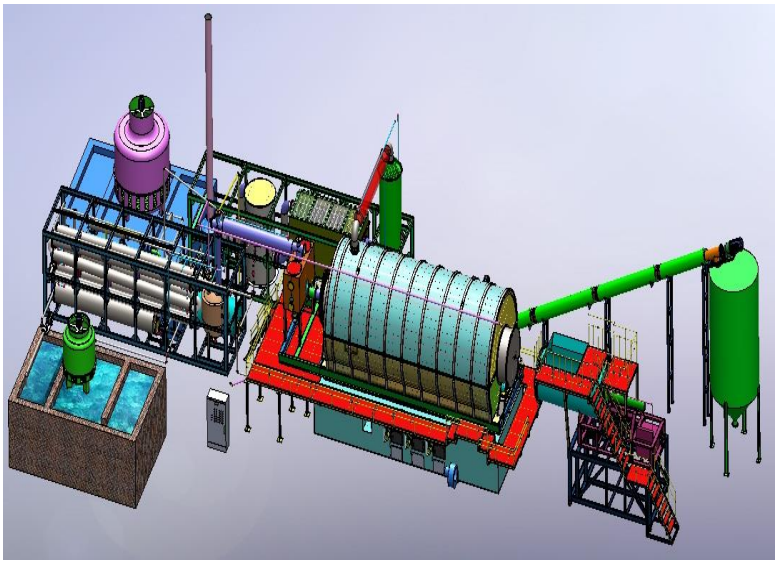
ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT

PROPOSED PYROLYSIS PLANT PROJECT ON PLOT LR NO MARIAKANI/KAWALA B/30 AREA ALONG MOMBASA-NAIROBI HIGHWAY AT MARIAKANI TOWNSHIP IN KILIFI COUNTY, KENYA.



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

PROPONENT

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JUNE, 2017

LIST OF PLANNING AND PARTICIPATING CONSULTANTS

The environmental experts who participated in the environmental impact assessment study for the Proposed Project for Pyrolysis Plant on Plot L.R. No. Mariakani/Kawala B/30 area along Mombasa-Nairobi highway at Mariakani Township in Kilifi County, within the republic of Kenya, is listed below.

NAME	QUALIFICATIONS
Mr. Edgar Ambaza (LEAD Expert, **Reg. No. 1916**)	Bsc. Natural resources Management, Cert. Occupational safety and health, ISO 9001, 14001, 18000 Lead Auditor.
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SUBMISSION OF DOCUMENTATION

I submit this Environmental Impact Assessment Report for the Proposed Pyrolysis Plant project on Plot L.R. No. Mariakani/Kawala B/30 area along Mombasa-Nairobi highway at Mariakani township in Kilifi County, within the republic of Kenya. To my knowledge all information contained in this report is accurate and a truthful representation of all findings as relating to the project.

PROPONENT/CONTACT PERSON

Sunraj Tech (K) Limited

Name: ……

Designation: .....**Signature:** ……

Date: ……....

LEAD ENVIRONMENTAL CONSULTANT

Name: Edgar Ambaza Malenge

Designation: Lead Expert **Signature:** ……

Date: ……...

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ACRONYMS, ABBREVIATIONS AND SYBMOLS

^0C	Degrees Celsius
WSSD	World Summit for the Social Development
UNCED	United Nations for the Environmental Development
EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act
EMP	Environmental Management Plan
EA	Initial Environmental Audit
KM^2	Square Kilometres
M^2	Metre Squared
EIK	Environmental Institute of Kenya
KWS	Kenya Wildlife Services
NEC	National Environment Council
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
PPE	Personal Protective Equipment
TOR	Terms of Reference
VAT	Value Added Tax
SWM	Solid Waste Management
Ha	Hectares
%	Percentage
WRMA	Water Resources Management Authority

EXECUTIVE SUMMARY

Introduction

The Waste Tyre pyrolysis plant is proposed within a vacant plot located in an industrial zoned area. The proposed site is secured within a perimeter wall and has access to other bulk infrastructure including water and electricity supply. Pyrolysis is an effective way of eliminating waste tyres in the republic of Kenya.

The proposed project entails the installation/construction of a Pyrolysis Plant within an existing yard for pyrolysis of waste tyres. Additional facilities to be put up include office block of ground floor level. The site neighbours undeveloped parcels of lands and a few establishments involving themselves in storage and transportation of cargos such as coal and clinker such as Queepaso Company, Ndogo Ventures Company, Truelinks Company. This area has been gazette as an industrial area by the County Government of Kilifi.

Sunraj Tech (K) Limited contacted the Lead Environmental consultant to carry out an Environmental Impact Assessment for the proposed Pyrolysis Plant on Plot L.R. No. Mariakani/Kawala B/30 area along Mombasa-Nairobi highway at Mariakani in Kilifi County, within the republic of Kenya. This was to comply with the Legal requirement stipulated in the Environmental Management and Coordination Act 1999 and the subsequent Legal supplement of 2003.

The **pyrolysis** method for recycling used **tyres** is a technique which heats whole or shredded **tyres** in a reactor vessel containing an oxygen-free atmosphere. In the reactor the rubber is softened after which the rubber polymers break down into smaller molecules.

Generally, there are three types of tyre pyrolysis plants, batch operating plants, semi-automatic operating plant and fully continuous operating plant.

Background information

Process and Design alternatives

The Waste Tyre Pyrolysis process is a relatively new process and is to a certain extent still being perfected. A number of process alternatives are being considered by the applicant and plant designer and the process that will be followed at the proposed plant. Process alternatives include, for example, the way in which the feedstock (waste tyres) will be cleaned; by either using water or compressed air. Other alternatives include the way in which the feedstock will be introduced into the reactor, such as through a gravity feed system or a bottom feeding system, and the type

of reactor that will be used, for example a horizontal or vertical reactor. Vertical reactors can be fluidized bed, entrained bed or fixed bed reactors.

It is with this framework that the proponent will be working closely with the, National Oil Corporation, and the National Environment Management Authority. They will offer investigations, surveys, design and supervision of engineering and civil works as well as oil products' management and training. This will prove invaluable to the project management team both in the initial period and for years to come.

Since the inception of the Environmental Management and Coordination Act (EMCA) 1999, it has now become a legal requirement for all projects leading to the activities listed in the second schedule to undertake Environmental Impact Assessment (EIA). EIA is a tool for environmental conservation and has been identified as a key component in new project implementation. The report of the EIA must be submitted to National Environment Authority (NEMA) for approval and issuance of license.

Scope, objective and criteria of the Environmental Impact Assessment (EIA)

The NEMA Registered Expert was appointed to conduct the Environmental and Social Impact Assessment of the proposed pyrolysis plant project. The scope of the assessment covered all the construction phase activities, operational phase activities and decommissioning phase activities. The output of this work was a comprehensive Environmental Impact Assessment study report for the purposes of guiding the project proponent through all the project phases, and applying for an EIA licence.

The consultant on behalf of the proponent conducted the EIA by incorporating (but not limited to) the following terms of reference:

- The proposed location of the pyrolysis project.
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
- The technology, procedures and processes to be used, in the implementation of the project.
- The materials to be used in the development and construction and implementation of the project.
- The products, by-products and waste to be generated by the project.
- A description of the potentially affected environment.
- The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
- To recommend a specific environmentally sound and affordable waste tyres management system.

- Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
- Analysis of alternatives including project site, design and technologies.
- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
- Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development and processing activities.
- Propose measures to prevent health hazards and to ensure security in the working environment for the employees and the management in case of emergencies.
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
- Assist the proponent to follow up and seek license approval of the proposed project.

Project description

The Proposed Project for Pyrolysis Plant on Plot L.R. No. Mariakani/Kawala B/30 area along Mombasa-Nairobi highway at Mariakani Township in Kilifi County. The site for the proposed project is neighboured by commercial yards and other lands which are undeveloped. The project will cover an approximate area of two hectares.

For maximum production, the following steps techniques will be adopted:

1. **Pretreatment**

For the continuous type, its feeding hole is very small, so it needs a shredder machine to cut tyre into small pieces (about 30-50mm). While for the batch system, the tyre can be directly put into the reactor without being pretreated.

2. **Feed raw materials**

For the continuous type, the waste tires can be put into reactor by an auto-feeder. While for the batch type, this process is manual.

3. **Tyre Pyrolysis**

Heat the reactor by using fuel materials, such as coal, charcoal, fuel gas, wood etc. The reactor will be slowly heated, when the temperature reaches around 250℃, the oil gas will be produced.

4. **Condensing**

A part of oil gas will be processed by our technology and then goes to cooling system to form liquid oil. We adopt new-type condenser which can improve the oil yield efficiency and make the oil yield to the maximum.

5. **Extra gas recycling**

The gas which cannot be liquefied under normal pressure will go back to combustion system. It can be used as fuel material to heat the reactor, which will save energy for the whole working process.

6. **Discharge**

In the process, there are also carbon black and steel wire produced. For the continuous type, the discharging of these two products are both automatic. When the temperature falls down to 40℃, workers will open the door and take the steel wire out.

When the whole working process has been finished, the reactor of the batch type must be cooled and then you can start another batch.

Methodology outline

Given the scale of the proposed project, proposed project complexity and the environmental conditions of the project area, Environmental Impact Assessment study was opted for to ensure comprehensiveness and completeness of the assessment. The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring environmental and social impact assessment under schedule 2 of EMCA, 1999.
- Environmental scoping that provided the key environmental issues.
- Desktop studies and interviews.
- Physical inspection of the site and surrounding areas.
- Photography and data collection on the key elements constitution the environmental resources (land, soil, water, flora and fauna) within the study area.
- Public participation via the use of questionnaires, interviews, door to door discussion, and public meetings.
- Reporting.

Physical Environmental Baseline surveys

Results regarding the environmental characteristics of the study area are as briefly discussed below, within the EIA report and exhaustively discussed in the respective specialist study reports commissioned by the proponent.

Proposed mitigation measures for the negative impacts

The EIA study found out that all the negative impacts resulting from the proposed project can be adequately mitigated. Given the scale of the project, its complexity and the existing environmental characteristics of the project area, the proponent commissioned specialist studies

to fully address the impacts on human being, vegetation cover and biodiversity, alteration and destruction of wildlife and wildlife habitats, soil, hydrology and water resources, livestock and fisheries.

To address the negative social and economic impacts resulting from the project, EIA project study was done to guide the proponent all along. This study recommends that the proponent adheres to the recommendations in the reports (EIA) which should be in agreement with the laws of the land.

This report emphasizes legal compliance for any negative aspect which might be a threat to any segment of the environment and mankind. The following legislations were found handy in providing mitigations measures to most of the likely negative impacts. For full disclosure of the various mitigation measures, see the chapter on mitigation measures of this EIA report.

- ✓ Occupational Safety and Health issues shall be addressed as per the provisions of OSHA, 2007 among the other measures given.
- ✓ Noise and Vibrations impacts shall be addressed as per the requirements of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.
- ✓ Waste management shall be addressed as per the provision of the Environmental Management and Coordination (Waste management) Regulations, 2006.
- ✓ Waste water shall be addressed as per the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006.
- ✓ Air emissions shall be addressed as per the provision of the Environmental Management and Coordination (Air Quality) Regulations, 2014
- ✓ Hazardous substance will be addressed as per the requirements of the Environmental Management and Coordination (Controlled Substances) Regulations, 2007.
- ✓ Public health concerns will be addressed through the provisions of the Public Health Act (Cap. 242).
- ✓ The Energy Bill, 2014.

Conclusion and way forward

The dumping of tires is a problem in urban areas of Kenya. Most people think that the best way to dispose scrap tires is to burn them or throw them in dumpsites but this creates environmental strain. The opportunity to make use of used tyres is rarely appreciated.

The pyrolysis method for recycling used tyre is a technique which heats whole or shredded tires in a reactor vessel containing an oxygen free atmosphere and a heat source. In the reactor the rubber is softened after which the rubber polymers continuously break down into smaller molecules. These smaller molecules eventually vaporize and exit from the reactor. These vapors can be burned directly to produce power or condensed into an oily type liquid, generally used as

a fuel. Some molecules are too small to condense. They remain as a gas which can be burned as fuel. The minerals that were part of the tire, about 40% by weight, are removed as a solid. When performed well a tyre pyrolysis process is a very clean operation and has nearly no emissions or waste.

The proposed pyrolysis plant project is commendable since it is one of the Best Environmental Practices that ensures that waste scrap tyres are properly managed (recycled) as opposed to burning them thus increasing dioxins and carbon into the atmosphere. This recycling process will reduce overall environmental impacts caused by poor management of used tyres. The project design seeks to ensure sustainable development through sustainable use of used tyres to produce fuel. Good processing techniques shall be employed to maximize production without injuring any segment of the environment. The positive and negative impacts which will come along with the establishment of the proposed project have been exhaustively discussed within the report with revelation that the positive impacts outweigh the negative impacts. The proposed project will not only enhance economic growth at local level but also contribute to the national, regional and international economy.

The study recommends that the proponent ensure environmental care within all the project phases as required by the laws of the land. The negative environmental impacts which will come along with the proposed project as per this study can be adequately mitigated. The proponent of the proposed project shall be committed to putting in place all the necessary measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects.

