

ENVIRONMENTAL IMPACT ASSESSMENT SUDY REPORT

**PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENTS ON
PLOT 209/14070 NAIROBI CITY COUNTY**



Southern By Pass

PROJECT PROPONENT: UNITED AFRICA CONSTRUCTION LTD

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NAIROBI

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NAIROBI

Proposed site

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COMPLIANCE

This Study report on Environmental Impact Assessment has been prepared by M. Ndungu a registered and license EIA/EA lead expert

The report has been Conducted with skills, care, honesty and diligence in accordance with the Environmental Management and Coordination Act 1999 and the Environmental (Impact Assessment and Audit Regulations 2003

We undersigned, certify that the particulars given in this report are correct and righteous to the best of our knowledge

PROJECT PROPONENT:

NAME : United Africa Construction Limited

DESIGNATION: PROPONENT

ADDRESS : 63756-00619, MUTHAIGA

NAIROBI

Signature Date

M. Ndungu – Environmental Expert

Registration No. 1967

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NAIROBI

Sign.....

ABBREVIATIONS

EMCA Environmental Management & coordination Act, 1999

PPA Physical Planning Act, 1996

NEMA National Environment & Management Authority

CO2 Carbon Dioxide

EHS Environment, Occupational Health and Safety

EMS Environmental Management System

UNEP United Nations Environment Programme

EIAR Environmental Impact Audit Report

FA Forest Act

WA Water Act

NCA Nature Conservation Act

NCWSC Nairobi City Water and Sewerage Company

PHA Public Health Act

WHO World Health Organization

1.0 EXECUTIVE SUMMARY

The project will comprise of 254 apartments which will be multi-storied with fifteen floors. The storied will be reinforced with concrete and natural stone dressed, with versa tile roofing, double storey reinforced concrete community centre and commercial building. Africa Construction limited is located on L.R No. 209/14070 in Nairobi County.

The project anticipates the following impacts and mitigation measures.

Possible impacts	Mitigation Measure
Hydrology and Water supply quality Degradation	<ul style="list-style-type: none"> • Hazardous substance control and emergency response plan that will include preparation for quick and safe clean-up of accidental spill • Hazardous materials handling procedures to reduce the potentials for spill during construction • Identify areas where refueling and vehicle maintenance activities and storage of hazardous materials, if any, shall be permitted
Dust and exhaust emission	<ul style="list-style-type: none"> • Ensure strict enforcement of on-site speed limit regulations • Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles • Personal protective equipment to be worn • Alternatively fueled construction equipment shall be used where feasible; equipment shall be properly tuned and maintained.
Noise pollution and vibration:	<ul style="list-style-type: none"> • Sensitive construction vehicle drivers machinery operators to switch off vehicle or machinery not being used • Ensure that construction machinery are kept in good condition to reduce noise generation • Trees around the site shall provide some buffer against noise propagation • The noisy construction works shall entirely be planned to be during day time when most of the neighbours shall be away at work
Incidents, accidents and dangerous occurrences	<ul style="list-style-type: none"> • Ensure that provisions for reporting incidents and dangerous occurrences during construction using prescribed forms obtainable from the local occupational health and safety office (OHSO) are in place. • Enforcing adherence to safety procedures and preparing contingency plan for accidental response in addition to safety education and training shall be emphasized • Ensure that the premises are insured as per statutory requirements (Third party and workman's compensation) • Develop, efficient, clean well-lit and adequate sanitary conveniences have been provided for construction workers
Oil spills	<ul style="list-style-type: none"> • A designated garage section of the site fitted with trapping equipments to be planned for changes. such an area shall be well protected from contaminating the soil

Solid waste generation	<ul style="list-style-type: none"> • Use of an integrated solid waste management system i.e. recover, recycle and reuse • Through accurate estimation of the sizes and qualities of materials required, order materials in the sizes and qualities they will be needed, rather than cutting them to size or having large quantity residual materials • Ensure that damaged or wasted construction materials are recovered for refurbishing and use in other projects • Donate recyclables /reusable or residual materials to local community groups, institutions, and individual local residents or home owners. • Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure. • Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste • Reuse packaging materials such as cartons, cement bags, empty metals and plastic containers to reduce waste at the site. • Dispose waste more responsibly by dumping at designated dumping sites or landfills only • Waste collection bins to be provided at designated points on site. • Running educational campaigns amongst residents, e.g. through use of posters, to encourage reuse or recycling of the solid waste.
Increased Storm water , runoff and soil erosion	<ul style="list-style-type: none"> • Roof water to be harvested and stored in underground reserves for use in cleaning and in the toilets. The tanks shall have a capacity of at 100,000 litres .To ensure the use of such water for the stated purposes, the building shall be fitted with a dual distribution system • A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and /or retention with graduated outlet control structure shall be designed • Apply soil erosion control measures such as leveling of the project site reduce run-off velocity and increase infiltration of storm water into the soil. • Ensure those construction vehicles are restricted to existing roads to avoid soil compaction within and around the project site. • Ensure that any compaction areas are ripped to reduce runoff.
Generation of wastewater	<p>Provision of means for handling sewerage generated by construction workers (there are toilets connected to septic tanks on the site)</p> <p>Conduct regular checks for sewage pipe blockages or damages since vices can lead to release of the effluent into the land water bodies</p>

	Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated
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1.2 PROJECT SUMMARY

1.3 Introduction

The Director General, National Environment Management Authority (NEMA) acting on powers legally conferred on his office in pursuant to sections 68 and 69 of Environmental Management and coordination Act (EMCA), 1999 and Environmental Audit Assessment and Assessment Regulations 2003 (Legal Notice No. 101), has given notice for submission of Environmental Assessments for all firms including office development inter alia operating within the Republic of Kenya to NEMA Environmental Study Assessment Report for all proposed projects. This project report was prepared to fulfill the above legal requirement in order to establish the impacts that will arise from the operations of the proposed project on the environment, as a result of its production and associated activities on the natural and social-economic environment. This process is motivated by the owner’s recognition that it has social responsibility over its environment and therefore needs to lay down strategies for sustainable use and improvement of the environment.

Nationally, environmental legislation has made it mandatory for all firms and citizens to take care of the environment when using it and specifically its mandatory to have Environmental impact Assessment ,so as to identify and mitigate harmful impacts that could be detrimental to the Natural and Social-economic Environment. After scoping, which included site visits and a series of meetings with the proprietor, the consultant compiled the following project report covering the following areas inter alia.

- A review of the policy, legal and administrative framework
- Description of the proposed project
- Baseline information.
- Assessment of the potential environmental impacts on the project area
- Development of the mitigation measures and future monitoring plans.
- Social Impact Assessment.

The United Africa Development Limited herein after referred to as the proponent. The proponent proposes to develop apartments along Kodi road 2 which connects Mombasa road and borders southern by pass. The development comprises three blocks of 15 floors, inclusive of ground floor and lower ground floor. The apartments on the first and second floor they will have general facilities which will have a parking and the thirteen Typical Upper Floors will have necessary sanitation adequately provided on each floor, water storage tank and staircase. The proposed project site is currently vacant though has a perimeter wall along the plot and thus the proponent wants to carry out the development to properly utilize the parcel of land currently

underutilized and idle people and muggers hide in the property so that it can conform to the developments in the area. It is situated on plot L.R No.209/14070 which is approximately at an altitude of 1500meters above sea level. There are no valuable natural resources in the proposed project site or its environs and the relevant Government authorities have already approved the development of the land parcel.

For a long time the world over, policy makers directed all the efforts in economic development without due regard to the resource base on which the economic development depend on. As a result, there has been unprecedented environmental degradation due to lack of environmental conservation resulting to unsustainable development. To ensure sustainable development, it was realized that all activities must be evaluated and monitored to ensure that they are not harmful to the environment. One of the main tools to achieve this is the Environmental Impact Assessment study before the implementation of a new project and this has been emphasized in the EMCA, 1999. Environmental Experts registered by National Environmental Management Authority (NEMA) conducted the EIA study pursuant to requirements of EMCA Environmental Impact Assessment and Audit Regulations, 2003, and the World Bank Guidelines. The need for the project is collaborated by the emerging high demand for housing developments in major towns and private sector's initiative in providing affordable housing to the members of the society and will be in line with government paradigm of providing affordable and adequate housing to the general population .

1.4 Scope, Objectives

The major objectives of this EIA study assessment are to evaluate the effects/impacts of the proposed development in relation to the entire environmental aspects i.e. physical, biological, and social-economic environments. It aims at influencing the protection and co-existence of the development with the surrounding as well as the compatibility of the proposed development to the area to ensure and enforce sustainable environmental management during construction and on occupation phases.

The scope of the assessment study report is to cover the physical extent of the project site and its immediate environs, construction works of the proposed development (ground preparation, foundations, walling, finishes, roofing, fixtures and fittings among others), installation of utilities/facilities and services as required by the stated development. The output of the assessment is the production of a comprehensive Environmental Impact Assessment project report for submission to NEMA for the purposes of seeking an EIA license.

1.5 Terms of Reference

The terms of reference for this report were but not limited to:-

- A critical look into project objectives.
- The proposed location/site of the residential project
- A concise description of the baseline information, National Environmental, Legislative and Regulatory framework, and any other relevant information related to the project.
- Evaluation of the technology, procedures and processes to be used, in the implementation of the project and their extended sources.

- Description, evaluation and analysis of the foreseeable potential environmental effects of the project broadly classified into Physical, Ecological/Biological and Socio-Economic aspects (direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated).
- Evaluation of the products, by-products and waste to be generated by the project
- To propose/recommend a specific environmentally sound and affordable liquid and solid waste management system.
- Propose alternative technologies and processes available and justification for the preferred/chosen technologies and processes.
- Evaluation and analysis of alternatives including the proposed project, no project alternative, project site, design and technologies.
- An Environmental Management Plans 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.
- An identification of gaps in knowledge and uncertainties, which were encountered in compiling the information
- Such other matters as NEMA may require.

