Environmental Impact Assessment (EIA) Report

For

The Proposed Mobile Stone Crusher

For

Longonot Gate Development Ltd.

P. O. Box. 64553 – 00620 Nairobi

Conducted by
Joseph M. Maitima, PhD
Lead Expert – NEMA, Reg. No. 2815
Ecodym Africa Ltd.
P.O Box 50901- 00200, Nairobi, Kenya
Tel: 020 233 1246 0r 0733 255 739

Declaration

This EIA report was prepared in accordance with Environmental Management and Coordination Act, 1999 and the Environmental Impact Assessment and Audit Regulations, 2003, for submission to National Environmental Management Authority (NEMA).

The undersigned, submit the following Environmental Impact Assessment report for the proposed Longonot Gate Stone Crusher

The location of the crusher is in Munyo Sub-Location, Longonot Location, Naivasha, District. All information contained in this report is accurate and truthful representation of all findings as relating to the project.

NAME.....

SIGNATURE.....

NEMA REGISTRATION No: 2815

DATE.....

On behalf of the Proponent:

Longonot Gate Development Ltd. P. O. Box. 64553 – 00620 Nairobi

Signed by:

PROPONENT

I, …….....on behalf of Longonot Gate Development Limited submit this Environmental Impact Assessment Report for the Proposed Longonot Gate Golf Resort and Holiday Homes. To my knowledge all information contained in this report is accurate and truthful representation of all findings as relating to the project.

Designation: ……

Signature: ……

Date: ……..

Disclaimer:
This Environmental Impact Assessment Report is strictly confidential to the Longonot Gate Development Ltd (the proponent) and any use of the materials thereof should be strictly in accordance with the agreement between the proponent and Dr. Joseph M. Maitima (the EIA Expert). It is, however, subject to conditions in the Environmental (Impact Assessment and Audit) Regulations, 2003 under the Kenya Gazette Supplement No. 56 of 13th June 2003.

ACRONYMS

^{0}C	Degrees Celsius
EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act
EMP	Environmental Management Plan
EA	Environmental Audit
ERP	Emergency Response Plan
KM	Kilometers
IAP	Consult with Interested and Affected Parties
ITC	Inter-Tropical Convergence Zone
MOH	Ministry of Health
NEAP	National Environmental Action Plan
NEC	National Environment Council
NEMA	National Environment Management Authority
NGOs	Non Governmental Organizations
NPEP	National Poverty Eradication Plan
OHSO	Occupational Health and Safety Office
PCC	Public Complaints Committee
TOR	Terms of Reference
UNEP	United Nations Environmental Programme
WSSD	World Summit for Social Development
WRMA	Water Resources Management Authority

Table of Contents

Executive Summary

This environmental impact assessment was carried out on behalf of Longonot Gate Development Ltd of P. O. Box. 64553 – 00620 Nairobi who have proposed to use a stone crusher to produce gravel from stones exposed during the construction of roads in the development of 3,000 housing units and the associated infrastructure on a 2400 acres land **L.R. No. Naivasha/Maraigushu Block 10/13 (Kedong)** in Kedong ranch village, Munyo sub location, Longonot Location, Naivasha division and Naivasha district on the foot hills of Mt. Longonot.

The main aim of the project is to assess the Environmental Impacts associated with crushing stones exposed during the construction of roads and re-use the ballast in making of the roads in places where the soils are loose.

The report was aimed at fulfilling the requirements of Part VI section 58 (1) and (2) of the Environmental Management and Coordination Act (EMCA) which requires developers to undertake Environmental Impact Assessment and submit a report to NEMA.

A number of methodologies were employed in gathering data relevant to this report including desk top studies, and consultations with member of public, stakeholders as well as with the potentially affected community.

The report analyzes some of the potential positive and negative environmental impacts and proposes measures to reinforce economic and social benefits as well as mitigating measures for the negative impacts.

The following are some of the potential economic and social benefits (positive impacts) likely to arise as a result of using the crusher by Longonot Gate:

- Job creation and employment opportunities for those who will be employed to operate the crusher and transportation;
- Improvement of general welfare for the local population as a result of increased income through employment;
- Increase in the income of the population working on the site and development of small businesses that will serve the employees;
- Possibility of meeting the fundamental social needs for the employees and their families (health care, schooling) etc;
- Promotion of development by influencing the commercial trends in the area hence contributing to poverty reduction.
- Reduction of wastes generated through roads construction in the overall development of the Project
- Better management of solid wastes (stones) through recycling of stones exposed during road construction

The report identifies the following negative impacts that are likely to occur as a result of the stone crushing development in Longonot Gate project:

1. Straining of existing water supply
2. Increased dust, air and noise pollution which can affect public health and safety

In order to ensure project sustainability and environmental enhancement, the report recommends the following mitigation measures to be incorporated into the project:

- Avoid excessive use of the water
- Provide Workers with relevant personal protective equipment
- Control areas generating dust particles by regularly cleaning and sprinkling with water to reduce dust
- The crusher should be maintained regularly to reduce noise resulting from friction.
- Maintenance of the crusher must be carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground
- Strictly adhere to the factories and other places of Work Act.
- Adapt an effective Accident prevention and Emergency Response Plan (ERP)

The report established that the developer had complied with the existing legislative and regulatory requirements in relation to the proposed development.

The Environmental Impact Assessment while supporting the approval of the proposed activity further recommends for the full implementation of the Environmental Management and impact mitigation plan proposed at the end of the document.

Introduction

Stone crushing is necessary in order to build roads, bridges, buildings and almost everything we need in our modern life. One can presume that several million workers are working in stone crushing around the world. Stone crushing provides income for families but the working conditions of employees are often unhealthy and dangerous. Major concerns in stone crushing are accidents and injuries, hearing loss, dust-related lung diseases. All of these diseases can be prevented; the working conditions can be improved with simple means and minimal cost.

Stone Crushing activity is a significant industrial activity as it is involved in production of crushed stone of various sizes (ballast) depending upon the requirement and catering requirement of raw materials for various construction activities such as construction of Roads, railway tracks, Highways, Bridges, Buildings, Canals etc. The existing number of stone crushing units is expected to grow rapidly further in view the growing demand for development of infrastructure such as roads, and buildings as envisaged in the Kenya's Vision 2030. The process involved in crushing large size stone boulders into different size of crushed stones depending upon the requirements in the demand sectors.

The important stages involved in stone crushing activity are primary crushing, screening, secondary/ tertiary crusher, screening, conveyance, storage of raw boulders and crushed stone and transportation of the crushed stones. We note here that there will be no quarrying of stones as all the raw materials to be used in this crusher will comprise of the already exposed boulders from road construction and the leveling of ground for construction of houses (landscaping).

The Longonot Gate Development Ltd, the proponent of the Longonot mixed development project have contracted Dr. Joseph M. Maitima a lead Expert in environmental Impacts assessment to conduct a study on the environmental impacts associated with the proposed development.

Administratively the development is located in Rift Valley Province, Naivasha district, Longonot Division, Longonot location, Munyo sub location , Kedong ranch village **L.R. No. Naivasha/Maraigushu Block 10/13 (Kedong)**. The area targeted for development measures approximately 2400 acres located on the foot hills of Mt. Longonot bordering Mt. Longonot National Park. On the northern side the fresh water Lake Naivasha is approximately 10 kilometres from the northern end of the proposed development.

This report aims at identifying specific environmental impacts associated with the development described above and informs the proponent on the mitigation measures that need to be taken into account during the planning, operation and decommissioning phase of the project. The report also presents results of public consultations done to solicit views of various stakeholders around the development site and the general public.

Objectives of the EIA

This EIA study report establishes the baseline conditions of the proposed development site, evaluates the existing conditions, assesses the anticipated impacts and proposes measures to enhance the positive impacts and measures to mitigate the effects of the significant negative impacts for the purposes of environmental enhancement and sustainability. The Proponent's intension to carry out an environmental impact assessment of the proposed development is to achieve the following:

- Comply with the legal requirements, as outlined in the Act and Regulations, and submit a Project Report to the National Environment Management Authority (NEMA);
- Produce a material output that presents a comprehensive background to the proposed development and one that will satisfy Kenyan environmental regulations in order to seek the approval of the regulating authority -NEMA;
- Obtain and define the baseline data for comparison during future environmental audits and monitoring procedures of the proposed project;
- Identify in detail the potential positive and negative environmental impacts envisaged as a result of the implementation of the project;
- Consult with Interested and Affected Parties (IAPs);
- Formulate recommendations on the appropriate measures needed to reinforce positive impacts and minimize any negative impacts at all phases of the project cycle; and
- Ensure that the project incorporates adequate protection of the environment, and protects essential interests of the local communities affected.

Specific Aims and Objectives of the impacts analysis

1. To assess the environmental impacts associated with the proposed use of stone crusher
2. Prepare a report detailing all impacts and the mitigation measures that the proponent should take to avoid or minimize the adverse effects and maximise the beneficial effects so as to preserve the environment for all
3. Conduct community participation surveys
4. Prepare an environmental Monitoring Plan
5. Prepare recommendations
6. Submit the report to the proponent
7. Submit the required number of copies of the report to NEMA for purposes of statutory approvals

Terms of Reference

The study is provisioned to comprise of:

1. Development of baseline surveys (full screening and scoping) on:
    a. Compliance with sectoral regulatory requirements or provisions
    b. Current vegetation and seasonal variations
    c. Current biodiversity and seasonal variations
    d. Soils

    e. Water resources
    f. Climate including air and local microclimate conditions
2. Effects of various project phases (installation, operations and decommissioning) of the development on the items listed above.
3. Conduct adequate public and stake holder participation
4. Identification of project specific impacts and development of mitigation measures
5. Development of Environmental Monitoring Plan (EMP)
6. Preparation of a comprehensive report with details of all the above for NEMA evaluations.
7. Submission of the relevant number of copies to the proponent (Longonot Gate Development Ltd. and NEMA.
8. Responding to any areas of concern to NEMA

    .

Responsibilities

The responsibilities are as follows:

The Proponent is to provide the following:

1. Site maps for the developments showing roads, services, development layout showing neighbouring lands and the full set up of the land to be developed.

2. Proposed measures intended for handling solid wastes, soil erosion and vegetation degradation

3. To provide permits and corporate principles that govern the proposed activities

The consultant is to provide the following:

1. An Environmental Impacts Assessment draft report to the Client

2. An Environmental management Plan (EMP) to the client

3. Final Environmental Impact Assessment report to the proponent that will be submitted to NEMA for approval

Scope of the Report

The Report focuses on the project site and the surrounding areas that are likely to be impacted by the development. Physical environment included landscape, air quality, microclimate and water. On the other hand, the cultural environment considered religious beliefs and cultural practices, land use, population, space, safety and ambient environment. Man made environment covers the socioeconomic infrastructure (roads, traffic flow, electricity, sewerage, telephone and space) while the biological environment covered sensitive ecosystem, important ecosystems and ecological processes. The report also covers both the direct and indirect impacts interaction of the project in addition to the short-term , long term, cumulative impacts and impact interaction. The impacts were classified as positive and negative.

An environmental management plan is formulated to provide viable and environmental friendly options to manage both the positive and the negative impacts. To assess potential environmental impacts, use is made of descriptive checklists and matrices. Sectoral guidelines on natural resources management were most useful during the initial stages of EIA process.

Methodology

The scope of this report was guided by the requirements of the Environmental Management and
Coordination Act No 8 of 1999 and in particular by the Environmental Impact assessment and audit regulations of 2003. Wide range of methods used in the various stages of report. They included methods used by the various specialists for: Stakeholder analysis; Scoping of key issues; Consultation and public participation; carrying out the various baseline studies; definition of the projects sphere of influence; and impact analysis.

An intensive survey provided an overview of the general implications of the proposed project. This involved the following steps:

1. Screening of the project, a process that identified the project as being among those that require an EIA study under schedule 2 of EMCA act 1999.

2. A scoping exercise that identified the key issues to be addressed in the report was also done.

3. The aims of the scoping exercise are firstly to identify at an early stage (when the project design is still amenable to modification) the key receptors, impacts and project alternatives to consider, the methodologies to use, and the stake holders to consult. Secondly to ensure that resources and time are focused on important impacts and receptors. Thirdly to establish an early communication between the proponents, consultants, statutory agencies and other interested groups who can provide advice and information. Lastly, to inform the proponent of any constraints which may pose problems if not discovered on time.

4. Documentary review on the nature of the proposed activities, policy and legal frameworks, environmental settings of the area and other available relevant data/ information.

5. A detailed discussion with the project proponent and consultation with relevant officials in the regulatory authorities.

6. Physical investigations of the site and the surrounding areas using a pre –prepared checklist identifying possible environmental and human safety issues that are likely to occur or be affected.

7. Reviewing the proposed project designs and implementation plan/schedules with a view of implementation of mitigation measures such as suggesting suitable alternatives, modification of methods and timing of construction; modification of design features e.g., landscaping, minimising of operational impacts (e.g., pollution and wastes); specific measures to compensate for losses, e.g., amenity or habitat features.

8. Developing an environmental management plan outlining the responsibilities, schedules, monitoring indicators and timeframes among other aspects.

9. A comprehensive report including all issues as listed in the environmental Impact Assessment and Audit Regulation 2003.