The No Action Alternative in respect to the proposed project implies that the status quo is maintained. The 'No project scenario' from a socioeconomic perspective would mean that the use of the site continues in a marginal manner with substantial underutilization of resources. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. Without the proposed used Pyrolysis plant project, the site would continue to be in the status quo with the prevailing economic marginalization of the area, high poverty and unemployment levels, insecurity, low development and land use, high illiteracy, poor health facilities, poor access roads and improper infrastructure leading to more loss of financial exchange. Additionally, potential for over 50 employment opportunities during and after construction of the proposed development would also be lost. The current Kenyan and regional economy cannot afford these loses while the rest of the country is on a tremendous economic growth. This alternative was the least favorable.

On the basis of the above and taking cognizance of the fact that the project is basically essential to local needs it is our recommendation that the project be allowed to go ahead provided the mitigation measures outlined in this report are adhered to and the Environmental Management Plan is implemented.

1 INTRODUCTION

1.1 Background and Rational for an Environmental Impact Assessment

The disposal of solid wastes from human activity is a growing environmental problem for modern society, especially in developing countries. The scrap tyres are one of the very common and most important hazardous solid wastes all over the world. As the number of vehicles on our roads continues to rise, the problem of scrap tyre disposal presents serious waste management challenges for society. Used tyres become waste when worn tires are replaced and when vehicles reach the end of their life. The industry has been created virtually due to government regulations enacted to address the environmental concerns about illegally dumped or stockpiled tyres. In Kenya as a whole, people have been burning tire in the open to obtain steel wire it the tyre. This not just produces a nuisance but it is also harmful for that environment. A lot of chemicals can be used for making tyres in addition to the rubber. When these waste tyres lie from the landfills, there exists a chance of these harmful chemicals leeching in the groundwater below and pollute the water supply.

Now there is a new technology called tires to oil pyrolysis technology that could not merely get rid of the huge piles of waste tyres but may also produce a profit from the end products while protecting the environment as well. This is why the use of waste tyre to fuel oil pyrolysis method is gaining plenty of popularity for recycling the waste tires/plastic.

The proponent to this proposed project, **Sunraj Tech (K) Limited** contacted the NEMA Lead Environmental consultant to carry out an Environmental Impact Assessment for the proposed Pyrolysis Plant on Plot L.R. No. Mariakani/Kawala B/30 area along Mombasa-Nairobi highway at Mariakani Township in Kilifi County, within the republic of Kenya. This was to comply with the Legal requirement stipulated in section 58 of the Environmental Management and Coordination Act 1999 and the subsequent Legal supplement of 2003.

The proponent intends to put up pyrolysis plant. The proposed project will be located in Mariakani area along Mombasa - Nairobi Road road at Kawala/Mariakani in Kokotoni sublocation, Kawala B area. This area is gazetted as Industrial Zone by the County Government of Kilifi in the year 2012.

Pyrolysis is a thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen (or any halogen). It involves the simultaneous change of chemical composition and physical phase, and is irreversible. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating". In this case, Pyrolysis basically involves the thermal decomposition of the tyre at high temperatures (300–900°C) in an oxygen-free atmosphere. Through the tire pyrolysis oil plant, waste tires can be effectively recycled into tyre oil, carbon

black and steel wire. These pyrolysis products can be applied in many fields. For example, tyre oil can be widely used as fuel oil in industries such as steel and iron and boiler factories, ceramics, power or chemical industries etc. And it can be used for generators to get electricity.

The facility will comprise of the following:

- ✓ Office block ground floor only,
- ✓ Shed to house the Tyre Pyrolsis machine
- ✓ Waste tire storage shed
- ✓ Parking area
- ✓ Soak pit and septic for disposal of sewage

One of the primary advantages of this method is by using pyrolysis technology; it is easy to get fuel oil from waste tyres and also plastics. The raw materials necessary for operating this pyrolysis plant is incredibly cheap as these raw materials are useless to people. Quite simply, it is actually a highly profitable business especially if you have an abundance of raw material.

Other benefits that will be accrued from this project will include;

- Convert waste into energy thus clearing the existing dumping site;
- It will provide renewable source of energy
- It will offer employment opportunities,

It is with this framework that the proponent will be working closely with the National Oil Corporation, and the National Environment Management Authority. They will offer investigations, surveys, design and supervision of engineering and civil works as well as oil products' management and training. This will prove invaluable to the project management team both in the initial period and for years to come.

1.2 Scope, objective and criteria of the Environmental Impact Assessment (EIA)

1.2.1 Scope

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

- Description of the proposed project.
- The baseline environmental conditions of the area.
- Provisions of the relevant environmental laws.
- Seeking views through Public participation and consultation.

- Identification and discussion of any adverse impacts to the environment anticipated from the proposed project.
- Appropriate mitigation measures.
- Provision of an environmental management plan outline.
- Occupational and Environmental health and safety management.
- Analysis of alternatives.

1.2.2 Objectives of the Project

The objective of the proposed project is to construct and operate a tyre recycling plant. This will reduce the amount of tyres directly burned unsustainably and reduce green- house emissions as while at the same time generating energy sources in the process, generating steel for recycling and carbon black (a material used as a main ingredient in industry to improve colouring features). The proponent targets the Mombasa area and its environs, where burning of tyres has been reported in the former Kibarani dumping site and the current Mwakiruge dumping site, among other individual transporters. This will do ensure that tyre materials are not released into the environment but recycled for re-use.

1.2.3 Objectives of the EIA

The overall objective of the study is to assess the potential significant adverse impacts of the proposed development and articulate appropriate mitigation measures.

i. The specific objectives of this study include the following:
ii. To identify and evaluate the significant environmental impacts of the proposed project.
iii. To assess the environmental costs and benefits of the proposed project to the local and national economy.
iv. To determine the compatibility of the proposed facility with the local environmental setting.
v. To evaluate and select the best project alternative from the various options.
vi. To propose mitigation measures for the negative environmental impacts
vii. To incorporate Environmental Management Plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project.

1.2.4 Purpose and terms of reference

The purpose and terms of reference developed for this project study is to assess the impacts that may arise during the construction/installation, operational and decommissioning phases of the proposed development. These are the impacts anticipated from the project to the vegetation and biodiversity, wildlife and their habitats, existing hydro-geological settings, livestock, and fisheries life, mankind and the physical environment at large.

The terms of reference developed for this study therefore covered the following;-

- The objectives of the project.
- Describe to details the baseline condition of the project area.
- Give a detailed outline of regulatory and legislative framework related to the project.
- To describe the potential impacts that may occur during the construction, operational and decommissioning phases.
- To describe the technology, materials, procedures, and process to be used in the implementation of the project.
- To describe the potential effects of the development on both the natural and human environment, and the likely products and by-products and waste generated by use of the project and how they would be treated or disposed taking into account health and safety matters.
- The impact imposed on existing infrastructure.
- Propose suitable mitigation measures for the identified impacts.
- Describe if any, alternative technologies and processes available and reasons for the preferred chosen location, technology and process.
- Develop a comprehensive environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse negative impacts on the environment including the cost, timeframe and responsibility to implement the measures.
- To develop the monitoring plan.
- Offer conclusion and recommendation, and
- Such other matters as the Authority may require.

1.2.5 Data collection procedures

First, the Consultant undertook environmental screening and scoping to avoid unnecessary data. The data collection was carried out through questionnaires/standard interview/public meetings schedules, use of checklists, observations and photography, site visits and desktop environmental studies, where necessary in the manner specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003.

1.2.6 EIA organization and structure

The EIA was carried out to full completion in line with NEMA Regulations as specified in section 58 of EMCA, 1999. The Consultants (Lead Expert) coordinated the day-to-day functions and any related institutional support matters. Otherwise, all formal communications were directed to NEMA through the proponent.

1.2.7 Reporting and documentation

The Environmental and Social Impact Assessment study report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the proponent for consideration and approval. The Consultant ensured constant briefing of the client during the exercise. Description plans and sketches showing various activities are part of the Appendices.

1.2.8 Responsibilities and undertaking

The Consultant (Lead Expert) undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material as agreed with the proponent to ensure respect of timelines as outlined in the NEMA approved TOR. The consultant arranged for own transport and travels during the exercise. On the site of the proposed re-processing of lubricating oil project, the proponent provided contact persons to provide information required by the consultant. The proponent also provided site plans showing roads, service lines, buildings layout and the actual sizes of the sites, details of raw materials, proposed process outline and anticipated by-products, future development plans, operation permits and conditions, land-ownership documents and site history. The output from the consultants includes the following:-

- An Environmental Impact Assessment study report comprising of an executive summary, study approach, baseline conditions, anticipated impacts and proposed mitigation measures.
- An Environmental Management Plan outlines which also forms part of the report recommendations.

1.2.9 Methodology outline

Given the scale of the proposed project and the environmental conditions of the project area, Environmental Impact Assessment study was opted for to ensure comprehensiveness and completeness of the assessment. The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring environmental and social impact assessment under schedule 2 of EMCA, 1999.
- Environmental scoping that provided the key environmental issues.
- Desktop studies and interviews.
- Physical inspection of the site and surrounding areas.
- Photography and data collection on the key elements constitution of the environmental resources (land, soil, water, flora and fauna) within the study area.

- EIA Public Participation via the use of questionnaires, door to door interview and public meetings.
- Reporting.

1.2.9.1 Environmental screening

This step was applied to determine whether an environmental impact assessment was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, 1999, and specifically the second schedule. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.2.9.2 Environmental scoping

The scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.2.9.3 Desktop study

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with key stakeholders, managers and design engineers, as well as interviews with site neighbours.

1.2.9.4 Site assessment and public participation

Field visits were meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. To ensure adequate public participation in the EIA process, structured questionnaires were administered, door to door interviews made and public meetings held to the project site neighbours and the information gathered was subsequently synthesized and incorporated into the EIA study report.

1.2.9.5 Reporting

In addition to constant briefing of the client, this Environmental Impact Assessment study report was prepared. The contents were presented for submission to NEMA as required by law.

2 PROJECT DESCRIPTION

2.1 Project Background

The proposed site where the project is to be located has good geological structure in a developing area which has been zoned as industrial area by the County Government of Kilifi. Plot No. B'/30 Kawala, Mariakani, is along Main Mombasa – Nairobi highway and is easily accessible for trucks that will be delivering raw materials to the plant for various collection points and collection of finished products to various to various consumers within the republic. The two acre piece of land that will hold an office block, used tyre storage shed and pyrolysis shed. The drawingng have been submitted to County Government of Kilifi for approval. The plot has an already existing concrete perimeter wall with entry lockable gate.

Electricity need will be met from the KPLC grid. To ensure uninterrupted power supply, a power generator will be installed.

The site will be designed to ensure optimum utilization of space, minimal waste movement and safe movement of machineries. During full operation, the plant will help to recycle a lot of waste especially tyre generated from various activities within Mombasa, Kwale and Kilifi counties. A location will be identified for segregating and holding waste within the yard.

Appropriate mitigation measures will assist in minimizing the potential impacts on the surrounding environment during the construction and operational phases of the proposed plant.

The main mitigation measures that should be applied to the proposed project include the following:

- Environmental Awareness Training for all contractors and workers;
- An Atmospheric Emission Analysis to be done for the pyrolysis plant on quarterly basis;
- Oil storage tanks must be designed and operated in accordance with SANS 10089-1:2008 and 10087-3:2008, respectively;
- Adequate firefighting equipment must be available on site and all employees must receive training on the correct use of the equipment. The equipment must be maintained as stipulated by the manufacturer and the local fire department must be satisfied with the fire prevention measures on the site
- All waste tyres must be stored in a manner that prevents the establishment of fires;
- No products from the pyrolysis process may be stored in the open and all storage containers and/or bags must be sealed during storage and transportation. Storage must occur on impermeable surfaces; and
- Soil, storm water and groundwater pollution must be prevented through the correct handling, storage and disposal of cement, concrete, waste and chemicals.

Based on the outcomes of the Environmental Impact Assessment, conducted as part of this full Scoping and Environmental Impact Assessment process, as well as the alternatives assessment, the following recommendations are made:

- The proposed project/activity (the construction and operation of the Waste Tyre Pyrolysis Plant) should be authorized and allowed to proceed on the preferred site on condition that the proposed plant should be carrying out ambient and stack emission's analysis on quarterly basis;
- The mitigation measures proposed in this report and the draft Environmental Management Programme must be implemented during all phases of the proposed project;
- It is assumed that the mitigation measures proposed in this report and the draft Environmental Management Programme will be correctly implemented by the applicant and that they will be effective;
- Proposed mitigation measures should be incorporated as far as possible into the operational plan for the plant; and
- Strict monitoring and enforcement of requirements of the EMP must be undertaken to ensure that contractors and operators adhere to these requirements.

2.2 The Project location

The proposed project will be located in Mariakani Kawala B'/30 georeferened as 3°53′18.7″S 39°29′56.8″E (**-3.888536, 39.499118)** along Main Mombasa - Nairobi road, Kilifi County. Administratively the site is located in Kokotoni location in Mariakani. The neighbourhod of the site features commercial and industrial developments. Mariakani lies about 35 km from Mombasa town.

Plates: showing neighbourhood of the proposed site and entry gate to the proposed site

2.3 Project Description and Design

The following figure shows a conceptual process flow for the proposed Waste Tyre Pyrolysis Plant. These designs are also subject to confidentiality agreements.

