# ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED APARTMENTS ON PLOT LR NAIROBI/BLOCK 13/362, ALONG OTHAYA ROAD, KILELESHWA, NAIROBI COUNTY

**PROPONENT:**

NAINESH KANTILAL SHAH, SHISHIV KUMAR KANTILAL SHAH & KARTIC KANTILAL SHAH
P.O BOX 14470-00100,
NAIROBI, KENYA.

**UNDERTAKEN BY:**

Tom Shikorire
P. O. Box 1222-00606
Nairobi
shikoriretom@gmail.com
Mobile: 0724055357/ 0724905749

## DECLARATION

**NAINESH KANTILAL SHAH, SHISHIV KUMAR KANTILAL SHAH & KARTIC KANTILAL SHAH**

This Environmental Impact Assessment (EIA) study report is submitted to the National Environment Management Authority (NEMA) pursuant to the Environment Management and Coordination Act, CAP 387 and the Environmental (Impact Assessment and Audit) Regulations, 2003.
The project is based on the proposed residential Apartments on LR No. Nairobi/Block 13/362 along Othaya Road, Kileleshwa, Nairobi County. The EIA has been conducted to the highest Environmental standards possible.

That the developer will abide by the recommendations (EMP) of the study and the EIA license conditions throughout the project implementation cycle

**NAME**: Nainesh Kantilal Shah, Shishiv Kumar Kantilal Shah & Kartic Kantilal Shah
P.O BOX 14470-00100,
Nairobi, Kenya.

**SIGNATURE**:…… **DATE:**……

**EIA CONSULTANTS:**

That the Environmental Impact Assessment (EIA) study report submitted is based on the proposed apartments on LR No. Nairobi/Block 13/362 along Othaya Road, Kileleshwa, Nairobi County

To my knowledge, all information contained in this document is an accurate and truthful representation of all findings as relating to the proposed project as per projects information provided by the proponent and contractor to the EIA consultant:

**Lead experts name:** Tom Shikorire **Reg. No:** 2724

**Experts' Contacts:**
Tom Shikorire,
P. O. Box 1222-00606
Nairobi.
Mobile: 0724055357 / 0724905749
shikoriretom@gmail.com

**SIGNATURE**……. **DATE** ……

**TABLE OF CONTENTS**

## LIST OF TABLES



## LIST OF FIGURES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **AWWDA** | Athi Water Works Development Agency |
| **$^{O}$C** | Degree Celsius |
| **CIDP** | County Integrated Development Plan |
| **CPP** | Consultation and Public Participation |
| **DRDS** | Domestic Refuse Disposal Services |
| **EA** | Environmental Audit |
| **EHS** | Environmental Health and Safety |
| **EIA** | Environmental Impact Assessment |
| **EMCA** | Environmental Management and Co-ordination Act |
| **EMP** | Environmental Management/Monitoring Plan |
| **HWM** | Household Waste Management |
| **JICA** | Japan International Cooperation Authority |
| **KEBS** | Kenya Bureau of Standards |
| **Km** | Kilometres |
| **KPC** | Kenya Power Company |
| **KVA** | Kilo Volts Amperes |
| **L.R** | Land Registration/Reference |
| **NCWSC** | Nairobi City Water and Sewerage Company |
| **NEC** | National Environmental Council |
| **NEMA** | National Environment Management Authority |
| **OHSO** | Occupational Health and Safety Office |
| **PCs** | Private Companies |
| **PPE** | Personal Protective Equipment |
| **PPM** | Parts Per Million |
| **SWM** | Solid Waste Management |
| **ToR** | Terms of Reference |
| **VOC** | Volatile Organic Compounds |

# 0. EXECUTIVE SUMMARY

## 0.1. Introduction

Nainesh Kantilal Shah, Shishiv Kumar Kantilal Shah & Kartic Kantilal Shah proposes to construct residential apartments of Two Hundred (200) units of residential apartments on L.R. No. NAIROBI/BLOCK 13/362 measuring 0.3076 Hectares; (approximately 0.76 acres) along Othaya road, in Kileleshwa, Nairobi County. The development will comprise of two-level basements, ground floor, 1st -21st floor having, two, three, four, and five bedrooms residential units.

The total project cost will be two billion, two hundred and fourty three million, four hundred and thirty nine thousand (2,243,439,000) Kenya shillings out of which a total of 2,243,439 is payable to the authority (NEMA) being the sum of 0.1% of total project cost.

The Kenya Government policy on such projects requires that an Environmental Impact Assessment (EIA) be carried out at the planning stages of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of such projects. Therefore, in compliance with the law and to avoid unnecessary conflicts that retard development, the proponent has undertaken this EIA and incorporated environmental concerns as required.

EIA is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) chapter 387 second schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003, new projects must undergo EIA process. Consequently, the EMCA 2019 categorizes projects of similar magnitude under ***High Risk Projects***, thus; ***(g) establishment of new housing estate developments exceeding One hundred housing units;*** The Report of the same must be submitted to National Environment Management Authority (NEMA) for approval and issuance of relevant licenses. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment.

## 0.2. Scope

The scope of the assessment covered construction works which included ground preparation, masonry of the proposed development as well as installation of utilities required by the proposed project. The output of this work was a comprehensive EIA Project Report for the purposes of acquiring the EIA licence.

### 0.3. Methodology Outline

Since the proposed site is located within an area with no rich natural resources whose total effect to the surroundings could be adverse and noting that the intended development and use of the facility will be in character with the surrounding; the area is characterised by developments of similar scale, an environmental study report was required. The general steps followed during the assessment were as follows:

- Formulation of the Terms of Reference (submitted under Ref: **NEMA/TOR/5/2/785**).
- Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of the EMCA Cap 387
- Environmental scoping that provided the key environmental issues
- Desktop studies and public interviews
- Physical inspection of the site and surrounding areas
- EIA Public participation via the use of questionnaires and photography
- Reporting.

### 0.4. Positive Impacts

The proposed project will come along with numerous positive impacts as exhaustively discussed within the report. They include: Employment opportunities, revenue generation to the County and National government, optimal use of land, economic benefit to the proponent and increased residential housing units,

### 0.5. Negative Impacts mitigation Measures

The proposed project is to be developed in an area that is already designated for such developments and hence, no conflict in land use is anticipated. The Table 1 below is a summary of anticipated impacts as well as proposed mitigation measures. The construction activities should not negatively impact on the adjacent developments and if they do, then a remedy should be agreed upon.

Table 1: A summary of anticipated Impacts and proposed Mitigation Measures

| Possible Impacts | Mitigation measures |
|---|---|
| **Soil erosion** | Control earthworks; Install drainage structures properly; Ensure management of excavation activities |
| **Vegetation Disturbance** | Restore/re-establish vegetation in some parts of the disturbed areas through implementation landscaping programme |
| **Air pollution** | Stockpiles of earth should be sprayed with water or covered during dry seasons; Provide dust masks for the personnel in dust generation areas; Sensitize construction workers on pollution control measurers |
| **Noise pollution** | Sensitize workforce including drivers of construction vehicles; Install sound barriers for pile driving activity; Install portable barriers to shield compressors and other small stationary equipment where necessary; Display signs to indicate construction activities; Maintain all equipment; Workers in the vicinity of high-level noise to wear safety and protective gear. |
| **Dust generation** | Spray stock piles of earth with water; Avoid pouring dust materials from elevated areas to ground; Cover all trucks hauling soil, sand and other loose materials; Provide dust screen where necessary |
| **Exhaust emissions** | Vehicle idling time shall be minimized; Equipment shall be properly serviced and maintained, |
| **Increased Water Use** | Installation of motion-sensing taps, urinals, and toilets to automatically switch off once the user leaves the station. A motion sensor tap would cut up to 85% of annual water usage compared to conventional taps. Rainwater harvesting: The harvested water would be used for cleaning, flushing toilets, watering plants, etc.<br>Avail storage tanks. |
| **Waste Management** | Special attention shall be paid to the sanitary facilities on site; Garbage shall be disposed periodically. Contract a NEMA licensed waste handler |
| **Emission of greenhouse gas emission** | Installation of a solar PV system on the rooftop to supplement KPC supply thereby abating about GHG emissions. Implementing energy efficiency mechanisms to reduce energy consumption. Undertaking annual energy audits to monitor progress and exploit opportunities for energy efficiency |
| **Public health and occupational safety** | Ensure proper solid waste disposal and collection facilities; Ensure dustbin cubicles are protected from animals, rains and are well covered; Provide suitable safety gear for all personnel; Proper treatment of waste water |
| **Climate change risks and vulnerability** | Water management; The project should invest in water management strategies like rainwater harvesting, storage facilities, and efficient water use practices. These measures aim to mitigate water scarcity during dry periods and reduce flood risks during heavy rainfall events.<br>Infrastructure Design: Incorporate resilient features to withstand extreme |

| | |
|---|---|
| | weather like flooding, storms, and high temperatures.<br>Energy Efficiency: Implement technologies and practices to reduce greenhouse gas emissions and dependency on fossil fuels.<br>Biodiversity Conservation: Protect and enhance natural ecosystems to preserve biodiversity and ecosystem services, including reforestation, habitat restoration, and sustainable land management practices. |
| **Traffic disruption** | Properly plan for transportation of materials to ensure that vehicles are optimally filled to reduce the number of trips done or the number of vehicles on the access roads; Employment of formal flagmen/women to ensure the public safety; Place clear signage's at the gate to alert drivers to be cautious about the construction and to look out for entering and/or exiting vehicles. |
| **Fire risks** | Install fire alarm with smoke sensors; Have standby fire extinguishers at the site in case fire erupts; Declare places with flammable construction materials as ''NO SMOKING ZONES'' and display conspicuous notices of the same. |
| **Encroachment of the area** | Demarcate the project area affected by construction activities to prevent unnecessary interference with areas not meant for proposed project.<br>Avoid encroachment into road reserves in totality |

### 0.6. Conclusion

Considering the positive socio-economic and environmental benefits to accrue as a result of the development, and the EIA having found no major impacts to arise from the development, it is our recommendation that the project be allowed to proceed on the understanding that the proponent will adhere to the recommended mitigation measures and will further implement the proposed EMP.

### 0.7. Recommendations

i. The proponent to implement strictly the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects.
ii. Maximize positive impacts as much as possible as exhaustively outlined within the report. These measures will go a long way in ensuring the best possible environmental compliance and performance standards.
iii. The developer be licensed to implement the project as proposed.

# 1. INTRODUCTION

## 1.1. Background and Rationale

Nainesh Kantilal Shah, Shishiv Kumar Kantilal Shah & Kartic Kantilal Shah proposes to construct 200 units of residential apartments on L.R. No. Nairobi/Block 13/362 along Othaya road, in Kileleshwa. The proposed development will comprise of Two Blocks of residential apartments comprising of two level basements, a Ground floor and 1st -21st floors.

The proposed site having acreage of 0.76 acres has adequate space to accommodate the proposed project with the proposed service infrastructure such as water, power supply, waste management and effluent disposal. It was recognised that this form of development is likely to impact on the site and the surrounding environment thereby calling for an EIA study to enable impact mitigation.

An EIA is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No.8 CAP 387 second schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003, new projects must undergo Environmental Impact Assessment. The report of the same must be submitted to National Environment Management Authority (NEMA) for approval and issuance of relevant certificates.

## 1.2. Scope, Objective and Criteria of the Environmental Impact Assessment (EIA)

### 1.2.1. Scope

The Kenya Government policy on all new projects, programmes or activities requires that an environmental impact assessment be carried out at the planning stages of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of the facility. The scope of this Environmental Impact Assessment, therefore, covered:

- The baseline environmental conditions of the area,
- Description of the proposed project,
- Provisions of the relevant environmental laws,
- Identification and discussion of any adverse impacts to the environment anticipated from the proposed project,
- Appropriate mitigation measures,
- Provision of an environmental management plan outline.

### 1.2.2. Terms of Reference (TOR) for the EIA Process

The TORs for the EIA study was approved by the authority under Ref: *NEMA/TOR/5/2/785.*

### 1.2.3. Data Collection Procedures

Data collection was carried out through questionnaires, use of checklists, observations and photography, site visits and desktop environmental studies in the manner specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003.

### 1.2.4. Reporting and Documentation

The EIA Project Report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared for submission by the proponent for consideration and approval. The Consultant ensured constant briefing of the client during the entire exercise.

### 1.2.5. Methodology Outline

The general steps followed during the assessment were as follows:

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

## 2. PROJECT DESCRIPTION

### 2.1. Location

The proposed project is to be established on land L.R. NO. Nairobi/Block 13/362 which is currently undeveloped, along Othaya road, in Kileleshwa, Nairobi County measuring 0.3076 Hactares. The proposed project is located on coordinates 1°17'15.0"S 36°47'19.7"E as shown by the pin drop in the Figure 2 below. The proposed project is in line with the zoning of the area and the project neighbours are high rise buildings.


*Figure 1. Proposed project site*

### 2.2 Project Cost

The total project cost will be Two Billion, Two Hundred and Fourty Three Million, Four Hundred and Thirty Nine Thousand (2,243,439,000) Kenya shillings out of which a total of 2,243,439 is payable to the authority (NEMA) being the sum of 0.1% of total project cost.

### 2.3 Design of the project

The proposal is to construct and establish twin blocks of residential apartments, along Othaya road, Kileleshwa area, Nairobi County. The housing development will consist of the following character;

Table 2: Salient features of the proposed project

| | |
|---|---|
| **No. of Floors** | **2 level Basements, Ground+21 Floors** |
| **Plot Size** | 0.3076 Ha (0.76 Acres) |
| **Built Up Area ($m^2$)** | |
| **Typology;**<br>Basement 02: 57 Parking Bays<br>Basement 01: 56 Parking Bays<br>Ground Floor: 42 Parking Bays<br>First Floor: 58 Parking Bays | 213 Parking Bays |
| **2nd -21st floor** | 20 units - 5 bedroom + DSQ<br>40 units - 4 bedroom + DSQ<br>20 units – 3 bedroom + DSQ<br>120 units - 2 bedroom<br><br>**Total 200 residential units** |
| **Employment** | The project is foreseen to employ an approximate number of 600 personnel directly during construction; a bigger number will be employed both directly and indirectly by the operation of the premises; |
| **Project timelines** | Approximately 24 months after licensing and construction commencement |

Proposed shared facilities to support the housing scheme are; children play area, gym, meeting hall and parking. Other supporting infrastructure includes washrooms and lifts.
Construction will be guided by national and international standards for both engineering and environmental compliance.

### 2.3.1 Project's components

The development will have the following environmentally sound characteristics:-

1. Power conservation e.g. by use of occupation sensors for lighting and enhancing natural lighting during the day.
2. Reduced need for air conditioning by enhanced natural cross ventilation and reduction of solar glare/heat gain through having the mid-section open to the sky.
3. Water conservation by use of water efficient sanitary fittings.

*2.3.1.1 Access for the physically challenged.*

The design has incorporated the following elements to enhance accessibility for the physically challenged.

a) **Providing for ramps and elevators**: Ramps and elevators will provide easy access to different levels for individuals using wheelchairs or mobility aids.
b) **Wider doorways and hallways**: The doors will have sufficient width to accommodate wheelchairs and other mobility devices comfortably.

c) **Accessible restrooms**: There will be restrooms that are wheelchair accessible, with features such as grab bars, lowered sinks, and spacious turning areas.
d) **Accessible parking**: Accessible parking spaces for the physically challenged will be designated close to entrances, ensuring they meet the required standards, including proper width and adjacent access aisles.

### 2.3.2. Electrical system

The building will be connected to the electricity main line of the Kenya Power Company, which will be used in all phases of the project. The various components of the electrical system shall comprise single and twin socket outlet, lockable meter board with glass view panel, gate lights and security alarm panel outlet and CCTV connection system. The necessary guidelines and precautionary measures relating to the use of electricity shall be adhered to.

### 2.3.3. Water reticulation system

Water from NCW&SCO will be used during the construction and operation phases of the project. There will be water storage tanks at the basement and at the roof level to increase water capacity at the project site to the required amount.

### 2.3.4 Waste/Sewerage & Storm water run-off

Effluent discharge from the project site will be connected to the pre-existing NCW&SCO sewer line. Solid waste management will consist of collections by dustbins in the apartments and along the corridors at designated points. The collected waste will later be transported to a waste treatment site by NEMA licensed waste collector. All storm water drainage will be channelled into the existing storm drains and into the NCW&SC sewer line.

Over time, the capacity of the existing sewerage system in Nairobi City has become largely insufficient to cope with the sewerage generated at present in terms of sewerage collection and treatment. The available data suggest that the sewage generated would be less treated or untreated as a whole and then discharged eventually to the tributaries of the Nairobi River (JICA).

## 2.4. Description of the project's construction activities

### 2.4.1 Excavation and foundation works

Excavation will be carried out to prepare the site for construction of foundations, pavements and drainage systems. This will involve a combination of earthmoving machinery such as excavators and wheel loaders as well as manual labour.

### 2.4.2. Storage of materials

Building materials will be stored on site. Bulky materials such as rough stones, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities of materials on site, the

proponent will order bulky materials such as sand, gravel and stones in quotas. Materials such as cement, paint and glasses among others will be stored in temporary storage structures built for this purpose.

### 2.4.3. Masonry, concrete work and related activities

The construction of the building walls, foundations, floors, pavements, drainage systems, swimming pool among other components of the project involves a lot of masonry work and. General masonry include stone shaping, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces. These activities are known to be labour intensive and are supplemented by machinery such as concrete mixers.

### 2.4.4. Structural steel works

The building will be reinforced with structural steel for stability. Structural steel works involve steel cutting, welding and erection.

### 2.4.5. Plumbing

Installation of pipe-work will be done to connect sewage from the ablution blocks to the sewer system. Plumbing will also be done for drainage of storm water from the rooftop into the peripheral storm water harvesting tanks. Plumbing activities will include metal and plastic pipe cuttings, the use of adhesives, metal grinding and wall drilling among others.

