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HYDRO WATER WELL (K) LTD.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY REPORT FOR THE PROPOSED ALUMINIUM EXTRUSION FOUNDRY PLANT LOCATED ON PLOT L.R.NO.100090/14/157 ALONG JUJA-GATUNDU ROAD OFF THIKA SUPERHIGHWAY, JUJA SUB-COUNTY, KIAMBU COUNTY

In Accordance with the Environmental Management and Coordination (Amendment) Act, 2015, Cap 387, This Report has been prepared for

Proponent

Hydro Water Well (K) Limited
P.O BOX, 38720-00600
Nairobi

Report prepared by:

TROPOSPACE Consultancy
Our future,our responsibility.

Tropospace Consultancy Limited
P.O BOX 15225-00400
Nairobi, Kenya
Lake Oil Plaza, 5th Floor-
Along Lunga Lunga Road,
Industrial Area
Mob: +254 733 348 283
+254 721 164 145
Email: info@tropospace.com

April, 2021

CERTIFICATION

In carrying out this project report, the lead consultant has endeavoured to comply with all statutory requirements as laid out in EMCA, CAP 387 and the Environmental (Impact Assessment and Audi) Regulations, 2003(Revised 2019).

Project proponent: Hydro Water Well (K) Limited.

Postal address: P.O Box 38720-00600, Nairobi

Contact address: Telephone: +254-772-423076/83/85| Cell: +254-722-206149, 0790457333,

Authorized representative

Name: .....

Position:.....

Sign: ..... **Date:** .....

Enviromental consultant:

PREPARED BY

TROPOSPACE CONSULTANCY LIMITED

Firm of Experts NEMA Reg. No. 10008

P O Box 15225-00400, NAIROBI

info@tropospace.com **Stamp**

LEAD EXPERT:

BONFACE OSORO

SIGNATURE: ……..

Date …20.04.2021.....

LEAD EXPERT NEMA REG.NO: 7121

Email. osoro.bonface@tropospace.com

ASSOCIATE EXPERT:
GEORGE WAIROMA
NEMA REG. NO. 9131
Email: wairomageorge@gmail.com

ACKNOWLEDGEMENT

Tropospace Consultancy Limited takes this opportunity to thank Hydro Water Well (K) Limited for entrusting us to conduct this Assessment for the proposed Aluminium Foundry plant. This was done in an endeavor to comply with the Legal requirements as stipulated in section 58 (2) of the Environmental Management and Co-ordination Act (EMCA) CAP 387; Environmental (EIA/EA) Regulation, 2003 and Legal Notice No. 31 & 32 of 2019. Great appreciation to Mr. Nikhil & the site engineers for availing all the necessary documents & information that enabled the experts effectively compile this report. We are further indebted to the area administration (the area chief & MCA), area residents and all project stakeholders for their participation in the public consultation and participation process.

ACRONYMS AND ABBREVIATIONS

(K)	Kenya
CBOs	Community Based Organizations
CP	Cleaner Production
dB	Decibels
EA	Environmental Audit
EHS	Environment Health and Safety
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and social management Plan
Ft	Foot (unit)
GHGs	Greenhouse Gases
GoK	Government of Kenya
Km	Kilometres
L	Litres
LCA	Life Cycle Assessment
MCA	Member of County Assembly
NECC	National Environment Complaints Committee
NEMA	National Environment Management Authority
NET	National Environment Tribunal
OSHA	Occupational Safety and Health Act
PES	Payment for Environmental Services
PPE	Personal protective equipment
SEAs	Strategic Environmental Assessments
SERC	Standards and Enforcement Review Committee

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Aluminium recycling is the process by which scrap aluminium can be reused in products after its initial production. The process simply involves re-melting the metal which is less expensive and energy intensive then producing a new aluminium. Aluminium does not degrade during the recycling process, since its atomic structure is not altered during melting. Aluminium recycling is both economically and environmentally effective, as recycled aluminium requires only 5% of the energy used to make primary aluminium, and can have the same properties as the parent metal. In fact, aluminium can be recycled endlessly without loss of material properties. During the course of multiple recycling, more and more alloying elements are introduced into the metal cycle. This effect is put to good use in the production of casting alloys, which generally need these elements to attain the desired alloy properties.

This Environmental & Social Impact Assessment is for the operation of an aluminium recycling facility belonging to Hydro Water Well (K) Limited herein referred to as the proponent & located on L.R No. 100090/14/157 Juja-Gatundu Road, Juja sub-county, Kiambu County and on geographical positioning coordinates of -1.0831897, 36.9948331, latitude and longitude respectively. Environmental Impact Assessment is a tool for environmental conservation and has been identified as a key component in project implementation. Pursuant to section 58 (2) of the Environmental Management and Coordination Act (EMCA CAP 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003 revised 2019 the study report is hereby submitted to NEMA for review and issuance of appropriate approvals.

Project objectives

1. To provide sustainable solid waste management system through recycling thus ensuring a healthy, safe and secure Environment in line with vision 2030.
2. Reduce production cost through reuse of recycled aluminium.
3. Enhance the Circular Economy in Kenya through adoption of the Life Cycle Assessment (LCA) and Cleaner Production (CP) technologies.
4. Production of aluminium for the manufacturing of aluminium windows and doors

Project description:

Operational phase

The process involves mainly charging scrap aluminium into the furnace and once it's charged, 0.6 Tonnes of pure Aluminium ingot or scrap wire is added and heated up to 900 °. White Dross is then removed from the sample whereas the molten Aluminium is left in the furnace. A sample of molten aluminium is taken for Quality Assurance using the Optical Emission Spectrometer (OES) so as to determine the quantity of Silicon lump and Magnesium ingot to be added to the mixture in order to adjust it to the alloy 6063.

Salt fluxes are continually added to the mixture until the desired chemical composition is attained and Nitrogen gas is used for degassing the mixture. The molten Aluminium is then cast in the casting machine and cooled with water which is then recycled back to the reservoir. Carbon filtering occurs to the smoke generated by the furnace before it is released to the atmosphere through a 52ft = 16 Metres above the ground chimney. The furnace is fired with Industrial Diesel Oil or furnace oil (CST 180) while the stored white dross is bought for further aluminium extraction by other recyclers.

The plant shall be designed, assembled, and operated in conformity with applicable national and international environment, health and safety guidelines and standards and the proponent shall put in place procedures to eliminate, control and or minimize the identified risks and promote continuous improvement. An environmental management & monitoring plan has been prepared which describes the environmental protection strategies at the facility. The EMMP contains the management programmes and plans for handling the adverse environmental impacts. Long term job opportunities will be created for both skilled and unskilled labour besides observing Safety and health measures in line with the occupational safety and health Act of 2007.

Objectives of the study

The specific Objectives of this study are to:

1. Identify and assess all potential environmental and social impacts of the proposed project.
2. Identify all potential significant adverse environmental and social impacts of the project and recommend measures for mitigation.
3. Verify compliance with the environmental regulations and relevant standards.
4. Identify non-conformity and recommend measures to improve the environmental management system throughout the project cycle.
5. Generate baseline data that will be used to monitor and evaluate the mitigation measures implemented during the project cycle.
6. Recommend cost effective measures to be used to mitigate against the anticipated negative environmental & social impacts.
7. Prepare an Environmental Impact Assessment Study Report in compliance to the Environmental Management and Coordination Act (Cap 387) and the Environmental (Impact Assessment and Audit) Regulations 2003 revised 2019.
8. Provide guidelines to stakeholders participating in the mitigation of adverse social impacts of the project

Analysis of impacts

Waste management

There will be no major solid waste as those generated during recycling will be recycled back. For the waste that cannot be recycled including office waste, the proponent is advised to engage services of a registered waste handler.

Impacts on Noise and Air Quality

Noise survey and air quality shall be undertaken annually so as to comply with air quality regulations of 2014.

Employees shall be provided with appropriate personal protective clothing i.e. ear muffs, helmets, safety boots and aprons.

Sources of noise during decommissioning phase, will be mainly machinery and vehicles used in demolition of the facility and removing the materials from the site.

Health and safety impacts

The potential health and safety impacts of the project include the occupational health safety risks related to the project activities such as injuries to workers from routine processes and machine operations; risks to the neighbours as a result of activities producing high emissions. Whereas during decommissioning; the potential Health & Safety risks include injuries occasioned by dismantling of the facility.

Environmental management and impact mitigation

This report presents an environmental management plan which covers on the measures for mitigating the adverse potential environmental impacts of the proposed project. The EMP includes programmes and plans for addressing the adverse environmental impacts.

The proposed programs and plans will be subjected to monitoring. Monitoring will have two elements: routine monitoring against standards or performance criteria; and periodic review or evaluation. Monitoring will often focus on the effectiveness and impact of the programme or plan as a whole.

Public consultation and participation

Public consultation was undertaken from neighbours within the vicinity of the project through formal public meeting, questionnaires administration and interviews in order to obtain their views and concerns regarding the proposed project. The neighbours consulted generally perceived that adverse environmental impacts

generated by the project operation should be adequately mitigated. All the pertinent issues which were raised have adequately been addressed in the proposed environmental management plan & monitoring plan.

Analysis of alternatives

Relevant alternatives for the project were evaluated; mainly location and design. On the basis of these considerations, the proposed project satisfies the overall economic, technical, environmental and safety criteria used.

Decommissioning phase

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

Conclusion and recommendations conclusion

The project involves recycling operation for aluminium products. The impacts before implementation of mitigation measures are assessed to be significant and the ratings are expected to improve further with the implementation of the proposed measures. Programs and plans developed and implemented through the EMMP will be monitored and audited to ensure compliance.

The project needs also to embrace Life Cycle Assessment (LCA) and Cleaner Production (CP) Technologies as part of enhancing the Circular Economy.

From analysis, the proposed project was found to offer many significant positive impacts to the economy. The proponent's major task in respect to the EMP is to properly manage the negative impacts while enhancing the positive ones to ensure a project that is economically, socially and environmentally sustainable. In so doing, the proposed project could be approved for implementation provided that the proponent shows capacity to implement the proposed Environmental Management & Monitoring Plan.

CHAPTER

INTRODUCTION

1.1 Background

Disposal of solid waste from industries is a growing Environmental challenge in Kenya. Over the years most local authorities did not prioritize the establishment of proper waste management systems and hence the County Governments have inherited this state of affairs. This has led to the current poor waste management situation across the country. Although Vision 2030 has prioritized on some cities and towns for implementation of sustainable solid waste management systems, this Strategy shall be applied countrywide.

In an effort to address poor solid waste management, NEMA developed some minimum requirements as a baseline for implementation by the Counties. These included designations, securing and manning of the disposal sites, promotion of efficient collection and transportation of waste. The basic requirements were expected to ensure continuous promotion of efficient solid waste management.

Despite the existence of such laws and policies guiding waste management, weak implementation and poor practices, lack of technical and institutional capacities to manage waste, growing industrialization, of the Kenyan economy and poor waste transportation mode has led to the current poor state of waste management which includes indiscriminate dumping, uncollected waste, lack of waste segregation across the country and littering, making waste an eye-sore, in the environment. It's for this reason that some companies have resulted to constructing onsite waste recycling plants. One such company is Hydro Water Well (K) Limited, who proposes to operate an aluminum waste recycling plant.

Hydro Water Well (K) Ltd is a subsidiary of Hydro Group. Its sister company Hydro Aluminum is involved in the manufacture of aluminum profiles from the aluminum billets. The reject aluminum profiles generated together with those supplied by other scrap metal vendors will form part of the raw material for the recycling plant. This study was aimed at establishing the potential environmental impacts of the proposed aluminum recycling unit at the company premises, and proposing mitigation measures for negative impacts throughout the project cycle.

1.2 Environmental Impact Assessment (EIA) Study

The Kenya Government's Environmental Policy of 2014 aims at integrating environmental aspects into national development plans by use of innovative environmental management tools such as incentives, disincentives, total economic valuation, indicators of sustainable development, Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs), Environmental Audits (EA) and Payment for Environmental Services (PES). The objectives of the policy are to ensure environmental and social impacts of all development projects are taken into account in order to achieve sustainable development.

In light of this, Environmental Management and Coordination Act Cap 387, sets out all projects that require mandatory Environmental Impact Assessment study prior to implementation. All projects that require mandatory EIA are listed in the second schedule of the same Act. This, proposed project lies among the projects listed; thus, the proponent contracted a licensed Environmental Consultant to undertake the task.

This ESIA Study was conducted by Tropospace Consultancy Ltd, a firm of Experts registered by the National Environment Management Authority (NEMA). The study for the proposed project was carried out to ensure that all significant negative environmental and social impacts are adequately mitigated throughout the project cycle.

1.3 Project objectives

a) To provide a sustainable solid waste management system through recycling thus ensuring a healthy, safe and secure Environment in line with vision 2030.
b) Reduce production cost through reuse of recycled aluminum.
c) Enhance the Circular Economy in Kenya through adoption of the Life Cycle Assessment (LCA) and

Cleaner Production (CP) technologies.

1.4 ESIA objectives

The purpose of this ESIA is to ensure adequate identification of potentially negative Environmental impacts and articulate appropriate mitigation measures.

Specific objectives are:

a) To identify and evaluate the significant environmental impacts of the proposed project.
b) To assess the environmental costs and benefits of the proposed project to the local and national economy.
c) Verify compliance with the existing environmental regulations and relevant standards.
d) Generate baseline data that will be used to monitor and evaluate the mitigation measures implemented throughout the project cycle.
e) To determine the compatibility of the proposed facility with the local environmental setting.
f) To evaluate and select the best project alternative from the various options available. To propose mitigation measures for the negative environmental impacts.
g) Provide guidelines to stakeholders participating in the mitigation of adverse social impacts of the project.
h) To incorporate environmental management plan and monitoring mechanisms during implementation, operation and decommissioning phases of the project.
i) Prepare an Environmental Impact Assessment Study Report in compliance with section 58(2) of the Environmental Management and Coordination Act Cap 387 and the Environmental (Impact Assessment and Audit) Regulations (2003), detailing findings and recommendations for submission to NEMA for review and approval

1.5 Scope of the study

The Kenya Government policy on all new projects, programmes or activities requires that an Environmental and Social Impact Assessment (ESIA) study report 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, operation and decommissioning phases of the facility. The scope of this Environmental Impact Assessment, therefore, covered:

a) Description of the project.
b) The baseline environmental conditions of the area.
c) Provisions of the relevant environmental laws.
d) Seeking views through Public participation and consultation.
e) Identification and discussion of any adverse impacts to the environment anticipated from the project.
f) Appropriate mitigation measures.
g) Provision of an environmental management plan outline.
h) Occupational and Environmental health and safety management.
i) Analysis of alternatives.

1.6 Terms of reference

The Terms of Reference for conducting this Environmental Impact Assessment for the operation of the recycling plant is to determine whether the project has adverse impacts on the environment and social life of the community & recommend mitigation measures for any adverse impacts identified. The terms of reference include:

1. To find out the positive socio-economic and environmental impacts and benefits associated with the project for the purpose of enhancement.
2. To analyze possible project alternatives in terms of, land uses and other criteria and seek justification for the preferred options.
3. To seek views and inputs of interested and affected parties and members of the public,
4. To promote environmentally and ecologically friendly operations.