Recycling of waste tyres could save energy resource, change waste in to valuables, reduce its pollution to environment, has great economic and social benefits.

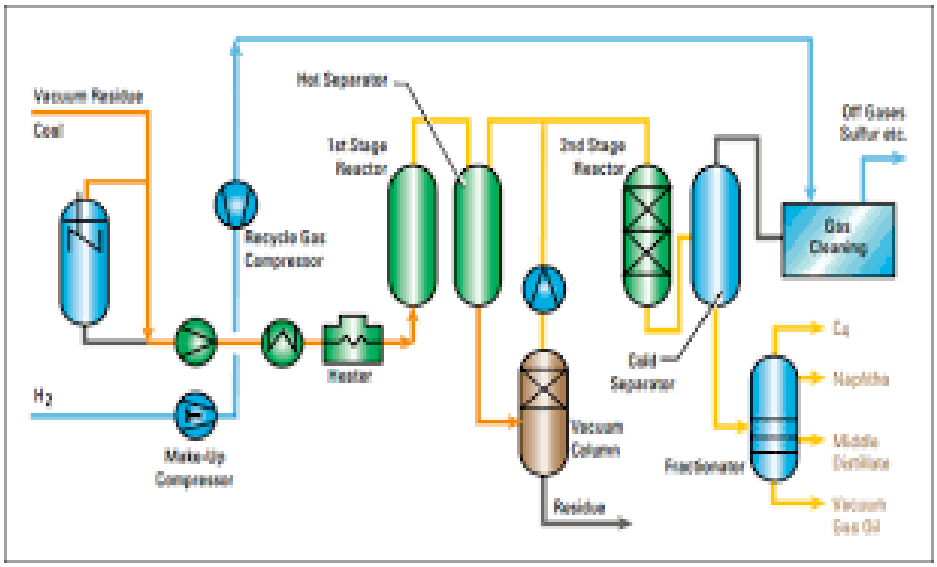
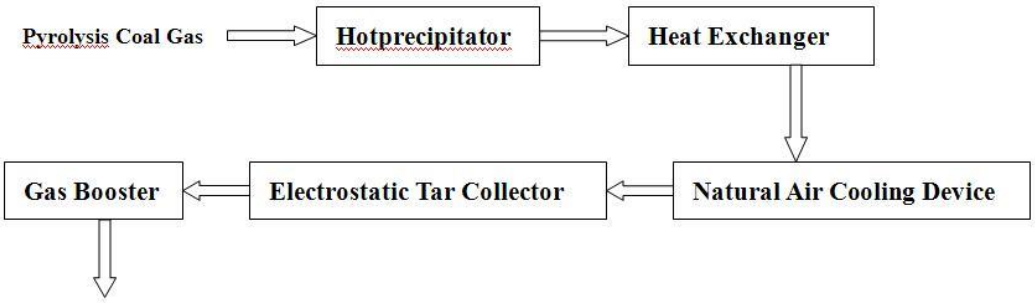


Figure 1: Waste Tyre Recying Flow Process Chart



2.3.1 Expected project activities

For maximum production, the following steps techniques will be adopted. The scope of works includes but is not limited to the following:

1. Pretreatment

For the continuous type, its feeding hole is very small, so it needs a shredder machine to cut tyre into small pieces (about 30-50mm). While for the batch system, the tyre can be directly put into the reactor without being pretreated.

2. Feed raw materials

For the continuous type, the waste tires can be put into reactor by an auto-feeder. While for the batch type, this process is manual.

3. Tyre Pyrolysis

Heat the reactor by using fuel materials, such as coal, charcoal, fuel gas, wood etc. The reactor will be slowly heated, when the temperature reaches around 250℃, the oil gas will be produced.

4. Condensing

A part of oil gas will be processed by our technology and then goes to cooling system to form liquid oil. We adopt new-type condenser which can improve the oil yield efficiency and make the oil yield to the maximum.

5. Extra gas recycling

The gas which cannot be liquefied under normal pressure will go back to combustion system. It can be used as fuel material to heat the reactor, which will save energy for the whole working process.

6. Discharge

In the process, there are also carbon black and steel wire produced. For the continuous type, the discharging of these two products are both automatic. When the temperature falls down to 40℃, workers will open the door and take the steel wire out.

Final Products and Usage:

No.	End Products	Usage
1.	Base oil (Crude oil)	• Blending or direct use in industries. • Turn to diesel and gasoline by waste oil distillation plant. • Fuel for industrial boilers, hotel boilers and furnaces in steel processing plants/smelters
2.	Carbon black	• Used in foundries, traditional brick and lime kilns and in bakeries
3.	Steel wire(for waste tyre)	• Sell directly. • Deep processing to steel bloom by hydraulic press-packing.
4.	Flammable oil gas	• Fuel burn by use gas burn system (pyrolysis machine included). • Flammable gas can be storage as fuel material for heating.

The remnant wastes will be burnt at temperatures of approximately 1,400 degrees Celsius ensuring complete combustion. At this temperature dioxins are not formed due to high temperatures.

2.4 Construction Inputs/ Raw Materials

The construction and operation phases of this project will utilize a lot of inputs and raw materials. The proponent and contractor are expected to procure building materials from licensed dealers. Besides, they have must meet both local and international safety and quality standards.

Main inputs during construction include metal and steel tanks and containers, building blocks, sand, gravel, glasses, hand cut construction stones, timber for making structural formwork and interior design.

2.4.1 Technology and Activities

The contractor shall employ modern and best building and construction technologies. They should not be inferior to locally and internationally established building standards. Construction of the project will involve ground excavations; making foundations; building courses; and roofing.

2.5 Description of the Project's Construction Activities

2.5.1 Excavation / Earthworks

In order to prepare the site for construction of the building, a lot of excavations will be carried out. In this regard, machinery and human labor will be relied upon. Debris and excavate

materials from earthworks, especially soil and stones will be used in various construction activities.

2.5.2 Foundation and Masonry

Completion of excavations will be followed with setting a foundation for the re-processing machines/equipments, and other constructions. Other masonry activities include stone carvings, concrete mixing, and plastering, slab construction, reinforcing walls/lintels and curing of walls.

2.6 Staff Amenities

2.6.1 Site Office

The proponent is to construct a modest site office with iron concrete walls and concrete floor. The roof will be made using iron sheets whereas the ceiling board will be constructed using soft board on timber framing.

2.6.2 Sanitary Waste Management

Wastewater from sanitary facilities should be generated to exhaustible septic tanks and or soakage pits. This is because the project area is not sewered.

2.6.3 Non-Hazardous Materials

The store for non-hazardous materials will be accommodated within the site office. Materials to be stored in this store shall include samples for review by consultants and inspectors.

2.6.4 Hazardous Materials

Hazardous materials shall include paints, oil, grease and fuel. The store for these materials shall have iron sheet walling and roof and a waterproof concrete floor to contain spills. Storage and handling of all Hazardous chemicals shall be in accordance with manufacturer's instructions as outlined on the material safety data sheets.

2.6.5 Bulk Construction Materials

The bulk materials to be stored on site include: sand, ballast, stones, cement, quarry chips and timber. However, to avoid material accumulation with potential for obstructing site activities, inducing safety hazards and creating a nuisance in the neighborhood, the main contractor intends to have materials delivered in small quantities.

2.7 Description of the Project's Operational Activities

Completion of construction activities will be followed by operation of the Pyrolysis plant and associated ammenities. The activities to be carried out during the operation phase of the proposed project include: Reactor still container, separation system, condensation unit, air compression unit, gear pumping, turbo pumping, oil filtration device, and the control cabinet unit.

2.8 Project's Decommissioning Activities

During decommissioning, of this Pyrolysis plant project it's advisable to return the excavated land to its original state. Analysis of the soil should be done to check on the salinity levels and the land should be rehabilitated.

2.9 Responsibilities

2.9.1 Proponents' Responsibilities

The proponent will have to ensure that all legal provisions and standardization benchmarks are observed .In this regard, the proponent shall ensure that:

- Building and mechanical materials are of high quality and from accredited dealers,
- Sanitary facilities are provided and hygiene observed,
- Avail a first aid tool kit,
- Ensure that any accident is well attended to and medical bills paid,
- All workers are duly compensated for their services,
- The proponent shall provide a room at the site for logistic purposes, and
- He will provide a dressing and changing room to all workers.

2.9.2 Contractors' Responsibilities

The contractor will have the following duties:

- Have an updated timetable of the progress documenting periods of each construction and mechanical fitting stage,
- During the night, public holidays and any other time when no work is being carried out onsite, the contractor shall accommodate only security personnel and never should a labor camp be allowed onsite,
- The contractor shall make good at his own expense any damage he may cause to public and private roads and pavements in the course of carrying out his work.
- The architect shall define the area of the site, which may be occupied by the contractor for use as storage, on the site, by providing a proper site layout plan.
- The contractor and proponent shall provide at his own cost all water required for use in connection with the works including the work of subcontractors, and shall provide temporary storage tanks,

- The contractor shall make his own arrangement for sanitary conveniences for his workmen,
- The contractor shall take all possible precaution to prevent nuisance, inconvenience or injury to the neighboring properties and to the public generally,
- The contractor shall take all effort to muffle the noises from his tools, equipment and workmen to not more than 70 Decibels

2.10 Estimated Project Investment Cost and NEMA Fee

The proposed project is to be completed at an approximate total project cost of Fifty two million, six hundred and forty five thousand seven hundred and sixty eight thousand shillings only **(Kshs. 52,645,768)**.

3 BASELINE INFORMATION OF THE PROPOSED PROJECT STUDY AREA

3.1 Site Location

The proposed project will be located on plot No.Mariakani/Kawala B'/30 Kokotoni area along Nairobi-Mombasa highway at Mariakani township in Kilifi County. The geographic coordinates of the site are as -3.8873800, degrees South and 39.4995900 degrees East. The neighbourhod of the site features similar oil handling yards that have already been licensed by NEMA, transport yard and Clinker handling yards and parcels of undeveloped lands.

3.2 Land Use

Agriculture, mostly of subsistence nature, is the main land use in the county. Tourism is also conspicuously present with tourism supporting facilities concentrated in the creeks, (Mida, Kilifi and Mtwapa). The main commercial centres in Kilifi District are Kilifi, Mtwapa and Mariakani towns. A major challenge impinging on the management of land use patterns in Kilifi is lack of a master plan to guide development activities and dictate land use activities. Development and land use activities have largely been uncontrolled leading to the proliferation of informal settlements.

The site for the proposed project was previously was unused site with existing boundary wall and a lockable gate. The proposed project will therefore not lead to changes in land use as it's already zoned as industrial zone by the County Government of Kilifi.

3.3 Climate

Generally, the Kenyan coastal region is charecterized with a tropical and monsoon climate. The temperatures are usually high throughout the year. Maximum and minimum temperatures range between 26.5-34^{o}C and 22.5-24.5^{o}C respectively. The region experiences more than 6 hours of sunshine on a daily basis with the period between October and March exceeding 8 hours. Winds follow a typical monsoon pattern; during December to February they blow from the east and east-north east. By March they start to shift towards the south and by April, the start of the monsoon season, they're predominantly from south-southwest. The predominant wind direction continues to be from the south from May until October with gradual eastwards shift beginning which becomes more pronounced by November and by December the cycle begins again.

The rainfall pattern is bimodal with rainfall averaging between 900-1200mm annually. The long rains come between March and July while the short one is experienced between November and December.

3.4 Topography, Geology and Soils

The project site is characterized by a slightly undulating terrain that slopes towards the Ocean. The land rises gradually from sea level to 900m on the south-western side of the district. It can be divided into six physiographic regions namely:

3.4.1 The coastal Plain

This region is generally below 30m in altitude except from Malindi northwards where the land rises to 60m in some places. The coastline consists of beaches, mangrove forests, sand dunes north of the Sabaki River, arid creeks of which the main ones are Mtwapa, Kilifi, Mida and Ngomeni. The creeks include marine swamps covered by mangrove forests.

3.4.2 The Foot Plateau

The western extension of the coastal plain lies between 60m and 135m in altitude. It is charecterised by a flat surface except where Mwembe-Chungu, Ngoni and Mtuni Hills between Mtwapa and Kilifi rise to over 120m. The Sabakia and Koronmi rivers have incised into the plateau almost obliterating it. Otherwise the region is dissected by several small valleys.

3.4.3 The Coastal Range

Several sand stone hills mark the coastal range. DakaWacha and Gaabo in the northwestern part of the District, Simba (347m), Kiwara (323m) and Jabana in the Kilifi and Mazaras areas and Mangea (705m) west of Watamu. The central part is incised by the Sabaki, Koromi and Goshi Rivers, lowering the altitude to below 150m level.

3.4.4 The Tana River Basin and Lowlands

This is in the northern part of the County, generally below 300m. It is made up of alluvium and old sediments including sand gravel, silt, clay, and marsh and composed of narrow elongated plateaus and lowlands.

3.4.5 The plateau

At an altitude between 300m and 900m, the plateau is formed of ancient rocks, mainly metamorphic of the basement complex. Flood plains are along the Sabakiriver, and in certain areas along the Ndzovuni and Rare (Goshi) rivers. Bottom land (depressions without visible drainage outlets) occur in the north, drained by the Mukale and Wildeinia Rivers.

