iPlan CONSULT (Intl) LTD.

Innovative Spatial Use - Planning for the Future

P.O. Box 28634 - 00100 NAIROBI

ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED RESIDENTIAL APARTMENTS ON PLOT L.R. NO 12715/537 OFF SYOKIMAU AIRPORT ROAD, ALONG CHADY ROAD IN SYOKIMAU AREA, MACHAKOS COUNTY

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

PROPONENT:

SUNPARK LIMITED

P.O.BOX 32705-00600

NAIROBI

DECEMBER 2020

DOCUMENT AUTHENTICATION

This Environmental Impact Assessment Study report has been prepared by **iPlan Consult (Intl) LTD** (NEMA Reg No. **7597**) in accordance with the Environmental Management and Coordination Act (EMCA) 1999 and the Environmental (Impact Assessment) and Audit regulations 2003 which requires that every development project must have an EIA report prepared for submission to the National Environmental Management Authority (NEMA). We the undersigned, certify that the particulars in this report are correct and righteous to the best of our knowledge.

EIA/EA LEAD EXPERT:

iPlan Consult (Intl) LTD (NEMA REG NO: 7597)
P.O BOX 28634-00100, NAIROBI
TEL: 02022251702 / 0203546499 CELL: 0721891005
EMAIL: sk.mbuta@gmail.com, iplanconsult1@gmail.com

Signature……Date…..…...……

SHADACK K. MBUTA (NEMA REG. NO 6315)

PROPONENT:

SUNPARK LIMITED
P.O.BOX 32705-00600
NAIROBI

Signature……..……Date……..……

ACRONYMS

EA	**Environmental Audit**
EIA	**Environmental Impact Assessment**
EMCA	**Environmental Management Coordination Act**
EMP	**Environmental Management Plan**
EMS	**Environmental Management System**
Ha	**Hectare**
HFCs	**Hydro fluorocarbons**
ICT	**Information Communication Technology**
IEA	**Initial Environmental Audit**
KPLC	**Kenya Power and Lighting Company**
KRA	**Kenya Revenue Authority**
MDGs	**Millennium Development Goals**
NEAP	**National Environment Action Plan**
NEC	**National Environment Council**
NEMA	**National Environment Management Authority**
NPEP	**National Poverty Eradication Plan**
SHE	**Safety, Health and Environment**
TOR	**Terms of Reference**
UNFCCC	**United Nations Framework Convention on Climate Change**
WRMA	**Water Resources Management Authority**
WSB	**Water Services Board**
WSRB	**Water Services Regulatory Board**

EXECUTIVE SUMMARY:

iPlan Consult (Intl) LTD ,a NEMA registered EIA/EA Firm of expert has been contracted by **Sunpark Limited (**herein referred to as the proponent**)** to carry out an Environmental Impact Assessment study report for the proposed Residential apartments comprising of fifteen (15) no. blocks of residential apartments consisting of a total of 360 units. The apartments comprise of typical three bedroom units & two bedroom units with each block having five (5) storeys on Plot L.R No. 12715/537 located off Syokimau Airport road, along Chady road, in Syokimau area, Machakos County. A change of use for the proposed development has been acquired from Mavoko Sub-County, Machakos County. This EIA report has been undertaken to comply with the Legal requirement stipulated in the Environmental Management and Coordination Act CAP 387 and the subsequent Legal supplement of 2003.

Environmental Impact Assessment is a tool for environmental Planning and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 second schedule 9 (1), and Environmental (Impact Assessment and Audit) Regulation, 2003, new projects must undergo Environmental Impact Assessment. The Report of the same must be submitted to National Environment Authority (NEMA) for approval and issuance of relevant certificates. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment.

Scope Objective and Criteria of the Environmental Impact Assessment (EIA)

The Kenya Government policy on all new projects, programmes or activities requires that an Environmental Impact Assessment is carried out at the planning stages of the proposed undertaking. The scope of this Environmental Impact Assessment, therefore, covered:

- The baseline environmental conditions of the area,
- Description of the proposed project,
- Provisions of the relevant environmental laws,
- Identification and discuss of any adverse impacts to the environment anticipated from the proposed project,

- Appropriate mitigation measures,
- Provision of an environmental management plan outline.

The scope of the assessment covered construction works of the proposed residential development and associated facilities which includes ground preparation, masonry, and installation of service lines as well as the utilities required by the estate. The output of this work was a comprehensive Environmental Impact Assessment Report for the purposes of applying for an EIA license.

The main objective of the assignment was to assist the proponent prepare an EIA study Report after carrying out an Environmental Impact Assessment (EIA) of the proposed Residential Development and associated facilities to ensure that appropriate measures to mitigate any adverse impacts to the environment are taken into consideration. The Environmental Impact Assessment carried out on the project identified existing and potential environmental impacts and possible concerns that interested and/or affected parties have with the development, as well as the associated prevention and mitigation measures for the negative impacts as stipulated in the environmental Management Plan (EMP) proposed.

Methodology outline

The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, CAP 387
- Environmental scoping that provided the key environmental issues
- Desktop studies and interviews
- Distribution of questionnaires
- Physical inspection of the site and surrounding areas
- Reporting

Housing market in Kenya has recently become one of the most lucrative businesses, many development companies and individuals are now putting up modern housing units for rental and sale, this has become possible by the many banks and financial institutions which are now offering loans and mortgages to both developers and home buyers at subsidized rates.

The report gives in detail the project background, its goal and objectives, scope, project justification and cost, baseline information, Policy- legal and institutional framework governing the exercise, identification of impacts and their respective mitigation measures, a clear description of the project's alternatives and a comprehensive environmental management plan to avert or minimize the anticipated impacts. The EIA study report has eight chapters in total.

Project objective

The main objective of the assignment was to assist the Proponent prepare a study report after carrying out an Environmental Impact Assessment (EIA) of the proposed Residential apartment Development to ensure the proposed development takes into consideration appropriate measures to mitigate any adverse impacts to the environment.

Project Description

The proposed project will involve construction of fifteen (15) no. blocks of residential apartments consisting of a total of 360 units.

Impacts and Mitigation Measures

Adequate environmental management systems will be incorporated during the entire planning, construction and operating stages of the project to minimize any adverse environmental impacts and assure sustainable development of the area.

Conclusions and Recommendations'

The proposed project offers significant boost to the national, regional and local economy. The project will provide housing for middle class population in the county which is a growing niche in the recent years in Kenya. The project is strategically located in the booming peri-urban centers such as Athiriver, Kitengela and Syokimau which have grown to be major residential estates for many urban families in Nairobi, Machakos and Kajiado Counties. It's therefore worthy to justify the importance of this project to the country at large.

The key effort should be geared towards safeguarding the environment. This can be effectively overcome through a close following and implementation of the recommended Environmental Management Plan (EMP).

TABLE OF CONTENTS

CHAPTER ONE: PROJECT BACKGROUND

1.1 Introduction: Project Background.

Housing market in Kenya has recently become one of the most lucrative businesses, many development companies and individuals are now putting up modern housing units for rental and sale, this has become possible by the many banks and financial institutions which are now offering loans and mortgages to both developers and home buyers at subsidized rates. The proposed residential development is privately owned and is targeted for rental/ sale purposes. The Architectural and structural drawings for the proposed structure have been approved by the Machakos County Government as well as the change of use. The report gives in detail the project background, its goal and objectives, scope, project justification and cost, baseline information, Policy- legal and institutional framework governing the exercise, identification of impacts and their respective mitigation measures, a clear description of the project's alternatives and a comprehensive environmental management plan to avert or minimize the anticipated impacts.

1.2 Principal of Environmental Impact Assessment

The fundamental principle of the EIA is that every person is entitled to a clean environment and that every person has a duty to enhance and safeguard the environment. EIA is a planning tool which presents methodologies and techniques for identifying, predicting and evaluating potential environmental impacts of the projects, policies, plans and programmes in the project cycle (planning, implementation and decommissioning phases). EIA presents decision with the information necessary to determine whether or not a project should be implemented.

1.3 Terms of Reference for the EIA Project Report

The terms of reference for the preparation of an EIA Project Report are usually but not limited to: -

- A decisive look at objectives of the project.
- The proposed location of the project site.
- Description of the baseline information, national environmental legislative and regulatory framework, and any other relevant information related to the project.

- Assessment of the technology, procedures and processes to be used, in the implementation of the project.
- Assessment of materials to be used in the construction and implementation of the project and their sources.
- Evaluation and analysis of the anticipated potential environmental effects which are categorized into physical, ecological/biological and socio-economic aspects; this can be further classified as direct, indirect, cumulative, irreversible, short-term and long-term effects.
- Evaluation of the products, by-products and wastes to be generated by the project.
- To recommend a specific environmentally sound and affordable solid waste management system
- Evaluation and analysis of alternatives including the proposed project, project alternative, project site, design and technologies.
- An Environmental Management Plan (EMP), proposing the measures for eliminating/minimizing or mitigating adverse impacts on the environment. `
- Propose measures to prevent health and safety hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies. This encompasses prevention and management of the foreseeable accidents and hazards during both the construction and occupational phases.
- Any other matters which may be required by NEMA.

This project report provides relevant information and environmental considerations on the project proponent's intention to seek approval from NEMA for the construction of the proposed project.