5. To identify health and public safety concerns associated with the operations of the project site and provide an action plan for managing public health and safety.
6. To provide a comprehensive environmental management plan for the project.
7. To enable the project proponent to comply with the requirements of the Environmental Management and Coordination policies & regulation.

These terms of reference were prepared in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003 revised 2009.

1.7 Study methodology

1.7.1 Criteria

1.7.1.1 Data collection

The experts employed various approaches in collecting data and information for assessing the impacts of the project. The following techniques were used:

1.7.1.2 Review of secondary data

A wide range of environmental and socio-economic data were sought to describe the baseline conditions at the project area. These included socio-economic, physical and environmental data and reports from government departments and on-line sources.

1.7.1.3 Interviews

Public consultation was done to obtain the views and concerns of the affected parties. Questionnaires (annexed) were distributed to capture the responses of the affected parties. A public meeting was also held within the project area whereby area administrators (Assistant chief and the Member of County Assembly) attended

1.7.2 Methodology outline

a) **Screening**

In screening the Consultants set out to confirm whether or not this project falls within a category that requires EIA prior to commencement. In addition, other considerations during the screening process included a preliminary assessment of the environmental sensitivity of the areas along the proposed site.

During screening It was determined that the proposed project was listed under Schedule 2 of EMCA, CAP 387 among projects requiring an EIA study.

b) **Scoping**

This process involved identification of the main issues and impacts to be analyzed in the EIA. At the scoping stage, the terms of reference for the EIA were developed.

c) **Establishment of the environmental baseline**

This involved study and description of the existing characteristics of the baseline environment on which the proposed project is to be implemented. It involved the study of the areas' physical environment, biological environment and the immediate socio-economic environment.

d) **Review and analysis of alternatives**

This entailed a review and analysis of the alternatives to the proposed project. This was aimed at determining better ways of avoiding or minimizing environmental impacts while still realizing the project goals. The review of alternatives provided opportunities for environmental enhancement. The alternatives reviewed were alternative project sites, design, raw materials, waste management and the "no project" alternative.

e) **Impact analysis**

This was the main stage and involved a detailed identification, prediction and evaluation of the potential environmental and socio-economic impacts of the proposed project. The impacts of the project were analyzed for the operation and the decommissioning phases.

f) **Public involvement and consultation (PIC)**

PIC was done at all main stages of the EIA right from scoping, analysis of alternatives, environmental baseline survey, and impact analysis and even at the preparation of the project EMMP. Various stakeholders were consulted including the neighboring residences, neighboring institutions, and members of the public and other interested and affected parties.

g) **Identification of mitigation measures**

This involved identification of mitigation measures to be undertaken for the identified negative impacts at all stages of the project cycle. An EMP was prepared as a framework for mitigation of impacts and monitoring environmental performance.

h) **Preparation of the EIA study report**

This report was prepared in accordance with the EIA terms of reference and in line with the guidelines specified in the Environmental (Impact Assessment and Audit) Regulations of 2003 revised 2019.

CHAPTER TWO

PROJECT DESCRIPTION

2.1 Nature of the project

The Aluminium Recycling Unit will be located within a leased go-down, and the plant will be operating in a partly open environment with free flow of atmospheric air and natural lighting. The raw materials for the facility will be waste aluminium pieces from the proponent's sister company; Hydro Aluminium Limited, purchases from local scrap metal dealers and imports. Once on site, the scrap metals will be sorted so as to remove any foreign material that might have been mixed with the aluminium products. The approved scrap Aluminium will then be placed into a furnace and melted at 750°C. The furnace will be fired with Industrial Diesel Oil or furnace oil in a diesel tank at the workshop. A sample shall be removed for chemical composition analysis of the mixture.

Pure Aluminium Ingot, pure magnesium ingots and silicon lumps shall be added to the mixture to adjust it to the alloy 6063. The furnace will then be slightly tilted to let the molten aluminium flow at about 1300 °C to the casting machine and cooled with water by running cold water from the reservoir over the cast aluminium billets. The cooling process raises the cooling water temperature to about 55°C. Each batch of casting will be using about 2,5000L of water. The used water is recycled back to the reservoir, which has a storage capacity of 20,000L and is recharged by rain water harvested from the go-downs roofs and directed to the micro-dam by storm drains.

Water from the reservoir will constantly be pumped to the casting machines while warm water after cooling the aluminium billets is pumped back to the reservoir, forming a circular flow of water. Fumes from the furnace will pass through carbon filter, before it is released to the atmosphere at 52ft (16 Meters) above the ground.

Photo 1: Showing the entire recycling plant for the proposed aluminium recycling facility.

Photo 2: Showing industrial diesel storage tank at the project site for storing bulk diesel for use.

2.2 Project location

The proposed project will be situated on Plot L.R. No. 100090/14/157 along Juja_Gatundu Road at approximately three (3) kilometers off Thika Super Highway on global positioning system coordinates of Latitude: -1.0831897 and Longitude: 36.9948331. immediate neighbors to the project area include juja pulp & paper ltd, supreme packaging ltd, star plastics, piki trading company ltd & premier trading company ltd; all making the project conform to the surrounding environment

Figure 1: Showing, google map drop pin, project site location along Juja-Gatundu Road (approximately 3km from Juja town).

2.3 Project Objectives

The primary objectives for this project are:

a) To provide a sustainable solid waste management system through recycling thus ensuring a healthy, safe and secure Environment in line with vision 2030.
b) Reduce production cost through reuse of recycled aluminum.
c) Enhance the Circular Economy in Kenya through adoption of the Life Cycle Assessment (LCA) and Cleaner Production (CP) technologies.

2.4 Project justification

Aluminum is a silvery-white, lightweight metal. It is soft and malleable. Aluminum is used in a huge variety of products including cans, foils, kitchen utensils, window frames, beer kegs and aeroplane parts. This is because of its particular properties. Aluminium is everywhere in our lives and is at the heart of a sustainable future. The Aluminium industry is an integral part of the Global Circular Economy (GCE). The circular economy is a move from Linear Business Models (LBM), in which products are manufactured from raw materials and discarded at the end of their useful lives, to Circular Business Models (CBM) where intelligent design leads to products or their parts being repaired, reused, returned and recycled. A circular economy aims to rebuild capital, whether it is financial, manufacturing, human, social or natural. This approach enhances the flow of goods and services as the concept of the circular economy drives optimal resource efficiency. It makes sure that resources are efficiently allocated to products and services in such a way that it maximizes the economic well- being of everyone. In addition, products need to be designed to be durable, easy to repair and, ultimately, to be recycled. The cost of reusing, repairing or remanufacturing products has to be competitive to encourage these practices. Simply replacing a product with a new one should no longer be the norm.

To measure progress in achieving a circular economy, we need a life cycle approach that measures the social, economic and environmental impact of a product throughout its full life cycle from raw material extraction to end-of-life (EoL) recycling or disposal. Life cycle thinking must become a key requirement for all manufacturing decisions, ensuring that the most appropriate material is chosen for the specific application, considering all aspects of a products' life. The aluminium industry has been developing Life Cycle Inventorying (LCI) data for 20 years. This is used to assess a product's environmental performance from aluminium production from bauxite to aluminium recycling at end-of-life. The aluminium industry has developed a methodology to show the benefits of using recycled aluminium to make new products. Using recycled materials also carries an embodied burden that should be considered when undertaking a full Life Cycle Assessment (LCA).

The recycling methodology is in accordance with ISO 14040/44:2006 and considers the environmental burden of using aluminium scrap and the benefit of scrap recycling from end-of-life products. It considers the recycling of scrap into new aluminium as closed material loop recycling, and thus, recycling aluminium scrap avoids the production of primary aluminium since recycling scrap produce 100% aluminium

The tilting rotary furnace is the "heart" of this complex metallurgical process. Because the tilting rotary furnace works as a periodic melting furnace, the harmful impurities (for example, iron) in the charge are significantly reduced during melting, which is very important for secondary aluminium alloys production. The rotation of the furnace facilitates the mixing of the scrap, melt and flux, contributes to the formation of a uniform melt, heat transfer, as well as an effective reaction with flux. The scrap melts 2-3 times faster than in a static furnace with the same capacity, which ensures low energy consumption.

Recycling aluminium has immense Environmental and economic benefits which include:

i. **Saves energy:** Recycling aluminium consumes 95% less energy than mining, processing and manufacturing new supplies and releases 95% lower quantities of greenhouse gases than the fresh aluminium production. Recycling of one ton of aluminium reduces energy consumption by 14,000 kilowatt hours, prevents 40 barrels of oil from being burned.
ii. **Prevents depletion of a valuable commodity:** Aluminium is a metal that is mined from the earth's crust as Bauxite ore. This therefore means that, recycling prevents continuous mining and depletion of this valuable commodity. Each year, recycling prevents approximately five percent of the total Bauxite ore mining in the world.

iii. **Reduction of the carbon footprint:** It's estimated that global aluminium recycling industry prevents the release of 170 tons of greenhouse gases into the planet's atmosphere.

iv. **Helps in satisfying the increasing demand:** As the population increases so does the need for aluminium products. Today, aluminium has more uses and applications than other metals. This means that there should be a continuous production of this metal so as to meet the increasing demand. Mining alone is not sufficient enough to meet this demand. Recycling therefore comes in to bridge the gap. Manufacturers today use approximately 35 percent of the recycled aluminium and approximately 65 percent of the natural aluminium to meet up their manufacturing needs.

v. **Solid waste management:** By reducing the amount of solid waste that is disposed on environment, and save ten (10) cubic yards of disposal sites and landfills recycling of this waste helps in minimizing waste.

2.5 Project design

Photo 3: Showing the entire aluminium recycling facility.

2.5.1 The features of the aluminium extrusion recycling foundry include;

i. **Tilting rotary furnace**

Melting is performed in a furnace. Virgin material, external scrap, internal scrap, and alloying elements are used to charge the furnace. Virgin material refers to commercially pure forms of the primary metal used to form a particular alloy. Alloying elements are either pure forms of an alloying element, like electrolytic nickel, or alloys of limited composition, such as ferroalloys or master alloys. External scrap is material from other forming processes such as punching, forging, or machining. Internal scrap consists of gates, risers, defective castings, and other extraneous metal oddments produced within the facility.

The process includes melting the charge, refining the melt, adjusting the melt chemistry and tapping into a transport vessel. Refining is done to remove harmful gases and elements from the molten metal to avoid casting defects. Material is added during the melting process to bring the final chemistry within a specific range specified by industry and/or internal standards. Certain fluxes may be used to separate the metal from slag and/or dross and degassers are used to remove dissolved gas from metals that readily dissolve in gasses. During the tapping, final chemistry adjustments are made then molten aluminum alloy is casted in circular casting molds. After cooling the alloy 6063 is ready for the market.

ii. **Circular casting mold machine**

The molten aluminum alloy 6000 series will be channeled into the circular casting machine through a ladle. After cooling the alloys are removed for storage in readiness for dispatch

iii. **Gas scrubber/emission control**

Green House Gases (GHG) and particulate matter will exit the tilting rotary furnace into the air control system which has four (4) carbon filters, wet scrubber and a centrifugal cyclone whereas the hot air is re-sucked into the furnace hence increasing its energy efficiency and effectiveness thus lower fuel consumption since the furnace needs to be kept constantly hot

iv. **Control panel**

The control panel is fitted with various control knobs that are used to operate the tilting rotary furnace. The control panel entails controls for time and temperatures.

v. **Dross grinding machine**

The machine will be to grind the white dross produced during the aluminum extrusion process.

vi. **Fuel storage**

The Heavy Furnace Oil (HFO) 180 will be used to heat the tilting rotary furnace. The tank will be fitted with a level gauge, feeder and fill pipes and a breather.

2.6 Project activities

i. **Sorting**

Scrap metals brought by vendors will be sorted, to separate aluminium from other metals. Magnets may be used to separate metals, which leaves aluminium behind since it is non-magnetic.

ii. **Melting**

Scrap aluminium is loaded in bales into high-temperature, high-capacity furnaces, and melted down at temperatures that reach or exceed 750 degrees Celsius. Pure magnesium ingots and silicon lumps are added into the molten aluminum to make it have the correct composition. All the impurities will then float to the top surface of the hot aluminum. This forms a layer called dross, which is then removed and returned to the furnace for further recycling.

iii. **Creation of aluminium alloy**

Aluminium alloys are created by adding metals like aluminium, magnesium or silicon to the molten mixture. Alloy formulas are chosen based on the planned uses for the reprocessed aluminium.

iv. **The holding furnace**

The holding furnace is basically where the molten aluminium is transferred to. It is also known as the holding furnace. This is where the aluminium waits to be turned into ingots. From time to time, the holding furnace tilts to pour the molten aluminium into moulds. The ingots, can then be transported to aluminium processing or manufacturing plants to be made into new products.

v. **Waste management**

The machine will be to grind the white dross produced during the aluminium extrusion process.

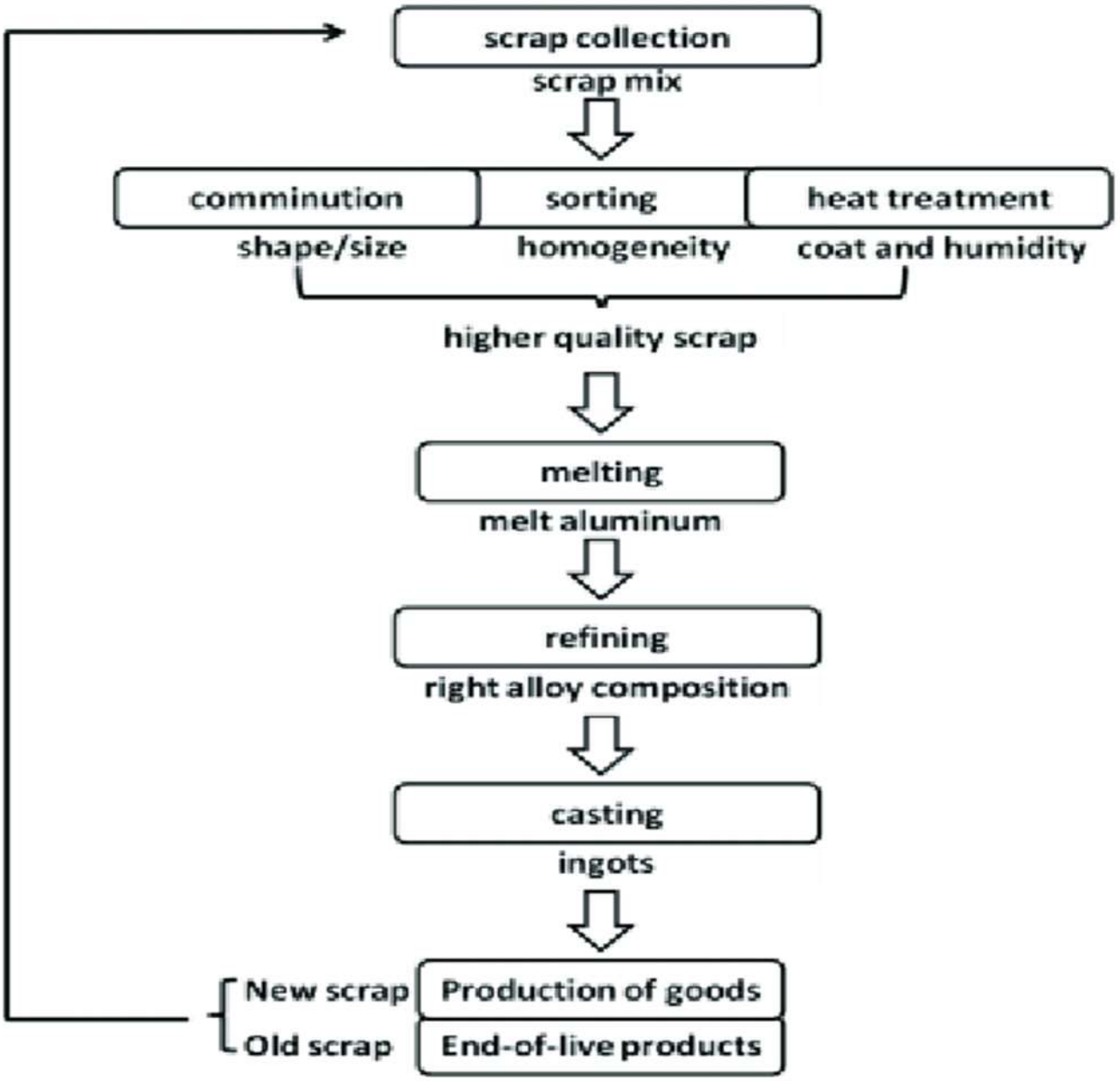

Figure 2: Showing the flow process of aluminium extrusion process.