10. Developing a post EIA Study monitoring protocol.

Project Information

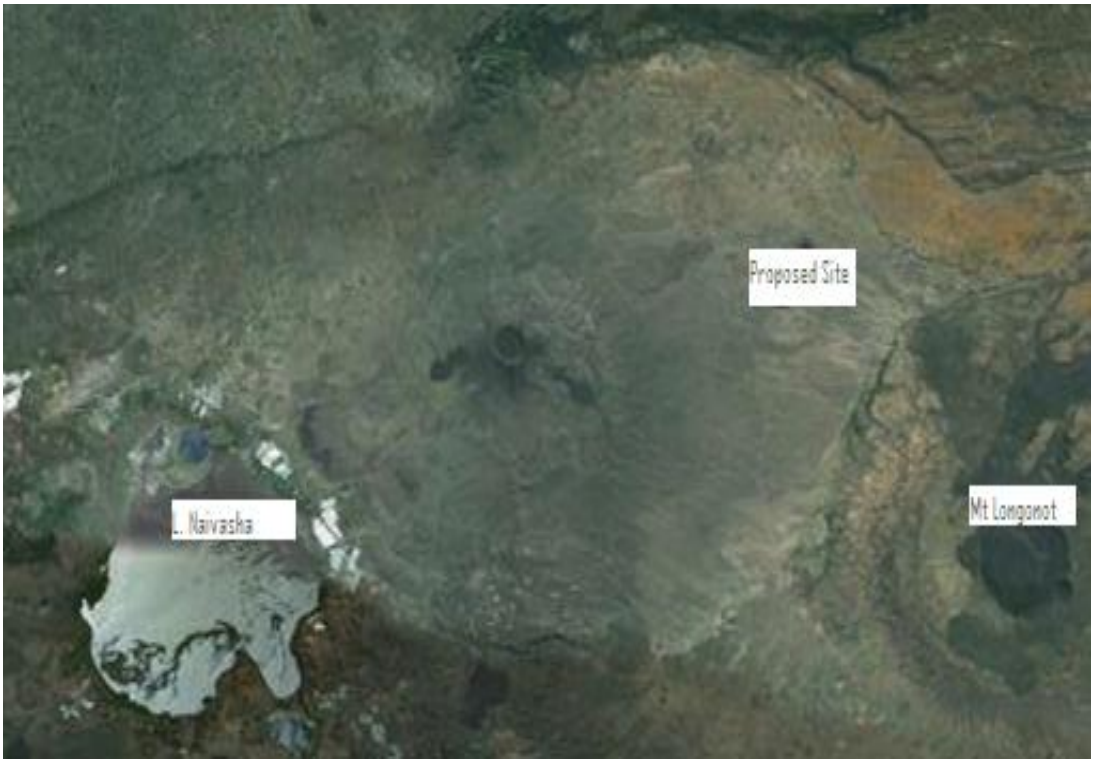
Objectives

The objectives of the proposed activity is to use a mobile stone crusher to crush the stones collected from the construction of roads in the Longonot gate development project and re-use them in a gravel form in the construction of paved roads in the estate. This in compliance with the regulations set forth in the EIA approval for the Longonot gate project that required re-cycling of solid waste materials emanating from the construction.

Site Location

The site proposed for development is located less than 100 kilometres from Nairobi along the old Nairobi Naivasha road on plot number Naivasha/Maraigushu Block 10/13 (Kedong) in Naivasha Municipality. The land was formally used as an agricultural and change of user to comprehensive development has already been obtained and all due payments have been made (see attached documents). The site is situated between Mt. Longonot and Lake Naivasha (Fig.1) Mt. Longonot situated at 0.92 S, 36.45 E, rises to 2617 m above sea level. The mountain which is a stratovocanic mountain is at the southern end of Naivasha trough and is situated between the rhyolite dome field of Olkaria, 20 km to the north-west and the phonolite-dominated Suswa, 30 km to the south.

Figure 1: Satellite map showing the location of the proposed site



Environmental Profile of the Project Site and the Surroundings

Naivasha is located in the vast central Rift Valley of Kenya, a lowland area that resulted from the formation of the rift. The area forms a catchment from two extensive forest stands on both margins of the rift. Lake Naivasha (0^0. $45^{'}$ S and 36^0 $20^{'}$ E) is located north west of Nairobi in the eastern Rift Valley at 1890m above sea level. The Lake is fed by several rivers from the north, where the Gilgil River and the Malewa River form the main inlets. The lake has an average depth of about 4 m. with a maximum of 7.6m. The lake has an area of about 120 m^2 and a shoreline of about 50 m. These measurements were made some two decades ago and changes in climate and human impacts may have caused some alterations. The area around the project site receives drainage from the higher parts

of the rift floor and also from the flanking escarpment to the east (Nyandarua Mountains. With over 3960 m high) and to the west from (Mau Escarpment – over 3000 m high) The Kinangop plateau extends between the Nyandarua mountains and the valley floor east of the site. To the south, Mt. Longonot, Mt. Suswa and other smaller volcanoes form conical extrusions where Mt. Longonot is an inactive volcano that forms a crater currently a National Park.

Biological Environment

Flora

The vegetation is heterogeneous from aquatic plants such as papyrus around the lake margins, submerged macrophytes to terrestrial vegetation comprising of grasslands, bushlands, woodlands and forests. Generally, savannah vegetation is predominant (Harper, 1990). The vegetation types and distribution patterns are strongly associated to soil type that in turn is associated to topography (Watson & Parker, 1970; Harper, 1990). Other factors that influence the vegetation types include the level of water table, herbivory or selective feeding, trampling and human disturbances such as logging and farming (LNRA, 1993). The natural vegetation of the basin mainly consists of low Acacia shrub grassland with *Acacia drepanolobium* ("Whistling Thorn") as the main woody species and *Themeda triandra* as the dominant grass. Since the 1980s, however, most of the natural vegetation has been cleared or degraded into grassland or converted to cropland due to population increase especially due to migration into the area.

Fauna

Birds

In total, there are more than 350 bird species, including many waterfowl species like grebes, pelicans, cormorants, herons, storks, ibises, African darters, spoonbills, flamingos, 22 species of ducks and geese, waders, gulls and terns. The woodland provides habitat for the globally threatened Grey‐crested Helmet‐shrike *Prionops poliolophus* (Red List: NT). Another globally threatened bird found in the Naivasha woodlands is the Basra Reed Warbler *Acrocephalus griseldis* (Red List: EN), a winter visitor and passage migrant whose exact status is unknown. There are regionally threatened species both as regular visitors and residents e.g. Great Crested Grebe *Podiceps cristatus* (critical), Maccoa Duck *Oxyura maccoa* (endangered), African Darter *Anhinga rufa*, Great Egret *Casmerodius albus* (CITES Appendix III), Saddle‐billed Stork *Ephippiorhynchus senegalensis* (CITES Appendix III), White‐backed Duck *Thalassornis leuconotus*, Baillon's Crake *Porzana pusilla* obscura and African Skimmer *Rynchops flavirostris* (all vulnerable). The riparian/papyrus habitat supports certain endemic species such as Papyrus Gonolek and White-winged Swamp-Warbler.

Mammals

The riparian, papyrus and littoral macrophyte zones provide safe haven, foraging and breeding ground for many resident and migrant bird species, as well as other wildlife such as the Hippo. Waterbuck, Buffalo, Giraffe, Eland, Zebra, Thomson's and Grant's gazelles, bushbuck, duikers, mongooses, otters, various snakes and rodents as well as the occasional leopard which are found on the shores of the lake, in the acacia woodland and the neighbouring national parks and sanctuaries. There are several hundreds of hippos Hippopotamus amphibious at Lake Naivasha. Other species of mammals, mainly living in the

riparian lands, are buffalo *Syncerus caffer*, monkeys *Colobus sp*., Impala and waterbuck *Kobus ellipsiprymnus*

Hydrology

Hydrology of the study site and the surroundings is dominated by Lake Naivasha. Other surface water bodies are the Malewa and Gilgil rivers whose waters feed into the lake. Lake Naivasha is a unique ecosystem in that it is the only fresh water lake in Kenya's Rift Valley floor, all others being salty (Gaudet, 1979). The lake has no surface outlet. It receives 90% of its inflow from the perennial Malewa and Gilgil rivers, which originate from Nyandarua ranges. Malewa River has drainage area of 1730 km^2 and that of Gilgil is 429 km^2 (Sikes, 1989). The remaining input comes from seasonal streams, and direct precipitation. The catchment is dominated by igneous rocks and a number of pyroclastic formations including basalts, pumice and tuffs as a result of volcanic activity.

Geology

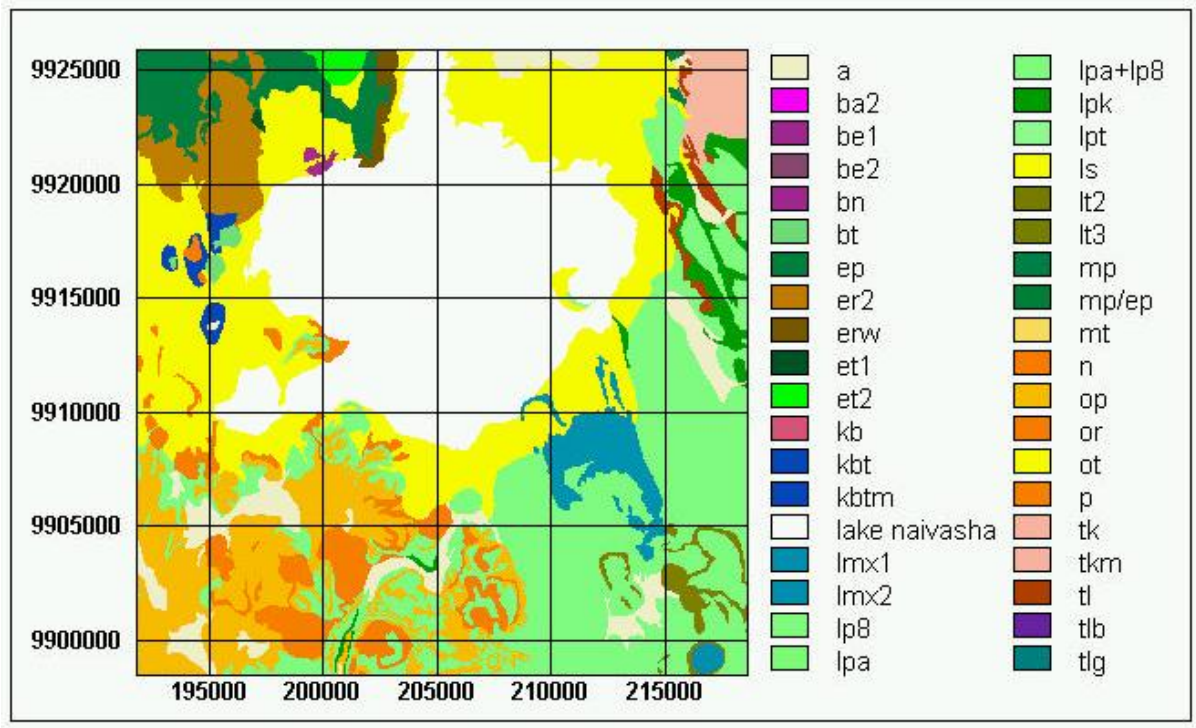
The Rift Valley floor around the proposed site has diverse in topography. Numerous volcanic cones and craters, scarps and lakes are present (lake Naivasha and the crater L. Sonnachi). Inside L. Naivaha is also a crater lake called Lake Naivasha Crater Lake bordered on one side by the crescent island. The site is situated between Mt. Longonot and Lake Naivasha. Mt. Longonot situated at 0.92 S, 36.45 E, rises to 2617 m above sea level. The Stratovocano Mountain is at the southern end of the Naivasha trough and is situated between the rhyolite dome field of Olkaria, 20 km to the north-west and the phonolite-dominated Suswa, 30 km to the south.

A more detailed geological survey of the greater Naivasha basin by Atkilt *et. al*. 2001, shows that it is dominated by two types of quaternary deposits, one of which is lacustrine and the other volcanic in origin. These have major implications for the distribution and properties of the (mostly young) soils. The oldest rocks found *in situ* in the area are Tertiary. On the basis of surface outcrops, the main products of volcanism within the Olkaria Volcanic Complex (termed the Olkaria Volcanic Group) are alkali rhyolite (comendite) lava and pyroclastic rocks. Trachyte and basalt-hawaiite lava have been minor products, but widespread trachytic pyroclastics to the north-west, west and south-west of the complex are believed to have been erupted from vents within the complex. According to Clarke et al (1990) the Longonot volcano constitutes the Longonot Volcanic Group which incorporates seven formations. The major events in its history are:

Archaeology of Naivasha Basin

In general there are no archaeological materials in the basin of Lake Naivasha. A detailed study examining the area between Mount Longonot in the east through Lake Naivasha Basin to Mount Eburru in the west found no archaeological materials. Though many surface concentrations of worked obsidian were found, no discrete sites were located. Obsidian occurrences from several quarry sources within this general area are described including their geochemistry. Geochemical results suggest possibility of extreme interaction and assimilation with the crust in the 'secondary' volcanic feeder chambers. The associated rocks encountered, are limited to volcanic lava flows and pyroclastics of the central rift system. Faulting, a major structural feature in the area is described and later considered as a possible major contributor to the development and distribution of obsidian outcrops although some of the faults have been covered by late stage volcanic activity together with weathering.

Geological map of the area (Clarke et. al., 1990)



The Geological map legend

A: Alluvial deposits
Kbt: Surtseyan tuff cones
Ls: Lacustrine Sediments
n : Ndabibi comendite lava flows, domes and pyroclastic
lpa: Akira pumice
op : Olkaria comendite, pyroclastics
p : Pantellerite lava flows
or : Olkaria comendite, lava flows and domes
lpk: Kedong Valley tuff, Trachytic ignimbrites and associated fall deposits
lp8: Longonot ash
lpa+lp8: Akira pumice, Longonot Ash
lmx1/lmx2: upper (lmx2) and Lower (lmx1) longonot mixed basalt/trachyte lava flows, and pyroclastic cones
lt2/lt3 : Upper (lt3) and lower (lt2) Longonot trachyte, lava flows and pyroclastic cones
lpt : tuff cones
Ba2 Akira basalt; basalt and hawalite lava flows and pyroclastic cones

Be1/Bn Older Elmentia (Be1) and Ndabibi (Bn) basalt and hawaiite lava flows and pyroclastic cones
Bt/Kbt/kbtm: Surtseyan tuff cones (KBt) with laterally equivalent fall tuffs (kBtm), and transitional
surtseyan/Strombolian ash cones (Bt)
Er2: Eastern Eburu pantellerite; lava flows and pyroclastic cones
Et1/Et2; Older (Et1) and Younger (Et2) Eburu trachyte; lava flows and pyroclastic cones
Kb: Kijabe Hill basalt
Tlg: Gilgil trachyte
Mp: Maiella pumice, trachyte and ? pantellerite pumice and ash fall deposits
Ot: Olkaria trachyte; lava flows
Tk/Tkm: Kinangop tuff (Tk) eastern rift margin. Mau tuff (TKm) Western rift margin
TI Limuru trachyte
Tlb Karati and Ol Mogogo basalts
Tlg Gilgil trachyte

Socio-Economic Environment

Health

Naivasha and the entire Nakuru county experiences the following main diseases: Malaria, respiratory tract infections, diarrhoea diseases, skin diseases and infections, and eye infections; Nakuru has a 22.8% malnourishment rate of children under 5 years of age, being ranked 21st of 42 of the nationally ranked counties.