The soils were observed to be mainly composed of rock outcrop with patches of brown loamy soil. The soils are poor in fertility except where indigenous vegetation remains and a layer of fertile loam soil has developed. The soils can be grouped into three major units namely coastal

plain, coastal uplands and erosional plain. In general terms, the lithology of Kilifi County is composed of sedimentary rocks of the Mesozoic and cainozoic eras. The sedimentary rocks consist of a variety of sandstones, siltstones, shales and limestone.

3.5 Demographic characteristics

3.5.1 Population

The population of Kilifi especially in its urban centers has been on the rise mainly due to rural urban migration, tourism and the influx of foreigners. In the Kenyan Coast as a whole, population distribution in the hinterlands is mainly affected by rainfall distribution, altitude, agro-ecological zones and administrative policy through which a number of settlement schemes have been created. The 1999 population census figures show that the District had 544,303 persons and a density of 144 persons per km² with a population growth rate of 3.05% against the national population growth rate of 2.49% (CBS 2005 estimate).

The Coastal population in Kenya is culturally heterogeneous. The largest indigenous ethnic group being the Mijikenda which is comprised of nine sub-tribes namely: Giriama, Digo, Rabai, Duruma, Kauma, Chonyi, Kambe, Ribe, and Jibana. Other indigenous Coastal ethnic groups are: Taita, Pokomo, Bajuni, Orma, Sagala, and Swahili. Due to its socio-economic dynamics which offer great opportunities for livelihoods and leisure, the Kenyan Coast and Mtwapa in particular has over the years attracted a multiplicity of ethnic and racial groups.

3.5.2 Settlement patterns

Settlement patterns in Kilifi County are influenced by infrastructure network (roads, water, and electricity) and high agricultural potential zones. High population densities are found in Bahari, Kikambala and Kaloleni divisions along the tarmac road of Mombasa-Malindi and Mombasa-Nairobi up to Mariakani urban town. These areas are also well supplied with piped water and electricity. High population clusters are also found in Chonyi division and some parts of Kaloleni division where there are high potentials for agricultural production. Sparsely populated divisions in the district are Ganze, Vitengeni, Bamba and some parts of Kaloleni division. These areas are rangelands and are less productive agriculturally. The three larger towns in the district (Kilifi, Mariakani&Mtwapa) have a total population of 72,451 (1999), which represents 13% of the total district population.

3.5.3 Poverty Status

The immediate cause of poverty in the Kilifi County has been attributed to landlessness, high and increasing cost of living, inaccessibility to credit facilities, lack of entrepreneurial skills, unemployment, low incomes and HIV/AIDS and discrimination at places of work. In general, poverty has led to over-use and destruction of natural resources where short-term development

goals are pursued at the expense of long-term environmental sustainability. Therefore there is need to ensure that environmental concerns are integrated into development planning and that development plans lead to empowerment of local communities to engage in sustainable livelihood activities.

3.6 Environmental quality

3.6.1 Water availability

Kilifi County is generally water scarce both in terms of surface and ground water and largely depend on piped water from the Mzima springs and Baricho water. The only permanent river is the Sabaki River which feeds the Baricho water works and crosses the northern part of Kilifi district. The others are temporary due to few catchment areas, sandy soils which have high infiltration rates and high evapo-transpiration rates. Ground water resources are exploited along the coastline through shallow wells and bore holes but diminish as one move inland. This is because inland boreholes have to be deep and in most cases the water quality is poor; hard, mineralized and saline.

3.6.2 Solid waste and sewerage management issues

The main waste generation sources are domestic, commercial ventures, hotels, markets, industries and institutions including health facilities. The types of waste that are generated can be classified as follows.

- **Mixed heavy plastics** -Soft drink bottles, detergent bottles, cooking oil/fat bottles, household plastics etc.
- **Mixed light plastics** - Shopping bags, wrapping films, waste collection bags
- **Rubber** - Old tires, shoe soles etc.
- **Mixed paper** - Books, office paper, newspapers carton pieces etc.
- **Metals** -Pieces and sheets of aluminum, steel and other metals
- **Mixed glass** - Coloured and non-coloured, broken or whole glass bottles, panes, household glass items etc.
- **Organics** - Food remnants, wooden debris, yard waste etc.
- **Biomedical waste-** waste from hospitals, dispensaries and medical clinics.

All types of waste are transported to the designated disposal site. These include hazardous types containing pesticides, heavy metals, oils, batteries, acids, domestic and hospital wastes. It is against this background that the private sector has initiated ways to address the problem of waste management through construction of compost pits in areas where collection is limited and providing waste disposal services to complement those provided by the County Council. The entire Kilifi County Council has no sewerage infrastructure hence the common methods for disposal of human wastes is through pit latrines and septic tank and soak away pit systems. The

proposed project will make use of septic tanks and soakage pit for disposal of sewage and waste water.

3.6.3 Protected areas

Gazetted forests, kayas and marine parks constitute the protected areas in Kilifi District. The gazetted forests include a section of the ArabukoSokoke forest and mangrove forests mainly found at Takaungu, Kilifi creek, Mtwapa creek and part of the Mida creek in Uyombo, with an area of approximately 880 Ha. The kayas (sacred forests) include Chonyi, Kambe, Ribe, Jibana, Kauma and Kaya fungo. The marine parks and reserves include, part of the Mombasa marine and National Reserve, Watamu-Malindi Marine National park and Reserve (coral gardens) and part of the Malindi Marine and National Reserve. The part of ArabukoSokoke forest which falls in Kilifi District constitutes 19,000 Ha out of the 37,000 Ha .The forest is situated between Kilifi creek and The Sabaki River. The forest has a very high biological diversity. It is one of the important sites for bird conservation in Kenya (Ksley and Langton). Six of the bird species listed as rare in the ICBP/IUCN Bird red data book occurs in this forest. Two of these bird species, the Sokoke Owl (*Otus arena*) and the clerk's weaver (*Ploceusgolandi*) are found nowhere else in the world except in this forest. In addition to the endemic bird species, ArabukoSokoke is also home to other terrestrial fauna. For instance it is the only known home for the endangered *Cephalophusadersi*, the frog *Leptopelisflavomacculatus*, and two butterfly species, the *Charaxesprotocles* and the *Charaxeslasti*.

The Marine Parks and Reserves in the coastal zone are made up of several different ecosystems each with a high degree of faunal and floral diversity. The ecosystems include coral reefs, mangroves, tidal and estuarine ecosystems. The coral reef runs parallel to the coast at distances ranging from 500m- 2 km from the shoreline. The coral reefs are one of the examples of biologically productive and taxonomically diverse ecosystems. About 140 species of soft and hard corals have been identified along the Kenyan coast. They are very important in that they form breeding grounds for various marine fauna, they serve as a barrier against the force of the sea and the lagoons they protect provides stable environment for breeding and feeding of marine biota.

3.6.4 Flora and Fauna

Human interference and particularly agriculture have greatly modified the original floral and faunal status of the District. Several vegetation types including coastal dunes, woodlands, bush lands and savannas are encountered from the shoreline inland. It is likely that prior to the maize and coconut cultivation, Kilifi County was covered in bush land. Currently, 30% of the district is covered under maize, coconut trees and citrus plants. The remaining 70% of the site comprises of bush land.

3.7 Infrastructure

3.7.1 Roads

Most rural areas at the coast are served with a dilapidated and narrow road network contrary to most urban centers such as Mombasa, Kilifi and Kwale which are well served by both classified and non-classified roads. The road networks are greatly influenced by existence of important industrial, tourism and commercial centers. Except for the Mombasa-Nairobi highway most of the roads in Kokotoni are earth roads. The proposed site has a good road network and adequate transport linkages.

3.7.2 Telecommunications

All mobile networks are available and fixed landlines provided by Telkom Kenya and Zuku fibre.

3.7.3 Energy supply

The main source of energy supply in the area is electricity from the Kenya Power and Lighting Company. However, this is mostly supplemented with diesel powered generators in times of power blackouts. A number of facilities have also ventured into harnessing solar energy by use of solar panels and accumulators. Wind energy has also been sparsely used especially in pumping water from boreholes in the remote parts of the District. In the rural areas, main energy sources are fuel wood, charcoal and paraffin. The proposed development will be connected to the nearby 240kV KPLC line.

3.8 Health Profile

Kilifi County has a total of 73 health facilities distributed across the district. Accessibility of health services is, however low and 57% of the population live over 5kms to the nearest health facility. The doctor patient ratio stands at 1:100,000 which in itself is a manifestation of staff shortages in the County. The most prevalent diseases include Malaria, Pneumonia and diseases of the digestive system. HIV/AIDs is a major health and development problem in the district. The prevalence in the County is estimated to be 10% and bed occupancy by people affected with HIV/AIDs related illnesses in the various health institutions is about 50%. The impact of HIV/AIDS is already evident in the County.

4 RELEVANT LEGISLATIVE, POLICIES, AND REGULATORY FRAMEWORK GOVERNING ENVIRONMENTAL MANAGEMENT IN KENYA

4.1 Introduction

There is a growing concern in Kenya and at global level that many forms of development activities cause damage to the environment. Development activities have the potential to damage the natural resources upon which the economies are based. A major national challenge today is how to maintain sustainable development without damaging the environment. The Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of developmental activities. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound. It is a condition of the Kenya Government to conduct Environmental Impact Assessment on the development Projects.

According to Sections 58 and 138 of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 and Section 3 of the Environmental (Impact Assessment and Audit) Regulations 2003 (Legal No. 101), all industries require an Environmental Impact Assessment project/study report prepared and submitted to the National Environment Management Authority (NEMA) for review and eventual Licensing before the development commences. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment.

4.2 Environmental Problems in Kenya

There are many environmental problems and challenges in Kenya today. Among the cardinal environmental problems include: loss of biodiversity and habitat, land degradation, land use conflicts, human and animal conflicts, water management and environmental pollution. This has been aggravated by lack of awareness and inadequate information amongst the public on the consequences of their interaction with the environment. In addition there is limited local community involvement in participatory planning and management of environmental and natural resources. Recognizing the importance of natural resources and the environment in general, the Kenyan Government has put in place wide range of policy, institutional and legislative framework to address the major causes of environmental degradation and negative impacts on ecosystem emanating from industrial and economic development programmes.

Table 5: Summary of legislations applicable to the proposed project

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
Environmental Management and Coordination Act (EMCA), 1999	NEMA	A framework legislation that addresses major issues concerning the environment. The purpose of the Act is to provide for sustainable management of the environment.	Requires the Proponent to: – Submit EIA Report to NEMA before commencing any new project. – Engage NEMA approved expert/firm of experts in conducting EIA studies
Environment Impact Assessment /Environmental Audit Regulations, 2003	NEMA	Provides for the framework for carrying out environmental impact assessment in Kenya	Requires the Proponent to: - prepare EIA Project report in accordance with the format specified in Regulations and pay attention to issues specified in the second schedule of the Regulations - carry out annual environmental audits to check on efficacy of EMP developed in EIA report - carry out corrective measures in the improvement order from NEMA - allow a NEMA inspector to enter the facility for the monitoring the effects of its activities on the environment - mitigate trans-boundary impacts taking into account regional and international treaties.
L.N. 121: Environmental Management and Coordination (Waste Management) Regulations, 2006	NEMA	Formulated for managing various kinds of waste in Kenya	The Regulations requires the Proponent to: - Acquire valid EIA license from NEMA prior to engaging in an activity that can generate hazardous substance - Segregates their waste (hazardous and non- hazardous) by type and then disposes the wastes in an environmentally acceptable manner.