### 2.4.6 Products, By-products and Waste generated during Project Construction

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

- Dust emissions during excavation of the site as well as emissions arising out of various construction activities,
- Wood, polythene sheeting and nails arising from the formwork that will be used to contain various concreting activities, empty cement bags, wet gunny bags used for curing concrete services.
- Oil spills arising out of improperly serviced transportation trucks and construction machines.
- Human effluent like sewage waste emanating from construction workers on the site.

## 2.5. Description of the project's occupational activities

### 2.5.1. Solid waste and waste water management

The proponent will provide facilities for handling solid waste generated within the facility. These will include dust bins/skips for temporarily holding waste within the premises before final disposal at the designated sites. Sewage and storm water generated from the building will be channelled into NCW&SCO sewer line.

### 2.5.2. Cleaning

The proponent will be responsible for ensuring regular washing and cleaning of the pavements, the car park area, staircases etc. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents.

### 2.5.3. General repairs and maintenance

The apartments and associated facilities will be repaired and maintained regularly during the operational phase of the project. Such activities will include repair of building walls and floors, repair and maintenance of electrical gadgets, painting and replacement of worn out materials among others.

### 2.5.4 Products, By-Products and Waste generated during The Operation's phase.

Products during operation include:

- Food cooked in the houses.
- Beverages and non-alcoholic drinks
- Services and goods provided by the residents

There are no by-products expected from the operation of the building.
Waste expected to be generated from the building includes:

- Food and drinks remains from the houses
- Laundry waste from cleaning of clothes and beddings within the premises
- Used paper from unpacking goods used in the building
- Glass breakages from beverage and non-alcoholic drinks
- Sewage waste from the washrooms in the residency, workers and clients visiting the building
- Wastewater from cleaning of the; building floor and walls, laundry that includes clothes and beddings, utensils cleaning.

## 2.6. Description of the project's decommissioning activities

The description of the decommissioning activities discussed below includes both the decommissioning of the single dwelling development currently on the proposed site and the project development.

### 2.6.1. Demolition works

Upon decommissioning, the project components including buildings, pavements, drainage systems and associated facilities will be demolished. This will produce a lot of solid waste, which will be re-used for other construction works or if not re-usable, disposed of appropriately by a licensed waste disposal company.

### 2.6.2. Dismantling of equipment and fixtures

All equipment including electrical installations, furniture, finishing fixtures partitions, pipe-work and sinks among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to reuse of these equipment in other projects. This will be achieved through resale of the equipment to other building owners or contractors or donation of this equipment to schools, churches and charitable institutions.

### 2.6.3. Site restoration

Once all the waste resulting from demolition and dismantling works is removed from the site, the site will be restored through replenishment of the top soil and re-vegetation using indigenous plant species.

## 3. BASELINE INFORMATION OF THE STUDY AREA

### 3.1. Physical environment

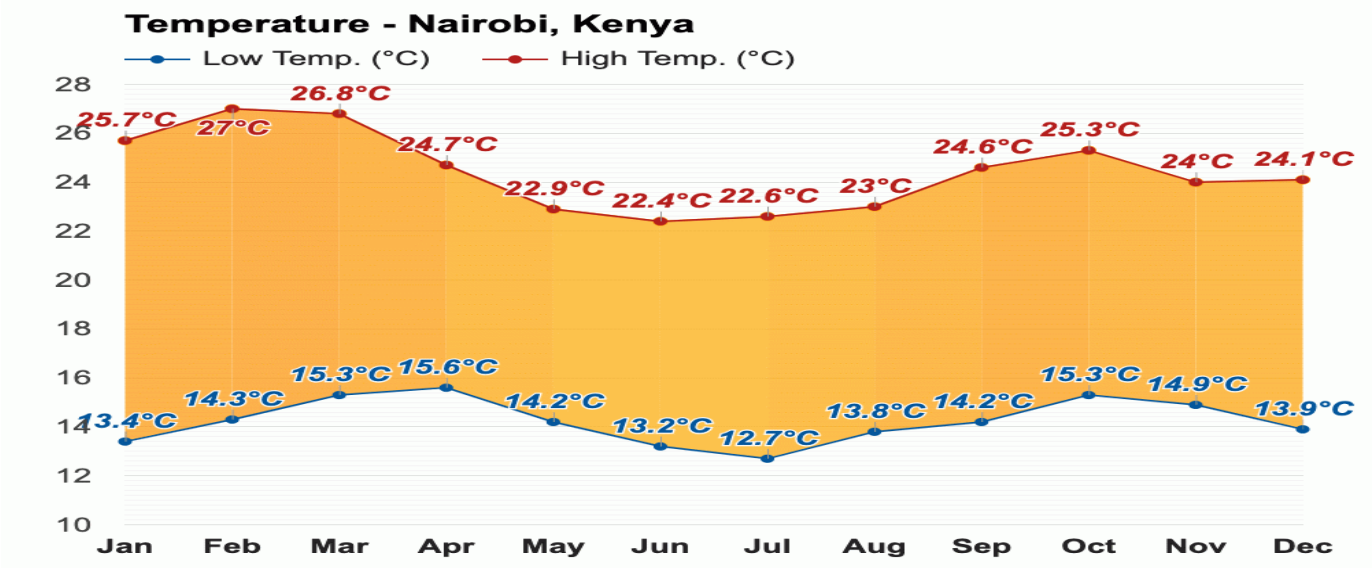
#### 3.1.1. Climatic Conditions

Nairobi city lies so close to the Equator but being 1680m above sea-level, its temperatures are altitude-modified tropical, but not torrid. The mean annual temperature is 17° C and the mean daily maximum and minimum temperature are 23° C and 12° C respectively, On the other hand, the mean annual rainfall is 1080 mm falling in two distinct seasons: the long rains from March to May and the short rains from mid-October to December. The Northern and Western areas have a high rainfall; the East and South a low rainfall.

The average annual temperatures of the area range from 18 to 20$^{o}$C, with average minima and maxima of 12–14 and 24 – 26$^{o}$C, respectively. The warmest period occurs from January to March. Average potential evaporation is between 1,550 and 2,200 mm per year.

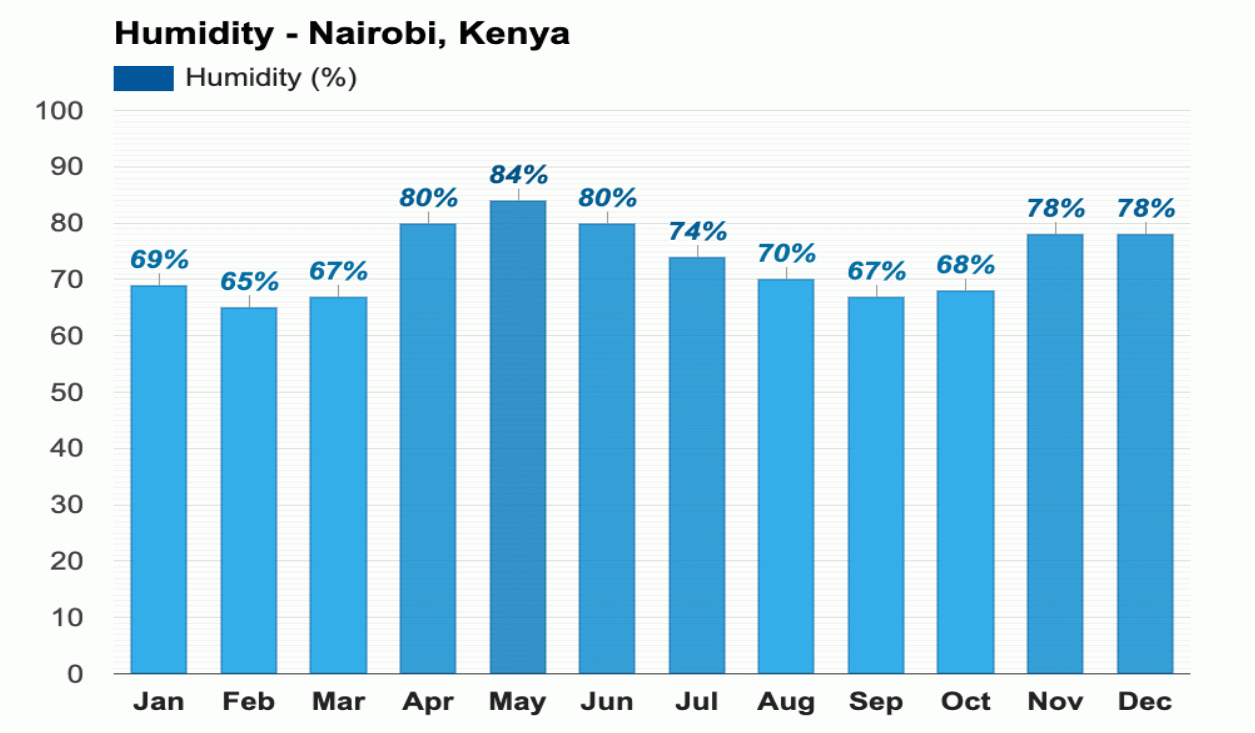
#### 3.1.2. Average Daily Temperatures

The average daily temperature throughout the year varies slightly from month to month with average temperatures of around 17°C during the months of July and August to about 20°C in March. But, the daily range is much higher, with the differences between maximum and minimum temperatures each day around 10°C in May and up to 15°C in February. Between the months of June to September, southeast winds prevail in the coastal parts of Kenya and last up to several days without a break. The clouds cause day temperatures to remain low and most times the maximum temperature stay below 18°C. The minimum temperatures also remain low during cloudy nights, usually hovering around 8°C and sometimes even reaching 6°C. Clear skies in January and February also bring colder nights. The highest temperature ever reached in Nairobi was 32.8°C and the lowest was 3.9°C.



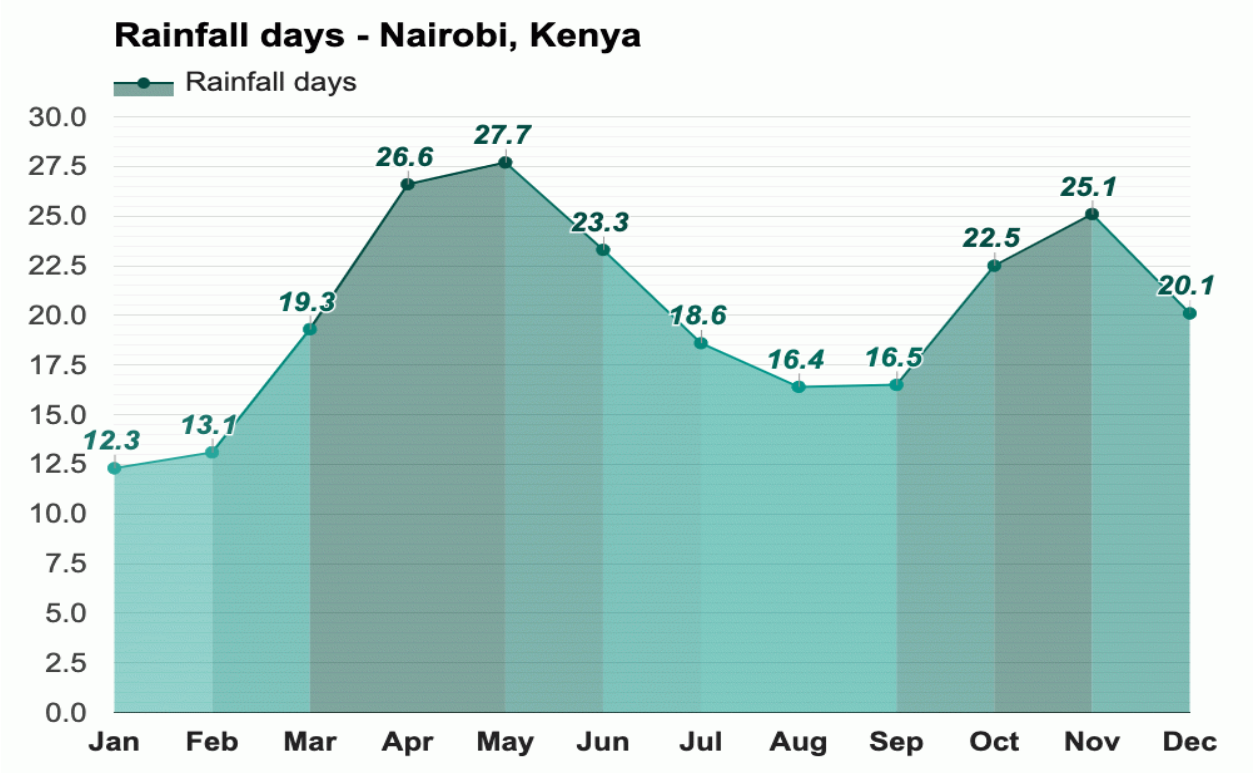
### 3.1.3. Average Humidity Values

Because of Nairobi's location just south of the equator in combination with humid air pumped in from the Indian Ocean, the humidity values for each day are generally on the higher end
This is not to say that values are always high, since the easterly winds coming off the Indian Ocean tend to keep the temperatures standard throughout the country; therefore the "warm sticky" feeling is usually not associated with Nairobi as much as one would think. In the summer to autumn months of January to April, relative humidity values have been known to plummet to anywhere from 10% to 20%. The typical day, humidity-wise, starts off with nearly saturated in the morning hours, and steadily decreases throughout the remainder of the day.



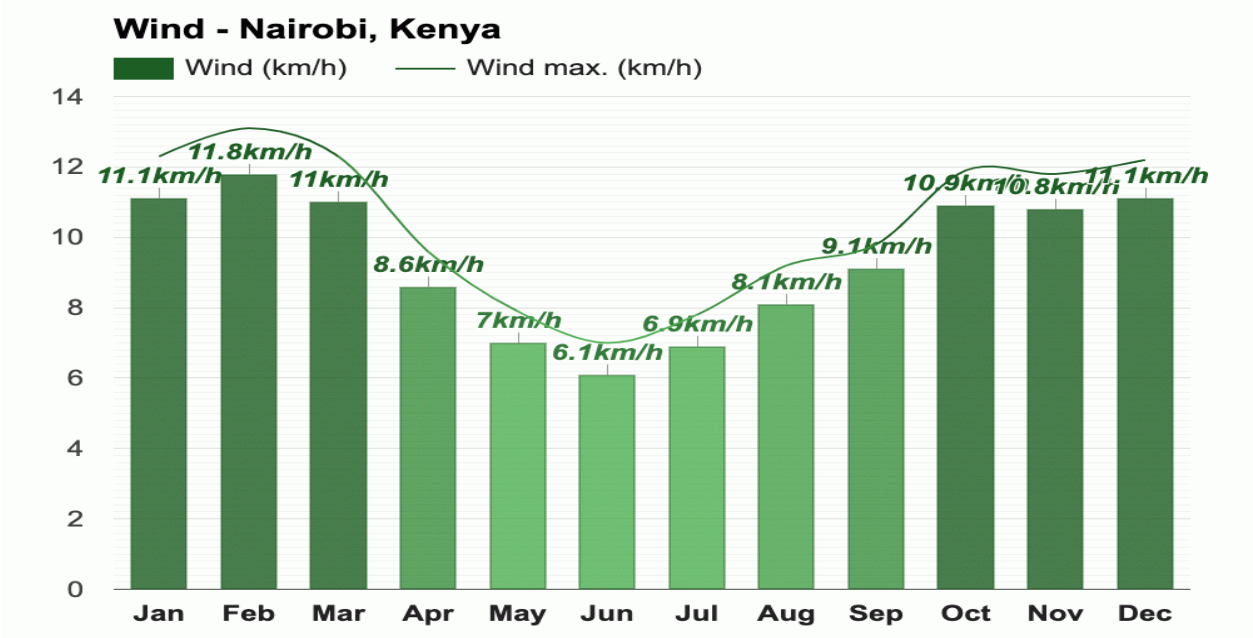

### 3.1.4. Average Rainfall

With these routinely high relative humidity figures, it is not surprising that the Nairobi climate is one that produces much rain annually. In fact, from the past 50 years, the expected amount of rain could be anywhere in the range of 500 to 1500 mm, with the average ringing in at 900 mm. The majority of these rainfall figures crash down in Nairobi in one major and one minor monsoon seasons respectively. The major monsoon season occurs within the months of March to May, and is called the "Long Rains" by the locals. The minor monsoon seasons emerges within the October to December Months, and is called the "Short Rains" by the Nairobi citizens. That is what the meteorologists as a whole know about the monsoon seasons. What they do not know is exactly when these seasons will start. There is usually not an indication of when these rainy seasons will start, since it is difficult to determine when one starts and when the other finishes. Consequently, one may think there is only one rainy season when looking at the annual rainfall amounts



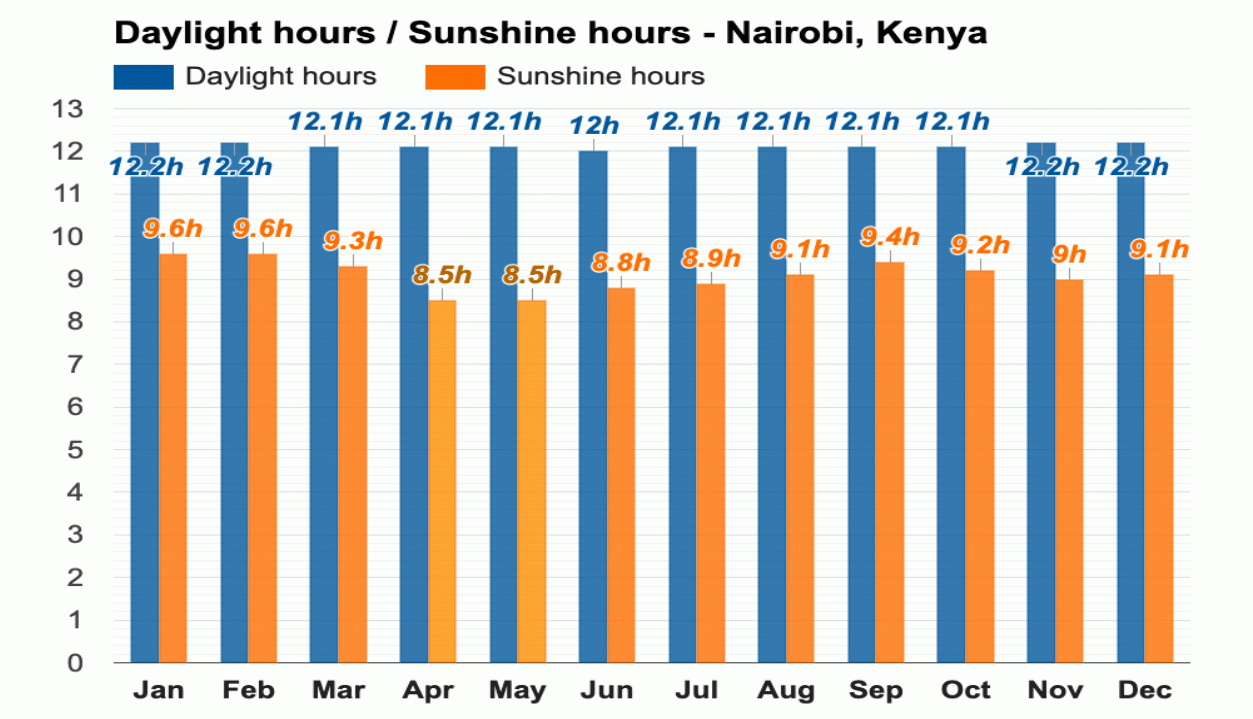

### 3.1.5. Average Winds

Winds along the surface are predominantly easterly throughout the entire year. They are shifted to northeast between October and April, and they are shifted southeast between May and September. Right before the “Long Rains” season, the strongest winds occur, reaching speeds of 20 to 25 miles per hour. During the rest of the year, winds are usually at speeds of 10 to 15 miles per hour. During the night, the winds are calm.



