks** ✓ **Install drainage structures properly** ✓ **Compact loose soils** ✓ **Ensure management of excavation activities especially during rainy conditions** ✓ **Provide soil erosion control structures.** ✓ **Undertake landscaping after construction is complete** ✓ **Provide soil erosion control structures.** ✓ **Undertake landscaping after construction is complete**
2. Pollution & Health Risk ➢ **Noise pollution onsite and within its immediate vicinity.** ➢ **Airborne pollution (particularly dust resulting**	✓ **Site enclosure to reduce noise and spreading of dust.** ✓ **Sprinkling of water on dry soils in excavated areas and access road to suppress dust.** ✓ **Regular maintenance of construction equipment** ✓ **Provide barriers such as walls and trees around site boundaries to provide some buffer against dust propagation.**

from clearing of the land and from exposed piles of building materials sand, cement, etc.) ➢ **Contamination of soil from spills of hazardous materials** ➢ **Injuries sustained due to direct contact with hazardous materials** ➢ **Odour/emissions (might result in nuisance to workers onsite & general public within the immediate vicinity)** ➢ **Pollution of the surface water resources through storm water runoff** ➢ **Underground water pollution through leaching.**	✓ **Construction activities to be restricted to daytime(008-1700hrs)** ✓ **Workers in the vicinity of high-level Noise to wear safety & protective gear.** ✓ **Affix Silencers and mufflers on exhaust systems of all mechanical equipment** ✓ **Stacked building material on-site shall be kept for shortest time possible.** ✓ **Provide workers with personal protective gear including gloves, respirators, safety boots and coveralls** ✓ **Maintain at the site, a file on material safety data sheets** ✓ **Store flammable materials in appropriately bundled and secured containers and in compliance with standards of fire safety regulations** ✓ **Use drip trays to collect waste oil and lubricants from stationery plant such as concrete mixers during servicing** ✓ **Train staff on safe handling of hazardous materials** ✓ **Maintain an inventory of all materials used at the site** ➢ **Ensure controlled water run off and also develop water harvesting Mechanism to reduce this run off**

3. Stacking of Construction Waste & Materials on Site ➢ **Site Aesthetic degradation due to site accumulation** ➢ **Contamination of surface and underground water resources by used oil and/or sewage** ➢ **Contamination of soil resources** ➢ **Fire caused by used oil or burning solid waste**	✓ **Segregating waste by separating hazardous waste from non-hazardous waste for appropriate disposal** ✓ **The contractor should adhere to bill of quantities to avoid wastage** ✓ **Providing adequate number of suitable solid waste containers** ✓ **Containers or package for storing hazardous waste including used oil to be securely bunded and labelled as provided for by Regulation 18 under the Environmental Management and Coordination (Waste Management) Regulations, 2006** ✓ **Contracting a NEMA licensed waste transporter to collect solid waste from the site for dumping at an approved site** ✓ **Contracting a NEMA licensed waste oil recycler for collecting used oil from the site for recycling (if any)** ✓ **Accumulating scrap metals in a safe place and contracting a scrap metal dealer with a valid license from NEMA for appropriate disposal** ✓ **Providing adequate number of sanitary facilities for the workers and visitors to the site** ✓ **Minimizing waste generated by adopting cleaner production methods such as conserving raw materials, enabling the recovery and re-use of the waste product where possible (e.g Reuse of quarry chips as base material for driveways and car park construction).**
Impacts At The Occupational Phase	
1. Increased Waste Generation	✓ **Provide adequate number of suitable solid waste containers for the facility** ✓ **Provide bins, one for bio-degradable matter and another for non- biodegradable.** ✓ **Contract a waste dealer registered with NEMA to collect solid waste from the site** ✓ **Conduct regular checks for the septic tank** ✓ **Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated**
2. Increased traffic flow and conflicts on the access road	✓ **Create ample parking within the compound.** ✓ **Improve the plot frontage with Gabbro paving to enhance entry and exit from the establishment.**

3. Increased Pressure on Infrastructure & Utilities; Energy, Water etc	✓ **Supplement piped water supply with rainwater harvesting systems** ✓ **Water conservation taps that turn off automatically when water is not in use will be installed.** ✓ **Sensitize the occupants on efficient water use.** ✓ **Construct a septic tank and soak pit on site for wastewater management and repair the supply system** ✓ **Correct leakage and water loss** ✓ **Use energy saving systems (bulbs)Purchase of step up systems to cushion against variation** ✓ **provide finishes that limit power use- paint the interior with a bright color** ✓ **Pave the compound with pervious materials to reduce storm water generation**
4. Occupational Health **and Safety Risks**	✓ **Indicate Clear warnings of hazards or risk prone areas** ✓ **Install firefighting equipment in strategic points** ✓ **Clearly mark emergency exist to guide occupants** ✓ **Install and label alarm systems in the block.** ✓ **Institute monitoring systems to ensure proper operation and good maintenance to address disaster needs.** ✓ **Well stocked first aid box which is easily available and accessible should be provided within the establishment** ✓ **Ensure general safety and security at all times by providing day and night security guards and adequate lighting within and around the block**
Impacts at the Decommissioning Phase	
Winding up of the Project (Decommissioning Imperatives)	✓ **Engage a qualified contractor to undertake demolition works** ✓ **Undertake ground verification before committing the ground to any new use.** ✓ **Engage qualified personnel in demolition of structures.** ✓ **Selectively undertake works in phases as advised by experts.** ✓ **Employ the best technology in demolition and destruction of structures** ✓ **Sample out useful materials Dispose off waste** ✓ **Provide advance notice to notify the public of impeding demolition**

	✓ **Engage a landscape architect to restore the site qualities in the preparation for new projects**
Loss of Aesthetics	**a) Landscape the site** **b) Level grounds** **c) Eliminate unnecessary wastes.**
Noise Pollution	**a) Switch of the engines of Lorries while on site.** **b) Undertake demolitions during the day.** **c) Engage qualified persons** **d) Avoid use of ballistic materials.**

The study established that there will be no significant environmental impacts expected to ensue from the construction work and during occupation provided that the proponent adheres to the proposed mitigation measures and other recommendation provided. An Environmental Management Plan was established for the project describing the parameters to be monitored and suggesting how monitoring should be done, how frequently, who should be responsible for monitoring and actions to be effected and the estimated cost of mitigation. Neighbours' comments were also sought, and none objected the proposed development as it suits other developments in the area.

OBJECTIVE OF THE ESIA

The major objective of the ESIA study is to evaluate the effects/impacts of proposed development in relation to the general environmental aspects i.e. physical, biological, and social-economic environments. It aims at influencing the protection and co-existence of the development with the surroundings as well as the compatibility of the proposed development to the area; to ensure and enhance sustainable environmental management during implementation and operational phases.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background and Rationale of Environmental Impact Assessment

Currently the rates of urbanization and population growth worldwide are increasing fast and with it come the need for improvement in service provision especially in our urban areas. Kenya's rates of urbanization are escalating and being a developing country; most of its urban population is forced to live in slums. Increased population due to rural-urban migration in search of job opportunities and or higher education in major towns of Kenya has increased demand for buildings, especially residential houses.

The principle measure of sustainable development is that all activities which are carried out to achieve development must take into account the needs of environmental conservation. The sustainability of the ecosystem requires the balance between human settlement development and the natural ecosystem, which is a symbiotic relationship. This can be achieved through careful planning and the establishment of appropriate management systems. In modern times, the need to plan activities has become an essential component of the development process. Consequently a number of planning mechanisms have been put in place to ensure that minimum damage is caused to the environment. Environmental planning is also integrated with other planning processes such as physical planning, economic planning, and development planning. Environmental and Social Impact Assessment (ESIA) is considered part of environmental planning. ESIAs are undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority. In Kenya, the competent authority is the National Environment Management Authority (NEMA).

As part of the ESIA process, it is necessary to devise alternatives to avoid undesirable impacts. Besides the alternative, identification of impacts may also lead to the development of mitigation measures i.e. means of reducing the impacts. As a tool of environmental planning, ESIA is therefore precautionary in nature. ESIA is neither antidevelopment nor does it stop actions which impact the environment. It only requires that those impacts be considered. Most development activities impact the environment hence a "no impact" interpretation of environmental and Social impact assessment could lead to no development. But a "considerable impact" interpretation of

ESIA will lead to better development. If environmental impacts are ignored, the project may not be sustainable in the long-run, in which case the money invested in it will have been wasted.

1.2 Terms of Reference

The TOR for this ESIA project study for the proposed development project addresses the following key specific aspects:

i. To hold appropriate meetings with the project proponent to establish the procedures, define requirements, responsibilities and a time frame.
ii. Carry out public involvement as far as the project is concerned to get views, inputs, areas of concern with view of providing mitigation measures
iii. To produce an ESIA study report that contains among other issues potential negative and positive impacts and recommendations of appropriate mitigation measures to minimize or prevent adverse impacts
iv. To carry out a systematic environmental and social assessment study at the proposed project site and the surrounding area.
iv. To provide a description of the proposed activities throughout the entire implementation process of the project with a special focus on potential impacts to the surrounding environment and facilities.
v. To develop an Environmental Management Plan for the proposed project.

1.3 Need for the Project

Increase in population and urbanization within and around Nairobi City has led to rapid increase in demand for residential houses which has led to people moving out of city centre and staying in the satellite towns within the vicinity of the city or staying in shanties. The satellite areas like Sokimau, Mlolongo, Athiriver, Machakos and specifically Mavoko sub county where the proposed project falls are currently experiencing enormous housing demand as dormitory areas of Nairobi City County population.

Mavoko area, where the project falls is also home to a number of education, industrial, commercial, administrative and health institutions that require accommodation for their staff members. The housing needs of these people can only be taken care of through construction of facilities like the proposed Residential Housing estate in Gimu. The scheme is planned to

cater for housing demand for all income level livelihoods. More importantly, it is vital to optimally utilize the land that has been undeveloped.

There are also similar projects within the area which have been operational without significant negative impacts to the environment and the neighboring populations. This land use is in harmony with the land use class of the area. The project will lead to economic empowerment not only to the project proponent but also to a host of other people who will both directly and indirectly benefit from jobs and business opportunities resulting from the presence of the project within the neighborhood.

Revenue generation to the central government through land rates and taxes as a result of the implementation of this project will lead to the much needed economic development.