1.6 Methodology Outline

The following general steps were followed during the assessment to ensure comprehensiveness and completeness of the report:-

- Environment screening in which the project was identified as among those requiring Environmental Impact Assessment under schedule 2 of EMCA, 1999
- Environment scoping that provided the key environmental issues.
- Physical inspection of the site and its environs.
- Desk stop studies, consultations, questionnaires and extensive interviews with stakeholders (the local community, the neighbours, the proponent and his consultants and the government among others).
- Soil laboratory analysis to find out whether there is presence of toxic compounds and elements (metals), which would otherwise be detrimental to the health.
- Reporting.

1.7 Project Description

The proposed apartment development in Nairobi West, involves the hooding the site, Excavation, construction and subsequent occupation of the Apartments. The proponent will sell or rent the apartments to members of the public. The proposed project entails development of 254 number of Apartments built in three towers block with all related infrastructure i.e. swimming pool, adequate parking for tenants and their guests, gyms, elevators to cater for high end customers . The proponent proposes to construct the blocks of Apartments with the entire project being projected to be complete in 2 year (Twenty four months) time from the date of

commencement. The proposed site is situated in a moderately developed area easily accessed by virtue of being along access roads of tarmac surfaced standards of Mombasa road and the southern bypass
The developments will comprise of:-

- **Apartments**

254 units of one, two and three bedrooms of typical floors

Note: Please find the attached copy of Architectural drawings

1.8 Positive Impacts of the Proposed Project

The proposed development was noted to have positive impacts to the society both at Local and National level. The benefits will be experienced during construction and occupation phases. They include the following:-

Provisions of residential units and thus increase in the National/Local Residential stock and quality. This is in line with the government policy of providing increase self-employment opportunities.

The optimal use of the land after the former owner sold the plot and relocated.

Water and sewerage systems will be improved under the influence of the proposed development.

Increase in Government revenue and improvement of Local and National standards of living of the society.

- Economic-investment hence increases in wealth. The property owner will enjoy income generated through the lease/rent of the units to be developed to individual holders.
- Improvement of social interaction. The development will bring together people with diverse cultural enterprise hence promotion of sharing ideas that will lead to better business operation and also increase in the number of clients through networking between the occupants/tenants.
- Creation of market for goods and services and especially construction inputs which include raw materials, construction machinery and labour. Many secondary businesses are also likely to spring up during the construction phase especially those providing foods and beverages to the construction workers.

1.9 Negative Impacts and Issues of concern associated with proposed project

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

- Impact to soil (including soil erosion) especially when laying the foundation and other earthworks.
- Increased noise and vibration mostly during construction phase.
- Impact (constraints) to the existing infrastructure i.e. water, sewer system, power, surface drains, roads among others.
- Clearing of the existing vegetation from the site.
- Increased storm water/run-off resulting from the roof catchments and as a result of decreased recharge areas after pavement of most areas thus hydrology and water quality degradation.
- Air pollution as a result of dust particles emanating from excavation and construction activities. Exhausts from the involved machinery will lead to increased levels of noxious gases such as Sulphur, carbon, and nitrogen oxides.

- The health and safety of workers and immediate occupants and neighbours may be compromised due to accidents, pollution and disturbance.
- Increased waste generation (both solid and liquid) during construction and occupation.
- Possible mushrooming of informal settlements in form of food kiosks during construction and same times during use of the Residential building block.

1.10 Proposed Mitigation Measures

To minimize the occurrence and magnitude of the negative impacts, mitigation measures have been proposed against each of the anticipated impact. Other measures have been integrated in the project designs with a view to ensuring compliance with applicable Environmental Laws and Guidelines. The measures include the following:-

- Erection of warning/informative signs (bill boards) at the site during the construction phase, and traffic control along the connecting access Kodi road 2.
- Soil compaction and watering of loose soils on all unpaved access roads, parking areas and staging areas and construction materials, at the construction sites to minimize air pollution and erosion i.e. water, animals and wind.
- To cater for storm water drainage, well-designed concrete invert channel drains are provided in the plans to harmonize management of the resulting storm water within the site. The drains are designed to channel the water to the NCC storm water drains at the proximity of the plot or use the combined NCC sewer system. Storm water runoff will be greatly reduced by rainwater harvesting. The drains must be regularly maintained.
- To reduce noise pollution, portable barriers to shield compressors and other small stationary equipment where necessary should

2.2 Scoping Process

The Environmental Impacts of the proposed project was carried out through the following process:-

- Evaluation of the location, land ownership and use.
- Design and proposed Construction materials and Methodology.
- Project site visits.
- Consultation with neighbors/general public in neighboring estates.

The scoping exercise was conducted to evaluate the project in its entirety so as to identify areas of concern and the sources of potential environmental impacts that will be associated with the development. The study has assessed the impacts of the project development on the environment in accordance with existing guidelines in compliance with Environmental Management and coordination Act of 1999 and the Environment Impact Assessment and Audit 2003 guidelines. The EIA project report has covered the following activities:-

- A review of the policy, legal and administrative framework.
- Description of the proposed project.
- Baseline information.
- Assessment of the potential environmental impacts on the project area.
- Social impact Assessment.
- Development of the mitigation measures and future monitoring plans.

2.3 Terms of Reference (ToR)

This Environmental Impact Assessment considered the following aspects among others that proved of significance during the study.

1. The ecological effects. This covered:-
 - Provision of background and baseline information.
 - Definition of the objectives/designs of the project.
 - Provision of information on the total project cost.
 - The effects of the development of biodiversity both within and outside the project development site.
 - Effects on habitat quality and issue of habitat disruption.
 - Losses of vegetation cover (mostly grass)
 - Surface water run-off containment and flood control.
2. Social implications of the development within the locality, Region and Nationally. These include:
 - Economic implications of the development.
 - Security – threats, risk and enhancement.
 - Employment.
 - Livelihoods
 - Public health implication's
 - Demand and development of infrastructure and social amenities.
3. Determination of the effects on Landscape and land use.

- Assessment of the effects on scenery/aesthetic modification.
 - Analysis of the compatibility of the land use development with the surrounding land uses i.e. effect(s) on neighbourhood characteristics.
4. Effects of the development on current demands on water sources as well as possible implications on surface and underground water qualities and quantities.
 5. Proposition of mitigation measures to be taken during and after implementation of the project; and development of an environmental management plan with mechanisms for monitoring and evaluating the compliance and environmental performance.

2.4 Methodology

Literature review pertaining to the project activities and salient features of the project area has been done. This has covered the review of the Environmental Management and Coordination Act, relevant studies and reports on the construction including design works and other related sources of information.

During the field investigations, reconnaissance survey was conducted in order to collect information on biophysical and social-economic environment of the project development area and its environs.

3.0 DESCRIPTION OF THE PROPOSED PROJECT

3.1 Nature of the Project.

The project proponent intends to build 254 apartments, with necessary adequate sanitation and parking facilities. The blocks will entails lower ground, ground floor which will house parking, 2 floors for general facilities, the other 13 number Upper floors will house the apartments. Each tower will have 3 number elevators, and necessary sanitation adequately provided for each house, water storage tank, staircase and adequate parking on the entire ground floor for the residents together with their visitors.

The project is collaborated by the emerging high demand for houses to take care of the emerging urban Lower middle and upper middle class with modest lifestyle and going high rise to fully utilize the land due to the high cost of land in the capital city .High demand of houses is as result of high population in the urban centers/areas, due to rural urban migration and the need for residential facilities. Security will also be given substantial priority in the proposed development. The suitability of this kind of development can be justified on diverse of use. This include the demand based on nature and trend of developments in most urban areas, policy focus; plot area and zoning regulation, land-use and infrastructure compatibility, economic impacts and Environmental Impact Assessment among others.

3.2 Location of the project

- The project area/site is situated in Kodi road 2 branching from Mombasa road at The Eka Hotel and Gen Park. The project is served well by a established developed physical and social infrastructure

which include good road network, electricity, water, drainage system, which is provided and rehabilitated by the City County of Nairobi.

3.2.1 Grid Coordinates

The Grid coordinates for the proposed site **S 1°19'35.20"**, **E 36°50'38.36"** **elevation 5427ft.**

3.2.2 Site Ownership

The land is the property of United Africa Development limited.

The proposed site is underdeveloped. The following are conditions to be observed.

- That the proponent provides adequate measures against environmental degradation.
- That the proponent is bound by any other conditions that may be imposed by the council in its by-laws.
- Plus the special conditions highlighted in the title deed attached.

3.3 Zoning Approval

3.4 The planning regulations allow the plot to be used for Residential purposes. The adjoining plots are residential. All the necessary physical planning regulations such as zoning, plot ratio and plot coverage were taken into account during the design of the proposed development, which observed the ground coverage and plot ratio allowed in the area. The development proposal has been submitted and approved by the City Council of Nairobi and other relevant departments.



Apartments within the neighbourhood



Immediate opposite project

3.5 Project Alternatives including the proposed action.

3.5.2 The Proposed Development Alternative

This E.I.A project report will be presented to the National Environmental Management Authority. This will help in evaluating and examining the effects of the project on the environment. After the evaluation and under the proposed development alternative and Environmental Impact Assessment License would be issued. This way, NEMA would approve for the implementation of the project. However, the development has to ensure that all environmental measures are complied with during the demolition of the existing building, construction period and during occupation and operation.

The alternative consists of the proponent's final proposal with the inclusion of the NEMA guidelines and regulations and procedures. This is as stipulated in the Environmental Management and Co-ordination Act (EMCA) of 1999, which aims at reducing environmental impacts to minimum extent practicable.

3.5.3 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 (ie. The project proponent doesn't 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 a guarantee that such land would be available. It's also worth noting that the said project is already underway in terms of seeking development approvals in various Government Departments.

The project proponent would spend another long period of time on design and approvals of the plans by the relevant government departments. The project design and planning before the stage of implantation would call for cost; already encountered in the proposed development i.e. whatever has been done and paid to date would be counted as a loss to the proponent. Assuming the project will be given a positive response (after relocation) by the relevant Authorities including NEMA, it (project) would have been delayed for a long period before implementation. This would also lead to a situation like No Action Alternative (as explained below). The other consequence of this is that it would discourage both foreign and local investors especially in the building sector. In consideration of the above concerns and assessment of the current proposed site, relocation is not a viable option.