### 3.1.6. Average Sunshine

Early mornings in Nairobi are often cloudy, but the sun peeks through by mid-morning. Throughout the year, there is an average of seven hours of sunshine per day. Thirty per cent more sunlight reaches the ground during the afternoon than in the morning. Of course, there is more sun shine during the summer months, when the sun is more overhead in the southern hemisphere. Infrequently during the rainy season the sun never show through the clouds. Even in August, the cloudiest month, there is an average of four hours of sunshine.




### 3.1.7 Water Resources

The main rivers in the County are Nairobi River, Ngong River and Kabuthi River. They transverse through the Nairobi County and joins the larger River Athi on the eastern edge. These rivers are highly polluted by effluence from open sewers and industrial waste. Nairobi dam, which is along the Ngong River, and Jamhuri Dam are the main water reservoirs in the County. The main types of soils are black cotton and red soils that form patches in different parts of the County. There are three forests in the County, namely Ngong Forest to the south, Karura Forest to the north and the Nairobi Arboretum. The three forests have a total coverage of 23.19 $Km^2$.

### 3.1.8 Ecological Conditions

The County is predominantly a terrestrial habitat that supports a diverse web of biodiversity and ecosystems. It is home to about 100 species of mammals, 527 bird species and a variety of plant species. The existence of Nairobi National Park has been of prestigious value as the only park within a city. The Park is covered by a highland of forest hardwoods. Variety of birds and animals find their home in the Park including the Big Five. To the North west of the city, adjacent to the Rift Valley is an area of undulating grassland with a covering of rich well-

drained “red- coffee soils”. To the North- East of the city, the high and ever sloping land is dissected by South- East flowing streams which have formed a series of steep sided parallel ridges and valleys. South and East of Nairobi are grassland plains of poorly drained “black cotton clays”. Due to high population growth and urbanisation rates, environmental degradation has been experienced in Nairobi, causing stress on the natural resources. The main surface water sources are Ngong and Nairobi Rivers, clean when they enter the city but highly polluted as they leave. All rivers in Nairobi have been excavated in search of sand for construction.

### 3.2. Socio-economic environment

#### 3.2.1. Population

Nairobi County’s population was 4,397,073 people as per the 2019 Kenya Population and Housing Census 2019 with 2,192,452 (49.9%) being male, 2,204,376 (50.1%) being female and 245 (0.006%) being intersex. The county had 1,506,888 households and an average household size of 2.9. the total population is expected to be 4,671,906 in 2022 (6.3% from 2019) and 5,049,701 in 2027 (14.8% from 2019). In 2019 Embakasi was the most populated constituting 22.49% of the total County’s population while Kibra had the lowest at 4.23% of the total. This rapid increase in population and the resultant higher population density will further strain the limited county resources. Provision of physical and social amenities at a pace that matches the population growth is ideal but elusive.

#### 3.2.2. Land use

Nairobi County has had a marked change in land use over the years. Industrial and commercial land has dwindled in the last decade and most industries have been looking for land in Athi river part of Machakos County. In 2012 the projected housing land requirement was estimated to be 250 $Km^2$. Land meant for urban agriculture has been on the decline as more of it is turned to residential use with the City relying on other counties for supply of food items. The industrial areas are largely concentrated in Industrial Area, Kariobangi South and Baba-Dogo (CIDP-Nairobi County).

#### 3.2.3. Energy Access

The use of various types of energy is influenced by its cost rather than access. For instance, 63.2 per cent of the population use paraffin as cooking fuel. Other sources of energy for cooking include LPG gas (20.2per cent), charcoal (10.5 per cent) and firewood (1.8 per cent). About 68.2 per cent of households use electricity as a means of lighting 28.8 per cent use paraffin while 2.9 per cent and 1.7 per cent use grass and dry cells respectively

#### 3.2.4 Infrastructure

In general, Nairobi city is well served with good communication and transport network such as air, road, and railway. It is centrally located to serve the Eastern African Countries. Bus and train stations are within an easy walk of the City Centre. The main Railway line runs from Mombasa

through Nairobi to Malaba. The Network facilitates transportation of agricultural products from Western Kenya to the Coast. The city is a hub of road transport connection other major towns in the country. On air transport Jomo Kenyatta International Airport makes it easy to transport goods from all over the world into the country and vice versa.

*3.2.4.1 Sanitation*

About 61.5 per cent of the population in the County use flush toilets as the main waste disposal method, while 32.1 per cent use pit latrines. The remaining 4.8percent of the population have no means of waste disposal. On garbage collection, 36.1 per cent of the communities have their garbage collected by private firms and similar percentage is collected by neighborhood community groups.

### 3.2.5 Climate change and its effects in the County

Climate change affects the environment negatively leading to water scarcity, increased health threats, increasing temperature, low precipitation, erratic weather patterns, food insecurity and increase in cost of food commodities.

*3.2.5.1 Climate Change Mitigation Measures and Adaptation Strategies*

Efforts have been made to control emission of carbon monoxide by motor vehicles with NEMA taking a leading role in enforcement of related laws. There has been a change in ways of disposing solid waste from dump and burn to recycling. In order to address the missing gaps in these areas the following strategies will be adopted: establishment of early warning systems, monitoring climate change and disseminating information to the farmers, adaptation of new technology in both solid and waste management as opposed to using open dumping sites, diversify energy sources by investing in renewable sources of energy, water harvesting, recycling and conservation.

# 4. LEGISLATIVE AND REGULATORY FRAMEWORK

## 4.1. Constitutional and Legal Framework

### 4.1.1. Constitution of Kenya (2010)

***Article 42-Environment*;** Indicates that every person has the right to a clean and healthy environment, which includes the right to –

- Have the environment protected for the benefits of present, future generations through legislative and other measures, particularly those contemplated in Article 69, and
- Have obligations relating to the environment fulfilled under Article 70 [1].

***Article 43-Economic and social Rights***
Indicate that every person has the right to accessible and adequate housing and to reasonable standards of sanitation.

### 4.1.2. The Environmental Management and Coordination Act CAP 387

The Environmental Management and Coordination Act (EMCA) chapter 387, and its Attendant Environmental (Impact Assessment and Audit) Regulations of 2003 Provides for the establishment of an appropriate legal and institutional framework for the management of environment in Kenya. The Act introduces two important aspects of urban environmental management, which are directly related to the proposed project: environmental impact assessment (EIA) and environmental audit (EA).
***Section 58 (1)*** has underscored that any person being a proponent of a project Shall before financing, commencing or proceeding with submit an EIA report to the National Environmental Management Authority (NEMA) of Kenya[2].
***Section 68 (1)*** gives NEMA the mandate for carrying out all environmental audits of all activities that are likely to have significant impacts on the environment. It authorizes environmental inspectors, as appointed by NEMA to enter in any premise and determine how far the activities carried out conform to statements in EIA study.

**Compliance with EMCA**

- The proponent has undertaken an EIA as per the requirements of Section 58 (1) of EMCA CAP 387 awaiting approval prior to the commencement of the project.
- The proponent will implement the proposed EMP and adhere to the conditions set in the license of the proposed project.
- The proponent will adhere to subsequent EMCA legislations such as the noise and waste regulations throughout the cycle of the project.

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[1] LAWS OF KENYA, *The Constitution of Kenya, 2010* (Attorney General Nairobi, 2010), http://www.wipo.int/edocs/lexdocs/laws/en/ke/ke019en.pdf.

[2] George M. Wamukoya and Francis DP Situma, *Environmental Management in Kenya: A Guide to the Environmental Management and Coordination Act* (Centre for Research and Education on Environmental Law, 2000).

- The proponent shall undertake Environmental audits for the project and submit the reports to NEMA as per the EIA/EA guidelines

### 4.1.3. Physical Planning and land use act (2019)

The Physical Planning and Land Use Act aims at developing a sound spatial framework[3]. The plan proposals enhance and promote intergraded spatial/physical development. The Physical planning Act makes specific provisions in respect to the mandate of local authorities.

***Section 24 (1):*** the Director may prepare with reference to any Government land, trust land or private land within the area of authority of a city, municipal, town or urban council or with reference to any trading or marketing center, a local physical development plan.

***Section 24(3):*** the Director may prepare a local physical development plan for the general purpose of guiding and co-coordinating development of infrastructure facilities and services for an area referred to in subsection (1), and for the specific control of the use and development of land or for the provision of any land in such area for public purpose.

***Section 25 (b):*** a local physical development plan shall consist of such maps and description as may be necessary to indicate the manner in which the land in the area may be used.

***Section 29 (a):*** confers upon local authorities the powers to prohibit or control the use and development of land and buildings in the interests of proper and orderly development of its area.

***Section 36:*** This section compels that if in connection with a development application, a local authority is of the opinion that proposals for industrial location, or any other development activities (such as building developments) will have injurious impact on environment, the applicant will be required to submit together with application an environmental impact assessment report.

**Compliance with this legislation**

- The architectural drawings (plans) of the proposed project have been submitted to the county government of Nairobi for approval
- The proponent will ensure that the land is utilized in an ecofriendly manner and is restored to its original condition once the project is decommissioned.
- Ensure the development does not in away have injurious impact on the environment and that a developmental footprint of less than 75% is maintained.

### 4.1.4. Physical Planning (Building and Development Control) Regulations

Under the provisions of the Physical Planning (Building and Development control) Regulations; The Director of Physical Planning shall refuse to recommend any new building or proposed development, or alteration or addition to any existing building if:

i. The proposal is not in conformity with approved development plan.
ii. Such plans disclose a contravention of the physical Planning (Building and Development) rules.
iii. The plans are not correctly drawn or omit to show information required.

[3] The Republic of Kenya, "The Physical Land Use & Planning Act, 2019" (Kenya law reports).

iv. On such being required, separate application accompanied by sets of plans has not been lodged in respect of building on separate plots or subplots etc.

**Compliance**

- The proponent shall adhere to the recommendations given in the building order by the county physical planner
- The proponent shall ensure that the building plans are available on site for inspection by county officials during construction and at any other time.

### 4.1.5. The public Health Act (Cap 242)

***Section 15 (1x) –Nuisance***

Any noxious matter or wastewater discharged from any premise, such as a building constitutes nuisance. Any premise not kept in a clean and free from offensive smell such as gases which are injurious to health such as those from commercial establishments shall therefore generate nuisance. The Act therefore stresses that no person shall cause a nuisance to exist on any land or premise occupied by him.

The Act acknowledge that it shall be the duty of all local authorities to take all lawful measures for maintaining its district at all times in a clean and sanitary condition for remedy of any nuisance or condition liable to be injurious to heath. To safeguard against this, part X of the public Health Act states that where in the opinion of the Medical Officer of Health that food stuffs within a warehouse, or a building are insufficiently protected, the owner shall be compelled to observe the require regulations, else he shall be guilty of an offense[4].

**Compliance**

- The proponent will ensure solid waste shall be handled by a professional NEMA Approved garbage collector on regular basis and disposed appropriately as per the waste regulations.
- Sanitary facilities shall be in conformity with MOH standards and installation of standard fittings. Liquid wastes shall be contained in a waste treatment plant.

### 4.1.6. The County Government Act, 2012

It affirms that every municipal council has the power to establish and maintain sanitary services for the removal and disinfection, or otherwise dealing with or kinds of refuse and effluent, such as spent oil, and where any such services is established, to compel the use of such services by persons to whom the services is available

***Section 166*** – empowers the local authority to be responsible for local planning and development control in the city.

[4] The Republic of Kenya, "The Public Health Act Chapter 242" (Kenya law reports, 2012).

**Compliance with this legislation**

- The proponent is obligated to comply with EIA study report proposed potential mitigation measures in the EMP.
- Adhere to all directives from the County Government of Nairobi as they may arise during the full cycle of the project

### 4.1.7. The OSHA, 2007

The Act aims at making provision for the health, safety and welfare of persons employed in factories and other places of work.

***Section 13*** – states that every factory shall be kept in a clean state and free from effluvia, arising from any drain, sanitary convenience or nuisance. Effective and suitable provisions is also proposed for securing, maintaining by circulation of fresh air in each workroom, the adequate ventilation of the room.

***Section 36*** –Provides for precautions with respect to explosive inflammable dust or gas. The section is specific that where in any building, if dust that could escape to work man's room and explode by ignition, steps must be taken to prevent such an explosion.

***Section 41*** – Compels that in every factory, there shall be maintained fire extinguishers, which shall be adequate and suitable in case of fire out breaks. Similarly, it mandates every factory to provide adequate means of escape in case of fire outbreak for the employees. The Act further requires that if a factory worker is employed in any process involving exposure to wet or to any Injurious or offensive substance, suitable protective clothing must be provided by the employer[5].

**Compliance**

- The proponent will appoint a reputable contractor who will be responsible for enforcing the requirements during construction and subsequent repairs and maintenance after project completion.
- They will make provision for the health, safety and welfare of persons employed in factories and other places of work. Ensure that every work place shall be kept in a clean state and free from effluvia, arising from any drain, sanitary convenience or nuisance.
- Avail fire extinguishers, which shall be adequate and suitable in case of fire out breaks. Provide adequate means of escape in case of fire outbreak for the employees.
- Ensure factory workers are in any process involving exposure to wet or to any injurious or offensive substance, suitable protective clothing must be provided.
- The proponent shall ensure that the factories and other places of work abstract is displayed at a strategic place within the factory premises

### 4.1.8. Planning & Building Regulations 2009

These are regulations that set standards for the design and construction of buildings to ensure the safety and health for people in or about those buildings. The regulations are as follows;

a) Any developer, who intends to erect a building such as a residential block, must

b) Sought for all approvals before commencement of the work and regular monitoring will follow to ensure compliance with set standards and conditions

c) All plans must be drawn by registered architect/ structural designer

d) Give the concerned local authority a notice of inspection, before the erection of the structure. After erecting the building, a notice of completion shall be issued to the local authority to facilitate final inspection/approval.

e) No person shall occupy a building whose certificate of completion has not been issued by the local authority. As a precaution against fire breakout, the by-law states that the walls of any premise shall be non-combustible throughout, similarly, in every building, other than a small house, which comprises more than one storey, shall have fire resistance.

**Compliance**

- All approvals will be sought before commencement of the work and regular monitoring will follow to ensure compliance with set standards and conditions.
- The proponent will obtain Certificate of Completion on decommissioning. They shall further provide fire-fighting equipment that may include one or more of the following: hydrants, hose reels and fire appliances, external conations, portable fire appliances, water storage tanks, dry risers, sprinkler, drencher and water spray spring protector system.

### 4.1.9. Penal code (Cap. 63)

The chapter on "Offences against Health and Conveniences" strictly prohibits the release of foul air into the environment, which affects the health of other persons. Any person who voluntarily violates the atmosphere at any place, to make it noxious to health of persons in general dwelling or carrying out business in the neighborhood or passing along public ways is guilty of misdemeanor, i.e. imprisonment not exceeding two years with no option of fine . Under this Act, any person who for the purpose of trade or otherwise makes loud noise or offensive awful smell in such places and circumstances as to annoy any considerable number of persons in the exercise of their rights, commits an offences, and is liable to be punished for a common nuisance, i.e. imprisonment not exceeding one year with no option of fine.

**Compliance**

- The proponent will ensure using appropriate technology, foul air which affects the health of other persons will not be released into the environment, Further they will for the purpose of trade or otherwise, using any appropriate systems and technology, ensure there is no loud noise or offensive awful smell in such places and circumstances that may annoy any considerable number of persons in the exercise of their rights.

### 4.1.10. Water Quality Regulations, 2006

The law is based upon the principle that everybody is entitled to a healthy and clean environment. Section 42, is pertinent to the implementation of this project. These Regulations shall apply to drinking water, water used for industrial purposes, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife, and water used for any other purposes[6].