1.4 Objectives of the EIA Project Report

The overall objective of this Environmental Impact Assessment project report is to ensure that environmental concerns are integrated in all developmental activities of this particular project. It aims at identifying the potentially effects and risks of the proposed project, evaluating and suggesting mitigation measures for the significant negative impacts through a comprehensive Environmental Management Plan.

1.5 The Project Scope

The extent of the project involves a comprehensive environmental assessment that generated environmental concerns in all phases of the project. This task involved: -

- Assessment of the potential Environmental Impacts of the project on the site and the surrounding areas.
- To identify the significance of these impacts.
- To propose the mitigation measures for the anticipated negative impacts to the environment.
- To generate baseline data for monitoring and evaluation of how well the mitigation measures are being implemented during the project cycle.
- To assess the importance of the impacts of alternative sites.
- To present information on the impacts of the alternative sites.
- A review of the environmental policy, legal and administrative framework.
- Social repercussions of the development within the locality and region.
- Development of an Environmental Management Plan with mechanisms for monitoring and evaluating the compliance and environmental performance.

1.6 Method and Criterion Used in the Report.

Several methods were employed to gather and compile data during the process of EIA project report making, these include: -

- Site visits to gather raw data on condition of the site and its surrounding.
- Use of self-administered questionnaires.
- Secondary data collection: This involved study of various publications to gather data especially the legal guidelines governing this type of project.
- Analysis of activities to be carried out in the implementation process and their possible anticipated impacts.
- Experts view on the impacts of the project.

The process was also guided by the recommendations from various legally established bodies like the Machakos County Government, Mavoko Sub-County Physical Planning office and various government ministries and agencies.

1.7 Justification

Several factors were considered as valid reasons why the proposed development should be implemented on this particular site, this were either in form of demand for the services or the available infrastructural facilities to support this type of development or the little impact the project will have to the environment. Some of the validating factors considered include: -

i. **Proper utilization of land: -**Construction of the proposed development will put this piece of land into a more profitable and economical use, it has been lying idle for many years thus no economic value. Installation of the proposed development in this area will reduce the current demand of housing units; the development is also in line with government policy of providing 750,000 housing units per annum.

ii. **Accessibility.** The accessibility to the site is good; the site is located along Chady road which is located off Syokimau Airport Road. With the booming development of similar apartments within the neighbourhood (Viraj Park apartments, Lifestyle terraces apartments), the developers will provide quality access roads with time and service the streets connecting the various residential units in the neighbourhood.

iii. **Sewer System.** This area is not connected to a functional sewer; the waste waters will be directed to a waste water treatment plant. The site will also have a pit latrine which will be utilized by the site workers during the implementation phases. This project does not pose any danger of human waste disposal to the environment.

iv. **Surface run -off.** Water from the roofs of the proposed developments will be harvested into a collection tank; this will not only increase the water stock in this area where water is scarce but also prevent any damage which may be caused by the roof waters. There will also be open drains to cater for drainage from the paved areas.

v. **Solid Waste Management.** Some solid waste will be generated from the site during construction. The main solid waste will include the following:-

- **Vegetation materials** which will be cleared from the site. This will be very minimal since the site is not heavily inhibited by vegetation. The area to be occupied by the project does not have mature trees and thus the little vegetation cleared from it will not have any significant impact to the environment.

- Concrete materials and pieces of masonry blocks.
- Pieces of wood and metal bars.
- Material wrappings and un-used wooden boxes.

All waste generated during the implementation phase will be disposed off suitably into the approved dumpsites. A plan to handle all waste has been included in the Environmental Management Plan. **(***Refer to the EMP Table***)**

vi. **Energy supply.** A source of energy will be required at both the implementation and operational phase of this project. The site area has hydro-power supply; this will be installed to the project once the construction work is fully done. Diesel energy will be utilized during the implementation phase; this will be mainly in the running of the poker vibrators, concrete mixture and compactors.

vii. **Security.** Security will be provided at all times (day and night) at all phases of the project; this will ensure the security of materials, operators and equipment on site. The site will also be fenced using a concrete perimeter wall and have day and night guards as a measure of boosting security.

CHAPTER TWO: PROJECT DESCRIPTIONS, DESIGN & CONSTRUCTION.

2.1 Introduction

The overall objective of this Project is to develop and avail modern residential apartments (15 blocks) with associated amenities in Syokimau area, Machakos County on plot L.R NO 12715/537. The proposed project will lead to conversion of the current undeveloped land into a housing project.

This will contribute towards increased availability of housing facilities within the area and the larger Metropolitan region in general, which is currently experiencing an acute shortage of such facilities. The project will also create several employment and business opportunities in addition to the several positive impacts discussed in this report.

The site falls within a residential area with several upcoming residential developments including a road network, electricity supply and other infrastructure. The main design components of the project include, but not limited to the following:

The project will include construction of fifteen (15) no. typical residential apartment blocks **(Block A to O)** comprising of **three hundred and sixty (360)** no. units all with associated facilities.

- **Each of the six (6) blocks of Ground floor to fifth floor** will have a typical plan consisting of; **twenty four (24)** - two bedroom apartments units each totaling to **one hundred and forty four (144)** no. units with associated facilities.
- **Each of the nine (9) blocks of ground floor to fifth floor** will have a typical plan consisting of **twenty four (24)** - three bedroom apartment units each totaling to **two hundred and sixteen (216)** no. of units with associated facilities.
- Other accompanying facilities include; lifts, CCTV cameras security system, common area, ample inside parking for visitors, solar panels, waste water treatment plant water tanks, and firefighting systems.

2.2 Electrical system

There will be connection to the existing electricity main line of the Kenya Power and Lighting Company, which will be used in all phases of the project. The necessary guidelines and precautionary measures relating to the use of electricity shall be adhered to.

2.2.1 Water Reticulation system

Water from private suppliers will be used during construction and operation phases. More over there will be water storage tanks to increase water supply to various components of the houses. The developers will drill a borehole on site and also harvest rain water to improve on water supply.

2.2.2 Sewerage

The area doesn't have existing sewer line. The proposed development will use a **Waste water treatment plant** for the disposal of liquid waste. The plant will be checked regularly to improve on its operation.

2.2.3 Solid Waste

Solid waste management will consist of dustbins stored in cubicles protected from **rain and animals.** The waste will then be collected by a NEMA licensed private waste management company and be composited, palletized or re-cycled depending on the waste management strategy to be adopted in line with the Environmental Management and Co-ordination (Waste Management) Regulations, 2006.

Security

There will be the main entrance for easy security operations around the compound, a boundary wall connected with security alarms, entry control, and quick response systems will be used within the project area.

2.2.4 Fire Safety

The development will provide for firefighting facilities such as fire extinguishers in the form of hydrants and carbon dioxide gas extinguishers. Fire breaks have also been provided for.

2.2.5 Perimeter Fence

A concrete perimeter wall will be erected around the project site.

2.2.6 Landscaping

The site will be landscaped after construction, using plant species available locally. This will include establishment of flower gardens and lush grass lawns to improve the visual quality of the site where pavements will not have taken space.

2.2.7 Buildings Construction

The technology used in the design and construction of the Houses will be based on international standards, which have been customized by various housing units in Kenya. The buildings will be constructed as per the respective structural engineer's detail as provided for in the drawings presented in the Appendix. Basically, the building structures will consist of concrete appropriately reinforced with metal (steel and iron). The roof will consist of structural timber and steel members and roofing tiles. The buildings will be provided with a well-designed concrete staircase for every house.

The buildings will be provided with facilities for drainage of storm water from the roof through peripheral drainage systems into the drainage channels provided and out into the natural drainage channel/system. Drainage pipes will be of the PVC type and will be laid under the buildings and the driveway encased in concrete. This is a sparsely build area and such no need for public drainage channel. The buildings will have adequate natural ventilation through provision of permanent vents in all habitable rooms, adequate natural

and artificial light, piped water stored in above ground water tanks and firefighting facilities.

2.3 Project Implementation

2.3.1 Preconstruction phase:

This involves study of the project area, design of the construction drawings and getting approvals for the same from the respective Local authority, NEMA, Physical Planning, County Lands officer and any other relevant authority. Soil tests are also done at this stage, soil tests provide the bearing capacity of the soil thus determining the type of foundation to be laid.

2.3.2 Site Construction

The construction of the units will be based on applicable international building standards. Other building standards including the Building Code and the British Building Standards which include BS 8110, BS 5950, BS4449, BS4461 will be incorporated. The constructions will as well incorporate environmental guidelines, health and safety measures.

Implementation activities include the following: -

Site clearing and Excavation of the Foundations and Space for Underground Foundations: This entails removal of unwanted vegetation from the site and excavation of the projects' foundations. The few shrubs on the site will be cleared to pave way for excavation activities; the excavation of the site will not involve much machinery since the soil on site is light and well drained.

Civil works: Civil works involves: -

- Procurement of construction materials from approved dealers.
- Transportation of construction materials to the site and disposal of the resulting flora waste using light machinery.
- Storage of the construction materials.
- Laying and construction of the foundations.
- Disposal of the existing debris/ materials.

Electrical works: Electrical works involve installation of the Power Distribution Box, control panel, and all power supplying cables and equipment. All electrical works are done by qualified electricians so as to avoid faulty connections which may later cause fire outbreaks and short circuiting of the site equipment.