3.5.4 The No Action Alternative

The No Action Alternative in respect to the proposed project implies that the status quo is maintained. This option is most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. However, the construction has already been experienced. This option will however, involve several losses both to the project proponent/land owner, the Kenya Society and Government. The property will remain under-utilized. The No Project Option is the least preferred from the socio-economic and partly environmental since if the project is not done.

- The economic benefits especially during construction i.e. provision of jobs for skilled and non-skilled workers will not be realized.
- There will be no generation of income by the developer of the Government.
- The social-economic status of Kenyans and local people would remain unchanged.
- The local skills would remain under utilized.
- No employment opportunities will be created for Kenyans who will work in the project area.
- Discouragement for investors to produce this level of standard and affordable developments.

From the analysis above, it becomes apparent that the No Project Alternative is not the appropriate alternative to the local people, Kenyans, and the Government of Kenya.

3.5.5 Mitigation for the proposed Action

Mitigation measures include proper handling of the waste material as generated especially during demolition of existing clearing and preparation for the site. The application of adaptation of standard construction management practices is fundamental. Conflicts arising from the foreseen negative impacts will be solved through consultation with the neighbours/ public; by explaining the mitigation measures prescribed for the impacts. In addition, the mitigation measures would be appropriately designed and implemented to protect the environment and especially water, soil, drainage, flora and fauna of the area/site. The environmental statutory certificate that would be issued and the project environmental aspects included in the report would help to

control damage to the environment. This is in accordance to the Environmental Management and Co-ordination Act (EMCA), 1999.

3.6 Project Design

This Environmental Impact Assessment study Report is based on information and consultations with the project proponent, The Architect is Bowman Associate, details contained in the architectural plans and drawings of the project. (Please see attached copies of Architectural Plans).

The project is composed of residential apartments. The blocks are designed in such a way that it makes it easy access the site using access road by the name Kodi road 2, which is connected to Mombasa road and the broader Nairobi West Estate. Each floor has designed according to the current market desire and demand. The individual floor units have common facilities such as staircase among other facilities as outlined in the architectural drawing provided in the annex.

3.7 Construction inputs and Activities.

3.6.1 Construction Inputs

The project inputs include the following.

- Construction raw materials i.e. sands, cements, stones, crushed rock gravel, steel metals, painting materials among others. All these will be obtained from licensed dealers and especially those that have complied with the environmental management guidelines and polices.
- Construction machines including machinery such as excavators, graders, mixers and bulldozers and other tools and equipment. These will be used for the transportation of materials, clearing of the vegetation and existing construction debris, and in the construction of the project such machinery will use petroleum products to provide energy.
- A construction labour force of both skilled and non-skilled workers. These will require services such as energy, water supply and sanitation facilities.
- Large volumes of water for construction purposes. It will be supplied form the NCC mains.
- Power from KPLC mains grid or provided by generators.

3.6.2 Construction Activities include the following

- Procurement of construction materials from approved dealers.
- Transportation of construction materials using heavy and light machinery
- Storage of the construction material
- Site clearing, excavation and filling, laying of foundation, building works, disposal of the existing debris/materials. All debris and excavated materials will be dumped on sites approved by the council.



(24) months to complete.

- Electrical, civil and water engineering works. These will be done by registered experts.
- Landscaping works and earth works.
- Completion of the development and occupation.

The project will begin after the National Environmental Management Authority (NEMA) issues the Environmental Impact Assessment (EIA) license. The project is estimated to take approximately Twenty four

4.0 THE PROPOSED HOUSING APARTMENTS

4.1 Justification of the Project

There has been a marked change in the approach of Housing developments in the urban areas and mostly within the major Kenyan cities. Increasingly, there has been a strong tendency to develop houses in areas with secure infrastructure within the confines of fenced boundaries with restricted and well-guarded entrances. The prevailing circumstances render this type of development popular in the cities. These types of development are a practical response to the growing insecurity in the urban areas. Such compounds with good security have relatively low incidences of robberies, break-ins or even attacks on people. The project is an expansion of existing offices currently on the site

The current practice in the old and growing urban centers/areas of the City of physically reducing some road sizes in order to fix/erect-manned gates to curb insecurity is illustrative of the serious concerns of the urban society.

The new housing developments are coming up with modern and efficient drainage and sewerage systems with high factors of safety to handle the ever-escalating volumes of waste materials. They are also installed following guidelines from NEMA, which aim at improving the general environmental quality. Landscaping and waste management are given first hand consideration to ensure sustainable use of the environment.

These kinds of developments are also backing up the

The government's initiative and policy on providing additional employment. It is a great initiative aimed at providing housing units to the urban society in order to decongest our City Center (this is for the case of Nairobi). In the near future, statistics have shown that nearly half of the world population will be living in urban areas. The proposed apartment's development therefore is a welcome idea that will go a long way in reducing

housing shortage in the urban area especially in Nairobi which is experiencing rapid urbanization. The development will also contribute to National/Local stock and quality and it's geared towards vision 2030.

It is noted that urbanization is increasing at a first rate. This brings in new classes of people with specialized demands for new and sophisticated lifestyles. People are considering staying in places with standard infrastructure i.e. Telephone, power and special shop and housing design. Again the desire of staying in groups to enjoy much security and socialization makes life more interesting to the urban society. These are areas with less congestion on the road as people now prefer to stay in areas with good road networks also there is a change from single dwelling to multi- dwelling units.

4.2 Physical Development

The project plans have been submitted and approved by the relevant departments including the Physical Planning, the local authority i.e. City Council of Nairobi, Ministry of lands and housing, health etc. The development is therefore compliant with the existing laws as evidenced by statutory documents provided in the annex.

4.3 The project Specifications

The development will be constructed within the plot boundary covering an area of approximately ^ hectares as earlier mentioned, the apartments with necessary infrastructures and / adequate parking will be developed within the confines of a fenced boundary having a single entry point for both the motorized and non motorized (pedestrians) modes from an access road of Hatheru plus a full time security.



Housing premises bordering the Project site

4.3.1 Property Management

On completion, the houses they will be handed over to the United Africa Construction Limited will rent/sell to the public who are in need of the home occupation purposes and therefore management will fall on them.

4.4 INFRASTRUCTURE AND SERVICES

A summary of the various services is presented below:-

4.4.1 Road and Accessibility

The property lies along Kodi road 2 accessed from Mombasa road and 50meters from Southern By- Pass road on which provides primary access and connection to other major and minor road networks within the city. The access road is fairly in good condition, but very busy during rush hour and this common phenomenon in the city.



Kodi road 2 connecting to Mombasa highway

Road Network serving the proposed site project

It is through this access Kodi road 2 that the traffic (both human and vehicles) will access the proposed project. The development has been designed in a way that there will only be one entry and exit to this access road. Though it is estimated that the development will bring in more people especially tenants and their visitors.



Kodi road 2 serving the proposed site

4.4.2 Sewer System

Currently, there is an NCWSC sewer line serving the project area. However, the project proponent will extend a sewer line from the site to connect to the NCWSC main sewer, which passes along one side of the plot/site. The laying of the sewer line (from the development site to the existing line) will be contracted (by the project proponent) to an independent, but experienced contractor per the NCWSC requirements.

The council has assured that the increased volume from the site will not affect negatively on the existing sewer (council main sewer) line once connected. The line is large enough and is said to have been designed with a capacity to serve the entire area.

The sewer system reticulation has been effectively designed in the approved plans and connected to each floor unit in the entire building block. The interior sewer system to be casted in 150mm concrete surround (B) drains having a diameter of 250mm. Manholes will be distributed evenly over the system, within the project areas to enhance the effectiveness and cleaning/management of the sewer system.

4.4.3 Surface Drainage

The object of surface drainage is to prevent land near human habitations from saturation with water containing putrescible matter (decaying organic matter). In this particular project some of the surface water/run-off will mainly be absorbed within the property i.e. open areas. However, these (open) areas are limited since structures and pavements will cover much land. Therefore as rain falls much water is anticipated to overflow the surface as storm water. In connection to this, the volume of water reaching the trunk sewer (refer to plan in the annex) in the combined project system will be large and as such it greatly influences the design of the combined drainage system. A surface drainage system has thus been designed to manage the storm water such as may be derived from the paved areas, courtyards and roofs of the building block. Open (concrete drainage – inverted concrete drains) channels will be used to drain the site off the excess surface water/storm. The channels are designed in a way to take the influence of the site's gradient and will drain the surface water in the NCC open drain on the lower part of the project site.

4.4.4 Solid Waste Management

Wastes from the project will be a lot and especially during construction (clearing of the existing debris) and occupation phase. The types of the solid wastes include the following.

- Stone materials resulting from the earthworks; excavation, laying of foundation and leveling.
- All wooden and glass materials resulting from related activities.
- Plastic materials from sewerage, drainage and water systems, electricity etc.
- Kitchen materials and other refuse especially during the occupation of the project.
- Sanitary litter.

Proper handling of solid wastes (household waste) mostly during occupation is anticipated especially through the inclusion of sound property management system. Both quality and quantity of house refuse vary from place-to-place and season-to-season depending upon the habits of the tenants. The problem of dealing with household waste refuse resolves itself into four parts.

- Storage
- Collection
- Transportation
- Disposal

Therefore bins come in handy during storage and collection both within the building and on foot paths of the road (along the access road) for the throwing of whatever rubbish such as paper wrappings, cigarette ends etc, into them instead of scattering them all over. Transportation of the collected waste need be separated and finally the use of sound method of waste disposal. As in the case of other similar residential developments, it is anticipated that the proponent (mount properties limited) will join the other developers in the area to hire a garbage collector who will be contracted to supplement the efforts of the NCC and encourage recycling especially of papers.

4.4.5 Energy

Construction machinery will require fuel during construction. This will be sourced from legalized dealers. Electrical power will come in handy in driving the selected construction machinery. It will also be needed during occupation phase of the completed project. The power (electricity) is accessible on the site and is connected to the project site. The proponent will only upgrade the existing power supply. This will help in accommodating the expected rise in power demand.