**Compliance with this legislation**

- The proponent shall strictly adhere to the provisions and requirements of these regulations. He must ensure all applicable water standards are observed to ensure clean, safe water for all purposes.
- The proponent shall carry out an initial environmental audit after the first year of operation. The report shall include analysis of effluent as stipulated in the second schedule of this legislation.

### 4.1.11. Noise and Excessive Vibrations Pollution (Control) Regulations

**Part II** of the rregulations[7] regulations; section 3 states:

1. Except as otherwise provided in these Regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment.

**Compliance:** The proponent shall take into concern the provisions of the local authority act to ensure that the development complies with the provisions of the Act.

### 4.1.12. Waste Management Regulations (2006)

This legislation gives guidelines for handling different kinds of waste. Some of the relevant sections to the proposed project are as follows:

**Part II Section 1**: No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle

**Part II Section 6:** Any person who owns or controls a facility or premises which generates waste shall minimize the waste generated by adopting the following cleaner production principles:

a) **improvement** of production process through:
   i. Conserving raw materials and energy
   ii. eliminating the use of toxic raw materials within such time as may be prescribed by the Authority
   iii. reducing toxic emissions and wastes
b) **Monitoring** the product cycle from beginning to end by:
   i. Identifying and eliminating potential negative impacts of the product.

[6] The Republic of Kenya, "The Environmental Management and Coordination, (Water Quality) Regulations 2006." 2006, www.nema.go.ke.

[7] The Republic of Kenya, "The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009." 2009, www.nema.go.ke.

ii. Enabling the recovery and re-use of the product where possible.
iii. Reclamation and recycling.

c) **Incorporating** environmental concerns in the design, process and disposal of a product[8].

**Compliance**

- The proponent will ensure that all waste are segregated before being transported to a designated waste treatment facility by a contracted NEMA licensed waste transporter

### 4.1.13 Urban Areas and Cities Act No. 13 Of 2011

PART V – on Integrated Development Planning, section 36 sets the objectives of integrated urban areas and city development planning (1) Every city and municipality established under this Act shall operate within the framework of integrated development planning which shall— (a) give effect to the development of urban areas and cities as required by this Act and any other written law; (d) be the basis for— (i) the preparation of environmental management plans; (v) disaster preparedness and response; (vi) overall delivery of service including provision of water, electricity, health, telecommunications and solid waste management; (2) In addition to the objectives set out in subsection (1), an integrated urban or city development plan shall bind, guide and inform all planning development and decisions and ensure comprehensive inclusion of all functions.

***Compliance****; the proponent has given into consideration all the requirements of the act by getting the planning proposal in line with the planning requirements of the county integrated development planning.*

### 4.1.14 Climate Change Act, 2016

These Regulations were published in the Kenya Gazette Supplement No. 68, Legal Notice No. 11 of 13th May, 2016. The Regulations provides for a legal framework to enhance response to climate change; to provide for mechanisms and measures to achieve low carbon development for connected purposes. Climate resilient development in Kenya, and is an important milestone on the country's path towards developing its economy while simultaneously reducing greenhouse gas emissions.

Part IV, Section 15 (5a) the act requires that public entities to integrating climate change plan into sectorial strategies and their implementation projections for the assigned legislative and policy functions

PART IV, Section 15 states that private entities that have a climate change obligation to submit reports the status of performance of climate change duties and prescribe the period of reporting.

Part IV, Section 17 (a) states that National Environment Management Authority (NEMA) has the duty of regulate, enforce and monitoring the compliance on levels of greenhouse emissions as set by the national council provided by the act.

[8] The Republic of Kenya, "The Environmental Management and Co-Ordination (Waste Management) Regulations, 2006.," n.d., www.nema.go.ke.

Part IV, Section 23 a person in pursuant of article 70 of the constitution may apply the environment and land court alleging that the person has acted in a manner that has adversely affected efforts towards mitigation and adaptation of climate change
Part V, Section 24 Public participation shall be undertaken in a manner that ensures it makes an impact in the threshold of decision making on climate change.

**Compliance;** The proponent is advised to identify and asses residual climate risks and risk reduction measures, incorporate climate adaptation measures into the design and do follow-up assessments needed during the project operation phase.

### 4.1.15 Sustainable Waste Management Act no. of 2022

AN ACT of Parliament to establish the legal and institutional framework for the sustainable management of waste; ensure the realization of the constitutional provision on the right to a clean and healthy environment and for connected purposes.
Section **(3)** The objects of this Act shall be to—

a. Promote sustainable waste management;
b. Improve the health of all Kenyans by ensuring a clean and healthy environment;
c. Reduce air, land, fresh water and marine pollution;
d. Promote and ensure the effective delivery of waste services;
e. Create an enabling environment for employment in the green economy in waste management, recycling and recovery;
f. Establish an environmentally sound infrastructure and system for sustainable waste management;
g. Promote circular economy practices for green growth;
h. Mainstream resource efficiency principles in sustainable consumption and production practices; and
i. Inculcate responsible public behaviour on waste and environment.

Sections 12, 19 and 20 give certain duties regarding all waste producers thus; waste classification and segregation, duties of private sector entities and duty to segregate and dispose waste respectively.
**Compliance;** The proponent is advised to take cognizance of all requirement of the act so as to address all matters waste management sufficiently.

### 4.1.16 NCA regulations 2014

This is an Act of Parliament that with a mandate to oversee the construction industry and coordinate its development.

Section 17 states that;

All construction works, contracts or projects either in the public or private sector shall be registered with the Authority in accordance with the Act. An owner shall make an application for registration of a project to the Authority in writing within thirty days from the dare on which a tender for construction works, contract or project is awarded to a contractor registered under this

Act. Also, an owner shall ensure that the tender for construction works, contract or projects is awarded to a person, firm or contractor registered under this Act.
*The proponent will adhere to this regulation and award a reputable, registered contractor.*

**4.1.15 National Construction Authority Act No. 41 Of 2011**

**Section 15 calls for the Requirement for registration**
(1) A person shall not carry on the business of a contractor unless the person is registered by the Board under this Act.

***Compliance;*** *The proponent, once obtained all the requisite permits and licenses must ensure that they shall engage the services of a registered contractor.*

**PART IV-Addresses the identification and Reporting of Construction Works Contracts or Projects by the Owner.**
Section 17. (l) All construction works, contracts or projects either in the public or private sector shall be registered with the Authority in accordance with the Act.
***Compliance;*** *The proponent to obtain all the requisite permits and licenses and must ensure that they register the construction site with the Authority.*

**4.2. Institutional Framework**

The environmental impact assessment for the proposed development is influenced by interest of several stakeholders and lead agencies, either exclusively or concurrently. Some of these stakeholders and lead agencies include:

- National Environmental Management Authority (NEMA)
- The National Construction Authority (NCA)
- Director of Physical Planning
- The County Government of Nairobi
- The Ministry of Housing and Urban Development
- The ministry of Environment and Natural resources

**4.2.1 The National Construction Authority**

The Mandate of the NCA is to regulate the construction industry and coordinate its development.
The National Construction Authority empowers the Authority to "Accredit and register contractors and regulate their professional undertakings". The Authority publishes a Register of Contractors that contains the particulars of the construction firm, including the Class of Works and Category for which the firm is registered. The Executive Director is the Registrar of Contractors.
The NCA is also responsible for project registration; project registration is an important step towards streamlining of the construction industry. Developing a projects register will facilitate planning and maintaining of construction records that makes quality assurance not just easier but more systematic.

### 4.3. Development Policy Framework

The overall development policy framework for the proposed project is captured in various local authority and government documents. The development of this project has been benchmarked against UN and International guidelines.

#### 4.3.1. The World Commission on Environment and Development

The commission commonly referred to as "the Brundtland Commission" is focused on the environmental aspects of development. Economic sustainable development is development for which progress towards environmental and social sustainability occurs within available financial resources. Social sustainable development maintains the cohesion of a society and its ability to help its members work together to achieve common goals, while at the same time meeting individual needs for health and wellbeing, adequate nutrition, shelter, cultural expression, and political involvement [9].

#### 4.3.2. The Rio Declaration on Environment and Development

The Rio Declaration on Environment and Development was adopted by more than 178 governments at the United Nation Conference on Environment and Development, known as the earth summit, held in Rio de Janeiro, Brazil from 3rd to 14th June 1992. Under Agenda 21, Principle No. 10 of the declaration underscores that environmental. Issues are best handled with participation of all concerned citizens at all relevant levels. At the national level, each individual shall have appropriate access to information concerning environment that is held by public authorities. States shall encourage and facilitate public participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy shall be provided.

The foregoing discussion is relevant to the proposed development because Kenya legislation demands that public must be involved before any development project that is likely to have adverse impacts to the environment is initiated by a project proponent. The environment Act has further established public complaints committee (PCC) where the issues raised by the public in regard to any proposed development can be addressed.

#### 4.3.3. Kenya Vision 2030

Kenya aims to be a nation that has a clean, secure and sustainable environment by 2030.The goals for 2030 are: (i) to increase forest cover from less than 3% at present to 4%; and (ii) to lessen by half all environment-related diseases. Specific strategies will involve promoting environmental conservation in order to provide better support to the economic pillar flagship projects and for the purposes of achieving the sustainable Development Goals (SDGs); improving pollution and waste management through the design and application of economic

[9] Gro Harlem Brundtland, *Report of the World Commission on Environment and Development:" Our Common Future."* (United Nations, 1987).

incentives; and the commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery. Kenya will also enhance disaster preparedness in all disaster-prone areas and improve the capacity for adaptation to global climatic change. In addition, the country will harmonize environment-related laws for better environmental planning and governance[10]

[10] Kenya Vision, "2030: A Globally Competitive and Prosperous Kenya (2007)," *Ministry of Planning and National Development and the National Economic and Social Council (NESC), Government of Kenya, Nairobi (GOK, 2007)*, n.d.

## 5.0. WATER SUPPLY DEMAND AND CONSERVATION SYSTEM

### 5.1 Water Requirement

The United Nations Water Conference Action Plan recognized water as a right, declaring that all people have a right to have access to safe drinking water. It is estimated that at least 1.1 Billion people, which represent 17% of the global population lack access to improved water. Water shortage is a severe and growing global challenge. Over the last 50 years, water withdrawals have tripled due to economic development and rapid population growth, placing serious pressure on the planet's water systems. However, 884 million people in the world still do not get their drinking water from safe sources, specifically in developing countries, such as in Africa and Southern Asia. The World Water Council (WWC, 2012) noted that the world's population tripled in the 20th century, the use of the world water resources has grown six-fold, coupled with industrialization and urbanization. Water in the Sub-Sahara region is not only scarce but also of exceptionally of poor quality. Due to pollution as well as unreliable supply and sanitation infrastructure, only a small percentage of what little water is available can be used for human consumption. Almost half of all Africans suffer from water-borne diseases, with cholera and infant diarrhea, the most frequently occurring sicknesses. Most of the countries with the lowest levels of sanitation are located in sub-Saharan Africa, where 45% of the population resorts to using shared or dangerously inadequate facilities – with little progress in the area recorded to date.

Eastern Africa's renewable freshwater resources amount to 187 $m^3$ per year; this is only 4.7 per cent of Africa's total, yet the sub-region is home to 19% of the region's population. This imbalance is set to worsen in the next two decades due to an increase in human and animal population increase.

Kenya is recognized by the United Nation Environment Programme (UNEP) as a water scarce nation, whose average supplies of available freshwater is 647m3 per capita, which is below the 1,000m3 per capita per year recommended by United Nation. Furthermore, Kenya ranks 21st for the worst levels of access to water in the world, compared to its neighbours in the region, Uganda and Tanzania at 2940m3 and 2696m3 respectively (UN-WWAP, 2006), and about 41% of the people do not have access to clean water causing about 10% of deaths (KCBS, 2009). The constitution of Kenya article 43(1) b and 43(1) d provides that access to reasonable standards of sanitation and clean safe water in adequate quantities is an economic and social right to every person.

In many urban areas, the shortage of water has been amplified by the government's lack of investment in water. Most of the urban poor Kenyans only have access to polluted water, which has caused cholera epidemics and multiple other diseases that affect health and livelihoods.
Access to safe water supplies throughout Kenya is 59% and access to improved sanitation is 32%. There is still an unmet need in rural and urban areas for both water and sanitation. Kenya faces challenges in water provision with erratic weather patterns in the past few years causing droughts and water shortages. Kenya also has a limited renewable water supply and is classified

as a water scarce country. Urban migration contributes to challenges in sanitation, as people crowd into cities and urban growth is unregulated (Kimutai 2018).

Over the years, demands for water for domestic and industrial processes has been steadily increasing, while the water catchment areas remain limited. Moreover, water catchment areas are increasingly being degraded due to the large volume of industrial and other wastes from human activities being disposed of to the environment without much treatment. Further downstream, there is pollution of water sources in the County. Under these circumstances, water management practices have to be efficient in order to ensure a continued adequate water supply for present and future needs. Increase in population in the County has resulted to more pressure on the existing water infrastructure leading to serious shortage of the commodity. Maintenance and expansion of the water supply infrastructure will be critical to the continued development of the County (CIDP- Nairobi, 2018).

In the National Water Master Plan 2030 developed in 2013 by the Government of Kenya, it was noted that future domestic water demands will increase drastically, while the available water resources are limited.

The water demand in Nairobi has outstripped the existing water supply capacity of the company which has necessitated rationed supply to some parts of the city. In Nairobi, there is an inadequate water supply to meet the difference in demands where demand of water far outstrips supply (estimated at 850000 cubic meters while supply is 525,000cubic meters), this is largely attributed to the old water infrastructure and cartels CIDP, 2023-2027.

A geotechnical investigation was undertaken at the proposed site to acquire information on the subsurface conditions at the site for use in developing recommendations for safe and cost-effective foundations. The survey generally entailed core drilling of 9 No. boreholes to the various depths between 15 m and 35 m Groundwater was reportedly not encountered during the drilling explorations.

### 5.2. Water Resources and Quality in Nairobi County

Nairobi County has no main water tower; most of the supply to Nairobi City is from the Tana Basin and is pumped to the City from distances of around 50 Km. This bulk water-supply is not reliable during periods of drought, and is also endangered by siltation of the reservoir due to deforestation in the catchment areas. The supply problem is further aggravated by the poor state of the distribution system, which results in about 50 per cent losses due to leakage, illegal connection and inefficient and wasteful use of water by some consumers.
Currently, the AWWDA is in the process of laying 27km bulk water transfer system for Nairobi County to enhance access to water.

### 5.3 Water supply schemes

Nairobi Water and Sewerage Company is the main water company in the County. Most of the water wells are operated by large private consumers (industrial enterprises, hotel complexes) or by individual residential owners in parts of the City that receive only intermittent supply. Wells are often shared with neighbors or water is sold for distribution by tankers. Many private well owners are also connected to the mains water-supply network (which provides cheaper water) but use groundwater as a back-up.

### 5.4 Nairobi County Surface water sources

The main sources of water for the residents in Nairobi County are from;

- Sasumua Dam in Nyandarua, with a Storage capacity of 15.9 million $M^3$ has a Design yield of 59,000m3/day. The Water from the dam is treated at Sasumua Dam Treatment plant and Contributes approximately 12% of Nairobi's current water supply.
- Thika dam with a designed storage capacity of 70,000,000$M^3$ whose Water is treated at Ng'ethu Treatment plant contributes approximately 84% of Nairobi's current water supply
- Ruiru Dam with a Storage Capacity of 2.9 million $M^3$ stores raw water with a yield of 21,600 $M^3$ /day, the Water from the dam is treated at Kabete Treatment plant. The dam Contributes approximately 4% of Nairobi's current water supply.
- Kikuyu Springs. The total production for Spring No.1 is estimated to be 2,000m3 per day, while production from spring 2 is 4000m3 per day. The combined total production from Kikuyu springs is estimated as 6000m3 per day. Areas which benefit from this water are: Karen, Dagoreti, Kawangware, Riruta, Uthiru & environs. The Yield is 4000-5,500 m3/day

Although Nairobi River is permanent, its water is unsafe for human consumption. There are residents that use borehole water, wells and roof catchments. Over 80 per cent of the residents have access to piped water. On average, it takes 52.5 per cent and 24.7 per cent of the population 0 and 1- 4 minutes to fetch water. Only 0.9 per cent of the population takes 30-59 minutes to nearest water point.

### 5.5 Water demand and Supply

The World Health Organization (WHO) recommends two (2) gallons (about 7.5 litres) per person daily to meet the requirements of most people under most conditions; and around five (5) gallons per person daily to cover basic hygiene and food hygiene needs. Household survey findings indicated that 50% of the households consumed 51–100 litres of water, 18.3% consumed 1–50 litres and 12.7% consumed 151–200 litres while 11.7% consumed 101–150 litres respectively. In other terms most of the households averagely use five jerricans (holds about 19-20 liters) of water daily for their domestic use.

Nairobi City is served mainly by the Nairobi City Water and Sewerage Company, NCWSC. The main sources of water for the residents in Nairobi County are from Sasumua Dam in Nyandarua, Kikuyu Springs, Ruiru Dam, Thika and Ngethu water works which sources its water from the Aberdare Ranges.

### 5.6 Causes of water shortages in Nairobi City

Growing water demand and water scarcity have turned into a notable challenge in Kenya. Climate change, population growth, urbanization, water pollution and poor management of water resources have aggravated the issue of the water crisis, which affects economic activities, food security, education and health. These challenges are especially evident in rural areas and urban slums where people are often unable to connect to piped water infrastructure.

Drinking water is becoming scarce, especially for the poor in Kenya. A third of the population does not have access to drinking water and nearly two-thirds lack basic sanitation. The capital has been suffering from years of water shortages. The Ndakaini Dam provides water to Nairobi but its normal level remains low many times owing to receding rainfall. There would be a shortage of 200,000 cubic meters of water a day to support Nairobi and its 4 million inhabitants.