2.4 Construction Inputs (Materials and Equipment)

The project inputs include the following:-

Construction inputs/ raw materials: These include i.e. sand, cement, machine cut stones, crushed rock (gravel/ ballast), steel metal bars, paint/painting materials among others. All these will be obtained from licensed dealers and especially those that have complied with the environmental management guidelines and policies.

Construction machines: These include machinery such as trucks, concrete mixers, masonry tools and other relevant construction equipment. These will be used for the clearing of the vegetation, transportation of raw materials and the resulting construction debris. Most of the machinery will use diesel or petrol energy as a source of power.

Labour force: Both skilled and non-skilled workers will be required at all phases of the project. The labour force will require services such as energy, water supply and sanitation facilities. Large volumes of water will also be required during the civil works.

2.5 Project Outputs

There will be little waste generated from the proposed project; this is due to the nature of the materials used and the magnitude of the project. Most of the waste materials generated will be re-used while the non-reusable waste will be disposed off in the appropriate manner as described in the management plan illustrated in this report. Some of the anticipated waste materials include pieces of Wood, Papers, Empty Tins, Electric cables, Plant materials, pieces of metal rods etc.

Waste will also be generated during the operation phase of the project, the anticipated waste will include:-

- Waste wasters/sewage: This will be directed to a waste water treatment plant.

- Product/material wrappings: These materials will be sorted and disposed off in the appropriate manner. Waste bins will be placed strategically within the compound for dumping this form of waste.

2.6 Public participation

Public participation basically involves engaging members of the public to express their views about a certain project. Public participation tries to ensure that due consideration will be given to public values, concerns and preferences when decisions are made. Public participation in this project was facilitated through interviews and questionnaires with the Syokimau residents on 18th December 2020. They however reiterated that more emphasis should

be put towards ensuring that the proposed project and its infrastructure will not negatively interfere with the environmental integrity of the surrounding areas especially the access road and waste water management plans

The purpose of public involvement is to:

- Inform the stakeholders about the proposal and its likely effects;
- Canvass their inputs, views and concerns; and
- Take account of the information and views of the public in the EIA and decision making.

CHAPTER THREE: BASELINE INFORMATION

3.1 Introduction

This chapter has information on the location, bio- physical, socio and economic aspects of the project area. These are elaborately discussed in order to identify areas likely to be affected as a result of project activities. This study therefore considered the physical location, climatic data, geology, drainage, infrastructure, demography and socioeconomic information.

3.2 Project Location and land ownership

The project site is located on Plot L.R No. 12715/537 in Syokimau area, along Chady road few kilometers off Syokimau Airport Road in Mavoko Sub-County, Machakos County. The project site is generally mixed use with both commercial, light industrial and offices, Gateway Mall and Summerville Estate. The project neighborhood has similar developments such as Lifestyle Terraces, Easy Prestige apartments, Viraj Park apartments and Amalia apartments. The plot is owned by Sunpark Limited and measures approximately 2.508 Hectares. The site coordinates are -1.361408, 36.920368.

3.3 Climatic Conditions

The general climate of Machakos County is semi-arid with an altitude range of 1000 – 1600 meters above sea level. There are two rainy seasons but rainfall can be moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. The area is characterized by sunny daylights and chilly night. The proposed project site is to the northwest of the Mlolongo town and it experiences relatively dry conditions just like the entire region.

3.3.1 Temperatures

The sunniest and warmest part of the year is from December to March, when temperatures average the mid-twenties during the day. The mean maximum temperature for this period is 27 °C (75 °F).The minimum temperature also remains low during cloudy nights, usually hovering around 11 °C and at times reaching 8°C. Clear skies in January and February also bring colder nights. Temperatures range from a minimum of 9.1$_{o}$C to a maximum of 26.7$_{o}$C

3.3.2 Rainfall

There are two rainy seasons but rainfall can be moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. Rainfall ranges from 500 mm to 900 mm per annum.

3.3.3 Wind Flows

The lower winds throughout the year are of the easterly type. Between October and April they shift to the northeast while as from May to September they move to the southeast .Prior to the "Long Rain" season strong winds prevail with an average speed of 22.5 Miles/hour. The rest of the year has wind speed varying from 10 to 15 Miles/hour. However, during night, the winds are usually calm.

3.3.4 Sunshine

Early mornings in Machakos in general are often blue sky, but the sun peeks through by midmorning. Throughout the year, there is an average of ten hours of sunshine per day. Thirty percent more sunlight reaches the ground during the afternoon than in the morning. Of course, there is more sun shine during the summer months, when the sun is more

overhead in the southern hemisphere. Infrequently during the rainy season the sun never show through the clouds. Even in August, the cloudiest month, there is an average of four hours of sunshine.

3.4 Topography and Drainage

Upper Machakos and Nairobi's main drainage follows the regional slope of the volcanic rocks towards the east, while subsidiary internal drainage into the Rift region is confined to the western part. Major plains which comprising mainly the Athi plains and the northern section of the Kapiti plain, extend westwards, rising from 4900 feet (1493 m) at the Athi River to 6000 feet (1829 m) in the faulted region near Ngong. The Kirichwa Valley Tuffs lying to the east of the highway function like a sponge and the contact between them and the underlying impermeable phonolite thus forms a perfect aquifer so much so that a number of channels containing water occur beneath Athi River region. The site of the project is flat and therefore with heavy rains flooding might result. The proponent is advised to construct a strong floor slab that is well raised to avoid any water surges to the project development.

3.5 Hydrogeology and Soils

In general groundwater in volcanic rocks is limited to fractures and erosion levels within the volcanic succession. Fresh lavas are usually not water bearing because of their massive and impervious nature. The most significant aquifer system west of the project area is the Upper Athi Series aquifer system. This is the main aquifer for boreholes in Upper Machakos, Nairobi and Kiambu areas and is composed of tuffs, lakebeds and sediments

The rocks in the Upper Machakos regions such as Mavoko, Syokimau and Mlolongo area mainly comprise a succession of lavas and Pyroclastics of the Cainozoic age and overlying the foundation of folded Precambrian schist's and gneisses of the Mozambique basement rock which traverses the entire lower eastern region upto Kilimambogo area .The crystalline rocks are rarely exposed but occasionally fragments are found as agglomerates derived from former Ngong volcano.

The soils of this area are products of weathering of mainly volcanic rocks. Weathering has produced black cotton soils that reach more than 50 feet (15m) in thickness.

Metamorphism process is witnessed in the region that has resulted to major deposits of limestone rich mines.

3.6 Biological Environment

This section describes key biological elements, including the identification and distribution of dominant, rare and unique flora and faunal species within the region of concern (proposed project site and other potentially affected areas).

3.6.1 Flora

Natural vegetation in Upper Machakos region (syokimau, mlolongo and Athi River) has been cleared to pave way for the establishment of both residential and commercial developments. The natural vegetation in the area has thus been greatly modified. The remnants of the natural vegetation of the site and its environs are a few scattered grasses. The site has no great vegetation cover and it is predominantly dry savannah, open grass plains with scattered acacia bushes. The region also has seasonal stream which supplies water to a nearby wetland. The proponent is encouraged to do a lot of landscaping to provide greenery and maintain a healthy environment.

3.6.2 Fauna

This will look at the aquatic and wetland faunal species as well as terrestrial species. The site is situated within a residential zone where human activities have altered the natural habitat for animals over the years. The principal source of water for this region is MAVWASCO and private water suppliers. The project's effect may seem insignificant to such lives but it is of great concern to the environment at large. It is expected that the area will be populated by small mammals such as mice, rats, moles and other members of the Rodent Family. Bird species were also observed at the site. None of the faunal species observed are rare or endangered.

3.7 Land use:

Urban land use refers to spatial distribution of social and economic activities. Accordingly, an up-to-date land use inventory is frequently required to facilitate urban planning and growth patterns as well as monitoring of urban expansion. A study by the Department of

Resource Surveys and Remote Sensing (DRSRS 1994) identified eight major land-use classes in major urban centres in Kenya. These include Residential use Industrial, commercial and service centres, Infrastructure land use, Recreational areas, urban agriculture as well as Water bodies and riverine areas.

3.8 Socio-economic Importance of the proposed project

The proposed project is in line with the governments' housing policy that aims to facilitate the attainment of adequate shelter and healthy living environment to all socioeconomic groups in Kenya. The project will therefore help to increase settlement in the region by investing in the construction industry; the proponent will also contribute towards the economic growth of our nation through revenue collection. In particular, the proposed project will generate the following positive socio-economic impacts:

1. The proponent will sell/rent the residential development to the public. The proposed project will therefore serve as a source of income to the proponent thereby improving their living standards
2. During the operation phase of the project, the proponent will be required to pay tax to the government hence contributing to the economic growth of our nation
3. The proposed project will indirectly contribute towards enhancement of security in the neighbourhood of the area
4. The proposed project will generate revenue to the County through payment of connection and service fee.

Apart from the direct employment of construction workers, the proposed project will also benefit the following categories of individuals:

- Transporters. Investors on lorry and trailer transport will benefit greatly from the project. This benefit will extend to vehicle dealers and manufacturers, lorry drivers and turn boys.
- Cement Manufacturers. The local cement manufacturers and their employees and shareholders are direct beneficiaries of the development.
- The government will also get some impressive increase in V.A.T. and other taxes levied on cement.