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
			- Contract a NEMA licensed waste handler to collect and disposed-off. - Ensure waste is in a licensed disposal facility. - Label hazardous wastes containers in accordance with the requirements provided in section18 of the Regulation.
L.N. 120: Environmental Management and Coordination (Water Quality) Regulations, 2006	NEMA	Formulated for sustainable management of water used for various purposes in Kenya	The Regulation requires the Proponent to: - Refrain from any activity which might cause water pollution. - Not to discharge any liquid, gaseous or solid into water resource as to cause pollution. - Acquire a valid effluent discharge license to discharge effluent into the environment. - Acquire EIA licence prior to abstracting ground water or any activity that is likely to have any adverse impact on the quantity and quality of the water - follow the monitoring guide set out in the Third Schedule to the regulation when discharging effluent into the environment
Legal Notice No.61 of 2009: The Environment Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations	NEMA CGM DOSH	Promulgated for control of Noise and excessive vibration pollution	The regulations: - Prohibits the Proponent from making or causing to be made noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety or safety of others and the environment. - Prohibits the Proponent from making or causing to be made excessive vibration which annoy, disturb, injure or endanger the comfort, response, health or safety of others and the environment

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
			- Prohibits the Proponent from causing noise which exceeds any sound level as set out in the First Schedule to the Regulations - Requires the Proponent (if wishing) to operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan air –conditioning apparatus or similar mechanical device or engage in any commercial or industrial activity which is likely to emit noise or excessive vibrations to do so within the relevant levels prescribed in the First Schedule of the Regulations. - Prohibits the Proponent from operating a motor vehicle which produces any loud and unusual sound and exceeds 84 dB (A) when accelerating. - Prohibits the Proponent from operating construction equipment or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to the Regulations. Requires the Proponent during EIA studies to: - Identify natural resources, land uses or activities which may be affected by noise or excessive vibrations from construction or demolition; - Determine the measures which are needed in the plans and specifications to minimize or eliminate adverse construction or demolition noise or vibration impacts - Incorporate the needed abatement measures in the plans and specifications. - Prohibits the Proponent from carrying out activities relating to demolitions without a valid permit issued by the Authority

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
Environmental Management and Coordination (Air Quality Standards) Regulations, 2009	NEMA	Formulated to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air	The proposed project has potential to impact on air quality. Dust and fugitive emissions from transport vehicles during construction and decommissioning phases and tyre (petroleum) fumes during operation phase could impact on air quality. In the light of the above, these Regulations prohibit the Proponent from: - Acting in a way that directly or indirectly cause or may cause air pollution to exceed levels set out in the second Schedule to the Regulations - Allowing particulates emissions into the atmosphere from any source not listed in the six schedule of the Regulations - Causing ambient air quality in controlled areas (listed in Schedule Thirteen) to exceed those stipulated under second Schedule. - Allowing emission of particulate matter above the limits stipulated in second Schedule.
Building Code	Local Government NCA	Formulated to provide rules, guidelines and standards to be observed during construction.	The Proponent is required to adhere to the rules, guidelines and standards stipulated in the Code during development of the proposed project

The Public Health Act Cap 242	Ministry of Public Health	The Act regulates activities detrimental to human and environmental health and safety	The Act prohibits the Proponent from engaging in activities that cause environmental nuisance or those that cause danger, discomfort or annoyance to inhabitants or is hazardous to human and environmental health and safety.
The Local Government Act (Cap. 265)	Ministry of Local Government		The Act requires the Proponent to grant the Officers and servants of Local Authority access to their premises to inspect, maintain, alter or repair sewers, drains, pipes, ventilating shafts or other
The Penal Code (Cap. 63)	Judiciary	Formulated to define the penal system in Kenya. It outlines criminal offences and prescribes penalties to them	The Code Prohibits the Proponent from: - Voluntarily corrupting or fouling water for public springs or reservoirs, rendering it less fit for its ordinary use Making or vitiating the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighbourhood or those passing along public way.
The Occupier Liability Act (Cap 34)	DOSH NEMA		The Act Requires the Proponent to ensure that visitors to his premises will be reasonably safe in using the premises for the purposes for which he is invited or permitted by the Proponent to be there

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
Occupational Health and Safety Act, 2007	DOSHS	Enacted to provide for the health, safety and welfare of persons employed in workplaces, and for matters incidental thereto and connected therewith.	It requires the Proponent to: - Undertaking S&H risk assessments, provide notification of accidents, injuries and dangerous occurrences, etc. - Provide first aid facilities at the workplace - provide PPEs to the employees
Legal Notice No. 25: Noise Prevention and Control Rules	DOSHS	Promulgated for work related noise exposures	It requires the Proponent to: Comply with the following permissible noise levels : a. *Workplace Noise*- 90 dB (A) over an 8-hour TWA period over 24-hours; and 140 dB (A) peak sound level at any given time. b. Community noise level emanating from a workplace -50 dB(A) during the day; and 45 dB(A) at night. ensure that any equipment brought to a site in Kenya for use shall be designed or have built in noise reduction devices that do not exceed 90 dB(A). Medically examine those employees that may be exposed to continuous noise levels of 85 dB (A) as indicated in Regulation 16. If found unfit, the Occupational hearing loss to the worker will be compensated as an occupational disease.

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
			It is not anticipated that there will be equipment that will generate noise exceeding the threshold levels of noise stipulated under the Rules. However, in case there will, it will be incumbent on the selected contractor to ensure that their equipment complies with the threshold noise values given above. Alternatively the selected contractor will be required to develop, rollout and implement a written hearing conservation program during the project period
Petroleum Act, Cap. 116	ERC	Promulgated for Management of Petroleum business in Kenya. It covers on import, export, transport, storage, wholesale and retail of Petroleum products	The act makes provisions for restricting and regulation for the importation, transport and storage of petroleum. A license to store petroleum in an installation shall authorize the keeping of the quantity and description of the petroleum product specified therein within the confines of the installation whether in tanks, storage sheds or otherwise in accordance with the specifications and plans attached to the license. The Act provides for specifications in the granting of a license of the premises to be licensed giving particulars of the materials and construction of each building. The position of the premises in relation to adjoining property and distances from neighbouring buildings should be specified. The position and capacity of each tank, the position of all buildings, structures or other works within the installation, all lighting arrangements including position of electric cables, switches and fuse boxes, drainage systems, water connections, fire hydrants and fire-fighting appliances should also be specified.

			The act makes provisions for restricting and regulation for the importation, transport and storage of petroleum. A license to store petroleum in an installation shall authorize the keeping of the quantity and description of the petroleum product specified therein within the confines of the installation whether in tanks, storage sheds or otherwise in accordance with the specifications and plans attached to the license. The Act provides for specifications in the granting of a license of the premises to be licensed giving particulars of the materials and construction of each building. The position of the premises in relation to adjoining property and distances from neighbouring buildings should be specified. The position and capacity of each tank; the position of all buildings, structures or other works within the installation; all lighting arrangements including position of electric cables, switches and fuse boxes; drainage systems, water connections, fire hydrants and fire-fighting appliances should also be specified.

Legalisation	Institution	Main Purpose	Relevance to the Proposed Project
Energy Act, 2006	ERC	Gives ERC the mandate (objects and functions) of regulating the importation, exportation, transportation, refining, storage and sale of petroleum and petroleum products	Ensuring petroleum handling facilities are developed to standard so as to avoid proliferation of products
The Weights and Measures Act Cap 513		Principal Act dealing with weights and measures in Kenya	- defines as the standards and units to be used and the regulations to be adhered to - dispensing pumps at filling stations must be examined and verified for their accuracy at least once in a year - The pump shall be provided with one or more plugs, seals or sealing material to protect all stops or other adjustable parts affecting the quantity delivered.

5 CONSULTATION AND PUBLIC PARTICIPATION

5.1 Introduction

One of the key information sources used during the Environmental Impact Assessment exercise was public participation exercise. Positive and negative views of the project site proponents, lead agencies, and neighbours were sought on the 4th August 2015. Public consultations for the proposed Re-processing of Lubricating Oil project were conducted as required in EMCA, 1999 section 58. Door to door interview with neighbours within the proposed project neighbourhood and one on one interview with the lead agencies to ensure comprehensiveness in the EIA study. This chapter outlines the key issues/concerns raised during the public consultations exercise. The proposed mitigation measures suggested by the public and other stakeholders that the proponent should incorporate to minimize environmental degradation and promote good working relationship with the community has been integrated in this chapter.

The specific objectives of the neighbors or community public participation process are to:

- Inform the local community about the project and thereby minimize conflicts and delays on implementation.
- To gain the views, concerns and values of the local community.
- To initiate public involvement processes, in a bid to induce and cultivate a sense of peoples' belongingness to the project.
- To suggest and facilitate the peoples roles in the project's sustainability, in terms of management, maintenance and productivity.
- To take into account public inputs in decision making regarding the proposed project.
- To gain local knowledge.

5.1.1 Objectives of Public Participation

The main objectives of public participation were to:

- Provide clear and accurate information about the project to the beneficiaries.
- Obtain the main concerns and perceptions of the community and their representatives regarding the project.
- Obtain options and suggestions directly from the affected communities on their preferred mitigation measures.
- Identify local leaders and relevant stakeholders with whom further dialogue can be continued in subsequent stages of the project.

5.1.2 Scope of the Consultation

This section of the report focuses primarily on Consultation and Public Participation Process (CPP) for the Environmental Assessment Phase of the Project, and presents the issues gathered

through this process. The purpose of this CPP is to gather and consolidate issues and Impacts raised by relevant institutions and affected persons.

The first phase of the Consultation and Public Participation was included in the Scoping section, the second phase of the CPP was meant to ensure that all affected persons were given accurate and timely project information, and that all were given adequate opportunity to raise comments and concerns. Specifically, the steps followed can be summarized into four phases of consultation, namely:

- Identification of institutions and affected persons;
- Project notification;
- Engagement with affected persons; and
- Feedback from consultation

5.1.3 Overview and approach

It is a mandatory requirement under EMCA 1999 and the EIA/EA Regulations, for all environmental impact assessments done in Kenya to incorporate a Public Consultation. The aim is to ensure that all stakeholder interests are identified and incorporated in the project development, implementation and operation. To give the public a chance to express its views, we have used questionnaires, and interviews.

5.2 Issues Raised

5.2.1 Employment Opportunities

The persons interviewed were positive that during the development and operation of the proposed project, numerous employment opportunities will be create for the local residents especially during the construction and installation works. A few of those interviewed suggested that the proponent should consider the youth and women in the area for the available casual jobs.

5.2.2 Improvement of the Surrounding

Those interviewed were happy with the project because it would improve the appearance of the area by making Mariakani Township a small industrial area, with potential for job opportunities and improving the aesthetical value of the area. They also suggested planting of trees and flowers as part of landscaping.

5.2.3 Increased Customer Base

Those with businesses within and surrounding the proposed project site, including eateries and canteens, shall benefit from serving workers and visitors to the project. The number of customers benefiting from such businesses will be available throughout the project, and will require their services.

5.2.4 Dust and Fume Emissions

There were concerns raised by some respondents over the possibility of generation of large amount of dust and fumes within the project site and surrounding areas as a result of excavation works and transportation of raw oil materials. The proponent shall require of the contractor to put in place measures to reduce dust levels at the site to a minimum as much as possible.

5.2.5 Noise Pollution

There were concerns of possibility of noise pollution interfering with activities of adjacent neighbors which include the cooling tank, black oil tanks, laboratory, vacuum pump installation, hydration and distillation tanks, filters, and the final products tanks and cylinders. The noise is anticipated from the transportation of materials, excavation, and construction works. The proponent shall require of the contractor to put in place adequate measures to curb noise pollution to avoid interrupting activities in existing adjacent buildings.

5.2.6 Safety and Security

Those interviewed suggested that the proponent should ensure the contractor provides and maintains safety and security around the site during the construction works. Measures should also be put in place to reduce the possibilities of accidents and disruption of traffic caused by trucks to the building site. The workers involved in the project should also be provided with appropriate personal protective equipment when at work to ensure their safety.

5.2.7 Waste Management

Some of the consulted people were concerned about the unsightly scenarios associated with construction sites due to the presence of wastes including empty cement bags, rejected metals, wrappings (plastic bags), and broken glass. Also the final products from re-processing of lubricating oil will generate some oil waste and hazardous waste. These wastes cumulatively lead to unpleasant scenes not attractive to many people, and may pollute the environment and provide breeding grounds for disease vectors. Suggestions were made to the proponent to ensure the contractor manages all the wastes resulting from the project in an environmentally accepted manner.

5.2.8 Optimal Land Use

Some of the consulted people acknowledge the fact that this was an idle land being put to productive use and benefits to the company are expected to be in line with the increase in Mariakani Township physical facilities. Majority of the respondents approved the proposed project.

6 ENVIRONMENTAL IMPACTS FOR THE PROPOSED PROJECT

6.1 Introduction

This section identifies both positive and negative impacts associated with the proposed re-processing of used lubricating oil project. These impacts are hereby identified in two distinct phases of the project i.e. Construction Phase and Operation Phase. Another study is expected to be carried out during the projects decommissioning phase. Scoring or weighing of the magnitude of the impacts was undertaken and results are outlined in this draft report.

6.2 Construction or machinery installation phase

This phase shall begin with the site preparations for construction works to take place. Construction Impacts have the potential to create nuisance for residents, however these could be managed in an acceptable limits. In addition the construction impacts are also temporary in nature.

6.2.1 Positive Impacts

6.2.1.1 Employment Opportunities

Both direct and indirect forms of employment shall arise from the project initiation. Direct employment will be mainly through skilled and unskilled laborers whose workforce shall be needed to build the proposed project. Employment opportunities will be a benefit both in economic and social sense. In the economic sense it means abundant unskilled labor will be used in economic production. In the social sense the young and energetic otherwise poor people from the surrounding areas will be engaged in productive employment other than remaining idle. Several workers including casual laborers, structural engineers, masons, carpenters, joiner's electricians, mechanics and plumbers are expected to work on the site for a period that the project will start to the end.

6.2.1.2 Local and National Economic Gains

Both the local and national economy shall gain much from the project in that materials for building shall be sourced locally within the country and that all the materials are charged VAT hence increasing revenue collection in the country.

6.2.1.3 Provision of Market for Supply of Building Materials

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

6.2.1.4 Informal Business Growth

During construction period, the informal sector will benefit from the operations. This will involve Jua kali operators selling their products to be used on site. Such a move shall promote Jua Kali entrepreneurs in the local areas. Food business will also emerge as most of the workers who will be working on the proposed project site will be buying food from the informal business owners who shall be operating in the vicinity.