4.4.6 Communication

The area is well covered by communication facilities such as Telkom, Safaricom, Celtel, among others. All these will facilitate communication during the implementation and on occupation of the proposed block of apartments.

4.4.7 Security

There will be one gate to the residential development, which will be fully manned 24 hours. A guardhouse will be installed at the gate to facilitate this. Patrols over the entire property will be conducted during day and night to counter and monitor illegal activities and movements during construction and occupation. The entire area of the project is banded with a perimeter wall. Street lights will as well be installed generously within the project area and along the access road. The property management is anticipated to engage security firms to beef-up security.

5.0 BASELINE INFORMATION OF THE PROJECT AREA

5.1 Physical Environment

5.1.1 Climate

The proposed site is situated within Nairobi Metropolis. The area is close to the Nairobi City Centre, which enjoys a double (bi-modal) seasonal rainfall pattern, the wetter and cooler part of Nairobi i.e the Kikuyu plateau as opposed to the Athi Plains in the east that are drier and hotter with high to moderate rainfall from April to May and November to December. The rainfall peaks during the months of April to November annually. Nairobi region is characterized by four well –marked seasons, namely

5.1.2 Topography

The proposed site is situated to the South east direction from Nairobi City Center.

Geology and hydrology

The underlying rock over which the proposed development site rests is constituted of Nairobi Trachyte. The main aquifers in the project area include the volcanic tuffs and laterite gravel. These comprise of layers of weathered tuffs (yellow) and lower, gray pyroclastic beds (with a yellow Tuff band). The project site lies within the Nairobi River drainage basin. There are no major rivers within the site environs

5.2 Biological Environment

5.2.1 Flora

The project site and its environs are situated within a cool climatic zone. As a result, the vegetation within and in the environs comprises of those species adapted to the same climatic conditions. There are no significant vegetation within the project site apart from one mature and some simple landscaping, which could be partly

contributed to the soil type, the depth and the current development. It should be noted that the development will clear the entire site hence landscaping is recommended.

5.2.2 Fauna

The project area was originally covered by several fruit trees and one exotic tree since it had a residential unit which was constructed during the colonial period. There are small organisms that depend on low vegetation (grass), rodents and some bird's species. The project's effect may seem insignificant to such lives but it is of great concern to the environment at large. It would contribute to imbalances in the ecosystem as a result of removal of the vegetation cover i.e. Grass and shrubs on site.

5.3 Socio-Economic Environment

5.3.1 Population size and Density

The area is within which the project is located within Nairobi Metropolitan and is sparsely populated with moderate development coming up.

5.3.2 Social Amenities

The site of the proposed development is situated along an access road which is in moderate condition and there is a bypass running next to the proposed project. The site being within a close proximity to the capital city (Nairobi), Churches, schools, shopping centres; petrol stations, social amenities within the environs and therefore within easy reach.

5.3.3 Economic Activities

Commercial activities in the capital city and the entire Nairobi Commercial and Administrative center provide employment to thousands of residents in this area and its environs and improve per capita of the country.

6.0 ENVIRONMENTAL LEGISLATIVE AND REGULATORY FRAMEWORK

The law has made provision for the establishment of the National Environmental Management Authority (NEMA), which has the statutory mandate to supervise and co-ordinate all environmental activities. The Environmental Management and Co-ordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003, are the legislation that governs Environmental Impacts Assessment (EIA) and Audit) Regulations, 2003, are the legislation that governs Environmental Impact Assessment (EIA) studies. Policies and legislation highlighting the legal and administrative requirements pertinent to this study are presented below.

6.1 National Environmental Action Plan (NEAP)

According to the Kenya national Environmental Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industries, economic and social development programmes

that disregarded environmental sustainability. Established in 1990, the plan's effort was to integrate environment considerations into the country's economic and social development. Under the NEAP process EIA was introduced and among the key participants identified were the industrialists, business community and local authorities.

6.1.1 Public Health Act cap 242

Under this Act, every local authority or health authority is mandated to take lawful, necessary and reasonable practicable measure to prevent all injurious conditions premise, construction condition or manner of use of any trade premises. Nuisances under this Act include and noxious matter of waste water, flowing of discharged from any premise wherever situated, into any public street, or into the gutter or side channel of any street or watercourse, or any accumulation or deposit of refuse or other offensive matter. Every Municipal council and every urban area council may make by-laws as to buildings and sanitation.

6.1.2 The world commission on environment and development – the Brundtland Commission of (1987)

The Brundtland Commission addresses the environmental aspects of development. It has emphasized on sustainable development that produces no lasting damage to the biosphere and to particular ecosystems. In addition to environmental sustainability is the economic and social sustainability. Economic sustainable development is development for which progress towards environmental and social sustainability occur within available financial resource.

6.1.3 Policy Guidelines on Environment and Development

Among the key objectives of the Policy paper on Environment and Development (Sessional paper No. 6 of 1999) are to ensure that from the onset, all development policies, programmes and projects take environmental considerations into account and to ensure that an immediate environmental impact assessment (EIA) report is prepared for any industrial venture or other development before implementation among others.

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

6.1.4 National Policy on Water Resources Management and Development

While the National on Water Resources Management (1999) enhances a systematic development of water facilities in all sectors for the promotion of the country's socio-economic progress, it's also recognizes the by-products of these processes as wastewater. It therefore, calls for the development of appropriate sanitation systems to protect people's health and water resources from pollution.

Project therefore, should be accompanied by corresponding waste management systems to handle the wastewater and other waste emanating there from. The policy requires that such projects should undergo comprehensive Environmental Impact Assessment.

6.1.5 The Water Act, 2002

Part II, section 18, of the Water Act, 2002 provide for national and information system on water resources. Following on this, sub-section 3 allows 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 facility operator and information thereof furnished to the authority. Section 73 of the Act allows a person with license (licensee) to supply water make regulations for purposes of protecting against degradation of water sources. Section 75 and sub-section 1 allows the licensee (CCN in this case) to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing and land for preventing pollution of water sources within his/her jurisdiction.

6.1.6 Building Code 2000

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

6.1.7 Factories and other places of Work Act – (Revised 1990)

The Act makes provision for the health, safety and welfare of persons employed in factories and other places of work. The provisions require that all practicable measures to be taken to protect persons employed in factory from dust, fumes or impurities originating from any process within the facility. The provisions of the Act are also relevant to the management of hazardous and non-hazardous wastes, which may arise at the project site.

6.1.8 The Physical Planning Act, 1996

The Physical Planning Act has provisions to control development and use of land in particular areas, especially where a project may involve subdivisions or amalgamation of land parcels, or located in an area otherwise reserved for other uses. The Executive Business Suites development is situated in an urban area, which is rightfully zoned for commercial/ residential purposes.

6.1.9 Local Government Act (Revised 1986)

The section of Local Government Act that are relevant to his project include making by-laws in respect of suppression of nuisances, imposing fees for any license or permit issued in respect of trade or changes for any services. Local authorities are given power to control or prohibit all developments which, by reason of smoke, fumes chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of damager, discomfort or annoyance to the neighborhood, and to prescribe the conditions subject to which such development shall be carried on.

6.1.10 Housing Policy

According to the Sessional paper No.3 (2004) by the Government of Kenya, the overall goal of the housing policy is to facilitate the provision of adequate shelter and a healthy living environment at an affordable cost to all socio-economic groups in Kenya in order to foster sustainable human settlements. This is seen as a way of minimizing the number of citizens living in shelters that are below the habitable living conditions as well as curtail the mushrooming of slums and informal settlements in major towns. The policy creates an enabling environment to the private sector to prove housing population to mitigate against the housing shortfall which is more than 200,000 per year.

6.2 Environmental Policy

The Kenya Government's commitment to environmental protection and sustainable use of natural resources has been stated in all development plans since independence. The sessional papers and presidential directives have also emphasized the need to conserve the environment and manage our natural resources. The Government's environmental policy aims at integrating environmental aspects into the National Development Plan. The broad objectives of the National Environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment.
- Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations.
- Integrating environmental conservation and economic activities into the process of sustainable development.
- Meet National goals and international obligations by conserving biodiversity, arresting desertification, mitigating effects of disasters, protecting ozone layer and maintaining ecological balance of the earth.

This project report has been prepared in accordance with the Environmental Impact Assessment and Audit Regulations of 2003 and the Draft Environmental Impact Assessment Guidelines and demonstrative procedure

(NEMA, November 2002). It is also guided by the World Bank's requirements for industrial projects (World Bank Pollution Prevention and Abatement Handbook, 1998)

- Goals and objectives is to provide environmental protection and sustainability.

7.0 DESCRIPTION OF THE EXISTING AND ANTICIPATED IMPACTS

In order to fulfill the legal requirements as outlined in the Environmental Management and Co-ordination Act, 1999, and the Environmental Impact Assessment and Audit Regulations, 2003, an Environmental Impact Assessment study has been carried out. The assessment of the environmental impact for the purposes of this EIA project report was therefore carried out on the following bases

- Compliance with Kenyan legislations and standards on the environment, health and safety.
- Professional judgment.
- Matters of concern arising from consultations with interested and affected parties in the vicinity of the site through a community approval schedule provided as an appendix.

7.1 Drainage and Hydrology

During construction phase drainage of the site may lead to the impairment of the construction, as the movement of the involved machinery will be affected. This may accelerate drainage problems and eventually land degradation. Well-designed drainage channels are needed to mitigate the impact.

7.2 Flora and Fauna

Natural Vegetation includes planted grass, few fruit trees on the site and the general gardening. The development will require all of vegetation (shrubs and grass) to be removed.

7.3 Climate Change

Human activities such as the combustion of fossil fuels, large-scale industrial pollution, deforestation and landuse changes, among others, have led to a build-up of GHGs in the atmosphere together with a reduction of the capacity of oceans and vegetation to absorb GHGs. This has reduced the Earth's natural ability to restore balance to the carbon cycle and is now resulting directly in the current global changes in average temperatures. The most important types of GHGs produced by human activities are CO₂, methane, nitrous oxide, and halocarbons and other fluorinated gases.