- Manufacturers and dealers of other building materials. Most of the building materials to be used are locally manufactured. Relevant companies, their workers and shareholders will be direct beneficiaries of the development.
- Sand Harvesters. Locals involved in sand harvesting in sand harvesting are to be major beneficiaries' of the project. The benefit will extend to the local authority entitled to levy taxes on sand transporters.
- Ballast Quarries. There will be massive use of ballast. These will ensure that the Quarry owners and workers benefits greatly.

Site access road (Chady road)

Neighbourhood character

Similar ongoing project in the neighbourhood

CHAPTER FOUR: RELEVANT ENVIRONMENTAL LEGISLATIVE AND REGULATORY FRAMEWORK.

4.1 Introduction

Environmental Impact Assessment is an instrument for environmental management and development control. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound. It is a condition of the Kenya Government for developers to conduct Environmental Impact Assessment (EIA) on the development Projects. According to Sections 58 and 138 of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 and Section 3 of the Environmental (Impact Assessment and Audit) Regulations, 2003 (Legal Notice No.101), construction of buildings require an Environmental Impact Assessment project report prepared and submitted to the National Environment Management Authority (NEMA) for review and eventual licensing before the development commences.

4.1 Policy Framework

Environmental policies cut across all sectors and government departments. As such policy formulation should be consultative steered by interdisciplinary committees. Recent policies which the government is working on include; Draft Wildlife Policy; Draft National Land Policy; and Wetlands Management and Conservation Policy among others.

4.1.1 National Environmental Action Plan (NEAP).

National Environmental Action Plan was a deliberate policy effort to integrate environmental concerns into the country's development initiatives/plans. This assumed a consultative and multi-sectoral approach. Such an approach ensured that environmental management and the conservation becomes integral in various decision making platforms.

As a result of its adoption and implementation, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process, Environmental Impact Assessments were introduced targeting the industrialists, business community and local authorities.

4.1.2 National Shelter Strategy to the Year 2000

Kenya adopted this strategy following the International Year of Shelter for the Homeless in 1987.This advocates for the involvement of various actors to come in and assist the government in providing housing. This took cognizance of the governments' inability to provide sufficient shelter for all its citizens. The government was to simply facilitate other actors such as developers to invest in shelter.

4.1.3 The National Poverty Eradication Plan (NPEP).

The objective NPEP is to alleviate poverty in rural and urban areas by 50 percent by the year 2015; as well as the capabilities of the poor and vulnerable groups to earn income. It also aims to narrow gender and geographical disparities and a healthy, better educated and more productive population. This plan has been prepared in line with the goals and commitments of the World Summit for the Sustainable Development (WSSD) of 1995.

4.1.4 National Policy on Water Resources Management and Development

While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as wastewater. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution. This implies that Industrial and business development activities should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating there from. The same policy also requires that such projects undergo comprehensive EIAs that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighbourhood and further downstream are not negatively impacted by the emissions. As a follow-up to this, EMCA, 1999 requires annual environmental audits to be conducted in order to ensure that mitigation measures and other improvements identified during EIAs are implemented.

In addition, the policy provides for charging levies on waste water on the basis of quantity and quality. The "polluter-pays-principle" applies in which case parties contaminating water are required to meet the appropriate cost of remediation. Consequently, to ensure water quality, the policy provides for establishment of standards to protect water bodies

receiving wastewater, a process that is on-going. The standards and measures to prevent pollution to water resources are provided for in the Environmental Management and Coordination (Water Quality) Regulations, 2006 which is a supplementary legislation to EMCA, 1999.

4.1.5 Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999):

The key objectives of the Policy include: -

- ✓ To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
- ✓ To ensure that an independent environmental impact assessment (EIA) report is prepared for any industrial venture or other development before implementation,
- ✓ To come up with effluent treatment standards that will conform to acceptable health guidelines.

Under this paper, broad categories of development issues have been covered that require a "sustainable development" approach. These issues relate to waste management and human settlement. The policy recommends the need for enhanced re-use/recycling of residues including wastewater, use of low or non-waste technologies, increased public awareness raising and appreciation of a clean environment. It also encourages participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others.

4.2 Legal and Legislative Framework

4.2.1 Environmental Management and Coordination Act CAP 387

This project report has been undertaken in accordance with the Environment (Impact Assessment and Audit) Regulations, 2003, which operationalizes the Environmental Management and Coordination Act, CAP 387. The report is prepared in conformity with the requirements stipulated in the Environmental Management and Coordination Act CAP 387 (EMCA) and the Environmental Impact Assessment and audit Regulations 2003, Regulation 7 (1) and the Second Schedule.

Part II of the said act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. In order to achieve the goal of a clean environment for all, new projects listed under the second schedule of Section 58 of EMCA No. 8 of 1999 shall undergo an Environmental Impact Assessment. The Environment Management and Coordination Act (EMCA), 1999 provides for the establishment of an umbrella legal and institutional framework under which the environment in general is to be managed. EMCA is implemented by the guiding principle that every person has a right to a clean and healthy environment and can seek redress through the High court if this right has been, is likely to be or is being contravened.

Pursuant to section 25 (4) of EMCA, National Environmental Management Authority (NEMA) is required to restore degraded environmental sites using the National Environmental Restoration Fund. Currently, the restoration fund consists of 0.1 % levied from industries and other project proponents through the EIA process. Section 58 of the Act makes it mandatory for an Environmental Impact Assessment study to be carried out by proponents intending to implement projects specified in the second schedule of the Act which are likely to have a significant impact on the environment. Similarly, section 68 of the same Act requires operators of existing projects or undertakings to carry out environmental audits in order to determine the level of conformance with statements made during the EIA study. The proponent is required to submit the EIA and environmental audit reports to NEMA for review and necessary action.

Section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. According to section 73 of the act, operators of projects which discharge effluent or other pollutants into the aquatic environment are required to submit to NEMA accurate information on the quantity and quality of the effluent. Section 76 provides that all effluent generated from point sources are to be discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities.

Section 87 (1) makes it an offence for any person to discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person.

The proponent will have to ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as sewerage connections, solid waste management plans, and landscaping and aesthetic improvement programme are implemented and maintained throughout the project cycle. As well the; proponent will have to ensure that appropriate measures to prevent pollution of underground and surface water are implemented throughout the project cycle.

4.2.2 The Environmental Management and Co-ordination (Waste Management Regulations 2006)

Legal Notice No. 121: Section 4-6

Part II of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 states that:-

Section 4

1) No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.
2) Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed off such waste in the manner provided for under these Regulations.
3) Without prejudice to the foregoing, any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose off such waste in a designated waste disposal facility.

Section 5

(1) A waste generator shall minimize the waste generated by adopting the following cleaner production methods

a. Improvement of production process through:-

- Conserving raw materials and energy;
- Eliminating the use of toxic raw materials; and
- Reducing toxic emissions and wastes

b. Monitoring the production cycle from beginning to end by:-

- Identifying and eliminating potential negative impacts of the product;
- Enabling the recovery and re-use of the product where possible;
- Reclamation and recycling

c. Incorporating environmental concerns in the design and disposal of a product.

Section 6

A waste generator shall segregate waste by separating hazardous wastes from non-hazardous waste and shall dispose of such wastes in such facility as shall be provided by the relevant local authority.

(23) No person shall engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by Authority under the provisions of the Act.

The proponent shall ensure that the main contractor adopts and implements all possible cleaner production methods during the construction phase of the project. During the construction phase of the project, the proponent shall ensure that the main contractor implements the above mentioned measures as necessary to enhance sound Environmental Management and Coordination (Noise management of waste).

4.2.3 Waste Water Management;

Legal Notice No. 120; Part II – Protection of Sources of Water for Domestic Use.

(1) Every person shall refrain from any act 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 these Regulations

(2) No person shall throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution

All sources of water for domestic uses shall comply with the standards set out in the First Schedule of these Regulations. The proponent and project Architect as well as engineer are urged to ensure that drainage channels are well designed during the construction phase of the project, and upon completion, the facility will be connected to a waste water treatment plant for proper management of liquid waste once the service is available in the entire neighbourhood.

4.2.4 Public Health Act Cap 242

Part IX section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health.

Section 116 requires that local Authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. The plans for the above project have been submitted for approval at Machakos County Government.

4.2.5 Physical Planning Act, 1996

The said Act section 29 empowers the local Authorities (Now County Governments) to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section allows for prohibition or control of the use and development of an area. Section 30 state that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local Authority.

4.2.6 Building Code 2000

A person who erects a building or develops land or changes the use of a building or land, or who owns or occupies a building or land shall comply with the requirements of these by-laws. For the purpose of this by- laws and the following operations shall be deemed to be the erection of a building:-

a) The alteration or extension of a building.

b) The changing of the use or uses to which land or building is put.

c) The formation or lying out of an access to a plot.

Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the local authority for permit to connect to the sewer line and all the wastewater must be discharged in to sewers. The code also prohibits construction of structures or building on sewer lines.

4.2.7 Water Act 2016

The water act 2016 provides for the management, conservation, use and control of water resources and for acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. Section 18 of this Act provides for national monitoring and information systems on water resources. Following on this, sub-Section 3 mandates the Water Resources Management Authority to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a site operator and the information thereof furnished to the authority.