In terms of environmental degradation, the project is likely to lead to very minimal negative impacts, which shall be easily taken care of in the design and the proposed mitigation measures as suggested in Chapter 8 of this project study report.

1.4 National Housing Policy and Housing Needs in Kenya

In August 2003, the government of Kenya through a Sessional Paper spelt out a Housing Policy whose overall goal was to facilitate the provision of adequate shelter and healthy living environment at an affordable cost to all socio-economic groups in Kenya in order to foster sustainable human settlements. The aim is to minimize the number of citizens living in shelters that are below the habitable living conditions.

Among other things, the policy aims at facilitating increased investment by the formal and informal private sector, in the provision of housing units for low and middle-income dwellers. The estimated current urban needs are 150,000 units per year, which can be achieved if the existing resources are fully utilized by the private sector with the enabling hand of the government. It is estimated that the current production of new housing in urban areas is only 20,000-30,000 units annually, giving a short fall of over 120,000 units per annum. The shortfall in housing has been met through the proliferation of squatter and informal settlements and overcrowding.

The current government as also included housing in its big 4 agenda to ensure that its citizens get low cost houses. Apart from being an investment to the proponent, the project is an indication on how the private sector is helping the Government to bridge the gap in the housing sector.

To alleviate the huge shortfall of urban housing mentioned above and to curb the mushrooming of informal settlements/slums, various interventions and strategies have to be adopted. In the Policy Paper, the government correctly accepts the fact that it cannot meet the housing shortfall on its own and that the best policy is to encourage the private sector (like the proponent) to chip in while the government provides an enabling environment for development. The government will provide an enabling environment by doing the following:

- Facilitating the supply of serviced land at affordable prices in suitable locations
- Expanding and improving infrastructure facilities and services e.g. the current construction of the Southern by-pass and expansion of Mombasa road which is ongoing. Also development of sewer in the project location is one of such facilitation
- Using research findings as well as innovative but cheap conventional building materials and technologies to improve production of housing units.
- Harmonizing the Banking Act, the Building Society Act, the Insurance Act and the various Acts that have so far proved to be a hindrance to the sourcing of housing finance.
- Generally easing the path of funds from the private investor/government to the development project.
- Issuing workable guidelines on Estate Management and maintenance.

The promotion of this development is therefore well within the government current and long term policies of ensuring decent housing for all by 2030 (Vision 2030).

1.5 Objectives of the ESIA

- The main objective of this ESIA was;
- To establish the baseline conditions of the proposed site,
- To evaluate the existing and the anticipated impacts and propose measures to enhance the positive impacts and measures to reduce 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.

This objectives is based on ensuring that the environmental concerns are integrated in the proposed project activities in order to contribute to the overall sustainable development .Other objectives include;

- To identify potential environmental impacts of proposed project; both positive and negative
- To assess the significance of these impacts to the environment and other stakeholders
- To assess the relative importance of the impacts of alternative plans to the proposed project.
- To propose mitigation measures for the significant negative impacts of the proposed project on the environment and all involved stakeholders.
- To propose measures that will enhance the positive impacts of the proposed project to the environment and all involved stake holders
- .To generate baseline data for monitoring and evaluation of how well the mitigation measures are being implemented during the proposed project cycle;
- To present information on the impact of alternatives;
- To present results of the ESIA in such a way that they can guide informed decision

1.6 Scope of the Study

The study was conducted to evaluate the potential and foreseeable impacts of the proposed development. The physical scope is limited to the proposed site and the neighbouring areas/environment as they may be affected by or may affect the proposed project. Any potential impacts (localized or delocalized), are also evaluated as guided by EMCA CAP 387and the Environmental (*Impact Assessment and Audit*) Regulations 2003.This study report includes an assessment of impacts of the proposed sites and its environs with reference to the following;

i. A review of policy, legal and administrative framework.
ii. Description of the proposed project.
iii. Review of baseline information.
iv. Assessment of the potential environmental impacts on the biophysical, socio-economic, and cultural aspects.
v. Proposition of project alternatives.
vi. Development of mitigation measures

1.7 Methodology

The methodology used in the study consisted of the following:

a) A site reconnaissance and visual survey to determine the baseline information of the

project area.

b) Comparative study of the project with existing land uses in the neighborhood.
c) Analysis of the project documents
d) Discussion with the proponent.
e) Seeking public views through public meetings with relevant stakeholders, interviews and questionnaires.
f) Focus group discussion at the project site.
g) Assessment of the site to detail the various existing and likely impacts.
h) Assessment of health and safety issues.
i) Proposal of mitigation measures to minimize any negative impacts.
j) Preparation and submission of the project report.

CHAPTER TWO

2.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

There are a number of policy and legal provisions that have implications on the optimum operation of the proposed development. They include the following:

2.1 Relevant National Policies

2.1.1 The National Environmental Action Plan (NEAP)

The NEAP was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectorial approach to develop a comprehensive framework to ensure that environmental management and conservation of natural resources are an integral part of societal decision making.

Relevance to the proposed project: The NEAP has indicated how resources within particular sections of the country should be managed in order to ensure their sustainable utilization. The project should be implemented and operated based on these guidelines.

2.1.2 Environment and Development Policy (Sessional Paper No.6 of 1999)

The aim of this policy is to harmonize environmental and development goals so as to ensure sustainability. The sessional paper provides comprehensive guidelines and strategies for government actions regarding environment and development.

Relevance to the proposed project: The interaction of the proposed project with physical elements may lead to some negative impacts. Mitigation measures are therefore necessary to ensure balanced co-existence of the project and the surrounding environment and facilities.

2.1.3. Vision 2030

Kenya Vision 2030 aims to provide the country's population with adequate and decent housing in a sustainable environment. Improvement in the quality of life of all Kenyans which is the supreme goal of Vision 2030cannotcome about if large sections of the rural and urban population are inadequately housed. Therefore, the housing sector has a critical role to play in the achievement of the goals envisaged by Vision 2030. Housing construction is a

labor-intensive activity that will create jobs for youth and the unemployed and the construction also has strong linkages with other sectors of the economy. Demand for new housing units in urban areas currently stand at 150,000 units annually and only 23 per cent of this demand is being met, the national gap is big and requires an urgent solution.

Relevance to the proposed project: One of the flagship projects under Vision 2030 is to produce 200,000 housing units annually by 2012 through a mixture of initiatives in order to fill the huge housing gap in the country. The proposed project will contribute towards this flagship projects.

2.2 Legal Framework

2.2.1. Kenya Constitution, 2010

Article 43 (b) on Economic and Social Rights for Kenyans emphasize that every person has a right to accessible and adequate housing, and to reasonable standards of sanitation.

Relevance to the proposed project: The proposed project will contribute towards this Constitutional right and shall offer an opportunity for over 700 Kenyans to access housing and standard sanitation.

2.2.2 Environment Management and Coordination Act cap 387

Section 58(1) of the Act states that notwithstanding any approval, permit or license granted under this Act or any other law in force in Kenya, any person, being a proponent of a project, shall, before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project study report to the Authority, in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee.

Relevance to the proposed project: Environmental Management and Coordination Act cap 387 provide a legal and institutional framework for the management of the environmental related matters. This study report has been written pursuant to section 58(1) of this Act.

2.2.3 Environmental Impact Assessment and Audit Regulations 2003.

These regulations stipulate how an ESIA project study report should be prepared and specifies all the requirements that must be complied with. It highlights the stages to be followed, information to be made available, role of every stakeholder and rules to be observed during the whole ESIA project study report.

Relevance to the proposed project: The proposed project will be planned, designed, constructed and operated based on these regulations. It shall also be maintained and guided by the same regulations and an environmental audit study shall be done periodically to monitor compliance with the set environmental standards.

2.2.4 Water Quality Regulations (2006)

The Water Quality Regulations (2006) are contained in the Kenya Gazette Supplement No. 68, Legal Notice No. 120. Water Quality Regulations apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. It is an offence to contravene the provisions of these regulations.

In addition, of immediate relevance to the proposed project for the purpose of this Project Study Report is Part II Sections 4-5 as well as Part V Section24.Part II Section IV states that

"Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution". Part IV Section 24 states that "No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump any such matter into water meant for fisheries, wildlife, recreational purposes or any other uses". According to these regulations, "Every person shall refrain from any action which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of the Act".

Relevance to the proposed project: The only reliable sources of water within the project site

are boreholes and MAVOWASCO. Therefore, the contractor shall take care and precaution not to cause any pollution on surface dams and pans, and if a pollution incidence occurs the contractor should notify the authority immediately.

Mto wa mawe' river flows in over 100m from project site, with in between an agricultural buffer zone. The view will add value to the serenity of the project. The proponent must desist in any way from polluting the river. Any pollution will be highly punished by law

2.2.5 EMCA (Waste Management) Regulation, 2006

The Waste Management Regulations (2006) are contained in the Kenya Gazette No. 69, Legal Notice No. 121. The Waste Management Regulations are meant to streamline the handling, transportation and disposal of various types of waste. The aim of the Waste Management Regulations is to protect human health and the environment. The regulations place emphasis on waste minimization, cleaner production and segregation of waste at source. The regulation requires licensing of transporters of wastes and operators of disposal site (sections 7 and 10 respectively). Of immediate relevance to proposed development for the purposes of this project study report is Part II Sections 4(1-2), 5 and 6.Section 4 (1) states that

"No person shall dispose of any waste on a public highway, street, road, recreational area or any other public place except in a designated waste receptacle". Section 4(2) and 6 explain that the waste generator must collect, segregate (hazardous waste from non-hazardous) and dispose waste in such a facility that shall be provided by the relevant local authority. Section 5 provides method of cleaner production (so as to minimize waste generation) which includes the improvement of production processes through conserving raw materials and energy. In section 14 (1) every trade or industrial undertaking is obliged to install anti-pollution equipment for the treatment of waste emanating from such trade or industrial undertaking.