6.2.2 Negative Impacts

6.2.2.1 Soil Erosion

There are high possibilities of soil erosion occurring during the construction phase are high specifically during rainy and windy seasons. This is even made worse by the type of soil and the gradient on site and some rain water runoff from other areas finding its way to the site. Such problems become serious when the top soil is left bare and agents of erosion become active. Removal of top soil after site clearance by agents such as wind, rain water, surface runs offs, movement is feasible action to occur. The top soil is made loose during site clearance and left vulnerable to soil erosion agents. Increased erosion as a result of unstable soil, nutrients imbalances in the soil, and/compaction of soil.

6.2.2.2 Storm Water Surface Run Off

There is a likelihood of interference of the construction activities from the storm water runoff either from the site, project accessing road or from the neighboring compounds. The gentle slope nature of the area facilitates surface run off to occur.

6.2.2.3 Noise pollution

The construction and mechanical installation works will most likely be a noisy operation due to the moving machines (mixers, tippers, hand held machines, communicating workers) and incoming vehicles to deliver materials and workers to site. However the site workers are likely to be affected since noise beyond some level is itself a nuisance and need to be avoided. Noise created shall be a nuisance to the neighboring community mainly immediate neighbors, though at a lesser scale.

6.2.2.4 Excavation Works

Excavation works is definite to take place during the leveling of the proposed project site in a bid to make a formidable ground for stable building structures. The result will be the removal of top soil to give way of laying foundation for buildings. The excavated soils have to be disposed off in an environmentally sound manner.

6.2.2.5 Oil Spills

The waste tyres product to be recycles or re-processed which might spill and to the machines on site may be containing moving parts which will require continuous oiling to minimize the usual corrosion or wear and tear. Possibilities of such oils spilling and contaminating the soil and water on site are real. Likewise, moving vehicles on site may require oil change.

6.2.2.6 Increased Water Demand

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

6.2.2.7 Dust Emissions

Particulate matter pollution is likely to occur during the site clearance, excavation and loading of the top soil, loading and transportation of the construction waste. There is a possibility of suspended and settle able particles affecting the site workers and even neighbours health.

6.2.2.8 Generation of Exhaust Emissions

Exhaust emissions are likely to be generated by the construction equipments and machines during the construction phase. Motor vehicles used to mobilize the work force and materials for construction would cause a potentially significant air quality impact by emitting pollutants through exhaust emissions.

6.2.2.9 Increased Runoff from New Impervious Areas

Construction of the proposed project and its associated constructions like roofing, the paved driving way could result in additional runoff through creation of impervious areas and compaction of soils. Impervious areas and compacted soils generally have higher runoff coefficients than natural area, and increased flood peaks are a common occurrence in developed areas.

6.2.2.10 Hydrology and Water Quality Degradation

Project related excavation could lead to water surface and ground water quality degradation. Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to surface waters. The excavated area, if linear could act as a conduit to extend groundwater contamination to new areas. Spills of oil and other hazardous materials in excavated areas during construction could introduce contaminants to ground water.

6.2.2.11 Workers Accidents and Hazards during Construction

During construction of the proposed project, it is expected that construction workers are likely to have accidental injuries and hazards as a result of handling hazardous waste. Because of the intensive engineering and construction activities including erection and fastening of roofing materials, metal grinding and cutting, concrete work, steel erection and welding among others, construction workers will be exposed to risks of accidents and injuries. At times, such injuries may be from accidental falls from high elevations, injuries from hand tools and construction equipment cuts from sharp edges of metal sheets and collapse of building sections among others.

6.2.2.12 Exposure of Workers to Diseases

During construction phase, workers are likely to be exposed to diseases from building materials. It is therefore recommended that before the construction commences, there is need for the materials to be well inspected according to the occupational health and safety standards.

6.2.2.13 Solid Waste Generation

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

6.2.2.14 Extraction and Use of Building Materials

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

6.2.2.15 Energy Consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental

implications on its availability, price and sustainability. The project will also use electricity supplied by Kenya Power & Lighting Company (KPLC) Ltd. Electricity in Kenya is generated mainly through natural resources, namely, water and geothermal resources. In this regard, there will be need to use electricity sparingly since high consumption of electricity negatively impacts on these natural resources and their sustainability.

6.3 Operation phase

6.3.1 Positive Impacts

6.3.1.1 Employment Generation

Employment opportunities are one of the long-term major impacts on the proposed project that will be realized after construction and during the operation and maintenance of the project. These will involve security personnel, workers, businesses that will be located within the vicinity of the building.

6.3.1.2 Increase in Revenue

There will be positive gain for the revenue system arising from the processing of the building plans to the proposed building to the local council; this is in addition to the annual rates to be paid to the council. The proposed project will also generate income to the owner through the sales from the re-processed final products of oil lubricants.

6.3.1.3 Individual Investments

Economically speaking, investing in products processing factory business is one area which never goes wrong. Investing in Pyrolysis plant project is a good investment to individual or even organizations like co-operatives. Through buying/construction of the project and then starting products manufacturing, the owner is able to earn some income or save on spent capital from lubricant oil sales.

6.3.1.4 Provision of infrastructure

Being a planned proposed project in Kilifi County area, the residents of Mariakani Township and entire Coast region will get affordable services within their reach from the work place. This has a direct impact of greatly reducing regular travel to far looking for Lubricating oil. Land is a scarce resource in Kenya and through construction of the proposed project will ensure optimal use of land to the great benefit of the country and its people.

6.3.1.5 Improved Security

With the erection of a traffic barrier at the entrance to the targeted plot for the proposed project, the level of security will improve around the project area. The community will be given the necessary security by gate officers to be attached to the barrier.

6.3.1.6 Optimal Land use

To develop under-used land for this kind of project that complements economic activities hence making use of land space to improve the economy and provide more business premises.

6.3.2 Negative Impacts

The proposed project development will cause significant disturbances within the area which shall be kept at controllable levels.

6.3.2.1 Increased Pressure on Infrastructure

To some level, new projects usually have a potential of increasing pressure on existing infrastructure such as roads, sewer lines among other infrastructural facilities. This would be due to increased volumes on human and vehicle traffic along the access road.

6.3.2.2 Air Pollution

Poor solid waste management could lead to blocking of drainage works especially when the proposed project is in existence and this can lead to flooding and unsanitary conditions within the neighboring area. Blocked drains lead to bad odor hence environment unfriendly. The project management proposed to have good controlled and well management of solid and liquid waste to avoid this from occurring.

6.3.2.3 Electricity Consumption

The Proposed project development shall consume good amount of electricity. Since electric energy in Kenya is generated mainly through natural resources, namely water and geothermal resources, increased use of electricity have adverse impacts on these natural resources base and their sustainability.

6.3.2.4 Solid Waste Generation

The Proposed project is expected to generate enormous amounts of solid waste during its operation phase. The bulk of the solid waste generated during the operation of the project will consist of paper, plastic, glass, metal, textile, organic wastes, and the produced oil spills. Such wastes can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on animal health. Some of these waste materials especially the plastic/polythene are not biodegradable hence may cause long-term injuries effects to the environment. Even the biodegradable ones such as organic wastes may be injurious to the environment because as they decompose, they produce methane gas, a powerful greenhouse gas known to contribute to global warming.

6.3.2.5 Increased Storm Water Flow

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

6.3.2.6 Water Use

The domestic activities during the operation phase of the project will involve the use of large quantities of water as a result of activities that will take place and the large number of people who will be working and operating in the proposed project. These activities include: cooking, washing, general cleanliness, drinking among other activities.

6.3.2.7 Traffic Density Increase

The Proposed project will have a potential of increasing pressure on existing infrastructure such as road, with many truck and vehicles plying the access road to deliver materials and equipment.

6.4 Decommissioning Phase

6.4.1 Positive Impacts

6.4.1.1 Rehabilitation

Upon decommissioning of the proposed project development, rehabilitation of the project site will be carried out to restore the site to its original status. This will include replacement of topsoil and re-vegetation which will lead t improved visual quality of the project area. If the new project to be put up at the site is listed in the second schedule of EMCA, then an EIA will be carried out again.

6.4.1.2 Employment Opportunities

Since the demolition exercise will utilize human resource manpower, employment opportunities shall therefore be created.

6.4.2 Negative Impacts

6.4.2.1 Solid Waste

Demolition of the related infrastructure will result in the accumulation of huge amounts of solid waste. This consists of materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. Large quantities of such waste may lead to release of certain hazardous chemicals into the environment. In addition, even the generally non-

toxic chemicals such as chloride, sodium, sulphate and ammonia which may be released as a result of leaching of demolition waste, are known to lead to degradation of groundwater quality.

6.4.2.2 Dust emission

Large quantities of dust will be generated during demolition works. This will affect demolition staff as well as the neighboring residents.

6.4.2.3 Noise and Vibration

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas.

7 MITIGATION MEASURES FOR THE NEGATIVE ENVIRONMENTAL IMPACTS

7.1 Introduction

This section highlights the mitigation measures for the identified possible negative environmental and social impacts of the proposed project.

7.2 Mitigation of Construction and Mechanical Installation Phase Related Impacts

7.2.1 Air quality

Controlling dust during construction is useful in minimizing nuisance conditions. It is recommended that a standard set of feasible dust control measures be implemented for all construction activities. Emissions of other contaminants that would occur in the exhaust from heavy equipment are also included. The project proponent is committed to implementing measures that shall reduce air quality impacts associated with this project. Construction vehicles drivers will be under strict instructions to minimize unnecessary trips, refill fuel tanks in the afternoon, and minimize idle running of engines. In addition, dust emissions will be controlled by the following measures:

- Watering all active construction areas as and when necessary to lay dust
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Apply water when necessary, or apply (non-toxic) soil stabilizers on all unpaved access road, parking areas and staging areas at construction sites.
- Sweep regularly (with physical sweepers) the parking area and staging areas at the project sites.
- Plant fast growing trees around the project area to act as a wind breakers to reduce the uplift of particulate matter that lead to respiratory diseases.
- All construction machinery shall be marinated and serviced in accordance with the contractors' specifications.
- Dust generating activities like excavation, handling and transportation of soil will be avoided during strong winds.

7.2.2 Noise Pollution

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

- Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- A substantial permanent increase in ambient noise levels (more than five dB) in the project vicinity above levels existing without the project.

- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

In consideration of the above, the project proponent shall put in place several measures that will mitigate noise pollution during the construction phase. The following noise-suppression techniques will be employed to minimize the impact of temporary construction noise at the project site.

- Install portable barriers to shield compressors and other stationary equipment where necessary.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Install sound barriers for pile driving activity.
- Limit pickup trucks and other equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.

7.2.3 Generation of Exhaust Emission

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

- Vehicle idling time shall be minimized
- Alternatively fuelled construction equipment shall be used where feasible
- Equipment shall be properly tuned and maintained

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

7.2.4 Risk Hazardous Waste Handling

Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. In addition the proponent is committed to adherence to the occupational health and safety rules and regulations stipulated in Occupational Health and Safety Act (Cap 514). In this regard, the project proponent is committed to provision of appropriate personal protective equipment, as well as ensuring a safe and healthy environment for construction workers as outline in the EMP.

7.2.5 Increased Runoff

Increased runoff from paved grounds and expansive roofs causing extreme flooding and overflows of drainage systems shall be mitigated. Surface runoff and roof water shall be harvested and stored in underground reservoir for reuse. A storm management plane that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structures will be designed.

7.2.6 Sustainable Utilization of Construction Materials

The project proponent will source building materials such as sand, ballast and hard core from a licensed quarry and sand mining firms, whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated. To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual project requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through run-off, wind, etc.) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials. In addition to the above measures, the project proponent shall consider reuse of building materials and use of recycled materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

7.2.7 Minimizing of Project Waste

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

7.2.8 Reduction of Energy Consumption

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

7.2.9 Minimization of Water Use

The project proponent shall ensure that water is used efficiently on site by sensitizing construction staff to avoid irresponsible water use.

7.3 Mitigation of Operation Phase Impacts

7.3.1 Ensuring Efficient Solid Waste Management

There shall be the provision of solid waste handling facilities such as waste bins and skips for temporarily holding domestic waste generated by the residents. There shall be arrangements to ensure proper disposal regularly and appropriately. Advice notices will be put up at strategic areas asking the occupants to manage their waste efficiently through recycling, reuse and proper disposal procedures. Overall, there shall be use of an integrated solid waste management system. In this regard, the project proponent will give priority to reduction at Source of the materials. This option will demand a solid waste management awareness programme in the management and the residents. Secondly, Recycling, Reuse and composting of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The recyclables will be sold to waste buyers within Kilifi County. The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. Finally, sanitary land filing will be the last option for the proponent to consider.

7.3.2 Minimization of Sewage Release

The project proponent will ensure that there are adequate means of handling the large quantities of sewage generated at the proposed project. It will also be important to ensure that sewage pipes are not blocked or damaged since such problems will lead to leakages and careless disposal of effluent, resulting in land and water contamination. Any such blockages or damages will be fixed expeditiously.

7.3.3 Ensure Efficient Energy Consumption

The project proponent plans to install an energy saving lighting system at the proposed project. This will contribute immensely to energy saving during the operational phase of the project. In addition, occupants of the shops will be sensitized to ensure energy efficiency in their domestic operations. To complement these measures, it will be important to monitor energy use during the operation of the proposed project and set targets for efficient energy use.

