# Environmental Impact Assessment (EIA) Study Report for the Proposed Aggregate Quarry at Kaputiei area, Kajiado County.

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# CERTIFICATION

## Certification by Lead Experts

We hereby certify that this Environmental Impact Assessment (EIA) Study Report for the proposed aggregate quarry at Kaputiei area, Kajiado County has been done under our supervision and that the assessment criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

Signed: _____ _____

Names: **Mr. Simon Nzuki** (1350) **Ms. Jane Gitau** (2015)

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## Certification by Proponent

We, **Karsan Ramji and Sons Limited,** confirm that this Environmental Impact Assessment (EIA) Study Report for the proposed aggregate quarry at Kaputiei area, Kajiado County has been prepared and submitted to NEMA with our authority as the proponent.

Signed for and on behalf of **Karsan Ramji and Sons Limited**

Name: _____ Signature: _____

Date: _____

Proponent Contact Details
Karsan Ramji and Sons Limited,
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Official Rubberstamp or Seal

## ACKNOWLEDGEMENTS

The preparation of this EIA study report was made possible by a collaborative effort involving the proponent, the consultants and project stakeholders. On behalf of the proponent, we thank Ms. Ruth Thuo and Mr. Phillip Kavisa for providing project documentation and financial resources required by the consultants to undertake the EIA process and assisted the team during site visits and community mobilization for consultations on the project.

We are indebted to the residents of Kaputiei for accepting to participate in the public consultations and providing their views, comments and concerns in respect of the proposed project.

Sampling and analysis of environmental media was undertaken by Polucon Services (K) Limited while the hydrogeological report was prepared by Geosol Consulting Limited. The consultants are grateful to the two firms for their invaluable input in the preparation of the EIA study report.

The staff of Envasses Environmental Consultants Limited assisted the consultants in data and information collection, interpretation and analysis, draft material write-up and the printing of the final report. In this regard, we acknowledge the input of Ms. Carolyne Njeri, Ms. Hellen Maingi and Ms. Julia Mbiu.

## EXECUTIVE SUMMARY

The proponent, Karsan Ramji and Sons Limited, commissioned Envasses Environmental Consultants Limited to prepare an Environmental Impact Assessment (EIA) Study Report for the proposed aggregate quarry which lies within the Kaputiei plains of Kajiado County. The EIA study is prepared pursuant to Section 58 of Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. In addition, the report will provide a baseline of the environmental and social conditions of the project area and enable future monitoring of the environmental performance of the project.

The proposed project features an open cast mine and auxiliary facilities such as access roads, power, water, site offices, sanitary facilities, generator room and explosive stores among others. Three main process will occur during mining; blasting, loading and transportation of boulders to the crushers which will break them into different categories of aggregate. The average production per day is estimated at 700 tonnes.

In carrying out the EIA study, the consultants used various methods which are prescribed by the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. These included site visits and observations, photography and public consultations. Environmental media quality was measured through analysis of air and noise level measurements in collaboration with a NEMA designated laboratory, Polucon Services (K) Limited. Hydrological survey targeting the potential for groundwater resources and quality was carried out in collaboration with registered hydro-geologists, Geosol Consulting Limited.

The proposed project will have both positive and negative impacts. The positive impacts will include stimulation of industrial development coherent with Kenya's Vision 2030, mitigation of national and regional demand for aggregates, source of revenue to both the County and National Governments, income generation to the proponent and creation of employment opportunities. However, negative impacts on the environment will also manifest during the pre-establishment and establishment, operational and possible decommissioning phases of the aggregate quarry.

At the pre-establishment and establishment phase, the possible negative impacts will include change in land use, environmental risks of obtaining raw materials for construction works, occupational safety and health, water demand and effluent generation, solid waste generation, air and noise pollution.

At the pre-establishment phase, the proponent will obtain a change of user from the County Government of Kajiado before commencement of work. To mitigate the impacts of the establishment phase, the contractor will ensure sufficient quantities of materials are procured for the intended works and they are sourced from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 Laws of Kenya. The workforce and visitors to the site will be exposed to potential health and safety risks such as injuries and potential accidental falls. To mitigate these impacts, the proponent will register the site as a workplace with the Directorate of Occupational Safety and Health Services (DOSHS), provide and enforce the use of Personal protective Equipment (PPE), provide the correct equipment for the jobs assigned and train the employees on their use, obtain insurance cover for the employees and comply with the provisions of the Occupational Safety and Health Act, 2007. The proponent will also procure and deliver to the site mobile toilets from a NEMA licensed solid waste contractor for use by the workers during the construction phase of the project cycle and ensure compliance with the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Construction activities and workers are expected to generate solid waste. These will be disposed off by contracting the services of a NEMA licensed waste handler and ensuring compliance with the Environmental Management and Coordination (Waste Management) Regulations, 2006. Air and noise pollution from construction activities is expected. The report recommends sprinkling of water on excavation areas, provision and enforcement of the use of PPE and ensure compliance with the Air Quality Regulations, 2014 and Noise and Excessive Vibration Pollution (Control) Regulations, 2009.

Mining operations have the potential to have adverse effects on the environment including land degradation, impacts of quarry overburden, effects on landscape and visual intrusions, occupational health and safety, increased water demand and wastewater generation, increased energy demand, solid waste generation, air and noise pollution, ground and surface water pollution, impacts of electric blasting, impact on biodiversity and road damage.

Land degradation will result from stripping of the topsoil and excavation to expose the rock strata. The proponent and contractor will treat the quarry faces by initializing stabilization of the quarry pits walls and restoring the affected areas through rehabilitation of decommissioned quarry pits. Generation of overburden during excavation will be evident which If inappropriately disposed, it becomes an eyesore in addition to harboring insects and disease causing vectors. The overburden will later be reused as backfilling material in site rehabilitation and restoration. To mitigate the impact of visual intrusion resulting from stockpiles and quarry waste piling as well as quarry depressions, the proponent will take into consideration the existing landforms, settlements and vegetative cover in siting and establishment of the quarry, backfill the quarry pits where applicable using the overburden generated and locate stockpiles, overburden, quarry waste & haul routes away from sensitive landscape & visual receptors.

Sections of the proposed site that will be cleared to pave way for excavation and other quarrying activities will disrupt the macro habitat and the species they support. Dust produced from quarrying activities also have physical effects on the surrounding vegetation such as blocking and blocking and damaging internal structures hence impacting on their physiological activities. To reduce the impacts of quarrying to the ecosystem, the proponent will retain vegetation cover where possible and rehabilitate the quarried areas by planting appropriate indigenous trees or approved exotic ones in collaboration with the Kenya Forest Service.

Quarrying activities pose potential threats to the health and safety of workers on site. This may be in the form of dust, fumes, accidents from machinery and equipment, injuries that may result from excavation activities and accidental falls. During rainy seasons, accumulation of water in the quarry pits may pose a threat to community health and safety as they may become important breeding grounds for disease causing pathogens and accidental falls of both human and livestock could lead to drowning. To mitigate this impact, the proponent will provide adequate training to staff on health and safety and ensure use of correct machinery for each assignment given, provide and enforce the use of PPE, regulate access to the site by deploying adequate security measures and fencing where appropriate to protect workers, local community members and livestock from potential accidents, rehabilitate quarried areas and comply with the provisions of the Occupational Safety and Health Act, 2007.

Effluent from domestic water use will be managed through a bio-digester and the proponent will apply and obtain an Effluent Discharge License from NEMA. Solid waste generated will be managed through a NEMA licensed solid waste contractor and compliance with the Environmental Management and Coordination (Waste Management) Regulations, 2006.

The quarry will exert pressure on energy for running the machinery and equipment and for lighting and powering of electrical appliances. The study recommends maintenance of machines and equipment to maximize their efficiency on fuel.

Dust from quarrying activities i.e. from blasting, crushing and transportation of aggregates will be mitigated by sprinkling water at the quarry site, enforcing the use of PPE to all employees and visitors while at the facility, retaining existing vegetation in areas which are not earmarked for quarrying to act as dust screens and a buffer zone between the quarry area and the settlements and complying with the provisions of the Air Quality Regulations, 2014.

Quarrying involves several activities that generate significant amount of noise and vibrations. To mitigate the impact of noise, the proponent will use buffer zones by locating the quarry facility away from settlements, enforce the use of earmuffs, increase the number of delay detonators used in a round of blasting, conduct noise mapping to inform mitigation measures, comply with Noise and Excessive Vibration Pollution (Control) Regulations, 2009 and adhere to the provisions of the Explosives Act. Blasting also pose safety and health concerns during its deployment and eventual use of explosives. This impact will be mitigated through ensuring a competent and accredited person(s) supervises all loading and firing, enforcing the use of earmuffs to all workers and visitors to the facility, increasing the number of delay detonators used in blasting, employing qualified personnel to handle and store the explosives and adhering to the provisions of the Explosives Act, 2016.

There is a potential for ground and surface water pollution during operations. Removal of the rock strata can cause the floor to heave and allow for water seepage and hence toxic materials from the quarry could seep into the ground water. The activities of the proposed quarry will have a potential to pollute the seasonal river that lies to the North West of the proposed site. The proponent will ensure that blasting and drilling are not undertaken to the water table level and in the event of flooding, water will be pumped out of the mines. The proposed site will be secured with an impermeable boundary wall to ensure that the mining tailings and overburden are contained within the site. The study also recommends maintaining maximum existing vegetation coverage and planting of more trees along the boundary wall to act as buffers.

Once the quarry begins operations, there will be heavy commercial vehicles ferrying aggregates to different areas. Overloaded trucks may cause damage on the roads leading to the quarry facility reducing their life span. To mitigate this impact the proponent and truck drivers will adhere to the axle load limits set by the Kenya Roads Board.

A decommissioning phase is possible in the event of closure by government agencies due to non-compliance with environmental and health regulations, end of project life, an order by a court of law due to non-compliance with existing regulations and Change of user. Key environmental concerns at this phase will be loss of livelihoods for the employees and income to the proponent. The proponent will prepare and submit a due diligence decommissioning audit report to NEMA for approval at least 3 months in advance.

Public consultations were undertaken using questionnaires administered to neighbors and stakeholders to collect and document their concerns regarding the establishment and subsequent operation of the proposed aggregate quarry. None of the respondents interviewed objected to proposed project. The main positive impacts identified include job opportunities for the locals, income generation to the proponent, improvement of businesses in the area, improved security,

revenue to the government and improved economy. The key environmental concerns that were identified include air and noise pollution.

The study also reviewed various governance frameworks and the most relevant ones are the Constitution of Kenya 2010, Environmental Management and Coordination Act Cap. 387 of the laws of Kenya, Mining Act, 2014, Explosives Act, 2016, Occupational Safety and Health Act, 2007, Public Health Act Cap. 242, Energy Act, 2006, Water Act, 2016, Physical Planning Act, 2012 and Occupiers Liability act Cap 34.

The proposed project is considered important and beneficial to the economic growth of Kenya and is coherent with the Kenya's Vision 2030. This EIA proposes a comprehensive environmental management and a monitoring plan for the entire project cycle to address negative environmental impacts and improve the environmental performance of the project.

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| | |
|---|---|
| **BDL** | Below Detection Limit |
| **DOSHS** | Directorate of Occupational Safety and Health Services |
| **EIA** | Environmental Impact Assessment |
| **EMCA** | Environmental Management and Coordination Act |
| **EMP** | Environmental Management Plan |
| **GoK** | Government of Kenya |
| **GPS** | Global positioning system |
| **KFS** | Kenya forest service |
| **MGR** | Meter Gauge Railway |
| **NEMA** | National Environment Management Authority |
| **NMHC** | Non-methane hydrocarbons |
| **OSHA** | Occupational Safety and Health Act |
| **PPE** | Personnel Protective Equipment |
| **SDG** | Sustainbale Development Goal |
| **SGR** | Standard Gauge Railway |
| **TBD** | To be determined |
| **TOR** | Terms of reference |
| **VOC** | Volatile Organic Compounds |
| **WRA** | Water Resource Authority |
| **WSB** | Water Service Board |
| **WSP** | Water Service Providers |
| **WSRB** | Water Service Regulatory Boards |

# 1 PROJECT BACKGROUND INTRODUCTION

## 1.1 Introduction

The proponent, Karsan Ramji and Sons Limited, proposes to set up an aggregate quarry in Kaputiei area of Kajiado County. Mining and other related activities including harvesting of aggregate, sand, gravel, soil and clay and exploration for the production of petroleum and minerals in any form are listed under the Second Schedule (6i) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya as high risk projects. Pursuant to Section 58 of the Act, all high risk projects listed under the Second Schedule should undergo an Environmental Impact Assessment (EIA) Study process.