Nakuru has 46 of 1000 of its live babies dying before the 1st birthday, being ranked 13th of 44 of the nationally ranked districts; It has a life expectancy of 57.4 years, being ranked 19th of 45 of the nationally ranked Districts.

Socio-Economic Profile

According to the 1999 Population and Housing Census report, the population for the Naivasha division was 112,058, with population growth at 3.5 %. According to 2005 Household poverty survey, Naivasha division had 39,692 individuals (39%) living below the poverty line. The locations with the highest number of individuals living below the poverty line include Moindabi (45%), Longonot (43%) and Ndabibi (42%) with populations of 2,249 out of 4,974, 8,596 out of 19,955 and 1,467 out of 3,534 respectively. People are involved in smallscale mixed farming. Maize and beans are the main crops grown but for subsistence only as crop failure is very high due to low and erratic rainfall. Some households keep a few livestock (sheep, goats and cattle) that are occasionally liquidated to buy food and as a result they have accumulated very little assets.

Majority of these farmers live below the poverty line are trapped in the vicious cycle of poverty and environmental degradation. To make up for crops losses, the people are involved in commercial production of charcoal. Those living close to Lake Naivasha are involved in fishing for both subsistence and commercial purposes. However, due to unsustainable fishing methods and over fishing, the lake is usually closed to fishing for six months (June to November) every year since 2005 and only about 42 boats are then licensed to fish. The most significant activity but for large scale farmers, however, is the intensive irrigated greenhouse floriculture and horticulture - Kenya is currently the leading exporter of cut flowers and Naivasha supplies about 75% of these. Although the sector employs thousands of Kenyans and significantly contributes to the GDP, it also poses a threat to the lake's integrity due to pesticide and fertilizer use, removal of fringing swamps, and over-abstraction of water. Livestock ranching and private game sanctuaries and conservation areas exist in the division.

Soils

Soils in the catchment area are generally developed from volcanic activity, and are of moderate to low fertility, deep clayish loam, greyish, brown to black in colour, often with drainage problems. The soils often degenerate into black cotton soils with impeded drainage in low-lying areas (Harper, 1990). The area in the lower portion of Malewa River has imperfectly drained silty, clay and sandy soils. The Eastern and Northern portion of the lakeshore has a combination of silty loam, sandy loam or clay loam that has developed in lacustrine deposits. The principles controlling the depth of the soil in the area are influenced by the complex relationship between the parent materials, climate, topography, vegetative cover, time and weathering process (Terborgh, 1974) The general conditions of the lakeshore soil series are predominantly alkaline, sodic and lacking organic matter. The high ration of sandy soil and high rate of land degradation through human interferences makes the soil

susceptible to surface erosion by water and wind. Slopes around the mountains and major escarpments are generally steep and pose a serious erosion hazard.

Identification of Impacts

In order to accurately identify the environmental impacts, the following environmental issues were considered pertinent and important for the coverage based on considerations of physical and natural environments, social welfare, economic and cultural environments.

Physical Environment

1. Water quality aspects for both surface water sources like piped water, storm water, and other related aspects
2. Soil conditions, soil contamination and landscape alterations/degradation associated with the proposed project.
3. Drainage patterns especially in relation to wastewater effluents, oil spillages, refrigerants/coolants discharges channelled into the drainage ditches.
4. Air quality aspects especially atmospheric emissions and related discharges from machinery like diesel run engines etc.
5. Noise and vibration (sonic factors) where applicable

Natural Environment

1. Natural flora and fauna from the proposed development and the adjacent ecosystems where applicable. (i.e., effects to natural plants and animals where applicable).
2. Effects on water flow patterns especially during the rainy seasons and quality aspects, user interference and contamination.
3. Topography: effects on soil and landscape.

Soil Erosion

This is loss of the top-most soft material on the earth surface (soil) down - slope or transportation by the use of machinery or other equipment including animals. Soil movement is common in construction activities. This mostly happens during the laying of foundations for the projects and site clearing. The top loose material is excavated and transported elsewhere. This also exposes the underlying material to more dangers of degeneration by erosion agents. In this case, soil erosion will not be a major environmental impact especially when the project is over since there will hardly be open areas. However, during site clearing and construction phases, there will be massive movement of soil materials from the site. The site currently shows some serious erosion by surface water runoff and winds due to having very little vegetation cover. There is high overgrazing and the area seems to be prone to wild fires. It has been reported that more than 4,600 hectares of bush-land around Mt Longonot were destroyed by bushfires in March 2009.

Potential Mitigation Measures

- Avoid unnecessary movement of soil materials from the site.
- Provide soil conservation structures on the areas prone to soil erosion.
- Control construction activities during rainy / wet conditions to mitigate erosion effects to the soil.
- Resurface (pavement) open areas after the completion of the project

- Introduce suitable and well-managed vegetation to generate surface covers on the open areas; to control soil movement by erosion agents i.e. water, animals and wind.
- Provide storm water drainage channel to discharge water to safe areas. Such channels need to be regularly maintained and repaired to avoid point discharges in case of breakages or blockages. Point water discharges usually have pronounced effect to soil erosion.

Water resources; supply and use

Water will be sourced from the approved sources i.e. either from the boreholes to be drilled in the project site or from the main pipes to be supplied from known sources. To avoid causing strain to the existing water supply, the proponent proposes to use water mainly from the surface runoff and bore holes, since construction activities are known to be heavy water consumers. The project occupation will also bring in very large population which will have direct impact on the water supply (hence high water demand).

To address this situation the proponent has engaged a water specialist to assess the potential of using water from surface runoff. The study found out that potentially there will be enough surface water runoff generated to feed the dams. This assessment is complete and has the following results:

1. Based on a 26 year rainfall data analysis (1983-2008), there is enough rain water runoff potential to generate 1,000,000 m3 of water per annum with 80% probability of occurrence. Of this 740,000 m3 per annum can be harness within the confines of the development this is enough for our target demand.
2. Long Rains generate up to 429,000 m3 (March to May)
3. Our estimated requirement based on 3 month demand is about 250,000 m3 Nett. The 3 month storage will be used to size the dams (water pan) storage.
4. Annual average rainfall is 657mm.

Based on the above data:

1. It is proposed that road drains be used to harness rain water runoff and transport the same to the reservoirs
2. Soil tests confirm the need for lining of the reservoirs to prevent seepage .
3. Check dams and silt traps placed before the main dams will be used to control silt transport into the main dams/pans. This is envisaged only in the first years after which densification of developments and greening of the area are likely to result in higher run off with less silt content
4. Treatment of water to meeting drinking quality is necessary. This will also treat the raw water from Kedong Ranch /Lake Naivasha source when it becomes available

Potential Mitigation Measures

- Avoid excessive use of the water. Water supply and use should follow approvals by the service provider and as per the extraction permits.
- Roof catchments should be provided with gutters to facilitate collection of the run-off. This water should be stored for general use i.e. cleaning, fire fighting, watering the

golf course etc. In fact, the water can be consumed after suitable treatments and approvals by relevant authorities.

- Sufficient water Storage tanks should be provided. Since houses will be constructed by their individual owners, they should be encouraged to put up water storage tanks per housing unit.
- Provide notices and information signs to the involved stakeholders on means and needs to conserve water resource.
- Install water conserving taps that turn-off automatically when water is not in use.
- Encourage water reuse/recycling mostly during construction and occupation phases.

Surface water drainage

As rain falls on a certain area, part of the rainwater is lost through evaporation in the air or percolation into the ground while the remaining overflows the surface as storm water. The runoff from catchments is largely influenced by the size of the catchments, topography, the imperviousness of the surface (i.e. roof, road surface etc) and open surface.

In this particular project much of the surface water/run-off will mainly be absorbed within the property's open spaces. About half of the property will be occupied by low density occupation plots approximately 2 acres each especially before the possible sub division into halves. Still in the half acre plots most of the areas will remain as open areas. However, these (open) areas may be limited since much land will be covered by lawns within individual compounds and others by house structures, roads and pavements. Therefore as rain falls much water is anticipated to overflow the surface as storm water. In connection to this, the amount of water reaching storm water drain channel will be large and this water will be expected to feed into the dams and lakes to be constructed within the Kingdom City.

The surface drainage system has been considered to manage storm water such as may be derived from the paved areas (street-wash), courtyards and roof catchments of the houses. Open (concrete drainage-inverted concrete drains) channels will be used to drain the site off the excess surface water/storm. The channels shall take the influence of the site's gradient and will effectively drain water into drainage channels.

The drainage of the storm water will be greatly compromised especially if it rains, since storm water drainage channels will not be present during construction. In addition, it should be realized that a given area of land can only absorb a certain quantity of rain water/surface water. Therefore it is suggested that dredging areas for dams should start early in the project development so that surface runoff water can collect as early as possible.

Potential Mitigation Measures

- During construction, the designs should ensure that surface flow is drained suitably into the existing drainage and water courses. There should be no flooding within the site at all.
- Drainage channels should be provided within the site and should be covered with suitable and approved materials. They must be installed as provided for in the approved plans and designs.
- The channels should be designed with regards to the peak volumes i.e. periods or seasons when there is high intensity of rainfall. They should never at any time be full; say due to the resulting heavy downpours
- The drainage channels must ensure the safe final disposal of run-off surface water and must be self-cleaning i.e. should have suitable gradient.

- Storm water generated from roof catchments should be harvested, stored and utilised in various household activities i.e. general cleaning. This will minimize resultant soil erosion and other associated impacts. It will reduce strain on the existing water supply systems. In this connection, it is recommended that gutters be incorporated in the designs as well as down pipes to enhance water collection into the storage tanks of individual households.

Noise and vibration

Exposure to loud noise can ruin a person's hearing and cause much physical and psychological stress. Without the ability to hear, it is nearly impossible to perform a job task successfully and safely. Permanent hearing loss can result from continuous noise exposure. It indicates that parts of the so called hearing cells in the inner ear have been destroyed. They will not grow back nor can they be repaired. Hearing is lost forever.

Noise is mostly produced by either impact or vibration. This happens at the following locations in a stone crushing unit:

- The crushers themselves (Primary and Secondary) when boulders are crushed and transported along conveyors
- The boulder loading point when boulders are fed into receiving pit
- The sieves when the gravel is sorted

Potential Mitigation Measures

The effects of noise on a person are not curable, but noise exposure can be controlled through many different technologies. In general, using work processes that are quieter, enclosing noisy equipment, and using sound-absorbing materials at impact sites is recommended to reduce the amount of noise being produced.

Potential Mitigation Measures

- When occupation of the estate commences, construction works should be carried out only during the specified time i.e. from 0800 hrs to 1700 hrs; when most of the neighbours will be at work
- Machineries should be maintained regularly to reduce noise resulting from friction.
- There should be no unnecessary horning of the involved machinery and vehicles.
- Provision of bill boards at the construction site gates notifying of the construction activity and timings.
- Workers should be provided with relevant personal protective equipment/ materials such as earmuffs and earplugs when operating noisy machinery and when in noisy environment.

These provide a physical barrier that reduces inner ear noise levels and prevent hearing loss from occurring.

Air Quality

The construction activities on the site will result into increased dust and gas emissions. Construction machinery and trucks (including small vehicles) generate hazardous exhaust fumes such as Carbon Oxides (COx), Sulphur Oxides (SOx) and Nitrogen Oxides (NOx). Dust particles caused by vibrations of machines and vehicle movement suspends in the air mostly during dry spells. Diesel engines emit black carbon, which absorbs sunlight and warms the atmosphere and micro-particles. Unseen and odourless, microscopic particles of air pollution is very harmful. Exhaust from diesel engines and dust swirl into an insidious

cocktail of tiny particles that can spend weeks airborne. The most harmful are the smallest, less than 2.5 microns in diameter; when inhaled, the lungs or pass directly into the bloodstream and damage arteries.

Potential Mitigation Measures

- Provide Personal Protective Equipment (PPE) such as nose masks to the workers on site.
- Regular and prompt maintenance of construction machinery and equipment. This will minimize generation of noxious gases and other suspended particulate matter.
- Control over areas generating dust particles. Such areas should be regularly cleaned or sprinkled with water to reduce dust. The areas can be enclosed to mitigate effects of wind on them.
- Workers should be trained to understand the hazards that may be generated in such work environments.
- Workers should be encouraged to go for regular health check-ups to ascertain their health standards.
- Enclose the site with dust-proof net during the construction.

Oil Leaks and Spills

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

Potential Mitigation Measures

- All machinery must be keenly observed not to leak oils on the ground. This can be affected through regular maintenance of the machinery.
- Maintenance must be carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground. Such areas should be covered to avoid storm water from carrying away oils into the soil or water systems. Waste water/ wash water from these areas should be properly disposed.
- All oil products and materials should be stored in site stores or in the contractor's yard. They should be handled appropriately to avoid spills and leaks.
- Car wash areas and other places handling oil activities within the site must be well managed and the drains from these areas controlled. Oil interceptors must be installed along the drainage channels leading from such areas.