7.3.4 Ensure Efficient Water Use

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

7.4 Mitigation of Decommissioning Phase Impacts

Decommissioning is a controlled process used to safely retire a facility that is no longer needed. During decommissioning, facilities or structures are cleaned or secured so that the facility does not pose a risk to public health or the environment now or in the future.

Following completion of the construction of the Project, any areas of land used for the project should be re-instated for sustainable future use.

- Termination of power supply to the development.
- Termination of water connections.
- Submit a decommissioning plan to NEMA for approval at least three months prior to decommissioning phase.
- Treatment plant to be decommissioned in an environmentally friendly manner.
- All facilities within the project are will be decommissioned in an environmentally friendly manner.
- Provision of Personal Protective Equipments (PPEs) to the workers who will participate in the demolition exercise.
- Waste from the site to be disposed in an environmentally friendly manner.
- Rehabilitation of land by removing any unnecessary materials that shall be covering land and preventing the natural biodiversity.
- Landscaping and re-vegetation of all disturbed areas.
- Building materials that cannot recycled should be disposed off by a registered waste handler recognized by NEMA in relation to Environmental Management and Co-Ordination (Waste Management) Regulations, 2006 Legal Notice No. 121.

7.4.1 Efficient Solid Waste Management

Solid waste resulting from demolition waste be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses. In this regard, the project proponent is committed to ensuring that demolition materials at the end of decommissioning phase will be used in other projects rather than being disposed-off. In addition, demolition materials including cabinets, doors, plumbing and lighting fixtures, marbles glass her and other steel machine parts will be recovered for refurbishing and use in other projects. Such measures will involve the sale or donation of such recyclable/reusable materials to construction companies and sold to scrap metal dealers, local community groups, institutions and individuals residents or homeowners. It is further recommended that the project proponent should consider the use of recycled or refurbished demolition materials. Purchasing and using once-used or recovered demolition materials will lead to financial savings and reduction of the amount of demolition debris disposed of as waste.

7.4.2 Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized by;

- Install portable barriers to shield compressors and other stationary equipment where necessary.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Install sound barriers for pile driving activity
- Limit pickup trucks and other equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.

7.4.3 Minimization of Noise and Vibration

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

- Install portable barriers to shield compressors and other stationary equipment where necessary.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Install sound barriers for pile driving activity.
- Observe a common-sense approach to vehicle use, and encourage workers to switch off vehicle engines whenever possible.

8 ANALYSIS OF ALTERNATIVES TO THE PROPOSED PROJECT

8.1 Introduction

The following definition of "alternatives" is given in the EIA Regulations: "alternatives", in relation to the proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to:-

a) The property on which or location where it is proposed to undertake the activity;
b) The type of activity to be undertaken;
c) The design or layout of the activity;
d) The technology to be used in the activity;
e) The operational aspects of the activity; and
f) The option of not implementing the activity".

Typically, alternative assessments are conducted to assist in comparing various projects or attributes of projects that will occur. The most critical comparison is evaluating any proposed project against the No-Go option. The alternatives assessment then considers alternatives to project site selection for the proposed development; alternatives to layout of the development; and alternatives to construction methodologies and/or materials used for the development.

8.2 No Project Alternative

This alternatives assessment was conducted using a simple cost-benefit analysis, through assessing various environmental attributes. These attributes can include physical (geology and soils, surface water quality and quantity, groundwater quality and quantity); biophysical (flora and fauna, sensitive environments); and social attributes (site of archaeological or cultural importance, land use issues, social health and welfare).

The impact of the each alternative was then evaluated in terms of whether it has a positive, negative, or no impact. In this instance, the impact is not evaluated in terms of significance but rather whether or not it will arise. Positive impacts are assigned a value of 1; no impact a value of 0; and a negative impact a value of -1.

By adding all of the attribute scores for each alternative, a suitability score is derived that indicates the preferred alternative. A total positive score indicates that the project benefits outweigh the potential negative impacts, while a total negative score indicates the project environmental costs outweigh the potential benefits. Essentially, the highest scoring alternative is then carried forward for full impact evaluation. The potential impact of the preferred project option on environmental and socio-economic attributes identified during the assessment phase is evaluated against the potential impact of the No-Go option on the same attributes.

The no project alternative option in respect to the proposed project implies that the status quo is maintained; this option is the most suitable alternative from the extreme environmental perspective as it ensures non-interference with the existing conditions. Under no project alternative, the proponent's proposal would not receive the necessary approval from NEMA proposed project would not be constructed and there would be no demand for the development. This option will however, involve several losses both to the land owner and the community as a whole. The No project option is the least preferred from the socio-economic and partly environmental perspective due to the following factors.

- Discouragement for investors
- Land will remain less utilized.
- No employment opportunities will be created for Kenyans bearing in mind the proposed project is estimated to take at least one year before completion.
- Local skills would remain under-utilized.

8.3 Analysis of Site Alternative Construction Materials and Technology

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public, health safety, security and environmental aesthetic requirements. Equipments that save energy and water will be given first priority without compromising on cost or availability factors. Heavy use of timber during construction is discouraged because of massive destruction of forests.

8.4 Domestic Waste Water Management Alternatives

The proponent shall connect all his waste water to the waste water treatment plant system which will be designed to accommodate the capacity of the whole project.

8.5 Solid Waste Management

The proposed project will generate massive solid wastes both during construction and operational phases. An integrated solid waste management system is recommendable. The proponent will give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management. Recycling, reuse and composting of waste will be an alternative in priority. This calls for a source separation programme to be in put in place. The recyclable will be sold to waste buyers within the surrounding areas.

Activity alternatives; The proposed activity is the recycling and recovery of waste tyres through the use of a pyrolysis processes. Currently, most tyres are disposed of to landfill or accumulate at various facilities or on vacant land where they are unmanaged. Alternative methods to dispose of, recycle or re-use the waste tyres include the following:

Alternative A1: Tyres can be retreaded, whereby the remaining tread is removed and a new tread (rubber strip) is fused to the old "skeleton" of the tyre using vulcanisation. The quality of the retreaded tyre is, however, not high;

Alternative A2: Tyres can be mechanically or cryomechanically milled/ground up and the rubber pieces used in other applications, such as for sport surfaces, carpets, playgrounds etc. If the rubber is ground up into a very fine powder, the powder can be used to reinforce new rubber products. These applications do not produce atmospheric emissions, but have a high energy usage and there is a limited market for the products;

Alternative A3: It has often been attempted to reclaim scrap rubber products, but the process is difficult and costly. The quality of the reclaimed rubber is also not high and the re-selling of the reclaimed rubber as a raw material is therefore problematic; and

Alternative A4: Pyrolysis presents an opportunity to produce valuable products from the waste tyres and can also result in less negative environmental impacts than for example, the burning of tyres or their disposal to landfill. The solid Char can be used as a smokeless fuel, to reinforce new rubber products or as activated Carbon. The oils can be used as fuels, a source of chemicals due to the oil's mixture of organic compounds, or as a feedstock for the petroleum industry. Gases from the pyrolysis process consist of non-condensable organics like CO, CO2, H2, H2S, CH4, C2H4 and C3H6, and can be used as a fuel for the pyrolysis process (Juma *et al.*, 2006).

Pyrolysis is seen as the most economically viable option at this stage and is also the type of recycling plant that the applicant would like to establish. The other alternatives are less viable as they are costly, have difficult processes and also do not always have proven markets for their products.

Site layout alternatives

On the proposed site, there are limited site layout alternatives that can be considered. The alternatives include which of the three existing buildings are used for the pyrolysis plant, the storage of raw materials, such as chemicals, and the storage of product, such as steel, Carbon black and oil. The ideal use of each of the three buildings is being considered as part of the planning phase for the project. It is anticipated that Buildings 1 and 3 will be used for storage purposes and Building 2 for the pyrolysis plant itself. As only one half of the site is still open space, this area will be used for the storage of waste tyres prior to their processing.

9 ENVIRONMENTAL MANAGEMENT/ MONITORING PLAN (EMP)

9.1 Introduction

This chapter presents the Environmental Management Plan (EMP) that will need to be implemented by the proponent to prevent or reduce significant negative impacts to acceptable levels. All the project components and support facilities like roads, electricity transmission lines, community CSR amenities, etc.) were all considered when this comprehensive EMP was developed.

An environmental monitoring plan is vital for any Environmental Management Plan of a development project. The monitoring plan helps in assessing the effectiveness of proposed mitigation measures, in assessing changes in environmental conditions and to provide warning of significant deterioration in environmental quality for further preventive action.

The following EMP has been structured in such a manner to provide a basis for Environmental Management System (EMS) ISO 14001 Principles for the life of the proposed project. It should be further noted that the proposed EMP is not static, as allowance has been made for it to evolve through the life of the project. Such a characteristic is seen to be important to key factors and processes may change through the life of the project. It is therefore necessary to alter proposed mitigation and monitoring methodologies in order to determine best approach to deal with such changes.

This EMP include the necessary specialist input to determine, mitigate and manage any environmental impacts that the proposed development may have, relating to bio-physical and socio-economic aspects.

Specific attention has been made to ensure that the EMP conforms to the following criteria:

- It is auditable in that it:
- Identifies specific quantifiable monitoring regimes;
- Delineates key lines of accountability;
- Associates mitigation and monitoring tasks to specific impacts;
- Gives guiding costs of implementation,
- Where practically possible identifies key indicator, which can be utilized for environmental performance monitoring
- Ensures flexibility to enable incorporation of additional monitoring and mitigation techniques as deemed necessary throughout the life of the project
- Conforms to all best practice principles by acknowledging the existence of both long time and immediate impacts and the resulting mitigation measures necessary to deal with such and;

- Identifies key corporate commitments made by project proponent and their local Partners in Kenya, with regard to its environmental performance.

9.2 Proposed Project – EMP for the Construction (Implementation) Phase

The following are the objectives, targets and measures that will be adhered to at all times.

Table 3: Proposed Project – EMP for the Construction (Implementation) Phase

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Increased exploitation of raw materials	▫ Source building materials from suppliers who use environmentally friendly processes in their operations. ▫ Ensure accurate budgeting and estimation of actual construction materials requirements to ensure that the least amount of material necessary is ordered ▫ Ensure that damage or loss of materials at the construction site is kept minimal through proper storage. ▫ Use at least 5% - 10% recycled refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills.	Developer	Once-off	0
Ecosystem disturbance	▫ Ensure proper demarcation and delineation of the project area to be affected by construction works ▫ Specify locations for trailers and equipment, and areas of the site which should be kept free or traffic equipment, and storage. ▫ Designate access routes and parking within the site. ▫ Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction.	Developer Contractor	Ongoing	0
Run off and soil erosion	▫ Create storm water management practices, such as piping systems or retention ponds or tanks, which can be carried over after the building is complete. ▫ Apply soil erosion control measures such as leveling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil. ▫ Ensure that construction vehicles are restricted to existing graded roads to avoid soil compaction within the project site.	Contactor,	When Necessary	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Solid waste generation	▫ Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed, rather than cutting them to size, or having large quantities of residual materials. ▫ Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed off. ▫ Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects. ▫ Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time. ▫ Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements. ▫ Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste. ▫ Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site. ▫ Dispose waste more responsibly by dumping at designated dumping sites or landfills only; the use of a registered waste disposal company is encouraged.	Developer Contractor	As necessary	0
Air/Dust Pollution	▫ Ensure strict enforcement of on-site speed limit regulations ▫ Avoid excavation works in extremely dry weathers ▫ Sprinkle water on graded access routes each day to reduce dust generation by construction vehicles.	Contractor	Once-off	5,000
Air pollution	▫ Sensitize truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, switch off or keep vehicle engines at these points. ▫ Ensure proper planning of transportation of materials to ensure that	Contractor	On-going	20,000

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
	vehicle fills are increased in order to reduce the number of trips done per vehicle or the number of vehicles on the road.			
Noise pollution	▫ Sensitize construction vehicle drives and machinery operators to switch off engines of vehicles or machinery not being used. ▫ Sensitize construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as schools, residential areas and hospitals. ▫ Ensure that construction machinery are kept in good condition to reduce noise generation ▫ Ensure that all generators and heavy duty equipment are insulated or placed in enclosures to minimize ambient noise levels.	Contractor	Once-off	0
Depletion of energy resources	▫ Ensure electrical equipment, appliances and lights are switched off when not being used. ▫ Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy. ▫ Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. ▫ Monitor energy use during construction and set targets for reduction of energy use ▫ Promptly detect and repair of water pipe and tank leaks ▫ Ensure taps are not running when not in use ▫ Promote recycling and reuse of water as much as possible ▫ Install a discharge meter at water outlets to determine and monitor total water usage	Contractor	Continuous	0
Effluent emissions	▫ Provide means for handling sewage generated by construction workers ▫ Conduct regular checks for sewage pipe blockages or damages since such vices can lead to release of the effluent into the land and water bodies ▫ Monitor effluent quality regularly to ensure that the stipulated	Developer Contractor	As necessary	5,000