Subsequently, the proponent commissioned Envasses Environmental Consultants Limited in May 2019 to prepare an EIA Study Report for the project proposal pursuant to Section 58 of Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. In addition, the report will provide a baseline of the environmental and social conditions of the project area and enable future monitoring of the environmental performance of the project.

## 1.2 Location of the project site

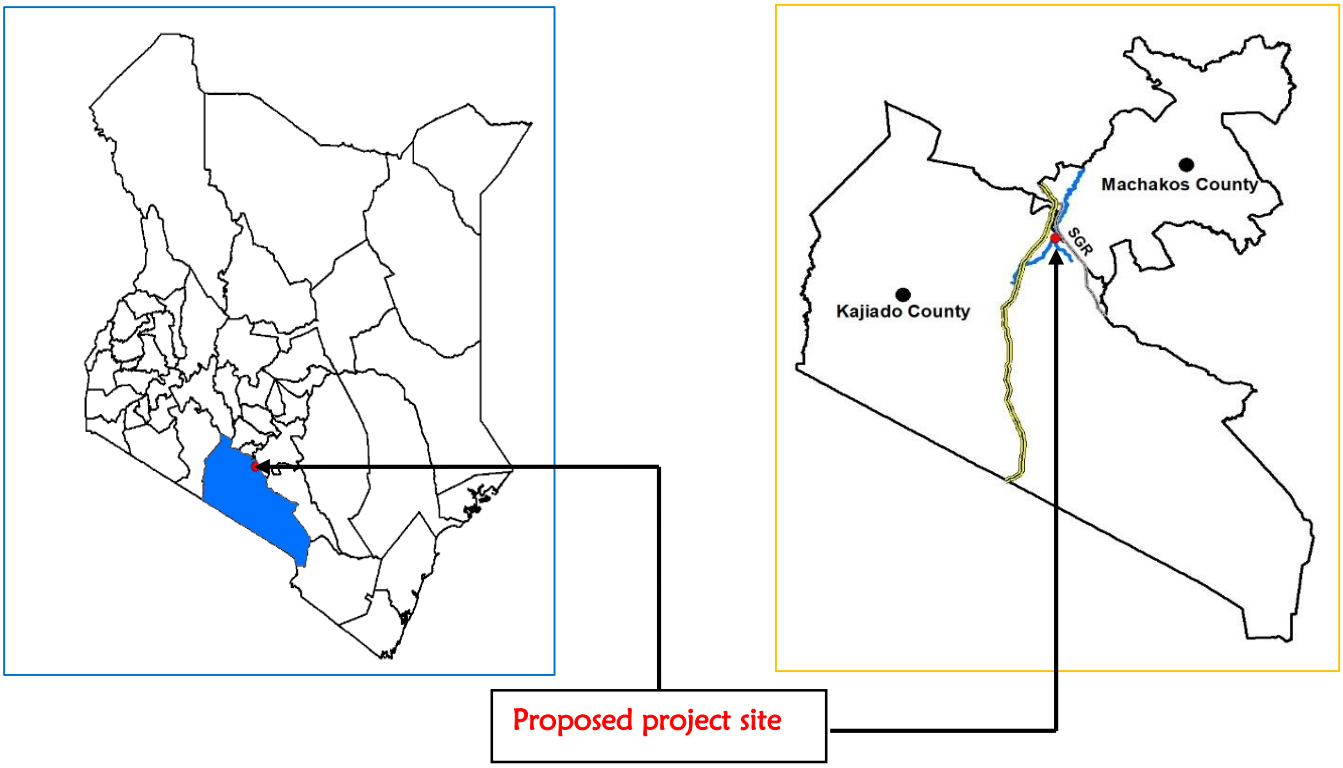
The proposed project site will be located on plots L.R. Nos. KAJIADO/KAPUTIEI NORTH/93111, 101848 and 1032333, Kajiado County in an area measuring 45.75 acres. The Global Positioning System (GPS) coordinates of the proposed site are **Latitude 1°33'49.00"S and Longitude 36°58'52.00"E** (Figure 1).

The proposed site is currently undeveloped with the vegetation cover dominated by grass and *Vachellia drepanolobium* (whistling thorn) tree species on phonolite outcrops. It can be accessed via an earth road abutting the Nairobi-Namanga Road and borders the Meter Gauge Railway (MGR) and Standard Gauge Railway (SGR) to the East. There are a few industrial establishments and residential developments neighboring the proposed site.

## 1.3 Project design and description

The project features an open cast mine and auxiliary facilities such as access roads, power, water, site offices, sanitary facilities, generator room and explosive stores among others. Three main process will occur during mining. They include blasting, loading and transportation of boulders to the crushers. Before blasting occurs, the quarrying site will be cleared of any vegetation. A vertical drill hole for loading explosives will then be made into the rock strata to determine the vertical extend of the ore's body. Both primary and secondary blasting will be undertaken for the purposes of breaking rock boulders into acceptable sizes for onward transportation to the crushers.

At the crushers, rocks will be passed through a system of conveyor belts and sieves where they will be broken into different categories of aggregate ranging from ½ to 10 inches as per the use required. The range between 4-10 inches is used for roads, railway lines and airport runways as base boulders. The average production per day is estimated at 700 tonnes.



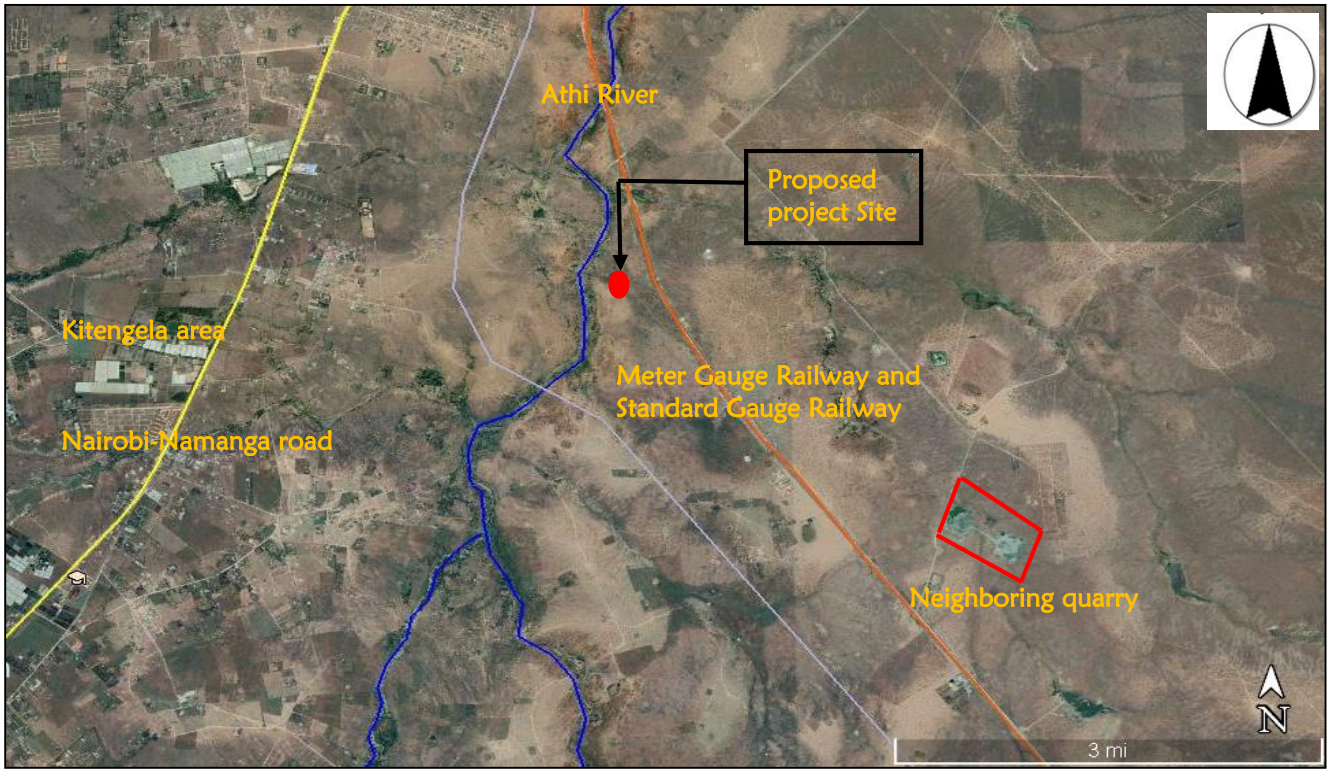




**Figure 1: The location of the proposed aggregate quarry (Google Extract, 2019)**

## 1.4 Study approach and methodology

The methods adopted for preparing the EIA study report were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The consultants prepared a scoping report and Terms of Reference (TORs) as required under Regulation 11 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 and submitted them to NEMA for consideration for approval. The TORs were approved on 20th May 2019 and the consultants began preparation of the EIA study report.

Site visits were undertaken in May 2019 for purposes of area reconnaissance, assessing the baseline environmental conditions of the proposed project site and screening of environmental risks associated with the proposed development as well as the applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this schedule, the issues considered by the experts included ecological impacts, socio-economic issues, landscape changes and land use character (Table 1).

**Table 1: Summary of results of the screening criteria**

| Criteria | Results |
|---|---|
| Ecological impacts | – Vegetation clearance and excavations will occur<br>– No endangered species of trees and plants found at the site<br>– There are indigenous tree species at the site<br>– Project has a potential to pollute a nearby river which lies approximately 1km from the project site |
| Social-economic considerations | – Income to proponent and employment creation<br>– Meeting demand for construction materials<br>– Revenue to the government through taxes & licenses<br>– The project compliments governments effort to attain economic pillar associated with development i.e. Vision 2030<br>– No cultural or heritage issues at the site |
| Landscape impacts | – The landscape of the area will be altered and new views created |
| Land uses | – Land cover is predominantly grass and less than 20 immature trees<br>– The current land use is agricultural and thus the proponent will apply for a change of user |

### 1.4.1 Data collection

The methods for carrying out the study included site visits and observations, consultations with the neighbors through administration of questionnaire and literature review of relevant documents. Other methods included sampling of baseline environmental media (air and water) in collaboration with NEMA registered laboratory, Polucon Services (K) Limited and a hydrological survey targeting groundwater resources and their quality in collaboration with Geosol Consulting Limited who are registered hydro-geologists.

### 1.4.2 Baseline monitoring

The methodology for sampling and analysis of environmental media (air and noise) and hydrological survey are discussed in the following sections.

### 1.4.2.1 Air Quality Monitoring

A Fixed-Point Monitoring strategy was used during measurements. Air samples were collected at areas of the site where the sampler and gas sensors were positioned. It was useful for identification of the sources of air impurities and determining their distribution at the site. Air monitoring was conducted over a 1 hour time weighted average period and a calculated 24 hour time weighted average period for the measurements of particulate matter, Volatile Organic Compounds (VOCs), nitrogen dioxide ($NO_2$), hydrogen Sulphide ($H_2S$) and sulphur dioxide ($SO_2$).

Sampling of gases was done by use of Aeroqual portable air monitors (Figure 2) which uses a mix of sensor technologies. Sampling for Volatile Organic Compounds (VOCs), nitrogen dioxide ($NO_2$), hydrogen Sulphide ($H_2S$) and sulphur dioxide ($SO_2$), was done using the gas sensitive electrochemical methods of active and continuous sampling. Dust was sampled using the laser particle sensors. The results interpretation and analysis as well as sampling duration information was used to calculate the gases concentrations.


**Figure 2: A portable Aeroqual series 500 that was used in obtaining baseline air quality measurements at the proposed project site**

### 1.4.2.2 Noise monitoring

Prior to recording the noise measurements, an inspection of the monitoring points and implicated activities of the area was undertaken, perimeter walls was identified and Noise level meter calibrated. Noise levels was determined by the Noise level meter (Figure 3), with an inbuilt, ῶoctave/octave band filter which does real time and octave analysis. The Noise level meter was raised 2 meters above the ground and fitted with a ½" electrets condenser microphone with a measurement range of between 30 - 130dB and a frequency range and weighting of 25Hz – 10KHz and A,C & Z respectively. For all measurements taken to establish the ambient noise levels, the equivalent noise level (LAeq), the sound pressure level at 5%, 50% & 95% (L5), (L50), (L95) respectively during that measurement period was at one hour interval. The noise level was measured in terms of the A-weighted equivalent continuous sound pressure level Leq. Each individual measurements was taken simultaneously with the nature of the noise climate of the area. This involved an auditory observation and identification of noise incidents influencing the noise level meter readings by the surveyor.