Ecological Impacts: Flora and Fauna

Vegetation has a great effect on the general and localized environment and normally can modify microclimate. Usually, the flora creates a good environment for habitats thus the two may go together more often than not. In consequence, de-vegetation may result to negative effects on the fauna. Singly, the proposed project may appear of no significant impact but the cumulative effect in concert with other current and future projects are capable of significant and serious effects including but not limited to soil erosion, decrease in air purifiers (carbon sinks) and thus contribution to global warming etc. As earlier indicated, there is no vegetation on site except some grass and weeds. However, there may be some temporary and permanent disturbances to insects that inhabit the grass/weeds.

Mitigation

- Avoid unnecessary clearing of vegetation by conserving vegetation not in the sections being built up
- Landscape and plant vegetation in all open areas after the completion of the project and manage the introduced vegetation on completion of the development to restore or improve the site.
- The arboretum planned in the developed sites should use appropriate tree species that protect the soil and conserve water.

Public safety, traffic, Occupational Health and Safety (OHS)

During construction, there will be increased dust, air and noise pollution. These are considered as negative impacts as they significantly lower the quality of environment. The residents and workforce involved would be more subjected to these environmental hazards. Food for the construction workers is provided by mobile individuals most of whom operate without licenses. This can compromise health of the workers especially if such foodstuffs are prepared unhygienically. Road entry and exit may also be a risk if not properly designed and controlled and more so the heavy trucks during construction. Traffic congestion is also a problem during occupation because the proposed project will add some cars.

Mitigation measures

- Provide properly fitting Personal Protective Equipment (PPE) depending on tasks being performed to avoid injuries and illness including working boots, overalls, helmets, goggles, earmuffs, masks, gloves etc

- Factories Act abstract should be posted at a strategic point on site. **Factories and other places of Work Act** should be strictly adhered to, the **Building Code** and other relevant regulations. Only specialised machine operators should operate machinery and specialised equipment and all moving parts should be provided with appropriate guards. A first aid kit should be provided within the site. This should be fully equipped at all times and should be managed by qualified persons.

- Proper designs to allow for deceleration and acceleration to the site. Clearly indicate direction of traffic throughout the project cycle. Internal driveways should also be erected with bumps to control speed and thus reduce potential accidents. There should be careful design and layout of the site entrance, providing adequate visibility

- Adapt effective emergence response plans especially during construction phase.

- Safety awareness may be gained through regular safety meetings, safety training or personal interest in safety and health. This awareness will increase ability to respond if, some day in future, one is a bystander in an emergency.

- The contractor should have workmen's compensation cover. It should comply with Workmen's Compensation Act, as well as other Ordinances, Regulations and Union Agreements.

- Sanitary facilities should be provided (for each sex where conditions warrant). Standard cleanliness of the facilities should be maintained.

- Local individuals preparing food for the workers at the site should be controlled to ensure that food is hygienically prepared.

- Workers during construction phase should always be sensitized on social issues such as drugs, alcohol, diseases etc. There should be training programs to facilitate this.

- Proper waste management of domestic waste to prevent vector-borne diseases.

- Public awareness campaigns on the prevention and management of prevalent diseases such as malaria, STDs and HIV AIDS.

- Ensure (consistently) good water quality through regular water analysis to ascertain compliance to public health standards.

Accident prevention and Emergency Response Plan (ERP)
Emergencies and disasters are a reality of everyday life. Stakeholders must therefore be sensitized and prepared on how to react during both the construction and occupational phases. Absence of such plans may be risky since there would be no guidelines to handle or control emergencies if they occur. The proponent and the contractor shall take all necessary steps to prevent accidents in the entire project cycle. All construction safety procedures shall be followed as discussed elsewhere in this report while measures to prevent and manage fires shall be taken as discussed elsewhere in this report. For further management of any foreseeable accidents, the proponent shall develop an ERP which shall be documented and all the residents shall be provided with the requisite training and annual drills conducted.

The ERP shall typically contain all information on all likely types of emergencies likely to be encountered mainly accidents and fires. The ERP shall include actions to be taken in case of emergencies and shall display emergency contacts (ambulance, doctors, police and fire engines) telephone list; simple instructions on do and don'ts in various emergencies such as fires, LPG incidents, armed robbery etc. On traffic safety, the road shall be constructed to adoptive standards and the entry and exit points provided with clear views. Bumps shall be erected to control speed along the driveway and the parking. The ERP shall also provide for basic First Aid training to some of the potential residents. The ERP shall also promote good neighbouriness which shall go a long way in emergency response. Such plans must be properly documented and made available to all. For instance, a fire assembly point must be identified and clearly

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

Potential Mitigation Measures
- The project should be enclosed using suitable walls and an electric fence on top of wall to beef-up security and to control movement within the site.

- Security guards must always guard the gate to the facility to keep away the intruders and to control movement within the site.
- Lighting as well as security alarms should be installed in strategic positions all over the site after the completion of the project.
- Contractor should provide adequate security during the construction period when there are no works on the site.
- The guards stationed at the gates should document movements in and out of the site/ property.

Fire preparedness

Fire outbreaks are common in Kenya and they usually subject detrimental effects to the environment. Fire causes both economic and social drawbacks. There are operations that are prone to such outbreaks at construction sites. It is therefore always important to consider the issue of fire.

Potential Mitigation Measures
Recommended Fire fighting equipment:
Potential causes of fire are many and varied electrical faults, smoking, gas leaks, carelessness etc. Fire incidences result to economic and social drawbacks. It is therefore always important to consider the issue of fire by bringing in the element of preparedness. In this regard, the design should provide and recommend implementation of fundamental fire fighting measures and control facilities.

- The home owners should install an automatic fire alarm system in housing units and provide 2No. 9kgs water or powder fire extinguisher for every house. Provide 2No. powder or carbon dioxide extinguishers for the ground floor where there is parking
- Provide appropriate Fire Hydrant Ring main with suitable outlet points.
- Install manual electric break-glass fire alarm system with secondary power
- All installation to follow Fire Masters requirements approval.
- Ensure that all fire fighting equipment are strategically positioned, regularly maintained and serviced.
- Encourage tenants to store LPG cylinders outside their houses
- Provide fire hazard signs such as 'No Smoking' signs, Direction to exit in case of any fire incidence and emergence contact numbers should be provided as well.

Conflict with the community
Projects of such magnitude usually attract public uproar (especially from the neighbouring residents and community) if they are not made to own the project. Conflicts usually arise mostly from the foreseen negative impacts but mainly due to carelessness in executing the works.

Potential Impacts
- Increased social crime risks
- Due to the influx of construction workers on site, there are chances of introduction of individuals with potentially anti-social behaviours such as thieves/thugs, drug users and traffickers and may pose a risk to the community both during the implementation and occupational phases.

Mitigation

- Adopt strict hiring guidelines to lock out the bad elements and limit movement outside the site.
- The contractor has a responsibly of sensitising the workers on social issues such as HIV/AIDS, drugs and other social issues through regular training and social gatherings and strict monitoring. Workers should not be housed on site.
- Consultation with neighbours on the mitigation measures prescribed for the negative impacts as a way of conflict resolution and neighbourhood association.

Safety conditions in operating a stone Crusher

Common unsafe conditions or acts

- Too many workers are too close when dangerous work is done
- Workers need to work on the high wall of the bolder pit with no fall protection
- Workers need to access the top of the platform by climbing through supporting poles or up the stone piles
- There is no set and separated path for vehicular and persons' movement
- There is no guard around the boulder pits
- Work is performed on work platforms which are not guarded and have no railings
- Maintenance work at heights (i.e. portable conveyors) is performed without securing the working Persons

Hazards and health risks

- Fall from heights or into pits with severe injuries such as fractures, head injury, or even death

Solutions to protect health

- Attach a bund wall or raised steel girder to entire length of pit to prevent falls; curb wall can be constructed from available boulders at site
- Movement on the top of the retaining wall should be avoided
- No person should be allowed to walk on the parapet of the loading pit
- Provide indicating alarms to sound when rocks are being loaded into the crusher 16
- Provide stable ladders that are in good condition
- Safety belts and harnesses should be provided for all those who work at heights
- Stop using the conveyor belt to climb to the top and do not use broken or make-shift ladders
- Provide steps and ladders where unconsolidated material slopes are currently used for climbing up and down. Steps can be carved to prevent the trip and fall hazard due to slippery and loose soil
- Provide ladders that are in good condition (preferably wooden) in places where there are electrical overhead lines running across and metal ladders in other places
- The ladders should be long enough to reach the top and also have an extra length of 75-90 cm for holding after reaching the top
- Provide ladders at 70-75 degree slopes Ladders should not be used as a platform to work

Keeping Workers Healthy

Stone crushing produces a lot of dust. Dust consists of particles, which are dispersed in the air and remain there for a while. It is generated from mechanical actions, such as stone crushing, truck movement, etc. Although most dust particles can be seen with the naked eye, some cannot be seen without the help of a microscope.

These fine dust particles can travel deep into the lungs and have the potential to cause the most damage. A "dusty lung" (pneumoconiosis in medical terms) or severe chronic lung disease (called "chronic-obstructive pulmonary disease", COPD in medical terms) is a common hazard caused by to much exposure to dust.

Several rocks such as granite and normal sand contain a substance called "silica" in varying degrees, typically about 10 or 20%. This substance causes even more severe lung disease when inhaled as fine, man-made particles ("silicosis" in medical terms).

These fine particles are typically found in the stone crushing process. Scar tissue forms deep in the lungs and makes the lungs less efficient and less strong. Over time, even AFTER work in stone crushing and the dust exposure has stopped, this destruction process in the lungs continues and the worker will eventually die from the damage.

Typical signs of lung damage by dust include difficulty breathing, shortness of breath, wheezing, constant coughing, reddish or bluish color of ears and/or the lips. This difficulty in breathing is often combined with fatigue, loss of appetite, weakness. Stone dust cannot be avoided in stone crushing. It is produced by the crushing itself, the sorting, the transport of gravel and also by vehicle movements over dusty roads. We can however reduce the amount of dust that reaches the lungs. By engineering controls, the places where dust is generated can be encapsulated so the dust is not easily carried off by the wind. Only after engineering and other controls have been used in all areas, personal protective equipment such as appropriate masks should be used. So-called Particulate Respirators Masks offer various amounts of protection depending on the type of filter and the fit provided. Using a cloth to cover the nose and mouth is NOT really protecting the worker.

There is no good short-term solution to the problem. Appropriate masks that protect workers from dust are often hard to find in developing countries. Even if they were available, the very high amount of dust would force the workers to change the masks or filters several times per day. In addition, the masks are often uncomfortable, specifically when one works in a hot climate.

The best solution is therefore to REDUCE the amount of dust that is being released into the ambient air. This can be done by:

- Enclosing the dust sources and processes
- Ventilate with a local exhaust system near the generating source
- Spraying water at the source of dust dispersion

Reducing Dust When Water is Available

Water spray dust control measures are effective at reducing respirable crystalline silica dust. Studies have reported significant reductions with the use of wet methods to control silica dust

in various applications including stone crushing, construction, mining, and manufacturing industries.

Reductions in respirable dust in stone crusher mills can be accomplished through engineering controls including process enclosures (or containment), dust collection (or local exhaust ventilation), and water spray systems. Water spray suppression systems may be pressurized or rely on available water pressure. Basic systems without pressurization can be effective at significantly reducing respirable silica if an adequate number of well positioned spray nozzles are used. Silica content is known to vary greatly from area to area and may help to determine the necessary extent of controls. Quarry and mill owners can test samples of the rock to determine the silica content.

Water Spray System Design
The spray nozzle is selected to achieve the desired spray characteristics, velocity, spray pattern and angle. Below is a general discussion of these factors:

Droplet and Orifice Size: Droplet size is the most important variable for proper dust control and is determined by the orifice size and available pressure. The smallest droplets are generated with pressurized systems.

Droplet Velocity: Normally, higher droplet velocities are desirable for dust suppression control. Information on the droplet velocity, based on the available water pressure, can be obtained from the nozzle manufacturer.

Spray Pattern: Nozzles are categorized by the spray patterns they produce. The following describes the different spay nozzles used in dust control:

- **Full-cone nozzles** produce a round spray pattern and provide high velocity over a distance. These nozzles provide optimal surface area coverage for non-pressurized spray systems

- **Hollow-cone nozzles** produce a spray pattern in the form of circular ring. Droplet range is normally smaller than the other types of nozzles

- **Flat-spray nozzles** produce a rectangular or even spray pattern. They also produce relatively large droplets that are delivered at high pressure

- **Air Atomizing nozzles** require a pressurized system to produce very fine mist. They are very effective in locations where airborne dust particles are extremely small and nozzles can be located in close proximity to the dust source

*Spray Angle***:** The spray angle determines the width of the cone-shaped spray pattern produced by the nozzle. The appropriate spray angle needed to cover a specific surface area would depend on the distance the nozzle is placed from the material.

*Flow Rate***:** The rate at which water flows through a nozzle depends on the operating pressure and orifice size. Increased water pressure improves mist delivery and may allow for the installation of fewer nozzles to achieve the same dust reduction. It is also important not to

apply too much water to the material as the finer particles can become muddy and sticky, which may cause equipment problems.

Placement of Nozzles: Nozzles should be placed upstream of the transfer point where dust missions are produced and located to allow maximum time for water droplet interaction with airborne dust. Distance to crushing material depends on nozzle type, spray angle and water pressure.

Water Consumption: A typical nozzle consumes 5 to 20 liters per minute (lpm) of water (per nozzle) depending on water pressure. A correct spray systems does not use a large amount of water as the ozzles are designed to supply a mist and not a stream of water.

Water Quality: Spray systems can rely on a variety of water sources that do not have to meet drinking water quality. For non-potable water sources, careful consideration should be taken with respects to microbiological contaminants in the water, as it may pose an inhalation hazard.

Road Sprinklers: Dust previously settled on roadways and on waste materials can get back in to the air and contribute to silica exposures. Intermittent use of sprinklers on roadways can reduce the dust generated by wind or vehicles. Commercially available sprinkler equipment can be used instead of a fine mist. However, such systems typically consume considerably more water than the fine mist nozzles.