In the NCWSC strategic plan 2019-2024, some of the highlighted environmental causes of water shortages include the following;

- **Climate Change and Global Warming**; the country continues to experience erratic weather patterns and reduced amount of rainfall, hence intermittent and inconsistent supply of adequate drinking water.
- **Change in Land Use**; increased human activities near the water catchment areas have also resulted in soil erosion resulting in increased siltation of water reservoirs and dams. Desilting of dams and raw water intakes require a lot of resources from the Company.

### 5.7 Projected Water demand at the residential development

The proposed residential development intends to establish 200 No. residential units of two, three, four, and five bedrooms, from $1^{st}$-$21^{st}$ floor. The development has made allocation for water storage tanks on basements 1 and 2 where water will be stored and pumped into the houses.
During construction, water from NCWSCo and other water vendors will be utilised mainly for masonry work. There will be water storage tanks to increase water capacity at the project site to the required amount.

At operation, the development will source water from reticulated supply by NCWSC main supply. Due to the unreliability in water supply, it is expected that the project proponent will supplement the water supply through the use of borehole water (WRA permit required before borehole drilling) and rainwater harvesting to ensure sufficiency of clean water during the operation/occupation stage of this project. There will be water storage tanks to increase water capacity at the project site to the required amount. It is a recommendation that the proponent

undertakes tests on yields and analysis of the water quality to determine capacity to meet the demand and conformity to Schedule 1 of the Water Quality Regulations, 2006. The proponent will undertake a hydrogeological survey to establish the viability of ground water for the project (the permit application processes with WRA and NEMA for the borehole will be carried out separately).

During the operation, assuming that the residential blocks will host approximately 1200 residents (Assumption: 200 units* 6 persons/ house) residents with each resident consuming an average of 70 litres per day. Thus 70 litres x 1200 residents will require approximately 84,000 litres ($84M^3$ of water daily).
This water will be adequately supplied from the municipal and from the proposed borehole facility (whose permit will be pursued with the WRA separately) and held onto storage tanks so that there is adequate supply for the residents.

### 5.8 Water conservation

Water conservation is vital for sustainable development and buildings contribute significantly to overall water usage among human activities. The following measures will contribute to using water sensibly during the construction and occupation phases of the project.

- Installation of motion-sensing taps, urinals and toilets to automatically switch off once the user leaves the station. A motion sensor tap would cut up to 85% of annual water usage compared to conventional taps[11]. Motion sensors would also reduce the spread of germs since users do not have to touch the tap or toilet flush buttons.
- Rainwater harvesting: The harvested water would be used for cleaning, flushing toilets, watering plants, etc.
- Reducing water losses (e.g., leaks) by ensuring high competency in plumbing and promptly fixing any damages immediately they occur.
- Educating employees and occupants about water efficiency to encourage water-saving behaviours.
- Reusing onsite water that would otherwise be discarded or discharged to the sewer (e.g., reusing treated grey water or rainwater to water landscaped areas).
- Creating a water management plan. This would include i) assembling a management team and making a commitment to conserve water, which shall be communicated to all occupants, ii) assessing the facility water use, iii) setting and communicating goals, iv) creating an action plan, v) implementing the action plan, vi) evaluating progress and vi) recognizing achievements on a semi-annual basis.

[11] Chicago Faucets. (2023). 5 Immediate Benefits of Motion-Sensor Faucets. https://learn.chicagofaucets.com/blog/5-immediate-benefits-of-motion-sensor-aucets#:~:text=5%20Leading%20Benefits%20of%20Motion-Sensor%20Faucets%201%201.,of%20Germs%20...%205%205.%20Simple%20Installation%20

### 5.9. Waste Water Treatment Plants

Nairobi County has two main waste water treatment plants; i.e.

- Kariobangi Sewerage Treatment Works; This is located at Nairobi City County Kamunde Road off Outering Road behind Kariobangi Light Industries. The Plant was built in 1961 and extended in 1963. It is a conventional treatment plant using biological filters known as trickling filters where organic waste is consumed or broken-down by microbial action.
  The plant was constructed in several stages to finally treat a design DWF capacity of 32,000$m^3$ waste water per day and hydraulic storm capacity of 96,000$m^3$. It has a laboratory to analyze waste water for the purpose of process control and as per legal requirements in the Environmental Management Coordination Act (2012).
  The treatment process involves two processes: Physical Treatment and Biological Treatment.

- Dandora Estate Waste Water Treatment Plant; this is located at 26 km from Nairobi city along Kangundo road, east of the city along the Eastern bypass at Ruai. The land on which it occupies is approximately 4,000 acres. The Dandora Estate Sewerage Treatment Works (DSTW) phase 1 construction started in 1975; the plant was commissioned in the year 1978. Phase II construction started in 1985 with a new inlet treatment work and additional 6 series which were commissioned in 1990. Between 2005 and 2014 anaerobic ponds were constructed and completed. The plant treats domestic and industrial about 120,0000m3/day equivalent to about 80% of waste water generated from Nairobi city. The design capacity for the plant is 160,000 $m^3$. The treatment Process involves two processes; Physical Treatment and Biological Treatment.

Currently, the AWWDA is in the process of constructing 14km trunk sewers and 15km reticulation sewers.
At construction the contractor will be responsible for handling the generated construction effluent waste which will be recycled to enhance curing of the premises.

During occupation, the effluent waste management will consist of the following mechanisms; All storm water drainage will be channelled into the existing storm drains and into the public drains whereas the black and grey water will be channelled to the public sewer management system.

In the NCWSC strategic plan 2019-2024, some of the highlighted issues affecting appropriate sewer management includes the following;

- **Trade & Industrial effluent**; the county hosts a high number of businesses and industries some of which do not comply with guidelines and standards for discharging effluent into the sewer system, resulting in increased pollution. Some of the trades and industries discharge their effluent into the rivers near their areas of operation.
- **Solid Waste**; some of the County residents clog the sewer systems with solid waste which causes sewer blockage and eventual overflow of sewage into the open causing health risks and pollution.

## 6.0. CLIMATE CHANGE RISKS AND VULNERABILITY ASSESMENT

### 6.1 Climate Change

Climate change is widely recognised internationally as a reality that is having a significant impact on the natural environment. This is due, in part to global warming which has accelerated as a direct result of human activity. Extreme weather events from droughts and heat waves, to cyclones and blizzards occur all too frequently, with devastating effect on human communities and the natural environment. It is expected that the average temperature of the atmosphere will increase by between 1.5 and 4.5 degrees Celsius (°C) in the next 90 years (IPCC, 2013).

### 6.1.2 Climate Change and Construction

Climate Change Act 2016 is an Act of Parliament to provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development, and for connected purposes.

It's a well-known and publicized fact that approximately 40% of greenhouse gas emissions come from buildings. While public and industrial structures play a part, burning, cooling, and heating primarily happen in the housing sector (habitat.org).

Even though there is awareness of the impacts of housing on climate change, it has not been prioritized appropriately as it's more complex than other issues. For example, a lot of the housing is privately owned. It's also costly, and many different stakeholders need to be engaged.

According to a recent UN Climate Change Report, less than 1% of climate adaptation efforts currently prioritize marginalized populations, leaving our most at-risk communities in the eye of the climate storm. To make matters worse, rapid urbanization and an increase in violent conflicts have exacerbated the number of low-income families struggling to find safe, climate-resilient and affordable shelter. Despite contributing the least to carbon emissions, these communities are often the most affected by the intensity and frequency of climate disasters, such as floods, fires, major storms and tsunamis.

### 6.2 Climate change impacts to Key Sectors

6.2.1 Water Overview

Cities in Kenya face significant challenges in water availability. For example, the city of Mombasa currently has only half of the water required to meet its needs, leading to rationing and the continued use of private sources. Rising temperatures and more variable rainfall will exacerbate these conditions.

In Nairobi, water shortages are also experienced as Nairobi Water and Sewerage Company is the main water company in the County. Most of the water wells are operated by large private consumers (industrial enterprises, hotel complexes) or by individual residential owners in parts of the City that receive only intermittent supply. Wells are often shared with neighbors or water is sold for distribution by tankers.

6.2.2 Energy

Kenya has developed adequate generation capacity that includes considerable renewable energy sources mainly geothermal, wind and solar. The installed generation capacity as at FY19/20 comprised hydro (30%), geothermal (28%), thermal (27%), wind (12%) and solar (2%). Kenya's successful development of geothermal resource for power generation stands at 820 MW has not only placed the country in the 8th position globally with geothermal development but has also transformed the country's generation mix that was dominated by hydro and thermal sources. Being baseload, geothermal and hydro account for (46.7%)

and 32% of generated energy while the other renewable energy source-wind and solar contributed to 11% and 0.8% respectively. Thermal contributes to less than 8% of generated energy. Going forward, continued development of geothermal resources, wind and solar sources provide a unique opportunity for Kenya to meet its electricity needs fully from renewable energy sources.

6.2.3 Infrastructure

Extreme weather events such as heavy rains can damage infrastructure, roads, communication networks and disrupt supply lines. An increase in the frequency of heat waves in urban centers like Nairobi or Mombasa could translate into higher demand for air conditioning and cooling systems, putting power plants under severe stress and reducing their efficiency. In coastal areas, sea level rise and storm surge threaten water and electricity infrastructure with inundation and salinity damage. Given increasing temperatures and the increased energy demand that will coincide, change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) might increase.

**6.3 Climate change risk assessment**

Climate change risk assessment is a risk assessment-based methodology for identifying potential climate impacts and assessing their severity. Carrying out a climate change risk assessment, at the simplest level, can be summarised into the following steps:

• Identifying potential climate change risks to a scheme or project;
• Assessing these risks (potentially prioritising to identify the most severe); and
• Formulating mitigation actions to reduce the impact of the identified risks

The aim of the study is to identify appropriate mitigation measures, including design features and construction materials, to provide an appropriate resilience to increased extreme weather as well as changes in average conditions. Such measures need to consider whether there are opportunities to introduce them later with more certainty, or whether they have to be allowed for in the initial design.

Climate change affects the environment negatively leading to water scarcity, increased health threats, increasing temperature, low precipitation, erratic weather patterns, food insecurity and increase in cost of food commodities.

**6.3.1 Climate Change Risks and Hazards**

Climate change vulnerabilities contribute to the risk of the occurrence of climate change impacts. Hazard refers to the potential occurrence of climate-related physical events or trends that may cause damage and loss. The most common climatic hazards such as floods, water scarcity, increased health threats, increasing temperature, low precipitation, erratic weather patterns, food insecurity and increase in cost of food commodities are the most common climate related hazards that occur in Nairobi County.

**6.4 Climate Change Mitigation Measures and Adaptation Strategies**

One of the possible solutions to addressing climate change in the construction industry is to integrate Green Building design and as built criteria into project assessment. A primary objective in Green Building is the reduction in GHG emissions. Buildings are considered to be responsible for approximately one third of global GHG emissions primarily through their energy requirements being largely met by the use of fossil fuels thus the buildings contribution to the climate change problem the world is facing

Adapting or mitigating projects or developments are possible solutions to addressing global warming effects on climate change. Adaptation measures require planning (adapting) to possible future impacts of climate change. Adaptation measures to address climate change in EIA are more widely and more easily considered where relevant to a specific project

The lifecycle of the project and the timeframes over which change might occur need to be considered in adaptation responses.

In order to address the missing gaps in these areas the following strategies will be adopted:

- Proper solid and waste management by contracting NEMA licensed waste handlers as opposed to using open dumping sites, diversify energy sources by investing in renewable sources of energy, water harvesting, recycling and conservation.
- Water management; The project should invest in water management strategies like rainwater harvesting, storage facilities, efficient water use practices and limiting borehole abstraction to sustainable levels . These measures aim to mitigate water scarcity during dry periods and reduce flood risks during heavy rainfall events.
- Infrastructure Design: Incorporate resilient features to withstand extreme weather like flooding, storms, and high temperatures.
- Energy Efficiency: Implement technologies and practices to reduce greenhouse gas emissions and dependency on fossil fuels. e use of less carbon intensive alternatives and construction methods that reduce the overall needs for transportation and materials haulage. Construction activities must avoid the use of old or improperly functioning equipment that use fossil fuels in an inefficient manner or that release fugitive emissions. Site administration (e.g. site camp) can also be run off renewable energy sources as far as possible
- Biodiversity Conservation: Protect and enhance natural ecosystems to preserve biodiversity and ecosystem services, including reforestation, habitat restoration, and sustainable land management practices.
- Vehicle movement and construction activities will mobilise dust, which may be exacerbated by increased air temperature and drought conditions: Appropriate road maintenance, activity staging and vegetation activities must be imposed to reduce the extent of bare surfaces or travel speeds on roads. The use of water for dust suppression must be considered Climate Change Risks Specific to Kileleshwa, Nairobi:
- *Increased Temperatures:* Nairobi, including Kileleshwa, is experiencing rising average temperatures, which can lead to increased energy demand for cooling, heat stress on residents, and accelerated wear and tear on building materials.
- *Altered Rainfall Patterns and Flooding:* Nairobi has been experiencing more intense and unpredictable rainfall, leading to frequent flooding. Kileleshwa, being a relatively low-lying area with limited drainage, is particularly vulnerable to flash floods, which can damage property and infrastructure.
- *Water Scarcity*: Droughts and inconsistent rainfall patterns can affect water supply, creating challenges for both construction and the long-term habitation of the housing units.

**6.5 Vulnerability of the Housing Project:**

The vulnerability assessment should evaluate how susceptible the housing project is to these climate risks based on sensitivity, exposure, and adaptive capacity.

- Sensitivity: Housing units in Kileleshwa will be sensitive to extreme weather, especially if they are not designed with climate resilience in mind. Poor drainage can lead to

flooding, while inadequate insulation can make units overly dependent on cooling systems during heatwaves.

- Exposure: The project's location in Kileleshwa exposes it to flooding due to its proximity to rivers and inadequate drainage systems. Additionally, high energy consumption for cooling during heat periods exposes it to increased operational costs.
- Adaptive Capacity: Assess whether the project design includes features that enhance resilience, such as sustainable water management systems, energy-efficient appliances, and robust building materials. If adaptive measures are not included, the housing units remain highly vulnerable.

**6.6 Adaptation Measures:**

Adaptation measures aim to reduce the vulnerability of the housing project to climate impacts.
Flood-Resilient Infrastructure:

- Implement elevated foundations and use permeable materials for pavements and driveways to improve water absorption and reduce surface runoff.
- Install a comprehensive drainage system with water retention basins that capture excess rainwater during storms and release it slowly into the environment.
- Water Conservation Systems:
- Integrate rainwater harvesting systems to collect and store rainwater for non-potable uses like irrigation and toilet flushing.
- Equip the housing units with water-efficient fixtures and fittings, such as low-flow taps and dual-flush toilets, to reduce water demand.

Heat Management:

- Use reflective roofing materials, green roofs, and energy-efficient windows to reduce heat absorption and improve indoor comfort.
- Plant trees and shrubs around the property to provide natural shading and reduce the heat island effect, thereby lowering the need for air conditioning.

**6.7 Implement Mitigation Measures:**

Mitigation measures focus on reducing the project's contribution to greenhouse gas emissions.
*Energy Efficiency*:

- Install solar panels on the roofs of the housing units to provide a renewable source of energy, reducing reliance on grid electricity.
- Use energy-efficient lighting (LEDs) and appliances throughout the housing units to minimize energy consumption.

*Sustainable Building Materials*:

- Use locally sourced, sustainable materials like bamboo or recycled bricks to reduce the carbon footprint associated with material transport.
- Utilize high-performance insulation materials to reduce energy needs for heating and cooling, thus lowering greenhouse gas emissions.

*Green Spaces:*

- Incorporate community gardens and green spaces within the housing complex to act as carbon sinks and improve air quality.
- Plant native trees around the site, which require less water and maintenance, to enhance biodiversity and provide ecosystem services.

**6.8 Monitoring and Evaluation:**

Establish a robust monitoring and evaluation framework to track the effectiveness of the adaptation and mitigation measures.
Monitoring Strategies:

*Performance Metrics:*

- Monitor water usage patterns to assess the effectiveness of rainwater harvesting and water-efficient systems.
- Track energy consumption data to measure the impact of energy efficiency measures, such as solar panels and LED lighting.

*Regular Risk Assessments:*

- Conduct regular flood risk assessments using updated climate data to ensure drainage systems
- To conduct a detailed climate change risks and vulnerability assessment for a project in nairobi, kenya, in line with the climate change act, 2016, the assessment should include the following steps:

## 7.0. TRAFFIC ANALYSIS

The deterioration of public transport and traffic conditions has afflicted Nairobi County since the 1980s. These can be explained by the problem of inadequate means of mass public transport, the rapid increase in the number of cars mostly private, the lack of mass public transportation, poor enforcement of traffic regulations and lack of discipline on the part of both motorists and pedestrians. Much time is lost on the roads with vehicles consuming extra fuel due to the delays. This means heavy losses for the economy every day. Massive road projects such as construction of the Thika super highway, Eastern and Southern by pass ring roads was aimed at easing congestion in the City. Some of the measures put in place and proposals to reduce the menace of traffic include; opening up various by-pass roads, removal of the round-a-bouts, finding alternative parking for motorists outside the City centre and review the Nairobi metropolitan public transport master plan (NCIDP, 2018).

Some of the strategies that the County of Nairobi has taken towards enhancing the reduction of traffic congestion include the following;

i. Installation of traffic signals
ii. Have a functional public transport system
iii. Installation of signages
iv. Construction of missing links
v. Construction of all more terminus
vi. Enforcement of order in public transport.