2.7 Utilities

2.7.1 Power/Electricity

Electricity for use within the project area shall be obtained from the Kenya power and lighting company while the furnace will be run by diesel oil

2.7.2 Water Reticulation System

The proponent will rely on water vendors for drinking water and water from an existing borehole for the running of machines.

2.7.3 Solid Waste and Sewerage

The amount of waste generated will be minimal as is evident. Waste that cannot be recycled within the facility shall be managed by a licensed waste handler while effluent waste shall be channeled into an existing septic tank

2.7.4 Offices and guard house

The guard house will be located next to the main entrance for easy security operation around the compound. An already leased go-down shall be used as an office and a storage area for the finished

products

2.7.5 Access Road

The newly tarmacked Juja-Gatundu Road shall be used as the main access road. The project site is approximately three (3) kilometers from Juja Town.

CHAPTER THREE

POLICY, LEGAL, REGULATORY AND INSTITUTIONAL FRAMEWORKS

3.1 National Policy Frameworks

3.1.1 The Constitution of Kenya, 2010

The Constitution is the supreme law as far as matters of development, environment, health and safety are concerned. It provides the overarching legal framework to ensure a comprehensive rights-based approach to services delivery. It recognizes in Section 43 that every person has the right to reasonable standards of sanitation, clean and safe water in adequate quantities.

Chapter Five on Land and Environment, stipulates the principles of sustainable utilization, exploitation, management and conservation of land, the environment and natural resources, as well as equitable sharing of the accruing benefits, for the benefit of the people of Kenya.

Article 43 (1) (b) of the Constitution states that "every person has a right to accessible and adequate housing and to reasonable standards of sanitation". Further, in Article 21 (2) "the State shall take legislative, policy and other measures, including the setting of standards, to achieve the progressive realization of the rights guaranteed under article 43."

In Article 69 (2), it imposes an environmental stewardship role on project proponents, requiring them to cooperate with state organs such as *NEMA* or *Water Resources Authority (WRA)* to protect and conserve the environment. The state does this through establishing mechanisms to assess and monitor the impacts of project activities like the proposed one. *The undertaking of this EIA is in accordance with these mechanisms detailing appropriate mitigation measures throughout the project cycle to ensure that they do not adversely affect the surrounding environment.*

3.1.2 Sessional Paper No. 10 of 2014 on the National Environment Policy 2014

The National Environment Policy (NEP) promotes an integrated approach towards the planning and sustainable use and management of Kenya's environment and natural resources so as to ensure better quality of life for Kenya's present and future generations. It particularly reiterates the constitutional right to a clean and healthy environment and imposes on the state the duty to safeguard and enhance the environment. However, it balances this with the right to development but with due consideration for sustainability, resource efficiency and economic, social and environmental needs. This therefore, requires the proposed development to reduce impacts on environment to the maximum extent possible, as well as putting in place appropriate mitigation measures. As part of environmental stewardship which requires a precautionary approach to environmental challenges and the promotion of greater environmental responsibility, infrastructural development and other related developments have to be subjected to Environmental Impact Assessment, in the planning and approval of such projects. *This EIA is thus in conformity with this requirement that obligates that the responsibility for environmental quality should be shared by all those whose actions affect the environment.*

3.1.3 Vision 2030

Kenya Vision 2030 is the country's new development blue print covering the period 2008 to 2030. The blue print aims at transforming Kenya into a newly industrialised middle-income country providing a high-quality life to all its citizens by the year 2030. The Vision is based on three pillars (the economic, social and political pillars). The adoption of Vision 2030 came after the successful implementation of the Economic Recovery Strategy for Wealth and Employment Creation (ERS) which has seen the country's economy back on the path to rapid growth since 2002 when Gross Domestic Product (GDP) grew from a low of 0.6% and rising gradually to 6.1% in 2006. One of the foundations for Vision 2030 is infrastructure. The Vision aspires for a country firmly interconnected through a network of roads, railways, housing, ports, airports, water and sanitation facilities, and telecommunications. In this Vision to ensure that the main projects under the economic pillar are implemented, investment in the nation's infrastructure is given the highest priority.

The Economic Pillar of Vision 2030 aims to achieve an average economic growth rate of 10 percent per annum and sustaining the same until 2030. To accomplish this, the pillar aims at developing Industrial Clusters focusing on market-oriented research, value addition and marketing of region specific products through the support of academia, the private sector and related actors; developing SME and Industrial Parks; establishing Special Economic Zones (SEZs) to attract local and foreign investments, expand and diversify produce of goods and services for domestic and export Markets, promote value addition, promote local entrepreneurship through SMEs, enhance technology development and innovation, and, promote rural and regional industrialization by exploiting comparative advantages of local resources; and finally, developing Industrial and Manufacturing Zones. *The proposed project development activities will contribute positively towards economic development through enhanced manufacturing and industrial sectors growth in the country thereby helping propel Kenya to a middle-income country as envisioned in Vision 2030.*

3.1.4 Sessional Paper no. 9 of 2012 on the National Industrialization Policy Framework for Kenya

This policy is aligned to the Kenya Vision 2030 which aspires to transform Kenya into a middle income rapidly-industrializing country, "a globally competitive and prosperous nation, offering a high quality of life to all its citizens" in a secure and healthy environment. It focuses on value addition for both primary and high valued goods; and linkages between industrial sub-sectors and other productive sectors to drive the industrialization process aiming at providing strategic direction for the sector growth and development. Its overall objective is to enable the industrial sector to attain and sustain annual sector growth rate of 15% and make Kenya the most competitive and preferred location for industrial investment in Africa leading to high employment levels and wealth creation.

It aims at promoting and sustaining a vibrant, globally competitive and diversified industrial sector for generation of wealth and employment through creation of an enabling environment, and use of dual approach encouraging an export oriented approach with import substitution for identified strategic industries; strengthening local production capacity to increase domestically-manufactured goods by focusing on improving the sector's productivity and value addition by 20 percent; developing niche products through which Kenya can achieve a global competitive advantage; increasing the share of Foreign Direct Investment in the industrial sector by 10 percent; increasing the local content of locally manufactured goods for export to at least 60 percent; increasing the share of industries located outside major urban centres (Nairobi, Mombasa, Kisumu, Nakuru, Eldoret) to at least 50 per cent; enhancing the growth and graduation of MSMIs into large industries that form the bedrock of industrialization; promoting sustainable industrial development that upholds environmental protection, management and efficient resource utilization; recognizing innovation as central to meeting the rapidly changing consumer tastes and preferences while also boosting productivity and competitiveness of the industrial sector through a broader engagement framework within which all stakeholders, including the public and private sector; civil society and development partners will contribute and play their respective roles in industrial development through the National Industrial Development Commission (NIDC).

3.1.5 Third Medium Term Plan, 2018 – 2022

Kenya aims to have a robust, diversified and competitive Manufacturing Sector to transform the country into a middle-income economy by 2030. In the medium term, the goal of the Sector is to increase its contribution to the GDP from 9.2 per cent in 2016 to 15 per cent by 2022; create additional one million jobs yearly; increase level of Foreign Direct Investments to $2 billion; and improve ease of doing business ranking from 80 in 2017 to 45 by 2022. The Sector is one of the "Big Four" initiatives and will play a key role in the country's economic growth and development by facilitating employment creation, attraction of investments and wealth creation. The Manufacturing Sector has been identified under the Economic Pillar as one of the eight (8) priority sectors to drive economic growth. To achieve this, the plan aims at establishing Special Economic Zones and Industrial Parks, creating an additional 1,000 manufacturing SMEs and providing them with access to affordable capital, training and skills enhancement, access to markets and establishing at least

one industry in each county. Additionally, the government will also facilitate the private sector to invest in Special Economic Zones (SEZs) and in industrial and SME parks.

3.1.6 Kenya Industrial Transformation Programme, 2015

The programme is guided by Kenya Vision 2030, the country's economic development blueprint that aims to transform Kenya into a newly industrializing, "middle-income country providing a high-quality life to all its citizens by the year 2030". The objective of the Economic Pillar of Vision 2030 is to create a robust, diversified and competitive manufacturing sector through boosting local production, expanding to the regional market and taking advantage of global market niches. Its goal is to develop Kenya into a new industrial hub in Africa by accelerating the development of industries that will drive the country's economic growth. It aims at capturing existing opportunities over the next ten years by identifying flagship projects in sectors where there is a competitive advantage as well as delivering projects that will achieve quick and measurable results on GDP and employment growth. The identified opportunities will more than double the amount of current formal manufacturing sector jobs to approximately seven hundred thousand and add USD 2 to 3 billion to the country's GDP while the challenges to be addressed include infrastructure and land availability, skills and capabilities in priority sectors, quality of inputs, cost of operation, access to markets and investor-friendly policies. *With the proposed project in place, employment opportunities are meant to be in place.*

3.2 National Regulatory Frameworks

3.2.1 Environment Management and Coordination Act, 1999, & Amendment Act, 2015, Cap 387

Section 58.(2) Of the Act states that "The proponent of a project shall undertake or cause to be undertaken at his own expense an environmental impact assessment study and prepare a report thereof where the Authority, being satisfied, after studying the project report submitted under subsection (1), that the intended project may or is likely to have or will have a significant impact on the environment, so directs. Part three follows by stating that the environmental impact assessment study report prepared under this subsection shall be submitted to the Authority in the prescribed form, giving the prescribed information and shall be accompanied by the prescribed fee. *This report has been prepared pursuant to section 58 (2) of this Act.*

3.2.2 EMCA Act, CAP 387, Second Schedule Amendment (Legal Notice No. 31 & 32) of 2019

Legal Notice No. 31 categorizes projects into low-risk projects, medium risk projects, and high-risk projects. Legal Notice No. 32 requires project proponents undertaking low risk and medium risk projects to prepare and submit to the Authority a summary project report of the likely environmental effects of the project. In a scenario where the Authority through screening and assessment of the report realizes that the project has significant adverse environmental impacts, then the proponent is advised to prepare and submit to the Authority a comprehensive project report or a full study environmental impact assessment report. *Upon screening the project was found to be a high risk project hence preparation of this study report.*

3.2.3 Environmental (Impact Assessment and Audit Amendment Regulations of 2019

These regulations stipulate how an EIA project report should be prepared and specifies all the requirements that must be complied with. It highlights the stages to be followed, information to be made available, role of every stakeholder and rules to be observed during the whole EIA project report preparation process. The proposed project will be planned, designed and operated based on these regulations. *This project report has been prepared as guided using the aforementioned guidelines. All relevant information as it regards the project have been incorporated.*

3.2.4 Water Quality Regulations, 2006

The Water Quality Regulations (2006) are contained in the Kenya Gazette Supplement No. 68, Legal Notice No. 120. Water Quality Regulations apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes,

rivers, streams, springs, wells and other water sources. It is an offence to contravene the provisions of these regulations with a fine not exceeding five hundred thousand shillings.

In addition, of immediate relevance to the proposed project for the purpose of this project report is Part II Sections 4-5 as well as Part V Section24. Part II Section IV states that "Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution".

Part IV Section 24 states that "No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump any such matter into water meant for fisheries, wildlife, recreational purposes or any other uses". According to these regulations, "Every person shall refrain from any action which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of the Act". *The project proponent and contractor shall take precaution not to pollute underground water or even surface water in anyway, and if a pollution incidence occurs the proponent or contractor shall notify the authority immediately.*

3.2.5 Waste Management Regulations, 2006

The Waste Management Regulations (2006) are contained in the Kenya Gazette No. 69, Legal Notice No. 121. They are meant to streamline the handling, transportation and disposal of various types of waste. It aims at protecting human health and the environment. The regulations place emphasis on waste minimization, cleaner production and segregation of waste at source. The regulation requires licensing of transporters of wastes and operators of disposal site (sections 7 and 10 respectively). Of immediate relevance to proposed development for the purposes of this project report is Part II Sections 4(1-2), 5 and 6.

Section 4 (1) states that "No person shall dispose of any waste on a public highway, street, road, recreational area or any other public place except in a designated waste receptacle".

Section 4(2) and 6 explain that the waste generator must collect, segregate (hazardous waste from non-hazardous) and dispose waste in such a facility that shall be provided by the relevant local authority.

Section 5 provides method of cleaner production (so as to minimize waste generation) which includes the improvement of production processes through conserving raw materials and energy.

In section 14 (1) every trade or industrial undertaking is obliged to install anti- pollution equipment for the treatment of waste emanating from such trade or industrial undertaking. *The proponent shall ensure that the waste handler contracted has a valid license from the National Environment Management Authority (NEMA) as well as a license to transport waste. So as to comply with these regulations, the proponent and contractor shall take precaution not to dump wastes in areas not registered and designated as so. The proponent is also advised to register the facility as a waste handling facility/transfer station.*

i. **Waste Water Management, 2006**

Legal Notice No. 120; Part II – Protection of Sources of Water for Domestic Use. 4. (1) every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of these Regulations (2) No person shall throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution. All sources of water for domestic uses shall comply with the standards set out in the First Schedule of these Regulations. The project proponent and engineer are urged to ensure that drainage channels are well designed and constructed to simulate the surrounding project area's natural drainage systems and topography during the respective project implementation phases. *All effluent emanating from the facility shall be channeled into an existing septic tank since the area has no sewer line.*

3.2.6 Noise and Excessive Vibrations Pollution Control Regulations, 2009

These Regulations determine that no person or activity shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise that annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. In determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors may be considered:

i. Time of the day.

ii. Proximity to residential area.

iii. Whether the noise is recurrent, intermittent or constant.

iv. The level and intensity of the noise.

v. Whether the noise has been enhanced in level or range by any type of electronic or mechanical means, and

vi. Whether the noise is subject to be controlled without unreasonable effort or expense to the person making the noise.

Part II Rule 4 state that: except as otherwise provided in these Regulations, no person shall

a) Make or cause to be made excessive vibrations that annoys, disturbs, injures or endangers the comfort, response, health or safety of others and the environment, or

b) Cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 meters from any moving source.