Reducing dust when Water is not available

The water-using dust control system introduce moisture into the material flow by spraying water at dust generating locations so that fine particulates do not become air borne. This requires an arrangement to provide pressurized water to nozzles. Its installation includes a water tank, pump, filter, pressure gauges, flow meter and a network of pipeline, fitted along with regulating valves and spray nozzles.

Install dust collection facilities at locations where dust is generated (crushers and sieves). This includes an effective encapsulation of the dust generating machinery parts and

Install dust separation system bag filters or water tanks to separate the dust and reduce dust emission into the environment air

Dust Suppression Technology: This systems capture the released dust, suck it through pipes to a cyclone with blower and finally leads to bag filters (dry system) or a water tank (wet & dry combo system) where finer dust particles are captured. The advantages of a completely dry system are the facts that it does not use water at all, does not alter the aspect and quality of the produced gravel and that the collected dust can easily be recovered and re-sold.

The system components include:

a. Enclosures and Ducts

A closed chamber made out of sheet metal or plastic encloses the major sources of dust such as crushers and sorters. A suction pipe connects to the enclosure and carries dusty air away to the cyclone. The complete suction hood with enclosure can easily be dismantled and refitted.

It is therefore easy to maintain and to clean if needed. The ducts transport dust-filled air to the cyclones, dust hopper or water tank.

b. Cyclone separator with blower

The air filled with dust particle enters first a cyclone separator. The cyclone separator creates a vortex (a spiral flow) inside the chamber and makes use of the centrifugal force to separate the particles from the air stream. They collect in a settling chamber at the base of the cyclone. The suction capacity can be adjusted by regulating the blower. This separation technology is very cost effective. In areas with no water at all, this dry cyclone separator system is an efficient and cost-effective solution to control dust emissions.

c. Dust Hopper

The coarse dust particles collected in the cyclone fall into the settling chamber and the dust hopper. Due to its size, it needs to be emptied only once a week. It therefore eliminates daily dust exposure of workers and reduces cost to the entrepreneur. The collected dust can usually be sold as a primary product to other industries such as cement or construction industry.

d. Bag filters (dry system) or Water Tank with Baffles and Chimney (wet & dry combo system).

The air coming out of the cyclone is still filled with finer dust particles. They can be captured in two ways. In a completely dry system, bag filters are used to trap the particles. The resulting dust can be sold for other purposes. In a wet & dry combo system, the air is let into a water tank where dust particles are captured in water. The finest dust particles, which are still not captured, escape from a five meter high chimney mounted onto the water tank. The tank requires about 1400 litres per week. The resulting slurry can be used for building construction.

Protecting Hearing from Noise

Exposure to loud noise can ruin a person's hearing and cause much physical and psychological stress. Without the ability to hear, it is nearly impossible to perform a job task successfully and safely. Permanent hearing loss can result from continuous noise exposure. It indicates that parts of the so called hearing cells in the inner ear have been destroyed. They will not grow back nor can they be repaired. Hearing is lost forever. The effects of noise on a person are not curable, but noise exposure can be controlled through many different technologies. In general, using work processes that are quieter, enclosing noisy equipment, and using sound-absorbing materials at impact sites is recommended to reduce the amount of noise being produced.

Noise is mostly produced by either impact or vibration. This happens at the following locations in a stone crushing unit:

- The crushers themselves (Primary and Secondary) when boulders are crushed and transported along conveyors
- The boulder loading point when boulders are fed into receiving pit
- The sieves when the gravel is sorted

Noise can have the following **effects on the health** of workers and owners:

- Distortion of sounds (hearing something, but not understanding)
- Temporary or permanent hearing loss
- A continual ringing in the ears for which there is no cure ("tinnitus" in medical terms)
- Quickened pulse rate, increased blood pressure and a narrowing of the blood vessels
- Abnormal secretions of hormones, muscle tensing, nervousness, sleeplessness, fatigue

Solutions to protect health

- Conduct regular maintenance: replace all unbalanced or loose parts of machines
- Lubricate turning machine parts regularly
- Replace metal parts with quieter plastic parts if possible, for instance rollers, washers
- Machines which vibrate should be mounted on heavy, rigid bases to prevent vibration
- Consider putting heavy rubber or plastic mats on places where impact or machine parts or boulders cause noise
- Enclose especially noisy machine parts with punctured metal plates, best in several layers so the sound gets "trapped"
- Position workers away from noise sources as much as possible
- Provide hearing protection for workers, such as earplugs and earmuffs, train workers on the purpose, proper fitting, and care of hearing protectors and provide continuous monitoring of employee noise-exposure levels if possible. However, in that case collaboration with experts in occupational health is needed for advice
- Always use properly shaped and sharpened cutting tools so you need less force to cut things.

Using Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) such as gloves, masks or goggles may sometimes be required to protect workers from an unsafe working environment. This should be used ONLY when ALL other possible means of controls, such as administrative and engineering controls, have been exhausted. This is why PPE is called a "secondary" control method, for it is a last resort option. When we cannot enclose or isolate machines, no proper ventilation is possible, and then PPE is an option to protect the health of workers and should be mandatory. It is important to realize that personal protective equipment does nothing to reduce the hazard; it merely serves as a barrier between the hazard and the worker. If the barrier fails, there is no backup and the worker is directly exposed to the hazard. When PPE is provided, the employer must be sure that workers are wearing the equipment properly and at all times. This can be accomplished through routine inspections throughout the yard. Proper training on how to wear PPE is needed for all workers and management. PPE might be needed throughout the stone crushing unit. It is needed to protect from: accidents and injuries for instance falls or hand injuries; noise; and dust

Solutions to protect health

- Identify which PPE is needed for which job. These job-specific PPE should then be required for all employees at that job. You might need advice from occupational health experts to select the proper PPE for different tasks.

- Ensure that PPE is used properly and regularly. Effective PPE program should be implemented to instruct employees on the importance of using PPE and the appropriate way to don and doff PPE equipment
- Wherever possible, sun protection in the form of shade should be provided, for instance a covered shed for tally clerk
- Provide cost effective rubber-soled shoes, hard hat, gloves, and goggles to the loader
- Make a wind sock with available material at site and fix it at the top most point; this will help persons working to place themselves in such a way to avoid the dust flow
- Masks against the dust are expensive and very uncomfortable. It is much less expensive and cost-effective to reduce the dust using engineering controls and dust reduction methods (see other chapters in this manual). Nose pads or cloths are not effective. The nose mask with changeable filters is more appropriate, however it is quite expensive. Wearing it the whole day is very uncomfortable. You need to consult with occupational health experts if you want to choose an appropriate respirator mask for the employees
- All those deployed in and around the crushing units and in particular those working near the vicinity of the crusher should wear the following: − Hard gloves for all employees: Helmets could be replaced once in a year and whenever they are damaged; - Safety shoes: Protect from falling objects, as well as sharp stone pieces for those working in the plant; − Goggles: To avoid fine stone dust entering the eyes which can create eye rashes, burning and cause chronic eye inflammation; - Noise Control PPE: This is crucial for those working near crushers

Working Safely at Night

Lighting is important in the workplace not only for worker comfort but also for safety reasons. Good lighting is needed throughout the plant and yard but specifically at access roads, at the boulder loading point at the top of the primary crusher, and at delivery points. Truck drivers, for instance, need to see their environment, the road and other workers. Illumination refers to the quantity of light in a certain area. A lack of illumination may make specific and general tasks both difficult and dangerous for workers

Hazards and health risks

Any kind of accident can and will occur when lighting is not sufficient: trips and falls or vehicle accidents Cost effective lamps such as sodium vapor lamp or mist/dust diffusing lights are available for stone crushing units

Solutions to protect health

- Ensure a good amount of lighting at the pit area and on the access areas. You can also conduct a survey on the continuous, frequent and occasional activity areas and provide lighting accordingly
- Focus the light on crusher operations
- Enough lighting at night time should be ensured by providing street lights and focused light to cover the entire area
- Ensure a torch light is also provided to workers at the top of the boulder pit for emergency use

- Ensure an illumination of a minimum of 150 lux around the crusher area and 200 lux projected as a spot light on the crusher itself. "Lux" is the unit in which light is measured. You might need the help of an occupational health expert or technician to determine appropriate and cost-effective light fixtures
- Metal sheets and other glare-generating materials should be removed from the site and stored in covered place

Reducing impacts on heat

Heat is bothersome. Heavy work in the heat is not only uncomfortable but it can also be dangerous. Heat stress is the body's response to extremes of hot temperature. In this environment, the body is not able to cool itself quickly enough. The risk of heat stress is even greater if the person exposed to the heat is also performing strenuous activity, like that performed in a rock crushing yard. Our body temperature and the consequent heat stress are not only influenced by air temperature, but also by air movement, humidity, and radiant heat. While more air movement (wind, for example) reduces the heat, higher humidity increases the body temperature. Radiant heat is what other objects give off as "heat" and which then is absorbed by the human body. Examples of this are hot surfaces of rocks or buildings. Proper ventilation (either local or general) is important in reducing dust and other airborne contaminants in an environment. Simple fans can and should be used to provide a cooling airflow. However, in higher temperatures they also increase the risk of drying the body out as hot air is being blown onto the workers. Regular drinking of large quantities of drinking water is specifically important. Air-conditioning systems provide cooled air. These ventilation systems need to be routinely inspected and evaluated in order to ensure they are operating properly and preventing exposure, for instance from molds growing inside such air-conditioning systems.

Unfortunately, water is often only available at the office shed and those who work hard, far away from the office, do not have easy access. If employees have to travel far distances for water, they are more likely to neglect drinking and are at risk of dehydration.

Activities and Processes

The risk of heat stress exists during all physically heavy work in a stone crushing plant, for instance during boulders pushing through the receiving pit and into the crusher, the collection of stray boulders throughout the yard surrounding the conveyors, maintenance work, cleaning work, dust and gravel collection by hand.

Hazards and health risks

Heat stress can cause strains, muscle cramps. If no water and cooling is provided, the damage can progress to dizziness, severe fatigue and exhaustion, disorders of the brain such as seizures, and unconsciousness. If no treatment and water is provided, the over-heating can cause more damage to the brain and can lead to death

Solutions to protect health The only possible solution against heat stress, is to provide shelters and shade wherever possible; air flow, e.g. with fans; sufficient quantities of cool drinking water, Provide temporary sheds at selected locations for the workers to rest and relax during idle hours; Provide a fan if possible for these places; Provide personal water bottles for those who work in a distance can carry drinking water with them or provide water pots at vital locations, maintain them clean and fill them regularly. *Example*: Each employee working at top loading points and other peripheral areas has a personal bottle to carry

drinking water to their work location. Workers should drink a full glass of water every 30 minutes if they are working in the heat. They should not wait until they feel really thirst

Being Prepared for Emergencies

Emergencies such as accidents can happen any time, specifically in a stone crusher unit. Heavy boulders are transported and crushed, truck are coming and going any time, workers are conducting work at heights to repair and maintain the crusher and the installations, gravel heaps can slide and bury workers.
In case of such a severe accident, rapid and correct response is needed. The unit and the owners can prepare for such medical emergencies. By acting fast in case of emergency, the victim can be helped better, maybe even lives can be saved and the losses for a company can be reduced significantly.

Very often, the following situations in crushing units are found:

Common unsafe conditions or acts

- No preparations are made in case of an emergency
- No current plan enables easy and quick action in case of emergencies
- Chaos and confusion at the time of an emergency lead to more damages
- No one is trained in appropriate first aid and incorrect "help" can worsen the condition of the injured

Solutions to prepare for medical emergencies:

- Make a board with important telephone or mobile numbers of nearest:
  - Ambulance facility
  - Fire station
  - Hospitals
  - Doctors or nurses
  - Police
  - Manager and Owner contact numbers
- Have a telephone line or mobile phone facility available at all times, also during night shifts
- Draw an emergency plan through a consultant; document the plan and train the employees
- Conduct a mock drill at least once a year
- Develop a rapport with nearby industries to get help when needed
- Train selected staff in First-Aid treatment, keep a well stocked First–Aid box at the site on several locations

Maximum Permissible Noise Levels

Zone		Sound Level Limits dB(A) (Leg. 14h)		Noise Rating Level (NR) (Leg. 14h)	
		Day	Night	Day	Night
A	Silent Zone	40	35	30	25
B	Places of worship	40	35	30	25
C	Residential: Indoor Outdoor	45 50	35 35	35 40	25 25
D	Mixed residential (with some commercial and places of entertainment)	55	35	50	25
E	Commercial	60	35	55	25

Time Frame
Day: 6.01 am – 8.00 pm **(Leg. 14h)**
Night: 8.01 pm - 6.00 am **(Leg. 10h)**

Emission during material handling

In the material handling section, various handling devices like feeders, conveyors belt, bucket elevators and screw conveyors are used to transport crushed materials from one point to another. Particulates may be emitted from any of the material handling operations.
The following activities may cause pollution during material handling in a stone crusher operations:

Activity	**Anticipated pollution**
Loading & unloading of raw materials	Dust emissions due to inter collision between large size stone boulders.
Conveyance	The transit moment of the crushed stone from one point to another and return of the screen, contributes for fugitive dust emissions
Stockpiles	Free fall dust along with the screened stone chips/powder from the conveyor belts and hoppers contributes huge quantity of fugitive emissions
Handling of crushed stones	The fine dust adhered to the crushed stone gets released during the manual/mechanical loading and unloading stages

The following pollution control measures shall be implemented for abatement of pollution by the stone crusher.