Section 73 of the Act provides that a person who is licensed to supply water has a responsibility of safeguarding the water sources against degradation. According to section 75 (1) such a person is required to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

On the other hand section 76 makes it an offence for any person to discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee which should be sought by making an application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including payment of rates for the discharge as provided under Section 77 of the same Act. Section 94 of the Act also makes it an offence to throw or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resource in such a manner as to cause, or be likely to cause, pollution of the water resource.

The main contractor will be required to implement necessary measures to ensure water conservation and also to prevent potential for water contamination during the construction phase.

4.2.8 The Electricity Power Act, 1997

Section 55 (1) in the execution of works in connection with the construction, modification, maintenance or operation of an electric supply line or apparatus or conductor connected thereto, every licensee shall:-

In no way injure the works, conveniences or property belonging to any such other such authority, company or person, nor obstruct or interfere with public traffic, except with the previous consent of the board.

4.2.9 The Penal Code (Cap. 63)

Section 191 of the Penal Code makes it an offence for any person or institution that voluntarily corrupts, or foils water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, section 192 of the same act prohibits making or vitiating the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighborhood or those passing along a public way.

T*he proponent will be required to ensure strict adherence to the Environmental Management Plan throughout the project cycle in order to mitigate against any possible negative impact.*

4.2.10 The Occupational Safety and Health Act, 2007

This is an act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. The Act was published in the Kenya Gazette Supplement No. 111 (Acts No.15). It received presidential assent on 22nd October, 2007 and became operational on 26th October, 2007. The key areas addressed by the Act include:

- ✓ General duties including duties of occupiers, self-employed persons and employees
- ✓ Enforcement of the act including powers of an occupational safety and health officer
- ✓ Registration of workplaces.
- ✓ Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences
- ✓ Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self-acting machines, hoists and lifts, chains, ropes & lifting tackle,

cranes and other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver

- ✓ Safety General Provisions including safe storage of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas
- ✓ Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials
- ✓ Welfare general provisions including supply of drinking water, washing facilities, and first aid
- ✓ Offences, penalties and legal proceedings.

Under section 6 of this act, every occupier is obliged to ensure safety, health and welfare of all persons working in his workplace. The occupier shall achieve this objective by preparing and as often as may be appropriate, revising a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy (Section 7).

He is also required to establish a safety and health committee at the workplace in a situation where the number of employees exceeds twenty (section 9) and to cause a thorough safety and health audit of his workplace to be carried out at least once in every period of twelve months by a registered safety and health Advisor (Section 11). In addition, any accident, dangerous occurrence, or occupational poisoning which has occurred at the workplace needs to be reported to the occupational safety and health officer of the respective area by an employer or self-employed person (section 21).

According to section 44, potential occupiers are required to obtain a registration certificate from the Director for all premises intended for use as workplaces. Such places shall be maintained in a clean state during the operation phase (section 47).

To ensure machinery safety, every hoist or lift – section 63 and/or all chains, ropes and lifting tackles – section 64 (1d), shall be thoroughly examined at least once in every period of six months by a person approved by the Director of Occupational Health and Safety Services. Similarly, every steam boiler - section 67 (8) and/or steam receiver - section 68 (4) and all their fittings and/or attachments shall be thoroughly examined by an approved

person at least once in every period of twelve months whereas every air receiver shall be thoroughly cleaned and examined at least once in every period of twenty four months or after any extensive repairs - section 69 (5). According to section 71 (3), every refrigeration plant capable of being entered by an employee also needs to be examined, tested and certified at least once in every period of twelve months by an approved person.

In relation to fire safety, section 78 (3) requires spillage or leaks of any flammable liquid to be contained or immediately drained off to a suitable container or to a safe place, or otherwise treated to make it safe. Furthermore, a clear and bold notice indicating that smoking is prohibited should be conspicuously displayed in any place in which explosive, highly flammable or highly combustible substances, are manufactured, used, handled or stored-section 78 (5). In addition, necessary precautions for dealing with fire incidents should be implemented including provision of means for extinguishing fire and means for escape, in case of fire, for the persons employed in any workplace or workroom – section 81. As far as disaster preparedness and emergency response program is concerned, section 82 (1) makes it a mandatory requirement for every occupier of a workplace to design evacuation procedures to be used during any emergency situation and to have them tested at regular intervals.

To promote health and safety of employees who are at risk of being exposed to chemical substances, section 84 (3) and 85 (4) requires every employer to maintain at the workplace material safety data sheets and chemical safety data sheets respectively for all chemicals and other hazardous substances in use and ensure that they are easily available to the employees.

The employers' positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water - section 91 and a first aid box or cupboard of the prescribed standard – section 95 at suitable point (s) conveniently accessible to all employees.

Other precautionary measures include: issuance of a permit to work to any employee, likely to be exposed to hazardous work processes or hazardous working environment, including such work processes as the maintenance and repair of boilers, dock work, confined spaces, and the maintenance of machinery and equipment, electrical energy

installations, indicating the necessary precautions to be taken – section 96 (1); provision and maintenance for the use of employees, adequate, effective and suitable protective clothing including suitable gloves, footwear, goggle and head coverings in any workplace where employees are likely to be exposed to wet, injurious or offensive substance – Section 101 (1). *The proponent will be required to ensure that the main contractor includes in the contract document, adequate measures to promote safety and health of workers.*

4.2.11 Environmental Vibration Pollution (Control) Regulations, 2009

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

i. Prohibition of excessive noise and vibration
ii. Provisions relating to noise from certain sources
iii. Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations and
iv. Noise and excessive vibrations mapping.

According to regulation 3 (1), no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Regulation 4 prohibits any person to (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

Regulation 12 (1) makes it an offence for any person to operate a motor vehicle which- (a) produces any loud and unusual sound; and (b) exceeds 84 dB(A) when accelerating. According to sub regulation 2 of this regulation, No person shall at any time sound the horn

or other warning device of a vehicle except when necessary to prevent an accident or an incident.

Regulation 13 (1) provides that except for the purposes specified in sub-Regulation (2) there under, 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.

4.3 Other relevant Provisions

The following are the relevant environmental treaties to which Kenya is signatory in order of ratification:

- Montreal Protocol on Substances that Deplete the Ozone Layer (1987) ratified 9 November 1988
- United Nations Convention to Combat Desertification (1994), ratified 12 June 1994
- United Nations Framework Convention on Climate Change (1992), ratified 30 August 1994
- Convention on Biological Diversity (1992), ratified 11 September 1994
- Bamako Convention (1991), ratified 17 December 2003
- Kyoto Protocol (2004), ratified 25 February 2005

4.4 Institutional Framework

At present there are over twenty (20) institutions and departments which deal with environmental issues in Kenya. Some of the key institutions include the National Environmental Council (NEC), National Environmental Management Authority (NEMA), the Forestry Department, Kenya Wildlife Services (KWS) and others. There are also local and international NGOs involved in environmental activities that impact on the environment in one way or the other in the country.

4.4.1 National Environmental Management Authority (NEMA)

The object and purpose for which NEMA is established is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the

environment. A Director General appointed by the president heads NEMA. The Authority shall, among others:

- Co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plans, programmes and projects with a view to ensuring the proper management and rational utilization of the natural resources environment on a sustainable yield basis for the improvement of the quality of human life in Kenya.
- Take stock of the natural resources in Kenya and their utilization and consultation, with the relevant lead agencies, and develop land use guidelines.
- Examine land use patterns to determine their impact on the quality and quantity of the natural resources among others. Moreover NEMA mandate is designated to the following committees:

4.4.2 County Environment Committee

County Environment Committees are responsible for the proper management of the environment within the County in respect of which they are appointed to. They are also to perform such additional functions as are prescribed by the Act or as may, from time to time be assigned by the Minister by gazette notice. The decisions of these committees are legal and it is an offence not to implement them.

4.4.3 National Environment Complaints Committee

The Committee is charged with the following functions:

Investigating allegations/ complaints against any person or against the Authority (NEMA) in relation to the condition of the environment and its management, Prepare and submit to the County periodic reports of its activities which shall form part of the annual report on the state of the environment, and to perform such other functions and excise such powers as may be assigned to it by the County.

4.4.4 National Environment Action Plan Committee

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

Analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time, and Analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity among other duties as the EMCA specifies.

4.4.5 National Environmental Tribunal

This tribunal guides the handling of cases related to environmental offences in the Republic of Kenya. The Tribunal hears appeals against the decisions of the Authority. Any person who feels aggrieved may challenge the tribunal in the High Court.

CHAPTER FIVE: IMPACT IDENTIFICATION, PREDICTION & EVALUATION.

5.1 Description of the Existing and Anticipated Impacts

5.1.1 Existing Impacts.

There are no existing environmental concerns on the site and the surrounding area. The site has no vegetation of value; only grass which is covering the site will be cleared for the new development.

5.1.2 Anticipated Impacts.

Impacts can either be positive or negative, direct or indirect. The magnitude of each impact is described in terms of being significant, minor or negligible, temporary or permanent, long-term or short-term, specific/localized or widespread and reversible or irreversible.

5.2 Positive Impacts of the Proposed Project

The proposed development will have numerous positive impacts to the area residents and to the general area. Some of the anticipated benefits include:-

5.2.1 Provision of Housing Units

The rate of urban sprawl has and continues to increase in Kenya today; this has been aggravated by increase in population as a result of natural growth or as a result of urban-rural migration. The proposed project will therefore provide adequate housing units to the increasing population especially the middle class (Working) which forms significant percentage of the Urban population and urban families.