Relevance to the proposed project: The Developer shall ensure that the garbage collector contracted has a valid license from the National Environment Management Authority (NEMA).So as to comply with this, the contractor shall take precaution not to dumb wastes in areas not registered and designated as so. Further, the project proponent shall be required to ensure, through public education and other law enforcement mechanism to ensure that all road users don't dumb wastes along the road

'Mto wa mawe' river flows in over 100m from project site, with in between an agricultural buffer zone. The view will add value to the serenity of the project. The proponent must desist in any way from polluting the river. Any pollution will be highly punished by law

2.2.6 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009

These Regulations determine that no person or activity shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise that annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. In determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors may be considered:

Time of the day
Proximity to residential area
Whether the noise is recurrent, intermittent or constant
The level and intensity of the noise
Whether the noise has been enhanced in level or range by any type of electronic or mechanical means
Whether the noise is subject to be controlled without unreasonable effort or expense to the person making the noise

These regulations also relate noise to its vibration effects and seek to ensure no harmful vibrations are caused by controlling the level of noise. Part II Section 4 state that: except as otherwise provided in these Regulations, no person shall:

a) Make or cause to be made excessive vibrations annoys, disturbs, injures or endangers the comfort, response, 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 30 meters from any moving source.

Part III Section 2(1) states that any person wishing to (a) operate or repair any machinery, motor vehicle, construction equipment, pump, fun, 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 provided in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence.

Section 13 (1) states that except for the purposes in sub-Regulation (2) hereunder, 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 domestic nature and/or public utility construction.

Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying site, and state that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose 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.

Relevance to the proposed project: The contractor shall be required to implement these measures, ensure that all machineries are in good working condition to reduce noise.

2.2.7Air Quality Regulations, 2008

The objective of these Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The general prohibitions state that no person shall cause the emission of air pollutants listed under First Schedule (Priority air pollutants) to exceed the ambient air quality levels as required stipulated under the provisions of the Seventh Schedule(Emission limits for controlled and non-controlled facilities) and Second Schedule (Ambient air quality tolerance limits).

Relevance to the proposed project: The proponent shall implement the mitigation measures provided in the EMMP to prevent air pollution

2.2.8 Occupational Health and Safety Act of 2007, CAP 514.

The Act makes provision for the health, safety and welfare of persons employed in factories and other places of work. The provision requires that all practicable measures be taken to protect persons employed in the factory and other places of work from any injury. The provisions of the act are also relevant to the management of hazardous and nonhazardous wastes, which may arise at the project site. The act provides that all measures should be taken

to ensure safety, health and welfare of all the stakeholders in the work place.

Relevance to the proposed project: Workers safety will be given priority during both construction and operation phases of the project.

2.2.9 The Physical and land use planning act 2019

P Section 56 of this act gives the county governments powers to control development within their areas of jurisdictions. It states that Subject to the provisions of this Act, the Urban

Areas and Cities Act, 2011, and the County Governments Act, 2012, the county governments shall have the power within their areas of jurisdiction to—

1. Prohibit or control the use and development of land and buildings in the interests of proper and orderly development of its area;
2. Control or prohibit the subdivision of land;
3. Consider and approve all development applications and grant all development permissions;
4. Ensure the proper execution and implementation of approved physical and land use development plans;
5. Formulate by-laws to regulate zoning in respect of use and density of development;
6. Reserve and maintain all the land planned for open spaces, parks, urban forests and green belts in accordance with the approved physical and land use development plans; and
7. Consider and determine development planning applications made in respect of land adjoining or within reasonable vicinity of safeguarding areas.

”

Relevance to the proposed project: This Act provides for order in terms of development execution. This development should therefore comply with all the provisions of this law including vertical zoning requirements.

2.2.10The Penal Code CAP 63

2.2.11The County Governments Act, No. 17 of 2012

This is an Act of Parliament to give effect to Chapter Eleven of the Constitution, which is to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes. Section 48 provides for decentralization of county government administration units into city or urban areas, sub counties, wards and villages. Section 134 repeals the Local Government Act, CAP 265 that provided for local authorities as institutions

of development control. The proposed project area was formerly under control of Municipal Council of Mavoko but is currently under the Town area of Mavoko under the devolved system of government. The proposed project area is within Mavoko sub county area of Machakos County. Section 103 establishes aspects of county land use and development planning with main objective of facilitating 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.

2.2.13 The Building Code 2000

The building code under Septic and conservancy tanks, section 202 allows for installation of septic tanks where a sewer system has not been provided that the proponent abides with the provisions. The area where the project is to be located a bit far from the existing sewer line though the proponent will ensure that wastewater and sewage is well disposed either through connection to this trunk sewer line or development of own treatment plant.

CHAPTER THREE

3.0 PROJECT DESCRIPTION

3.1 Project Proponent

The project proponent is **FAIRVALLEY HEIGHTS LIMITED, P.O. Box 4159-00506**, Nairobi. The land which the proposed project will be implemented is under lease to the proponent for a period of ninety nine years from 1/2/ 1997 (revisable).

3.2 The location of the project

The proposed project is located in Gimu area, off Mombasa Road near CITAM Athiriver. It is approximately 2 Kilometres off Mombasa Road. The project site lies within geographical coordinates -1.440339, 37.008467 4983f above sea level and within a neighborhood of other proposed and existing residential estates, agricultural parcels and light industry (godowns).

Google earth photo showing the location of the proposed project has been shown in executive summary of this report.

3.3 Site Description

The site is falls within Mavoko Sub-county which shares the vegetation of Athi Kapiti plains that is constituted of grasslands, shrub vegetation with sections of rocky ridges. Currently the land is not utilized A view of the proposed project site is illustrated in Figure below.

Figure 1 A on site photo showing the vegetation in the proposed project site

3.4 Site size, zoning and land use

3.4.1 Site Size

The proposed site falls within Land Reference Number 10426/61 measuring 1.99 hectares and will all be utilized to develop the proposed development.

3.4.2 Site Zoning and Land use

The proposed site is within an area formerly zoned for single dwelling use and due to the nature of the project the proponent has already obtained an approval for change of use from Single Residential to Multi-dwelling residential use. The Structural and Architectural drawing have already been approved. The change of user has been granted. See annexes

3.5 Nature and Design Components of the Project

3.5.1 Overview

The project shall consist of the following:

- 3 blocks which are 8 floors each. The 3 blocks combined contain 102 three (3) bedroom units and 85 two (2) bedroom units.
- 1 block containing 24 one (1) bedroom units
- 18 four (4) bedroom villas
- A commercial zone with adequate shops to support the development
- Ample parking, playground and other social amenities
- The site neighbourhood is sewered and the development will be connected to the sewer line for liquid waste disposal
- The total number of units is 229, all fitted with associated amenities

  There shall be a phase 2 on the same plot in future

3.5.2 Clearing and Preparation of the Project Site

The existing ground situation will be altered through clearing of existing vegetation and other barriers to pave way for development of various proposed development projects on the site. The proponent plans to plant trees and flower gardens to create a green cool environment

3.5.3 Development of Perimeter Wall /Fence

Before the commencement of the construction within the site, a perimeter wall will be laid around the project site with one wide gate. This has been recommended to minimize dust and also noise impacts to the surrounding during construction. It will also ensure safety of materials during construction.

3.5.4 Community Facilities

The proposed estate development will provide for community facilities including playground and shops.

3.5.5 Local Access Roads, Parking and Walkways

The proposed housing estate development has provision for adequate width access roads. The walkways will be at least 2.5 m wide. Car parking spaces will also be provided at the plots and communal facility areas level.

3.5.6 Trunk Infrastructure and Utilities

Water Supply: The proposed development will utilize a private borehole for water supply.

Foul Water Drainage: The proposed development will generate substantive amount of waste water per day. The proposed development will also be connected to a sewer system which fronts the site

Sewer manhole fronting the site

Storm Water Drainage: The proposed development will generate enormous surface water. It is therefore recommended that adequate and well drainage channels be provided to accommodate the increased discharge. The flow of the storm water has been well captured in the plans and the proponent plans to develop a storage tank for storage and use.

Solid Waste Disposal: The proposed development will generate enormous solid waste. It is

recommended that private waste management contractors be contracted to collect the waste. It is further recommended to have one common point on the plot to store the waste before final collection.

Electricity Supply: The proposed development will be connected to the Kenya Power and Lighting Company power supply line. The KPLC electricity supply lines are already available within the neighbourhood of the proposed project site. Plate 2-2 shows a view of

Figure 2 View of electricity lines near the near the project site

Telecommunication: Cell phone services are available in the area for connection to the proposed development.

3.5.8 Landscaping and Tree Planting

The project will involve clearing of vegetation and excavation of soil material. The site development involves cut and fill arrangement, whereby excavated material is used for backfilling. Any excess material will be disposed off-site.

The project site will be landscaped according to scheme plan. This will entail establishment of flower gardens, planting of trees, grass and related ground cover to compensate for any cleared vegetation and to improve general aesthetics of the estate.

3.6 Neighborhood Development

Land use in the area is mostly Resintential, light industry, agricultural and institutional user. See below some photos taken on the neighbourhood.

Figure 3-Similar developments in the Neighbourhood

3.7 Construction Activities and Inputs

All the construction inputs shall be obtained from licensed dealers. The following will be required for successful implementation of construction activities. Construction tools and equipment including machinery mainly transportation vehicles will be used for the transportation of materials and in the execution of the proposed works.

3.7.1 Inputs during Construction

Typical inputs which will be used in construction phase are land and water which will be

readily available. The materials that shall be used include building sand, aggregates, natural stones, either hand or machine cut construction stones, steel and timber for making structural formwork and interior design, tiles for roofing and floor tiles. Others include concrete block for constructing selected internal and external pavements, precast units for drains, PVC pipes for sewer and water reticulation, paints, electrical wiring and fitting, barbed wires, wire mesh, water tanks and gutters. Window casement and glasses, spades, pick axes, and other hand held tools will also be needed.

3.7.2 Construction Activities and Timetable.

The construction activities shall begin from the time NEMA gives approval of the Environmental and Social Impact Assessment Study. The construction activities shall begin with drilling of borehole, development of the artificial water reservoir, perimeter wall fence, gates and gate houses and grading of internal access roads. Site clearing, setting out and excavations for laying of various housing units and ancillary facilities will then proceed. Materials from the excavations of the ground and foundation work will be reused for earth works and landscaping.