**Figure 3: Noise level meter TES 1358 C used in obtaining baseline noise levels at the proposed site**

### 1.4.2.3 Hydrogeology

Electrical resistivity geophysics method was used to investigate the underlying conditions of the proposed site. This involved driving Direct Current signal into the ground and measuring the resulting potential (voltages) created in the earth and infer the geological properties of the earth from the data. Two current electrodes (AB) were driven about 1 foot into the earth to apply the current and two additional potential electrodes (MN) measured the earth voltage (electrical potential) generated by the current.

The electrical properties of rocks in the upper part of the earth's crust are dependent upon the lithology, porosity, and the degree of pore space saturation and the salinity of the pore water and thus two methods were employed to determine the resistivity profile; I) Horizontal Electrical Profile (HEP), where lateral changes in resistivity across the fault and fractures was measured at a given depth depending on the values of the distance between the current electrodes (AB) and potential electrodes (MN) and hence detect regions where Vertical Electrical Sounding would be conducted. II) Vertical Electrical Sounding (VES) was conducted at the site using Non-polarized potential electrodes placed at fixed distances while the current electrodes expanded in Logarithmic order about the centre of spread. Whereby electric current was passed through the current electrodes and the potential difference measured within the potential electrodes therefore determining the depth of the water table, salinity of water (Self-potential), hardness of the rocks and depth of the bedrock. Schlumberger array configuration was used to carry out the study with expanding spread of up to more than 200 m (AB/2).

# 2 BASELINE CONDITIONS OF THE PROJECT SITE

## 2.1 Introduction

Baseline conditions of the project site were assessed and documented for the purposes of determining the future impacts of the proposed project on the environment and the local community. This section details on the environmental, socio-economic and bio-physical characteristics of the site, and the findings of the survey which will form a basis for impact monitoring plans and improvement of the environmental and social performance of the project during implementation.

## 2.2 Demographics

According to the 2009 population census, Kajiado County was found to have a total population of 697,312 people. Kaputiei North has the highest population density of 1,369 persons per square kilometer (GoK, 2013). The Maasai form the bulk of the population but other ethnic groups such as the Kamba and Kikuyu have infiltrated the area.

## 2.3 Climate and vegetation cover

Kajiado County experiences a bi-modal rainfall pattern. Short rains are experienced between October and December whereas long rains are between March and May. Temperatures vary with altitude and season with the highest recorded temperature being 34˚C. The coolest period is between July and August whereas the hottest period is between November and April (Figure 4).

Kaputiei area lies in a semi-arid zone thus the vegetation consists of grass and thorn trees. The fauna is comprised of various species of weaver birds (Figure 5).

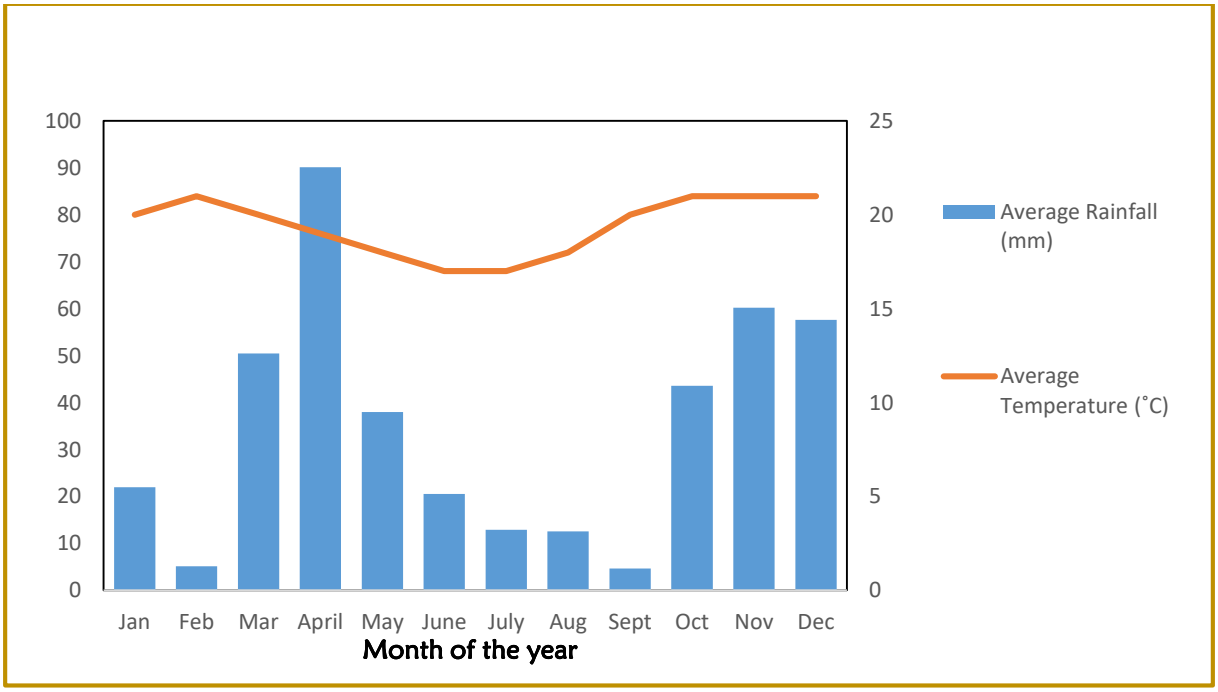



**Figure 4: Average rainfall and temperature distribution for Kajiado County in 2019 (Source: World Weather Online)**

**Figure 5: Vegetation consisting of grass and thorn trees and a species of a weaver bird at the proposed site (Source: Site visit, May 2019)**

## 2.4 Land use patterns and socio economic activities

Land use patterns in Kaputiei area feature nomadic pastoralism, livestock rearing, industrial establishments like quarries, subsistence agriculture and sparse settlements. The bulk of the population in the area practice nomadic pastoralism owing to the dry weather conditions. The main livestock types reared include goats and sheep (Figure 6). Subsistence agriculture is carried out in small areas by only non-indigenous people in the southern and western parts of the County along rivers and springs.

**Figure 6: The types of livestock present at the proposed site (Source: Site visit, May 2019)**

## 2.5 Topography, geology and soils

The main physical features in Kajiado County are plains, valleys and occasional volcanic hills. The proposed site lies within the Kaputiei plains which has an undulating topography. The geology of the area is characterized by phonolites and basement system rocks (Figure 7). The soils are well drained, shallow to moderately deep and highly calcareous.

**Figure 7: Phonolite rock outcrops at the project site (Source: Site visit, May 2019)**

## 2.6 Water resources and local hydrogeology

The area is water stressed thus the local population is dependent on boreholes and springs from nearby plateaus. The decomposed sub-volcanic floor in this area is expected to yield good aquifer, but this is not case. This might be attributed to low rainfall and the catchment area feeding the sub-volcanic horizon is of low relief, resulting in the loss of much of the scanty rainfall by evaporation. The quarry will exert high demand for water resources and it was therefore imperative for the study to assess water availability within the project area. The consultants engaged the services of Geosol Consulting Limited to undertake a hydrogeological survey of the proposed project site targeting ground water resources (Table 2 and 3). The results indicated that groundwater bearing

formation is expected within weathered/porous or fractured phonolites and that there are a number of relatively productive boreholes in area.

**Table 2: Hydraulic Conductivity for the proposed project site (Source: Geosol Consulting Limited, June 2019)**

| Material | Hydraulic Conductivity | Remarks |
|---|---|---|
| **Fetter 1994** | | |
| Clay | $8.6^{-7} – 8.6^{-4}$ | |
| Silt, sandy silts, clayey sands or till | $8.6^{-4} – 0.09$ | |
| Silty sands, fine sands | $8.63^{-3} – 0.86$ | |
| Well-sorted sands, glacial outwash | 0.86 – 86 | |
| Well-sorted gravel | 8.6 – 860 | |
| **Domenico et al 1990** | | |
| Shale | $8.6^{-11} – 1.7^{-6}$ | |
| Anhydrite | $3.5^{-10} – 1.7^{-5}$ | |
| Salt | $8.6^{-10} – 8.6^{-8}$ | |
| Siltstone | $8.6^{-9} – 1.2^{-5}$ | |
| Sandstone | $2.6^{-7} – 5.2^{-3}$ | |
| Limestone and dolomite | $8.6^{-7} – 5.2^{-3}$ | |
| Karts and reef limestone | $8.6^{-4} – 17$ | Value Stoni Athi area region |

**Table 3: Vertical Electrical Sounding Layered model interpretation for the proposed project site (Source: Geosol Consulting Limited, June 2019)**

| Layer No. | Resistivity (ohm-m) | Thickness (m) | Depth (m) | Lithology | Water prospects |
|---|---|---|---|---|---|
| 1 | 7.34 | 0.812 | 0.812 | Weathered phonolites | Poor |
| 2 | 59.83 | 0.933 | 1.74 | Slightly weathered phonolites | Poor |
| 3 | 121.6 | 17.77 | 19.52 | Com slightly weathered phonolites | Fair |
| 4 | 203.4 | 63.55 | 83.08 | Slightly weathered phonolites | Fair |
| 5 | 30.75 | 154.60 | 237.60 | Highly weathered phonolites | Fair to Good |
| 6 | 43.49 | ---- | >237.6 | Highly weathered phonolites | Fair to Good |

## 2.7 Baseline environmental quality

The proposed aggregate quarry will generate dust and noise pollution during its establishment phase and subsequent operations mainly from blasting, loading and offloading activities. For the purposes of obtaining the baseline conditions for future monitoring of the environmental performance of the facility, the consultants engaged a NEMA designated laboratory, Polucon Services (K) Limited, to sample and analyse environmental media which included air and noise based on the corresponding Environmental Management and Coordination Act Regulations. The results (Table 4 & 5) will be used to provide a benchmark for implementing the Environmental Monitoring Programme proposed under Chapter 7 of the report.

### 2.7.1 Air Quality

Particulate matter and gaseous pollutants measured were all within the stipulated standards under the Environmental Management and Coordination (Air Quality) Regulations, 2014 (Table 4). The measured levels of $SO_2$ and $H_2S$ were below detectable limits (BDL).

**Table 4: Baseline air quality measurements for the project site (Source: Polucon Services (K) Limited, June 2019)**

| Location | VOC $\mu g/m^3$ | $NO_2$ PPM | $H_2S$ $\mu g/m^3$ | $SO_2$ $mg/m^3$ | $PM_{2.5}$ $\mu g/m^3$ | $PM_{10}$ $\mu g/m^3$ |
|---|---|---|---|---|---|---|
| Site | 0.095 | 0.0995 | BDL | BDL | 6.5 | 17 |
| Hourly average conc. | 0.095 | 0.0995 | - | - | 6.5 | 17 |
| Precision of results | 0.095±0.01 | 0.095±0.039 | | | 6.5±1.0 | 17±4.0 |
| EMCA ( Air Quality) Regulations 2014 | | 0.2 ppm 1 hour mean average | | 10 $mg/m^3$ | 75 $\mu g/Nm^3$ | 150 $\mu g/Nm^3$ |

### 2.7.2 Noise Monitoring

The results of noise level measurements comply with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control), 2009 (Table 5).

**Table 5: Baseline noise quality measurements for the project site (Source: Polucon Services (K) Limited, June 2019)**

| Location | Coordinates | LAeq (dBA) | L5 (dBA) | L50 (dBA) | L95 (dBA) | EMCA Guidelines (Day time) |
|---|---|---|---|---|---|---|
| Proposed Quarry site | E: -1.566695 N: 36.978685 | 39.6 | 43.2 | 35.2 | 33.6 | 55 |

## 2.8 Infrastructure

Kaputiei area has both classified and unclassified roads and is majorly serviced and accessed by the Nairobi-Namanga Road. The proposed site is accessible via an earth road. The MGR lies to the East of the proposed site (Figure 8). The proponent will adhere to the 30 meters setback as stipulated by the Kenya Railways Corporation Act.

**Figure 8: The old railway line (MGR) that passes to the East of the proposed site (Source: Site visit, May 2019)**

# 3 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

## 3.1 Overview

The proposed project will have both socio-economic benefits and associated negative environmental impacts. The purpose of the EIA process is to therefore systematically assess the value of the benefits against the environmental concerns and provide measures to either avoid, prevent or reduce the magnitude of the impacts. The mitigation measures are based on the underlying principle of EIA that everyone is entitled to a clean and healthy environment and a duty to enhance and safeguard the environment.

## 3.2 Positive impacts of the proposed project

The following are the positive impacts of the proposed development.

### 3.2.1 Simulation of industrial development coherent with Kenya's Vision 2030

Mining ensures industrialization and development through the utilization of the country's mineral resources to catalyze diversified industrial development. This is in line with the Kenya Vision 2030 which aims at harnessing the mineral resources for industrial development and transforming Kenya into a newly industrializing middle income country.

### 3.2.2 Mitigating national and regional demand for aggregates

The establishment of the quarry will increase production of aggregate which will help mitigate the deficit in national and regional demand as well as provide adequate raw materials for construction industries.