5.2.2 5.2.2 Creation of Employment Opportunities:-

Several employment opportunities will be created for construction workers during the construction phase of the project and operators during the operation phase of the project. This will be a significant impact since unemployment is currently quite high in the country in general.

5.2.3 Provision of Market for Supply of Building Materials

The project will require supply of large quantities of building materials most of which will be sourced locally and from the surrounding areas. This provides ready market for building

material suppliers such as quarrying companies, hardware shops and individuals with such materials.

5.2.4 Increased Business Opportunities

The large number of project staff required provides ready market for various goods and services, leading to several business opportunities for small-scale traders such as food vendors around the construction site.

5.3 Negative Impacts of the Proposed Project

There are a few negative impacts anticipated from the proposed project, these negative impacts however are not major enough to cause any major impact to the environment. They are also few compared to the anticipated positive impacts. The anticipated negative impacts include: -

5.3.1 Increased Soil Erosion

Land and excavation works will lead to increased soil erosion at the project site and release of sediments into the drainage systems and ultimately into water bodies. Uncontrolled soil erosion can have adverse effects on the local water bodies such as sedimentation, introduction of nutrients into the water bodies, de-coloration of water affecting the penetration of sunlight into the water.

5.3.2 Solid gaseous and liquid Waste Generation.

The three forms of waste will be generated at the site during construction and operation phases of the projects infrastructure. Such waste will consist of metal cuttings, rejected materials, surplus materials, spoilt, excavated materials, waste oils and grease, pieces of tryes, paper bags, empty cartons, empty paint and solvent containers, broken glass among others. Such solid waste materials can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on human and animal health. This may be accentuated by the fact that some of the waste materials contain hazardous substances such as oils and grease, paints, cement, adhesives and cleaning solvents, while some of the waste materials including metal cuttings and plastic containers are not biodegradable and can have long-term and cumulative effects on the environment. They also pose danger to the safety of the public in case of accidental cutting or injury.

5.3.3 Extraction and Use of Building Materials

Building materials such as hard core, ballast, cement, rough stone and sand required for construction of the project will be obtained from quarries, hardware shops and sand harvesters who extract such materials from natural resource banks such as rivers and land. Since substantial quantities of these materials will be required for construction of the project, the availability and sustainability of such resources at the extraction sites will be negatively affected, as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, removal of vegetation, poor visual quality and opening of depressions on the surface leading to several human and animal health risks and associated impacts.

5.3.4 Dust Emissions

During construction, the project will generate substantial quantities of dust at the construction site and its surrounding. The sources of dust emissions will include leveling works, excavation and to some extent, transport vehicles delivering building materials. Emission of large quantities of dust may lead to significant impacts on construction workers and the local residents, which will be accentuated during dry weather conditions.

5.3.5 Exhaust Emissions.

The trucks used to transport various building materials from their sources to the project site will contribute to increases in emissions of $C0_2$, NO and fine particulate along the way as a result of diesel combustion. Such emissions can lead to several environmental impacts including global warming and adverse human health impacts, the same can be experienced from the vehicles visiting the facility. Because large quantities of building materials are required, some of which are sourced outside the site area, such emissions can be enormous and may affect a wider geographical area. The impacts of such emissions can be greater in areas where the materials are sourced and at the construction site as a result of frequent gunning of vehicle engines, frequent vehicle turning and slow vehicle movement in the loading and offloading areas.

5.3.6 Noise and Vibration

The construction works, delivery of building materials by heavy trucks and the use of machinery/equipment including generators, metal grinders and concrete mixers will contribute high level of noise and vibration within the site and the surrounding area. Elevated noise levels within the site can affect project workers and the residents, passers-by and other persons within the vicinity of the project site.

5.3.7 Risks of fire Accidents and Injuries to Workers

Because of the intensive engineering and construction activities including erection and fastening of roofing materials, metal grinding and cutting, concrete work, steel erection and welding among others, construction workers will be exposed to risks of accidents and injuries. Such injuries can result from accidental falls from high elevations, injuries from hand tools and construction equipment cuts from sharp edges of metal sheets and collapse of building sections among others. Fire accidents are also prone in such a facility, proper care should be taken during implementation and operation phases of the project.

5.3.8 Energy Consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability. Combustion of fossil fuels in engines leads to production of carbon dioxide, a greenhouse gas, associated with global warming.

5.3.9 Oil and fuel Spills

The machines on site may be containing moving parts which will require continuous oiling to minimize the usual corrosion or wear and tear. Possibilities of such oils spilling and contaminating the soil and water on site are real. Waste oils and greases should be disposed off in the designated oil receptors.

5.4 Issues of Concern and their Respective Mitigation Measures

5.4.1 Soil Erosion

Soil erosion is loss of topsoil through agents of soil erosion like wind and water (rain), during the implementation phase of the project, light machinery under use will loosen the

soil making is susceptible to soil erosion. In this particular project soil erosion will not be a major environmental issue of concern since there is hardly any major excavation or levelling to be done. However, it is important to note that the project will involve excavation and burying of underground fuel tanks, digging of foundation trenches and hence soil disturbance which will expose and set the soils loose to the agents of soil erosion.

Mitigation measures

- Avoid unnecessary movement of soil materials from the site.
- Use of heavy machinery which will loosen the soil should be discouraged.
- Control construction activities especially during rainy / wet conditions.

5.4.2 Noise and Public Disturbances

Noise is unwanted/undesirable sound that can affect job performance, safety, and health. Psychological effects of noise include annoyance and disruption of concentration. Physical effects include loss of hearing, pain, nausea, and interference with communications when the exposure is severe. As explained earlier, construction activities will be generating some noise. Such noise will mainly emanate from the construction machinery and equipment which include concrete mixers and compactors and noise that will emanate from the workers on site.

Mitigation measures

- Construction works should be carried out only during the specified time of 0800 hrs to 1700 hrs.
- Machineries should be maintained regularly to reduce noise levels.
- Workers should be provided with protective materials when operating noisy machinery and when in a noisy environment. E.g. ear muffs.

5.4.3 Water

The proposed project will need a lot of water since construction activities are known to be a lot, the various structures will require water; construction workers will create additional demand to the supply in some ways. Once the project is complete, water will also be required. The site is also not located near a water source thus no pollution is anticipated.

The contractor also will have storage tanks onsite to store water thus no waste will be experienced.

Mitigation measures

- The contractor should install water tanks on site to conserve water for construction activities especially during periods of high water demand which will mainly be during civil works.
- Encourage water re-use/recycling mostly during construction to avoid water wastage.
- Keep the water taps off when not in use.
- Install tanks to tap rain water to increase to the water reserve.

5.4.4 Air Quality

The construction activities on the site will result to increased dust and gas emissions. Some Construction machinery and trucks generate hazardous exhaust fumes such as Carbon Oxides (CO_2), Sulphur Oxides (SO_2) and Nitrogen Oxides (NO_2). Dust, as caused by vibrations of machines and vehicle movement suspends in the air mostly during dry spells. Such dust and gases have direct negative impact to the quality of air.

Mitigation measures

- Provide protective equipment and materials and clothing such as nose masks and goggles
- Regular and prompt maintenance of construction machinery and equipment. This will minimize production of hazardous gases.
- Areas generating dust particles should be sprinkled with water to reduce dust blowing out over the area and should be enclosed where possible to mitigate effects of wind on them.
- Workers should go for regular health check-ups to ascertain their health standards and should be encouraged to take milk regularly as this will control the level of congestion of dust in their chests.
- The generator exhaust should be directed away from the facility to avoid smoke clouding.

5.4.5 Oil Leaks and Spills

Oil spills are prevalent in construction sites. Though this may not be common, it is wise to control and observe the little leaks and spills that will occur especially during maintenance of the involved machinery and vehicles.

Mitigation measures

- All machinery should be keenly observed not to leak oils on the ground. This can be ensured through regular maintenance of the construction machines and equipment.
- Maintenance should be carried out in a well-designed and protected area and where oils/grease is completely restrained from reaching the ground. Such areas should be covered to avoid storm from carrying away oils into the soil/water systems.
- All oils/grease and materials should be stored in a site's store which is usually located in the contractor's yard/site office.

5.4.6 Solid Waste

- Construction activities results to increased solid wastes within the site. Such waste materials include stones, pieces of metal rods, pieces of iron, pieces of pipes, papers, equipment wrappings etc.
- On completion, the property management should adapt a waste management system to handle any waste that will be generated from various operations.

5.4.7 Flora and Fauna

Removal and disposal of such refuse and other related wastes comes in handy in this project.

Mitigation measures

- The waste materials should be properly segregated and separated to encourage recycling of some of them such as concrete debris which can be used as backfills with the approval of the site engineer. The site has minimal vegetation which has no conservation values. Some temporary and permanent disturbances will be caused to small animals.

Mitigation measures

- Flora and fauna on site should be conserved.

5.4.8 Construction Materials

They include stones, sand, cement, ballast and steel rods for the raft, walls and the columns. They should be of the good quality.