Rule 11 requires any person wishing to operate or repair any machinery, motor vehicle, or construction equipment which is likely to emit noise or excessive vibrations to carry out the activity or activities within the relevant levels provided in the First Schedule to these Regulations. Rule 14 requires that where construction is to be carried out in an area, the Authority may impose on how the work is to be carried out including the machinery that may be used, and the permitted levels of noise as stipulated in the Second Schedule to these Regulations.

In this case, permissible levels applicable to public utility construction should be in line with Table 3 below.

Second Schedule – Maximum permissible noise levels for a construction site.

Table 1: Second Schedule – Maximum permissible noise levels for a construction site.

Maximum permissible noise levels for construction sites (measurements taken within the facility)		
Facility	**Day**	**Night**
i. Health facilities, educational institutions. Homes for	60	35
ii. Residential	60	35
iii. Areas other than those prescribed in (i) and (ii)	75	65

Time frame: Day: 6.01 a.m. – 6.00 p.m. (Leq, 14h) Night: 6.01 p.m. – 6.00 a.m. (Leq, 14h)

The proponent and contractor shall be required to implement these measures, ensure that all machineries, vehicles and equipment are in good working condition to reduce noise. They are advised to conduct regular noise monitoring to ensure that emitted noise is within the required levels.

3.2.7 Air Quality Regulations, 2014

The objective of these regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The general prohibitions state that no person shall cause the emission of air

pollutants listed under First Schedule (Priority air pollutants) to exceed the ambient air quality levels as stipulated under the provisions of the Seventh Schedule (Emission limits for controlled and non-controlled facilities) and Second Schedule (Ambient air quality tolerance limits). The project proponent shall implement the mitigation measures provided in the EMP to prevent air pollution and any other impact that will emanate from the proposed project activities. *Regular air quality monitoring is also advised and should be carried out to ensure that emissions meet the stipulated standards. The chimney should also be raised high so as to exceed the tallest building within the project area.*

3.2.8 Energy (Energy Management) Regulations, 2012

These regulations stipulate that:

In Section 4 (1) on Energy Consumption Rating, that it shall be the responsibility of the Commission to carry out energy consumption rating of facilities for purposes of these regulations. In Section 5 (1) on Energy management policy, that the owner or occupier shall develop an energy management policy for the facility which shall have the minimum requirements as provided in the First Schedule. In Part (4), that the owner or occupier of a facility shall maintain records of information for every designated facility for a minimum period of five years from the date of occupation of the facility, which shall include: -

(a) Monthly and annual electricity, fuel and water consumption;

(b) Monthly production data or occupancy levels; and up to date building plans, infrastructure plans and floor area drawings.

In Section 6 (1) on Energy audits, it states that the owner or occupier shall cause an energy audit of the facility to be undertaken by a licensed energy auditor at least once every three years. In Section 7 (1) on Energy Investment Plan, it requires an owner or occupier of designated facilities shall within six months from the end of the financial year in which an energy audit is undertaken, prepare and submit to the Commission an energy investment plan for the next three years, setting out proposals for the conservation of energy during that period. It also requires the owner or occupier to take measures to realize at least fifty percent of the identified and recommended energy savings specified in the energy investment plan by the end of three years and thereafter at every audit reporting date in its Section 8. (1) on Energy conservation measures. In section 9. (1) on Implementation Reports, stipulates that every designated facility shall submit an annual implementation report as provided in the Fourth Schedule. *The proponent is thus advised to monitor energy use within the facility and keep records on energy used for monitoring purposes*

3.3 National Legal Frameworks; Safety Health & Environmental; and, Other Related Laws

3.3.1 Water Act, 2002 and 2016

This is an Act of Parliament to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. It recognises in its Section 63 the constitutional requirement in Article 43 stating that every person in Kenya has the right to clean and safe water in adequate quantities and to reasonable standards of sanitation as stipulated. Additionally, it stipulates that every water resource is vested in and held by the national government in trust for the people of Kenya. *The proposed development project has no sewer connection but has a septic tank for proper liquid (effluent) waste handling and management.*

i. **Water Act (Resources Management) Rules, 2007**

In Rule 23, it requires Water Users in Category A to apply to user rights. In Rule 99, Class B, C or D water user, whether for water abstraction or effluent discharge, shall be required to have installed a controlling device and measuring device for the accurate measurement of water abstracted, obstructed or diverted and for effluent discharged. Section 101 requires class B, C or D permit holder to maintain a record of the daily abstraction and or effluent discharge, in cubic meters per day, made by him or her. In 104, any person in possession of a valid permit or who is required to have a valid permit for water use, shall be required to pay

to the Authority water use charges on the basis of the water abstracted, diverted, obstructed or used including energy derived from a water resource at the appropriate rate as set out in the First Schedule. *The project proponent has complied with the provisions of this Act as the borehole belongs to the landlord who has all necessary permits.*

3.3.2 The Public Health Act (Cap 242)

The Act makes provisions for securing and maintaining health. Part IX, section 115, of the Act prohibits any person or institution from causing nuisance or a condition likely to cause injury or which might be dangerous to human health. As well, section 116 of the Act mandates the relevant departments of the county government to take proceedings at law against any person causing or responsible for the continuance of any nuisance or condition liable to be injurious or dangerous to human health. The proponent will be required to undertake necessary measures to ensure such nuisances which may arise during the operation phase are avoided and mitigated as required

3.3.3 Physical Planning Act (Cap 286)

The Act provides for the preparation and implementation of physical development plans, and for connected purposes. In part V, it vests on local authorities the powers for development control.

This requires the proponent to apply for development permission, approvals or compliance certificates to be granted by the local authority prior to the start of any developments. Failure to do so is an offence and shall be liable to a fine or to an imprisonment with the risk that the development shall be discontinued. The proponent has complied.

Any application for development permission for development activities which are likely to have injurious impact on the environment shall be submitted together with an environmental impact assessment report, as stipulated in section 36.

These local authorities may manage and let land besides regulating and licensing trade activities including construction in their areas of jurisdiction besides provision and maintenance of roads, footways, street lighting and sewerage in their areas. Section 160 of the Act empowers municipal authorities to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available. *The proposed development is in conformity with the prevailing area land use as all relevant documents had been obtained.*

3.3.4 County Government Act, 2012

This is an Act of parliament to give effect to chapter 11 of the constitution; to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes. The Act gave credence to all 47 County Governments. The county government will perform one of its functions in the form of approving the development through issuance of relevant approvals which among them include a single business permit

3.3.5 The Penal Code (Cap. 63)

Section 191 of the Penal Code makes it an offence for any person or institution that voluntarily corrupts, or foils water for public springs or reservoirs rendering it less fit for its ordinary use. Similarly, section 192 of the same act prohibits 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 a public way. *The proponent will be required to ensure strict adherence to the environmental management plan throughout the project implementation cycle in order to mitigate against any possible negative impact.*

3.3.6 Occupiers' Liability Act (Cap 34)

This is an Act meant to amend the law as to the liability of occupiers and others for injury or damage resulting to persons or goods lawfully on any land or other property from dangers due to the state of the property or to things done or omitted to be done there.

3.3.7 Employment Act (Cap 226) and the Employment Act Subsidiary Legislation

This Act looks at the welfare of the employees regarding wages, leave days, water provision, food, medical attention and the provision of safe and clean working environments. Part V and VI define the conditions of employment. For instance, in Part V, Section 32, the proponent and the contractor are required to provide a sufficient supply of wholesome water for employees on site. Some of these conditions are elaborated on in the subsidiary legislations.

3.3.8 The Standards Act (Cap 496)

This Act promotes the standardization of the specification of commodities, and provides for the standardization of commodities and codes of practice to ensure public health and safety. It establishes the Kenya Bureau of Standards (KEBS) and defines its functions as related to the promotion of standardization in industry and commerce; and making arrangements or provision of facilities for testing and calibration of precision instruments, gauges and scientific apparatus, for the determination of their degree of accuracy by comparison with standards approved by the Minister on the recommendation of the Council, and for the issue of certificates in regard thereto. *This implies that the proponent and contractor have to ensure that all materials, machines and equipment in use adheres to the highest standards and do not pose any human health and safety risk.*

3.3.9 Traffic Act (Cap. 403)

In Section 51, only proper fuel should be used in vehicles. Similarly, vehicles should be well maintained and regularly serviced to prevent any fumes/exhaust that could pollute the environment. All vehicles transporting raw materials and finished goods should abide by this act.

3.3.10 The Work Injury Benefits Act (WIBA), 2007

The WIBA Act provides for compensation to employees for work related injuries and diseases contracted in the course of their employment and for connected purposes;

Section 7(a) of the Act, on the obligations of the employer, requires an employer to obtain and maintain an insurance policy with an insurer approved by the State in respect of any liability that the employer may incur under this Act to any of his employees.

Section 10(1) States that an employee who is involved in an accident resulting in the employee's disablement or death is subject to the provisions of this Act, and entitled to the benefits provided for under this Act. It also states expressly that an employer is liable to pay compensation in accordance with the provisions of this Act to an employee injured while at work.

On First Aid covered in section 45(1), an employer is supposed to provide and maintain such appliances and services for the rendering of first aid to his employees in case of any accident as may be prescribed in any other written law in respect of the trade or business in which the employer is engaged.

3.3.11 The Energy Act, 2019

This is an Act of Parliament to consolidate the laws relating to energy, to provide for National and County Government functions in relation to energy, to provide for the establishment, powers and functions of the energy sector entities; promotion of renewable energy; exploration, recovery and commercial utilization of geothermal energy; regulation of midstream and downstream petroleum and coal activities; regulation, production, supply and use of electricity and other energy forms; and for connected purposes.

It recognises the government's obligation to facilitate the provision of affordable energy services to all persons in Kenya. It also establishes in its (Part III), national energy entities such as Rural Electrification and Renewable Energy Corporation, Energy and Petroleum Tribunal, and Energy and Petroleum Regulatory Authority. The Energy and Petroleum Regulatory Authority shall among other functions regulate:

(i) generation, importation, exportation, transmission, distribution, supply and use of electrical energy with the exception of licensing of nuclear facilities;

(ii) importation, refining, exportation, transportation, storage and sale of petroleum and petroleum products with the exception of crude oil;

(iii) production, conversion, distribution, supply, marketing and use of renewable energy; and,

(iv) exploration, extraction, production, processing, transportation, storage exportation, importation and sale of coal bed methane gas and other energy forms.

The proponent shall apply to Energy and Petroleum Regulatory Authority (EPRA) for a license to transport and store bulk petroleum at the proposed site before main project activities commence if need be.

3.3.12 Occupational Safety and Health Act, 2007, and its Regulations.

This is an act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. The Act was published in the Kenya Gazette Supplement No. 111 (Acts No.15). It received presidential assent on 22nd October, 2007 and became operational on 26th October, 2007. The key areas addressed by the Act include: Under section 6 of this act, every occupier is obliged to ensure safety, health and welfare of all persons working in his workplace.

The Act makes provision for the health, safety and welfare of persons employed in a workplace. The provision requires that all practicable measures be taken to protect persons employed in a workplace from any injury. The provisions of the act are also relevant to the management of hazardous and non-hazardous wastes, which may arise at the project site. The act provides that all measures should be taken to ensure safety, health and welfare of all the stakeholders in the work place.

a) **Fire Risk Reduction Rules of 2007**

These rules apply to every workplace, process and operations to which the provisions of the Act apply.

Section 4. states that a person wishing to set up or operate a facility for the use on or storage of highly flammable substance shall ensure that such facility is located in the designated area.

Section 5. (1) requires, among other things, that every owner and occupier of a workplace to ensure that every workroom where flammable substances are used, manufactured or manipulated, is constructed with fire resistant material.

b) **Safety and Health Committee Rules of 2004**

These Rules apply to all factories and other workplaces, which regularly employ twenty or more employees. In Section 4. (1) It states that the occupier of every factory or other workplace to which the Rules apply shall establish a Safety and Health Committee in the manner provided in the Rules. It continues to state that Part (2), a Safety and Health Committee shall consist of safety representatives from the management and the workers in the following proportions-

a) in the case of factories or other workplaces with between twenty and one hundred regular employees, not less than three safety representatives each from the management and the workers;
b) in the case of factories or other workplaces with between one hundred and one thousand regular employees, not less than five safety representatives each from the management and the workers; and
c) in the case of factories or other workplaces with one thousand or more employees, not less than seven safety representatives each from the management and the workers.

In Part (3), it requires an occupier to appoint a competent person, being a member of the management staff, to be responsible for safety, health and welfare in the factory or workplace not later than six months after the coming into operation of the Rules.

c) **Medical Examination Rules of 2005**

These Rules apply to medical examination of all those employees in employment or have been in employment in every workplace, to which the provisions of the Act apply. Section 4. (1) states that it shall be the duty of the employer to ensure that all persons employed in any of the occupations outlined in the Eighth Schedule to the Act undergo both pre-employment and periodic medical examinations by the Designated Health Practitioner as outlined in the First Schedule

d) **Noise Prevention and Control Rules, 2005.**

These rules apply to every factory, premises, place, process and operations to which the provisions of the Act apply. Section 4. (1) states that no worker shall be exposed to a noise level in excess of:

(a) the continuous equivalent of ninety dB (A) in eight hours within any twenty-four hours duration; and
(b) one hundred and forty dB (A) peak sound level at any given time.

Part (3) Where noise is intermittent, noise exposure shall not exceed the sum of the partial noise exposure equivalent continuous sound level of ninety dB (A) in eight-hour duration within any twenty-four hours duration,

Part (4) (a) It shall be the duty of the occupier to ensure that noise that gets transmitted outside the workplace shall not exceed fifty-five dB (A) during the day and forty-five dB (A) during the night; and (b) any person who does not comply with this provision shall commit an offence.

Section 5. (I) Where noise in a workplace exceeds the continuous equivalent of eighty-five dB (A) the occupier must develop and implement an effective noise control and hearing conservation programme. Section 6. (I) requires the occupier to carry out measurements of noise at least once in every period of twelve months in order to determine the prevailing noise conditions.

The proponent will ensure that the safety of workers is given priority during both project implementation, operation and decommissioning phases as well as adherence to the provisions of OSHA, 2007, Fire Risk Reduction Rules, and the subsidiary rules and regulations under it.

3.3.13 The Electricity Power Act, 1997

Section *55* (1) in the execution of works in connection with the construction, modification, maintenance or operation of an electric supply line or apparatus or conductor connected thereto, every licensee shall: - In no way injure the works, conveniences or property belonging to any such other such authority, company or person, nor obstruct or interfere with public traffic, except with the previous consent of the board. Take adequate precautions to protect from danger any person engaged upon such works by the provision and maintenance in safe and efficient conditions of the necessary safety appliances for the use of such persons and by ensuring their proper use, or by other means approved by the board.

3.4 World Bank Operational Guidelines

3.4.1 OP/BP 4.01 on Environmental Assessment, 2001

Operational Policy (OP) 4.01 on Environmental Assessment, 2001 (later revised in 2013) is to assist in identifying, avoiding, and mitigating potential negative environmental impacts with a specific objective of ensuring proposed projects are environmentally sound and sustainable. Ensures that appropriate levels of environmental and social assessments are carried out as part of project design.