### 3.2.3 Creation of employment opportunities

This proposed project will provide short term and long term employment opportunities for various experts and person(s) that will be hired during the planning and implementation activities. This will include both skilled and unskilled personnel especially from the local population. Hence, the experts and the local community members will derive income from the project.

### 3.2.4 Source of revenue to the government

Both the County and National government will generate revenue in form of taxes generated during the acquisition of licenses and operations of the facility and also PAYE remitted from the employees' salaries.

### 3.2.5 Source of income to the proponent

The proposed facility through its operations will accrue income to the proponent enabling expansion of business and creating more employment opportunities for Kenyans.

## 3.3 Negative environmental impacts

Alongside the project benefits, there will are potential negative environmental impacts at the three phases of the project cycle. These are pre-establishment and establishment, operational and possible decommissioning phases. The proceeding sections discuss each of these phases' impacts on the environmental and the livelihoods of the local community.

### 3.3.1 Pre-establishment and establishment phase impacts

#### 3.3.1.1 Change in land use

The current land use of the area is agricultural. However, the proponent proposes to set up an aggregate quarry which is inconsistent with the current land use.

Mitigation measure

1. The proponent will apply and obtain a change of user from the County Government of Kajiado

#### 3.3.1.2 Environmental risks of obtaining raw materials

Installation of the aggregate crusher and other construction activities will require raw materials such as aggregate, cement and sand among others which will be sourced from the environment. These materials will have an impact at their points of origin.

Mitigation measures

1. Procure quantities that are sufficient for the intended works and recycle as far as practical to curtail wastage
2. Source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 Laws of Kenya

#### 3.3.1.3 Occupational safety and health

The workforce and visitors to the site will be exposed to potential health and safety risks such as injuries that may result from accidental falls and the use of construction tools and equipment with a potential to cause injury, permanent disability or death. Further, workers may be exposed to high noise levels and dust which may cause health problems.

Mitigation measures

1. Register the site as a work place with the Directorate of Occupational Safety and Health Services (DOSHS)
2. Provide adequate and appropriate PPE and enforce their use
3. Provide employees with correct tools and equipment for the jobs assigned and train on their use
4. Obtain insurance cover for the workers at the site
5. Provide first aid services and an emergency vehicle at the site
6. Regulate the entry of visitors to the site by deploying adequate security measures
7. Ensure moving parts of machines and sharp surfaces are securely protected with guards to avoid unnecessary contacts and injuries during construction phase
8. Comply with the provisions of the Occupational Safety and Health Act 2007

#### 3.3.1.4 Water demand and effluent generation

The construction activities will utilize substantial quantities of water for mixing and casting concrete, drinking and sanitation purposes which will lead to an increased demand for water. Water will be sourced from a borehole and 70% of domestic water use will generate effluent.

Mitigation measure

1. Procure and deliver to the site mobile toilets from a NEMA licensed waste contractor for use by the workers during the construction phase of the project cycle
2. Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006

#### 3.3.1.5 Solid waste generation

The workforce at the site and activities undertaken during site preparation and construction of auxiliary facilities are expected to generate significant quantities of solid waste such as cuttings, plastic materials and rejected materials among others. The proponent will therefore ensure proper management of solid waste to avoid potential risks associated with poor disposal.

Mitigation measures

1. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site
2. Create awareness on best waste management practices among the workers i.e. on the process of solid waste collection, segregation and proper disposal
3. Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
4. Procure the services of a NEMA licensed waste handler to dispose the solid waste
5. Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

#### 3.3.1.6 Air pollution

Sources of air pollution during the construction activities and installation of the crushing plant will result mainly from excavation works, mixing of aggregates and from movement of vehicles carrying construction materials. If generated in large quantities, dust may present a respiratory hazard, cause eye irritation or visual intrusion. It will potentially affect the workers, visitors to the project site and the neighbors if it is in excess of 100 $\mu g/m^3$.

Mitigation measures

1. Restricting the speed of trucks and other vehicles accessing the project site to 40km/hr
2. Sprinkling water on excavation areas
3. Provision and enforcement of appropriate PPE to workers such as dust masks
4. Develop and implement an air quality monitoring plan to ensure compliance with the limits set under Schedule 1 of the Environmental Management and Coordination (Air Quality) Regulations, 2014

#### 3.3.1.7 Noise pollution

Noise and vibration emanating from vehicle accessing the site, excavation works and machinery operations may be a concern during operations at the site. Noise may lead to hearing impairments which will reduce the workmanship of the employees and also affect their finances due to treatment and medication. Construction sites such as the proposed quarry which are near residential areas can only emit noise levels of up to 60 dB(A) during the day and 35dB (A) during the night as per the Second Schedule of the Environmental Management and Coordination (Noise And Excessive Vibration Pollution) (Control) Regulations, 2009. Some of the project activities such as use of heavy machinery and equipment may produce noise levels which are above these limits and are a health hazard. While the noise at this stage is inevitable its impact can be mitigated in the following ways

Mitigation measures

1. Provision and enforcement of appropriate PPE to workers such as ear muffs
2. Truck drivers will be sensitized to avoid unnecessary hooting or running of vehicle engines
3. Minimizing the frequency of transport of construction materials
4. Compliance to the Environmental Management And Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

### 3.3.2 Operational phase impacts

#### 3.3.2.1 Land degradation

This mainly results from stripping of the topsoil and excavation to expose the rock strata. This will tamper with the soil structure exposing the site to possible landslides and soil erosion as well as interrupting the continuity of open space.

Mitigation measures

1. Treat the quarry faces by initializing stabilization of the quarry pits walls through stepping of the faces to prevent erosion. This also reduces the risk of loose boulders falling from quarry faces during blasting
2. Restore the affected areas through rehabilitation of decommissioned quarry pits and planting of indigenous plant species which create a stable final landform with acceptable post-mining land use capability

#### 3.3.2.2 Removal and disposal of quarry overburden

Establishment of the quarry will result in generation of overburden comprised of top soils, vegetation and rock rumble. If inappropriately disposed, the overburden becomes an eyesore apart from harboring insects and disease causing vectors.

Mitigation measure

1. Reusing overburden as backfilling material during site rehabilitation and restoration

#### 3.3.2.3 Effects on landscape and visual intrusions

Stockpiles and quarry waste piling have a negative effect on the landscape by causing visual intrusion. Blasting activities usually destroy the original landscape of the affected area leaving behind huge depressions and a potential point of collecting water forming artificial ponds. These water pools have a potential to be hazardous and pose a threat to health. There is also a huge possibility that many of the surface features that were present before mining activities cannot be replaced after the process has ended.

Mitigation measures

1. Take into consideration the existing landforms and vegetative cover in siting before drilling and excavation
2. Locate stockpiles, overburden, quarry waste & haul routes away from sensitive landscape & visual receptors
3. Backfill the quarry pits where applicable using the overburden generated during excavation

#### 3.3.2.4 Impact on biodiversity

Sections of the proposed site will be cleared to pave way for excavation and other quarrying activities. Quarrying activities disrupts the macro habitat and the species they support. There are species that are resistant to such disturbances while others are adversely affected to the extent of completely disappearing from the mining zone. Endemic plant and animal species are most affected since they are very sensitive and they require specific environmental conditions, even the slightest disruption of their habitats can result in extinction or put them at high risk of being wiped out.

Dust produced will also have physical effects on the surrounding vegetation such as blocking and damaging internal structures hence impacting on their physiological activities. Vegetation provide habitat for organisms. They also protect ground surface from wind and water erosion and stabilizes other physical environmental attributes such as microclimate, water and soil moisture regimes which in turn influence organisms' abundance.

Mitigation measures

1. Retain vegetation cover where possible within the site
2. Rehabilitate the quarried areas and plant appropriate indigenous trees or approved exotic ones in collaboration with the Kenya Forest Service

#### 3.3.2.5 Occupational health and safety

Quarrying activities pose potential threats to the health and safety of workers on site. This may be in the form of dust from excavation works, fumes from machinery and vehicles accessing the site, accidents from machinery and equipment, injuries that may result from excavation activities and accidental falls. The quarry pits may also pose a threat to community health and safety as they may become important breeding grounds for disease causing pathogens especially during the rainy seasons, and accidental falls of both human and livestock in the water pools could lead to drowning.

**Mitigation measures**

1. Register the site as a workplace with the Directorate of Occupational Health and Safety
2. Provide adequate training to staff on health and safety
3. Provide and enforce appropriate PPE among workers and visitors to the site
4. Provide a fully equipped first aid box, first aid services and emergency vehicle at the site
5. Provide the correct equipment to employees for the jobs assigned and trained on their use
6. Designate a fire assembly point within the facility
7. Set-up a fire safety plan for the facility
8. Regulate access to the site by deploying adequate security measures and fencing where appropriate to protect workers, local community members and livestock from potential accidents
9. Backfill the quarried areas to reduce the risk of becoming breeding ground for disease causing pathogens
10. Ensure compliance with the provisions of the Occupational Safety and Health Act, 2007

#### 3.3.2.6 Water demand and effluent generation

The quarry will exert pressure on water for washing of vehicles and machinery, sanitation purposes, dust suppression and general housekeeping around the area during operations. 70% of the domestic water use will be generated as effluent while the rest will seep into the ground areas within the site. Effluent generated will need to be disposed off appropriately.

**Mitigation measures**

1. Install a bio-digester to manage effluent
2. Undertake quarterly analysis of the effluent
3. Compliance with Environmental Management and Coordination (Water Quality) Regulations, 2006

#### 3.3.2.7 Energy demand

The operations of the quarry will increase the demand on energy for running the machinery and equipment and for lighting and powering of electrical appliances. Energy supply for development will be obtained from the national grid and supplemented by a standby generator.

**Mitigation measure**

1. Maintenance of machinery and equipment in a serviceable and good working order to maximize their efficiency on fuel

#### 3.3.2.8 Solid waste generation

The quarry facility will generate solid waste mostly in form of explosives packaging, oil and grease containers used for maintenance of machinery and overburden among others. These have a potential of pollution if not disposed off appropriately. The proponent will therefore ensure

proper management of solid waste during the operation of the quarry through the following measures.

Mitigation measures

1. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the site
2. Create awareness on best waste management practices among the workers i.e. on the process of solid waste collection, segregation and proper disposal
3. Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
4. Procure the services of a NEMA licensed waste handler to dispose the solid waste
5. Re-use quarry waste and soil materials piled at the site to refill (restore) the excavated areas that exist as a result of mining
6. Complying with the Environmental Management and Coordination (Waste Management) Regulations, 2006

### 3.3.2.9 Air pollution

Dust from quarrying activities is a major source of air pollution. Mining requires soil to be removed which eventually causes the particles to become airborne through road traffic and wind erosion. The unrefined particles can be composed of toxic materials and ultimately affect the human health causing respiratory diseases. Blasting and crushing of the boulders will also produce lots of dust. In addition fumes and hydrocarbons produced by the heavy commercial vehicles and heavy machinery may lead to respiratory complications.

Mitigation measures

1. Sprinkling water at the quarry site to suppress dust
2. Provision and enforcement of appropriate PPE to workers such as dust masks
3. Retaining existing vegetation in areas which are not earmarked for quarrying to act as dust screens and a buffer zone between the quarry area and the settlements
4. Develop and implement an air quality monitoring plan to ensure compliance with the limits set under Schedule 1 of the Environmental Management and Coordination (Air Quality) Regulations, 2014

### 3.3.2.10 Noise pollution

Quarrying involves several activities that generate significant amount of noise. These include blasting, use of powered machineries to transport the aggregates and processing plants that will crush and grade the materials. Excessive vibrations are mainly from drilling and crushing of the boulders is a nuisance and cause further disturbance to the environment.

Mitigation measures

1. Use buffer zones by locating the quarry facility away from settlements
2. Provide and enforce the use of earmuffs to all workers and visitors accessing noisy areas of the facility
3. Increase the number of delay detonators used in a round of blasting so as to yield minimal ground vibrations and noise
4. Conduct noise mapping to inform mitigation measures
5. Comply with the Environmental Management And Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

#### 3.3.2.11 Impacts of electric blasting

Blasting has both safety and health concerns during its deployment and eventual use of explosives. It exposes workers to airborne hazards from naturally occurring gases, chemical vapors and principal hazard such as noise, segmental vibration and heat. Susceptible structures to ground vibrations cause disturbances to the occupants.