Mitigation measures

- Should be sourced only from licensed dealers and suppliers.
- Quality should be thoroughly monitored through regular tests e.g. cube tests.
- Recycling of raw materials should be encouraged, e. g, pieces of stones and construction waste can be used for backfilling.

5.5 Occupational Health and Safety (OHS)

During construction, there will be increased dust, air and noise pollution. These are considered as negative impacts. The residents and workforce involved will be more subjected to these environmental hazards. Food for the construction workforce is usually provided by mobile vendors most of which operates without health licenses. This can compromise the health of the workers especially if such foodstuffs are prepared in unhygienic conditions

Falls from high heights is also a common risk which is common is such works and proper protective gear is of importance during the erecting of the walls.

Mitigation measures

- All workers should be provided with full protective gear. These include working boots, safety harness, overalls, helmets, goggles, masks and gloves.
- People preparing food for the workers on site should be monitored to ensure that food is hygienically prepared.
- A first aid kit should be provided within the site. This should be fully equipped at all times, site workers should also be trained on basic First Aid Skills.
- Some tasks require one to be in very good health, workers should be subjected to medical examinations before starting work. This will ensure that only medically fit persons are engaged for such tasks.
- The site workers should be warned of drugs and alcohol since they might affect their concentration at work causing accidents.

- Sanitary facilities should be provided on site during construction and should be kept clean at all times.

5.5.1 Security

Security is a fundamental aspect to consider in any development. Good security ensures that materials and equipment are not stolen or vandalized from site and that construction activities are not disrupted with during the normal working hours.

Mitigation measures

- A site office should be constructed on site to store materials and equipment while not in use.
- The site should be enclosed using suitable walls to beef-up security and to control movement in and out of site.
- Lighting as well as security alarms should be installed on site after completion.
- There should be security guard stationed on site to monitor movements of people in and out of the site area.

5.5.2 Fire Safety

Fire safety measures should be considered in any development plan. Fire outbreaks are common occurrences in many premises mainly due to poor installation of electric devices or poor handling of fire equipment or flammable substances. In this development proposal; proper care will be taken into account during and after the implementation phase so as to minimize chances of fire outbreaks.

Mitigation measures

- Fire alarm and fighting equipment should be installed within the facility once it is complete.
- A “No smoking” notice should be placed strategically on site.
- Ensure that all firefighting equipment installed on the site once it is complete are regularly maintained and serviced.
- Dry sand buckets should be placed in strategic places in case of fire.
- The facility operators should be trained on how to use various firefighting devices.

- Emergency chart numbers should be placed strategically in case of any emergency.

5.5.3 Traffic Density

Heavy traffic will be generated during the construction phase; this will be caused by construction trucks ferrying materials and equipment to the site. Stringent measures should be adapted to minimize or avert any vehicular congestion which may occur.

Mitigation measures

- The traffic should be controlled during implementation and operation phases and mostly when large trucks for delivery of materials, this will control or prevent accidents.
- Transportation of materials should be done between 8.00AM-5.00AM and on the weekends only when the vehicles are few.
- The acceleration and deceleration lanes getting in and out of the facility should be wide enough and with no obstruction to avoid any vehicular snarl up.
- Signs of '**MEN AT WORK'** should be placed on the side of the road to warn incoming vehicles.

5.5.4 Public Participation

The project will not be implemented without participation of the local people; public opinion was sought before the beginning of the project through the Syokimau Residents Association. The idea behind the distribution of questionnaires was to get the perception the community has towards the proposed project. In principle, the project was wholly accepted by the community, there was no objection raised by the community towards the implementation of this project. Reasons which led to acceptance of the project by the community include: -

- **Provision housing units**: The proposed development will provide the community around with additional housing units; the similar existing facilities cannot meet the demand.
- **Social cohesion**: The implementation of the project will involve people from diverse cultural backgrounds, this will enhance social cohesion.

- **Employment/income**: The project will demand both skilled and non-skilled labour force, the required labour force will be provided by the local community; closely related to this is the source of income to the Machakos County Government in form of statutory payments.

CHAPTER SIX: ALTERNATIVES AND PROPOSED ACTION

6.1 Analysis of Alternatives

Alternatives to the project, including the no action alternative will be presented in this section, as well as the historical use of the overall area in which the project site is located. These alternatives will be discussed from environmental and socio-economic perspectives.

6.2 The No-Action Alternative

Without the proposed development, the location will remain in its current abandoned state. This no-action alternative in itself, presents environmental concerns, as the site in its current state is prime but underutilized. From a socio-economic perspective, the no-action alternative will definitely not yield any benefit to the proponent and the surrounding communities. This alternative will mean that the project does not proceed

Advantages

- Air pollution from dust as a result of the construction process will not occur
- There will not be soil compaction as a result of heavy machinery use
- There will be no soil or water contamination

Disadvantage

- There will be no creation of employment
- There will be no additional facility to drive socio-economic development
- There will be no secondary development as a result of the project
- The improvement in infrastructure as a result of the project will not be realized
- The value of land might improve but it will remain underdevelopment
- The expected income in the form of profits to the developer and in the form of taxes to the government will not be realized
- Provision and supply of construction materials will not improve

6.3 Relocation Alternative

Relocation option to a different site is an option available for the project implementation. At the moment, there are no alternative sites for the proposed development (i.e. the project proponent does not have an alternative site). This means that the proponent has to look for

the land if relocation is proposed. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take a long period. In addition, it is not guaranteed that such land will be available.

6.4 Comparison of Alternatives

Under the NO Action alternatives, no development will be allowed therefore, there will neither be benefits from the project nor the insignificant effects. Under the proposed development alternatives, the proposed development will create temporary employment for contractors. Provided the mitigation measures are implemented, including construction and best management practices, insignificant impacts on soils and water quality are anticipated. Commitments associated with this alternative will ensure that potential impacts are avoided or reduced to levels of insignificance.

6.5 Site Decommissioning Phase

No project will exist forever, at some point the site will be demolished and the space it had occupied be restored to its original form. This exercise will have some impacts to the environment. The following takes place during decommissioning:-

- All foundations must be removed and recycled, reused or disposed of at a licensed disposal site
- Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the material should be taken to a licensed waste disposal site.
- Donate reusable demolition waste to charitable organizations, individuals and institutions
- Implement an appropriate re-vegetation programs to restore the site to its original status
- Consider use of indigenous plant species in re-vegetation.
- Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent areas and the development**.**

The above activities will also have some impacts to the environment, this will involve:-

- Occupational health risks like cuts and bruises.

- Production of solid, liquid and gaseous waste.
- Pollution of air with dust particles.
- Likely spillage of fuel, oil and grease.
- Vibration caused by the site construction equipment and machines e,g drilling machines.
- Landscaping the land to its original form.

All buildings, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused.

CHAPTER SEVEN: ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS.

7.1 Introduction

The environmental management plan involves risk management strategies that should be undertaken by the project proponent, project manager and the residents to mitigate environmental degeneration. They are approaches to monitor, control, reclaim and restore the environment back to its appropriate state. EMP's for projects thus provide logical frameworks within which the identified issues of environmental concern can be mitigated, monitored and evaluated. Environmental monitoring involves measurement of relevant parameters, at a level of details accurate enough, to distinguish the anticipated changes. Monitoring aims at determining the effectiveness of actions to improve environmental quality.

The environmental management and monitoring plans has been developed and outlined to bring home the key findings of the Environmental Impact Assessment of the project in mention, recommending necessary mitigation actions, defining roles and the estimated cost. The EMP outlined in the tables below addresses the potential negative impacts and mitigation measures as well as roles and costs that can help to determine the effectiveness of actions to upgrade the quality of environment; as regards the proposed project. The EMP has considered construction, operational decommissioning phase.

ENVIRONMENTAL IMPACT	MITIGATION MEASURES	RESPONSIBILITY	COST (KES) ESTIMATE	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	500,000	Presence of Site store
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	- Proper signage	Contractor/Project team and	800,000	- Presence of site

Traffic flow during construction	- Awareness creation - Education to truck drivers - The proponent has come up with a traffic management plan	general public		Notice Board /Hoarding - Presence of Security guards to control traffic - 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 County - Restoration of sites Excavated	Contractor	4,000,000	Landscaping after completion of construction
Soil Erosion	- Create and Maintain soil traps and embankments. - Landscaping after completion of construction	Contractor/Proponent, Architect/Site engineer Landscape Architect	1,000,000	Lack/Absence of Soil Erosion
Noise Pollution and Vibration	- Ensure use of serviced and greased equipment - Switch off engines not in use - Construction work to be confined to between 7am to 5pm - Ensure use of earmuffs by machine operators	Proponent and Contractor	Part of Routine operation procedure	Lack of complaints from the immediate neighbours
Air Quality	- Water sprinkling of driveways or the use of biodegradable hydrant e.g. Terrasorb polymer will reduce dust emission during construction - Ensure servicing of vehicles regularly	Proponent and Contractor	1,000,000	- Lack of complaints - Workers wearing protective clothing and earmuffs