3.7.3 Project implementation sequencing/Phasing

i. Pre-construction stage

a) Plan preparation and seeking of the appropriate approvals from the relevant authorities which has been done
b) Appraisal of baseline condition to determine supply and demand for required infrastructural utility services.
c) ESIA Project Report preparation including the necessary approvals.

ii. Construction stage

a) ***Establishment of related works and all support infrastructure that are significant for the construction work****:* This would involve the transportation of machinery and deployment of the workers to the construction site. The machinery would be used for ground breaking and transportation of materials from the sources to the site. The major machineries that will be used include mixers, welding machines and transmission machines. The contractor will also mobilize human workforce at casual, permanent, skilled and unskilled levels.
b) ***Acquisition and transportation of building materials:*** The contractor shall source for

materials for construction from the various available suppliers. Supply of materials will be a continuous activity throughout the project life since different materials will be needed at different phases of the construction. The materials that shall be used in the construction include among others building stones, sand, ballast, cement, timber, reinforced concrete frame, steel, bars, G.I pipes, PVC pipes, pavement blocks, concrete slabs, murram, hardcore, insulated electrical cables and timber among others.

c) ***construction of residential houses and ancillary facilities and services:*** The engineering designs and site layout plans that have been approved shall be implemented.

The setting out will comply with the specifications set out by the client to the contractor under the supervision of qualified engineers. In accordance with the designs and the layout plans, the construction of the proposed project and associated infrastructure will begin immediately NEMA approves the ESIA study report. The contractor will then be supplied with all the approved documents including the ESIA study report.

d) ***Excavation and land filling works:*** Excavation will be carried out to prepare the site for construction of foundations to lay the residential houses and all other proposed facilities and utilities. This will involve the use of heavy earthmoving machinery such as tractors, tippers and bulldozers

e) ***Masonry, Concrete Work and Related Activities:*** The construction of the perimeter walls, building walls, foundations, floors, pavements, drainage systems among other components of the project will involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, 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 labour intensive and will be supplemented by machinery such as concrete mix

f) ***Structural Steel Works:*** The buildings will be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection.

g) ***Roofing and Sheet Metal Works:*** Roofing activities will include iron sheet, raising the roofing materials such as structural timber to the roof and fastening the roofing materials to the roof.

h) ***Transportation of the construction wastes from the site:*** Construction waste that

cannot be used for either back filling or landscaping work at the site will be deposited in approved dumpsites by a contracted licensed waste handler.

i) ***Electrical Work:*** Electrical work during construction of the premises will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets etc. in addition, there will be other activities involving the use of electricity such as welding and metal cutting.

j) ***Power distribution:*** The position for location of power transformer to serve the proposed estate will be determined by experts from KPLC. The project will increase power demand in the area and it is proposed that the proponent should consider other power sources like solar to reduce on the power demand. The proposals include solar power especially for water heating purposes and to supplement power supply when experiencing power outage problems.

k) ***Plumbing:*** Installation of pipe work for water supply and distribution will be carried out within the proposed residential houses and associated facilities. In addition, pipe work will be done to connect sewage from the premises to the main waste water disposal lines, and for drainage of storm water. Plumbing activities will include metal and plastic cutting, the use of adhesives, metal grinding and wall drilling among others.

l) ***Fire protection:*** Self-contained fire detection and alarm system complete with manual call points, optical smoke detectors, heat detectors and electronic sounders will be proposed especially in the kitchen areas. Hose reel fire protection system will be provided to cover the buildings. The system will comprise of a water storage tank, distribution of pipe work and fire hose reels and portable fire extinguishers will be provided at convenient spots. Additional provision will be made for special hazards and high risk areas.

m) **Landscaping and tree planting:** To improve the environmental and aesthetic value or visual quality of the site once construction ceases, the proponent will carry out landscaping and tree planting. This will include establishment of flower gardens and lush grass lawns and will involve replenishment of the top soil. It is noteworthy that the proponent will use plant species that are available locally preferably indigenous ones for landscaping. The proponent has already established a tree nursery in preparation of the trees to be used for landscaping and tree planting.

3.7.4 Occupation/Operational stage

This stage shall involve running and managing the facility as per the laid down rules and procedures.

a) ***Residential activities:*** Once construction is complete, the houses will be ready for occupied by respective owners.

b) ***Solid waste and waste water management:*** The proponent will provide facilities for handling solid waste generated within the facility. These will include dust bins/skips for temporarily holding waste within the premises before final disposal by the contracted licensed waste handler at the designated dumping site. Sewage generated from the residential buildings will be discharged into the sewer system, while the storm water drainage system will also consist of a network of Inverted Block Drains, manholes and road gullies which will discharge to the proposed artificial water reservoir.

c) ***Compound Cleaning:*** The neighbourhood association will be responsible for regular washing and cleaning of the paved and non-paved areas. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents, blooms, rakes, wheelbarrows among others.

d) ***General Repairs and Maintenance:*** The residential and other facilities buildings will be repaired and maintained regularly during the operational phase of the project. Such activities will include repair of building walls and floors, repairs and maintenance of electrical gadgets and equipment, repairs of leaking water pipes, painting, maintenance of the gardens and grass lawns and replacement of worn out materials among others.

3.7.5 Decommissioning Phase

Decommissioning of operations is here taken to mean that the buildings cease to operate and the premises are closed down or reverted to another use. Under such circumstance, the house owners will be expected to adhere to the legislation applicable to such undertaking in the laws of Kenya but in general the decommissioning shall be staggered through a number of steps and measures to rehabilitate the site to its status before the commencement of the buildings occupancy or to a suitable state for its next use. This will involve looking for alternative uses for the site that is compatible to the surrounding and to the former use. An environmental impact assessment shall be commissioned to advice on the environmental

aspects with respect to the identified new use if found necessary. If no other use(s) are found for the site, rehabilitation measures to revert it to its former use a state shall be implemented that include:-

i. Building stones, paving slabs, and other installations of economic use can be sold-off in the market through a biding or auction sale.
ii. Dug up areas such as the boreholes should be backfilled with uncontaminated earth.
iii. All solid wastes including debris shall be disposed in a designated dumpsite.
iv. The site shall be re-vegetated with vegetation capable of protecting the soil from erosion

The owners will then, deregister its operations and legal requirements such as the certificates of operations will be surrendered to the relevant issuing bodies.

3.8 Air Emissions

Relative air emission is expected during construction when dust from construction activities and smoke from construction machinery will be emitted. It is recommended that watering the site especially during dry periods be enforced to keep dust at minimal levels. The employees at the site especially during construction activities shall be provided with dust masks to protect them from dust and fumes associated with construction activities.

3.9 Waste Management

The principle objective of waste management program is to minimize the pollution of the environment as well as to utilize the waste as a resource. This goal should be achieved in a way that is environmentally and financially sustainable.

3.91 Solid Waste Management

The technologies for the management of the solid wastes will incorporate the collection of the waste from the source, transportation of the waste to the place of storage and final disposal through a contracted waste handler. The following waste management techniques shall be used in the different stages of the project.

a) ***During construction:*** The main wastes from the construction site will consist of material residues of the construction materials. These include pieces of concrete, heaps of sand and aggregate, bits and pieces of various pipe types, cans of paint, polythene sheets, paper packaging materials, pieces of timber, and off cuts of metals among others. They

shall be managed as follows:

Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable by the supervising architect and environmental consultant.

Materials from excavation of the ground and foundation works shall be reused for earth works and landscaping.

b) ***During operation:*** During operation phase, residents will contract a licensed waste handler who will collect their household waste at agreed intervals and dump them at licensed waste dumping sites.

3.9.2 Effluent Treatment

During construction stage, wastewater that shall be discharged shall be sprinkled on the working areas to reduce dust generation by the construction machinery. Wastewater during operational stage shall be managed through connection to the wastewater Disposal system (Sewer system). The waste water disposal systems will meet the standard set by the County Government of Machakos, Department of Public Health and NEMA specifications.

3.10 Project Cost and Budget

The total project cost and budget is approximately Five Hundred million shillings. This total cost has been generated from the estimates of expected cost of constructing all the proposed residential housing units, and attendant facilities.

CHAPTER FOUR

4.0BASELINE INFORMATION FOR THE STUDY AREA

4.2Site Conditions

4.2.1 Climate

The climatic conditions of an area highly influences the land use patterns, levels of productivity and general development decisions of the area. The climate of the proposed project site in identifies with that of the Athi River-Mavoko area and wider Athi Kapiti plains. The climatic of this area is of semi-humid, cool temperate, tropical highland type. Below is a summary of the climatic conditions the proposed residential housing estate development is located:

i) Rainfall

The average annual rainfall is 875 mm, which may actually vary from 500mm to more than 1500 mm. The rainfall pattern exhibits a bi-modal distribution, with wet seasons in March – May and October – December corresponding to the long and short rains respectively. Between 70% to 85% of precipitation falls during these rainy seasons.

ii) Temperature

The average annual temperature of the area ranges between 16^{o} C to 18^{o} C, with average minima and maxima of 10^{o} C to 12^{o} C and 22^{o} C to 28^{o} C respectively. The warmest period occurs from January to March with coolest period falling between months of May to August.

iii) Wind Patterns

The area experiences occasional dry season, hot sun with strong winds. A significant feature of the climate of Athi River/ Mavoko area is the frequency with which the wind comes from the North East and to a somewhat lesser degree to the South East. These are the North East and South East Monsoon, which blow very steadily but without high intensity. Both wind run and mean wind speed are at a maximum in December. Winds also remain high during January, February and March which coincides with the period of higher potential evaporation.

iv) Sunshine and Solar Radiation

Solar radiation and sunshine is considered together since they are so closely connected. The area experiences a total of about 2,500 hours of bright sunshine per annum, which is equivalent to annual mean of approximately 6.8 hours of sunshine per day. July and August are characterized by cloudiness and during these months the average daily sunshine in the area is about 4 hours. Frequently there are several days in succession when the sun fails to penetrate the thick stratocumulus cover, although on other days the cloud does break to a greater or lesser extent for a short period. There is about 30% more sunshine in the afternoon than in the morning and it follows that westerly exposures receive more isolation than easterly one.

v) Evaporation

The annual variation of evaporation is as expected from consideration of temperature and sunshine factors. The mean annual evaporation as measured by the pan is seen slightly to exceed the mean rainfall at the altitude of area but it would be expected that at higher altitudes this position would be reversed. The peak evaporation values are during March, followed by January, February and October. The average annual evaporation ranges between 1550 to 2200mm per year.

Vi) Water resource

The surface water and sub-surface water resources in the county are a bit scarce. Most natural rivers and wells in the area and its neighbourhood are seasonal in nature. Therefore the only most reliable source of water in the area are boreholes. This underground water resources are greatly exploited and boreholes drilled in most major developments within the area. A substantial percentage of households in the area also harness rain water through roof catchment .Mavoko water supply in the area is unreliable hence it is received averagely two days per week and sometimes disappear for a whole week.