#### Mitigation measures

1. All loading and firing shall be directed and supervised by competent person(s) thoroughly experienced in this field and accredited accordingly
2. Employing qualified personnel to handle and store the explosives
3. Providing and enforcing the use of earmuffs to all workers and visitors to the facility
4. Increasing the number of delay detonators used in a round of blasting
5. Adhere to the provisions of the Explosives Act, 2016

#### 3.3.2.12 Ground and surface water pollution

Quarrying activities present potential ground and surface water pollution. The hydrogeology regime will be affected by the distinct aspects of surface mineral extraction and associated activities which will result in groundwater pollution. Removal of the rock strata can cause the floor to heave and allow for water seepage. Sometimes quarries are dug below the water table and hence toxic materials could seep into the ground water. The activities of the proposed quarry will have a potential to pollute the river that lies approximately 1km from the proposed site. Surface water pollution can be caused by acid mine drainage and loading of Sediment, debris and impurities from soil erosion or surface runoff.

#### Mitigation measures

1. Ensure that blasting and drilling are not undertaken to the water table level
2. In the event of flooding, water will be pumped out of the mines to avoid acid rock drainage and dissolution. In case of any contamination, pumped water will be treated to neutralize the contaminants
3. Secure the site with an impermeable boundary wall to ensure that the mining tailings and overburden are contained within the site
4. Maintain maximum existing vegetation coverage and plant more trees along the boundary wall to act as buffers

#### 3.3.2.13 Impact of heavy trucks on roads

Once the quarry begins operations, there will be heavy commercial vehicles ferrying aggregates to different areas. Overloaded trucks may cause damage on the roads. To mitigate this impact the proponent and truck drivers will adhere to the axle load limits set by the Kenya Roads Board.

### 3.3.3 Decommissioning phase impacts

The lifespan of the quarry is dependent on the quantities of the rock deposit, technology used to mine and financial sustainability of the business. Other circumstances that may warrant decommissioning include withdrawal or expiry of licenses issued by government agencies, closure by government agencies, court orders and natural calamities. The proponent will prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance. The impact at this phase will include the following:

1. Creation of an ecologically vulnerable land
2. Economic decline
3. Insecurity
4. Safety and health risks

5. Waste generation

#### 3.3.3.1 Creation of an ecologically vulnerable land

At this phase, destruction of various fauna and flora at the site is evident. Quarrying activities also have a direct impact on the land by leaving pits and heaps of waste material. Excavation, drilling and blasting will tamper with the soil structure exposing the site to possible landslides and soil erosion. Additionally, the terrain of the site would be against the topography of the area.

**Mitigation measures**

1. Construct contour banks to protect disturbed areas from erosion prior to stabilization
2. Rip along the contoured slopes and immediate re-vegetation to increase slope stability
3. Promote re-vegetation through the encouragement of the natural process of secondary succession

#### 3.3.3.2 Economic decline

Employment opportunities and the County and National economic gain from the investment activity will be lost in the event of decommissioning of the proposed project.

**Mitigation measures**

1. Train employees on alternative livelihoods prior to decommissioning
2. Pay terminal benefits to all employees
3. Comply with the Labor laws

#### 3.3.3.3 Insecurity

Insecurity will result from the site when it's abandoned succeeding the decommissioning. Unoccupied structures and uncovered pits within the site will act as criminal dens and the security boost that had been provided by the facility to the local community would be lost.

**Mitigation measure**

The proponent will contract a reputable security firm to man the site.

#### 3.3.3.4 Safety and health risks

Any remaining structures will collapse and the open pits will accumulate water overtime. There will be environmental hazards stemming from the exposed left over substances which may cause soil and water contamination and/or generate noxious odor. Possible dust emission and accidents during rehabilitation of the site could also pose a health and safety hazard to workers and general public.

**Mitigation measures**

1. Ensure the process of rehabilitation is supervised by competent personnel
2. Install signage to warn person(s) of the ongoing activities
3. Provide adequate and appropriate PPE and enforce their use
4. Ensure first aid kit are be available on site
5. Ensure workers are given the correct hand tools and equipment for the jobs assigned

#### 3.3.3.5 Waste generation

Demolition activities will result in generation of both solid waste and effluent. The main sources of solid waste will include demolition waste from the auxiliary facilities. Effluent generated will also need to be disposed off appropriately.

### Mitigation measures

1. Contract a licensed construction company to carry out demolitions
2. Reuse and recycle demolition waste and equipment as far as practical
3. Contract a NEMA licensed waste handler to handle and dispose both solid waste and effluent generated

### 3.3.4 Neighborhood consultations

Public consultations were undertaken using questionnaires administered to neighbors and stakeholders to collect and document their concerns regarding the establishment and subsequent operation of the proposed aggregate quarry (Table 6). None of the respondents interviewed objected to proposed project. The main positive impacts identified by the neighbors include job opportunities for the locals, income generation to the proponent, improvement of businesses in the area, improved security, revenue to the government and improved economy. The key environmental concerns that were identified include air and noise pollution.

**Table 6: Summary of comments obtained from neighbors and stakeholders of the proposed aggregate quarry**

| No. | Respondents profile | | | |
|---|---|---|---|---|
| | Name | Tel contact | ID No: | Comments |
| 1. | Philip Kipino | 0743725606 | | • No objections<br>• Water supply<br>• Provision of job opportunities<br>• Dust emissions |
| 2. | Samuel Kipino | 0797291786 | | • No objections<br>• Employment opportunities<br>• Business improvement<br>• Benefit to the proponent |
| 3. | Josephine | 0713935988 | 25052815 | • No objections<br>• Employment opportunities<br>• Dust pollution<br>• Noise pollution |
| 4. | Emily Samuel | 0700670701 | | • No objections<br>• Employment to the locals<br>• Government revenue<br>• Improvement of small business in the area |
| 5. | Stanly Rukunga | 0723142601 | 8695879 | • Employment to the locals<br>• Improved security<br>• Air pollution from dust<br>• Noise pollution |
| 6. | Jackline Joseph | 0781250070 | | • No objections<br>• Job creation<br>• Dust emission |
| 7. | Jane Nzisa | 0759701556 | 2009641 | • No objections<br>• Employment opportunities<br>• Government revenue |
| 8. | Nice Lankisa | 0726976454 | 24506073 | • No objections<br>• Employment to the locals<br>• Air and noise pollution |

| | | | | |
|---|---|---|---|---|
| 9. | Stephew Guhelo | 0711509538 | 33030846 | • No objections<br>• Employment to the locals<br>• Dust pollution |
| 10. | Vyonne Meshack | 0703579785 | 28796910 | • No objections<br>• Electricity<br>• Job creation to the locals<br>• Dust and noise pollution |
| 11. | Esther | 0791201166 | 30272041 | • No objections<br>• Improvement of the economy<br>• Noise and dust pollution |
| 12. | Mapedin Letoje | 0733219236 | 30644700 | • No objections<br>• Improvement of small business in the area<br>• Dust emission |
| 13. | Lmayan Leitore | 0717203591 | 26128794 | • No objections<br>• Job creation for locals<br>• Noise pollution |
| 14. | Lacha Ortoya | | 30618137 | • No objections |
| 15. | Lesitii Letore | | 20137109 | • No objections<br>• Employment opportunities |
| 16. | Japok Bulyar | 0716012223 | 26165645 | • No objections<br>• Job opportunities<br>• Dust emissions |
| 17. | Lomogi Lesa | 0755904731 | 30912081 | • No objections<br>• Creation of employment<br>• Improvement of infrastructure<br>• Dust and noise pollution |
| 18. | Rapunye Lenanayankerra | | 31859434 | • No objections<br>• Job creation<br>• Dust emission |
| 19. | Lopir lengeribei | | 8150319 | • No objections<br>• Job opportunities |

### 3.3.5 Impact analysis

Potential project impacts are predicted and quantified to the extent possible. The magnitude of impacts on resources such as water and air or receptors such as people, communities, wildlife species and habitats is defined. Magnitude is a function of the following impact characteristics;

1. Type of impact(direct, indirect, induced)
2. Size, scale or intensity of impact
3. Nature of the change compared to baseline conditions(what is affected and how)
4. Geographical extent and distribution( eg local, regional, international)
5. Duration and/or frequency(eg temporary, short-term, long term, permanent)

Magnitude describes the actual change that is predicted to occur in the resource or receptor. It takes into account all the various impact characteristics in order to determine whether an impact is negligible or significant. Some impacts can result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be

regarded as essentially having no impact and are characterized as having a negligible magnitude (Table 7)

The levels of impacts are defined using the following terms

1. **Negligible impact (very low) -** Where a resource or receptor would not be affected by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background variations.
2. **Less than significant impact (Low**) - Is a minor impact where a resource or receptor would experience a noticeable effect but the impact magnitude is sufficiently low (with or without mitigation) and /or the resource or receptor is of low sensitivity. In either case, a less than significant impact must be sufficiently below applicable standard threshold limits.
3. **Potentially significant impact (moderate) -** A moderate impact that meets applicable standards but comes near the threshold limit. The emphasis for such moderate impacts is to demonstrate that the impact has been reduced to a level that is as minor as reasonably practicable so that the impact does not exceed standard threshold limits.
4. **Significant impact (high) -** One where an applicable standard threshold limit would or could be exceeded, or if a highly valued or very scarce resource would be substantially affected.

**Table 7: Risk and impact significance matrix for the proposed aggregate quarry**

| Environmental impact | Magnitude of impact at establishment phase | Magnitude of impact at operational phase |
|---|---|---|
| Sourcing of raw materials | 2 | - |
| Land degradation | 1 | 2 |
| Noise and air pollution | 1 | 2 |
| Landscape and visual intrusions | 0 | 1 |
| Solid waste generation | 1 | 1 |
| Water demand | 0 | 2 |
| Effluent generation | 2 | 2 |
| Occupational Safety and Health | 1 | 2 |
| Increased demand for energy | 0 | 2 |
| Ground and surface water pollution | 1 | 2 |
| Electrical blasting | - | 3 |
| Impacts on biodiversity | 0 | 2 |
| Road damage | 0 | 1 |

**Legend**

| Magnitude | Impact score |
|---|---|
| Negligible | 0 |
| Low | 1 |
| Moderate | 2 |
| High | 3 |

# 4 ENVIRONMENTAL MANAGEMENT PLAN

## 4.1 Introduction

The preceding section has analyzed and identified the potential environmental and social impacts of the proposed aggregate quarry as well as the mitigation measures to address the impacts. Under this section three EMPs are proposed to guide the proponent in implementing the mitigation measures. These are EMPs for establishment, operational and possible decommissioning phases. Each of the EMP is organized into five sections comprising of the environmental concerns, specific issues, the proposed mitigation measures, implementing party and a budget. The strategies for mitigation include preventing the impact from occurring in the first place, minimizing the impact, taking corrective action where impact occurs among others. The overall focus is to ensure that the project complies with the substantive EIA Principle of ensuring the right to a clean and healthy environment during the entire project cycle.

## 4.2 Environmental Management Plan for establishment phase

At the establishment phase, the focus on the EMP is on addressing the use of environmental resources, pollution of environmental media and occupational health and safety (Table 8).

## 4.3 Environmental Management Plan for operational phase

The main environmental concern at this phase is land degradation, pollution of environmental media and occupational health and safety. Others will include use of environmental resources and road destruction (Table 8).

## 4.4 Environmental Management Plan for decommissioning phase

The decommissioning EMP is important in the event of end of project cycle and non-compliance. The key issues of concern at this stage will be the waste generated by demolition, health and safety and loss of employment opportunities and income to the proponent (Table 9).