Unit operation/Area of operation	**Pollution control measures**
Crushing units	• The outlet of all primary stone crushers, and both inlet and outlet of all secondary and tertiary stone crushing, shall be enclosed and ducted to a dust extraction and collection system such as a fabric filter • Water sprayers shall be installed and operated in strategic locations at the feeding inlet of stone crushers • Stone crusher enclosures shall be rigid and be fitted with self closing doors and close-fitting entrances and exits. Where conveyors pass through the crusher enclosures, flexible covers should be installed at entries and exits of the conveyors to the enclosure
Vibratory screens and Grizzlies unit	• All vibratory screens shall be totally enclosed in housing. Screen houses shall be rigid and reasonably dust tight. Where conveyors pass through the screen house, flexible covers should be installed at entries and exits of the conveyors to the housing. Where containment of dust within the screen house structure is not successful then a dust extraction and collection system should be provided • All grizzlies shall be enclosed on top and from 3 sides and sufficient water sprayers shall be installed at their feeding and outlet areas
Belt conveyors	• For better environmental protection practices, the energy efficiency and production efficiency must be maximized. For this purpose effective belt scraper such as the pre-cleaner blades made of hard wearing materials and provided with pneumatic tensioner, or equivalent device, should be installed at the head pulley of designated conveyor as required to dislodge fine dust particles that may adhere to the belt surface and to reduce carry-back of fine materials on the return belt. Bottom plates should also be provided for the conveyor unless it has been demonstrated that the corresponding belt scraper is effective and well maintained to prevent falling material from the return belt • Except for those transfer points which are placed within a totally enclosed structure such as a screen house, all transfer points to and from conveyors should be enclosed. If the dust not remain confined within the enclosure, water spraying
Storage piles and Bins	• Wherever feasible, free falling transfer points from conveyors to stockpiles should be fitted with flexible curtains or be enclosed with chutes designed to minimize the drop height. Water sprays should also be used to prevent the dust from going in to air • The surface of all surge piles and stockpiles of blasted rocks or aggregates must be kept sufficiently wet by water spraying • All open stockpiles for aggregates of size in excess of 5mm must be kept sufficiently wet by water spraying. The stockpiles of aggregates 5mm in size or less must be suitably covered to ensure that the same is not carried away (or whipped out) by the wind • Scattered piles gathered beneath belt conveyors, inside and around enclosures must be cleared regularly

Material transportation	• Active haul roads inside the works should be adequately wetted with water • Exhausts of trucks for transportation of rock materials within the site should be directed upward • Wheel cleaning facilities should be provided for delivery trucks leaving the works for the removal of mud • Trucks carrying crushed and screened products must have their loads covered with tarpaulin sheets before leaving the premises • The handling and storage of the dust collected by the dust collection system must be carried out without fugitive particulate emissions
Rock drilling equipment	Appropriate dust control equipment such as wet drilling or dust extraction and collection system must be used during rock drilling activities where mining activity is carried out along with the stone crushing
Operation and maintenance	• Wetting agents should preferably be added in the water used in the spraying systems so that water consumption is reduced • All spraying systems used for dust suppression must be maintained in good condition and shall be used regularly. The spraying system must be able to cover the areas of emission points concerned • Water storage facility must be provided at the stone crusher site • The dust extraction and collection system must be regularly inspected and maintained in good condition and shall be used as required • A high standard of housekeeping should be maintained. Any piles of materials accumulated on or around the relevant plant shall be cleaned up regularly • Malfunctioning or breakdown of equipment leading to abnormal emissions should be dealt with promptly. In case of the abnormal emission due to equipment failure the process must be stopped • The premises of the stone crushing industry must be clearly demarcated by barbed wire fencing/dry stone wall/stone wall boundary of adequate height

The table below provides a summary of the issues and impacts identified, the significance rating arising from the assessment, possible mitigation (or enhancement) measures, and recommendations for further investigation or monitoring at some stage of the project life cycle.

Environmental Impact or Issue	**Significance Rating**	**Possible Mitigation**	**Further Investigation or Monitoring Recommended**
Management of topsoil	Low	Removal and stockpiling of topsoil	Response to rock extraction plan
Potential for sinkhole formation	Low	-	Warning of cavities, if any
Impacts of groundwater abstraction – local level	Low	-	Hydro assessments

Cumulative impacts of groundwater abstraction	Low	-	“
Potential for groundwater contamination	Low	Avoid dolomite and limestone substrates when siting activities that could pollute soil. Control all potential sources of pollution at source.	Periodic water quality tests
Solid & liquid fuels	Low	Compaction of soil, Bunding of liquid installations, Paving for woodchips	Site facilities on tillite or shales
Site camp	Low	Site selection, housekeeping, proper sanitation	Site selection to avoid sensitive areas
Waste disposal	Low	Use in kilns, recycling, or disposal at approved landfill	Monitor compliance with management plan
Impacts on natural vegetation	Low	Avoid extracting stones for vegetated habitats,	Environmentally sensitive planning, Monitor presence of rare plants around the rocks.
Impacts of alien invasive plants	Low	Monitoring of common plant species	Ongoing monitoring
Impacts of harvesting encroacher bush (benefits)	Low	Observe the species around the rock exposures	Establish economic constraints – threshold distances etc.
Impacts of harvesting encroacher bush (negatives)	Low	Education and supervision.	Follow the EMP
Impacts on indigenous fauna	Low	Speed limits, road design, and housekeeping.	Recording of animal fatalities
Impacts on birds	Low	Avoid any raptor nests, and avoid large trees	Plan road alignment to avoid large tree clumps
Impacts of noise - quarry	Low	Blast during daylight only Maintain vehicles	Design of crusher

Impacts of noise - plant	Low	Design to meet SABS standards	
Impacts on air quality – quarry, crusher, tracks	Medium	Clearing & stockpiling of soil, Spraying with water, dust filters	
Impacts on air quality – manufacturing plant	Low	Apply modern technology as proposed	
Health and emergency services	Low	Planning of emergency procedures, training in first aid	
Occupational Health & Safety	-	Technological solutions to comply with dust and noise standards	
Impact of project on HIV/AIDS	Low	Staff education, voluntary testing	Ongoing awareness programme
Impacts on public perceptions	-	Good, regular information supply to the public.	

Relevant Legislative and Regulatory Framework

Overview

There are a number of legislations and regulatory frameworks that the proposed development will have to consider in order for the development to be in full compliance with their guidelines and requirements. This study has outlined them here below and given suggestions of how the development can comply or the steps proponent has taken in compliance.

The Environmental Management and Co-ordination Act, 1999

The Act entitles every person in Kenya to a clean and healthy environment and aims to safeguard and enhance the environment. Though there are other sectoral laws on environmental conservation, this is the supreme legislation. It provides guidelines on issues of environment, stipulates offences and penalties and establishes NEMA. The Act also lists the type of projects, which must be subjected to the EIA process and establishes NEMA as the statutory body responsible for the implementation of the act.

In compliance to the requirements of the act, the proponent was appointed an expert to conduct the EIA study project report in order to seek approval before implementation of the proposed project.

The Environment (Impact Assessment and Audit) Regulations, 2003

The regulations are entrenched under section 147 of the EMCA. The regulations provide the framework for carrying out EIAs and EAs in Kenya.

This EIA project report is conducted in conformity with these regulations and EMCA, 1999.

Discretionary approvals required

The Act requires that projects acquire approval before their commencement. NEMA approves and issues an environmental licence after the Environmental Impact Assessment or a project report depending on the extent to which the project satisfies it. This is also in compliance with the requirements of the Environmental Management and Coordination Act (EMCA) Part VI section 58 (1) and (2) which states:

Notwithstanding any approval, permit or license granted under this Act or any other law in force in Kenya, any person, being a proponent of a project, shall, before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the second schedule to this Act, submit a project to the authority in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee.

The proponent of the project shall undertake or cause to be undertaken at his own expense an environmental impact assessment study and prepare a report thereof where the authority, being satisfied, after studying the report submitted under Subsection (1), that the intended project may or is likely to or will have a significant impact on the environment, so directs.

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

These regulations define the responsibilities of waste generators and define the duties and requirements for transportation and disposal of waste. It provides for mitigation of pollution and provides for hazardous and toxic wastes. The regulations require a waste generator to dispose waste only to a designated waste receptacle.

The proponent shall adhere to the regulations and proposes to contract a NEMA registered waste transporter.

Environmental Management and Co-ordination (Noise and Excessive Vibrations Pollution) (Control) Regulations, 2009.

The recently gazetted noise and excessive vibrations regulations require that noise and excessive vibrations should be minimized to the largest extent possible and that this should not exceed particular decibels. To minimize the impacts of noise and vibrations from the proposed activities, the activities will be limited to working hours between, 8.00 am and 5.00 pm. All possible care will be undertaken to ensure that the machinery are properly greased and oiled to reduce friction and possible noise emission.

The proponent shall strictly adhere to the provisions and requirements of these regulations

The Environmental Management and Co-ordination (Water Quality) Regulations, 2006

Then law is based upon the principle that everybody is entitled to a healthy and clean environment.

Section 42, pertinent to the implementation of this project

National Environmental Action Plan (NEAP)

According to NEAP, 1994 the Government recognized the negative impact on ecosystems emanating from development programmes that disregarded environmental sustainability.

Established in 1990, the plan's effort was to integrate environmental considerations into the country's economic and social development. Under the NEAP process EIA was introduced.

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

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

The proponent is committed to adhere to the proposed EMP to ensure environmental enhancement and this would first be monitored through the initial environmental audit.

National Policy on Water Resources Management and Development

It enhances a systematic development of water facilities in all sectors for the promotion of the country's socio-economic progress, and also recognizes the by-products of these processes as wastewater. It calls for development of appropriate sanitation systems to protect people's health and water resources from pollution.

The proponent has conducted a detailed analysis of the hydrology and water resources in the area and has provided designs for septic tanks to be used by individual plot owners.

Factories and Other Places of Work Act – (Cap. 514)

The Act aims at making provision for the health, safety and welfare of persons employed in factories and other places of work. Section 13 states that every factory shall be kept in a clean state and free from effluvia, arising from any drain, sanitary convenience or nuisance. Effective and suitable provisions is also proposed for securing, maintaining by circulation of fresh air in each workroom, the adequate ventilation of the room. Section 36 provides for precautions with respect to explosive inflammable dust or gas. The Section is specific that where in any building, if dust that could escape to work man's room and explode by ignition, steps must be taken to prevent such an explosion. Section 41 compels that in every factory; there shall be maintained fire extinguishers, which shall be adequate and suitable in case of fire out breaks. Similarly, it mandates every factory to provide adequate means of escape in case of fire outbreak for the employees. The Act further requires that if a factory worker is employed in any process involving exposure to wet or to any injurious or offensive substance, suitable protective clothing must be provided by the employer.

The proponent will appoint a reputable contractor who will be responsible for enforcing the requirements during construction and subsequent repairs and maintenance after project completion.

Public Health Act- (Cap. 242)

Environmental degradation may pose a health hazard to the general public. This is among the factor considered by the Public Health Act to constitute "nuisance". For the interpretation of the Act, Section 15 (IX) indicates that any noxious matter or wastewater discharged from any premise, such as a building constitutes nuisance. Any premise not kept in a clean and free from offensive smell such as gases which are injurious to health such as those from commercial establishments shall therefore generate nuisance. The act therefore stresses that no person shall cause a nuisance to exist on any land or premise occupied by him. Because of

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

The Water Act, 2002

Part II, section 18, of the Water Act, 2002 provides for national monitoring and information systems on water resources. Section 73 of the Act allows a person with license (licensee) to supply water to make regulations for purposes of protecting against degradation of water sources. Section 75 and sub-section 1 allows the licensee to construct and maintain drains and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

Institutional Framework

The environmental impact assessment for the proposed development is bound to be influenced by the operational interests of several lead agencies. These include, but not limited to the following key institutions:

Municipal Council of Naivasha and Nakuru County Council

The Municipal Council of Naivasha and Nakuru County Council are the principle lead agencies on all matters pertaining to planning within the proposed site. The Local Government Act (Cap 265) clearly defines the functions of this key institution. Section 166 empowers them to be responsible for local planning and development control in the region. The Physical Planning Act (Cap 286) also confers upon local authorities the powers to control development in their areas of legal jurisdiction. Accordingly, Section 29 (a) has granted all local authorities in Kenya, the Municipal Council of Naivasha and County Council of Nakuru (Naivasha is in Nakuru County) being no exceptions, the power to prohibit or control the use and development.

Conclusion

The institutions guided by relevant policies and legislations must regulate urban development and planning projects. The above expression is envisioned as a basic principle component of coordinated and harmonious development in urban areas, and is one of the core pillars for attaining sustainable development. These provisions will therefore guide the proposed project.

Project Alternatives

The consideration of alternatives is one of the more proactive sides of environmental impacts assessment – enhancing the project design through examining options instead of only focusing on the more defensive task of reducing adverse impacts of a single design. This calls for the comparison of feasible alternatives for the proposed project site, technology, and/or operational alternatives.

Alternatives have been compared in terms of their potential environmental impacts, capital and recurrent costs, suitability under local conditions, and acceptability by neighbouring land users.

The proposed Alternative

The EIA Project report has been prepared for submission to NEMA; facts, findings and recommendations/ proposals of which are based on the proposed site, design, materials and proposed technologies. This helps in evaluating and examining the foreseeable effects of the project on the environment and therefore assisting in addressing how the proposed development has to ensure that all environmental measures are complied with during the premises preparation and during operational phase.

The alternative consists of the proponent's/applicant's final proposal with the inclusion of the legal guidelines, regulations and procedures as stipulated in the EMCA, 1999 which aims at reducing environmental impacts to the maximum extent practicable. Appropriate Environmental Management Plans have been prepared as per the proposed project.

Relocation alternative

While we appreciate that monetary costs should not be used to justify a wrong project, this would also result in extra costs in terms of money and time as whatever has been done and paid to date would be a direct loss to the proponent. This may also lead to a No Action Alternative situation. The other consequence is that it would discourage both foreign and local investors especially in the housing sector that has been shunned by many public and private investors hence aggravating the housing short fall. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option. The problem is further aggravated by the fixed characteristics of land and the bottlenecks of the planning policy. The other question is, what will the proposed site be used for if the proposed project is relocated and what shall be the associated impacts?

The no action alternative

The No Action Alternative in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. The anticipated insignificant environmental impacts resulting from construction, and occupation activities would not occur.

This option will however, involve several losses both to the project proponent/land owner and other stakeholders; society and government. The landowner will continue to pay high taxes on the unutilized property. The No Project Option is the least preferred with reasons such that there will be no incremental housing stock, forfeiture of economic benefits that would accrue to the proponent, the public and the government, and it could also discourage investors wishing to invest in the housing sector. From the analysis, it becomes apparent that the No Project Alternative is not the appropriate alternative.