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
	discharge rules and standards are not violated			
Violation of rules and Regulations	▫ Ensure that all building plans are approved by the Local Authority and the local Occupational Health and Safety Office. ▫ Registration of the premises under the Factories and Other Places of Work Act Cap 514, Laws of Kenya is mandatory. ▫ A general register should be kept within the facility as stipulated in Sec 62 (1) of the Factories and Other Places of Work Act.	Developer Contractor	Ongoing	10,000
Ventilation obstructions	▫ Suitable, efficient, clean, well-lit and adequate sanitary conveniences should be provided for construction workers	Contractor	Ongoing	30,000
Physical fitness	▫ Arrangements must be in place for the medical examination of all construction employees before, during and after termination of employment.	Developer Contractor,	Ongoing	5,000
Injuries caused by machineries and equipments	▫ Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded. ▫ Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain. ▫ All machines and other moving parts of equipment must be enclosed or guarded to protect all workers from injury. ▫ Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations ▫ Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued. ▫ Reports of such examinations must be presented in prescribed forms, signed by the examiner and attached to the general register.	Developer Contractor	Ongoing	2,000
Poor storage of materials	▫ Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse.	Contractor	As necessary	2,000

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Unsafe means of access and safe place of employment	▫ All floors, steps, stairs and passages of the premises must be of sound construction and properly maintained ▫ Securely fence or cover all openings in floors ▫ Provide all staircases within the premises with suitable handrails on both sides ▫ Ensure that construction workers are not locked up such that they would not escape in case of an emergency ▫ All ladders used in construction works must be of good construction and sound material of adequate strength and be properly maintained.	Developer Contractor	Ongoing	10,000
Emergencies	▫ Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency ▫ Such procedures must be tested at regular intervals ▫ Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers ▫ Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site. ▫ Provide measures to deal with emergencies and accidents including adequate first aid arrangements.	Developer Contractor	Ongoing Continuous	0
Catastrophes	▫ Well stocked first aid box which is easily available and accessible should be provided with the premises. ▫ Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body. ▫ Firefighting equipment such as fire extinguishers and hydrant systems should be provided at strategic locations such as stores and construction areas. ▫ Regular inspection and servicing of the equipment must be undertaken by a reputable service provider and records of such inspections maintained.	Developer Contractor	Once-off	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Food and toxins	▫ Develop a suitable system for the safe collection, recycling and disposal of chemical wastes, obsolete chemical and empty chemical containers to avoid their reuse for other purposed and to eliminate or minimize the risks to safety, health and environment. ▫ Ensure that all chemicals used in construction are appropriately labeled or marked and that material safety data sheets containing essential information regarding their identity, suppliers classification of hazards, safety precautions and emergency procedures are provided and are made available to employees and their representatives/ ▫ Keep a record of all hazardous chemicals used at the premises, cross-referenced to the appropriate chemical safety data sheets ▫ There should be no eating or drinking in areas where chemicals are stored or used.	Developer Contractor	Once-off	0
Pollution	▫ Ensure that workers at the excavation sites and other dusty sites are adequately protected from inhalation of substantial quantities of dust through provision of suitable protective gear (e.g. nose masks) ▫ Provide workers in areas with elevated noise and vibration levels, with suitable ear protection equipment such as ear muffs ▫ Suitable overalls, safety footwear, dust masks, gas masks, respirators, gloves, ear protection equipment etc should be made available and construction personnel must be trained to use the equipment. ▫ Ensure that construction workers are provided with an adequate supply	Developer Contractor	Continuous	0
Sanitary	▫ Ensure that conveniently accessible, clean, orderly, adequate and suitable washing facilities are provided and maintained in within the site. ▫ Provide and maintain adequate and suitable accommodation for clothing not worn during working hours for construction employees	Developer Contractor	Continuous	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
	▫ Provide and maintain, for the use of all workers whose work is done standing, suitable facilities for sitting sufficient to enable them to take advantage of any opportunity for resting which may occur in the course of their employment ▫ Accumulations of dirt and refuse should be cleaned daily from the floors, benches, staircases and passages. ▫ Provision for repairing and maintaining of hand tools must be in place			

9.3 Proposed Project - EMP for Operational Phase

Table 4: Proposed Project-EMP for Operational Phase

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Solid waste generation	▫ Provide solid waste handling facilities such as waste bins and skips ▫ Ensure that solid waste generated at the development is regularly disposed of appropriately at authorized dumping sites ▫ Donate redundant but serviceable equipment to charities ad institutions	Developer	Continuous	0
Sewage release into environment	▫ Provide adequate and safe means handling sewage generated at the project	Developer	When necessary	0
Energy consumption	▫ Switch off electrical equipment, appliances and lights when not being used ▫ Install occupation sensing lighting at various locations such as storage areas which are not in use all the time ▫ Install energy saving fluorescent tubes at all lighting points within the proposed development instead of bulbs which consume higher electric energy ▫ Monitor energy use during the operation of the project and set targets for efficient energy use ▫ Sensitize the occupants to use energy efficiently	Developer	As necessary	0
Water Exploitation	▫ Promptly detect and repair of water pipe and tank leaks ▫ Residents to conserve water e.g. by avoiding unnecessary toilet flushing. ▫ Ensure taps are not running when not in use ▫ Install water conserving taps that turn-off	Developer	As necessary As necessary	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
	automatically when water is not being used ▫ Install a discharge meter at water outlets to determine and monitor total water usage			
Higher and Safety Risks	▫ Implement all necessary measures to ensure health and safety of workers and the general public during operation of the Proposed project project as stipulated in Factories and Other Places of Work Act Cap 514	Developer	Continuous Continuous	0
Safety and security of the premises and surrounding areas	▫ Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises during night hours.	Developer	Continuous	0
Air Pollution	▫ All unnecessary movement must be limited ▫ Strict on-site speed controls are to be enforced	Developer	Ongoing	0
Registration of the project premises	▫ The developer must acquire application forms for the registration of the project site under the Occupational Safety and Health Act, Laws of Kenya. This registration application forms need to be completed and returned to the local occupational health and safety office.	Developer	Once-off	0
Approval of development plans	▫ Development plans should be presented to the local occupational health and safety office for subsequent scrutiny and approval	Developer	Once-off	0
Providing copies of the Occupational Safety and Health Act	▫ The abstract of the Occupational Safety and Health Act must be well posted in prominent places in the project site	Developer	Once-off	0
Dangerous occurrences	▫ Provision for reporting dangerous occurrences needs to be in place	Developer	Once-off	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Environment, Health and Safety committee	▫ Provision must be put in place for the formation of an Environment, Health and Safety committee, of which the employer and workers are represented	Developer	Once-off	0
Medical Examination for all employees	▫ Arrangements must be in place for the medical examination of all employees, before employment, during and after termination of employment	Developer	Continuous	0
Safety of all persons	▫ All machines and other moving parts of equipments must be enclosed to protect all workers from injury	Developer	Ongoing	5,000
Examination of plant and equipment	▫ All compressors, lifts (if any), and other lifting machines must be examined by a government or company authorized person. The equipment may only be used if a certificate of examination has been issued	Developer	Once-off	60,000
Sitting facilities	▫ Provisions need to be in place to provide adequate and suitable sitting facilities for workers who work standing	Developer	Once-off	10,000
Facilities for the physically disabled workers	▫ Provisions need to be in place to provide adequate and suitable facilities for physically disabled workers who work standing. Such people should be employed in areas without machinery movements.	Developer	Once-off	15,000
First aid and emergency preparedness	▫ Provision must be made for persons to be trained in first aid with a certificate issued by a recognized body. ▫ Three trained first aid personnel are needed for first hundred employees plus one additional person for each extra employees or thereof	Developer	Once-off	30,000
Ventilation	▫ Enough space needs to be left at all facilities to allow for adequate natural ventilation	Developer	Once-off	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Fire emergency plan	▫ Emergency plan and evacuation routes should be marked and communicated to staff	Developer	Ongoing	0
Electrical safety (only when electricity is used)	▫ Circuits must not be overloaded ▫ All electrical equipments must be grounded	Developer	Once-off	0
Emergency Exits	▫ ALL the emergency exits should be opened outwards and be marked in RED and should be clear of slip, trip and fall hazards	Developer	Once-off	0
PPE	▫ Provision for suitable overalls, safety footwear, dust masks, respirators, gloves, ear protection where possible.	Developer	Continuous	100,000
Handling of chemicals	▫ Chemical safety data sheet of the chemical used at the plant should be kept on record	Developer	Continuous	0
Ventilation at the administration block	▫ Air conditioners and overhead fans need to be installed (when electricity is available)	Developer	Continuous	0
Painting of administration block	▫ Ceilings must be painted white and walls light colour	Developer	Continuous	0
Ergonomics	▫ Must have a proper backrest to provide lower back support	Developer	Once-off	0
Noise Pollution	▫ Ambient noise impact mitigation needs to focus on the following: • The planning of construction activities must endeavour to minimize the noise impact on adjacent landowners • In this regard, vehicles should idle as little as possible, construction schedule times must be adhered to ,and all construction workers must be	Developer	Continuous	0

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
	encouraged to keep noise to a minimum on site; • All generators and heavy duty equipment is to be insulated and/or placed within buildings to minimize the ambient noise levels			
Signage provision	▫ All signs must be within the guidelines of the Kenyan legislative framework and as directed by NEMA	Developer	Once-off	0
Odour smell	▫ It is the responsibility of the developer to ensure that wastewater storage and load off areas are functioning correctly and that the source of odours is identified and dealt with immediately.	Developer	Continuous	0
Spirit of EMP	▫ In the spirit of this EMP document, the maintenance and the future improvement of the integrity and functioning of the project is fundamental. All the activities mentioned herein, must be carried out in this spirit, with this end-goal in mind.	Developer	Continuous	0

9.4 Proposed Project – Decommissioning and Closure Phase

In addition to the above Tables it is necessary to outline the basic rehabilitation measures that will be required to be undertaken once all operations activities have ceased. To this end Table 5 below outlines basic principles, which need to be adhered to during the rehabilitation process. It should however be noted that such principles should not be viewed in isolation but rather an extension of all actions identified in the above Tables.

Table 5: Proposed Project – EMP for Decommissioning Phase

Activity	Action Required	Responsible Party	Frequency	Approx Cost (Kshs)
Landscaping	▫ All cleared slopes shall be terraced and re-vegetated	Developer, Contractor	Continuous	30,000
Removal of construction materials	▫ Once construction is complete; all construction materials are to be removed in appropriate manner.	Developer, Contractor	Daily	50,000
Replacement of topsoil	▫ Topsoil is to be replaced strictly according to all principals outlined by environmentalist.	Developer, Contractor	Continuous	25,000
Restriction of vehicle access	▫ Vehicles must be kept on existing tracks and no new tracks should be created through rehabilitated areas.	Developer, Contractor	Once-off	0
Ripping of soil	▫ Soil that has been compacted by the passage of vehicles and pedestrians must be ripped to a depth of 15cm in lines not more than 50cm apart. ▫ Ripping should be done in two directions perpendicular to each other	Developer, Contractor	Once-off	8,000
Solid waste generation	▫ All building, machinery, equipment, structures and partitions that will not be used for other purposed must be removed and recycled/reused ▫ All foundations must be removed and recycled, reused or disposed-off at a licensed disposal site, ▫ Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site ▫ Donate reusable demolition waste to charitable organizations, individuals and institutions	Developer, Contractor	Once-off	60,000

10 CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The pyrolysis of waste tyres has been identified as the only viable Activity Alternative, even though such a plant will result in negative environmental impacts. The identified impacts/environmental risks to the environment as a result of the proposed Waste Tyre Pyrolysis Plant are mostly **medium.** The impacts can, however, be mitigated to mostly **Low,** provided that the draft Environmental Management Programme, containing all proposed mitigation measures, is implemented. It is further important that the EMP must be viewed as a dynamic, working document that will be improved upon as and when required.

The construction of the pyrolysis plant on a site with access to infrastructure and bulk services was found to be the most viable option for the client in terms of the financial costs associated with establishing a site for the proposed plant. Designing the Waste Tyre Pyrolysis Plant with a stack height in line with Good Engineering Practice is the preferred design alternatives as it resulted in fewer exceedances, however, still prove to be acceptable in practice, although it is more likely to require abatement technology.

The proposed project is in line with the government's objective to ensure environmental protection is put into control. The project design seeks to ensure sustainable development through sustainable use of waste tyre resources. The positive and negative impacts which will come along with the establishment of the proposed project have been exhaustively discussed within the report with revelation that the positive impacts outweigh the negative impacts. The proposed project will not only enhance economic growth at local level but also contribute to the national, regional and international economy.

10.2 Recommendations

Based on the outcomes of the Environmental Impact Assessment, conducted as part of this full Scoping and Environmental Impact Assessment process, as well as the alternatives assessment, the following recommendations are made:

1. The proposed project/activity (the construction and operation of the Waste Tyre Pyrolysis Plant) should be authorized and allowed to proceed on the preferred site on condition that the proposed plant also should be carrying out ambient and stack analysis on quarterly basis.
2. Strict monitoring and enforcement of requirements of the EMP must be undertaken to ensure that contractors and operators adhere to these requirements,
3. Proposed mitigation measures should be incorporated as far as possible into the operational plan for the plant.

4. A communications pathway must be established that would allow the designated ECO to accept and deal with stakeholder complaints.

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APPENDICES

1. Copy lease agreement for the Proposed project
2. Architectural/ Engineering Drawings/Layout Plans for the proposed plant
3. PIN copy
4. Certificate of incooperation
5. Consultation and Public Participation field Questionnaires
6. NEMA Registration Certificate and Annual License (2017) for the Environmental Consultants