3.4.2 OP/BP 4.04 on Natural Habitats (June 2001)

This supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable development. The Bank does not support projects that involve significant conversion or degradation of critical natural habitats.

3.4.3 OP/BP 15.50 on Public Disclosures

This Policy details the Bank's requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups

affected by the projects and programs supported by the Bank, including Non-Governmental Organizations (NGOs), is essential for the effective implementation and sustainability of projects.

3.4.4 OP/BP 4.10 on Indigenous People (April, 2013)

This policy requires project to be designed and implemented in a way that fosters full respect for Indigenous Peoples' dignity, human rights and cultural uniqueness, so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during the development process.

3.5 Multilateral Environmental Agreements

3.5.1 The Basel Convention

Sets an ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system.

3.5.2 Kyoto Protocol

Drawn up in 1997, pursuant to the objectives of the United Nations (UN) Framework Convention on Climate Change, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990.

3.5.3 Paris Climate Change Agreement, 2015

The Paris Agreement is a legally binding international treaty on climate change adopted by 196 Parties at COP 21 in Paris, on December 12, 2015 and entered into force on November 4, 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

CHAPTER FOUR

DESCRIPTION OF BASELINE ENVIRONMENT

4.1 County overview

4.1.1 Position, size & project location

Kiambu County is located in the central region covering a total area of 2,543.5 Km^2 out of which 76.3 Km^2 is under forest cover according to the 2019 Kenya Population and Housing Census. It borders Nairobi and Kajiado Counties to the South, Machakos to the East, Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West. The county lies between latitudes 00 25' and 10 20' South of the Equator and Longitude 36^0 31' and 37^0 15' East. The proposed project will be located within a leased godown along Juja-Gatundu Road, on Plot LR No. 100090/14/157 Juja-Gatundu Road at approximately three (3) KM from Thika Super Highway, Kiambu County. The proposed project will be situated on global positioning system coordinates of Latitude: 1°04'58.3"S and Longitude: 36°59'40.4"E.

4.2 Physiographic and natural conditions

4.2.1 Physical and topographic features

The county is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 metres above sea level. It is dominated by highly dissected ranges and it is very wet, steep and is a water catchment area. The lower highland zone is characterized by hills, plateaus, and high-elevation plains and lies between 1,500-1,800 metres above sea level. The upper midland zone lies between 1,300-1,500 metres above sea level with a landscape comprising of volcanic middle level uplands. The lower midland zone lies between 1,200-1,360 metres above sea level with dissected and easily eroded soils. *The proposed project site is within a low midland zone.*

4.2.2 Soils

The county is covered by three broad categories of soils which are: high level upland soils, plateau soils and volcanic footbridges soils. These soils are of varying fertility levels with soils from high-level uplands, which are from volcanic rocks, being very fertile and conducive for livestock keeping and growth of various cash crops and food crops such as tea, coffee, horticultural products, pyrethrum, vegetables, maize, beans, peas and potatoes. Low fertility soils are mainly found in the middle zone and the eastern part of the county which form part of the semi-arid areas. The soils are sandy or clay and support drought resistant crops as well as ranching. Most parts of the county are covered by soils from volcanic footbridges which are well drained with moderate fertility. They are red to dark brown friable clays suitable for cash crop farming. However, parts of Thika Town, Ruiru, Juja and Lari constituencies are covered by shallow soils, which are poorly drained, and these areas are characterized by low rainfall, which severely limits agricultural development. *The proposed project site is characterized by red volcanic soils.*

4.2.3 Ecological conditions

Water in the county is from two principal sources-surface and sub-surface. The county is divided into several sub-catchment areas. The first one is Nairobi River Sub-catchment which occupies the southern part of the county with the major rivers being Nairobi, Gitaru, Gitathuru, Karura, Rui Rwaka, and Gatharaini. The second one is Kamiti and Ruiru Rivers Sub-catchment which is located to the north of the Nairobi river sub-catchment. It has eight permanent rivers which include Riara, Kiu, Kamiti, Makuyu, Ruiru, Bathi, Gatamaiyu and Komothai. The third one is the Aberdare plateau that contributes to the availability of two sub-catchments areas comprising of Thiririka and Ndarugu Rivers. The main streams found in the two areas include Mugutha, Theta, Thiririka, Ruabora, Ndarugu and Komu. They flow from Nairobi, Kamiti, Ruiru, Thiririka, and Ndarugu sub-catchments to form Athi River sub-catchment. The fourth is the Chania River and its tributaries comprising of Thika and Karimenu Rivers which rise from the slopes of Mt. Kinangop in the Aberdares range.

4.2.4 Climatic conditions

The county experiences bi-modal type of rainfall. The long rains fall between Mid-March to May; cold season with drizzles and frost during June to August; and, the short rains between mid-October to November. The annual rainfall varies with altitude, with higher areas receiving as high as 2,000 mm and lower areas receiving as low as 600 mm. The average rainfall received by the county is 1,200 mm. The mean temperature in the county is 26°C with temperatures ranging from 7°C in the upper highland areas to 34°C in the lower midland zone. July and August months experiences the lowest temperatures, whereas January to March is the hottest months. *Jujas' average relative humidity ranges from 54 percent in the dry months and 300 percent in the wet months of March up to August.*

4.3 Administrative and political units

4.3.1 Administrative subdivision

The county is subdivided into twelve sub-counties namely Limuru, Kikuyu, Kabete, Lari, Gatundu South, Gatundu North, Githunguri, Kiambu, Kiambaa, Ruiru, Juja and Thika Town, and sixty wards. *The proposed site is located within Juja Sub-County*

4.3.2 Political units

Kiambu County has twelve constituencies and sixty wards.

Table 2: Administrative Units

Sub County	Area (km^2)	No. of Wards
Gatundu South	192.4	4
Gatundu North	286.0	4
Juja	326.6	5
Thika Town	217.5	5
Ruiru	201.4	8
Githunguri	173.5	5
Kiambu	105.9	4
Kiambaa	83.2	5
Limuru	281.7	5
Kikuyu	175.8	5
Kabete	60.3	5
Lari	439.2	5
Total	**2543.5**	**60**

Source: Kiambu County Economic Planning Unit, 2013

4.4 Demographic features (population size and composition)

According to the 2009 Kenya Population and Housing Census, Kiambu County population for 2012 was projected to be 1,766,058 with 873,200 males and 892,857 females. Further, the population is expected to reach 2,032,464 people by the end of

2017. This is influenced by the county's high population growth rate, which is at 2.81 per cent and the influx of people working in the city who prefer to stay in Kiambu and its environs where there is less congestion and well developed infrastructure. In terms of gender, the sex ratio of male to female is approximately 1:1.02. In 2019 census, the population of Kiambu was at 3,175,200 persons

4.5 Infrastructure development

4.5.1 Roads and rail network

The county has a total road network of 5533 Km out of which 865.4 KMs is under bitumen standards, 1051km on gravel, and 3167km on earth surface. However, 249 Km of road is yet to be opened. The county is served by Thika Super Highway from Githurai-Ruiru-Juja-Thika on average of 50Kms and A104 Uthiru-Kikuyu-Kamandura- Kinungi on average of 65km. It is also served by a railway line which is 131km and has Railway stations in Kahawa, Ruiru, Juja, Thika, Kikuyu and Limuru. There exist bus parks in all sub-counties, 9 paved and 4 unpaved. *The access road to the project site is tarmacked, making it easy to access (Juja-Gatundu Road)*

4.5.2 Information, communication technology

Kiambu County has 98 percent mobile network coverage. However, landline coverage is on the decline due to adoption of new technology and ease of using mobile phones. There are a total of 19 post offices and 14 sub post offices (in Ruiru, two at Thika, Juja, Githunguri, Karuri, Kiambu, Kikuyu, Limuru and Matathia-Lari) fairly distributed in the county. There are quite a number of cyber cafes offering internet access thus easy access of communication. The county has fibre optic cables connection network; radio coverage (local FM and radio stations like Kameme, Inooro and Coro FM); television network coverage. There is one Huduma Centre located at Thika where citizens access government services. *The project area is well connected to the aforementioned networks.*

4.5.3 Energy access

Kiambu county has a 98 percent electricity coverage. The total household connected to electricity is 70 percent, expected to rise to 100 percent in the year 2022. Solar energy accounts for less than 5 percent coverage; biogas 25 percent while wind is not active. Utility directorate has installed flood mast as follows; 56 no. 30m high, 9no. 20M high and 139 no. 15 M high all distributed in all the sub counties and 235 street lighting through World Bank financing. Kenya power and Lighting Company has installed 30M 12 flood masts in Thika, 11 in Kiambu, 5 in Kikuyu, 11 in Limuru, 11 in Ruiru, 11 in Juja and 9 in Kiambaa for street lighting. *The proposed project site is already connected to Kenya power line and this will act as a source of energy in the offices. The furnace will purely rely on diesel oil.*

4.5.4 Housing

According to the Kenya Population and Housing Census, 2009 analysis of the County's housing tenure indicates that there are 469,244 housing units under different tenure in the county. Number of housing units owned by individuals stood at 205,447; individually constructed rental units at 202,170; government housing at 5,443; local government housing at 3,138; private companies 17,428; and, faith-based organizations at 1,797.

4.5.5 Fire and rescue services

The Directorate has measures in place for emergency fires and accident in the section of Fire and rescue. The Directorate plans to build capacity in all the Sub-Counties to ensure timely fire response. All sub-counties fire stations should be operational on 24hours. The county has ensured reduction of emergency response time; Fire Safety Audit Training of Fire Officers; Installation of Fire hydrants; Construction of Fire Stations, projects for Limuru, Githunguri and Kiambu which are ongoing. It has twelve fire vehicles, one utility vehicle and three terrain vehicles. *The proponent has been advised to ensure that all emergency numbers are posted on site so as to be used in case of any eventuality*

4.6 Land and land use

Land in the county is under diverse uses including industrial, agricultural, commercial, wetland forest and public land. There are three categories of land, namely, public land accounting for approximately 5%, community land at 0.01%, and the private land at approximately 94.99%. The average mean holding size of land is approximately 0.045 hectares on small scale and 69.5 hectares on large scale. 85 percent of land owners in the county have title deeds. The remaining 15 per cent have not received their title deeds. There are no recorded cases of incidences of landlessness. There is no incidence of landlessness. The main settlement

patterns in the county include dispersed, nucleated, and linear settlement patterns. Arable land in the county accounts for 1,878.4 Km^2 while non-arable accounts for 649.7 Km^2. However, 15.5 Km^2 is under water mass. The proposed project area is of mixed use development but it's changing into industrial in some parts. *The specific project are is industrial since it's within existing go-downs.*

4.7 Employment

Most of the employees in the county are wage earners. According to the Labour office- Kiambu, 75% of employees are employed in the tea and coffee estates, and horticulture. There are many self-employed persons within the county in mainly construction companies, super markets, jua kali, manufacturing, hotels and bars, among others. Coffee and tea estates are the leading sectors hiring labour force with each employing between 100 and 500 workers. Other sectors include, manufacturers employing between 1 to 1000 workers, supermarkets, between 1 to 60, bars, more than 20 workers, petrol stations, between 1 to 15, security farms, between 1 to 500, pharmacists, between 1 to 10 and hotels, between 1 to 20 workers. The level of unemployment is acute standing at an approximately 60 %.

4.8 Industry and trade

i. **Markets**

The county has 118 designated markets. The main markets are Gatundu Modern Market in Gatundu South, Kamwangi market in Gatundu North, Juja Market in Juja Sub county, Jamhuri and Madaraka markets in Thika, Githurai and Ruiru in Ruiru Sub-County, Githunguri Market in Githunguri Sub County, Wangige Main Market and Wangige egg shed in Kabete Sub-County, Kangangi Market in Kiambu Sub County, Limuru Barter Hawker market in Limuru, Karuri market in Kiambaa Sub County, Dagoretti and Kikuyu Markets in Kikuyu Sub County and Kimende market in Lari Sub county.

ii. **Industrial parks**

The county has a gazetted and an established industrial park, Tatu City in Ruiru Sub-County which is also a Special Economic Zone. The county has many industries especially in Thika, Juja,
Ruiru and Limuru towns with a concentration of manufacturing sub sector. There are also 30 registered Jua Kali groups. There are more than 200 boda-boda sheds for boda-boda operators across the county.

iii. **Major industries**

The county host major industries for all sector of the economy. Major industries are for Agro-processing and manufacturing sectors. The agro-processing industries are Farmers Choice Ltd, Kenchic Co. Ltd, Brookside Dairies, Githunguri Dairies, Ndumberi Dairies, Limuru Milk and Palmside Dairies, among others. Thika Sub-County has more than 58 industries which include Bidco Oil Industries, Thika Motor Vehicle dealers, Thika Pharmaceutical Manufacturers Limited, Devki Steel Mills, Broadway Bakeries, Kenblest Industry, Kel Chemicals, Thika Rubber Industries Limited, Macadamia Nuts, Campwell Industry and Kenya Tanning Extracts Limited. In Ruiru Sub County, the major industries include Clay Works as well as Spinners and Spinners while the Bata Shoe Factory is located in Limuru Sub County. *Implementation of the proposed project is a big boost to the industrial sector.*

iv. **Types and number of businesses**

The county has all types of businesses which include mega stores, large traders, transport operators, financial services providers, among others. The total number of registered business is estimated at 72,000. Thika Sub County has the highest number of registered businesses estimated at 10,000 whereas Gatundu North Sub County has the minimum number estimated at 1,199. Mega stores, large traders and petrol filling stations are estimated at 63, 5,348, and 219 respectively. Registered financial service providers are estimated at more than 560.