Alternative design, layout and technology

Various alternative designs and technology have been evaluated by the proponent and various professionals involved i.e. the architect, engineers, quantity surveyors, land surveyors and environmental consultants. After extensive discussions and relevant considerations, the various options were assessed and the most optimal design and technology were agreed as per the proposed plans, materials and technology. There is the alternative design as to accommodation details and the size of the usable areas. These alternatives however shall call for little re-designing and could be worth further exploration.

The comparison of alternatives

Under the proposed development alternative, the project would create more standard housing stock and would provide employment directly and indirectly to the public. It would provide jobs for the workers during construction. After completion more jobs would be generated during occupation. Under the No Action Alternative, there would be no development at all. There would be no benefits from the site and neither would there be the insignificant environmental impacts. Layout redesign may perhaps give an optimal design and should be explored for optimization of the benefits and environmental enhancement.

Provided the environmental impact mitigation measures are implemented as well as adoption of sound construction management practices, negative impacts will be avoided/ minimized. However, commitments related to development alternative would ensure that potential impacts are minimized to levels of insignificance as envisaged in the EMP.

Conclusion

All the alternative options analyzed have implications, which make the current design option proposed by the proponent to be more viable. It is concluded that:

- The available development alternatives are likely to reduce the returns to investment that the proponent would have realized if the current proposed design were to be approved
- The land within Naivasha is prime and finding another piece of land of the same size is scarce and costly. Because of this, the proposed project may not be relocated to an alternative site.
- The neighbourhood, where the proposed development is located already shows land use for agriculture is unsuitable due to insufficient amount of rainfall. On the other hand land use for grazing as is currently used results into land degradation due excessive removal of vegetation by herbivores. The proposed development will improve conservation of surface water, increase wetlands, and maintain more vegetation cover than now.

The Proponent undertakes to incorporate all necessary measures to ensure adverse impacts are mitigated to the maximum extent practicable.

Impacts Identification, Analysis and Mitigation Measures

Crusher stones involve a series of defined physical operations which include site activities like collecting stones, moving them to the crusher or the crusher moving to the stones in case of mobile crushers; crushing the stones and transporting the products to the place where they are to be used. All these activities are potentially considerable sources of particular impacts. The size of the crusher will be relatively small and due to the fact that no quarrying of stones will be involved, these impacts will be very insignificant.

For impact identification a checklist was employed to identify possible impact from the crusher operations. Interviews were help with workers at the Longonot Gate to determine public opinions on the proposed development. Apart from the workers in Longonot development there are no residents within three to five kilometre radius of the stones that will be crushed.

A) Levels of potential negative impacts

Impacts on Geological Resources.

Activity	Environmental Aspect	Potential Environmental Impact	Mitigating Measures	Time Frame & Responsibility	Indicators to be monitored
Loading stones, grading; and offloading of construction ballast	Oil, chemical and material spills	Soil contamination	Establish site spill control procedures Training of workers on spill control procedures/ preparedness Off-site maintenance operations Spill control kit be availed at the site	Main contractor Prior to construction	Spillage incident records/ complaints from workers/ neighbours Training records Visual observation

Table 7: Impact on Water Resource

Activity	Environmental Aspect	Potential Environmental Impact	Mitigating Measures	Time Frame& Responsibility	Indicators to be monitored
Loading stones, grading; and offloading of construction ballast	Spills of oil and other hazardous chemicals from construction equipment	Ground water contamination through leaching Contamination of surface water through storm water run-off Legal non-compliance	Spill prevention procedures & response plan Off-site maintenance of fuel powered equipment and vehicles Spill control kit is available on site. Training of staff on spill response plan and procedure	Main contractor- prior to construction	A record of incidents be kept on site for inspection Visual observation Records of staff training Complaints from workers and neighbours during/prior to inspection.

Table 8: Impacts on biodiversity

Activity	Environmental Aspect	Potential Environmental Impact	Mitigating Measures	Time Frame& Responsibility	Indicators to be monitored
Removal of stones from the ground, laying gravel on roads	Changes in plant and animal biodiversity	Loss of above and below ground biodiversity	Preserve indigenous plants as much as possible	During site preparation and construction Responsibility: The proponent and home owners	Changes in the number of indigenous plants, birds and insects
Noise	Noise to wildlife and human beings in the surrounding areas	Disturbance to wildlife in the neighbouring Longonot National Park	Maintain low noise (to the recommended levels of decibels)	During and construction and occupancy Responsibility: The proponent and home owners	Complaints from people in the neighbourhood or visitors

Table 9: Impacts on humans and socio-economics

Activity	Environmental Aspect	Potential Environmental Impact	Mitigating Measures	Time Frame& Responsibility	Indicators to be monitored
Noise	Noise pollution	People or wildlife affected negatively	Observe recommended noise levels	During construction, occupation and decommissioning Responsibility: Proponent and Residents	Noise levels

Air Quality	Pollution by particulate matter	Contamination by dust and other aerosols	Wet the ground if excavating during dry seasons	During construction, occupation and deco Responsibility: Proponent and Residents.	Particles in the atmosphere
Water quantity and quality	Effects on water quality and quantity	Poor and scarcity of water for domestic uses	Rational use of water resources, and avoid contamination. Maintain 6 m riparian vegetation around dams	During construction, occupation Responsibility: Proponent and Residents	Water flow, quality (chemical and solutes composition)
Security	Dangers to people and property	Impacts on land use, property ownership, and freedom of association	Enhance security	During construction, occupation and decommissioning Responsibility: Proponent and Residents	Incidences of insecurity
Cultural and social activities	Interference with local social and cultural events	Impacts on freedom of association and movement	Rights of people observed	During construction, occupation and de Responsibility: Proponent and Residents commissioning	Complaints of people on the effects on their social and cultural events

B) Proposed Mitigation Measures for Negative Environmental Impacts

Mitigation measure to reduce effects of negative impacts

NEGATIVE IMPACT	MITIGATION
Air quality: This may be negatively impacted upon by dust emanating from construction transport trucks and traffic fumes both during construction and operation stages. This will have effects on construction workers and residents.	• Wetting the roads during construction • Use of personal protective clothing and appliances • Using compact murram roads • Use of well maintained vehicles
Vegetation loss: Loss of vegetation on specific sites to be covered by buildings is expected during construction. Restoration measures are expected to happen during operation.	• Planting and tending of vegetation. • Maintain 6m riparian vegetation around dams • Try as much as possible to retain existing plants especially those with medicinal and other
Micro climate change: Expected changes in micro climate due to the proposed project include Altered wind movements. Loss of vegetation.	• Maintain ground coverage at understory at not more than 35% to facilitate air circulation below the trees. • Replanting of trees and other vegetation.

Noise: Noise is mostly produced by either impact or vibration. This happens at the following locations in a stone crushing unit: ➢ The crushers themselves (Primary and Secondary) when boulders are crushed and transported along conveyors ➢ The boulder loading point when boulders are fed into receiving pit ➢ The sieves when the gravel is sorted	• Conduct regular maintenance: replace all unbalanced or loose parts of machines • Lubricate turning machine parts regularly • Replace metal parts with quieter plastic parts ifpossible, for instance rollers, washers • Machines which vibrate should be mounted on heavy, rigid bases to prevent vibration • Consider putting heavy rubber or plastic mats on places where impact or machine parts or boulders cause noise • Enclose especially noisy machine parts with punctured metal plates, best in several layers so the sound gets "trapped" • Position workers away from noise sources as much as possible • Provide hearing protection for workers, such as earplugs and earmuffs, train workers on the purpose, proper fitting, and care of hearing protectors and provide continuous monitoring of employee noise-exposure levels if possible. However, in that case collaboration with experts in occupational health is needed for advice • Always use properly shaped and sharpened cutting tools so you need less force to cut things. • Liaise with neighbouring communities to agree on the best times to operate the machines
Population influx and traffic: Success of the project shall definitely result in in-migration of populations. During construction. .	• Fence off the construction site to avoid unauthorized access and to safeguard materials. • Provide basic welfare facilities for the workers.
Increased water demand: Increasing water consumption will occur both during construction and operation phases.	• Ensure sustainable use and conservation of water resources.

Falls from heights • Hands and fingers or toes being crushed by stones • Body parts such as hands or arms being caught in machines • Traffic accidents inside the unit	• Attach a bund wall or raised steel girder to entire length of pit to prevent falls; curb wall can be constructed from available boulders at site • Movement on the top of the retaining wall should be avoided • No person should be allowed to walk on the parapet of the loading pit
Machines and Power Tools Machines can hurt people. They need to be constructed correctly to be safe for the workers who handle them or even just passing by. All too often, a worker is pulled into a machine such as a conveyor belt, a grinder or a crusher • Accidents and Injuries due to entangling with unguarded machine parts and being pulled into a machine, being caught between, stuck by, and dragged in to machinery • Accidents when mobile conveyors topple over • Equipment and conveyor damage	• Train employees on safe work methods, avoid wearing loose clothing when working near moving machinery and conveyors • Working near conveyors and moving machinery should be avoided as much as possible • Install machine guards that are needed on and around all moving parts • Repair and maintain all hand and power tools • Only work with power tools when they are connected to a circuit, which is protected by an ELCB interrupter (see chapter on "Working Safely with Electricity") • Use a so-called "Lock out – Tag out" system for safe locking of power sources, so that no one can accidentally switch on the machine while others are working on it

Using Gas Cylinders Safely Gases are used in a stone crushing unit for repairs and maintenance work where welding or torch cutting is necessary. Especially dangerous are: • cylinders of liquid propane or natural gas (LNG, LPG), even though there is little pressure in the cylinder they are highly flammable; • cylinders with Oxygen or Acetylene, which are pressurized and also highly flammable	• Cylinders should be stored and used upright and secured with a chain to prevent them from tipping • Cylinders should be stored in cool and dry place, in the shade. They should be placed in an upright position, never be left open, or exposed to sunlight • Put full and empty cylinders in different places and mark which ones are full and which are empty • Always use the protective caps on cylinders that are not-in-use. They protect the outlet from being damaged in case of a fall • Simple trolleys can be used for transporting cylinders in an upright position. NEVER roll or drop cylinders • All cylinders are equipped with pressure gauges • Color-coding of each cylinder is used to indicate the kind of gas in the cylinder. Please ask someone for the national color coding standards, so the marking is uniform in the entire country when cylinders are bought, sold and refilled • No sparks should be created when working close to the cylinders. No smoking is allowed in the vicinity of the work.
Human health and safety: Many risks to human health will exist during construction and operation. These include: • occupational respiratory diseases • Slips and trips • Traffic accidents inside and outside the plant • Injury by heavy physical work and manual handling of heavy loads • Accidents with electricity	• safe systems of work during construction i.e. appointment of safety supervisors, provision of welfare facilities, appointment of first aiders, arrangements for emergency services etc. • Provision of personal protective clothing and appliances e.g. helmets, gloves, earmuffs, respiratory protectors, overalls, protective shoes and safety harnesses. • Proper ventilation of confined spaces. • Handrails and balustrades to engineers' specifications

Fire Risks: Fire outbreaks are a serious yet possible risk during construction. These can come as a result of use of faulty or wrong electrical appliances; careless use of inflammable materials.	• Provision of operational fire fighting appliances. • Observance and practice of safe working procedures when working with flammable substances. • isolation of flammable substances • Use of standard electrical appliances • Electrical installations to be undertaken by qualified persons

Public Participation

Introduction

This is a very important and an integral part of the EIA process, which is part the legal requirements and a very important tool for collection of data and especially the baseline/background information. The process helps bring out the contentious issues and gives a chance to those who may be affected by a proposed project to give their views, inputs and opinions and any significant issue is addressed at the initiation stage. This enables evaluation of the public and neighbours views and is thus a very important part of the study.

Questionnaires and interviews were used to collect the views of the various stakeholders during the initial preparation of the study report that was formally approved by NEMA (EIA/798) on 16th April 2012. All the respondents consulted on the development of Longonot Holiday Homes, Golf Course and the associated infrastructure were happy to fill the questionnaire.

For this particular report we called the same respondents who were interviewed during the study for the main project and informed them of the use of a mobile crusher to grid the stones retrieved from road construction and landscaping for r e-use in paving the roads within the estate. None of them had any objections to the development.

In the main approved report we indicated that we will use as much as possible the materials retrieved from road making and landscaping in the construction of the estate roads measuring 38km in phase 1 (Crater park) 20km in phase 2 (Naivasha Gardens) and 4km in phase 3 (the Kingdom City).

Stone Crusher is one of the equipments that were earmarked for the development of infrastructure in the Longonot Gate Holiday Homes and Golf Resort. During the public consultations for the development of Longonot gate infrastructure development was one of the key features in the development. This type of development is commonly viewed to bring a development in the area. They indicated the obvious advantages including creation of employment, and promotion of development in the area and enhancing the utility of the land and urbanization.

All the people consulted had no objection because the crusher has no effects on anything they or the people around their villages are doing. They Noted that:

1. The crusher has no effect on their daily activities
2. The crusher has no effect on their water resources
3. The crusher will emit much less dust than the road construction that is already going on and which has no effect on them at all.
4. The same also applies to noise. The crusher will cause less noise than the many tractors and vibrators already in use in road construction in the site.

The nearest residents in the area are a few kilometres from the site where the crusher will be used and really did not have anything to say.

Comments from public participation meetings

1. All people were glad to see the development of the real estate in the area

2. of the local towns and businesses as the project will bring an influx of Population
3. The proposed project will use locally available materials due to the presence of such materials on the site and areas nearby hence creating local jobs for the local community.
4. Recycling of the stones and other materials exposed by the construction and landscaping in the development is very welcome as such materials would have occupied space as a dump site.
5. Initially they had a problem with where the contractors will take the massive soils to be displaced by the construction and welcome the idea of re-cycling.
6. The mitigation measures the neighbours think can be put in place to reduce the negative impacts include:
    a) Local employment of the youths in the area to reduce the youth unemployment in Kenya and the area in general
    b) Use locally available resources instead of importing
    c) Build a perimeter wall in the estate
7. Positive impacts the neighbours identified from the project include
    a) Provision of houses
    b) Increased infrastructural development of the area like roads and development of towns
    c) Increased supply of water in the area, to cater for the growing population for such estates
    d) Increase in population will spur the area growth and increased businesses opportunities
    e) The estate will make the place admirable and invite more people to settle in the area

The issues raised and many others foreseeable have been adequately addressed in the report and in the EMP.