Table 8: Environmental Management Plan for the establishment and operational phase of the proposed aggregate quarry

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| **Pre-establishment and establishment phase** | | | | |
| Land use | Change in land use | Obtain a change of user from Kajiado County Government | Proponent | TBD |
| Use of environmental resources | Impact of raw materials at origin | Procurement of sufficient quantities of materials to reduce wastage of resources | Proponent/Contractor | Nil |
| | | Source materials from sites which are compliant with EMCA Act Cap 387 | Proponent/Contractor | Nil |
| Health and safety | Occupational health and safety | Register site as a workplace with DOSHS | Proponent/Contractor | 5,000 |
| | | Provide and enforce the use of PPE | Proponent/Contractor | 500,000 |
| | | Provision of correct tools to workers and trained on use | Proponent/Contractor | 50,000 |
| | | Obtain insurance cover for workers | Proponent/Contractor | 200,000 |
| | | Provide first aid services and emergency vehicle | Proponent/Contractor | 2,000,000 |
| | | Regulate access to by deploying security measures | Proponent/Contractor | 100,000 |
| | | Secure moving parts of machines and sharp objects with guards | Proponent/Contractor | 100,000 |
| | | Comply with OSHA, 2007 | Proponent/Contractor | Nil |
| Pollution | Air pollution | Restriction of vehicles' speed to 40km/hr | Drivers | Nil |
| | | Sprinkle water to suppress dust | Proponent/Contractor | 3,000,000 |
| | | Provision and enforcement of appropriate PPE | Proponent/Contractor | 500,000 |
| | | Implement Air Quality Monitoring plan | Proponent/Contractor | 100,000 |
| | | Comply with Air Quality Regulations, 2014 | Proponent/Contractor | Nil |
| | Noise pollution | Provision and enforcement of ear muffs | Proponent/Contractor | 200,000 |
| | | Avoid unnecessary hooting or running of vehicle engines | Truck drivers | Nil |
| | | Minimizing the frequency of transport of construction materials | Proponent/Contractor | Nil |
| | | Compliance to the Noise and Excessive Vibration Pollution (Control) Regulations 2009 | Proponent/Contractor | Nil |
| | Effluent generation | Procure and deliver to the site mobile toilets from a NEMA licensed waste contractor | Proponent/Contractor | Tender |

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| | | Comply with Water Quality Regulations, 2006 | Proponent/Contractor | Nil |
| | Solid waste generation | Procure waste collection bins with capacity for segregation | Proponent/Contractor | 200,000 |
| | | Create awareness on waste management | Proponent/Contractor | Nil |
| | | Procure a sizeable central waste collection bin | Proponent/Contractor | 250,000 |
| | | Procure the service of NEMA licensed solid waste handler | Proponent/Contractor | Tender |
| | | Comply with Waste Management Regulations, 2006 | Proponent/Contractor | Nil |
| Operational phase | | | | |
| Quarry overburden | Disposal and pollution | Re-using overburden in backfilling of decommissioned quarry pits | Proponent | Nil |
| Habitat destruction | Land degradation | Treat the quarry faces by initializing stabilization of the quarry pits walls through stepping of the faces to prevent erosion | Proponent | Nil |
| | | Restore the affected areas through rehabilitation of decommissioned quarry pits and planting of indigenous plant species | Proponent | 3,000,000 |
| | Effects on landscape & visual intrusions | Take into consideration the existing landforms, settlements & vegetative cover | Proponent | Nil |
| | | Locate stockpiles, overburden, quarry waste & haul routes away from sensitive landscape & visual receptors | Proponent | Nil |
| | | Backfill quarry pits using overburden generated | Proponent | Nil |
| | Impact on biodiversity | Retain vegetation cover where possible | Proponent | Nil |
| | | Rehabilitate the quarried areas and plant appropriate indigenous trees or approved exotic ones | Proponent/KFS | TBD |
| Pollution | Air pollution | Sprinkle water to suppress dust | Proponent | 3,000,000 |
| | | Provide and enforce use of PPE | Proponent | 200,000 |

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| | | Retaining existing vegetation in areas which are not earmarked for quarrying to act as dust screens and a buffer zone | Proponent | Nil |
| | | Implement Air Quality Monitoring plan | Proponent | 100,000 |
| | | Comply with Air Quality Regulations, 2014 | Proponent | Nil |
| | Noise pollution | Locating the quarry facility away from settlements | Proponent | Nil |
| | | Provide and enforce use of earmuffs to workers and visitors accessing noisy areas | Proponent | 200,000 |
| | | Increase number of delay detonators in a round of blasting | Proponent | Nil |
| | | Conduct noise mapping to inform mitigation measures | Proponent/NEMA designated laboratory | 30,000 |
| | | Comply with Noise and Excessive Vibration Pollution (Control) Regulations, 2009 | Proponent | Nil |
| | Ground and surface water pollution | Ensure blasting and drilling are not undertaken to water table level | Proponent | Nil |
| | | Pumping of water out of the mines in the event of flooding | Proponent | Internal costs |
| | | Secure the site with an impermeable boundary wall | Proponent | TBD |
| | | Maintain maximum existing vegetation coverage and plant more trees along the boundary wall to act as buffers | Proponent | 50,000 |
| | Solid waste generation | Procure waste collection bins with capacity for segregation | Proponent | 200,000 |
| | | Create awareness on waste management | Proponent | Nil |
| | | Procure a sizeable central waste collection bin | Proponent | 250,000 |
| | | Procure the service of NEMA licensed solid waste handler | Proponent | Tender |
| | | Re-use quarry waste and overburden to refill (restore) the excavated areas that exist as a result of mining | Proponent | Nil |

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| | | Comply with the Waste Management Regulations, 2006 | Proponent | Nil |
| | Effluent management | Install a bio digester | Proponent | 200,000 |
| | | Undertake quarterly analysis of the effluent | Proponent/NEMA designated laboratory | 10,000 |
| | | Compliance with Water Quality Regulations, 2006 | Proponent | Nil |
| Health and safety | Occupational safety and heath | Register site as a workplace with DOSHS | Proponent/OSH department | 5,000 |
| | | Provide adequate training to staff on health and safety | Proponent/OSH department | 50,000 |
| | | Provide the correct equipment to employees for the jobs assigned and trained on their use | Proponent/OSH department | 50,000 |
| | | Provide adequate and appropriate PPE & enforce use | Proponent/OSH department | 500,000 |
| | | Provide a fully equipped first aid box, first aid services and emergency vehicle at the site | Proponent/OSH department | 2,000,000 |
| | | Designate a fire assembly point | Proponent/OSH department | Nil |
| | | Set-up a fire safety plan for the facility | Proponent/OSH department | Nil |
| | | Display informative and warning signage | Proponent/OSH department | 50,000 |
| | | Regulate access to the site by fencing & deploying security measures | Proponent | 100,000 |
| | | Backfill the quarry pits | Proponent | Nil |
| | | Comply with OSHA, 2007 | Proponent/OSH department | Nil |
| | Impacts of electric blasting | All loading and firing of explosives shall be directed and supervised by competent person(s) | Proponent/OSH department | Nil |
| | | Employ competent personnel to handle & store explosives | Proponent/OSH department | Nil |

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| | | Enforce use of earmuffs to workers and visitors to the site | Proponent/OSH department | 300,000 |
| | | Increase the number of delay detonators | Proponent/OSH department | Nil |
| | | Adhere to the provisions of the Explosives Act, 2016 | Proponent/OSH department | Nil |
| Use of environmental resources | Energy demand | Maintain machines & equipment in a serviceable & good working order | Proponent | 50,000 |
| Road destruction | Impact of heavy trucks on roads | Adhere to the axle load limits set by the Kenya Roads Board | Proponent/truck drivers | Nil |

Table 9: Environmental Management Plan for Decommissioning Phase of the proposed aggregate quarry

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| Environmental rehabilitation | Quarry pits | Rehabilitate quarry pits | Proponent | 10,000,000 |
| Pollution | Waste generation | Contract a construction company for demolitions | Proponent | 100,000 |
| | | Re-use and recycle salvaged materials | Proponent | Nil |
| | | Engage a NEMA licensed waste handler to handle and dispose waste | Proponent | 100,000 |
| Community safety | Insecurity | Contract a reputable security firm | Proponent | 1,000,000 |
| | Health and safety risks | Competent personnel to supervise the rehabilitation | Proponent | 1,000,000 |
| | | Install signage to warn persons on ongoing activities | Proponent | 300,000 |
| | | Provide and enforce use of PPE | Proponent | 500,000 |
| | | Avail First aid kit | Proponent | 100,000 |
| | | Give correct tools and train workers on use | Proponent | Nil |
| Social impact | Economic decline | Train employees on alternative livelihoods | Proponent | 200,000 |
| | | Pay terminal benefits | Proponent | TBD |
| | | Comply with labor laws | Proponent | Nil |

| Environmental concern | Specific issues | Mitigation measures | Implementing party | Costs (KES) |
|---|---|---|---|---|
| Litigation | Court cases | Engage services of a lawyer | Proponent/Lawyer | TBD |
| | | Arbitration | Proponent/Lawyer | TBD |

# 5 TYPICAL PROPOSED QUARRY REHABILITATION PLAN

## 5.1 Re-profiling

The objective of re-profiling is to reinstate soils to a more stable landform, which includes:

1. Re-establishing surface drainage lines
2. Reinstating the land surface that is visually consistent with surrounding land
3. Features re-profiling to original contours and established drainage lines
4. Minimizing the potential for subsidence/ erosion gullies to occur
5. Replacing top soil over subsoil

## 5.2 Contouring the site

Land form reinstatement involves surface contouring to create a stable land formation consistent with the surrounding land form. This ensures water flow over the surface is in cohesion with the surrounding landscape and minimizes the risk of potential erosion. It also ensures that the final landform is consistent with the surrounding land features. Surface contouring should be completed prior to re-spreading of topsoil.

## 5.3 Ripping and scarification

This will be undertaken along contours to assist with binding of the soil layers, increase retention time of water on the slope, aid water infiltration into the soil increasing the opportunity of seed germination success while reducing the volume and velocity of runoff generated from the slope. Ripping will be excluded from under the drip lines of retained vegetation to avoid impacts on the root systems of adjacent vegetation. Scarification can be achieved by ploughing of the sub-surface material prior to topsoil reinstatement

## 5.4 Top soil re-spreading

This involves the reapplication of topsoil accumulated from the original clearing. Top soil will be re-spread to the following specifications:

1. Re-spread over watered and scarified or ripped subsoil's in even layers at a thickness appropriate for the intended land use of the area to be rehabilitated
2. Spread back over in an even layer and left "rough" (rather than smooth. and compacted) to minimize potential erosion, increase water infiltration and to trap seed.
3. Topsoil will cover the entire width of the disturbed area so that there is no exposed sub-surface material. This ensures seeding and germination has the best opportunity to take, enabling establishment of groundcover
4. Topsoil application will only take place following initial reinstatement of the subsoil, construction of contour banks on steep slopes and compaction of subsoil's to account for subsidence
5. Topsoil stockpiled for extended periods will be turned over and mixed prior to replacement.
6. Vehicle movement will be restricted following topsoil re-spreading

## 5.5 Re-vegetation

The re-vegetation of the site will involve direct seeding of native species. This species selection is guided by soil conditions, micro-climate and aspect of the new land form. The ground cover will consist of native grasses or sterile exotic grasses to ensure exotic grasses do not become established. Initial re-vegetation with suitable sediment binding ground cover is essential to provide soil stability. Final slopes and surface contours will approximate native gradients and will blend with adjacent topography. Consequently, subsidence and erosion from areas re-profiled and rehabilitated will be monitored.

# 6 ANALYSIS OF PROJECT ALTERNATIVES

The environmental management plans proposed for the entire project cycle are considered adequate to mitigate the identified potential negative environmental and social impacts. However it is important to analyze the possible alternatives to the project to inform decision making by relevant government agencies and improve the environmental performance of the project. For the proposed project, four alternatives are feasible as follows;

1. The 'No Project' alternative
2. The 'Yes Project' alternative
3. Alternative site
4. Alternative project

## 6.1 The 'No Project' alternative

Under this alternative the project will not be implemented and hence the status quo will be retained. This alternative represents the ideal mitigation measure for the negative environmental and social impacts as they will not occur as a result of the project. Conversely, the positive impacts of the project which include simulation of industrial development coherent with Kenya's Vision 2030, increased production of aggregate, creation of employment opportunities and revenue generation to the government will be lost. This alternative is therefore not viable.

## 6.2 The 'Yes Project' alternative

This alternative envisions that the proposed project will be implemented as proposed in its entirety. It is the best alternative in mitigating the potential loss of benefits to the proponent, the community and the Government of Kenya. In addition, the project will improve the development ranking of Kaputiei area.

## 6.3 Alternative site

An alternative site could be considered for the proposed aggregate quarry if the proposed project would present serious environmental challenges that cannot be reasonably be effectively managed. However, the proposed mitigation measures are considered adequate to minimize the impacts to levels that do not warrant significant environmental damage. Additionally, the proposed site is considered suitable as it has sufficient and substantial rock deposit quantities. Hence, this alternative is not considered viable.

## 6.4 Alternative project

An alternative project such as a residential development, a farm or a ranch could be possible in the event an industrial development is not feasible. There is availability of adequate land and substantial rock deposit quantities suitable for mining activities and this project is deemed economically viable compared to other project alternatives. Thus, an alternative project is not viable.

# 7 ENVIRONMENTAL MONITORING PLAN

## 7.1 Introduction

An Environmental Monitoring Plan is required to ensure full and systematic implementation of the Environmental Management Plan. It entails assessment of environmental performance of the proposed project by documenting, tracking and reporting any changes in environmental parameters in space and time. The purpose of environmental monitoring is to ensure that impacts do not exceed legal standards specified under Environmental Management and Coordination Act Cap 287 of the laws of Kenya and where they exceed appropriate mitigation measures and early warning systems are provided. The frequency of monitoring will vary depending on the parameters, stage of project implementation and the severity of the anticipated/predicted environmental impacts.