4.2.2 Geology and Soils

The geology and soils of an area have a great influence on the type of physical development and also determine the type of land use appropriate for the area. The site has leptosols. These soils are limited in depth by a parent rock in about 1.5m deep. This kind of geology is ideal to hold the proposed development. However it is costly to excavate such soils.

4.2.3 Vegetation

The project site is under shrubs and savanna grass vegetation cover. Exotic grass and trees are found along the riparian buffer zones. The proposed project site is situated in an area where single Resintential houses are coming up. See below a photo of the vegetation on site.

Figure 4 A view of shrub vegetation onsite

4.3 Land Use Zoning in the Area

4.3.1 Current Physical Development Planning Policy

There is not current physical development plan for the area. There is no current local physical

4.4 Socio-Economic Profile

Development of the proposed residential housing estate project will be influenced by two important socio-economic aspects, i.e. population/demography and economic trends in the neighbourhood, Mavoko area, Machakos County, and Nairobi City County.

4.4.1 Population Demography

The City County of Nairobi and Machakos County at large are among the key county areas in Metropolitan region that have continued to experience high rates of demographic transition over time. This is mainly due to the urban rural migration as well as natural population increase. The increased population in these areas has led to sprawl of increased housing demand into Syokmau, Athi River/Mavoko area, which acts as a dormitory zone for these adjoining counties. The dynamisms of population growth of Nairobi City County and Machakos County has been analysed in the below Table

Table 1 A summary of Population Growth in Machakos and Nairobi from 1889 to 2009

CITY	1989	1999	2009
Nairobi	1,324,570	2,143,254	3,138,369
Machakos	1,402,002	906,644	442,930
Total	2,726,572	3,049,898	3,581,299

Source: Population and Housing Census Surveys – 1989, 1999 and 2009

Current numbers have increased significantly

4.4.2 Housing Demand in Machakos and Nairobi City Counties

As per census, with inter-census population growth rate of about 3.8%, the two counties had a total population of 3,581,299 persons, with 1,102,889 households, which also represents the housing demand. This is projected to 15,919,694 persons, with 4,902,594 households/housing demands in the year 2049. Therefore, the proposed residential housing development will significantly contribute towards meeting this increasing housing demand for the rapidly growing population within Nairobi and Machakos counties.

4.4.3 Employment Trends in the Area

Currently numerous educational facilities, recreational facilities, industrial establishment and commercial outlet businesses are located in vicinity to this proposed development project. Some of these people would prefer to live close to their places of work. This further justifies the relevance of the proposed housing estate development project in Syokimau area.

4.4.4 Trunk Infrastructure, Utilities and Community Social Services

a) Transport Network

Machakos County, where the proposed project falls is served by a well-established network of all-weather access roads. The main access road connecting the project site to Mombasa road is all weather murram surface and evenly graded. The area is served by the public motor Vehicles but most residents have their own vehicles. A railway station is also well established in Syokimau area which are all well accessible at distances of about KM project site. The Jomo Kenyatta International Airport is also well accessible at a distance of about7 KM from the project site.

b) Water Supply

The area has existence of natural water sources including underground water, seasonal rivers, streams, wells and dams. Due to unreliability of the seasonal natural water sources, most existing major development in the area have exploited underground water sources through drilling of boreholes which have proofed as adequate and reliable source of water.

c) Foul and Storm Water Drainage Systems

Movoko Sub County has a major trunk sewer line running from Kitengela/Athiriver EPZ to the sewerage treatment plants at Kenanie. Most developers within the project area, who are at long distances from existing sewer line, have adopted septic tanks system for foul waste management. Storm water drainage channels for all surface run off are well provided in

existing roads within the area. Storm water generated from existing housing developments in the area is usually harnessed and consumed by the community.

d) Solid Waste Disposal

The solid wastes generated by existing communities in the area is disposed to farm compost pits with some developers especially within organized or gated estates seeking private contractor waste disposal services. Mavoko town area waste disposal trucks also collect damped solid wastes for final disposal especially in areas close to commercial Centres along Mombasa road

e) Energy Supply

The area is well developed and has proper network of Kenya Power and Lighting Company power supply lines. Some development in the area have also exploited solar energy as an alternative or back up source of electricity. The community in the area mostly use charcoal, LPG and firewood as sources of cooking energy.

f) Communication Facilities

The project area is well served with communication network and facilities. This has a strong implication on the socio- economic development activities of the area. Mobile phone services like Orange, Safaricom and Airtel are present in the area

CHAPTER FIVE

5.0PUBLIC CONSULTATION AND PARTICIPATION

5.1Introduction

Public participation is basically concerned with involving, informing and consulting the public in planning, management and other decision-making activities for the project. Public participation ensures that due consideration is given to public values, concerns and preferences when decisions are made. It encompasses the public actively, sharing in the decisions that government and other agencies make in their search for solutions to issues of public interest. Public consultation in this project was done with the following aims:

- ✓ To inform the neighbours and other stakeholders about the proposed project and its objectives.
- ✓ To seek views, concerns and opinions of local community and other people around the area concerning the project.
- ✓ To establish if the local people foresee any positive or negative environmental effects from the proposed project and if so, how they would wish the perceived impacts to be addressed.

5.2 Methodology in Public Consultation

Public participation was mainly achieved through direct interviews, observations and questionnaire administration. Traditionally the tool used to collect information is the administration of open ended questionnaires where the respondent is free to comment on the identified issues.

Respondents were selected among the individual households, institutions surrounding the proposed project site. Most of those consulted were happy to fill the questionnaire freely. The following is a detailed discussion of public consultation methodology used by the ESIA team. The questionnaires were administered with strict adherence covid19 rules. Mostly individua to avoid gathering

5.2.1 Direct Interviews

Direct interviews were used to get responses from the project proponent whose comments were sought through engaging the project unit in discussions about the proposed project and other related issues. We also had direct discussion with architect and engineer who will be implementing the project

5.2.2 Questionnaire Administration within the Neighbourhood

Questionnaires were uniformly distributed around the proposed project site. The local people and neighbours were informed of the proposed project and requested for their views concerning the project. The sample area covered up to a radius of about 500 Metres within the project area which provided view of the immediate neighbours. The questionnaires were used to capture views in terms of the positive and negative impacts that the locals anticipate from the project and the mitigation measures. They were also requested to provide information about the area, focusing on aspects such as sensitive ecosystems, provision of various infrastructure facilities and socioeconomic environmental impacts of the project in the area amongst other issues. The questionnaires administered have been attached at the back of this report.

5.3 Socio-economic Impacts

The local communities were keen to talk to the ESIA field team on the proposed project and they were appreciative of the fact that the field team involved them in responding to the questionnaire in a consultative manner. The people encountered participated actively in raising their concerns and they expressed their hope that lawful procedures will be taken into consideration during the project implementation. In addition, below are the various social economic aspects that the community members raised:

Water: Generally, there is a problem of accessing clean and reliable water in the proposed project area. There is no piped water within the project site and communities' access water from boreholes, seasonal water pans and streams. All the people interviewed expressed confident and optimistic that the proposed project will lead to reliable availability of clean water accessible to the local community.

***Employment*:** Most respondents pointed that the proposed project will create employment to people and especially youth in the area in all phases of the project. This will also directly contribute to the economy of Machakos County and the wider Kenya.

5.4 Environmental views

Waste Management: Waste disposal was highlighted by the local communities as one component from the project activities that will pollute the environment if not properly handled. Respondents proposed waste management methods such private contractor, dust bin installing within estate, waste recycling, county government disposal services, use of septic tanks, connection to main sewer line, and construction of own sewerage treatment plant.

Air quality: Fifteen out of twenty respondents were of the opinion that the proposed project will not affect level of air quality in the area. The rest of respondents were of the opinion that the project will affect air quality of the project area in terms of dust generation during construction phase. A number of respondents proposed planting of trees to minimize deterioration of air quality. They also recommended sprinkling of water to reduce dust. The waste water during borehole drilling and construction will be disposed in the project site to reduce the dust. In addition the Concrete perimeter wall will minimize effects of dust to the immediate neighbourhood.

Traffic: some respondents of the opinion that the proposed project will lead to an increase in both vehicular traffic generation with the area during transportation of materials. These respondents proposed that the project proponent should ensure that materials are not transported during rush hours (Before 8am). The rest of respondents were of the opinion that the proposed project will have nil impact in relation to traffic generation within the area. Some respondents also noted that the anticipated increase in traffic will necessitate improvement of roads in the area leading to convenient access to various community facilities and services during all-weather seasons.

5.5 Support for the Proposed Project

A hundred percent of the total respondents interviewed were in support of the project. Most of these respondents argued that the proposed development was good and recommendable for general development and basically it conformed to other developments in the area. Some quoted that increased development will necessitate services such as sewer lines and water supply from the County government.

CHAPTER SIX

6.0 PROJECT ALTERNATIVES

6.1 Introduction

In deciding on the type of developments to be included in the project, the proponents considered various alternatives. Three options were considered as outlined below. Note that for some issues, little data is available on which to base the assessment, and that many of the judgments are subjective. Also, despite a number of detailed technological alternatives at project proponent's discretion, the technology adopted in this project is informed by conventional building trend in the project area. It's worth noting also that only those alternatives with the potential to materially affect the outcome of the environment have been discussed here.

6.1.1 Zero Option/ No Development

The zero option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures noninterference with the existing conditions. This option will however, involve several losses both to the landowner and the community as a whole. The landowner will continue to pay rent on the plot while the property remains underutilized. The Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:
The landowner will continue to pay rent on the plot while the property remains idle. The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The economic status of the Kenyans and the local people would remain unchanged.
- The local skills would remain underutilized.
- Reduced interaction both at county, national and international levels
- No employment opportunities will be created for Kenyans who will work in the project.
- No housing provided to alleviate a critical shortage high standard commercial use

- Development of infrastructural facilities (roads, electrical etc.) will not be undertaken. From the analysis above, it becomes apparent that the No Project alternative is no alternative to the local people, Kenyans, and the Government of Kenya.