Scientists estimate that Africa, which contributes a negligible amount of greenhouse gas emissions (less than 4 per cent), is likely to experience higher temperature increases, changing rainfall patterns, rising sea levels, and increased climate variability due to its proximity to the equator(already being witnessed in most parts of the country-decreased food production, flooding). Africa and consequently Kenya is particularly vulnerable to climate variability and change. In addition to its geographical location, it relies on local ecological resources, and faces existing stresses on health and well-being and limited financial, institutional and human resources.

These factors severely limit the country’s capacity to adapt to climate change and hence the need for integrated territorial planning.

7.4 ANTICIPATED IMPACTS

This section focuses on the impacts likely to occur as a result of the demolition, construction works and occupation of the proposed apartments developments. Mitigation measures that can be incorporated and implemented during the design stage, construction and occupation for the various impacts highlighted are also presented. Impacts can be positive or negative, direct or indirect. The magnitude of each impact is described in terms of being significant, minor or negligible, temporary or permanent, long-term or short-term, specific (localized or widespread, reversible or irreversible. Some impact mitigation has already been addressed in the pro-active design and other mitigations can only be guaranteed through active, responsible management, helped by following the guidelines in the project environmental management plan.

These qualities are indicated in the assessment tables as follows.

Table 1: KEY

Key of impact	Type of Impact	Key	Type
++	Major positive impact	+	Minor
Positive impact			
--	Major Negative impact	-	Minor Negative impact
0	Negligible/zero impact	NC	No
Change			
Sp	specific/localized	w	wide
Spread			
R	reversible	ir	
	Irreversible		
Sh	short term	L	long
Term			

T

temporary

p

Permanent

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

TABLE 2: IMPACTS

Impacts on or due to	Construction	Occupation	remarks
Change in land use-events	-	-/0	The project will change the site from the current status of land being a truck storage to construction of Apartment .
Changes in hydrology	-/0	0	There will be effect to the orientation of the general area since the one tree and landscaping will be cleared which has influence on hydrological pattern. This will however be compensated by the landscaping which will have some effect to the hydrological-ground water recharge.
Pollution: - air/dust - noise - oil - waste	- t ir - t ir -- L ir	1/0 - 0	<p>During construction, air dust and noise pollution and oil wastes will increase as a result of its activities. Noise from construction activities will be a nuisance to the bordering residential premises, and the workers on site.</p> <p>Air pollution will result from soil dust, stress, sand and exhausts from the machinery involved and vehicle of tenants/visitors on occupation. Oil wastes will result for the construction machinery such as excavators, dumpers, elevators, trucks and other vehicles. These will pollute the environment i.e soil and water, if there will be no mitigation measures.</p>

Impacts on or due to	Construction	Occupation	remarks
Site drainage	-0/	+0/	<p>There will be increased storm water as a result of site clearing and construction activities on site. This will however be temporary and will hardly have any major effect to the general environment. Storm conservation structures will be installed during construction phase to manage the resulting run-off.</p> <p>Due consideration will have to be given to the structure and civil designs of the project to effectively drain all the run-off resulting from the property into the public drainage system during occupation.</p>
			<p>The use of roof catchments to supply water will be encouraged, as will have a significant positive impact to the surface drainage. Rainwater harvesting and provision of sufficient water storage facility will minimize run-off and use it for irrigating the flower gardens</p>
Soil erosion	- L sp	0	<p>Earthworks during construction will have an impact on soil erosion and structure. There will be mass soil material movement from the site and from one area to another</p> <p>The removal of the vegetation cover will accelerate soil movement by erosion agents notably water, wind, animals and machinery</p> <p>Incorporating appropriate soil conservation measures and proper drainage facilities during construction would mitigate the impacts. During operation soil erosion will not be a problem. It will be mitigated by the proposed standard landscaping</p>

Impacts on or due to	Construction	Occupation	remarks
Fauna	- t	+/-	There will be some minor/temporary disturbance to small animals due to clearing of the site and noise/dust pollution from construction activities. Small animal will have to find new homes
Public health/health hazard			<p>During construction, increased dust, noise and air pollution levels could impact on public health, particularly in the direct impact zone.</p> <p>During the occupancy of the scheme there will be no much change compared to present conditions with regard to pollution. However, the exhausts from vehicles of the occupants and client/customers will generate more dusts and gases, which are detrimental to the public health.</p>
Sites of cultural, historical or traditional significance	0	0	There are no sites of cultural, historic or traditional significance
Disturbance of the public	- t ir sp		<p>Disturbance to the public would occur due to noise and dust during construction and traffic movement</p> <p>During occupation, noise from traffic is likely to increase since almost tenants or occupants will be having vehicles with high traffic of clients/customers. . The hooting of such traffic will have effect to the tenants.</p>
Visual intrusion			<p>During construction, visual intrusion is attributed to construction works including construction traffic. After construction, the scheme/project will be permanent.</p> <p>Neighboring occupants and the general public will experience/feel a change. However, their social life might improve as a result of increased neighbours. Mitigation will be achieved through controlling the</p>

	+ t/p	+/-p	operating hours of construction traffic, clearing debris after construction, landscaping the site.
Income generating opportunities	+ t	+	During construction, there will be employment opportunities of the skilled and non-skilled workers and specialists. During occupation, the development will provide income the proponent, and employments to a few people especially those involved with security and management of the property. Business in the area will improve
Construction materials	-	0	Reinforced concrete will be required for foundation. Other material will include steel, plumbing, electrical, sand, cement, wood etc. All materials must be sourced from approved suppliers, and undesirable, hazardous or otherwise banned materials should not be used. The excavated rock materials can be made use were applicable but should be approved by the involved engineers.
Waste materials: Solid wastes effluent	- sh sp	-,p	Construction waste will be much; ranging from stones, concrete, metal and wood cuts etc. other wastes and effluent will result during the occupation of the property. These will be generated from the residential, etc. Proper storage, collection, transportation and disposal of waste is fundamental.
			The contractor should ensure that when works are completed, the site must be better than the original form. This should be ensured through landscaping.

8.0 MITIGATION MEASURES

8.1 Noise and Vibration

Noise is unwanted 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 noise and hence affecting the immediate environment; i.e. other operations in the nearby.

Such noise will emanate from the construction machinery and equipment i.e. concrete mixers, excavators, workers, trucks and other vehicles assessing the site. It will also affect small animals and bird life.

Mitigation

- ✚ Construction works should be carried out only during the specified time i.e. from 0800hrs to 1700hrs; when most of the neighbours will be at work.
- ✚ Sensitize construction vehicles' drivers and machinery operators to switch off engines of vehicles or machinery when not in use.
- ✚ Machineries should be maintained regularly to reduce noise resulting from friction.
- ✚ The generators and other heavy-duty equipment should be insulated or placed in enclosures to minimize ambient noise levels.
- ✚ There should be no unnecessary hooting of the involved machinery and vehicles. The same should apply during project occupation.
- ✚ Provision of bill boards at the construction site gates notifying of the construction activity and timings.
- ✚ Workers should be provided with relevant personal protective equipment/materials such as earmuffs and earplugs when operating noisy machinery and when in noisy environment. These provide a physical barrier that reduces inner noise levels and prevent hearing loss from occurring.
- ✚ Barriers such as walls and trees should be introduced around the site to provide some buffer against noise propagation.

8.2 Soil Erosion

This involves massive loss of the top-most soft material on the earth surface (soil) down-slope or transportation by the use of machinery or other equipment including animals. Soil movement is common in construction activities. This mostly happens during the laying of foundations for the projects and site clearing. All the top loose material is excavated and transported elsewhere. This also exposes the underlying material to move dangers of degeneration by erosion agents. In this case soil erosion will not be a major environmental impact especially when the project is over since there will hardly be open areas. However, during the site clearing and construction phases, there will be massive movement of soil materials from the site. Site will be cleared (and in fact much of it has been extirpated) paving way for soil degradation.

Mitigation

- ✚ Avoid unnecessary movement of soil materials from the site.
- ✚ Provide soil conservation structures on the areas prone to soil erosion.

- ✚ Control construction activities during rainy/wet condition to mitigate erosion effects to the soil.
- ✚ Resurface (pavement) open areas after the completion of the project.
- ✚ Introduce suitable and well-managed vegetation to generate surface covers on the open areas; to control soil movement by erosion agents i.e. water, animals and wind.
- ✚ Provide storm water drainage channel to discharge water to safe areas. Such channels need to be regularly maintained and repaired to avoid point discharge in case of breakages or blockages. Point water discharge usually has pronounced effect to soil erosion.
- ✚ Conduct standard landscaping after project completion to maximally control any possible chance of soil movement.

8.3 High Water Demand

Water is a major issue of concern within the area of the proposed project. As mentioned elsewhere, the water supply is currently inadequate. The proposed development will cause strain to the existing water supply since construction activities are known to be heavy water consumers. Both workers and the construction works will create additional demand to the already scarce commodity (water). The project occupation will also bring in very large population, which will have the direct impact to the already existing problematic water supply (hence there will result high water demand).

Mitigation

- ✚ Avoid excessive use of the water supplied by the Nairobi Water and Sewerage Company. Water supply and use should follow approvals by the water department of water and sewer.
- ✚ The contractor should use water browsers and tankers to bring in water for construction activities on the site. Water fetching however should be subject to authorization by existent water authority.
- ✚ Roof catchments should be provided with gutters to facilitate collection of the run-off. This water should be stored for general use i.e. cleaning, fire fighting, gardening etc. In fact, the water can be consumed after suitable treatments and approvals by relevant department. Since this is a controlled development (that restrict any modification once installed), the developer will have to provide roof water collection system to enhance roof rainwater harvesting. Standard gutters, down pipes and suitable water storage tanks will be provided.
- ✚ The local community should be sensitized on the use of roof catchments to enhance rainwater harvesting and storage. This will ease pressure to the current water supply in the area.
- ✚ Provide notices and information signs to the involved stakeholders on means and needs to conserve water resource i.e. 'KEEP/LEAVE THE TAP CLOSED', WATER IS LIFE. SAVE IT' etc. this will awaken the civic consciousness of the community with regard to usage and management of the water resources.