Traffic congestion wastes a huge amount of time cost and fuel cost, deteriorating Kenya's business climate. A full set of measures ranging from immediate countermeasures including traffic management by ICT to longer-term structural measures such as shift to multi-centric urban structure was proposed by JICA in the Integrated Urban Development Master Plan for the City of Nairobi in the Republic of Kenya, 2014.
Due to the increasing severe traffic congestion in the city, the need for mass transit system is widely recognised as necessary. Over time, traffic congestion has worsened over time in terms of extent and area. Since the growth in population as well as the sharp increase in car ownership has grown rapidly.

JICA observed that measures necessary to enhance modal shift to public transport were required. A large number of passengers waiting for a bus or matatu are observed during peak hours. Moreover, facilities such as bus stops are inadequate and the timetable is seldom prepared. In some areas, the quality of public transport services is insufficient, which causes an extensive use of private vehicles hence worsening the traffic situation. Severe traffic congestions are observed along several roads within the city calling for a heightened traffic management system.

### 7.1. Integrated Urban development Master plan

#### 7.1.1 Strengthening of Traffic Management

- *Constraints*

A traffic counting at major intersections was conducted in a survey by JICA, it was evident that manual traffic control by a police officer is not efficient to achieve the maximum capacity of intersections. Immediate introduction of signal control system was recommended to be necessary.

#### 7.1.2 Requirement of Non-motorised Transport Protection

- *Constraints*

While pedestrian crossings and pedestrian signals are not sufficiently installed in Nairobi City, non-motorised transport (NMT), especially pedestrians, are exposed to danger as the traffic volume increases. In the current condition, women, children, and persons with disability will have difficulty of travel not only in the city centre but also in suburban areas.

Table 3; Nairobi County Spatial Development Strategies on transport Thematic Areas (Source; Nairobi CIDP 2023-2027)

| Thematic area | Status | Policy Strategy |
|---|---|---|
| **Transportation network** | The current major public transport system is predominantly road based which includes bus and matatu (which is a minibus). | Undertake an upgrading programme to address deficiencies on existing roads by expanding road network; |
| | - Railway plays a partial role in public transport. | Construction of NMT with the objective of appropriate allocation of county space to public transport, NMT, and public spaces; |
| | In addition, taxis, tuk tuk (motorized 3-wheel taxi) and motor cycles (boda boda) are also operated. | Introduce city/area-wide traffic control and information systems, including real-time traffic management and enforcement of traffic laws and regulations; and Introduce city/area-wide traffic control and information systems, including real-time traffic management and enforcement of traffic laws and regulations; and ICT and good understanding of road user behaviour. |

## 7.2 Existing Road Network Hierarchy

The proposed development is located along Othaya road off Lenana Road Nairobi County. The road is used as a two-way road with vehicles to and from Kileleshwa - NCBD.

The proposed development project which consists of 200 residential units will have a negative net effect on the traffic in the area for both Motorized (MT) and Non-Motorized (NMT) traffic due to the additional daily generated trips to and from the development particularly during the peak hours.


***Figure 2: site location on Othaya road***

## 7.3 Non-Motorized Traffic (NMT) Analysis

Walking and other non-motorized modes of transport has become popular in the urban setup as the mode is cheaper, convenient, healthy and pollution free. Therefore, it is encouraged that proper NMT facilities are provided to increase the safety of pedestrians and cyclists in order to encourage more people to embrace this mode of transport especially in towns. The proposed development will generate both Motorized (MT) and non-motorized traffic NMT (pedestrians) traffic.

## 7.4 Design of Vehicle and Access Turning

The most dominant vehicle that will be frequenting the development will be passenger cars with approximate overall lengths of 3.5m to 4m. However, to cater for vehicles such as occasional delivery trucks and garbage collection, a single unit truck of overall length of 11m should be adopted for the access junction design. The minimum required turning radius recommended by

the Kenya Road design manual is 12.5m. A turning radius of 13 - 15m should therefore be allowed.

### 7.5 Increased traffic during construction and operation

The traffic at construction at the site will increase due to vehicles transporting building equipment and materials. The situation could worsen because the road serving the site ie. Othaya road is a narrow two-way road.

#### 7.5.1 Proposed Mitigation Measures

- The contractor and the proponent should transport the materials and equipment during the evening or early in the morning (off peak hours).
- An appropriate Traffic Management plan should be developed for the same and plausible as a mitigation measure to ensure traffic congestion and possible accidents are kept to bare minimum.
- Limiting the number of trips made by the construction vehicles during peak hours and which will be ensured through proper planning on material acquisition.
- Provision of adequate basement and ground level parking spaces.

#### 7.5.2 Need for Auxiliary Lanes

Auxiliary lanes are designated lanes at intersections that aim at facilitating smoother traffic flow, especially during peak hours by separating the turning traffic from the through traffic. They include turning right and left lanes and acceleration/deceleration lanes. Othaya road is a two way traffic road that links either to Lenana Road and Nyangumi Road, both two way traffic roads.
Traffic management during construction should be enhanced to help promote a smooth flow of vehicles.
At occupation, traffic is expected to be heighted owing to the number of vehicles expected at the hostels.

To enhance vehicular traffic mobility within and around the proposed project site and to reduce traffic conflicts and ensure the safety and comfort of the pedestrians it is recommended that: -

i. Provision be made for an adequate property access junction, a safe pick and drop-off within or adjacent to the development to ensure ease of access with the approval of the concerned road agency.

ii. Provision for security lighting at the entrance to enhance security of the development and neighbourhood (Solar street lighting is highly recommended).

iii. Designated pedestrian crossings (zebra crossing) to be provided with calming measures (rumble strips, speed bumps) to enhance the safety of crossing pedestrians.

iv. Develop a comprehensive traffic management plan during construction period to ensure safety and minimal disruptions to the existing traffic circulation.

Provisions for the Non-motorized traffic should be made to allow for pedestrians access into the premises as well as allow for ease of passage for other road users.

Provisions should include;

1. Pedestrian walkways
2. Zebra/ pedestrian crossings
3. Bus stops and drop off zones
4. Street lighting ang signages.

The generated traffic due to the proposed development will have a significant effect to the future traffic operating conditions in the area largely owing to the nature of residents within the residency and the road size.

### 7.5.3 Parking space allocation

The proposed development has made parking provision for a total of 213 parking bays as follows;
Basement 02: 57 Parking Bays
Basement 01: 56 Parking Bays
Ground Floor: 42 Parking Bays
First Floor: 58 Parking Bays

Given that there are 200 residential units, this translates to an allocation of 1.065 parking spaces for each house unit which according to Road Design Manual Part 2 is adequate for the kind of development.

### 7.5.4 Policy requirements to improve on traffic management

- There is need to establish a comprehensive urban transport system that would restrict the circulation of ill-conditioned vehicles around CBD while alleviating the traffic congestion, which is one of the serious factors that accelerate roadside air quality degradation.
- Enhanced pedestrian walkways be developed because one of the characteristics of Nairobi CBD identified is a large number of pedestrians (pedestrian walkways will link CBD with open space and green corridor).
- Introduction of a monorail line for consideration in a circular route in CBD, which will link Railway City and Upper Hill to reduce inflow of traffic to the existing CBD.
- Relocation of bus terminals: one of the major causes of traffic congestion in and around CBD is the existence of a number of bus terminals in the CBD. Bus terminals are located in the centre of CBD and all bus routes terminate at these bus terminals. Bus terminals should be relocated and dispersed depending on the destinations.
- The reinforcement of mass transit and introduction of a new transit system are requisite.

- By reinforcement of commuter rail and introduction of BRT to six corridors, traffic congestion is eased especially in the eastern area of the city centre; this will be a major solution against the future increasing traffic demand.

# 8.0 PUBLIC PARTICIPATION

## 8.1. Objectives of the consultation and public participation

The objective of the Consultation and Public Participation (CPP) as required in EMCA chapter 387 was to:-

1. Disseminate and inform the public and other stakeholders about the proposed project with special reference to its key components, location and expected impacts.
2. Create awareness among the public on the need for the EIA for the proposed project.
3. Gather comments, concerns and suggestions of the interested and, would be affected/interested parties.
4. Ensure that the concerns of the interested and, would be affected/interested parties were known to the decision-making bodies and the proponent at an early phase of project development planning.
5. Establish a communication channel between the interested, would be affected/interested parties, the team of consultants and the Government.
6. Incorporate the information collected in the project by EIA Experts.
7. Establish if the local people foresee any positive or negative environmental effects from the project and if so, how they would wish the perceived impacts to be addressed
8. Obtain the socioeconomic information of the project area

The purpose for such a process was to identify the positive and negative impacts of the project and subsequently suggest mitigation measures.

## 8.2. Methodology used in the CPP

The Consultation and Public Participation (CPP) Process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated by EMCA chapter 387 section 58, on Environmental Impact Assessment for the purpose of achieving the fundamental principles of sustainable development[12]. The process is continuous and is on-going. Questionnaires (see attached) were administered to the local community members around the proposed project. The views and concerns have been incorporated into the impacts and mitigation measures in section 8 and 9 below.

The following is a summary of the activities carried out in the CPP;

i. Key Informant interviews were used to get responses from key stakeholders in the project area
ii. Open ended questionnaires were also gathered from the local community and affected stakeholders regarding the installation of the project.

[12] Adapted from "Introduction" in McKeown, Rosalyn. Education for Sustainable Development Toolkit, Version 2, Centre for Geography and Environmental Education, University of Tennessee, July 2002.

iii. Proposed project will be advertised in two national newspapers, one radio station and one advertisement in the Kenya Gazette
iv. As part of the stakeholder engagement a public meeting is planned to take place so as to disseminate information as well as gather opinion regarding the proposed project.

Table 4: Summary of Issues and Concerns raised by members of the public, Expectations and Mitigation Measures

| **Positive Expectations** | **Adverse Impacts** | **Proposed Measures proposed by stakeholders** |
|---|---|---|
| • Employment opportunities to residents<br>• Increased residential facilities<br>• Enhanced economy; national and county<br>• Infrastructural development<br>• Enhanced CSR within the project area<br>• Reduced social evils within the community<br>• Enhanced security | • Air and dust pollution which may cause respiratory ailments to local residents during construction<br>• Increased traffic flow leading to traffic snarl-up during construction and operation phases in the area.<br>• Noise pollution during construction and operation.<br>• Production of solid waste during the operation and construction phases<br>• Increased resource exploitation during construction<br>• Increased infrastructural resource demand; water, power, roads etc | • Ensure CSR activities are aimed at the locals' welfare<br>• Ensure project site is fenced off to avoid intrusion by non-authorized persons<br>• Intrusion by non-authorized persons.<br>• Ensure workers to the site are well trained and are always under strict supervision either.<br>• Ensure registered waste handler is contracted to collect waste from the site for appropriate disposal in the designated dumping sites.<br>• Ensure that exposed excavated soil heaps are covered and dampen to reduce dust emission. Similarly ensure that, the exposed soil surface is revegetated<br>• Deploy adequate traffic marshals to the site to ensure there are no snarl ups. |

## 9.0 POTENTIAL ENVIRONMENTAL IMPACTS

### 9.1. Positive Impacts during Construction

#### 9.1.1. Employment Opportunities

One of the main positive impacts during projects construction phase is the availability of employment opportunities especially to casual workers and several other skilled workers such as building and construction engineers. Employment opportunities are of benefit both economically and socially.

Several workers including casual labourers, masons, carpenters, joiners, electricians, and plumbers are expected to work on the site during the construction phase, most of these will be sourced locally from the surrounding community. Apart from casual labour, semi-skilled, unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction. Generally, employment during the construction phase will lead to multidimensional development in the area and improve several people's living standards.

#### 9.1.2. Optimal use of land

In Africa the UN predicts that the current 400 million urban citizens will exceed 750 million by 2030 and will reach 1.2 billion by 2050[13]. It is also plausible to note that while urban population increases the size of land available for development will continue to decrease. The effect of this trend has been the reduction of farmland and encroachment into animal habitats and migration routes. Thus, it is highly recommended that land being a finite resource must be optimally utilized. The proposed project will see conversion of land currently accommodating a few households to being a home for over eight hundred households. The new design will also make it easier for provision of services such as waste management, piped water and electricity..

#### 9.1.3. Economic Growth

Through the use of locally available materials during the construction phase e.g. cement, concrete and ceramic tiles, timber, sand, ballast electrical cables and others; the project will contribute towards growth of the country's economy by contributing to the gross domestic product. The consumption of these materials, oil, fuel and others will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

[13] Pieterse, E. (2009). African cities: Grasping the unknowable. *Inaugural Lecture, University of Cape Town, August*, *26*.

### 9.1.4. Improvement of the Informal Sector

There are usually several informal businesses, which come up during the construction periods of such projects. These include food vendors who benefit directly from the construction workers buying food and other commodities from them. This will promote the informal sector in securing some temporary revenue and hence improve their livelihood.

### 9.1.5. Market for Supply of Building Materials

The project will require supply of large quantities of building materials most of which will be sourced locally in within Nairobi and the surrounding areas. This provides ready market for building material suppliers such as quarrying companies and hardware shops.

## 9.2. Negative Impacts during construction

### 9.2.1. Noise pollution

The construction works will most likely be a noisy operation due to the moving machines (mixers, tippers, communicating workers) and incoming vehicles to deliver construction materials and workers to the site. Workers are most likely to be affected since noise beyond some level is itself a nuisance if not maintained within acceptable levels.

### 9.2.2. Disposal of excavated soil

Site excavations shall be done to the satisfaction of the Principal Consultant's specification hence some materials shall be rejected as waste for disposal. Improper disposal of this category of waste may have adverse impacts on the receiving environment.

### 9.2.3. Soil Erosion

The excavation and construction activities are likely to loosen the soil particles making them prone to soil erosion. Such problems become serious when the topsoil is left bare and agents of erosion become active. Soil erosion is an important problem both at its source and downstream of the development site. Lost soil will be deposited somewhere, and the location of the deposition could alter downstream hydrology and increase chances of flooding. It may also pose a water quality issue directly as a result of siltation and indirectly from contaminants carried with or attached to soil particles.

### 9.2.4. Dust Emissions

Particulate matter pollution is likely to occur during the site clearance, demolitions, excavation and loading and transportation of the construction waste. There is a possibility of $PM_{10}$ suspended and settle-able particles affecting the site workers and even neighbours health.

### 9.2.5. Increased Water Demand

Both the workers and the construction works will create an increased demand for water in addition to the existing demand. Water will be mostly used in the creation of aggregates for construction works and for wetting surfaces for softening or hardening after creating the formworks.

### 9.2.6. Generation of Exhaust Emissions

Exhaust emissions are likely to be generated during the construction period by the various construction machinery and equipment. Motor vehicles used to mobilise the work force and materials for construction would cause a potentially significant air quality impact by emitting pollutants through gaseous exhaust emissions.

### 9.2.7. Building Materials and Energy Consumption

The main sources of energy that will be required for construction of the project will include mains electricity and fossil fuels (especially diesel). Electricity will be used for welding, metal cutting/grinding and provision of light. Diesel will run material transport vehicles and building equipment/machinery. The proponent should promote efficient use of building materials and energy through proper planning to reduce economic and environmental costs of construction activities.

### 9.2.8. Generation of construction solid wastes

During construction solid waste will be generated. These include papers used for packing cement, plastics and timber remains among others. Dumping around the site will interfere with the aesthetic status of the area. This has a direct effect to the surrounding community. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

### 9.2.9. Risk of accidents

During construction, it is expected that workers are likely to have accidental injuries as a result of accidental occurrences, handling hazardous waste, lack or neglect of the use of protective gear etc. All necessary health and safety guidelines should be adhered to so as to avoid such circumstances.

Workers are also likely to be exposed to diseases from contact with potentially harmful building materials. It is therefore recommended that before the construction activities, materials should be thoroughly inspected and harmonised to the occupational health and safety standards.

### 9.2.10. Oil spills

The machines on site may be containing moving parts which will require continuous oiling to minimise the usual corrosion or wear and tear. Possibilities of such oils spilling and contaminating the soil and water on site are real. Likewise, moving vehicles on site may require oil change. But these dangers are curbed by maintaining the machinery in specific areas designed for this purpose.

### 9.2.11. Energy consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil fuel is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability. The project will also use electricity supplied by KPC. Electricity in Kenya is generated mainly through natural resources, namely, water and geothermal resources. In this regard, there will be need to use electricity sparingly since high consumption of electricity negatively impacts on these natural resources and their sustainability.

## 8.3. Positive Impacts during Operation Phase

### 8.3.1. Increased national housing stock

There is currently a high demand for housing in Nairobi and other cities and towns in Kenya. It has also been projected that 60% of the world population will live in cities by 2050[14]. The growing urban population calls for affordable housing. The proposed project is geared towards filling the existing housing stock gap by availing over 500 units for rental and or purchase option. This will add to the supply of housing which is currently a major socio-economic problem for Kenya and especially in Nairobi's Metropolis and its vicinity.

### 8.3.2. Employment Opportunities

Employment opportunities are one of the long-term impacts of the proposed project that will be realised after construction and during the operation and maintenance of the building. These will involve other sources of employment of many skilled and semi-skilled people to work in the proposed residential building.

### 8.3.3. Incorporation of proper Waste Management System

The project is designed such that there will be provision of a well-planned strategic waste management system. The wastes will thus be collected from the site in bulk and as one unit such that the careless disposal leading to proliferation of wastes within the surrounding areas will be curbed.

[14] Heilig, G. K. (2012). World urbanization prospects: the 2011 revision. *United Nations, Department of Economic and Social Affairs (DESA), Population Division, Population Estimates and Projections Section, New York*.

### 8.3.4. Increased Revenue generation

Revenues paid to the national and county government in form of taxes will increase once the project is complete. The value of the plot will increase leading to increased land rates payable to the County government.

## 8.4. Negative Impacts during operation

### 8.4.1. Increased Pressure on Infrastructure

The proposed development project will lead to increased pressure on existing infrastructure such as roads, service lines etc. due to the increased number of people who will be using these facilities to access the services and facilities in the proposed apartments.