4.9 Solid waste management facilities

The main solid waste management facilities in the county include landfills, dumpsites, incinerators, recycling facilities and bio-decomposers. There is one landfill in Kangoki which is a pilot project, Gatuanyaga Asbestos disposal site, six dumpsites in Gatundu South, Kiambu, Ruiru, Gacharage, Limuru and Githunguri. There are eight incinerators for girls' secondary schools (Demonte-fort), Lang'ata Hospital in Githurai and Thika Level 5 Hospital. The recycling facilities include; two Taka Taka solutions (composting facility) in Kiambaa Sub-County and three Alternative Energy Solutions Limited (AESL) - Pyrolysis plant in Thika Sub-County. There is also a bio decomposer in Kangoki composting facility which is a pilot project in Thika. *If the proposed project is given a go ahead then Kiambu will be advantaged as they will have an aluminium recycling plant in place.*

4.10 Water and Sanitation

Kiambu County has both surface and ground water resources. It has sixteen permanent rivers. The major rivers are Ndarugũ, Thiririka, Ruiru, Kamiti and Kiu, draining into Athi River. The five major wetlands are Kikuyu, Lari, Theta, Kiganjo and Gacii wetlands. The eastern part of the county has surface water from Chania, Thika, Karimenu, Ruabora, Ndarugu, Thiririka, Theta, Mukuyu, Ruiru rivers. The western part of the county relies on underground water sources like boreholes. Kiambu County is in a sub catchment that has two main aquifers; the Nairobi Suite and Basement Athi Suite. The county falls within the Upper Athi Catchment Area covering seven Sub-Catchments. Kiambu County has a total of eight main licensed water management institutions. 46% of the populations in the county are not currently served by Water Service Providers (WSPs) instead they are served by Community Based Organizations (CBOs), private water operators and direct abstraction from surface and ground water sources. The county has 16 permanent rivers. The shortest distance covered is less than a kilometre while the largest in about 2.5 kilometres. In Gatundu North, Gatundu South, Limuru, Lari, Githunguri and Kiambaa sub counties, the distance is approximately 2 kilometers. In Juja, Thika and Ruiru sub counties the distance to the nearest water point is less than a kilometre. In Kiambu and Kabete sub counties the distance is approximately 1.5 kilometers while Kikuyu records the longest distance of about 2.5 kilometers. *The proponent will rely on water from an existing borehole throughout the project cycle.*

i. **Sanitation**

There are twelve main urban centres within the county out which five; Thika, Kiambu, Limuru, Ruiru and Juja urban centres have convectional sewer treatment system. A substantial number of the developing centres within the county are not served by the sewer system. The urban and peri-urban areas which are not served by the sewerage network use septic tanks as an alternative mode of sanitation. Garbage collection and disposal around the urban centres within the county of Kiambu is at 75%. The average number of residents in a household is 5 persons/household, with an average daily waste discharge of 0.53 to 0.65kg/person/day (JICA, 2010). Seventy-two (72) private firms and 26 registered youth group compliment Kiambu county government in waste collection. A pyrolysis plant for recycling plastic waste is in place at Thika Sub County. Public sanitation facilities include one in Juja sub county, two in Gatundu South sub county, two in Lari sub county, three in Ruiru sub county, four in Gatundu North sub county, three in Githunguri sub county, five in Kiambu sub county, three in Kiambaa sub county, four in Limuru sub county, six in Kikuyu sub county, five in Kabete sub county and twenty-one in Thika sub county. *Waste water from the proposed plant shall be channelled into an existing septic tank while solid waste that cannot be recycled shall be collected and disposed of by a licensed waste handler.*

4.11 Health Access and Nutrition

The county has 505 health facilities; 108 are public health facilities (70 Dispensaries offering Level 2 Services; 24 Health Centres providing Level 3 Services; 11 Hospitals providing Level 4 Services; and, 3 Hospitals offering Level 5 Services), 64 are faith-based health facilities and 333 are private health facilities. The average distance to the health facilities is 7kms. The total number of health workers in the county is 2,652. The doctor/population ratio is 1:6667, while the nurse population ratio is at 1;1110. The common illnesses affecting the residents are mainly communicable diseases. The top five causes of morbidity in the year 2016 include: Respiratory diseases with 1,006,395 hospital cases, disease of the skin with 190,576 cases, diarrhoea

disease with 140,493 cases, urinary tract infection with 101,120 cases, and hypertension with 82,882 cases. The county stunting level according to KHDS (2014) is at 15.7%, wasting at 2.3% and underweight at 5.1%, against the national stunting level which is at26%, wasting at 4%, and underweight is at 11%. The projected global 2025 targets are to reduce stunting by 40%, reduce and maintain childhood wasting to less than 5%, reduce low birth weight by 30% and to ensure that there is no increase in childhood overweight.

In 2016, the county had immunization coverage of 89% (51,419). Facility based maternal mortality ratio in the county stand at 78/100,000 live births. In 2016, there were 36 maternal deaths reported in the health facilities. Haemorrhage and hypertensive disorders during pregnancy are the major causes of maternal mortality. Total number of skilled deliveries in 2016 were 62,476 mothers, while in the last 10 months, 57,580 skilled deliveries were conducted. Skilled delivery in the county is at 88.5%. The county has a Contraceptive Prevalence Rate (CPR) of 74%, higher than the national CPR of 58% with a total fertility rate of 2.7, which is among the lowest in the country (KDHS, 2014). The county is ranked among the 18 high burden counties with a prevalence rate of 5.6 % according to the HIV estimates released in 2016. *The proponent is advised to have an emergency contact number for the nearest hospital. This will help in referring of emergency cases.*

CHAPTER FIVE

POTENTIAL ENVIRONMENTAL IMPACTS

This chapter focuses on the potential positive and negative impacts that will arise from the implementation of the proposed project in the proposed area. Some impact mitigation has already been proactively addressed in the design while others will be undertaken through incorporation in the implementation of the project and guided by the Environmental Management Plan developed under this report.

The environmental impacts will be felt during the two major project phases namely:

i. Operation and,
ii. Decommissioning.

5.1 Potential positive impacts

i. **Creation of employment opportunities:** The project will need skilled and unskilled personnel. These opportunities will go to people around the project area. Additionally, scrap metal dealers will get more market for their aluminum materials and thus indirectly contributing to improvement of people's livelihood.

ii. **Increased lifecycle of Materials.** Sustainable Development Goal 12 aims at achieving Responsible Consumption and Production. Responsible consumption ensures raw materials and finished goods are maintained in circulation for as much time as possible. This can also be termed as green production and consumption which saves on water and energy needed for extraction and processing of mineral ores from their natural existence to raw materials and finished goods. Operating a recycling plant ensures there is circular flow of materials and thus non-renewable natural resources are conserved while creating green jobs and cheaper commodities to consumers.

iii. **Reliable Supply of Raw Materials**. Hydro- Aluminum Ltd, a sister company to Hydro Water wells Ltd will get reliable supply of aluminum billets which is her chief raw material for their activities. This supply will mean lesser carbon emissions for supply of raw materials from distant suppliers will be significantly dropped.

iv. **Economic growth and increase in country's gross domestic product:** This will be attained through remitted revenue generated from taxes, permits, approvals, and licenses. The multiplier effect of the project's economic contribution will be felt across all sectors of development including healthcare, education, infrastructural development, among others, important in helping the country attain its goals as envisaged in its long-term development blue print of Vision 2030 under the Social and Economic Pillars which intends to ensure that the country is industrialized by the year 2030. It will also play a vital role in revenue generation contributing immensely towards industrialization and infrastructural development in the housing sector.

v. **Driving Big 4 Agenda:** The activities of the project will be feeding into government's big 4 agendas by encouraging local manufacturing industry. Although recycling will do this indirectly its contribution cannot be ignored. Aluminum products produced will be used in various industries in Kenya, including the highest consumer of aluminum products; the construction industry.

vi. **Promotion of industrial and manufacturing sector growth:** The implementation of the proposed development project will contribute immensely towards industrial and manufacturing sector growth, a key objective in the country's Vision 2030 Economic Pillar's target of having the country attain the industrialized nation status by 2030 as well as have modern world class infrastructural facilities. This is aimed at promoting industrial infrastructure development as well as participation and performance in manufacturing activities. It is also aimed at creating industrial competitiveness in the country to ensure that quality is guaranteed. The proposed aluminium recycling factory will ensure that aluminium products' consumers have a variety of quality aluminium products from which to choose from in the country.

vii. **Promotion of infrastructural development:** Implementation of the project will result in improvement

of such infrastructures as industrial facilities, access roads, pavements, drainage systems, sewer systems, energy services (provision of electricity), water supply, vehicle parking slots, and tarmacked roads, among other infrastructures. These will be achieved through the county and national government initiatives through the remitted revenues and taxes allocated for the development purposes or through the project proponent's initiative.

viii. **Dissemination of advanced technology and technical knowhow and skills:** During the operation phase, the local staff will be trained in the technology, the management philosophy training. Their local staff skills will improve, and the local Kenyan industry promoted boosting local people's technical knowhow and skills in the process.

ix. **Economic utilization of idle space (land) (optimal land use):** The development will ensure that the currently unoccupied space (proposed site) is put into economic use for maximum economic returns.

5.2 Potential negative impacts

5.2.1 Flora and fauna

During operation and decommissioning, there are no anticipated negative impacts on flora and fauna from the project. The plant is a relatively small unit within an existing developed premise, Hydro Water Well (K) Limited. The area where the recycling unit will be installed does not have any vegetation that will be disturbed.

5.2.2 Water pollution

The possible ways in which the proposed project can pollute surface and ground water resources is through improper release of coolant water to the environment. Carbon Filtration Chamber will also contain some water that has potential to pollute the environment if improperly handled. However, these aspects have been addressed in the following ways:

i. Water for Aluminum cooling will be circulating in a closed system. From the reservoir to the recycling plant and back. The reservoir is cemented such that no water seeps will occur at any time.

ii. The proponent will be carrying out periodical water quality monitoring for the water in the reservoir to note any change in water quality parameters and be able to address them accordingly.

iii. At the Filtration chamber, CO_2 and other gases will be trapped. The filtration unit will be about one third filled with water. Which will be approximately ten litres. This water will be changed every three (3) months. Water analysis shall be carried out before it is disposed into the environment. In the event that the water parameters are above the recommended limits, it shall be disposed as per the law (water quality regulation 2006).

iv. There is no likelihood that the operations will directly release any pollutants to the storm water/storm drains during rains since the plant is fully enclosed in a roofed area.

5.2.3 Soil pollution

The recycling plant will be installed on a cabro paved surface. This means that there is minimal direct interaction between contents from plant operations and the top soil. The plant will be entirely handling solid substances, thus by any chance there is spillage, it can be scooped before much damage to the soil happens. By fact that the plant will be handling entirely aluminum rejects and pieces, chances of any top soil pollution are insignificant and not anticipated.

5.2.4 Oil spillage

The plant will be running on industrial diesel which will be stocked on a storage tank within the premises. In case of tank bursting, the content can cause environmental damage. However, the storage tank is made of a sound material and elevated on stable structures (***See photo 2***). *In an event that a leakage occurs, the proponent should notify the authority immediately and clean the area as required by law.*

5.2.5 Solid waste

The plant is geared toward realizing a zero solid waste generation. It will be practical since all raw materials will be supplied ready for use and aluminum oxide removed from the top oxidized layer of molten aluminum metal, known as dross will be recovered and returned to the furnace for further recycling. *Solid waste from the offices shall be disposed of by a licensed waste handler*.

5.2.6 Air quality

The plant will have a chimney that will be releasing gases into the atmosphere at a height of 16 metres. Before the gases are released into the atmosphere, they will be passed through gas filtration chamber. Carbon dioxide and other soluble gases will be trapped in the water at the filtration; thus, no toxic gases are released to the atmosphere. *Air quality monitoring is advised throughout the project cycle.*

5.2.7 Occupational safety & health issues

Operation of this plant is expected to pose potential health and safety risks to the workers. The plant will be operated by six people. This is the number of people directly exposed to hazards from the plant. The main issues of concern from the plant in terms of safety are:

i. Plant/machinery safety.
ii. Chemical safety.
iii. Noise.
iv. Air quality.

The proponent will ensure maximal safety of the employees by i) carrying out periodical occupational safety & health risk assessments, ii) annual occupational safety & health audits, occupational noise level survey and air quality monitoring. All plant operators shall be qualified persons and will be provided with appropriate Personal Protective Equipment (PPE). The area between the holding furnace and casting pit will be guarded to prevent employees from coming in contact with molten aluminum.

5.2.8 Noise and vibration

i. **Deterioration in ambient noise quality**

High noise levels are not anticipated during operation. A noise survey will be undertaken to determine noise exposure levels and take measures which shall include the following.

Mitigation measures

The company will put in a place a noise control program that will involve among others,

i. Provision of ear muffs and ear plugs to exposed workers.
ii. Annual audiometric test.
iii. Education and training.
iv. Engineering noise control – maintenance.
v. Posting warning signage.

During decommissioning phase, sources of noise will be mainly machinery and vehicles used in the process and removal of the materials from the site.

Mitigation

i. Follow the rules and regulations set out in the relevant codes of practice and instructions contained in the Environmental Management Plan (EMP).
ii. Use of protective equipment by workers at the site including ear protectors.
iii. Proper maintenance of plant and equipment used in operation at the site.

Decommissioning

The proponent will ensure that the machinery and vehicles used during demolition comply with Noise Quality Standards. Noise from the activities of the project is unlikely to cause a nuisance at the nearest residence due to their location far away from the facility, provided that operations are limited to daytime.

5.2.9 Waste water

This will be sewage waste from toilet. The water used for cooling in extrusion machine is recycled back. The site area is not sewered but has a septic tank for proper effluent waste management.

The proponent should

i. Ensure regular exhaustion of the septic tank by an approved and licensed exhauster.

ii. Install an onsite waste water treatment plant or a biological septic tank- biodigester.
iii. Ensure resultant water from treatment plant undergo water quality analysis before its discharged in to the environment or can be re used in toilets or watering environment among others.

CHAPTER SIX

PUBLIC CONSULTATION AND PARTICIPATION

6.1 Principles of public consultation and participation

Article 69(1) of the Constitution of Kenya 2010 states that the State shall encourage public consultation and participation in the management, protection, and conservation of the environment. In Kenya the willingness of developers to engage with the public and vice versa is often limited by concerns over costs and the need for confidentiality. Involving the public is also seen as time consuming.

The Association of Accredited Public Policy Advocates to the European Union published operational Principles of successful public participation. These principles include:

1. **Initiated early and sustained**

The public should be involved early (before major decisions are made) and regularly in the process. This builds trust among participants, gives more time for public participation, improves community analysis, improves screening and scoping of the process, increases opportunities to modify the proposal in regards to the comments and opinions gathered during the public participation process, reduces the risk of rumors, and improves the public image of the proponent. It can also give the regulator more confidence in the approval decision they must make.

2. **Well planned and focused on negotiable issues**

All stakeholders should know the aims, rules, organization, procedure and expected outcomes of the public participation process undertaken. This will improve the credibility of the process for all involved. Because consensus is not always feasible, public participation should emphasize understanding and respect for the values and interests of participants, and focus on negotiable issues relevant to decision making.

3. **Supportive to participants**

The public should be supported in their will to participate through an adequate diffusion of information on the proposal and on the public participation process, and a just and equitable access to funding or financial assistance. Capacity-building, facilitation and assistance should also be provided particularly for groups who don't have the capacity to participate, and in regions where there is no culture of public participation, or where local culture may inhibit public participation.

4. **Tiered and optimized**

A public participation programme should occur at the most appropriate level of decision- making (e.g., at the policy, plan, programme or project level) for a proposal. The public should be invited to participate regularly, with emphasis on appropriate time for involvement. Because public participation is resource consuming (human, financial, time) for all stakeholders, public participation optimization in time and space will ensure more willing participation.

5. **Open and transparent**

People who are affected by a proposal and are interested in participating, whatever their ethnic origin, gender and income, should have access to all relevant information. This information should be accessible to laypersons required for the evaluation of a proposal (e.g., terms of reference, report and summary). Laypersons should be able to participate in relevant workshops, meetings and hearings related to the process. Information and facilitation for such participation should be provided.

6. **Context-oriented**

Because many communities have their own formal and informal rules for public access to resources, conflict resolution and governance, public participation should be adapted to the social organization of the impacted communities, including the cultural, social, economic and political dimensions. This shows respect for the affected community and may improve public confidence of the process and its outcomes.

7. **Credible and rigorous**

Public participation should adhere to established ethics, professional behavior and moral obligations. Facilitation of public consultation and participation by a neutral facilitator in its formal or traditional sense

improves impartiality of the process as well as justice and equity in the right to information. It also increases the confidence of the public to express their opinions and also to reduce tensions, the risk of conflicts among participants, and opportunities for corruption. In a formal context, the adoption of a code of ethics is encouraged.