- ✚ Install water –conserving taps that turn-off automatically when water is not in use.
- ✚ Encourage water reuse/recycling mostly during construction and occupation phases.
- ✚ On a policy level, the government should make the rainwater harvesting facilities affordable through tax incentives such as Zero ratings or scrapping of VAT on such facilities.

8.4 Sewage and Effluent

Sewage is the used water or liquid waste of a community, which includes human and household wastes together with street washings, industrial wasters such as ground and storm water as may be mixed with it. Effluent/ sewage resulting from sanitary facilities and wastewater from washrooms is of significant importance to the environment. It must never come into contact with the surrounding i.e water, soil, air, etc. It must always drain effectively into the existing sewer systems via well designed and laid pipe networks. Sound sanitation should be ensured to influence prevention of the sporadic outbreak of diseases dangerous for the general health of the community (within the projected area), workers and the general public. Either controlling or eliminating such environmental factors that contribute in some form or the other to the transmission of the diseases can achieve this.

Mitigation

- ✚ The system (sewer) should be made of hard, strong, durable, smooth, impervious, and non-corrodible materials.
- ✚ Sanitary facilities must be kept clean always. They should be washed at least twice per day. A person should be assigned such duties (mostly for the communal sanitary facilities) by the management to facilitate the required cleanliness.
- ✚ The design of the sewer system should consider the estimate discharges from individual sources and the cumulative discharge of the entire project i.e. must have the capacity to consistently handle the loads even during peak volumes. The gradient should be sufficient to ensure and maintain maximum depth of flow.
- ✚ The trunk sewer in the site must be emptied regularly to avoid overfilling and overflowing. The must be checked regularly to monitor level of effluent. Again if possible, covered with heavy-duty coverlids.
- ✚ Branches should be streamlined in the direction of flows and there should be no right-angled junctions that would affect the flow of the effluent.
- ✚ All drain pipes passing under building; driveway or parking should be of heavy duty PVC pie tube encased in 150mm concrete surround.
- ✚ All waste pipes must have cleaning roding eyes accessible from outside i.e. free to every part of the system for inspection cleaning and repair.

- ✚ All manholes on driveways and parking areas must have heavy-duty covers set and double sealed airtight; as approved by specialists.

8.5 Surface Drainage

The aim of a good surface drainage is to prevent land near human settlement from being saturated with water containing decaying organic matter. Poor drainage causes dampness to building structures as well as water stagnation. Damp is very bad from every point of view. Apart from the annoyance it causes by unpleasant smell, foul air and mildew, which makes it impossible to store supplies of household goods, it is positively dangerous to health and also to the building structure. Damp (as influenced by poor drainage), in the presence of warmth and darkness, breeds germs of tuberculosis, malaria and acute and chronic rheumatism can be directly traced to it.

The drainage of the storm water will be greatly compromised especially if it rains, since storm water drain channels will not be present during construction. In addition, it should be realized that a given area of land can only absorb a certain quantity of rainwater/surface water. Therefore, in and around the projected area where the block is built the space of land (left open), which is useful in absorbing the surface water, is very small. The drainage of the general property comes in handy to enhance the flow of the much anticipated surface run-off emanating from the roof catchments and other areas within the site, into the water courses.

Mitigation

- ✚ During construction, the design should ensure that surface flow is drained suitably into the public drains provided and water courses.
- ✚ There should be no flooding within the site at all.
- ✚ Drainage channels should be provided within the site and should be covered with gratings of other suitable and approved materials. They must be installed as provided for in the approved plans and designs.
- ✚ The channels should be designed with regards to the peak volumes i.e. periods or seasons when there is high intensity of rainfall. They should never at any time be full; say due to the resulting heavy downpours.
- ✚ The drainage channels must ensure the safe final disposal of run-off surface water and must be self-cleaning i.e. should have suitable gradient.
- ✚ Storm water generated from roof catchments should be harvested, stored and made use in various household activities i.e. general cleaning. This will mean that very little run-off is generated within the site since the largest percent is covered with house (or which run-off is generated within the site since the largest percent is covered with houses (of which run-off from roof catchments is harvested and suitably stored)).

- ✚ Paving of the sidewalk ways sand other open areas should be done using cabro, which are pervious. This will further reduce impact of the surface water, as part of it will be percolated on the ground.

8.6 Air Quality

The construction activities on the site will result to increased dust and gas emission. Construction machinery and trucks (including small vehicles) generate hazardous exhaust fumes such as Carbon Oxides (CO_x), Sulphur Oxides (SO_x), and Nitrogen Oxides (NO_x). Dust parties caused by Demolition, vibrations of machines and vehicle movement suspends in the air mostly during dry spells.

Mitigation

- ✚ Provide Personal Protective Equipment (PPE) such as nose masks to the workers on site.
- ✚ Regular and prompt maintenance of construction machinery and equipment. This will minimize generation of noxious gases and other suspended particular matter.
- ✚ Control over areas generating dust particles. Such areas should be regularly cleaned or on them.
- ✚ Workers should be trained to understand the hazards that may be generated in such work environments.
- ✚ Workers should be encouraged to go for regular health check-ups to ascertain their health standards.
- ✚ Regular air quality tests to enhance air quality monitoring.

8.7 Oil Leaks and Spills

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

Mitigation

- ✚ All machinery must be keenly observed not to leak oils on the ground. This can be affected through regular maintenance of the machinery.
- ✚ Maintenance must be carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground. Such areas should be covered to avoid storm from carrying away oils into the soil or water systems. Waste water/wash water from these should be properly disposed.

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

8.9 Solid Waste

Construction activities results to increased solid wastes within the sites. Such waste materials include stones, wood, broken, glasses, containers, rods of metal, pieces of iron sheets etc. On completion, the site will be generating waste products from various operations and activities household waste refuse. Removal and disposal of household refuse comes public cleaning and is very important and costly item on the City County sanitary budget. If it is not removed promptly away from the generation points (commercial compounds), it accumulates in large heaps harboring rats, flies etc, which disseminate germs of disease. A good deal depends upon the mutual cooperation between the City County authorities and the public. Proper maintenance and sue of dustbins is the key to the satisfactory solution of the problem of sanitary storage and collection of refuse without causing nuisance.

Mitigation

- ✚ The contractor or proponent should work hand in hand with private refuse handlers and the NCC to facilitate sound waste handling, and disposal from the site. All wastes must be taken to the approved dumpsite.
- ✚ The wastes should be properly segregated and separated to encourage recycling of some useful waste materials i.e. some excavated stone materials can be used to backfills. (Use of an integrated solid waste management system; through a hierarchy of options; source reduction, recycling, composting and reuse, and sanitary land filling).
- ✚ On completion, the project management should adapt effective waste management system to handle solid materials that will be generated from various operations. (Use of an integrated solid waste management system; through a hierarchy of options; source reduction, recycling, composting and reuse, and sanitary land filling).
- ✚ A provision for dustbin rooms/cubicles should be made in the plans and to each floor space unit. This is a significant step towards solid waste management and handling. There should be a bin – preferably two bins maintained by every floor space unit, one for garbage and the other organic matter and the other for mineral matter. Each floor space unit – holder should be compelled under law to use a bin of approved type and size. The receptacle must be kept in a good condition, and sanitary cleaned by frequent washing and disinfecting.
- ✚ The place where the receptacle is located should be fixed and easily accessible to the refuse collector. As far as possible, the council should insist on the developer to show it on the building plan while submitting the same for sanction.

- ✚ The collection should be made small at least once in 24 hours, and it should be done in such a way to minimize nuisance of smell and dust during filling into carts or vans or any employed (suitable) collection method. All the refuse collected from floor to floor must be carried away from the storage site to a safe place where it can be suitably disposed. Lastly, suitable and most effective method of disposal should be applied.
- ✚ Train or educate the involved stakeholders on the importance and means of waste (garbage) management and handling especially during operation.
- ✚ Training should be conducted on how to prevent and manage incidences. This should involve proper handling of electricity, water etc. and sensitization on various modes of escape, conduct and responsibility during such incidences.
- ✚ All must fully be aware and mentally prepared for potential emergency. Analyze beforehand what to do if one of the co-workers is injured. And if that injury is life threatening. Must know how to protect oneself, co-workers and the company/workplace. In case of say a serious accident (i.e. chemical spill, serious breakages etc).
- ✚ Chances are, during a crisis, one won't have much to plan the best possible action – so make those decisions and preparations ahead of time. Such plans must be properly documented and made available to all.

8.10 Flora and Fauna

The site has minimal vegetation, which has no conservation value. There will be some major temporary and permanent disturbances to small animals/bird life.

Mitigation

- ✚ Avoid unnecessary clearing of vegetation.
- ✚ Plant vegetation in all open areas after the completion of the project.
- ✚ Reserve vegetation having conservation value, medicinal value and fruit trees if any.
- ✚ Manage the introduced vegetation on completion of the development to restore or improve the site.
- ✚ Specialists should do landscaping as proposed in the designs and plants trees that would aesthetic the area.

8.11 Construction Materials

They include stones, sands, cement, ballast, reinforcing steel rods etc. They should be of the appropriate quality.

Mitigation

- ✚ Should be sourced from licensed dealers and suppliers.
- ✚ Quality should be thoroughly controlled through regular tests.
- ✚ Procurement of the materials should follow specifications by the structural and architectural engineers.

8.12 Visual Intrusion

Visual impacts occur during earthworks for the foundation of projects. However, the proposed project will not by far be out of scale with the existing projects or developments (within the area). The general area is earmarked for same type developments. The visual impact will not be significant and will have very little effects neighbouring activities and the general public. There are already completed similar projects in the immediate neighbourhood, which is brought to have psychologically prepared the general environment.