### 8.4.2. Water use

Domestic consumption of water during the operation phase of the project will involve the use of large quantities of water that will take place due to the increased number of households in the area.

### 8.4.3. Solid Waste Generation

It is envisaged that substantial amounts of solid wastes will be generated from the proposed development once it is complete. The bulk of the solid waste produced during the operation of the project will entail paper, plastic, glass, metal, textile and organic wastes. Such wastes can be harmful to the environment through obstruction of drainage systems, clogging of water bodies and negative impacts on animal health. Some of these waste materials especially the plastic/polythene are not biodegradable hence may cause long-term effects to the environment. Even the biodegradable ones such as organic wastes may be harmful to the environment because as they decompose, they produce methane gas, a greenhouse gas known to have a high warming potential.

### 8.4.4. Increased storm water flow

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

## 8.5. Positive Impacts during decommissioning

### 8.5.1. Rehabilitation

Upon decommissioning of the proposed project, rehabilitation of the project site will be carried out to restore the site to its original status or to a better state than it was originally. This will

include replacement of topsoil and re-vegetation, which will lead to improved visual quality of the area.

### 8.5.2. Employment Opportunities

Employment opportunities will be created for the demolition staff during the demolition phase of the proposed project.

## 8.6. Negative Impacts during decommissioning

### 8.6.1. Noise and Vibration

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. This will be because of the noise and vibration that will be experienced as a result of demolishing the proposed project.

### 8.6.2. Generation of Solid Waste

Demolition works will result in large quantities of solid waste. The waste will contain the materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment.

### 8.6.3. Increased dust emission

Large quantities of dust will be generated during demolition works. This will affect demolition workers as well as the neighbors and plants in the area.

# 11. MITIGATION MEASURES AND MONITORING PROGRAMMES

## 11.1. Mitigation of Construction Related Impacts

### 11.1.1. Air Quality

Controlling dust during construction is useful in minimizing nuisance conditions. It is recommended that a standard set of feasible dust control measures be implemented for all construction activities. Emissions of other contaminants (greenhouse gases, and diesel related particulate matter) that would occur in the exhaust from heavy equipment are also included. The proponent is committed to implementing measures that shall reduce air quality impacts associated with construction.

All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. This means that construction workers will be trained regarding the minimization of emissions during construction. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Construction vehicles drivers will be under strict instructions to minimize unnecessary trips and minimize idling of engines.
Dust emissions will be controlled by the following measures:

- Watering all active construction areas as and when necessary to lay dust.
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Pave, apply water when necessary, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with physical sweepers) all paved access roads, parking areas and staging areas at construction sites.

### 11.1.2. Minimize the Effects of Noise Emitted from the Site

Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

a) Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
b) Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels.
c) A substantial permanent increase in ambient noise levels (more than five decibels) in the project vicinity above levels existing without the project.
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The proponents shall put in place several measures that will mitigate noise pollution arising during the construction phase. The following noise-suppression techniques will be employed to minimise the impact of temporary construction noise at the project site.

- Install portable barriers to shield compressors and other small stationary equipment where necessary.
- Establishment of noise buffer, for example waterfalls to mask the traffic noise.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Co-ordinate with relevant agencies regarding all substation construction activities in the residential areas.
- Install sound barriers for pile driving activity.
- Limit pickup trucks and other small equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Construction/Demolition works should be done during the day when people are away and also the outside environment is also noisy.
- Adhere to the provisions of Noise Prevention and Control Rules 2005, Legal notice no. 24 regarding noise limits at the workplace.

### 11.1.3. Minimise the Effects of Exhaust Emission

In order to control exhaust emissions the following measures shall be implemented during construction:

a) Vehicle idling time shall be minimized
b) Alternatively fuelled construction equipment shall be used where feasible
c) Equipment shall be properly tuned and maintained

This will also be achieved through proper planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.

### 11.1.4. Hydrology and Water Quality Degradation

Soil sampling and trial holes digging will be conducted before construction begins and soil information will be provided to construction crews to inform them about soil conditions and potential hazards. If hazardous substances are unexpectedly encountered during trenching, work will be stopped until the material is properly characterised and appropriate measures are taken to protect human health and the environment. If excavation of hazardous materials is required, they will be handled in accordance with applicable regulations. If suspected contaminated groundwater is encountered in the depths of the proposed construction areas, samples will be collected and submitted for laboratory analysis of petroleum hydrocarbons, metals, volatile organic compounds and semi-volatile organic compounds. Appropriate personal protective equipment will be used and waste management will be done in accordance with applicable regulations. Oil absorbent material and storage drums will be used to contain and control any minor releases of engine and other equipment oil.

### 9.1.5. Worker Accidents and Hazards when Handling Hazardous Wastes

Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. In addition the proponent is committed to adherence to the occupational health and safety rules and regulations stipulated in Occupational Health and Safety Act, 2007. In this regard, the proponent is committed to provision of appropriate personal protective equipment, as well as ensuring a safe and healthy environment for construction workers as outlined in the EMP.

### 9.1.6. Increase of disease Vectors

Disease vectors such as rats, flies, and cockroaches increase where refuse is exposed or uncollected and can be a hazard. Complete refuse collection and handling service will be provided by the proponent so that this is not a hazard in compliance with the Public Health Act and as also required in the Occupational Safety and Health Act, 2007 regarding hygiene at the workplace.

### 9.1.7. Possible Exposure of Workers to Diseases

Possible exposure of workers to diseases from building materials at construction site shall be mitigated by occupational health and safety standards enforcement as required in the OSHA, 2007.

### 9.1.8. Worker Accidents during Construction and Operation

Workers accidents especially in deep trenching operations and from gas accumulation in sewers and other confined spaces shall be mitigated by enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.

### 9.1.9. Reduction of Impacts at Extraction Sites and Efficient Use of Raw Materials

The proponent will source building materials such as sand, ballast and hard core from registered quarry and sand mining firms, whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated.

To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through run-off, wind, etc.) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

### 9.1.10. Minimization of Run-off and Soil Erosion

The proponent will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site during construction. These measures will include terracing and levelling the project site to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off.

### 9.1.11. Minimization of Construction Waste

It is recommended that demolition and construction waste be recycled or reused to ensure that materials that would otherwise be disposed as waste are diverted for productive uses. In this regard, the proponent is committed to ensuring that construction materials left over at the end of construction will be used in other projects rather than being disposed. Furthermore, damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects. Such measures will involve the sale or donation of such recyclable/reusable materials to construction companies, local community groups, institutions and individual residents or home owners.

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal. It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the project include:-

a) Use of durable, long- lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time
b) Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements
c) Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials
d) Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste
e) Use of construction materials containing recycled content when possible and in accordance with accepted standards.

### 9.1.12. Reduction of energy consumption

The proponent shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used. In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.

### 9.1.13. Minimization of Water Use

The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use. The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff.

### 9.1.14. Controlling Oil Spills during Construction Phase

The proponent will control the dangers of oil, grease and fuel spills during construction by maintaining the machinery in specific areas designed for this purpose. Machinery site repair will be discouraged and repair work restricted to approved garages to avoid pollution from oil, grease and fuel.

### 9.1.15. Public Health, Safety and Awareness

a) The contractor should provide a small section of the construction site with a shed and a water stand where the food can be served to the construction workers to promote hygiene and health of the employees.
b) A fully equipped first aid kit should be provided at the site.
c) The contractor must have workmen's compensation cover as required by law (The Workmen's Compensation Act), as well as relevant ordinances, regulation and union's agreements.
d) The workers, immediate neighbour and other stakeholders should be sensitized on the dangers and risk associated with the construction works for enhanced self-responsibility on personal safety.
e) The proponent should ensure that the completed buildings are fitted with safety facilities including fire detectors, fire-fighting equipment, fire exits, adequate access and buffer between the residential premises.
f) Disabled access features and safety signage should be placed strategically around and within the buildings.
g) Appropriate sanitation conveniences should be provided at the site as required in the OSHA, 2007 and echoed in the Public Health Act.

## 9.2. Mitigation of Impacts during Operation Phase

### 9.2.1. Ensuring Efficient Solid Waste Management

The proponent will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as waste bins and skips for temporarily holding domestic waste generated from the apartments. Moreover, the proponent will ensure that such waste is regularly and appropriately disposed.

An integrated solid waste management system is recommended. First, the proponent will give priority to Reduction at Source of the materials. This option will demand a solid waste management awareness programme in the management and the residents. Recycling, reuse and compositing of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The recyclables will be sold to waste buyers within Nairobi City. The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. Finally, sanitary land filling will be the last option for the proponent to consider. The proponent will adhere to the Environmental Management and Coordination (Waste Management), Regulations 2006.

### 9.2.2. Wastewater Management

The proponent will ensure that there are adequate means for handling the large quantities of sewage generated from the facility. It will also be important to ensure that sewage pipes are not blocked or damaged so that the waste can be directed to the sewer line since such vices can lead to release of the effluent, resulting in land and water contamination. Such blockages or damages will be fixed expeditiously. Waste water shall be disposed in compliance with the provisions of the Environmental Management and Coordination (Water Quality), Regulations 2006.

### 9.2.3. Ensure Efficient Energy Consumption

Tenants will be sensitized to ensure energy efficiency in their domestic operations. Hot water solar heating equipment will be installed. Use of solar will reduce the overall electricity consumption. Furthermore, security lights that have to be kept on throughout the night will be powered by solar. Incandescent bulbs will be highly discouraged.

### 9.2.4. Ensure General Safety

A competent security firm will be engaged to ensure the general safety and security at all times. The existing perimeter wall will be enhanced by installation of electric fence. The proponent is also advised to install CCTV cameras at strategic zones within the compound.

### 9.2.5. Ensure Efficient Water Use

The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff. In addition, the occupants of the facility will be sensitized to use water efficiently.

## 9.3 Traffic Management

The proponent will employ traffic marshals to control the movement of the construction vehicle in and out of the site. They will ensure there are no construction vehicles idling around the site or parked along the road. During operation phase, the proponent has provided enough parking spaces at the basement and also availed adequate entry and exit lanes to the site.

## 9.4. Mitigation of Impacts during Decommissioning Phase

### 9.4.1. Efficient solid waste management

Solid waste resulting from demolition or dismantling works will be managed as described in Section 9.2.1.

### 9.4.2. Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized as described in Section 9.1.1.

### 9.4.3. Minimization of Noise and Vibration

Significant impacts on the acoustic environment will be mitigated as described in Section 9.1.2.

# 10. ANALYSIS OF PROJECT ALTERNATIVES

## 11.1. Relocation Option

Relocation option to a different site is an option available for the project implementation. At present the landowner/developer does not have an alternative site. This means that he has to look for the land. Searching for a new site may take long with no guarantees for a suitable find. This would also lead to a situation like No Project Alternative option. The other consequence of this is that it would discourage private/local investors especially in the housing sector. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

## 11.2. No Project Alternative

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

- It may lead to further land use change elsewhere
- It will jeopardize the goal of creating more housing units for the increasing urban population
- No employment opportunities will be created for thousands of Kenyans who will work in the proposed residential development area and Nairobi at large.

From the analysis above, it becomes apparent that the No Project alternative is no alternative to the proponent, local people, and the government of Kenya.

## 11.3. The proposed development alternative

Under the proposed development alternative, the developer will be issued with an EIA License. In issuing the license, NEMA will approve the proponent's proposed development. The proponent will be required to implement the project in line with the licensing conditions.

## 11.4. Analysis of Alternative Construction Materials and Technology

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment that saves energy and water will be given first priority without compromising on cost or availability factors. The concrete pillars and walls will be made using locally sourced stones,

cement, sand (washed and clean), metal bars and fittings that meet the Kenya Bureau of Standards requirements.

Beautiful and durable re-enforced concrete roofs because they are good in heat insulation with minimal iron sheet roofs. Heavy use of timber during construction is discouraged because of destruction of forests. The exotic species would be preferred to indigenous species in the construction where need will arise. However, this construction methods and technologies to be used will require very little timber.

### 11.5 Analysis of Alternatives

It can be concluded that if the proposed development is not implemented, some low environmental impacts could be avoided, though the development of the area and socio-economic condition will be impeded. Considering rational design decisions and appropriate mitigation measures that will be put in place, the proposed development construction and operation will result in important socio-economic benefits, rather than the no-action alternative, hence, the latter was ignored. Construction of the project is of notable importance for the improvement of the student enrolment and in the economic situation in the local area and country at large.

## 11. ENVIRONMENTAL MANAGEMENT/MONITORING PLAN

### 12.1. Introduction

An environmental management/monitoring plan has been developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of the project. It is noteworthy that key factors and processes may change through the life of the project and considerable provisions have been made for dynamism and flexibility of the EMP. As such, the EMP will be subject to a regular regime of periodic review.

The below tables form the core of this EMP for the construction, operational and decommissioning phases of the proposed project respectively. In general, the Tables outline the potential safety, health and environmental risks associated with the project and detail all the necessary mitigation measures, their financial costs, as well as the persons responsible for their implementation and monitoring. The EMP will be used as checklist in future environmental audits.

### 12.2. Construction Phase Environmental Management Plan

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction phase the proposed project are outlined in the table below.