During public consultation and participation for this study all these principles were taken into account and results are presented in this section.

6.2 Scope of public consultation and participation

The geographical extent of the people involved in public consultation and participation are those within one (1) kilometer diameter in the project area. This is due to the nature of the project activities which will hardly affect stakeholders who are not very adjacent to the project. The exercises were aimed at determining the views of the community on potential impacts of the projects to them. The following are the key stakeholders: business owners/tenants of Hydro Business Park Juja Pulp & Paper Limited, Cura Complex Tenants, Area MCA, Area Chief and residents around Hydro Business Park.

6.3 Objectives of public consultation and participation

The specific objectives of public consultation and participation were:

1. To create awareness on the proposed project.
2. To ask the local residents especially the interested and affected parties about the problems they anticipate with the project and how these can be overcome or addressed.
3. To provide an opportunity to the community to raise issues and concerns pertaining to the project and environment, and allow the identification of alternatives and recommendations.

6.4 Materials and methods

Data gathering was done through use of questionnaires, formal public meeting and interviews with the relevant stakeholders.

6.5 Findings and discussions

During and after public consultation and participation, it was noted that no serious negative issues are anticipated from the implementation of the project. All stakeholders were seen to welcome the project because of the benefits it is projected to bring in the proposed location. All raised concerns are well elaborated in the attached minutes and they have been adequately addressed in the proposed EMP.

Photo 4: Showing the environmental expert addressing meeting attendants during the public consultation and participation meeting.

Photo 5: Discussion (question and answer) session involving the meeting attendants (the project stakeholders) and the environmental expert during the public consultation and participation meeting.

Photo 6: Showing public consultation and participation meeting in progress.

CHAPTER SEVEN

ASSESSMENT OF PROJECT ALTERNATIVES

7.1 Alternatives to site

The current proposed location is on an already developed plot that underwent through the required approvals. Other feasible locations will be procuring of a piece of land near the proponents' other facilities around Juja. For development to occur in such area, a lot of ecological disturbance by clearance of vegetation will happen.

In the current location supply of water for the project processes is catered for by rainwater harvesting from the go down roofs as well as an existing borehole. Relocating the project will mean the proponent has to seek connection to the county water services which can strain the water services supplier during low water level situations –this also implies that the proponent has to procure another parcel of land and undergo all other approval processes which are quite costly

7.2 Alternatives to technology

Aluminium metal extraction relies on Hall-Heroult (HH) electrolytic process and technology, where an electric current is passed between two electrodes to electrolytically reduce alumina [which is dissolved in cryolite] to aluminum metal. However, this process entails high energy consumption, high perfluorocarbons and greenhouse gases emission. The alternative technological processes for aluminium extraction however exist and include the direct carbothermic reduction of alumina which provides an alternative production route with less energy consumption and lower total greenhouse gas emissions than Hall-Heroult (HH) estimated at least 30% less than those from electrolytic cells (Cochran and Fitzgerald, 1981). Another alternative technological process that ensures for low energy consumption and greenhouse gas emissions is Indirect Carbothermal reduction route. It includes at least two stages, stage one (1), where aluminium is reduced to an intermediate compound by carbothermal reduction, and stage two (2) involving mainly extraction of aluminium from the intermediate compound. Since aluminium extraction has high energy demand and results in high emission of greenhouse gases, these alternative technological processes are the best. However, for large scale commercial purposes, they are not viable due to their high temperature requirement, and low yield resulting from the formation of aluminum carbide and oxycarbides.

The Hall-Heroult process generates solid and gaseous fluorides, as well as CO_2 emissions. All smelters use scrubbing systems to treat the off-gases. Dry scrubbers designed to put the gases in contact with alumina in dispersed phase or fluidized bed reactors, are the preferred technology because unreacted alumina is used to capture hydrogen fluoride and electrolyte compounds that can be returned to the cell. Elemental impurities (e.g., fluorine, vanadium, lithium, iron, phosphorus, and nickel) concentrated in the scrubber alumina are subsequently returned to the cell. Once in the cell, iron reduces metal quality, phosphorus reduces current efficiency, and vanadium reduces both. However, better separation technologies for removing iron, phosphorous, and vanadium from the scrubber alumina are required. The best alternative separation technology is ceramic foam filters which removes impurities from molten metal.

7.3 Alternatives to materials & machinery

Plastic and glass remain the best alternative materials to aluminum materials. Aluminium has a larger footprint in production because of the vast power needed in the smelting process and the higher percentage of greenhouse gas emissions it produces. The cost of producing and recycling it aluminium is very high. As such aluminium free alternatives can offer a significant reduction in the carbon footprint of the material as well as the recycling cost, which in turn can be healthy for our planet.

However, aluminium has on average 68% recycled content compared to just 3% for plastic. Additionally,

recycling plastic is more complex resulting in degradation. It also has lower reuse rates than aluminium which has been heralded as a greener alternative. Aluminium is an environmentally friendly material with undisputed recyclable credentials. It retains its properties throughout its life span which is essentially indefinite. Its longevity and main attribute as the most common natural metal in the earth's surface that has long been used in everyday life for everything from soda cans to construction beams only makes it the most viable option. Therefore, its versatile nature makes it the most viable alternative to single-use plastic, which has become one of the world's most detested environmental pollutants. Other alternatives relating to carbon anodes should focus on no-consumable inert materials with the required current conducting properties that are capable of withstanding the aggressive environment in the cell (note that this may lead to a greater consumption of electricity).

Equipment and machines that use energy and water efficiently will be given first priority without compromising on cost or availability factors.

7.4 No project alternative

This means that the status quo remains and the proponent will have to contend with the land being underutilized. This will also require the proponent to abandon the proposed project and choose a new project for implementation which will involve fresh surveys, studies, designing, planning, acquisition of various project affiliated approvals, a costly and time-consuming venture as opposed to implementing the proposed development project on the identified existing site. As a result, there will be loss of anticipated project benefits to the proponent, local communities, local community members, county government, the country and other key project stakeholders. This option is the most suitable alternative from the extreme environmental perspective as it ensures non-interference with the existing conditions which is not the case for the proposed development project.

Socio-economically, this means that the proponent will not utilize the land for the purpose it was intended for leaving the property idle. Additionally, this will discourage potential investors and donors in the sector; there will be no employment opportunities; local skills in the sector will remain under-utilized; development of infrastructural facilities (industrial infrastructures, roads, energy facilities, electrical, etc.) will not take place; and finally, Vision 2030 will not be achieved since the Economic Pillar remains one of the key areas important for it to gear the nation towards the realization of its agenda, industrialization and manufacturing growth. With the ever-growing demand for aluminum materials for industrial use exerting pressure on the available aluminum products in the market, the development is key in ensuring that the available gap and need in demand is met. Additionally, the developer is investing in solid waste management which has been a major challenge in Kenya by recycling aluminum offcuts and scrap materials from aluminum products. This therefore makes the proposed project viable and with no alternative. In order to encourage future developments and investment in the industrial and manufacturing sector, the project should be allowed to be implemented in accordance with the drafted ESMMP, set rules and regulations. Not implementing the proposed project will imply that all project stakeholders forego the benefits associated with it which is in bad taste for the project investor, industrial and manufacturing sector, and the economy in general.

7.5 Analysis of project alternatives

The proposed development project is perfectly compatible with the land use in the area. The site an industrial park in an existing godown categorized under light industrial zone, a land use zonation under which the proposed project falls. It neighbours other warehouses within the godown, residential and agricultural land use activities in the area. The project proponent has in possession all the documentations required to implement the project within Kiambu County. As such, the proposed project option is the most suitable both from situational, locational, technological, environmental, social, and economic perspectives for implementation. The socio-economic and environmental benefits of the project through sustainable industrial and manufacturing sector growth by far outweighs the minimal mitigatable negative impacts associated with it.

7.5 Waste water management alternatives

Five locally available technologies are discussed below:-

7.5.1 Alternative one: *Waste water treatment plant*

This involves the construction of a plant that will enable the recycling of the waste water from the project activities to reusable standards and utilized within the site in activities such as irrigating the flower gardens and flushing of the toilets. It is usually expensive to construct and maintain, but it is the most reliable, efficient and cost-effective in the long term. *This is the most preferred option for such projects because of its benefits but the space available cannot accommodate it. More so the area is leased.*

7.5.2 Alternative two: *Use of stabilization ponds/lagoons*

This refers to the use of a series of ponds/lagoons that allow several biological processes to take place, before the water is released back to the river. The lagoons can be used for aquaculture purposes and irrigation. However, they occupy a lot of space but are less costly. No chemicals are used/heavy metals sink and decomposition processes take place. They are usually a nuisance to the public because of smell from the lagoons/ponds. *This option is not preferable in the area because the required space is not only available, but the local community are not likely to accept the option.*

7.5.3 Alternative Three: *Use of Constructed/Artificial wetland*

This is one of the powerful tools/methods used in raising the quality of life and health standards of local communities in developing countries. Constructed wetland plants act as filters for toxins. The advantages of the system are the simple technology, low capital and maintenance costs required. However, they require space and a longer time to function. Long term studies on plant species on the site will also be required to avoid weed biological behavioral problems. *Hence it is not the best alternative for this kind of project*

7.5.4 Alternative Four: *Use of septic tank*

This involves the construction of underground concrete-made tanks to store the sludge with soak away pits. It is however, expensive to construct, and septic tanks demand regular emptying.

7.5.5 Alternative Five: *Connection to the existing sewer system*

Connection to the sewer system will solve the waste water management issue, and is usually the most cost-effective option. This can only apply in an area served with a sewer line

In conclusion, the recommended course of action for this site would be connection into an existing septic tank.

7.6 Solid waste management alternatives

Minimal solid wastes will be generated from the proposed project throughout its cycle. An integrated solid waste management system is recommendable.

a) The proponent shall give priority to Waste Reduction at Source of the materials. This option will demand a solid waste management awareness programme in the management and the residents.
b) Secondly, Recycling, Reuse and composting of the waste. This calls for at source separation programme to be put in place. The recyclables will be sold to waste buyers within Kiambu or donated.
c) The third priority in the hierarchy of options is combustion of the wastes that are not recyclable (This is highly prohibited)
d) Finally, sanitary land filling will be the last option for the proponent to consider. This should be undertaken by a registered and licensed waste handler.

CHAPTER EIGHT

ENVIRONMENTAL MANAGEMENT PLAN

8.1 Rationale of Environmental and Social Management Plan

This section discusses the Environmental Management Plan (EMP) for the proposed project.

Importance of EMP:

i. Serves as a commitment and reference for the proponent to implement the EMP including conditions of approval from NEMA.
ii. Serves as a guiding document for the environmental and social monitoring activities for the project parties.
iii. Provides detailed specifications for the management and mitigation of activities that have the potential to impact negatively on the environment and social wellbeing of the community.
iv. Provides instructions to relevant Project personnel regarding procedures for protecting the environment and minimizing environmental effects.
v. Documents environmental concerns and appropriate protection measures; while ensuring that corrective actions are completed in a timely manner.

8.2 Management responsibilities and accountability

The management of the proponent is responsible for making sure the mitigation measures proposed herein are adhered to as they will be the basis for establishing environmental performance during the annual environmental auditing exercises.

The management is advised to take necessary measures to ensure all significant environmental incidences are reported within the stipulated timelines.

8.3 Environmental impacts management hierarchy

The proponent will follow the following hierarchical environmental and social impacts management steps during the project life cycle.

Table 3: Showing hierarchical environmental and social impacts management steps during the project life cycle.

Approach	**Description**
Avoidance	Avoiding activities that could result in adverse impacts and/ or resources or areas considered highly sensitive.
Prevention	Preventing the occurrence of negative environmental impacts and/ or preventing such an occurrence having negative impacts.
Minimization	Limiting or reducing the degree, extent, magnitude or duration of adverse impacts through scaling down, relocating, redesigning and or realigning elements of the project.
Mitigation	Measures taken to minimize adverse impacts on the environment.
Enhancement	Magnifying and/ or improving the positive effects or benefits of a project.
Rehabilitation	Repairing affected resources.
Restoration	Restoring affected resources to an earlier (possibly more stable and Productive) state, typically "background or 'pristine' condition.

8.4 Decommissioning phase

At the end of the project cycle, the proponent will follow the following chart to ensure there is minimal environmental disturbance.

Table 4: Steps in decommissioning phase.

Step	Actions	Responsibility
Step 1: Initiation	Prepare worksheets for decommissioning activities Checklists for references, and guiding legal and regulatory frameworks	Proponent
Step 2: Prepare Decommissioning Design	Conduct design review to validate elements of the design and ensure design features are incorporated in the decommissioning design. Conduct Public consultations	Proponent
Step 3: Conduct ESIA	To determine Environmental Impacts and propose appropriate mitigation measures	Proponent
Step 4: Award Responsibilities	If the proponent will do it or award contract if the proponent will contract the decommissioning activities	Proponent
Step 5: Execute Demolitions	The entity doing the decommissioning to start the activities as per the designs	Proponent
Step 6: Commission ESMP	Carry out the necessary rehabilitation works	Proponent
Step 7 Tackle Non-Compliance	Identify and analyze the root causes of non-compliance. Propose corrective measure. Propose future preventive measures.	Proponent

Summary of Environment Management Plan

Table 5: Summary of the environment management & monitoring plan.