Risks of Accidents and Injuries to Workers	- Education and awareness to all construction workers - Ensure use of appropriate personal protective clothing - Provide First Aid Kits on site - Ensuring Building Strength and stability - Proper supervision	Proponent Contractor	800,000	- Presence of well-equipped First Aid kit Presence of Security Guards on site Presence of a register on the site
Health and Safety	- Provide First Aid Kits on site - Proper signage and warning to public of heavy vehicle turning - Ensuring Building Strength and stability - Provide clean water and food to the workers - The contractor to abide by all construction conditions especially clause B12 which stipulates health safety and workforce welfare	Proponent Contractor	1,000,000	- Presence of well-equipped First Aid kit - Presence of Security Guards on site - Presence of a register on the site
ENVIRONMENTAL IMPACT	**MITIGATION MEASURES**	**RESPONSIBILITY**	**COST (KES)**	**MONITORING MEASURES**
Solid Waste Generation	- Ensure waste materials are disposed of on County and NEMA approved sites - Ensure re-use of materials that can be re-used - Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent Contractor	1,000,000	- Absence of Solid waste on the site
Energy Consumption	- Use electricity sparingly since high consumption of electricity negatively impacts on these natural resources and their sustainability - Use of Standby Generators	Proponent Contractor	1,000,000	- Presence of KPLC power lines - Presence of Generators
Excessive Water Use	- Excessive water use may negatively impact on the water source and its	Proponent	1,000,000	- Metering of water

	sustainability - Consider drilling borehole to supplement MAVWSCO supply	Contractor		
OCCUPATION PHASE				
Architectural incompatibility leading to distortion of neighborhood aesthetic image	- Harmonize building scale with existing developments in neighborhood. - Harmonize detail, material and finishes for roofs and walls with existing development in the neighborhood.	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 - Provide waste disposal bins to each suite well protected from adverse weather and animals - Ensure waste materials are disposed off on County approved sites - Engage a NEMA licensed waste handler to transport the waste - Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent Contractor	1,500,000	- 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 - Proper connection to the waste water treatment plant	Proponent Contractor	1,000,000	- Absence of liquid wastes
ENVIRONMENTAL IMPACT	**MITIGATION MEASURES**	**RESPONSIBILITY**	**COST (KES)**	**MONITORING MEASURES**
Increased loading on Infrastructure services	- Have paved private access road and walkway system - Have paved road drainage system	Contractor Proponent	1,000,000	- Absence of run-off - Presence of

- Increased vehicular and/or pedestrian traffic - Increased demand on water, sanitation services	- Encourage rainwater harvesting - Provision of increased water storage capacity - Provide adequate storm water drainage system			good roads - Pavements and drainage channels
Traffic	- Come up with traffic management plan - Provide adequate parking facilities within the project site - Construction of private access road	Contractor Proponent	Routine operation procedure	- Presence of amble parking in the premises
Increased social conflict	- Increased economic activities – employment generation and income earnings - Encourage good relation with the neighbors through neighborhood associations	Contractor Proponent		-Good relationship with neighbours -absence of conflicts
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	900,000	Absence of Flooding and dampness in the premise

Disruption of existing natural environment and modification of micro-climate: - Increased development density - Increased glare/solar reflection - Reduced natural ground cover/surface run-off - Obstruction of ventilating winds	- 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. - The balcony's should have garden	Project team (Contractor Proponent, Architect or Lead Consultant, etc)	2, 000,000	Proper orientation Planted trees/Landscaping
ENVIRONMENTAL IMPACT	**MITIGATION MEASURES**	**RESPONSIBILITY**	**COST (KES)**	**MONITORING MEASURES**
Insecurity	- secure the premise with a perimeter wall and an electric fence - Installation of CCTV cameras at strategic points - Have a entry point that is manned 24 hours - Construction of gate house	Contractor Proponent	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	1,000,000	Engineer and Tests on the building
Land and Building use	Ascertain the Planning development policy	County Physical Planner	900,000	Consultants present
Accidents/Injuries	Securing the Site by fencing off	Contractor Proponent	1,000,000	Presence of perimeter fence
Un-disconnected	Ensure disconnection of all services	Contractor	2,000,000	Absence of

Services e.g. Power, Water, telephone, sewer etc	Remove all surface and underground cables and wiring			cabling
Solid Waste Generation (demolition waste)	Ensure waste materials are disposed of on County and NEMA approved sites Ensure re-use of materials that can be re-used -Use of the 3rs – Reduce, Re-use, Re-cycle	Proponent/Contractor	2,000,000	Absence of Debris
Noise and Vibration	- Ensure use of serviced equipment - Switch off engines not in use - Demolition work to be confined to between 8am to 5pm - Ensure use of earmuffs by workers	Proponent Contractor	900,000	Lack of complaints from the neighbors

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS.

8.1 Conclusion

The Kenyan government has with great concern realized shortfall in standard (urban) housing infrastructure and has come up with a policy that aims at providing over one hundred thousand new house units per annum. It has in addition recognized the input of individuals and private developers in providing planned house infrastructure to bridge the gap in the housing sector. The proposed project is focused on the construction of the proposed modern residential apartments of fifteen (15) no. blocks of residential apartments consisting of a total of 360 units. The apartments comprise of typical three bedroom units & two bedroom units with each block having five (5) storeys in Syokimau area, Machakos County on plot L.R NO 12715/537.

The project under consideration in this report residential apartment, it has met all requirements in terms of design and space, and all the safety measures have also been put into consideration. The project is not expected to have any negative impact to the environment especially due to its location; the area is quite secure and has basically all the basic facilities. It is our considerable opinion that the proposed development is a timely venture and will supplement considerably to the government policy. It is thus our recommendation that the project is allowed to go ahead with strict implementation of the mitigation measures provided to minimize anticipated environmental impacts. More focus shall be put to minimize the occurrence of impacts that will degrade the environment while exploiting those impacts that are positive.

Finally, the project proponent has promised to work closely with environmental experts, residents, local authority, local County Environment committees and NEMA to ensure smooth facilitation of the issues that touch on environment to include; water supply, effluent disposal, solid waste management, air pollution but to mention a few. This will ensure that environmental concerns are integrated into the project process.

8.2 Recommendations

Recommendation for the preventive and mitigation of adverse impacts is presented as follows:

1) The proponent will ensure that the development has been approved by the relevant regulatory departments as Department of Physical planning, Ministry of Lands and Settlement, health, NEMA etc. the proponent should therefore follow guidelines as set by the government to safeguard EMP principles during the construction and operation phases of the proposed project.
2) It is important that warning information signage is erected strategically at the site. This will indicate the operation hours and works are likely to start and completed. The signage will be positioned in a way that both pedestrians and motorist will see.
3) All solid waste and debris resulting from the construction activities must be disposed off at approved dumpsites.
4) All construction materials to include, sand, gravel, hardcore, metals, treatment chemicals must be sourced from known and approved dealers or manufacturers who have environment sign of quality.
5) Ensure that construction activities must be undertaken only during the day i.e. 0800 hours to 1700 hours. This will minimize anticipated disturbance and nuisance to the residents of adjacent properties and the general public.
6) The service road to the site be well maintained even after use by the heavy machinery e.g. Lorries.
7) Traffic along nearby roads should be controlled and informed during construction hours especially of heavy turning Lorries and plant in and out. This will minimize potential accidents from unsuspecting motorists.
8) The contractor will ensure that loose soils must be covered to prevent erosion. Other soil erosion preventive measures including watering during dry season to prevent wind erosion will be implemented. Any stockpiles of earth will be enclosed or covered to reduce dust to the neighbors.
9) Once earth works have been done, restoration of the worked areas should be carried out immediately through backfilling by experienced landscape experts. This will include planting trees and grass, flowers etc.
10) Drainage system will be properly designed, installed, and regularly maintained to prevent storm water runoff.

11) Used and new oils from the motor vehicles and plant will be handled and stored properly. Due care on leakages and accidental spills will be taken.

12) Workers should be provided with complete personal protective equipment (PPE) and safety gear. They should be provided with safety boots, overalls, gloves, helmets, ear plugs and muffs, goggles etc. A fully equipped first aid kit must be within reach.

13) The contractor must have workman compensation cover. He or she must comply with Workman compensation Act as well as other ordinances that apply to the workers. Where the workers have a union, the Collective Bargaining Agreement (CBA) shall be observed.

14) A complete firefighting system with water hydrants must be provided after completion of the project. A fire response emergency plan shall be designed and communicated to be used in situations of fire outbreak.

15) Due diligence should be exercised by the contractor or the project agent during the construction phase to safeguard and ensure that all the mitigation measures are adhered to the letter.

REFERENCES

1. Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act CAP 387. Government printer, Nairobi
2. Kenya gazette supplement Acts Building Code 2000 by government printer, Nairobi
3. Kenya gazette supplement Acts Land Planning Act (Cap. 303) government printer, Nairobi
4. Kenya gazette supplement Acts Local Authority Act (Cap. 265) government printer, Nairobi
5. Kenya gazette supplement Acts Penal Code Act (Cap.63) government printer, Nairobi
6. Kenya gazette supplement Acts Physical Planning Act, 1999 government printer, Nairobi
7. Kenya gazette supplement Acts Public Health Act (Cap. 242) government printer, Nairobi
8. Kenya gazette supplement number 56.
9. Environmental Impact Assessment and Audit Regulations 2003. Government printer, Nairobi
10. United Nations (1987) The Rio Declaration on Environment and Development
11. United Nations (2000) The World Commission on Environment and Development
12. Sombroek W. G., Braun H. M. M. and Van der Pouw B. J. A., 1982, Exploratory Soil Map and Agro-Climate Zone Map of Kenya, Nairobi