List of respondents consulted (same as those consulted during the study for **NEMA/EIA/S/2/798**)

Name	**Gender**	**Village**	**ID Number**
Henry Mugo Muhunyo	Male	Maraigushu	3630140
Pharis Chege	Male	Mirera Farm	0479277
Keneth Maina M.	Male	Longonot Location	27077186
Joan Deruiyet	Female	Longonot town	26137978
Helen Kituy	Female	Longonot Park	22360242
Evans Chege	Male	Mirera	11290110
Mary Wanjiru Mucheru.	Female	Maraigushu	14421103
Lucy Njoki Mukiri	Female	Mirera	20415325
Ruth Wanjiku Njenga	Female	Mirera	23829984
Luka Gichui Mugwe	Male	Karagita	10934950

Gabriel Karanja Wanjiru	Male	Karagita	25922729
Peter Kagui Rugene	Male	Longonot	8642448
Damaris Mwende Muasya	Female	Mirera	22572431
Victor Mureithi Kiruki	Male	Maraigushu	11008684
Phoebe Litunda	Male	Hotelier (along the lake)	Was not comfortable to reveal the number
5 Respondents	(3 Males + 2 Females)	2 farmers 1 Construction worker 2 Business people	(Requested anonymity)
Total Respondents 20 People	**Female = 8** **Males = 12**		**Percentage Female = 40%** **Percentage Male = 60%**

NOTE: Most of them though being the nearest, are far (2-3 kilometres form the place where the crushers will be located) and thus did not have any issue with the crusher, especially when there will be no quarrying or blasting of stones.

Environmental Management and Monitoring Plan

General

The Environmental Management Plan involves risk management strategies that should be undertaken by the project proponent, project manager and contractor (in this particular case) to mitigate environmental degeneration. They are approaches to monitor, control, reclaim and restore the environment back to its appropriate state. EMPs for projects thus provide logical frameworks within which the identified issues of environmental concern can be mitigated or monitored i.e. provides a check list for project monitoring and evaluation.

Environmental monitoring involves measurement of relevant parameters, at a level of details accurate enough, to distinguish the anticipated changes. Monitoring aims at determining the effectiveness of actions to improve environmental quality. The environmental management and monitoring plans have been developed and out lined to bring home the key finding of the environmental impact assessment; recommending necessary mitigation actions, defining roles, monitorable indicators and estimated cost. The EMPs outlined in the table below addresses the identified issues of concern (potential negative impacts and mitigation measures) as well as roles, costs and monitorable indicators that can help to determine the effectiveness of actions to upgrade the quality of the environment; as regards the proposed project. The EMPs have considered the crushing and movement of crushed materials to the locations of use.

Preparation Phase

The crusher will be a mobile unit moving to areas where the stones have been retrieved by road construction or where landscaping needs to be done. Since it is not be permanently installed, there no environmental impacts associated to preparation phase. All environmental impacts are during the operation phase and are as outlined in the section below.

Operational Phase EMP

Operational phase refers to the time when the crusher will be operational and activities include collecting stones and moving them close to the mobile crusher, movement of the crusher closer to the stones, crushing of stones, and transportation of crushed stones to the locations where they will be put into use. The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of negative

Environmental Management Plan for the Operational Phase

Impacts	Recommended management measures	Responsible party	Time frame	Monitoring Plan	How to Monitor	Cost (ksh)
Vegetation	Maintenance and watering vegetation	Proponent and Plot owner	Continuous	Ensure that plans plants do not dry	Regular checks	Various
Solid waste	Provide solid waste handling facilities such as waste bins and skips	Plot owner	One-off	Ensure that garbage bins are available	Inspection	10,000

management	Ensure the solid waste generated is regularly disposed of appropriately at authorized dumping sites	Plot / House owner	continuous	Ensure that garbage is collected by registered collector	Observations	10,000/month
	Efficient waste management through recycling, reuse and proper disposal procedures	Proponent/ Plot owners	Continuous	Make sure solid wastes are recycles and reused as much as possible	Observation	0
	Monitor energy use during the operation of the project and set targets for the efficient energy use	proponent	Continuous	Check on efficiency of energy use	Random checks	5,000
Health and safety	Implement all necessary measures to ensure health and safety for the workers and the general public during operation of the project as stipulated in occupational Health and safety Act, 2007	Proponent	Continuous	Conduct audits on health and safety	Observation	5,000
Hazards and Security	Develop an environmental policy as guiding principle for corporate environmental management and encompass an elaborate environmental plan a frame work for monitoring mitigation	Proponent and NEMA consultant	3 months often acquiring NEMA approval	Ensure the guidelines are developed	Proponent	30,000
	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting	Proponent	Continuous	Monitor security status and take appropriate actions to enhance	Proponent and Residents	20,000/month

	within and around the premises			security		
	Promote cleaning of spillages; adopt proper housekeeping; practices such as damp sweeping	proponent	continuous	Maintain clean environments	Proponent & residents	insignificant

Water quality	Regular monitoring of drains bosh reside and outside the deport to avoid blockage and overflows Regular monitor effluents According to Nairobi city Council by laws standards	proponent	Immediately	Maintain high standards of water quality	Regular checks	7,000
Solid Waste Management	Water Act & the Environmental Management (Water Quality) Regulations; and Waste Management Regulations Follow the prevailing NEMA regulations on waste collection, storage, transportation and disposal. Identify suitable solid waste disposal arrangements.	Proponent , NEMA consultant and Nairobi City Council	Various	Monitor application of regulations, installation of structures	Regular checks	50,000 (annually)
Fire safety and preparedness	Conduct training on fire fighting, evacuation and emergency response Adapt effective emergency response plan Maintain/service fire fighting machinery regularly Provide emergency numbers at strategic points Sensitize the residents on fire risks i.e. conduct regular fire drills	House owners	Random	Ensure appropriate fire management firms are engaged and give good service	Checking and observations	100,000

Decommissioning Phase

Environmental Management Plan for the Decommissioning Phase

Expected Negative Impacts	Recommended Measures	Responsibility	Time Frame	Costs (KSh)
Presence of scraps and other debris on site	Use of an integrated solid waste management system i.e., through a hierarchy of options: Wastes generated as a result of facility decommissioning activities will be characterized in compliance with standard waste management procedures. Disposal locations will be selected by the contractor based on the properties of the particular waste stream. All buildings, machinery, equipment, structures and tools that will not be used for other purposes should be removed and recycled/ reused say in other projects Where recycling/reuse of the machinery, equipment, implements, structures, tools and other waste is not possible, the materials should be disposed to approved dumpsites.	Contractor, Proponent/property manager	One off	1,300,000
Potential Pollution	procedures for finding contaminated material during excavations will be established Covering and damping of excavated materials Appropriate storage of contaminated material if found. Ground contamination and storm water contamination will be limited on site by proper handling and storage of materials and equipment.	Contractor, Proponent/property manager	One-off	600,000

Rehabilitation of Project site	Implement an appropriate re-vegetation programme to restore the site to its original status	Site Manager	During rehabilitation / after demolition	20,000
	Use indigenous plant species as much as possible	Site Manger	During rehabilitation / after demolition	5,000

Conclusions and Recommendations

This report indicates that the installation and use of stone crusher will be in fulfilment of the NEMA requirement to re-use and re-cycle solid waste materials that come out of the development project that has already been approved by NEMA.

It is our considered opinion that the proposed development is a timely venture with a positive and significant contribution to sustainable use of natural resources, proper handling of solid waste materials, and an economical way of constructing the roads. It is thus our recommendation that the project be allowed to go ahead with the implementation provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment. This will however be overcome through close following and implementation of the recommended Environmental Management and Monitoring Plans (EMPs).

We have also recommended that the proposed mitigation measures should be implemented. The project proponent should also work closely with the environmental experts and other bodies to enhance the facilitation of the issues of concern. This will also help in solving any problem arising and which may not have been foreseeable during the EIA project report. This will ensure that environmental concerns are integrated into the project.

Wastes should be reduced to the minimum as this will save on costs and at the same time preventing environmental pollution. The operators during the operational phase should exercise diligence in all activities to ensure environmental sustainability.

References

Atkilt Girma, David Rossiter, Wouther Siderius and Rob Henneman. Soils of Lake Naivasha Area, Kenya. Technical Report. International Institute of Aerospace Survey and earth Sciences. ITC, the Netherlands .

Clarke, M. C. G.; Woodhall, D. G; Allen, D. & Darling, G. (1990). Geological, Volcanic and Hydrological Controls on the Occurrence of Geothermal Activity in the area surrounding Lake Naivasha, Kenya. Ministry of Energy, Nairobi: 138 pp.

Gaudet, J. J (1979). Seasonal changes in nutrients in a tropical swamp: north swamps, Lake Naivasha, Kenya. .Journal of ecology (1979) 67: 953-981.

Harper, D. M. (1990). Lake Naivasha and Hell's Gate National Park. Ecological Investigation, University of Leicester, United Kingdom LNRA (1999) Lake Naivasha Management Plan. Lake Naivasha Riparian Association, Naivasha, Kenya.77pp.

Sikes, H. L. (1989). Notes of the hydrology of Lake Naivasha. Journal of East Africa and Uganda Natural History Society 13: 74-89.Red List, EN

Terborgh, J.W. (1974). Preservation of natural diversity: the problem of extinction of prone species. Bio .Sc 24: 715-722.Watson & Parker, 1970.

Watson, R. & Parker, I. (1970). The ecology of lake Naivasha; The identification and description of some important components for a model. African Scientist 2: 1-87.

Attachments and annexes:

1. Land transfer documents
2. Copy of Title Deed
3. Road designs

LOAD ANALYSIS FOR FULL DEVELOPMENT

	Number of plots	Estimated Load(KVA)	Total
Phase 1 (Crater Park)	2120	3	6,360
Phase 2 (Naivasha Gardens)	630	3	1,890
Phase 3(Kingdom City)	678	3	2,034

Roads Network

The road network details for Longonot Gate project is summarized in the table below. The entire road length totals 78Km.

The cross section details for the roads are as shown in the attached Typical cross sections.

As can be seen from the cross section details, the drainage features of the roads will mainly comprise of open side drains and a combination of culverts. In steep sections, the open drains will be lined with concrete to avoid soil erosion. The concrete lining will also help in retaining and directing the surface runoff to the water pans.

Scour checks will also be constructed to reduce possibility of erosion in not very steep sections.

The table below summarizes road network details

DESCRIPTION	Phase 1	Phase 2	Phase 2
Name of Phase	Crater Park	Naivasha Gardens	Kingdom City
Proposed type of surfacing	***Gravel wearing course***	Precast concrete paving block (cabro)	Precast concrete paving block (cabro)
Length of Main Roads (trunk & Perimeter)	12 Km	2 km	2 km
	Trunk Road Reserve = 20m Perimeter Road Reserve= 30m	Trunk Road Reserve= 18m Perimeter Road Reserve= 30m	Trunk Road Reserve= 20m Perimeter Road Reserve= 30m
Length of Estate	38 km		

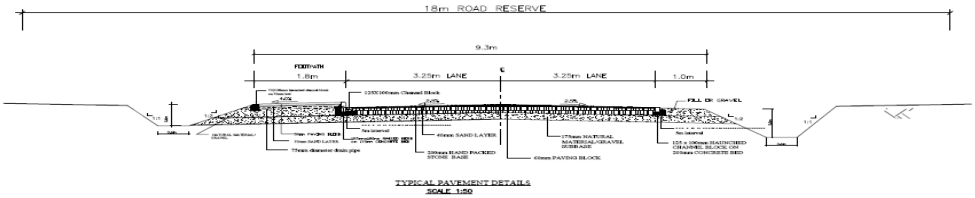
Roads (5.5m width)		20 km	4 Km
	Road reserve = 15m	Road reserve = 12m & 15m	Road reserve = 15m

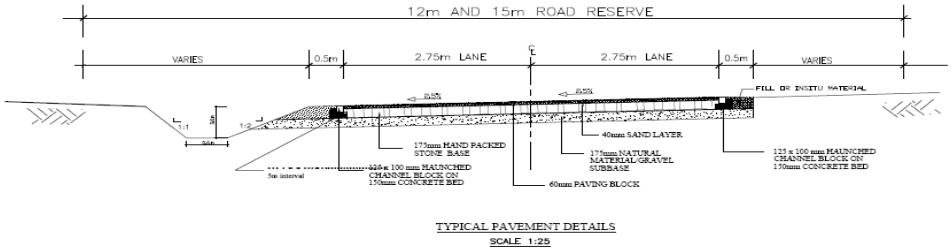
*** The above road network excludes the security patrol road with a road reserve of 9m and running on the Longonot mountain side edge of Phase 3 and Phase 1.*

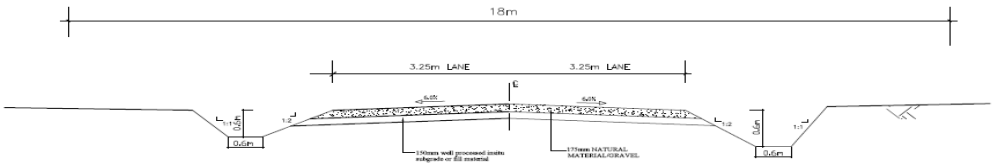
Road Construction Materials

Except for the road surfacing materials, all other road construction materials will be sourced from the project site. The extraction of the material is expected to be through ordinary surface methods.

Road designs







TYPICAL PAVEMENT DETAILS
FOR GRAVEL ROADS - PHASE 1
SCALE 1:50