Mitigation

- ✚ On completing the earthworks, the worked area should be restored through backfilling, leveling and planting of vegetation.
- ✚ All solid waste and debris from construction site must be cleared on completion.
- ✚ The scheme should be blended in a way to merge with existing environment. It should in fact upgrade the quality of the surroundings.

8.13 Public Health and Safety

During construction, there will be increased dust, air and noise pollution. These are considered as negative impacts as they significantly lower the quality of environment. The residents and workforce involved would be more subjected to these environmental hazards. Food is provided by mobile individuals most of who operate without licenses. This can compromise health of the workers especially if such foodstuffs are prepared in unhygienic manner.

Mitigation

- ✚ Depending on the occupational safety and health hazards encountered while performing assigned job tasks, workers may require using properly fitting personal protective equipment (PPF) to avoid injuries and illness. They (workers) must be provided with full protective gear. These include working boots, overalls, helmets, goggles, earmuffs, masks, gloves etc.
- ✚ A first aid kit should be provided within the site. This should be fully equipped at all times and should be managed by qualified persons.
- ✚ Adapt effective emergency response plans. A good start of learning how to respond to an emergency is through certification in Basic First Aid. Regular drills and emergency situations should follow to

impart the anticipated insight and awareness to the workers. This should happen during both construction and operation phases.

- ✚ Safety awareness may be gained through regular safety meetings, safety training or personal interest in safety and health. This awareness will increase ability to respond if, some day in future, one is a bystander in an emergency.
- ✚ The contractor should have workmen's compensation cover. It should comply with Workmen's Compensation Act, as well as other Ordinances, Regulations and Union Agreements.
- ✚ Sanitary facilities should be provided for each sex. Standard cleanliness of the facilities should be maintained.
- ✚ Local individuals preparing food for the workers at the site must be controlled to ensure that food is hygienically prepared.
- ✚ Workers should always be sensitized on social issues such as drugs, alcohol, diseases etc. There should be training programmes to facilitate this.
- ✚ Proper waste management of domestic waste to prevent vectoral diseases.
- ✚ Ensure consistently good water quality through regular pipe and borehole water analysis to ascertain compliance to public health standards.

8.15 Emergency Response Plans – ERPS

Emergencies and disasters are a reality of everyday life. Most people do not know what to do if an emergency occurred while on the job. In addition, they do not know what actions to take if a co-worker was seriously injured, a fire ignited, or a structure collapsed. Too many lives are lost and property is damaged because no one is prepared to properly react when immediate decisions and actions counted. Workers/people must therefore be sensitized and prepared on how to react. Such swift decisions and actions come in handy mostly during construction phase since there is likelihood of occurrence of hazards. During occupational phases, ERPs are a prerequisite to environmental management. Absence of such plans may be risky since there would be no guidelines to handle or control emergencies if they happen to accidentally occur during operation. Such plans are fundamental as they facilitate coordination of the involved stakeholders.

Mitigation

- ✚ The contractor/proponent should initiate and develop effective ERPs to cater for various eventualities such as fire outbreaks, and other accidents/incidents that are likely to occur.

8.15.1 Fire Preparedness

Fires outbreaks are natural disasters are common in Kenya where they usually leave behind detrimental effects to the environment. Fire incidents result to economic and social drawback. There are operations that are prone to such outbreaks i.e. poor handling of electricity systems, faulty electrical equipment, carelessness etc. It is therefore always important to consider the issue of fire by bringing in the element of preparedness. In this regard, the design should provide and recommend implementation of fundamental fire fighting measures and control facilities. These should include the following:-

Mitigation

Fire fighting equipment

- ✚ Provide 4500 Lts emergency fire-fighting
- ✚ Underground cold water storage tank with automatic booster pump.
- ✚ Provide 1x 30m Hose Reel at each level.
- ✚ Provide Manual/Electric fire-alarm systems.
- ✚ Provide 2No. x 9kg CO2 Dry Powder fire extinguisher at each level.
- ✚ Provide 2No.x 9Lts H2O fire extinguisher at each level.
- ✚ Provide 1No. x4.5Kg CO2 dry powder fire extinguisher and 1No. Fire Blanket in kitchen.
- ✚ Provide Fire Instructional Notices and Fire Exit signs on all levels.
- ✚ Provide alternative emergency lighting system

In addition to the above, the structure management should consider the following:

- ✚ Conduct regular firefighting drills within the development. This will facilitate training and sensitization of the occupants.
- ✚ Adapt an emergency response plan for the entire development and floor space units.
- ✚ Ensure that all firefighting equipment is strategically positioned, regularly maintained and service.
- ✚ Provide fire hazard signs such as 'No Smoking' signs. Direction to exist in cases of any fire incidence and emergency contact numbers should be provided.

Contact/emergency numbers should be provided generously within the projects.

8.16 Security

Security is a prerequisite for any development. During construction, security is very important in any site. This ensures that materials are in order. It also controls movement within the site especially for the intruders who might be injured by the materials and other hazardous features available within the site. The area is well covered with communication facilities, which facilitate security to large extents. After the project is over, security guards are facilities should be provided. The issue has been catered for in the drawings

Mitigation

- ✚ The project should be enclosed using suitable walls to beef-up security and to control movement within the site.
- ✚ There will be a guardhouse at the gate. Security guards must always guard the gate to the facility to keep away the intruders and to control movement within the site. Patrols should frequently be done during the day and night.
- ✚ Lighting as well as security alarms should be installed in strategic position all over the site after the completion of the project.
- ✚ Contractor should provide adequate security during the construction period when there are not works on the site.
- ✚ The guards stationed at the gates should document movements in and out of the site/properly.

8.17 Conflict with the community

Projects of such magnitude usually attract public uproar (especially) from the neighbouring occupants and community. Conflicts usually arise mostly from the foreseen negative impacts.

Mitigation

- ✚ Consultation with neighbours on the mitigation measures prescribed for the negative impact as provision of jobs during construction.
- ✚ Involvement of the local people in some activities such as provision of jobs during construction.
- ✚ Assisting in the solution of contentious issues affecting the community i.e. water, sewerage etc.

8.18 Traffic Density

The proposed project will come along with increased vehicular traffic along Kodi road 2 especially during construction phase. The effect will also be felt during occupation phase along the connecting roads. The anticipated density of traffic using this service road is likely to overwhelm the road's capacity.

Mitigation

- ✚ Notify the motorists about the proposed development once implementation is started. It is important that warning/informative signs (bill boards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed and also operation hours. The signs should be positioned in a way to be easily viewed by the public and mostly motorists.
- ✚ The service road to provide access to the project site should be widened. Tarmac and provision of at least 1 meter sidewalks on both sides of the road. This would effectively be able to serve the envisaged population inhabiting the project.

- ✚ The traffic along Kodi road 2 should be controlled especially during construction phase and mostly when large trucks are turning into the site, say for delivery of materials.

8.19 Project Completion

On completing the construction works on the site, everything should be left in order to achieve this, the following must be accomplished.

- ✚ Landscaping of open area should be done. Such areas should be sealed from pits and other depressions and vegetation introduced.
- ✚ All waste materials must be cleared and removed from the site. There should be no such materials as wood, glass, stones, scrap metals etc. However, these should be disposed appropriately and the approved dump sites.
- ✚ General rehabilitation of any excavated areas, flowers and vegetation should be introduced to add aesthetic value to the site. This should be regularly watered.
- ✚ The structure should be cleared and rubbed of any dust particles before occupation or inception/shifting of the operations.

	<ul style="list-style-type: none"> ▪ Landscaping ▪ Ensure management of excavation activities ▪ Control activities especially during rainy conditions. ▪ Provide soil erosion control structures on the steep sided during construction phase. ▪ Efficiency of erosion control measures. ▪ Ensure standard farming methods on the provided gardens 				<p>(o) once a month</p> <p>(c) Once a month</p> <p>(o) Once a month during project lifetime</p>
Air Pollution	<ul style="list-style-type: none"> ▪ Control speed and operation of construction vehicles ▪ Discourage idling of vehicles ▪ Water should be sprayed during the construction phase of excavated areas. ▪ Regular maintenance of 	Contractor	Property Manager	(c) Inspection/observation	(c) Daily

	<p>construction plant and equipment</p> <ul style="list-style-type: none"> ▪ Engage sensitive construction workers 				
Noise Pollution	<ul style="list-style-type: none"> ▪ Sensitize drivers of construction machinery on effects of noise ▪ Maintain plant equipment ▪ Construction activities to be restricted to daytime ▪ Workers in the vicinity of high-level noise to wear safety and protective gear. ▪ Provide barriers such as walls and trees around site boundaries to provide some buffer against noise prorogation 	Contractor	<p>Contractor</p> <p>Property Manager</p>	(c) Inspection/observation	(c) Random
Oil pollution	<ul style="list-style-type: none"> ▪ Proper storage, handling and disposal of oil wastes ▪ Maintain plant and equipment to avoid leaks 	Contractor	Contractor	(c) Inspection	(c) Daily

	increase the water supply capacity of the NWASC				
Contractors lay down area	<ul style="list-style-type: none"> ▪ Special attention should be paid to the sanitary facilities on the site ▪ Garbage should be disposed off periodically and at approved dumpsites 	Contractor		(c) Inspection	(c) Daily
Road Safety	<ul style="list-style-type: none"> ▪ Enforce speed limits for construction vehicles especially along roads leading to the site ▪ Provide bill boards at the site/entrance to notify motorists about the development 	Contractor	Traffic police/transporters	(c) Observation	(o) Daily
Public health and occupational safety	<ul style="list-style-type: none"> ▪ Ensure proper solid waste disposal and collection facilities ▪ Ensure effective waste water management. ▪ Design of sewerage system should be as provided in the plans. 	Contractor, supervising foreman	Properly manager Properly manager	(o) observation (o) observation	(o) weekly for solid waste disposal and once an month for others