6.1.2 Relocation Option

Relocation option to a different site is an option available for the project implementation. At present the landowner/developer does not have an alternative site. This means that he has to look for the land. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take up to three (3) years although there is no guarantee that the land would be available. The developer will spend another two years on design and approvals since design and planning has to be according to site conditions. Project design and planning before the stage of implementation will cost the developer hundreds of thousands of Kenya shillings. Whatever has been done and paid to date will be counted as a loss to the developer. Assuming the project will be given a positive response by the relevant authorities including NEMA, this project would have been delayed for about two (2) years period before implementation. This is a delay that our economy can ill afford. This would also lead to a situation like No Project Alternative option. The other consequence of this is that it would be a discouragement for private/local investors especially in the housing sector that has been shunned by many public and private investors already aggravating our critical housing shortages. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

6.1.3 Alternative Land use

The proponent has no option to use the land for other purposes other than proposed residential housing estate.

6.1.4 Proposed Alternative

Various alternative methods for development of the proposed project were considered, however in all instances the outstanding difference was either material or technology used but development of the residential development emerged as the most plausible option according to the project area setting and primacy.

CHAPTER SEVEN

7.0 IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 Basis of Identification of Impacts

In order to accurately identify the environmental impacts the following environmental Issues were considered pertinent and important as per the Terms of Reference.

7.1.1 Physical Environment (Biophysical Impacts)

a) Water quality aspects for both surface water sources like piped water, storm water, and other related aspects.
b) Soil conditions, soil contamination and landscape alterations/degradation (based on aesthetic aspects) associated with the proposed project.
c) Drainage patterns especially in relation to wastewater effluents
d) Air quality aspects especially atmospheric emissions and related discharges from machinery like diesel run equipment etc.
e) Noise and vibrations where applicable

7.1.2 Natural Environment

f) Flora and fauna from the adjacent ecosystem (i.e. effects to natural plants and animals where applicable).
g) Adjacent river pollution indicators, impacts on water flow patterns and quality aspects, user interference and contamination.
h) Topography: effects on soil and landscape.

7.13 Social welfare, Economic and Cultural Environment

i) Determination of implications to the human society distribution, demographic details, settlement patterns, changes to the cultural lifestyle and indigenous knowledge of the local society/public where applicable.
j) Notable changes in land use systems and the general land utilization types where applicable.

k) Aesthetic, landscape alterations and changes to infrastructural facilities, among others.

l) Effects associated with the construction and operation activities and related handling and disposal of wastes generated during the operations.

e) Effects associated with income generation opportunities created by the project due to the upcoming operations.

f) Implications on the employees, visitors and public health, safety and related hazards/risks such as HIV/AIDS, consumption of contaminated intravenous infusions products due to disease outbreaks, sanitary facilities, etc.

g) Introduction of nuisances, such as pests, invasive species and related multiplication breeding sites

7.2 Description of the Existing and Anticipated Impacts

7.2.1 Existing impacts

There were no major environmental impacts at the time of the study.

7.2.2 Anticipated impacts

The anticipated impacts of the proposed project on the environmental elements are both positive and negative. The magnitude of each impact is described in terms of being significant, minor or permanent, short-term or long term, specific (localized) or widespread, reversible or irreversible. The table below shows the assessment criteria for the significant impacts are.

Table 2-Potential Environmental and social impacts

Impacts on **Or due to**	**Remarks**
Noise Pollution	During construction, hooting of construction vehicles and communication by workers may generate relative noise and vibration that may have

	Some negative effect to the neighborhood. This will however be very minimal as light tools and Equipment will be used for construction activities. There shall be no noise pollution during operation stage as residential related activities do not cause Significant noise.
Oil waste pollution	Petroleum oils and grease used in vehicles and construction machinery may spill or leak on/into the ground hence into the soil or water system Within the neighborhood. During occupation, oil waste mainly from the kitchens may find their way into the sewerage Network. Sound and up to date pollution control measures will be put in place to mitigate this Impact.
Air/Dust Pollution	During construction, dust and exhaust emission from the construction activities, may pollute the ambient air. This will be minimal as the site will be dampened to reduce dust generation. Operation phase of the project is not associated with dust/air pollution.
Soil erosion	Earthworks during project construction usually influence soil erosion. By Incorporating appropriate soil conservation measures and proper drainage facilities both during construction and operation phase of the project, soil erosion problem will completely be minimized.
Pressure on water resources	During construction, the proponent will source reasonable amounts of water for the construction

	activities from water vendors in the neighborhood.
	Waste water from Construction activities will be recycled and used to wet the site. A borehole will be drilled to serve the residents after the proponent has acquired a water abstraction permit from WRMA during the Operation phase.
Vegetation and flora	There will be minimal clearance of vegetation during excavation and demolition activities. The proponent will landscape with vegetation within the compound once construction activities are Completed.
Water Quality	The removal of vegetation will increase the runoff and therefore sedimentation will increase in these areas as well.
Public Health	During the construction process, health threats will only be limited to the workers on site.

7.3 Positive Impacts

There are a number of positive benefits associated with the proposed development. The Following are some of the positive benefits anticipated:

Table 7-3; Positive Impacts of the Proposed Development and Justification

No	Positive Impacts	Justification
1	Provision of high class and affordable housing to the Residents.	The proposed project will provide affordable housing to the residents with emphasis on their safety and well being

2	Generation of direct and indirect employment and income	Besides the direct employment by the proposed development, other forms of employment are likely to result from the spillover effects, through indirect services During the construction and operation phases. The employment opportunities will generate income and improve the living standards of the local population and its Environs.
3	Contribution To Government Revenue	Through payment of relevant taxes, rates and fees to the national and county governments, the project will Contribute towards the national and local revenue earnings.
4	Economic investment.	The proponent will receive returns on his Investments hence increases in wealth.
5	Improved Security.	Security will be ensured around the proposed development Through distribution of suitable security lights and presence of 24 hour . This will lead to improvement in the general security in the surrounding area.
6	Social amenities such as Play ground	The proposed project will boost social amenities in the general area and this will stimulate more development for the Machakos County
7	Creation of market for local goods and services.	The proposed project will create demand for local farm produce and this will greatly benefit small scale farmers within the project area.

7.4 Specific Negative Impacts during Construction and Operational Phases and Mitigation Measures

The issues that are seen as likely to negatively affect the environment and population therein Include the following:

7.4.1 Air quality

Construction Phase

Dust is likely to be generated due to excavation activities, during building construction and deliveries of sand. There may be minimal air pollution due to combustion of fossil fuels expected from construction machinery. The proponent will ensure that plant and equipment which will be acquired for on site preparation of pre-cast materials and concrete mixing will utilize the latest technology to have minimum emission.

Operational Phase

During operational phase, air quality is not likely to be affected.

Potential mitigation measures

Provision of full protective gear for workers. Workers shall also be sensitized on hazards encountered in such work environment and shall undergo regular health check-ups.

Watering access roads and the site to suppress dust

Covering truck loads using tarpaulins

Personnel will be also provided with dust masks to avoid inhalation of the same.

7.4.2 Soil Erosion

Construction Phase

The activities involved in the site preparation and construction phase of the development may have a major negative and moderate impact on soil and geology of the project site. This is due to the removal of vegetation from the area which will leave considerable areas of soil exposed to the elements, which may result in soil erosion. Heavy machinery will be traversing the site due to the construction activities this may lead to soil compaction and erosion of the soil. Uncontrolled soil erosion can have adverse effects on the local water bodies.

Operational phase

The building roofs and pavements will lead to increased volume and velocity of storm water or runoff flowing across the area covered by the buildings. This will lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems in addition to increased erosion or water logging in the neighboring areas.

Potential mitigation measures

Excavation should be done under controlled conditions which will include minimizing vegetation removal, avoiding creating large open expanses of bare soil, creating wind breaks, using of single or few designated tracks to bring vehicles into the area and watering using water.

Landscaping should be done on the land during the operation phase and de-commissioning phase to ensure that the same is returned to its original state. The contractor should also provide adequate soil conservation structures to ensure that areas prone to soil erosion are protected from runoff.

7.4.3 Solid Waste

Construction Phase

A significant amount of solid waste will be generated in this phase through the clearing of vegetation. The other activities that will generate related solid wastes include stones, wood, broken glasses, containers, rods of metal, sharp objects (nails) etc. This will therefore have a major negative short-term impact on solid waste collection in the area. The proponent should take the initiative of removal of the solid waste which is expected to be generated during this phase of the development.

Operational phase

The project is expected to generate enormous amounts of solid waste during its operation phase. Solid waste will be generated from the residential houses and the associated facilities. The accumulation of solid waste can cause the proliferation of domestic pests such as rats (*Rattusnorvegicus*and *Rattusrattus*. These vermin are very destructive and can rapidly multiply especially where garbage collection is infrequent and therefore food is abundant. This phase may also encourage stray animals such as dogs which can be nuisance species because they may bring with them ecto-parasites such as fleas (*Ctenocephalidescanis*) and ticks (*Ixodes sp*.) which can create health problems for domestic pets. The bulk of the solid waste generated during the operation of the project will consist of paper, plastic, glass, metal, textile and organic wastes.

Such wastes can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on animal health. Some of these waste materials especially the plastic/polythene is not biodegradable may cause long term injurious effects to the environment. Even the biodegradable ones such as organic wastes

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may be injurious to the environment because as they decompose, they produce methane gas, a powerful greenhouse gas known to contribute to global warming.

Potential mitigation measures for solid waste

Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable to the supervising architect and environmental consultant.

Materials from excavation of the ground and foundation works shall be reused for earth works and landscaping.

Bins/ receptacles shall be placed at strategic locations within the site as collection centers to facilitate separation and sorting of the various types of wastes.

The contractor and proponent shall work hand in hand with private refuse handlers and Mavoko Sub-County to facilitate sound waste management.

The wastes shall be properly segregated and separated to encourage recycling of some useful waste materials i.e. some demolished stone and concrete materials can be used as backfills.

Use of an integrated solid waste management system through a hierarchy options i.e. source reduction, recycling, composting and reuse shall be encouraged. This will facilitate proper handling of solid waste during operation stage.

7.4.4 Noise pollution

Construction phase

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

Operation Phase

This phase is not likely to cause noise pollution as residential activities do not cause any significant noise.

Proposed mitigation measures

Equipment to be used should be selected on the basis of the noise minimization during acquisition.

Equipment should also be properly maintained while in use during the construction phase.

The equipment to be used should be located far away from the receivers and also so as to prevent interference, the proponent should ensure that construction is done between.

The proponent should also establish the noise levels during construction and install appropriate noise barriers and acoustic screens.