Table 5: EMP for Construction Phase

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **1. Curb project associated conflicts and Lost Time Injuries (LTI) e.g. land ownership disputes.** | | | | |
| **Project implementation disputes** | Sufficient planning for adequate resources required i.e. financial, personnel and equipment | Proponent & Contractor | Project planning phase | In progress |
| | Land transfer agreements should be formalized before the project start as per the laws of the land | Proponent/Government of Kenya | Project planning phase | Done |
| | Community support mobilization and sensitization through consultative forums or questionnaire methods | Proponent & EIA Experts | Project planning phase | Done |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| | Change of use from single residential dwelling to multiple residential dwelling | Proponent & County government | Project planning phase | Done |
| **2. Minimize extraction site impacts and ensure efficient use of raw materials in construction** | | | | |
| **High Demand of Raw material** | Source building materials from local suppliers who use environmentally friendly processes in their operations | Project Manager & Contractor | Throughout construction period | |
| | Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered | Project Manager & Contractor | Throughout construction period | 10,000 |
| | Ensure that damage or loss of materials at the construction site is kept minimal through proper storage. | Project Manager & Contractor | Throughout construction period | 8,000 |
| | Use at least 5%-10% recycled, refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills | Project Manager & Contractor | Throughout construction period | 0 |
| **3. Minimize vegetation disturbance at and or around construction site** | | | | |
| **Vegetation disturbance** | Ensure proper demarcation and delineation of the project area to be affected by construction works. | Contractor, Civil engineer & Project Manager | 1 month | 10,000 |
| | Specify locations for trailers and equipment, and areas of the site which should be kept free of traffic, equipment, and storage | Civil Engineer, Architect and Project Manager | 1 month | 5,000 |
| | Designate access routes and parking within the site | Civil Engineer, Architect and Project Manager | 1 month | 5,000 |
| | Introduction of vegetation (trees, shrubs and grass) on open spaces and their maintenance | Architect & Landscape specialist | Monthly to Annually | 8,000 |
| | Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction | Architect & Landscape specialist | 2 months | 7,000 |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **4. Reduce storm-water, runoff and soil erosion** | | | | |
| **Increased storm water, runoff and soil erosion** | A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structure will be designed | The Civil Engineer, Mechanical Engineer and Project Manager | 1 month | 15,000 |
| | Apply soil erosion control measures such as levelling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil. | The Civil Engineer, Mechanical Engineer and Project Manager | 1 months | |
| | Ensure that construction vehicles are restricted to existing graded roads to avoid soil compaction within the project site | The Civil Engineer, Mechanical Engineer and Project Manager | Throughout construction period | |
| | Ensure that any compacted areas are ripped to reduce run-off. | The Civil Engineer, Mechanical Engineer and Project Manager | 2 months | |
| | Open drains all interconnected will be provided on site | Civil Engineer | Throughout construction period | 5,000 per unit |
| **5. Minimize solid waste generation and ensure efficient solid waste management during construction** | | | | |
| **Increased solid waste generation** | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling | Project Manager & Contractor | Throughout construction period | 10,000 |
| | Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials | Project Manager & Contractor | One-off | 0 |
| | Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed of. | Project Manager & Contractor | One-off | 0 |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| | Ensure that damaged or waste construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects | Project Manager & Contractor | One-off | 0 |
| | Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners. | Project Manager & Contractor | One-off | 0 |
| | Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time | Project Manager & Contractor | Throughout construction period | – |
| | Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements | Project Manager & Contractor | One-off | 20,000 |
| | Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials. | Project Manager & Contractor | Throughout construction period | 0 |
| | Use building materials that have minimal or no packaging to avoid the generation of excessive waste | Project Manager & Contractor | Throughout construction period | 0 |
| | Use construction materials containing recycled content when possible and in accordance with accepted standards. | Project Manager & Contractor | Throughout construction period | 0 |
| | Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site | Project Manager, Mechanical Engineer & Contractor | Throughout construction period | 0 |
| | Dispose waste more responsibly by dumping at designated dumping sites or landfills only. | Project Manager, Mechanical Engineer & Contractor | Throughout construction period | 10,000/ month |
| | Waste collection bins to be provided at designated points on the site | Project Manager, Mechanical Engineer & Contractor | Throughout construction period | 15,000 |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| | Private waste disposal company to be contracted to transport and dispose the solid waste from site | Project Manager, Mechanical Engineer & Contractor | Throughout construction period | |
| | Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste | Project Manager, Mechanical Engineer & Contractor | Throughout construction period | |
| **6. Reduce dust emissions** | | | | |
| **Dust emission** | Ensure strict enforcement of on-site speed limit regulations | Project Manager & Contractor | Throughout construction period | 15,500 |
| | Avoid excavation works in extremely dry weathers | Project Manager & Contractor | Throughout construction period | |
| | Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles | Project Manager & Contractor | Throughout construction period | |
| | Personal Protective equipment to be worn always when at work place | Project Manager & contractor | Throughout construction period | |
| | Ensure there is proper hoarding of the site to prevent dust / construction materials falling into neighbouring properties | | | |
| **7. Minimization of exhaust emissions** | | | | |
| **Exhaust emission** | Vehicle idling time shall be minimized | Project Manager & Contractor | Throughout construction period | 0 |
| | Alternatively fuelled construction equipment shall be used where feasible equipment shall be properly tuned and maintained | Project Manager & Contractor | Throughout construction period | 0 |
| | Sensitise truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off vehicle engines at these points | Project Manager & Contractor | Throughout construction period | 0 |
| **8. Minimization of noise and vibration** | | | | |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **Noise and vibration** | Sensitise construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used. | Project Manager & Contractor | Throughout construction period | 0 |
| | Sensitise construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals | Project Manager & Contractor | Throughout construction period | 0 |
| | Ensure that construction machinery are kept in good condition to reduce noise generation | Project Manager & Contractor | Throughout construction period | 25,000 |
| | Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels | Project Manager & Contractor | Throughout construction period | 10,000 |
| | The noisy construction works will entirely be planned to be during daytime when most of the neighbours will be at work. | Project Manager & all site foremen | Throughout construction period | 0 |
| | Comply with the provisions of Noise Prevention and Control Rules 2005, Legal notice no.24 regarding noise limits at the workplace | Project Manager & all site foremen | Throughout construction period | 0 |
| **9. Minimization of energy consumption** | | | | |
| **Increased energy consumption** | Ensure electrical equipment, appliances and lights are switched off when not being used | Project Manager & Contractor | Throughout construction period | 0 |
| | Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy | Project Manager & Contractor | Throughout construction period | 5,000 |
| | Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts | Project Manager & Contractor | Throughout construction period | 5,000 |
| | Monitor energy use during construction and set targets for reduction of energy use. | Project Manager & Contractor | Throughout construction period | 5,000 |
| **10. Minimize water consumption and ensure more efficient and safe water use** | | | | |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **High water demand** | Install water conserving taps that turn-off automatically when water is not being used | Project Manager & Contractor | One-off | 10-40 % higher |
| | Promote recycling and reuse of water as much as possible | Project Manager & Contractor | Throughout construction period | 2,000 |
| | Install a discharge meter at water outlets to determine and monitor total water usage | Project Manager & Contractor | One-off | 2,000 |
| | Promptly detect and repair water pipe and tank leaks | Project Manager & Contractor | Throughout construction period | 5000 per month |
| | Sensitise staff to conserve water by avoiding unnecessary water use | Project Manager & Contractor | Throughout construction period | 0 |
| | Ensure taps are not running when not in use | Project Manager & Contractor | Throughout construction period | 1,500 |
| **11. Minimize release of liquid effluent** | | | | |
| **Generation of wastewater** | Ensure that liquid effluent generated by construction workers is directed to the sewer line. | Mechanical Engineer & Project Manager | One-off | 15,000 |
| | Conduct regular checks for pipe blockages or damages since such vices can lead to release of the effluent into the land and water bodies | Mechanical Engineer & Project Manager | Throughout construction period | 3,000/ month |
| | Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated | Mechanical Engineer & Project Manager | Throughout construction period | 3,000/ Month |
| **12. Minimize occupational health and safety risks** | | | | |
| **Approval of building plans** | Ensure that all building plans are approved by the Local Authority and the local Occupational Health and Safety Office | Developer | One-off | Based on the area size |
| **Registration of the construction site** | Registration of the premises under the Occupational Safety and Health Act, 2007 Laws of Kenya is mandatory | Developer | One-off | 5,000 |
| **General register** | A general register should be kept within the facility as stipulated in Sec 122&123 of the Occupational Safety and Health Act, 2007. | Project Manager & Contractor | One-off | 1000 |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **Posting of abstract of Act, rules and notices** | There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007. | Project Manager & Contractor | One-off | 600 |
| **Incidents, accidents and dangerous occurrences.** | Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place. | Project Manager, Developer & Contractor | Continuous | 5,000/ month |
| | Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized. | The Contractor, Project Manager& Site Safety Officer | Continuous | 11,600 |
| **Insurance** | Ensure that the premises are insured as per statutory requirements (third party and workman's compensation) | Developer | Annually | Insurer |
| **Safety, health and environment (SHE) policy** | Develop, document and display prominently an appropriate SHE policy for construction works | Project Manager, Developer & Contractor | One-off | 5000 |
| **Health and safety committee** | Provisions must be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented | Project Manager | One-off | 20,000 |
| **Sanitary conveniences** | Suitable, efficient, clean, well-lit and adequate sanitary conveniences should be provided for construction workers | Project Manager | One-off | 15,000 |
| **Medical examination** | Arrangements must be in place for the medical examination of all construction employees before, during and after termination of employment | Project Manager, Developer & Contractor | Continuous | 500 per examination |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| **Machinery/equipment safety** | Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded | Project Manager, Developer & Contractor | One-off | _ |
| | Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain | Project Manager, Developer & Contractor | Continuous | _ |
| | All machines and other moving parts of equipment must be enclosed or guarded to protect all workers from injury | Project Manager | One-off | _ |
| | Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations | Project Manager | Continuous | 5,000 per training/pax |
| | Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued | Project Manager | Continuous | 5,000 per examination |
| | Reports of such examinations must be presented in prescribed forms, signed by the examiner and attached to the general register | Project Manager | Continuous | 3,000 per examination |
| **Storage of materials** | Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse | Project Manager | Continuous | 5,000 |
| | Ensure that items are not stored/stacked against weak walls and partitions | Project Manager | Continuous | _ |
| **Safe means of access and safe place of employment** | All floors, steps, stairs and passages of the premises must be of sound construction and properly maintained | Project Manager & Contractor | Continuous | _ |
| | Securely fence or cover all openings in floors | Project Manager & Contractor | One-off | _ |

| EXPECTED NEGATIVE IMPACTS | RECOMMENDED MITIGATION MEASURES | RESPONSIBLE PARTY | TIME FRAME | COST (KSHS) |
|---|---|---|---|---|
| | Provide all staircases within the premises with suitable handrails on both sides | Project Manager & Contractor | One-off | |
| | Ensure that construction workers are not locked up such that they would not escape in case of an emergency | Project Manager & Contractor | Continuous | _ |
| | All ladders used in construction works must be of good construction and sound material of adequate strength and be properly maintained | Project Manager & Contractor | One-off | _ |
| **Emergency preparedness and evacuation procedures** | Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency | Project Manager & Contractor | One-off | 4,000 |
| | Such procedures must be tested at regular intervals | Project Manager & Contractor | Every 3 months | 4,000 |
| | Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers | Project Manager & Contractor | One-off | 6,000 |
| | Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site | Project Manager & Contractor | One-off | 2,000 |
| | Provide measures to deal with emergencies and accidents including adequate first aid arrangements | Project Manager & Contractor | Continuous | 5,000 |
| **First Aid** | Well stocked first aid box which is easily available and accessible, should be provided within the premises | Project Manager & Contractor | One-off | 5,000 |
| | Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body. | Project Manager & Contractor | One-off | 5,000 |
| **13. Ensure the general safety and security of the site and surrounding areas** | | | | |
| **Increased Pressure on Infrastructure** | Coordinate with other planning goals and objectives for the region | Architect, Project Manager, Contactor and the Developer | Continuous | 18,000 |

| | | | | |
|---|---|---|---|---|
| | Upgrade existing infrastructure and services, where feasible. | Architect, Project Manager, Contactor and the Developer | Continuous | |
| **Insecurity** | Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site. | Security Officer, Project Manager & Police | Continuous | 15,000 |
| | Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen. | Security Officer | Continuous | |
| | Ensure only authorised personnel get to the site | Security Officer | Continuous | |
| | Security alarms will be installed | Security Officer | Continuous | |
| **14. Environmental monitoring of the project** | | | | |
| **Environmental concern during the construction phase** | Due to the magnitude of the project the proponent will liaise with the environmental consultants throughout the construction phase and ensure that the conditions of approval are adhered to. | Proponent, Contractor and Consultant | Throughout construction phase | |

## 12.3. EMP for operational phase

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the operational phase of the office project are outlined in the table below

Table 6: EMP for Operation Phase

| Expected Negative impact | Recommended Mitigation Measures | Responsible Party | Time Frame | COST (KSHS) |
|---|---|---|---|---|
| **1 Minimization of solid waste generation and ensuring more efficient solid waste management** | | | | |
| **Solid waste generation** | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary landfilling. | Proponent/Property Managers | One-off | 5,000/Month |
| | Provide solid waste handling facilities such as waste bins and skips | Proponent/Property Managers | One-off | 10,000 |
| | Ensure that solid waste generated is regularly disposed of appropriately at authorised dumping sites | Proponent/Property Managers | Continuous | 10,000/month |
| | Donate redundant but serviceable equipment to charities and institutions | Proponent/Property Managers | Continuous | 0 |
| | Comply with the provisions of Environmental Management and Co-ordination (Solid Waste) Regulations 2006 | Proponent/Property Managers | Continuous | 0 |
| **2 Minimise risks of liquid waste release into environment** | | | | |
| **Liquid waste release into the environment** | Provide adequate and safe means of handling liquid waste at the premises | Proponent/Property Managers | One-off | |
| | Conduct regular inspections for pipe blockages or damages and fix them appropriately | Proponent/Property Managers | Continuous | 500 per inspection |
| | Ensure regular monitoring of the sewage discharged from the project to ensure that the stipulated sewage/effluent discharge rules and standards are not violated | Proponent/Property Managers | Continuous | 500/parameter |

| Expected Negative impact | Recommended Mitigation Measures | Responsible Party | Time Frame | COST (KSHS) |
|---|---|---|---|---|
| | Comply with the provisions of Environmental Management and Co-ordination (Water Quality) Regulations 2006 | Proponent/Property Managers | Continuous | 0 |
| **3 Minimize energy consumption** | | | | |
| **Energy Use** | Switch off electrical equipment, appliances and lights when not in use | Proponent/Property Managers | Continuous | – |
| | Install occupation sensing lighting at various locations such as the parking areas which are not in use all the time | Proponent/Property Managers | One-off | 10-40 % higher than ordinary lighting |
| | Install energy saving fluorescent tubes at all lighting points within the building instead of bulbs which consume higher electric energy | Proponent/Property Managers | One-off | 10-40 % higher than ordinary lighting |
| | Monitor energy use during the operation of the project and set targets for efficient energy use | Proponent/Property Managers | Continuous | 5,000/month |
| | Sensitise workers on how to use energy efficiently | Proponent/Property Managers | Continuous | 500/month |
| **4 Minimize water consumption and ensure more efficient and safe water use** | | | | |
| **Water management** | Promptly detect and repair water pipe and tank leakages | Proponent/Property Managers | Continuous | 5,000/month |
| | Workers/visitors to conserve water e.g. by avoiding unnecessary toilet flushing | Proponent/Property Managers | Continuous | 500/month |
| | Ensure taps are not running when not in use | Proponent/Property Managers | Continuous | 500/month |
| | Install water conserving taps that turn-off automatically when water is not being used | Proponent/Property Managers | One-off | 10-40 % higher than ordinary taps |

| Expected Negative impact | Recommended Mitigation Measures | Responsible Party | Time Frame | COST (KSHS) |
|---|---|---|---|---|
| | Install a discharge meter at water outlets to determine and monitor total water usage | Proponent/Property Managers | One-off | 5,000 |
| **5 Minimization of health and safety impacts** | | | | |
| Implement all necessary measures to ensure health and safety of workers and the general public during operation of the offices as stipulated in the Occupational Safety and Health Act,2007 | | Proponent/Property Managers | Continuous | – |
| **6 Ensure the general safety and security of the premises and surrounding areas** | | | | |
| Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises | | Proponent/Property Managers | Continuous | 10,000/month |
| **7 Control of informal activities around the project site** | | | | |
| Mushrooming of Informal Settlement | | Local Administration; Local Authority | Continuous | 0 |
| **8 Ensure environmental compliance** | | | | |
| Undertake an environmental audit within 12 months after operation commences as required by law | | Consultant | 12 months after operation commences | 40,000 |

### 12.4. Decommissioning Phase

In addition to the mitigation measures provided in the above table and below; it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the project have ceased. The necessary objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project are outlined in Table 7 below.

Table 7: EMP for Decommissioning Phase

| Expected Negative Impacts | Recommended Mitigation Measures | Responsible Party | Time Frame | Cost (KShs) |
|---|---|---|---|---|
| **1. Demolition waste management** | | | | |
| **Demolition waste** | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling. | Project Manager & Contractor | Once-off | 5,000 |
| | All buildings, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible | Project Manager & Contractor | Once-off | 15,000 |
| | All foundations must be removed and recycled, reused or disposed of at a licensed disposal site | Project Manager & Contractor | Once-off | 7,000 |
| | Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site | Project Manager & Contractor | Once-off | 0 |
| | Donate reusable demolition waste to charitable organizations, individuals and institutions | Project Manager & Contractor | Once-off | 0 |

| Expected Negative Impacts | Recommended Mitigation Measures | Responsible Party | Time Frame | Cost (KShs) |
|---|---|---|---|---|
| **2. Rehabilitation of project site** | | | | |
| **Site degradation** | Implement an appropriate re-vegetation programme to restore the site to its original status | Project Manager & Contractor | Once-off | 0 |
| | Consider use of indigenous plant species in re-vegetation | Project Manager & Contractor | Once-off | 0 |
| | Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent area and the development. | Project Manager & Contractor | Once-off | 0 |

# 13. CONCLUSION AND RECOMMENDATION

## 13.1. Conclusions

1) The proposed development project is a worthy investment by the proponent and broadly with no doubt will contribute significantly to the increased housing stock and by extension spur economic development.
2) Key positive impacts that will result from the project include; growth of the economy, boosting of the informal sector during the construction phase, provision of market for supply of building materials, employment generation, increase in government revenue and optimal use of land.
3) Negative environmental impacts that will result from establishment of the proposed project which include pressure on the existing facilities, noise pollution, dust emissions, solid waste generation, increased water demand, increased energy consumption, generation of exhaust emissions, risk of workers accidents, possible exposure of workers to diseases, increased
4) Negative impacts can be sufficiently mitigated by implementation of the proposed EMP

## 13.2. Recommendations

1) The proponent shall implement the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects.
2) Maximize positive impacts as much as possible as exhaustively outlined within the report. These measures will go a long way in ensuring the best possible environmental compliance and performance standards.
3) The developer be licensed to implement the project.

## REFERENCES


Baker, B. H., J. G. Mitchell, and L. A. J. Williams. "Stratigraphy, Geochronology and Volcano-Tectonic Evolution of the Kedong–Naivasha–Kinangop Region, Gregory Rift Valley, Kenya." *Journal of the Geological Society* 145, no. 1 (1988): 107–16.

Brundtland, Gro Harlem. *Report of the World Commission on Environment and Development:" Our Common Future."* United Nations, 1987.

Hens, L. "The Rio Declaration on Environment and Development." *Regional Sustainable Development Review: Africa. Oxford, UK, Eolss Publishers*, 2005. http://www.eolss.net/sample-chapters/c16/E1-48-43.pdf.

https://www.weatherbase.com/weather/chart.php?type=Average+Wind+Speed&units=kilometers+per+hour&location=l%2C+Kenya&symbol=km%2Fh&data=17,17,17,16,12,9,8,9,12,16,17,17

https://cgspace.cgiar.org/server/api/core/bitstreams/e74c4bab-1de8-4c66-8f89-9477cdf14573/content

KENYA, LAWS OF. *The Constitution of Kenya, 2010*. Attorney General Nairobi, 2010. http://www.wipo.int/edocs/lexdocs/laws/en/ke/ke019en.pdf.

KENYA, LAWS OF. *The Constitution of Kenya, 2010*. Attorney General Nairobi, 2010. http://www.wipo.int/edocs/lexdocs/laws/en/ke/ke019en.pdf.

MacDonald, Jamie P. "Strategic Sustainable Development Using the ISO 14001 Standard." *Journal of Cleaner Production* 13, no. 6 (2005): 631–43.

Nairobi City Water Sewerage Company Limited Strategic plan 2019-2024

Satterthwaite, David, Hannah Reid, and Stephen Bass. *Reducing Poverty and Sustaining the Environment: The Politics of Local Engagement*. Routledge, 2013.

———. "The Environmental (Imapct Assessment and Audit) Regulations, 2003," 2003. www.nema.go.ke.

———. "The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.," 2009. www.nema.go.ke.

———. "The Environmental Management and Co-Ordination (Waste Management) Regulations, 2006.," n.d. www.nema.go.ke.

———. "The Environmental Management and Coordination, (Water Quality) Regulations 2006.," 2006. www.nema.go.ke.

———. "The Public Health Act Chapter 242." Kenya law reports, 2012.

Vision, Kenya. "2030: A Globally Competitive and Prosperous Kenya (2007)." *Ministry of Planning and National Development and the National Economic and Social Council (NESC), Government of Kenya, Nairobi (GOK, 2007)*.

Wamukoya, George M., and Francis DP Situma. *Environmental Management in Kenya: A Guide to the Environmental Management and Coordination Act*. Centre for Research and Education on Environmental Law, 2000.

Weeks J.L. (2011) *Health and safety hazards in the construction industry*, Geneva, ILO

Winnie V. Mitullah (Ed.). *(*2021), *Construction workers in Kenya Straddling with formal and informal social protection,* United States: Taylor & Francis. Lone, et.al.

Yao, G; Sun, W T; Yang, Y (2022), Analysis and Identification of Building Construction Accident Risk in China basing Exclusively Database. IOP Conference Series. Earth and Environmental Science; Bristol Vol. 1101, Issue 7, IOP Publishing