	<ul style="list-style-type: none"> ▪ Sensitize residents on environmental management ▪ Provision of Personal Protective Equipment (PPE) 				
Vegetation	<ul style="list-style-type: none"> ▪ Replant areas where vegetation is unnecessarily removed ▪ Landscaping and planting all disturbed areas. ▪ Planting and grassing should be done just before the rains or irrigated on dry spells 	Contractor Contractor	Properly manager	(c) Inspection (c) observation (c) observation	(o) Daily (c) Weekly (o) Random
Fire safety training/emergency response	<ul style="list-style-type: none"> ▪ Adapt effective emergency response plans involving all both during construction and occupation phases ▪ To enhance health and safety preparedness among stakeholders ▪ Ensure equipment is in good working condition 	Proponent/contractor	Property Manager	(c) Inspection (o) Inspection	Monthly

Record Keeping	Collection and analysis of relevant environmental data of the site	Proponent/contractor	Property Manager	(o) Inspection	(o) Weekly
Internal Audits	<ul style="list-style-type: none"> ▪ Monitoring will involve measurements, observations, evaluations, assessment of changes in water quality, waste management, noise levels, contractor safety etc. 	Proponent/contractor	Property Manager	(o) Inspection	(o) Random
Fire outbreak	<ul style="list-style-type: none"> ▪ Install firefighting equipment as provided elsewhere in the report ▪ Sensitize the residents on fire risks i.e. conduct regular fire drills. ▪ Adapt effective emergency response plan ▪ Maintain firefighting machinery regularly ▪ Provide emergency numbers at strategic points 	Contractor	Proponent	(c) observation (o) observation	(c) On completion time (o) Random

ENVIRONMENTAL MANAGEMENT FRAMEWORK

IMPACT	MITIGATION	MONITORING	RESPONSIBILITY	ANNUAL COST(KSH S)
SOIL				
1. Soil erosion	<ul style="list-style-type: none"> • Creation and maintenance of storm water drainage ways • Provide soil conservation structures mostly to the steep areas such as the existing cliff. • Landscaping 	<ul style="list-style-type: none"> • Vegetation cover • Paving 	Project proponent Project Manager	150,000
2. Soil compaction	Use of light machinery and equipment	Type of machinery and equipment	Proponent
3. Paving	Reduction of area to be paved	Paved area	Proponet	200,000
WATER				
4. Increase in demand	Recycling ,wise water usage Use of roof catchment to harvest rain water by provision of rain water harvesting systems i.e. gutters, down pipes and storage facilities. Upgrading existing water supply systems in collaboration with NWC and other stakeholders	Water amount used. Rain water harvesting systems	Project Manager /proponet	100,000
5.Surface runoff	Embankment Harvesting and proper storage of runoff from roof catchment. Provide water recharge areas landscaping	Amount of storm water	Proponent	100,000
6. Pollution / contamination	Proper use /handling of oils /chemicals and waste management Proper maintenance of water supply systems Regular quality analysis	<ul style="list-style-type: none"> • Incidences of spillage • Poorly disposed wastes • Composition of runoff 	Project Manager/ Proponent	Part of daily activities
AIR				

7. Dust	<ul style="list-style-type: none"> • Ensure strict enforcement on site speed limit regulations • Sprinkle water on dusty areas ,access routes and loose construction materials • Pavement 	<ul style="list-style-type: none"> • Amount of dust • Extent of paved areas 	Proponent	-----
8. Emissions	Use of Scrubbers Use of low emissions machinery	<ul style="list-style-type: none"> • Type of machinery • Amounts of emission 	Proponent	-----
9. Noise	<ul style="list-style-type: none"> • Personal protective equipment(PPE) • Constant machinery maintenance to reduce noise from friction, loose parts. • Appropriate sound proofing and silencers to the working equipments. • Avoid unnecessary hooting 	Ear muffs Buffers Mufflers	Project Manager/ proponent	5,000
10. Micro-climate modification	Reduction of paved areas Planting of trees	Area paved Number of trees	Proponent	20,000
BIODIVERSITY				
11. Degradation of Vegetation	<ul style="list-style-type: none"> • Maintaining tree strands • Planting more trees • Creation and maintenance of waterways 	<ul style="list-style-type: none"> • Number of trees • State of waterways • State of landscape 	Proponent	30,000
12.Paving	Reduction of areas to paved	Paved areas	Proponent	
13. Solid waste	Use of integrated solid waste management systems i.e <ul style="list-style-type: none"> - Source reduction - Recycling - Composing and reuse - Sanitary land filling 	Waste management system Waste collection center and individual bins Incinerator	Project Proponent Property Manager/ Residents/ City council	50,000

	<p>Enhance cooperation between city county authority and the public /resident</p> <p>Adopt a centralized waste collection centre (WCC)</p> <p>Provide dust bins to individual houses and different trash bags (in colours) to effect waste segregation at source and disposal</p>			
14. liquid Waste	<p>Proper design of the sewerage system</p> <p>Prompt maintenance of the system</p> <p>Provision of reliable water supply</p>	<ul style="list-style-type: none"> - Water supply - Design network - Maintenance records 	Project Proponent/ Project manager/ City council	10,000
15. Occupational Health and safety	<p>Public /residents awareness on health and safety i.e. HIV and AIDS</p> <p>Adopt emergency response plans</p> <p>Provision of collective and individual First Aid Kits</p> <p>Provision of individual fire fighting systems and equipment provide emergency contact numbers to all</p> <p>Provide security plans and systems i.e. alarms, lighting etc</p> <p>Conduct regular Emergency simulations / drills i.e. on fire, security etc</p>	<ul style="list-style-type: none"> - Public awareness campaigns - ERPs - First Aid kits - Fire systems and equipment (update) - Security systems 	Residents Proponent/ property manager City council	70,000

10.0 SUSTAINABLE ENVIRONMENTAL MANAGEMENT (SEM)

10.1 Sustainable environmental management (SEM)

This should be envisaged during the project cycle. Environmental sustainability means acting environmentally sensibly, socially and economic effectively. The aim is to avoid Inadequate use of natural resources , conserve nature sensibly, and guarantee a respectful and fair treatment of all people working on the project , neighboring residents and occupants (after project completion) . All operations and activities undertaken should aim at maintaining sound environmental standards indefinitely.

Sustainable Environmental Management will involve critical monitoring and evaluation of the operation and activities during construction and occupation phases in relation to the guiding environmental standards and

laws. The monitoring and evaluation will eventually help in determining effective actions and strategies to improve environmental quality. Such actions and strategies must be designed in light of a realistic assessment of the long-term financial and human resources that are likely to be available. Monitoring of environmental quality involves tracking of trends overtime. It aims at understanding the state of the ambient environment or to monitor the emissions and impacts of specific discharge i.e. waste water, dust gases etc. Assuming that due to environmental considerations has been taken during the design and demolition of existing building, construction phases, and the occupation phase must embody.

11.0 RECOMMEDATIONS

Recommendations for the prevention and mitigation of adverse impacts are as follows

- The development has been approved by the relevant Government Department i.e physical planning in Ministry of Land and Physical planning; State Department of Housing and Urban Development and ministry of health. The proponent should therefore follow the guidelines as set by the department to safe and envisage environmental management principles during construction and operation phases of the proposed development.
- It is important that warning / information signs (bill boards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed. The signs should be positioned in a way to be easily viewed by the public and mostly motorists.
- All solid waste materials and debris resulting from construction activities must be disposed off at approved dumpsites. The waste should be properly segregated and separated to encourage recycling of some useful waste material; i.e some excavated stone materials can be used as backfills.
- All construction materials and especially sand ,gravel, hardcore and wood must be sourced/ procured from legalized dealers
- Construction activities must be undertaken only during the day i.e. between 0800hours to 1700 hours. This will minimize disturbance to the general public within the proximity of the site/project.
- Traffic on Kodi road 2 will be controlled and informed during construction and especially when heavy trucks are turning in and out of the site. This will ensure that no accidents are caused by the sites activities

During construction, all loose soils must be compacted to prevent any erosion by wind or water. Other appropriate soil control measures can be adopted. Any stockpiles of earth should be enclosed, covered or sprinkled with water during dry or windy condition to minimize generation of dust particles into air.

- Once earthworks have been done, restoration of the worked areas should be carried out immediately by backfilling, professional landscaping /leveling and planting of low grass in open areas), flowers and suitable tree species.
- Kenya is a water scarcity and therefore the project proponent should look into modalities aimed at enhancing water supply to the proposed scheme and also give a hand in upgrading in the neighborhood. Rainwater harvesting systems should be provided as well as standard storage systems

to every housing unit; to enhance connection of the run-off generated from the roof catchments. We proposed a borehole to be drilled to supplement water supply by after approval from the relevant Authorities.

- Drains will be properly designed, installed and regularly maintained to prevent storm water (run-off) from accumulating within the site spreading to the neighbourhood. These must effectively drain the storm the premise into the existing public drainage system say to be developed along access road.
- Proper and regular maintenance of construction plant and equipment will reduce emission of hazardous fumes and noise resulting from friction of rubbing metal bodies. Maintenance should be conducted in a designated area and in a manner not to interfere with the environment.
- Maintenance activities must be carried out in service bay to reduce chances of oils or grease or water other maintenance materials, from coming into contact with environment (water or soil). Wastewater from such areas must be refrained from coming into contact with solid mass or water bodies as it contains oil/grease spills.
- Used and new oils must be handled and stored appropriately to a void oil leaks and spills on the site
- Sewerage system must be properly designed with the site / office and effectively connected to the public sewer system. Design specifications must be followed during installation. Standard cleanliness and waste disposal facilities at construction site and during occupation must be maintained.
- Workers should be provided with completed personal protective equipment (PPE) and safety gear. They should have working boots, completed overalls, helmets, earmuffs, gloves, nose masks; goggles etc .A fully equipped first aid kit must be provided within the site.
- The constructor must have workmen's compensation cover; the contractor is required to comply with workmen's compensation Act as well as other relevant ordinance, regulations and Union Agreement.
- The contractor must provide adequate security during the construction period and especially during the night when there are no construction activities.
- A complete firefighting system must be provided after completion of the project. The equipment is clearly provided in the design plan, and in the report. This must be installed or provided at strategic points.

Diligence on the part of the contractor, project agent and proper supervision by the supervising foreman during construction and the property manager during occupancy is fundamental for mitigation.