The monitoring plan is developed not only in relation to satisfying the statutory requirements of the EIA process, but also as a proactive tool for the proper implementation of the proposed project, within the context of its relationship to the integrity of the environment as well as the stakeholders in the area. The proposed monitoring plan will have the following components;

1. Health and safety monitoring plan
2. Air quality monitoring plan
3. Water quality monitoring plan
4. Solid waste monitoring plan
5. Noise monitoring plan
6. Rehabilitation and biodiversity monitoring plan
7. Energy monitoring plan
8. Environmental monitoring plan

### 7.1.1 Health and safety monitoring plan

#### 7.1.1.1 Introduction

Quarrying activities pose potential threats to the health and safety of workers and visitors. This may be in the form of dust from excavation works, fumes from machinery and vehicles accessing the site, accidents from machinery and equipment, injuries that may result from excavation activities and accidental falls. During rainy seasons, abandoned quarry pits may become important breeding grounds for disease causing pathogens or lead to drowning in case of accidental falls. The purpose of health and safety monitoring plan is to assess existing controls alongside potential health and safety risks in order to develop an effective plan of action and to ensure compliance with Occupational Safety and Health Act, 2007.

#### 7.1.1.2 Monitoring frequency

The responsibility for implementing this monitoring plan will vest in the Department of Occupational Safety and Health and overall the Management on an annual basis.

#### 7.1.1.3 Monitoring strategy

The monitoring schedule will involve conducting occupational health and safety reviews and reports by the proponent, fire safety audits, energy audits among others that will be necessitated by operational activities of the quarry. There will be need for incidents register to document all occurrences, date, place, time, nature of incident, who was involved, action taken and preventive measures implemented throughout the year.

The ideal indicators of success will include zero accidents and fatalities and reduction in the number of incidents and accidents at the site.

### 7.1.2 Air quality monitoring plan

#### 7.1.2.1 Introduction

Potential sources of air pollution at the project site are mainly dust from excavation activities, drilling and blasting. Other sources include emissions from machinery/ equipment and exhaust fumes from vehicles accessing the site and standby generator. Air pollution and emissions above the acceptable level can potentially cause health problems which include respiratory diseases and visual irritants. The purpose of the air quality monitoring plan is to therefore measure the concentrations of dust and gaseous emissions emanating from the project activities and the results compared to the Air Quality Regulations, 2014 to ensure compliance. In addition, the results will be used to evaluate if the adopted air pollution controls and management are effective.

#### 7.1.2.2 Monitoring parameters

The standard specified target values for the purpose of environmental monitoring and protection are stipulated in the First Schedule of the Air Quality Regulations, 2014 (Table 10).

**Table 10: Ambient air quality tolerance limits as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014**

| Pollutant | Time weighted average | Industrial area | Residential, Rural and other area | Controlled areas |
|---|---|---|---|---|
| Sulphur oxides ($SO_x$) | Annual Average* | 80 $\mu g/m^3$ | 60 $\mu g/m^3$ | 15 $\mu g/m^3$ |
| | 24 hours** | 125 $\mu g/m^3$ | 80 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| | Annual Average | | 0.019 ppm/50 $\mu g/m^3$ | |
| | Month Average | | | |
| | 24 hours | | 0.048 ppm/125 $\mu g/m^3$ | |
| | One hour | | | |
| | Instant Peak | | | |
| | Instant Peak (10 min) | | 500 $\mu g/m^3$ | |
| Oxides of Nitrogen ($NO_x$) | Annual Average* | 80 $\mu g/m^3$ | 60 $\mu g/m^3$ | 15 $\mu g/m^3$ |
| | 24 hours | 150 $\mu g/m^3$ | 80 $\mu g/m^3$ | 30 $\mu g/m^3$ |
| | 8 hours | | | |
| | Annual Average | | 0.2 ppm | |
| | Month Average | | 0.3 ppm | |
| | 24 hours | | 0.4 ppm | |
| | One hour | | 0.8 ppm | |
| | Instant Peak | | 1.4 ppm | |
| Nitrogen Dioxide | Annual Average | 150 $\mu g/m^3$ | 0.05 ppm | |
| | Month Average | | 0.08 ppm | |
| | 24 hours | 100 $\mu g/m^3$ | 0.1 ppm | |
| | One Hour peak | | 0.2 ppm | |
| | Instant peak | | 0.5 ppm | |
| Suspended Particulate Matter (SPM) | Annual Average | 360 $\mu g/m^3$ | 140 $\mu g/m^3$ | 70 $\mu g/m^3$ |
| | 24 hours | 500 $\mu g/m^3$ | 200 $\mu g/m^3$ | 100 $\mu g/m^3$ |
| | Annual Average **** | | 100 $\mu g/m^3$ | |
| | 24 hours | | 180 $\mu g/m^3$ | |
| Respirable particulate | Annual Average* | 70 $\mu g/m^3$ | 50 $\mu g/m^3$ | 50 $\mu g/m^3$ |
| | 24 Hours** | 150 $\mu g/Nm^3$ | 150 $\mu g/Nm^3$ | 75 $\mu g/Nm^3$ |

| Pollutant | Time weighted average | Industrial area | Residential, Rural and other area | Controlled areas |
|---|---|---|---|---|
| matter (< 10$\mu$m) (RPM) | | | | |
| PM $_{2.5}$ | Annual Average | 35 $\mu g/m^3$ | | |
| | 24 Hours | 75 $\mu g/m^3$ | | |
| Lead (Pb) | Annual Average* | 1.0 $\mu g/Nm^3$ | 0.75 $\mu g/Nm^3$ | 0.50 $\mu g/m^3$ |
| | 24 hours** | 1.5 $\mu g/m^3$ | 1.00 $\mu g/m^3$ | 0.75 $\mu g/m^3$ |
| | Month Average | | 2.5 | |
| Carbon monoxide/ carbon dioxide | 8 hours | 5.0 $mg/m^3$ | 2.0 $mg/m^3$ | 1.0 $mg/m^3$ |
| | One hour | 10 $mg/m^3$ | 4.0 $mg/m^3$ | 2.0 $mg/m^3$ |
| Hydrogen Sulphide | 24 hours** | 150 $\mu g/m^3$ | | |
| Non methane hydrocarbons | Instant Peak | 700ppb | | |
| Total VOC | 24 Hours** | 600 $\mu g/m^3$ | | |
| Ozone | One hour | 200 $\mu g/m^3$ | 0.12ppm | |
| | 8 hour (Instant Peak) | 120 $\mu g/m^3$ | 1.25ppm | |

#### 7.1.2.3 Monitoring location

Air quality monitoring will be conducted within the proposed project and areas in close proximity to the residential developments and other neighborhoods. These locations are considered to be sensitive receptors.

#### 7.1.2.4 Monitoring frequency

Baseline Air quality monitoring was conducted on 8th June 2019 and thereafter monitoring will be done on a quarterly basis in collaboration with a NEMA, DOSH or by a NEMA accredited laboratory.

#### 7.1.2.5 Test equipment

The instruments to be used during Air Quality measurements should be similar to the one used during the baseline survey to ensure accuracy of inspection, measurements and results.

### 7.1.3 Noise monitoring plan

#### 7.1.3.1 Introduction

Quarrying involves several activities that generate significant amount of noise. These include blasting, use of powered machineries to transport the aggregates and processing plants that will crush and grade the materials. The purpose of noise monitoring plan is to therefore ascertaining the extent of the impact due to the establishment and subsequent operation of the proposed project in compliance with the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (control) Regulations, 2009. The results will be compared to the results that will be obtained during the baseline survey and the maximum permissible noise levels stipulated under the Environmental Management and Coordination (Noise and Excessive Vibration pollution) (control) Regulations, 2009 (Table 11).

**Table 11: Maximum permissible noise levels (mines and quarries) as per the Environmental Management and Coordination (Noise and Excessive vibrations) Regulations, 2009**

| Facility | | Limit Value in dB (C) Max |
|---|---|---|
| 1. | For any building used as a health facilities, educational institutions, convalescent home, old age home or residential building | 109 dB (C) |
| 2. | For any building in an areas used for residential and one or more of the following purposes:<br>Commerce, small-scale production, entertainment, or any residential apartment in an area that is used for purpose of industry, commerce or small-scale production or any building used for the purposes of industry, commerce or small-scale production | 114 dB (C) |

#### 7.1.3.2 Monitoring location

Noise level measurements shall be conducted at the same locations as for air quality monitoring.

#### 7.1.3.3 Monitoring frequency

Baseline noise monitoring was conducted on 8th June 2019 and thereafter monitoring will be done on a quarterly basis in collaboration with a NEMA, DOSH or by a NEMA accredited laboratory. Noise levels will be measured in dB (A).

#### 7.1.3.4 Test equipment

The instruments to be used during noise measurements should be similar to the one used during the baseline survey to ensure accuracy of inspection, measurements and results.

### 7.1.4 Water quality monitoring plan

#### 7.1.4.1 Introduction

The quarry will exert pressure on water for washing of vehicles and machinery, sanitation purposes, dust suppression and general housekeeping around the area. 70% of the domestic water use will be generated as effluent which will be managed through a bio-digester. The objective of the monitoring plan is to provide data and information to improve water quality and management of effluent and to comply with the standards prescribed by the Third Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

#### 7.1.4.2 Monitoring parameters

The water quality parameters to be monitored and the corresponding values prescribed in the Water Quality Regulations, 2006 are shown below (Table 12).

**Table 12: Water Quality Monitoring Parameters and the standards prescribed by the Environmental Management and Coordination (Water Quality) Regulations, 2006.**

| Parameter | EMC (Water Quality) Regulations, 2006 Standards |
|---|---|
| PH Value | 6.5-8.5 |
| BOD mg/L | 30max |
| Chemical Oxygen Demand mg/L | 50 max |
| Total Suspended Solids mg/L | 30 max |
| Ammonia-NH+;mg/L | 100 Max |
| Total Dissolved Solids mg/L | 1200 Max |
| E. *Coli* Colonies count/100ml | Nil |
| Total coliform count/100ml | 1000/100ml |

#### 7.1.4.3 Monitoring frequency

The frequency of monitoring will be quarterly. This will be implemented in collaboration with NEMA, DOSHS or by a NEMA accredited laboratory.

### 7.1.5 Solid waste monitoring plan

#### 7.1.5.1 Introduction

Solid waste generation is likely to emanate from workforce at the site, construction activities and servicing of machinery, equipment and motor vehicles. Poor disposal of solid waste causes environmental pollution and therefore a health risk to communities. The purpose of the monitoring plan is to therefore ensure solid waste is managed in such a way that it protects both the public health and the environment.

#### 7.1.5.2 Monitoring frequency

The frequency of solid waste monitoring will differ from the collection to the disposal stage in order to ensure reduced odours and accumulated heaps of waste. Table 13 describes the outline for which the activity will be monitored but can be adjusted depending on the amount generated.

**Table 13: Sample outline for solid waste monitoring plan**

| Parameter | Frequency | Critical levels (Tons) | Target | Responsibility |
|---|---|---|---|---|
| Collection | Daily | | | |
| Storage | Daily | | | |
| Management | Daily | | | |
| Disposal | Weekly | | | |

#### 7.1.5.3 Monitoring strategy

The solid waste monitoring plan will document the collection, storage and disposal of solid wastes from the warehouses. There is need to code each of the collection points, note the capacity and critical levels, frequency of disposal and the personnel and contractor responsible. In addition, it will be important to characterize the waste streams at the collection points to inform investments in segregation infrastructure.

Indicators of success will include timely collection and disposal of wastes by the contractors, waste disposal tracking documents and certificates issued at the disposal sites in case of hazardous wastes.

### 7.1.6 Rehabilitation and biodiversity monitoring plan

#### 7.1.6.1 Introduction

Quarrying activities will lead to creation of ecologically vulnerable land by tampering with the soil structure leaving pits and exposing the site to possible landslide and soil erosion, and destruction of various fauna and flora. A rehabilitation and biodiversity monitoring plan will ensure the site is restored to its near natural productive state and it will inform continual improvement of the ecological state after rehabilitation.

#### 7.1.6.2 Monitoring frequency

The proponent will ensure monitoring is carried out annually.

#### 7.1.6.3 Monitoring strategy

Monitoring will entail documenting on the flora and fauna species and ecological communities present at monitoring sites, monitoring of subsidence and erosion from areas re-profiled and

rehabilitated and providing recommendations where necessary to enable continual improvement of the ecological management of the project area.

### 7.1.7 Energy monitoring plan

Energy consumption will be monitored through power bills from the Kenya Power and the fuel consumption by the standby generators and other machinery on a monthly basis. The quantitative audit findings will aim to inform substantial practical guidelines for continuous improvement of consumption efficiency and identifying cost saving opportunities in energy efficiency.

### 7.1.8 Environmental monitoring plan

This plan will entail conducting environmental Audits annually to ensure compliance with Regulation 4 of the Environmental Management (Impact Assessment and Audit) Regulations, 2003.