Buffer zones of undeveloped land should be maintained between the project area and the neighbors.

7.4.5 Increased Water Demand

Construction Phase

This phase of the development might place a strain on an already limited supply through the construction of buildings and other infrastructural works proposed for the development. This will create additional demand to the water supply within the project vicinity as most people source water from Mavoko Water and Sanitation Company which is unreliable. The development will draw water from a private borehole to meet demand

Operational phase

The operation phase of the proposed development might place a strain on the water availability in the area. Even with the use of recycled water for irrigation, the current supply will have a cumulative major negative impact on already limited supply. This phase of the development will therefore have a major negative long-term impact on the water availability in the area.

Potential mitigation measures

Provision of notices and information signs within the project site to notify on means and needs to conserve water resource.

Installation of water conserving taps will be done.

Encourage water recycling during both construction and occupation phases of the project.

Practice rain water harvesting to supplement the borehole water.

Construction phase

Clearance of land and excavation works will lead to increased soil erosion at the project site and release of sediments into the drainage systems.

Operational phase

The building roofs and pavements will lead to increased volume and velocity of storm water or runoff lowing across the area covered by the buildings. This will lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems.

Potential mitigation measures

Leveling the project site to reduce run-off velocity and increase infiltration of rainwater into the soil.

Drainage channels shall be installed in all areas that generate or receive surface water. The channels will be covered with gratings or other suitably approved materials to prevent occurrence of accidents and dirt entry that may compromise flow of run-off.

The channels shall be designed with regard to peak volumes.

Paving of the sidewalks, parking and other open areas shall be done using pervious materials i.e. concrete blocks to encourage water percolation thus reducing run-off volume.

7.4.7 Oil Leaks and Spills

It is important to note that oil/grease spills are prevalent in construction sites and in most areas that make use of petroleum products. Such products contain detrimental elements to the environment. They contain such heavy metals 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 machinery must be keenly observed not to leak oils on the ground. This can be affected through regular maintenance of the machinery.

Maintenance must be carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground. Such areas should be covered to avoid storm from carrying away oils into the soil or water systems. Waste water/ wash water from these areas should be properly disposed.

All oil products and materials should be stored in site stores or in the contractor's yard. They should be handled appropriately to avoid spills and leaks.

Car wash areas and other places handling oil activities within the site must be well managed and the drains from these areas controlled. Oil interceptors must be installed along the drainage channels leading from such areas.

7.5 Socio-Cultural and Socio-Economic Impacts

7.5.1 Increase in Population

There is currently no evidence of overcrowding in around the development area and therefore there will be minimal variations on its demography. The population growth rates in the area are not expected to be consistent in the future however, as there has been a significant increase in the number of approved and proposed developments for the Mavoko areas. These proposed developments will serve to attract migrants to the area who will be seeking employment during construction phase. This will result to an increase in population.

In the operational phase, the area will experience immigrants who will become the new residents of the constructed houses and this will impact on the population of the area.

Proposed mitigation measures

Planned settlement, ensuring that adequate social and other infrastructure meet the needs of occupants.

7.5.2 Employment and Income

The residents polled in the area are excited about the increase in job availability that the development will bring. Any available jobs will be provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the county and national levels. This phase of the development will provide the most benefits in terms of sustained employment and increase in income. Initially, the site preparation phase will employ specific vehicles and equipment in order to clear vegetation, for landscaping and grading and leveling and the cutting of access roads for these vehicles and laborers to access the site. This means that many skilled workers will be necessary to operate front-end loaders, excavators, bulldozers and backhoes and other vehicles. In addition to this unskilled labourers will still be necessary for other tasks. This phase of the development will therefore have a short-term major positive impact on the employment and income at the local level. During operation phase, employment opportunities will be created e.g. at the laundry and maintenance personnel.

Proposed mitigation measures

The proponent should encourage recruitment of labour from the locals for unskilled and semi-skilled labour. For skilled labour this will depend on how much is available locally and the shortfall shall be supplemented by artisans from outside.

The proponent will give equal opportunities to women where possible.

7.5.3 Increased Energy Demand

The construction and operation phases of the development will impact slightly on the electricity supplying the area as well as demand will increase.

Proposed mitigation measures

All electrical appliances should be switched off when not in use during construction and operation phases.

Use of energy conserving electric lamps for general lighting during operational phase.

Residents should utilize natural light when inside their houses to avoid using electricity for lighting during the day.

The contractor should ensure that all buildings have access to natural light during the day.

7.5.4 Workplace Accidents

Workers at the site may be exposed to various workplace accidents especially during construction period. These include being hit by falling objects and falling off from elevated heights among others. During operation period, accidents may include exposure to exposed electrical parts.

Potential mitigation measures

Occurrences of accidents may be prevented by observing the following:

- Ensuring that the operational manuals are available and accessible for every equipment/machinery used at the site.
- Proper maintenance of all machinery and equipment to prevent premature failure or possible accidents
- Ensuring all electrical equipment and machinery are properly grounded
- Only properly trained employees to operate equipment or machinery and proper instructions in their safe operation is provided.
- Workers to wear personal protective equipment (PPE)
- Naked wires should always be sealed

7.5.5 Site Security

Security of the site and those working within is of utmost significance and those operating within the facility must be assured of their security at all times. Security lapses that may lead to injury of occupants of the building and loss of personal property should be taken care of.

Potential mitigation measures

- The management shall strategically install lighting as well as security alarms and backup systems including surveillance of the area on a 24 hours basis.
- Security guards shall guard the property in a 24-hour basis and document any suspicious movement within the facility and its environs.
- The proposed project site will be completely under a fence.

7.5.6 Fire Hazards

The operations that lead to fire outbreaks include poor handling of electricity systems, faulty electrical equipment, carelessness etc. These should be avoided both during construction and

operation phases of the project.

Potential mitigation measures

In this regard, the design of the project has provided and recommended implementation of firefighting measures and control facilities. These include the following:

Installation of an automatic fire alarm system for the building

Provision of firefighting equipment and hydrant points

Display fire excavation procedures and emergency at the buildings

Regular maintenance of fire electrical and first aid equipment

Provision of sufficient fire exit points and fire assembly points

7.5.7 Road Infrastructure

Traffic along Syokimau road may increase during construction phase since vehicles will be accessing the site to deliver construction materials, to take away waste materials and experts coming for supervision purposes. The roads in their current states will be able to handle this increased traffic including for heavy-duty equipment traffic. This phase of the development may have a major negative impact of surface status deterioration on the present road network in the study area.

Operational Phase: During the operation phase of the project, there might be a major negative impact on the road network in the area as the volume of traffic associated with the development will increase significantly, therefore placing a strain on the existing road network. Within the immediate environs of the project site the following traffic measures and rules will be observed:

- Maximum speed limit within this area will be 20km/hr for both operation and personal vehicles
- Speed limits and all other road signs and traffic rules shall be strictly observed.
- Vehicles will be used for the purposes to which they are intended only.

7.5.8 Occupational Health and Safety (OHS)

Construction phase

During the proposed project construction works, there may be increased risks to health and safety such as dust, air, and noise pollution. The workforce and general public involved would be more subjected to these possible environmental hazards and disturbances. Food for the construction workforce is usually provided by individuals most of who in most cases operate without public health licenses. This can compromise health of the workers especially if such foodstuff is not prepared following strict hygiene standards. Flammable substances including diesel and motor oil may be stored or used within the project site for heavy-duty equipment. These substances are precursors for fires and explosions, which may range from small incipient to larger fires of great intensity, which generates heat causing damage to property, injuries or loss of human life.

Operational phase

It is expected that most residents will used LPG for cooking which is also highly flammable, which may increase the vulnerability of the operation to a fire or an explosion.

Potential mitigation measures

During construction, the contractor will be required to prepare a waste management plan for the worksites and equipment camp at the start of the project. The site is to be kept clean, neat and tidy at all times. The contractor shall implement measures to minimize waste and develop a waste management plan to include the following:

All personnel shall be instructed to dispose of waste in designated waste baskets.

At all places of work, the contractor shall provide litter collection facilities.

The final disposal of the site waste shall be done at the location that shall be approved by the engineer on site. This must be in full recognition of the existing legal requirements.

There shall be provision of sufficient bins to store the solid waste produced on a daily basis.

Wherever possible, materials used or generated by construction shall be recycled. Provision shall also be made of responsible management of any hazardous waste generated during the construction works.

Workmen shall be provided with suitable protective gear (such as dust masks, ear muffs, helmets, overalls, industrial boots etc.) particularly during construction. There must be fully equipped First Aid kits on site and a safety officer who has First Aid training and knowledge of safety procedures. In addition, the contractor must have insurance for the workmen.

The contractor will be required to adhere to Occupational Safety and Health Act (OSHA) of2007, especially the building operations and works of engineering construction rules and its subsidiary and supplementary regulations on safety and public health in the construction activities.

7.5.9 Social Conflict with the Community

Projects of such magnitude usually attract public uproar (especially from the neighboring residents and community) if they are not made to own the project. Conflicts usually arise mostly from the foreseen negative impacts and increased interactions from the increase in population levels.

Potential Mitigation measures

Consultation with neighbors on the mitigation measures prescribed for the negative impacts as a way of conflict resolution and neighborhood association.

The proponent will give women equal employment opportunities as men whenever possible. The proponent will give priority to the local community in allocation of jobs at both skilled and unskilled levels.

CHAPTER EIGHT

8.0 ENVIRONMENTAL & SOCIAL MANAGEMENT & MITIGATION PLAN (ESMMP)

8.1 Significance of ESMMP

This is aimed at identifying mitigation measures for negative impacts already identified so that the mitigation measures are incorporated. The mitigation measures will on the one hand eliminate or offset adverse environmental and social impacts or reduce them to acceptable levels and on the other hand reinforce measures for enhancements. The strategies employed for impact mitigation are avoidance, reduction and remedy as suggested in the Table below.

8.2 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 CAP 387 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.

ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN FOR CONSTRUCTION AND OPERATION

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Pre-construction

ENVIRONMENTAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	COST (KES)	MONITORING MEASURES
Commissioning of the Construction Works	- Site hand-over and Ground breaking	Project team (Lead Consultant/Architect, contractor Proponent)	Part of/Covered in the Project Cost	Presence of the project Team
Securing the Construction Site	- Construction of Perimeter Wall and Hoarding	Contractor	Part of/Covered in the Project Cost	Presence of Perimeter Fence
Security for Construction Material	- Construction of Site Stores - Construction materials to be delivered in small quantities to minimize storage problems	Contractor	200,000	Presence of Site guard
Extraction and Use of Building Materials	- Availability and sustainability of the extraction sites as they are non-renewable in the short term - Landscape changes e.g. displacement of animals and vegetation, poor visual quality and opening of depressions on the surface	Contractor/Proponent/project team	Part of/Covered in the Project Cost	Material site rehabilitation
Collapse of Building during Construction	- Ensuring Building Strength and stability - Use of appropriate construction materials and reinforcements as per specifications - Ensuring building components are as per designs - Proper supervision - Ensure proper timelines are followed e.g. curing time	Contractor/project team	Part of/Covered in the Project Cost	Presence of the project Team
Disturbance of Traffic flow during construction	- Proper signage - Awareness creation - Education to truck drivers	Contractor/Project team and general public	100,000	- Presence of site Notice Board /Hoarding - Presence of Security guards to control traffic - Presence of warning signs.

Construction phase

ENVIRONMENTAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	COST (KES)	MONITORING MEASURES
Soil Excavation leading to site disturbance	- Excavate only areas to be affected by buildings - Dumping of excess excavated materials to sites designated by NEMA and Council	Contractor	1,000,000	Landscaping after completion of construction

Occupation Phase				
Architectural incompatibility leading to distortion of neighbourhood aesthetic image	- Harmonize building scale with existing developments in neighbourhood. - Harmonize detail, material and finishes for roofs and walls with existing development in the neighbourhood.	Architect Proponent Contractor	Part of/Covered in the Project Cost	- Compatibility with the neighbourhood
Solid Waste Generation and Management	- Regular inspection and maintenance of the waste disposal systems during operation phase - Establish a collective waste disposal and management system for each component of the development - Provide waste disposal bins to each house well protected from adverse weather and animals - Ensure waste materials are disposed of on Council and NEMA approved sites - Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent Estate Managers	500,000	- Presence of NEMA registered waste management companies - Presence of waste handling bins - Absence of wastes
Liquid Waste Generation and Management	- Regular inspection and maintenance of the waste disposal systems during the operation phase. septic tanks have been provided to adequately handle liquid waste	Proponent	2,500,0000	- Presence of adequate conservancy tank - Presence of waste handling bins
Increased loading on Infrastructure services - Increased vehicular and/or pedestrian traffic - Increased demand on water, sanitation services	- Have paved local access road and walkway system - Encourage rainwater harvesting - Provision of increased water storage capacity - Provide adequate storm water drainage system	Contractor Proponent Estate Managers	500,000	- Absence of run-off - Presence of good roads - Pavements and drainage channels
Traffic	- Provide adequate parking facilities within the project site	Contractor/Proponent Residents	Routine operation procedure	- Presence of amble parking in the premises
Possible fire out break	- Provide fire assembly points for incase of such happening - Multiple exit points to be provide in all components of the development - Water hydrants to be strategically provided and should be easy to operate - Provide fire extinguishers in all the components of the development. They should be properly functioning at all times	Proponent/ residents	1,200,000	- Presence of fire assembly points - Presence of multiple exit points - Presence of functional water hydrants - Presence of firefighting machines
Noise pollution and air pollution	- Ensure use of serviced equipment.	Contractor	350,000	No complaint for noise and air pollution
Storm Water impacts	- Provide roof gutters to collect and direct roof water to drains - Construct drains to standard specifications - Develop a storm water drainage system and linkage to natural drains	Proponent Contractor	700,000	Absence of Flooding and dampness in the building

Architectural incompatibility leading to distortion of neighbourhood aesthetic image	- Harmonize building scale with existing developments in neighbourhood. - Harmonize detail, material and finishes for roofs and walls with existing development in the neighbourhood.	Architect Proponent Contractor	Part of/Covered in the Project Cost	- Compatibility with the neighbourhood
Solid Waste Generation and Management	- Regular inspection and maintenance of the waste disposal systems during operation phase - Establish a collective waste disposal and management system for each component of the development - Provide waste disposal bins to each house well protected from adverse weather and animals - Ensure waste materials are disposed of on Council and NEMA approved sites - Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent Estate Managers	500,000	- Presence of NEMA registered waste management companies - Presence of waste handling bins - Absence of wastes
Liquid Waste Generation and Management	- Regular inspection and maintenance of the waste disposal systems during the operation phase. septic tanks have been provided to adequately handle liquid waste	Proponent	2,500,0000	- Presence of adequate conservancy tank - Presence of waste handling bins
Increased loading on Infrastructure services - Increased vehicular and/or pedestrian traffic - Increased demand on water, sanitation services	- Have paved local access road and walkway system - Encourage rainwater harvesting - Provision of increased water storage capacity - Provide adequate storm water drainage system	Contractor Proponent Estate Managers	500,000	- Absence of run-off - Presence of good roads - Pavements and drainage channels

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Noise pollution and air pollution	- Ensure use of serviced equipment.	Contractor	350,000	No complaint for noise and air pollution
Storm Water impacts	- Provide roof gutters to collect and direct roof water to drains - Construct drains to standard specifications - Develop a storm water drainage system and linkage to natural drains	Proponent Contractor	700,000	Absence of Flooding and dampness in the building
ENVIRONMENTAL IMPACT	**MITIGATION MEASURES**	**RESPONSIBILITY**	**COST (KES)**	**MONITORING MEASURES**

Disruption of existing natural environment and modification of micro-climate – - Increased development density - Increased glare/solar reflection - Reduced natural ground cover/surface run-off	- Development restricted to follow zoning policy/approved density – building line, plot coverage and plot ratio. - Careful layout and orientation of buildings to respect wind and sun direction. - Adequate provision of green and open space planted with grass, shrub and tree cover. - Minimum use of reflective building material and finishes for roof, wall and pavement.	Project team (Contractor Proponent, Architect or Lead Consultant, etc)	800,000	Proper orientation Planted trees/Landscaping
Insecurity	- Ensure secure perimeter wall where applicable around the development - Have a single entry point that is manned 24 hours	Contractor, Proponent Neighbourhood Estate Managers	2,000,000	Presence of perimeter wall Presence of day and night security guards
Decommissioning Phase				
Building Safety	Assess the condition of buildings to ascertain usefulness	Engineer/Proponent	600,000	Engineer and Tests on the building
Land and Building use	Ascertain the Planning development policy	County Government of kirinyaga Physical Planner	150,000	Consultants present
Accidents/Injuries	Securing the Site by fencing off	Contractor/Proponent	300,000	Presence of perimeter fence
Un-disconnected Services e.g. Power, Water, telephone, sewer oil pipes etc	Ensure disconnection of all services Remove all surface and underground cables and wiring	Contractor	1,000,000	Absence of cabling
Solid Waste Generation **(demolition waste)**	- Ensure waste materials are disposed of by the county in NEMA approved waste disposal sites - Ensure re-use of materials that can be re-used -Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent/Contractor	300,000	Absence of Debris
Noise and Vibration	- Ensure use of serviced equipment. A service lane has been used between the petrol station and residential area. It's used as a buffer zone to reduce disturbance in the residential area - Switch off engines not in use - Demolition work to be confined to between 8am to 5pm - Ensure use of earmuffs by workers	Proponent/Contractor	200,000	Lack of complaints from the neighbours

CHAPTER NINE

9.0 CONCLUSION AND RECOMMENDATIONS

9.1 Overview

From the foregoing analysis, the social and economic rating for this project is highly positive. Evaluation of alternatives has already shown that options are limited and costly. Already the proponent has sunk a substantial amount of money in the project up to design stage. Further delay of the project is denying all stakeholders the anticipated benefits of the investment. On the other hand, redesigning or relocation will lead to loss of time and money that is already tied in the preliminary costs of the project. The project does not pose any serious and negative environmental impacts. Adequate mitigation measures have been proposed to address any of the negative impacts arising from the project. The project will create employment and improve income earnings. The project will boost the diminishing housing supply in the country and more in urban areas.

During the preparation of this report for the proposed development it is observed and established that most of the negative impacts on the environment are rated low and short term with no significant effect. The positive impacts are highly rated and will benefit all stakeholders and the County residents at large. The project proponents have proposed to adhere to prudent implementation of the environmental management plan. They are obtaining all necessary permits and licenses from the relevant authorities and have qualified and adequate personnel to do the project as proposed. They have proposed adequate safety and health mitigation measures as part of the relevant statutory requirements

9.2 Conclusion

This study is recommendable and should be approved by NEMA for issuance of an ESIA license subject to annual environmental audits after it has been completed and occupied. This will be in compliance with the Environmental Management and Coordination Act of 1999 and the Environmental Impact Assessment and Audit regulations, 2003. Above all the proponent should carry out Environmental Audit 12 months after the project is completed.

REFERENCES

1. GOK 2002: water Act Law of Kenya. Kenya Gazette supplements no. 107 (Acts No 9) NairobiOctober 2002

2. GOK 1978: Local Government Act (cap 265) laws of Kenya.

3. GOK 1986: Sessional paper no 1 of 1986 on development prospects and policies, GovernmentPrinters

4. GOK 1999: Sessional paper No 6 of 1999 on Environmental and Development.

5. GOK 1999: Environmental Management and Coordination Act (EMCA) 1999.

6. Republic of Kenya (2005). Machakos District Strategic *Plan* 2005-2010 for Implementation of the National. Population Policy for Sustainable *Development*

7. Republic of Kenya, (1968): The Building Code.

8. Republic of Kenya, (1968): The Local Government Act (Cap 265).

9. Republic of Kenya, (1972): The Public Health Act, CAP 242.

10. Republic of Kenya, (2007): Occupational, safety and health Act No. 15, 2007.

11. Republic of Kenya, (1996): The Physical and land use Planning Act, 2019.

12. Republic of Kenya, (1999): Environmental Management and Coordination Act cap 387

13. Republic of Kenya, (2003) Legal Notice No. 101: The Environmental (Impact Assessment and Audit) Regulations, 2003.

14. Republic of Kenya, (2009): National Land Policy, 2009.

15. Republic of Kenya, (2010): Constitution.

16. Republic of Kenya, (2012) The County Governments Act, No. 17 of 2012

17. Proposed development site and architectural plans

18. Reference to other ESIAs of the area prepared by the consultants