Aspect	Identified Impact	Specific Mitigation Measures	Performance indicators	Timeline	Responsibility	Cost estimate (Kshs.)
Increased solid waste generation	• Scrap metal brought by dealers. • General refuse.	• Create awareness on solid waste management -to all workers and visitors, through regular talks and signage. • Assign a person to be in charge of ensuring the scrap metal brought or that which cannot be recycled is kept in one place awaiting disposal. • Strategically position collection bins/ receptacles within the project site as collection centers. • Proper waste segregation and separation. • Contract a licensed waste handler to collect solid wastes. • Adopt the 3R waste management approach, that is	• Clean workplace free from solid waste lying around. • Copies of contractual agreements with licensed waste handlers. • Adequate waste receptacles. • Waste management plan in place. • Color coded waste segregation bins installed and labelled for waste disposal.	During project operation.	Plant manager-Hydro Water Well (K) Limited	**50,000 per month for waste handlers.** **1000 per bin.**

		(reduce, reuse and recycle) whereby waste shall be segregated – plastics, glass, tins, papers, wood, metals etc. (later to be re-used or recycled). • Avail color coded waste bins for source waste sorting at the project site.				
Surface drainage, wastewater and water pollution/ contamination	• Underground and surface water pollution	• Ensure that hazardous materials are handled and stored in a good manner, to limit their movement into the environment. • Trenching during plumping works should not interfere with the existing drainage channels. • Ensure that open stockpiles of materials are covered with tarpaulin or similar fabric during rainy season. • Stockpile of construction materials	• Drainage channels free from solid wastes. • Zero or minimal siltation in nearby water bodies/drainage systems. • Unobstructed drainage channels. • Zero incidences of flooding.	• During all project phases	• Contractor • Hydro Water Well (K) Limited • EHS officer	**80,000**

		i.e., sand, ballast, stones etc. be placed away from drainage system. • Clear any blocked drainage channels. • Clear all soil residues/debris after trenching works. • Provide containments to used oils. • Construct a bund wall to the generator set room (if any). • Install grease trap or oil water separator. • Establish drainage channels to ensure that surface runoff do not mix with effluent from the sanitary facilities. • Wastewater shall be managed through proper disposal into the existing septic tank. Regular analysis of waste water before discharge into the environment				

Increased energy demand	• Energy pollution • increased energy bills	• Ensure Kenya power supply line and substation for the area has sufficient spare capacity. • Provide alternative sources of power such as solar and generator. • Acquire clearance and permits from service providers. • Conduct energy use audits. • Employ energy saving methods and initiatives at the project site. • Adopt clean renewable energy sources.	• Energy saving initiatives in place.	• During project operation	• Contractor • Hydro Water Well (K) Limited	**200,000**
Water use and increasing demand	• Increased strain on available water sources and infrastructures.	• During operation phase, use water economically to avoid wastage. • Conduct regular audits of water systems to identify and rectify any possible water leakages.	• Water meters installed. • Leak free taps.	• During all project phases	• Hydro Water Well (K) Limited • Project contractor	**10,000**

		• Used water can be sprinkled on the dusty surfaces to reduce dust emissions. • Provide additional source of water to reduce pressure on the existing water source. E.g., through rainfall harvest, • Routine check-ups and monitoring of the drainage system to avoid leakages and blockages. • Construction of separate storm water and waste water drain. • Install water saving devices e.g., dual flush toilets, automatic shut-off taps, etc.				
Health and safety **Public and OSH concerns & fire safety**	• High noise levels from plant operation activities. • High temperatures near the plant	• Avail a well-stocked first aid kit on site. • Nominate an Environment, Health and Safety officer to oversee all project activities. • Provide appropriate	• Occupational injury and illness incidents records. • Medical examination records. • Audit report records.	During operations. Annually for the audits, drills, and medical examination.	Hydro Water Well (K) Limited	**300,000 for undertaking all the OSHA activities** **120,000 for policy, training and**

	area. • Accidents and incidents during operations. • Unsafe electrical connections like direct connections of electrical equipment into the socket without use of appropriate plugs. • Inadequate basic knowledge on how to operate fire extinguisher by workers. • Use of flammable liquids like industrial diesel oil.	personal protective equipment (PPEs) to all site workers. • Ensuring that the operational manuals are available and accessible for every equipment /machinery used at the site. • Proper maintenance of all machinery and equipment. • Regular inspection to identify hazards such as unsafe electrical connections and eliminating them. • Ensuring all electrical equipment and machinery are properly guarded and grounded. • Only properly trained workmen to operate equipment or machinery and proper instructions on their safe operation provided. • Training programmes for temporary staff	• Reduced occupational accidents and illnesses. • Presence of well stocked First aid kit boxes. • Well trained First Aiders. • Stock of PPEs for workers. • OSH Audit Reports by qualified safety advisor. • Elaborate ERP in place. • Adequate safety and informative signage. • Fire policy Fire audit Reports. • Fire drill reports. • Fire marshals training certificates. • Records for inspection of firefighting equipment.	And training every two years.		**fire drill.** **6000 per fire extinguishers.** **The cost of purchasing personal protective equipment may vary.**

		on how to safely handle equipment and machineries. • Install firefighting equipment e.g., Fire extinguishers. • Ensure all workers are conversant with basic fire safety techniques. • Ensure safe electrical installations of possibility exposed wires which can lead to short circuiting. • Provide emergency numbers at strategic points as well as adequate signage on fire action. • Various measures should be taken to reduce possible fire outbreak e.g., warning signs, insulating electric wires exposed, hire electrician to manage electrical works. • Provide containment of hazardous materials such as used	• Presence of a fire assembly point • Availability of work place register			

		oils, paints. • Provide adequate protective gears to all workers. • Adherence to the provisions of Occupational Safety and Health Act of 2007 and the rules formulated under it. • Use signage to warn staff and/ or visitors that are not involved in operation activities. • Restrict non-essential staff from the recycling plant. • Regular supervision of works to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work. • Develop evacuation procedures to handle emergency situations.				

		• Speed controls where necessary within the project site and its environs. • Develop and enforce the health and safety policy. • Conduct annual OSH audit and Noise levels measurement to identify unsafe conditions and give recommendation. • Provision of suitable and adequate PPE. • Undertake Medical examination of workers. • Train health and safety committee, fire safety and first aid. • Examination of hazardous plant and equipment. • Allowing for sufficient ventilation in the plant area.				

Noise and excessive vibration pollution	• High noise level from plant operations.	• Undertaking annual noise survey to monitor levels of noise. • Provide ear protectors to exposed workers. • Engineering controls through regular servicing of equipment. • Conduct annual audiometric test to workers exposed to high noise levels as per recommendation of the noise survey report. • Conduct annual noise survey and implement recommendations. • Limit working hours to daylight hours (8am-5pm). • Erect signage to prohibit unnecessary hooting at the project site. • Ensure that noise & excessive vibration from operation	• Noise survey report. • No noise related complaints received from residents and landholders and workers. • Documentation of repair and replacement of faulty equipment as soon as possible. • Erected of noise prohibitory signage.	During operation.	• Hydro Water Well (K) Limited • OSH advisors/Lead expert • Approved DHP.	**200,000**

		activities are within permissible levels as per the provision of EMCA (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. This includes among others adhering to permissible noise and vibration levels. • Provide PPEs such as ear muffs to the contractors and all staff. • Carry out baseline noise monitoring within the area before, during and after the project works. • Acquire noise and excessive vibrations emission permit from NEMA when undertaking excessive noise and vibration emitting activities.				
Water quality	• Degradation of underground water quality	• Regular checking and maintenance of all plant.	• No evidence of uncontrolled waste (i.e., not in appropriate	Annually for the discharge license.	Hydro Water Well (K) Limited- Project Operations	**10,000 per sample for water quality analysis every**

		• Regular maintenance of water reservoir to ensure no underground seepage happens. • Periodical water quality analysis for water in the reservoir and from filtration chamber. • Apply for an effluent discharge license.	containers) at above ground facilities during inspections. • Effluent Discharge license.	Water analysis every three months.	Manager	**three months.** **100,000 for effluent discharge license.**
Air pollution **Increase in airborne/ air emissions (vehicular exhausts), paint emissions (Volatile Organic Compounds, VOC), and dust emission from aluminium recycling plant.**	• Release of noxious gases from chimney to the atmosphere. • Fumes from workplace operations.	• Dust generated from the access roads to be abated by continuous sprinkling water on the road. • Drivers to minimize speed to at least 10km/hr. • Maintaining all equipment to minimize emissions. • Provision of appropriate personal protective equipment (PPEs) to all site workers. • Turning off equipment and vehicles when not in use for extended	• Stack emission reports. • Minimal complaints from the public visiting the site as well as project neighboring community. • Nil visible particulate matter in the air.	Every year	Hydro Water Well (K) Limited Management in liaison with EIA experts and approved laboratories.	**Ksh 150,000 for stack emission** **And cost for regular maintenance.**

		time periods. • Minimize flue gas production through efficient design to ensure complete combustion. • Averting emission of such pollutants as Carbon (IV) oxide, Carbon (II) oxide, and Sulphur IV oxide through muffling. • All equipment to be maintained in good operating condition to reduce exhaust emissions. • Screen off/cordon off the project site to minimize dust migration to nearby facilities by wind. • Use of PPEs must be enforced. • Avoid open burning of solid wastes during project works. • Regularly service and maintenance of the plant. • Passing of chimney gas through gas filtration and wet scrubbers before				

		releasing it to the atmosphere. • Stack emission measurement. • Provision of adequate ventilation				
Housekeeping	• Slips and falls, due to lack of clear gangways, trip hazards.	• Create clear gangways at the facility. • Close monitoring of workers and continuous sensitization to ensure they maintain good housekeeping.	• Clear walkways that are not obstructed.	Throughout project cycle.	Hydro Water Well (K) Limited- Workshop Manager Workers	**No extra cost**
Irresponsible social behavior, HIV/AIDS prevalence, and drug abuse within the project area	• Disruption of societal cultural and moral fabric.	• Conduct sensitization to the staff and community on drug abuse, irresponsible sexual behaviors, HIV and AIDS, stress management, and voluntary counseling and testing. • Avail condom dispensers at the site to the staff and visitors. • Strengthen advocacy through awareness training in HIV/AIDS	• Number of people tested. • Informative leaflets distributed to workers. • Presence of condom dispenser. • Number of people sensitized • Number of signage erected.	Throughout project cycle	Hydro Water Well (K) Limited Project contractor	**10,000**

		and other Sexually Transmitted Infections to the community members. • Provide counseling and testing for HIV/AIDS. • Prohibit smoking within the project site.				
Social impacts	• Income generating Initiatives: No directly negative impact to income generation on the area. • Positively affecting the local social and economy. • Social and cultural Issues: Social nuisance from pollution to physical environment such as land and air by emissions from the site.	• Establish a public relation strategy with the neighborhood for enhanced co-existence. • Undertake statutory annual environmental audit for continuous improvement on social issues. • Enhance monitoring system on social concerns. • Maintain efficiency in the emission reduction point sources and minimize external effects.	• Complaints from neighborhood. • Concerns from environmental authorities and local municipal council.	Throughout project cycle.	Hydro Water Well (K) Limited	**No direct cost involved**

	• Social complaints and concerns on health and safety, cultural intrusion from employee intrusion.					
Compliance	• Compliance aspects.	• Develop an environmental policy. • Establish a legal register on critical relevant environmental laws. • Annual environmental audits as required by law. • Develop Standard Operation Procedures focusing on environment, health and safety.	• A facility to ensure compliance with laid down procedural guidelines at all times.	Throughout project cycle	Hydro Water Well (K) Limited	**100,000 for the Environmental audit**

Environmental and social Impacts	Action required	Responsibility	Cost
Generation of solid waste	▪ All solid waste to be collected at a central location and stored temporarily until removal by a licensed solid waste handler; ▪ Adopt the method of selective demolition as far as practicable to enable the removal of wastes of the same category one at a time thus facilitating recycling of wastes for beneficial reuse and minimizing the burden on dumpsites; ▪ No dumping within the surrounding area is to be permitted. Where potentially hazardous substances are being disposed of, a chain of custody document should be kept with the environmental register as proof of final disposal; ▪ General waste is to be collected either by the County Government or via a licensed waste disposal contractor. ▪ Waste generated at the site should be categorized by the contractor and disposed of in a suitable manner into different waste streams (including general and hazardous waste). Wherever possible recycling should be done	Contractor	As per budget
Noise and excess vibrations	▪ Use modern equipment, which produces the least noise. Any unavoidably noisy equipment should be identified and located in an area where it has least impact; ▪ Demolition machinery shall be kept in good condition e.g. greasing to reduce noise generation from friction of movable parts; ▪ Obtain special permit from NEMA to undertake demolitions works; ▪ Ensure that noise & excessive vibration from demolition activities are within permissible levels as per the provision of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. This includes among others adhering to permissible noise and vibration level	Contactor	As per budget

Environmental and social Impacts	Action required	Responsibility	Cost
Safety and Health risks	▪ Decommissioning workers should be issued with appropriate PPEs and the decommissioning contractor to enforce their use; ▪ Restrict onlookers/scavengers from site; ▪ Develop safe work procedures for demolition works.	Contractor	As per budget
Land degradation	▪ Ensure that the ground is levelled and landscaping done using indigenous plants	Owner of the premises	As per budget

CHAPTER NINE

CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

From the assessment, the EIA experts concludes that the proposed aluminum recycling plant in Juja Sub-County is appropriate. This conclusion has been made in terms of environmental impact, site selection, public health and public participation. By using a multi-criterion assessment model for economic, social, public health and environmental effects, this study indicates the proposed plant has taken much consideration of the local residents' health and environment. This study further concludes that public participation is a necessary condition for improving the environmental impact assessment and increasing total welfare of different interest groups in Juja. This study finally offers some corresponding recommendations for improving the environmental impact assessment and enhancing the benefits of the proposed aluminium recycling plant. The ESIA report for the proposed project has revealed that only significant issues is from the perspective of:

i. Pollutant emissions, disposal (management) of fly and bottom ash, which causes serious pollution to the environment and is a threat to public interests and public health;
ii. Technology used in the furnace; the older generations are often much more dangerous to public health. More advanced furnace has flue gas cleaning systems to reduce the air pollution.
iii. Enhancement of the Circular Economy in Kenya through adoption of the Life Cycle Assessment (LCA) and Cleaner Production (CP) technologies.

9.2 Recommendations

i. The proposed project be supported as the Experts' appraisal of the impacts of the proposed plant from the perspectives of economy, society, public health and environment is largely positive.
ii. Social inclusion: Waste management system relies heavily on informal workers, who collect, sort, and even manage generated waste. The project proponent should address waste picker livelihoods through strategies such as integration into the formal system, as well as the provision of safe working conditions, social safety nets, child labor restrictions, and education.
iii. The ESMP should be implemented fully at all stages along the project cycle to maximize related positive environmental, economic, social, and public health influences of the proposed project as well as minimizing the negative ones.
iv. The proposed plant should have a provision for a computerized monitoring system device to allow for the troubleshooting of most problems related to filter (scrubber system). A computerized monitoring will also make operators work easily as they will be able to track the environmental and operational efficiency of the furnace.
v. Air quality analysis to be undertaken annually to monitor emissions.
vi. During full operation of the proposed development, adhere to waste management regulations i.e., through contracting solid waste handler to manage all the solid waste generated within the premises as well as registering the facility as a waste handling facility
vii. Ensure that all operational permits and licenses have been acquired and strict adherence to various law provisions observed accordingly.
viii. In an event of an environmental incidence posing significant negative impacts to the environment, the proponent to notify the authority within stipulated timelines.

REFRENCES

1. Kenya gazette supplement number 56. Environmental Impact Assessment and Audit Regulations 2003. Government printer, Nairobi.
2. Kenya gazette supplement; Environmental Management and Coordination (Emissions Control) Regulations, 2006 Government printer, Nairobi.
3. Kenya gazette supplement; Environmental Management and Coordination (Water Quality) Regulations, 2006 Kenya gazette supplement; Environmental Management and Coordination (Waste Management) Regulations, 2006. Government Printer: Nairobi.
4. Kenya gazette supplement; Environmental Management and Coordination (Excessive Noise and Vibration Control) Regulations, 2009. Government Printer: Nairobi.
5. Kenya gazette supplement, Special Issue 51, Legal Notice number 19; Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations (2009). Government printer: Nairobi.
6. Kenya Gazette Supplement Acts Land Planning Act (Cap. 303) Government Printer: Nairobi.
7. Kenya Gazette Supplement Acts, Local Authority Act (Cap. 265). Government Printer: Nairobi.
8. Kenya Gazette Supplement Acts, Penal Code Act (Cap. 63). Government Printer: Nairobi. Kenya Gazette Supplement Acts, Physical Planning Act, 1999. Government printer: Nairobi Kenya Gazette supplement Acts, Public Health Act (Cap. 242) Government printer: Nairobi.
9. GoK (2013). National Environment Policy. Government printer: Nairobi.
10. Basic principles for public participation practice http://www.aalep.eu/basic-principles-public-participation-practice.

ANNEXES

1. Certificate of incorporation.
2. KRA PIN.
3. Lease agreement.
4. Administered questionnaires & Minutes of the held meetings.
5. Expert licenses