# 8 GOVERNANCE FRAMEWORK

## 8.1 Introduction

The Third Schedule of EIA/EA Regulations requires that environmental guidelines and standards which include Kenya government policies and strategies, national legislation, multi-lateral environmental agreements and the institutional arrangements to render them should be incorporated in an EIA report. The legal and institutional frameworks provide important precautions for protection and conservation of the environment and ensuring community health and safety through compliance with the standards. Under this section, the EIA will therefore review the relevant sets of institutional, legislative and regulatory framework relevant to the proposed aggregate quarry.

## 8.2 Policy Framework

### 8.2.1 National Environment Policy

Kenya has a National Environment Policy prepared and approved in 2013 by the Ministry of Environment, Water and Natural Resources. Its overall goal is to provide better quality of life in Kenya for present and future generations through sustainable management and use of the environment and natural resources. This policy elaborates the effects of uncontrolled exploitation of minerals on the quality and health of the environment. It also encourages equitable exploitation and sound management of mineral resources while ensuring local participation and involvement of indigenous enterprises for investment in the mining sector.

### 8.2.2 The National Industrialization Policy

This policy is aligned to the Kenya Vision 2030 which aspires to transform Kenya into a middle income rapidly-industrializing country. This policy framework focuses on value addition for both primary and high valued goods and linkages between industrial sub-sectors and other productive sectors to drive the industrialization process. It aims at providing strategic direction for the sector growth and development.

### 8.2.3 Mining and Minerals policy

The mining and minerals policy's overall goal is to provide a clear guidance for sustainable mineral resources development and address existing gaps in the mining sector. It strengthens the institutional framework and addresses governance and operational issues, environmental protection, equity, mineral value addition, post-mine closure activities capacity building and mainstream artisanal and small-scale mining. The policy promotes the use of appropriate technology in order to enhance information on the country's mineral potential and increase investment in the mining sector.

## 8.3 Legislative Framework

### 8.3.1 The Constitution of Kenya, 2010

The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the propone in respect to protection of the environment and enforcement of environmental rights.

**Relevance to the proposed project**

- The proponent should ensure that establishment and operations of the quarry do not infringe on the right to a clean and healthy environment for all.
- The proponent must ensure that the development is carried out in an ecologically, economically and socially sustainable manner.

- The proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.

### 8.3.2 Legislation on environment

#### 8.3.2.1 The Environmental Management and Co-ordination Act Cap 387 of the laws of Kenya

The Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.

**Relevance to the development proposal**

Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit an EIA report to NEMA for consideration for decision making. This report is prepared to comply with the provisions of this section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act as discussed below.

**Regulations under the Environmental Management and Coordination Act Cap 387 Laws of Kenya**

To operationalize EMCA, several Regulations have been gazetted since its enactment in 1999 and its amendment in 2015. These relevant ones are;

1. **Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003**
   These Regulations guide the preparation of EIAs including how experts should conduct the EIA process and guidelines and standards to be met by the reports. The Regulations were reviewed in 2016 to align them to the Kenya Constitution 2010. They were also recently amended (2019) to address challenges that have been reported since they were gazetted. This report complies with the provisions of these Regulations.

2. **Environmental Management and Coordination (Water Quality) Regulations, 2006**
   These Regulations address the challenges of pollution of water resources and conservation. It consists of VI parts and eleven schedules dealing with protection of sources of water for domestic use to miscellaneous provisions. For the proposed development, the proponent and contractor will implement measures to prevent water pollution from construction activities and effluent discharge at operational phase. Once the facility is operational, the proponent shall apply and obtain an Effluent Discharge License from NEMA.

3. **Environmental Management and Coordination (Waste Management) Regulations, 2006**
   The Regulations focus on management of solid waste, industrial waste, hazardous waste, pesticides and toxic substances and radioactive substances. The regulations are aimed at addressing the impact of pollution from solid waste on the environment which become important sources of disease-causing pathogens. In compliance with these Regulations, the proponent will ensure proper waste disposal throughout the project cycle and procure the services of a NEMA licensed contractor for solid waste management.

4. **Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009**
   These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The operations at the site especially excavation and

transportation by trucks are likely to generate noise above the acceptable limits. Appropriate PPE will be provided for employees engaged in activities that may produce noise above the acceptable limits within the facility (in excess of 60 dB (A)).

5. Environmental Management and Coordination (Air Quality) Regulations, 2014
   These regulations were aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air. The proponent is obliged to address any source of air pollution from the operations of the quarry.

### 8.3.3 Legislation on mining

#### 8.3.3.1 The Mining Act, 2016

The mining Act makes provision for land set suitable for mining. This Act will guide the identification of land meant for mining and protects the ecologically fragile areas.

**Relevance to the proposed project**

Any person planning to carry out a mining activity should familiarize with the requirements spelt out in the Act and obtain authority from the Department of Mines and Geology to operate the quarry.

### 8.3.4 The Explosives Act Cap. 115

The Act regulates the purchase, assemblage, manufacture and use of explosive materials. Explosives are used routinely in many quarries for blasting and lessening of rocks. It also stipulates conditions for use, precautionary measures and storage requirements. The Act requires one to seek authority to acquire, transport and use blasting materials. It furthers makes it an offence liable for penalties to any person causing an explosion where life or property is endangered.

**Relevance to the proposed project**

The proponent is obliged to comply with the provisions of this act.

### 8.3.5 Legislation on health and safety

#### 8.3.5.1 Public Health Act, 2012

The Act aims at prohibiting activities that may be injurious to the general public. It outlines the responsibilities for the County Government to maintain a safe and clean environment by controlling the development activities during the establishment and operation of proposed project.

**Relevance to the proposed project**

The proponent will ensure the safety of the public and its employees during establishment and operation of the proposed quarry.

#### 8.3.5.2 The occupational Safety and Health Act, 2007

The OSHA 2007 commenced on 26th October 2007. It is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the OSHA 2007 repealed the Factories and Other Places of Work Act, Cap 514 Laws of Kenya, it inherited all the subsidiary legislation issued under Cap 514. Examples of subsidiary legislation inherited include:

- Docks Rules L.N. 306 of 1962
- Eyes Protection Rules L.N. 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N. 40 of 1984
- Electric Power Special Rules L.N. 340 of 1979
- First Aid Rules L.N. 87 0f 1964

- Cellulose Solutions Rule L.N. 87 of 1964
- Health and Safety Committee Rules L.N. 31 of 2004
- Medical Examination Rules L.N. 24 of 2005
- Noise Prevention and Control Rules L.N. 25 0f 2005
- Fire Risk Reduction Rules L.N. 59 0f 2007
- Hazardous Substances Rules L.N. 60 of 2007

### Relevance to the proposed project

Under OSHA, the proponent should provide the workers with appropriate PPE and enforce their use at work.

### 8.3.6 Legislation on environmental resources

#### 8.3.6.1 The Water Act, 2016

The Water Act provides the legal framework for sustainable utilization and management of water resources through an elaborate governance framework. It has four key institutions charged with separate functions and decentralized decision making systems. These institutions are summarized in the table 14 below.

**Table 14: Water Resources Management Institutions and their roles as established under the Water Act, 2016**

| Institution | Role |
|---|---|
| Water Service Boards (WSBs) | Development and maintenance of regional water provision infrastructure |
| Water Service Providers (WSPs) | Provision of reticulated supply |
| Water Resources Authority (WRA) | The Authority is responsible, among other things, for the issuance of permits for boreholes |
| Water Services Regulatory Board (WSRB) | License all providers of water and sewerage services who supply water services to more than twenty households |

### Relevance to the proposed project

The Water Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services. The proponent will obtain a permit from Water Resources Authority (WRA) for the drilling and abstraction of water from the borehole.

#### 8.3.6.2 The Energy Act, 2006

The Act stipulates the electrical supply requirements one has to meet and offenses related to supply and use of electricity.

### Relevance to the proposed project

The proponent is required to ensure that the energy supplied is consumed in accordance to the provisions of the Act and energy audits carried out annually.

### 8.3.7 Legislation on planning

#### 8.3.7.1 The Physical Planning Act, 2012

The Act provides for preparation of development plans and zoning of land for different types of use. Further section 36 of the Act allows the County Government to order for the project to comply with EMCA Regulations, that is, EIA reports if deems that the project has injurious impacts on the environment.

**Relevance to the proposed project**
The proponent will obtain pertinent approvals and requisite operational licenses from the County Government of Kajiado.

### 8.3.7.2 The Occupiers Liability Act Cap. 34
The Act regulates the duty that an occupier of premises owes to his visitors in respect of dangers due to the state of the premises or to things done or omitted to be done on them.

**Relevance to the proposed project**
The act requires that the occupier warn the visitors of the likelihood of dangers within his premises to enable the visitor to be reasonably safe.

### 8.3.7.3 The County Government Act, 2012
The new constitution grants County Governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new constitution, the County Governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well-being of the general public.

**Relevance to the proposed project**
The Act gives right to access private property at all times by the County Government officers and servants for inspection purposes.

### 8.3.8 Institutional arrangements
To implement the above legal framework the government has established a number of institutions with varying mandates of implementation. These include;

1. The National Environment Management Authority (NEMA) to implement the Environmental Management and Coordination Act and associated Regulations.
2. The Mines and Geology Department to implement the Mining Act, the Explosives Act and minerals.
3. The Directorate of Occupational Safety and Health Services (DOSHS) to implement the Occupational Safety and Health Act alongside the subsidiary legislation.
4. The Water Resources Authority to implement the Water Act.
5. The County Government of Kajiado to implement the County Government Act, its by-laws and the Public Health Act.

# 9 CONCLUSION AND RECOMMENDATIONS

## 9.1 Conclusion

The proposed project is considered important and beneficial as it has the advantage of optimal use of land, stimulation of industrial development coherent with Kenya's Vision 2030 and revenue generation to the government. Additionally, it will provide raw materials for construction and socio-economic benefits to the proponent and the residents of Kaputiei area. However, there will be negative impacts at all phases of the project cycle. The main concerns include habitat degradation, pollution of environmental media and health and safety concerns.

These impacts are found mitigatable and hence the EIA proposes a comprehensive Environmental Management Plans and Monitoring plans to improve the environmental performance during the entire project cycle.

## 9.2 Recommendations

The main recommendation of the EIA is the need for concerted implementation of the EMP and Monitoring Plans by the proponent. These include;

1. Register the site as a work place with Directorate of Occupational Safety and Health Services
2. Install a bio-digester
3. Provide adequate and enforce the use of PPE
4. Procuring a sizeable central solid waste collection bin with chambers to accommodate separated wastes
5. All loading and firing of explosives to be directed and supervised by competent person(s)
6. Comply with the provisions of the Mining Act, 2016
7. Adhere to the provisions of the Explosives Act Cap 115
5. Comply with Environmental Management and Coordination (Air Quality) Regulations, 2014
8. Comply with the provisions of the Occupational Safety and Health Act, 2007
9. Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006
10. Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

On the basis of a commitment by the proponent to implement the proposed mitigation measures and the Environmental Management Plan, we recommend the issuance of an EIA License as per the Environmental Management and Coordination Act Cap. 387 of Kenya Laws and Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003.

# 10 REFERENCES

1. Government of Kenya Policies
    - National Environmental Policy
    - The National Industrialization Policy
    - Mining and Minerals Policy
2. Government of Kenya Statutes:
    - The Kenya Constitution, 2010
    - Environmental Management and Coordination Act Cap 387 of the Laws of Kenya
    - Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003
    - Environmental Management and Coordination (Waste Management) Regulations, 2006
    - Environmental Management and Coordination (Water Quality) Regulations, 2016
    - Environmental Management and Coordination (Air Quality) Regulations, 2014
    - Environmental Management and Coordination (Noise and excessive vibration) Regulation, 2009
    - Occupational Safety and Health Act, 2007
    - Physical Planning Act, 2012
    - Public Health Act Cap 242
    - The County Government Act, 2012
    - The Energy Act, 2006
    - The Explosives Act Cap 115
    - The Mining Act, 2016
    - The Occupiers liability Act Cap 34
    - The Water Act, 2016
3. Documents provided by the proponent

# 11 ANNEXTURES

1. Copy of Certificate of Incorporation for Karsan Ramji and Sons Limited
2. Copy of PIN Certificate for Karsan Ramji and Sons Limited
3. Copies of Title Deeds of the project site
4. Copy of the air quality and noise monitoring report
5. Copy of the hydrogeological assessment study report
6. Copy of approval of the scoping report and Terms of Reference for the study
7. Copies of neighborhood consultation questionnaires
8. Copy of practicing EIA License for the firm, Envasses Environmental Consultants Limited
9. Copies of practicing Licenses for EIA Experts, Mr. Simon Nzuki & Ms. Jane Gitau